

Dallol Potash Project - ERM Project 0143047

*Draft Environmental, Social
and Health Impact
Assessment Report*

December 2012

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Allana Potash Corp.

Draft Environmental, Social and Health Impact Assessment Report


December 2012

Reference 0143047

Prepared by: Environmental Resources Management (ERM)

For and on behalf of
Environmental Resources Management

Approved by: Mike Everett (PiC)



Signed:

Position: Partner

Date: December 2012

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Annex K – In-Migration Management Plan

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1.1 BACKGROUND TO THE DALLOL POTASH PROJECT

Allana Potash Corp. (Allana) is a Canadian publicly traded corporation with a focus on the international acquisition and development of potash assets. Allana holds one consolidated potash concession created from the amalgamation of their four original licenses (Exploration license Numbers – 2952-2954/2000, 2949-2951/2000, 2955-2957/2000 & 1878/2002 from the Ethiopian Ministry of Mines and Energy) in the Danakil Depression, Afar National Regional State (ANRS) in the Woreda of Dallol and Berahale (*Figure 1.1*) ⁽¹⁾, in north eastern Ethiopia. Allana propose to develop a potash mine (known as the Dallol Potash Project or the proposed Project) within their concession area, which covers an area of approximately 158km² (*Figure 1.2*). The resource potential of this area is significant and constitutes a potential target of nearly two billion tonnes of potash.

Under the Ethiopian Environmental Impact Assessment (EIA) Proclamation (No. 299/2002) the proposed Project requires an EIA and authorisation by the Environmental Protection Authority (EPA), before any mining activities may commence. Allana have appointed Environmental Resources Management (Pty) Limited (ERM) as independent environmental practitioners to undertake an Environmental, Social and Health Impact Assessment (ESHIA) ⁽²⁾ for the proposed Project.

The objective of this ESHIA is to assess the potential environmental, social and health impacts associated with the planning, construction, operation and decommissioning phases of the proposed Project. Allana have not yet commenced mining, and are currently carrying out exploration activities to assess the economic feasibility of the proposed Project. Exploration entails field investigations involving drilling, sampling, geophysics, mapping and pilot solution mining of the target mineral resource to determine the overall economic feasibility of the proposed Project.

Allana is one of four companies that currently have mining concessions in the Danakil Depression. Although this ESHIA will assess the potential cumulative impacts associated with other mining activities in the Danakil Depression, it will not specifically assess the direct environmental, social and health impacts associated with each of these companies' mining activities. Furthermore, at this stage of the proposed Project, the routing of linear infrastructure for the transportation of potash product offsite has not yet been finalised. This infrastructure will need to be considered under a separate environmental and

(1) The border between the Dallol and Berahale Woreda illustrated in this figure was sourced from the Afar National Regional State – Finance and Economic Development Bureau (2009). *Regional Atlas 2*. It must be noted that the border between the two Woreda is currently under dispute. Discussions with both the Dallol and Berahale Woreda have indicated that Allana's concession is administered (including payment of taxes) primarily by the Berahale Woreda Administration.

(2) The use of the term ESHIA as opposed to EIA is to emphasise that the process will not only assess environmental impacts but will also assess potential socio-economic and health impacts of the proposed Project.

social impact assessment process at a later stage, once the mineral resource is proven economically feasible.

Figure 1.1 Location of the Proposed Project

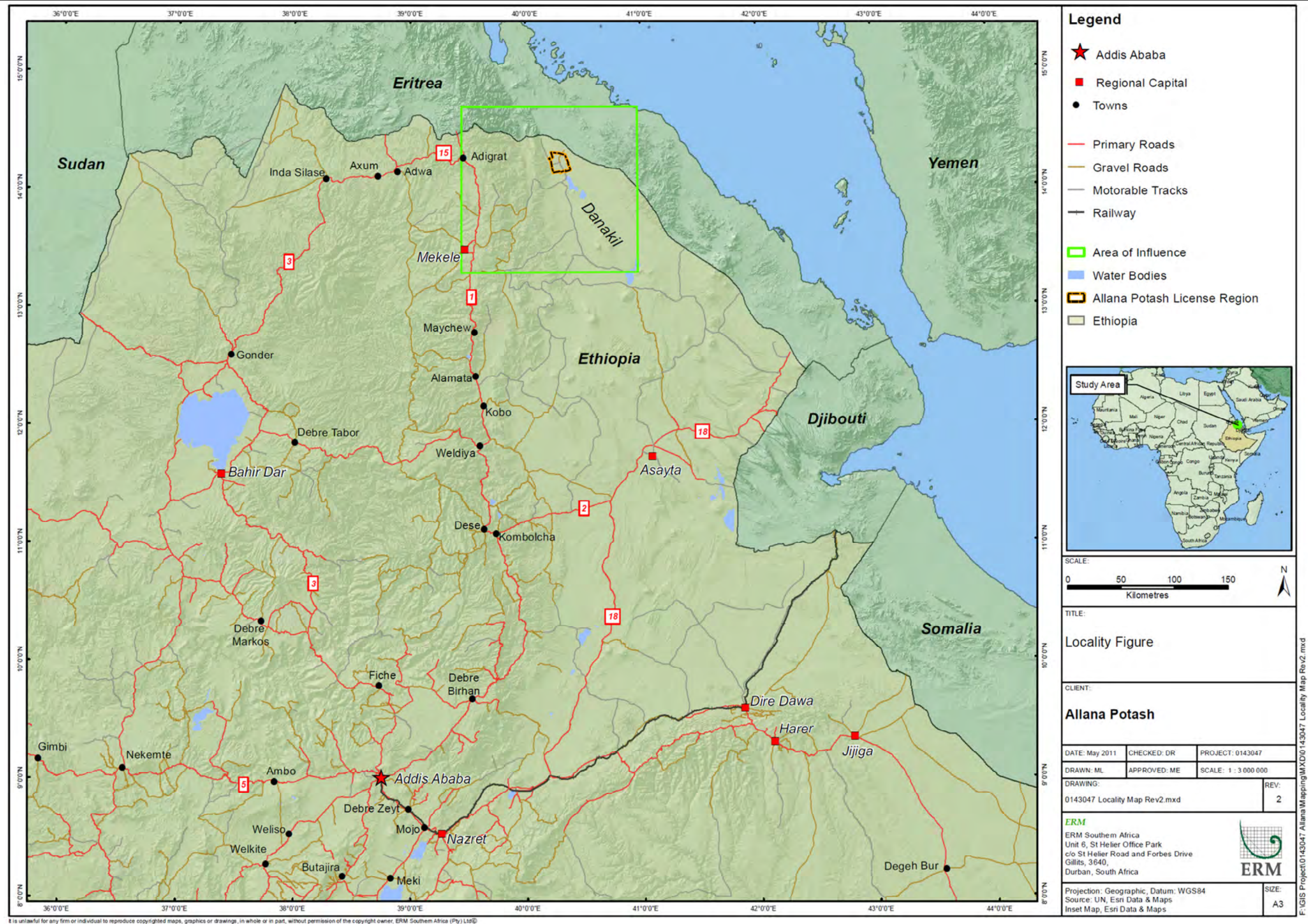
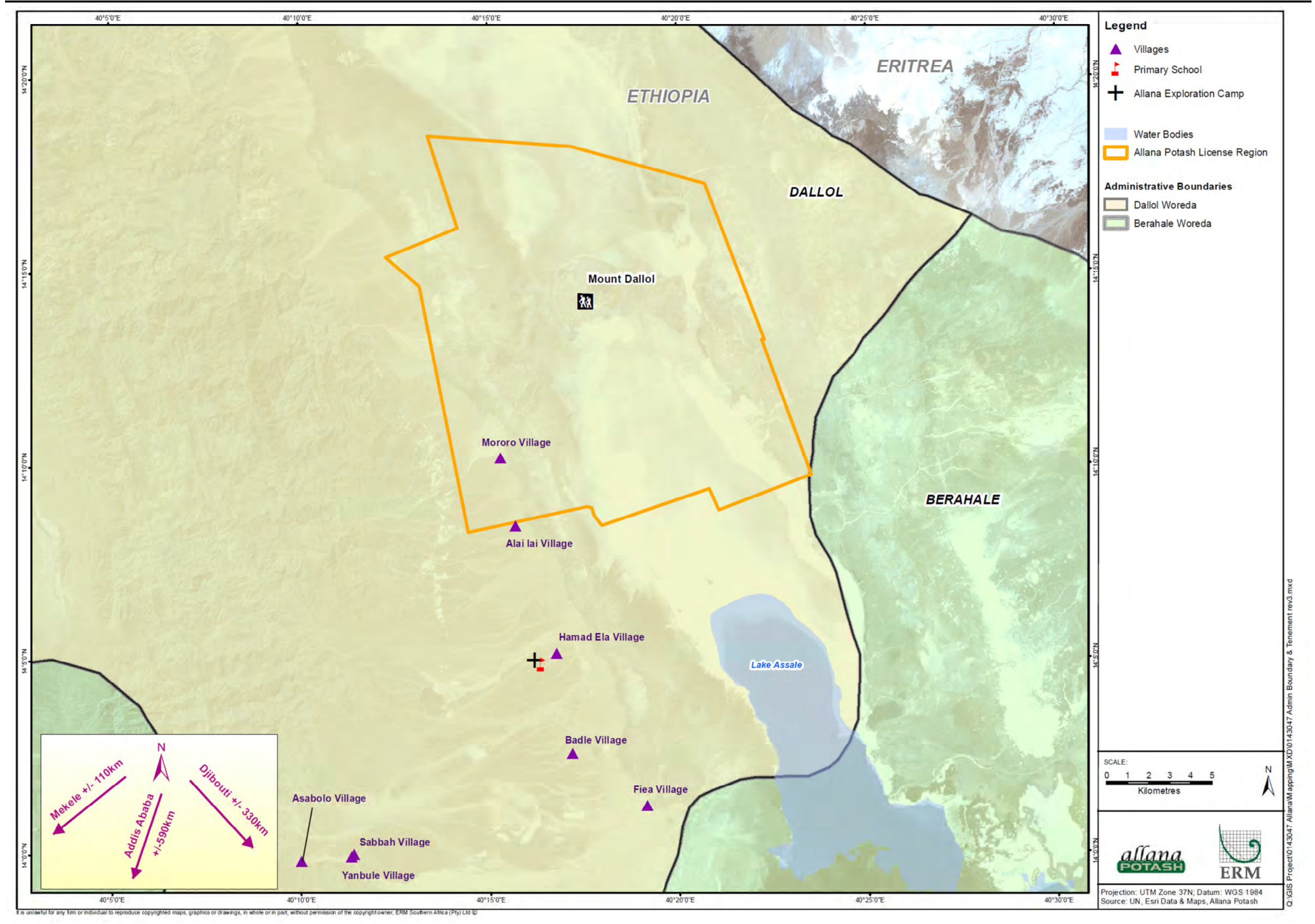


Figure 1.2 Proximity of the Allana Concession Area with Respect to the Dallol and Berahale Woreda Boundaries

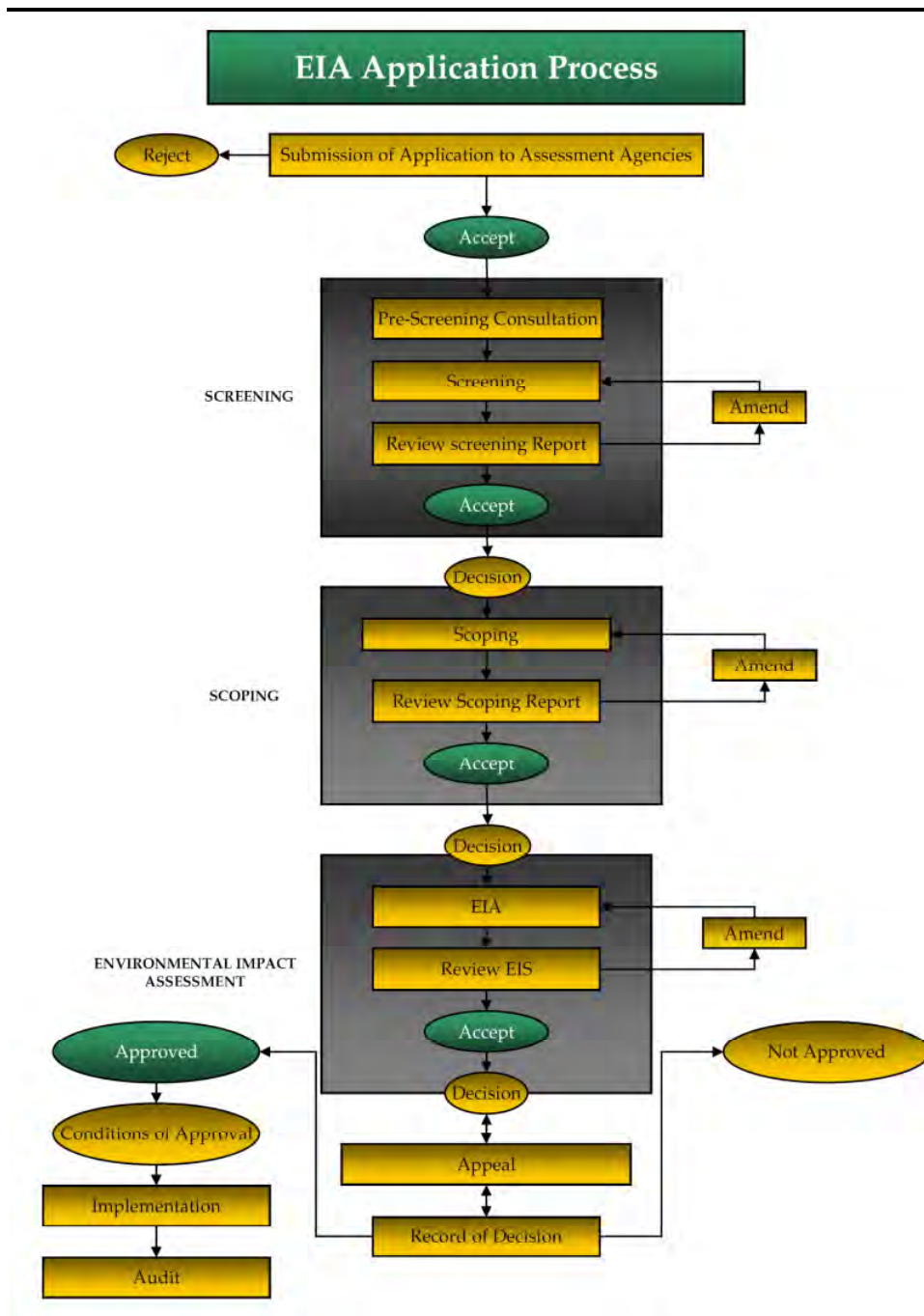


This ESHIA process is being conducted in accordance to the Ethiopian EIA Proclamation (No. 299 of 2002). The Ethiopian EIA process is made up of a number of procedural steps, as prescribed in the Ethiopian EIA Proclamation (n° 299/2000). These procedural steps are also prescribed in the EIA Guideline Document (final draft 2000) and the EIA Procedural Guideline (Series 1, 2003), both of which are published by the Federal Democratic Republic of Ethiopia Environmental Protection Authority. These steps and the process undertaken to date is as follows:

1. **Pre-Screening** – not considered relevant in the case of the Dallol Potash Project, as a full scoping and EIA was deemed necessary due to the proposed Project involving the development of a new mine.
2. **Scoping** – the objective of this phase was to present a description of the proposed Project, the ESHIA process, relevant legislation, the physical, biological, socio-economic and health characteristics of the Study Area, perceived issues and an outline of the Terms of Reference (ToR) for the various specialist studies that will assess the identified environmental, social and health issues. During this phase, interested and affected parties and key stakeholders were identified and provided with an opportunity to raise any interim comments/concerns/queries that they may have with the proposed Project. The final scoping report was approved by the Ethiopian Federal Ministry of Mines on 04 May 2012 (reference number: MA229/34) (refer to *Annex A*).
3. **Environmental, Social and Health Impact Assessment** - This study functions as the main assessing document and provides a detailed analysis of the potential environmental, social and health impacts, supported by objective and defensible scientific studies. It forms the basis on which the environmental license/approval is issued.

The Ethiopian EIA procedure according to the aforementioned proclamation and guidelines is outlined below in *Figure 1.3*.

Figure 1.3 Ethiopian EIA Process



Note: The screening phase illustrated in Figure 1.3 was not applicable to this Project, as the decision to carry out a detailed scoping EIA had already been made.

Host country laws of Ethiopia relevant to the successful implementation of all components of the proposed Project were also considered during the EIA process and all necessary licensing and permitting requirements have been identified based on current Project concepts and design.

In addition to the applicable regulations and norms of the government of Ethiopia, the proposed Project has committed to comply with the

requirements of the International Finance Corporation (IFC), the World Bank Safeguard Policies and the African Development Bank (AfDB) Policies and Strategies. A complete legal review is provided in *Chapter 5*.

1.3 *DETAILS OF THE APPLICANT*

The contact details for Allana in Ethiopia are as follows:



Allana Potash Corp. Afar

Contact: Jason Wilkinson
Bole Sub City, Kabele 05,
Robel Plaza,
6th Floor
Addis Ababa, Ethiopia
Tel: +251 (0) 116 630 870

1.4 *DETAILS OF THE ESHIA TEAM*

In 2011, Allana appointed ERM as independent environmental and social practitioners to undertake the ESHIA process for the Dallol Potash Project. ERM have established an association with local expertise from Ethiopian environmental and geological consultants, Beles Engineering and TS Environmental Technology (TET). TET are assisting ERM with the social impact assessment and stakeholder engagement tasks and Beles Engineering are assisting with the hydrological and aspects of the ecological study.

1.4.1 *Environmental Resources Management*

ERM is a global environmental consulting firm employing over 3,300 specialists in over 145 offices in 41 countries. ERM Southern Africa in turn is one of the largest totally focused environmental consulting firms in the southern Africa region. The contact details for ERM are as follows:



Environmental Resources Management – Southern Africa

Contact: Mike Everett
Unit 6, St. Helier Office Park,
c/o St Helier Rd and Forbes Drive
Kwazulu-Natal, South Africa
Tel: +27 (0) 31 767 2080,
Fax: +27 (0) 31 764 3643

1.4.2 *TS Environmental Technology*

TS Environmental Technology

Contact: Samuel Hailu
 Saay Building, 4th Floor,
 Bole Road (African Avenue)
 Addis Ababa, Ethiopia
 Mobile: +251 (0) 911 373 167

1.4.3 *Beles Engineering*

Beles Engineering Pvt. Ltd. Co.

Contact: Tenalem Ayenew
 Bole Kifle Ketama,
 Kebele 08/09, Jemma Building,
 Addis Ababa, Ethiopia
 Tel: +251 (0) 116 634 843

The specialists that form part of the ESHIA team are provided in *Table 1.1* below.

Table 1.1 *The ESHIA Team*

Activity	Person and Company
Compilation of ESHIA	<ul style="list-style-type: none"> - Mike Everett (ERM) - Dieter Rodewald (ERM)
Legal Opinions	<ul style="list-style-type: none"> - Wondemagegnehu G.Selassie
Hydrogeology	<ul style="list-style-type: none"> - Stefan Muller (ERM) - Heinrich Schreuder (ERM) - Prof. Tenalem Ayenew (Beles Engineering) - Kefyalew Girma Hailemariam (Beles Engineering) - Aregawi Gebremedhin Mengesha (Beles Engineering)
Air Quality	<ul style="list-style-type: none"> - Dr Chris HazellMarshall (ERM)
Noise study	<ul style="list-style-type: none"> - Rod Linnett (ERM) - Dale Hutton (ERM)
Ecology	<ul style="list-style-type: none"> - Andrew Cauldwell (Natural Scientific Services) - Juan Potgieter (Natural Scientific Services) - Crystal Rowe (Natural Scientific Services) - Dr. Tadesse Dejenie Haile (Beles Engineering) - Dr. Tsehay Asmelash Dejene (Beles Engineering)
Socio-economic specialist study and public participation process facilitator	<ul style="list-style-type: none"> - Philippa Spence (ERM) - Lisa Van Dongen (ERM) - Nomsa Fulbrook-Bhembe (ERM) - Alastair Gow-Smith (ERM) - Samuel Hailu (TS Environmental) - Hirut Yibabe (Independent Specialist) - Dr Ali Hassan Muhaba (Independent Specialist)
Community Health and Safety	<ul style="list-style-type: none"> - Philippa Spence (ERM) - Alastair Gow-Smith (ERM) - Nomsa Fulbrook-Bhembe (ERM) - Fikru Tessema (Independent Specialist)

Archaeology and Cultural Heritage	<ul style="list-style-type: none"> - Philippa Spence (ERM) - Alastair Gow-Smith (ERM) - Emlen Myers (ERM) - Doug Park (ERM) - Dr. Hailu Zeleke (Independent Specialist)
Visual	<ul style="list-style-type: none"> - John Flannery (ERM) - Naushad Tahsildar (ERM) - Dale Hutton (ERM)

1.5 *PURPOSE OF THIS REPORT*

The purpose of the ESHIA report is to present the following:

- A detailed description of the proposed Project and relevant Project alternatives;
- The ESHIA process and a detailed legal review of legislation, guidelines and strategies pertinent to the proposed Project and associated ESHIA;
- The outcomes associated with stakeholder engagement activities carried out to date;
- A detailed baseline review of the physical, biological , socio-economic and health characteristics of the Study Area;
- An assessment of impacts to the physical, biological, socio-economical and health environments related with the different phases (construction, operational and decommissioning and closure phases) of the proposed Project;
- Mitigation measures and associated management plans that aim to avoid / minimise / manage the severity of identified impacts; and
- An assessment of cumulative impacts associated with other planned, existing or project-related developments in the Study Area.

1.6 *STRUCTURE OF THE ESHIA*

This ESHIA is broken up into three volumes. These include:

- *Volume One* – ESHIA Report;
- *Volume Two* – Annexures; and
- *Volume Three* – Environmental and Social Management Plans (ESMP)

The structure and contents of these volumes may be seen in *Table 1.2* to *Table 1.4*.

Table 1.2 *Volume One – ESHIA Report*

Chapter	Contents
<i>Chapter 1 - Introduction</i>	Presents a brief background to the Project and the purpose and structure of the report
<i>Chapter 2 – Project Description</i>	Describes the Project Area and the proposed Project components
<i>Chapter 3 – Project Motivation</i>	Describes the need and motivates the rationale for the proposed Project
<i>Chapter 4 – Project Alternatives</i>	Discusses the Project alternatives that have been considered in the ESHIA process
<i>Chapter 5 – Applicable Legislation and Standards</i>	Describes the legislative, policy and administrative requirements, as well as international good practise and local development plans and guidelines applicable to the Project
<i>Chapter 6 – Environmental, Social and Health Impact Assessment Process</i>	Describes the EISHA Process followed for the Project and the associated impact assessment methodology employed
<i>Chapter 7 – Stakeholder Engagement</i>	Summarises the stakeholder engagement for the ESHIA Project
<i>Chapter 8 – Receiving Environment – Physical and Biological Characteristics of the Study Area</i>	Provides a detailed baseline assessment of the receiving physical and biological environment in the Study Area
<i>Chapter 9 – Receiving Environment – Socio-economic and Health Characteristics of the Study Area</i>	Provides a detailed baseline assessment of the receiving socio-economic and health environment in the Study Area
<i>Chapter 10 – Assessment of Physical and Biological Impacts and Mitigation</i>	Presents the predicted impacts to the physical and biological environment as a result of the proposed Project and associated mitigation
<i>Chapter 11 – Assessment of Socio-economic and Health Impacts and Mitigation</i>	Presents the predicted impacts to the socio-economic and health environment as a result of the proposed Project and associated mitigation
<i>Chapter 12 – Assessment of Cumulative Impacts and Mitigation</i>	Presents the cumulative impacts that are as a result of existing and further planned developments in the Study Area and other Project related developments
<i>Chapter 13 – Environmental, Social and Health Management System</i>	Presents the system necessary for the integrated management of all social, health and environmental management plans
<i>Chapter 14 – Conclusion</i>	Summarises the key findings of the ESHIA

Table 1.3 *Volume Two - Annexures*

Annexure	Contents
<i>Annex A – Scoping Report Approval Letter</i>	Approval letter for the Scoping Report from the Federal Democratic Republic of Ethiopia Ministry of Mines.
<i>Annex B – Baseline Data Collection Methodologies for Ecological and Social Studies</i>	Presents the methodology used to collect primary and secondary baseline for the ecological and social studies.
<i>Annex C – ESHIA Stakeholder Engagement Plan</i>	Presents a detailed overview of all stakeholder engagement activities taken place during the course of the ESHIA process.
<i>Annex D – Social Impact Assessment Sensitivity Criteria</i>	Describes the impact criteria used to define social sensitivities.

Annexure	Contents
<i>Annex E – Inventory of Cultural Heritage Sites Identified at the Project Site</i>	Provides a complete inventory of all cultural heritage sites identified in the Study Area.
<i>Annex F – In-migration Risk Assessment</i>	Considers the potential for the proposed Project to lead to significant levels of Project-Induced In-Migration.

Table 1.4 **Volume Three – Environmental and Social Management Plans**

Management Plan	Contents
Environmental Management Plans	
<i>Annex A – Air Quality Management Plan</i>	A plan that addresses potential air quality related impacts that have been identified in the ESHIA and associated air quality impact assessment.
<i>Annex B – Biodiversity Management Plan</i>	A plan to set out a formal system by which Allana can manage mitigation measures that will reduce the impacts on biodiversity.
<i>Annex C – Emergency Response Plan</i>	A plan that presents a framework outlining procedures essential for effectively containing emergency situations for the proposed Project.
<i>Annex D – Integrated Mine Closure Plan</i>	A plan that presents a framework which aims to address environmental issues related to the rehabilitation, decommissioning and closure of the proposed Project.
<i>Annex E – Spill Prevention, Control and Containment Plan</i>	A plan developed to address the general requirements for management of unplanned spills of dangerous or hazardous materials.
<i>Annex F – Waste Management Plan</i>	A plan developed to address the potential waste-related impacts that have been identified in the ESHIA.
<i>Annex G – Water Management Plan</i>	A plan developed to address the potential water related impacts that have been identified in the ESHIA.
Social Management Plans	
<i>Annex H – Archaeology and Cultural Heritage Management Plan</i>	Provides detail regarding the implementation of avoidance, mitigation and management measures for impacts related to items of archaeological or cultural heritage significance.
<i>Annex I – Community Development Plan</i>	A plan developed to enhance the positive impacts of the Company’s presence in the area, focusing where needs have been identified in the areas of health and education infrastructure, skills and enterprise development as well as capacity building and livelihoods diversification.
<i>Annex J – Community Health Safety and Security Management Plan</i>	A plan describing the approach to managing the relevant impacts related to community health safety and security.
<i>Annex K – In-Migration Management Plan</i>	A plan describing the approach to managing the potential impacts and consequences of Project-Induced In-Migration.
<i>Annex L – Sourcing, Procurement and Recruitment Management Plan</i>	A plan guiding the sourcing and recruitment of the direct and indirect workforce and the procurement of goods and services.

Management Plan	Contents
<i>Annex M</i> – Stakeholder Engagement Strategy	A plan that sets the framework to guide Allana’s approach to stakeholder engagement for the life of Mine following completion of the ESHIA.
<i>Annex N</i> – Worker Management Plan	A plan providing detail regarding the implementation of avoidance, mitigation and management measures for workforce related impacts.

This chapter provides a description of the proposed Project and associated phases and activities, and ancillary infrastructure. The information provided in this section is derived from the resources report for the Danakil Potash Deposit and the Preliminary Economic Assessment (PEA) associated with the bankable feasibility study currently been undertaken by Ercosplan, the appointed Engineering and feasibility consultants for the Dallol Potash Project. Furthermore, this Project description formed the terms of reference for specialist studies associated with this ESHIA.

2.1 PROJECT BACKGROUND

Potash ⁽¹⁾, also known as potassium chloride (KCl), is predominately used as an ingredient in fertilizer for agricultural purposes (90%), while the remaining supply is used in chemicals production (Allana, 2009).

The Danakil Depression can be characterised as a tectonic graben ⁽²⁾, located 100 to 125m below sea level. The Allana concession area is located within this graben and consists of salt flats with alluvial fan deposits along the western perimeter. Historical data indicates the local occurrence of potash salts within the concession area. The geological history of the Danakil Depression is linked directly to the rifting process and tectonic faulting, which essentially opens the graben structure, a process that is still on-going. Potash occurs within this graben in a geological layer known as the Houston Formation (*Figure 2.1*), which consists of the mineralised layers Sylvinite, Carnallitite and Kainitite. Allana proposes mining a portion the *Sylvinite & Carnallitite mineral deposit* in their concession area, through a process known as solution mining, described in further detail in *Section 2.4.1*.

An exploration programme to assess the concentration of these Potash salts was initiated by Allana in 2010 and is still on-going. In addition, a 2D seismic survey was undertaken to evaluate the geology and continuity of the resource deposit. Results from these surveys indicated and measured a Sylvinite ⁽³⁾ mineral resource of approximately 110.6 million tonnes (at 31.1 % KCl) and 60.8 million tonnes (at 30.7% KCl) respectively. This resource will contain an approximate 53 million tonnes of KCl product (Allana Potash Corp., 2012) (*Table 2.1*).

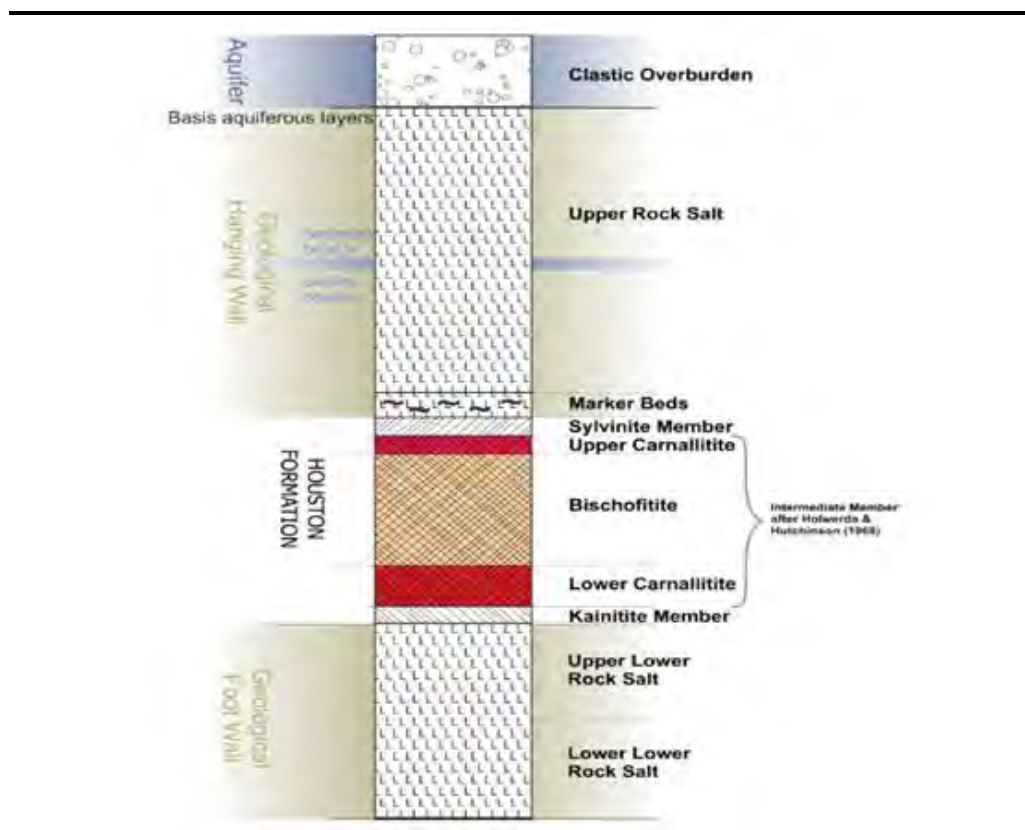
Production is estimated to produce 1 million tonnes of K60 potash product (95% KCl) per year. The potash resources in different categories per mineral resource are outlined in *Table 2.1*.

(1) A group of potassium (K) bearing minerals and chemicals. The dominant potash in the market is a compound known as potassium chloride (KCl).

(2) A depressed segment of the crust of the earth bounded on at least two sides by geological faults

(3) A geological mineral that consists of Sodium Chloride (NaCl), a mineral mined as a source of potash

Figure 2.1 Potash Mineralisation



Source: Ercosplan, (2011)

Table 2.1 Mineral Resources by Potash Member

		Mineralised Material Tonnage (10 ⁶ t)	KCl Grade [%]	KCl (10 ⁶ t)
Measured	Sylvinite	60.78	30.7	18.66
	Upper Carnallitite	49.94	17.49	8.74
	Lower Carnallitite	137.67	11.12	15.31
	Kainitite	319.43	20.15	64.37
Indicated	Sylvinite	110.58	31.05	34.34
	Upper Carnallitite	105.60	16.69	17.62
	Lower Carnallitite	131.42	10.58	13.90
	Kainitite	382.12	20.36	77.79
Inferred	Sylvinite	46.62	30.25	14.10
	Upper Carnallitite	89.67	13.81	12.39
	Lower Carnallitite	78.15	8.48	6.63
	Kainitite	373.71	20.35	76.05

Source: Ercosplan, June (2012)

* *Measured* – these are indicated resources that have undergone enough further sampling that a competent person has declared them to be an acceptable estimate, at a high degree of confidence.

** *Indicated* – this is simply an economic mineral occurrence that has been sampled to a point where an estimate has been made at a reasonable level of confidence.

*** *Inferred* – this is an assumed, unverified estimate of a low level of confidence.

The Project Site is approximately 590km north east of the capital Addis Ababa and 330km north west of Djibouti (refer to *Figure 1.1* in *Chapter 1*). Orientation of the Project site within the Danakil Depression is provided in *Figure 2.2*.

Allana is one of four concession holders within the Danakil Depression. Other concession holders include:

- **BHP Billiton (BHP)** – BHP, who completed their first phase of seismic surveys (totalling a length of approximately 300 to 400km) and had entered into the first phases of their exploration drilling programme, when they made a decision to withdraw from their project in the Danakil. BHP have not made a definitive statement as to why they have withdrawn from Ethiopia, however, this decision is most likely based on global trends and BHP's exploration and mining project consolidation efforts worldwide. To date, BHP still holds the licence to their concession.
- **Ethiopian Potash Corporation (EPC)** – EPC, a Canadian Listed Exploration company who has an agreement in place with G&B to conduct exploration work in their license areas. Exploration commenced with diamond drilling in May 2011 and to date the company has completed over 25 exploration holes.
- **Samaria** – Samaria, a private Israeli construction company that opportunistically picked up an exploration and a mining license in the area in 2008. To date, the company has not completed any work in the area and subsequently the mining license was removed by the MoM and sold on to Haro Petroleum. This license was then acquired by Allana in 2010. Samaria still owns the exploration rights to their property, though the area has little potential as it covers a large portion of Dallol Mountain.
- **Yara/ Sainik Potash Private Limited** – Sainik, a joint venture with Yara International (a fertilizer company based in Norway) have been carrying out exploration drilling in their concession area since March 2010, and have recently completed their exploration drilling programme. Yara/Sainik have now embarked on a solution mining pilot programme and have recently constructed pilot evaporation ponds. The pilot programme is being supervised by Ercosplan.

In November 2012, Allana made a strategic acquisition of Nova Potash Corporation (Nova), who had previously amalgamated three Potash Exploration Licenses (held under Nova and General Trading) into one large Exploration License. At the time of the acquisition Nova had drilled approximately twenty-one exploration holes. The Nova license also incorporates extensions of the alluvial fans and potential aquifers present on the western portion of the Allana license. Coupled with Allana's land position in its adjacent claims, upon closing of the transaction, Allana will

control approximately 312 km² of the centre of the potash basin in the Dallol area.

These concession holders, together with their concession areas are illustrated in *Figure 2.3*. *Figure 2.2* provides context as to the location of these concession areas, relative to the Allana concession, within the broader region.

Figure 2.2 Orientation Map of Project Site

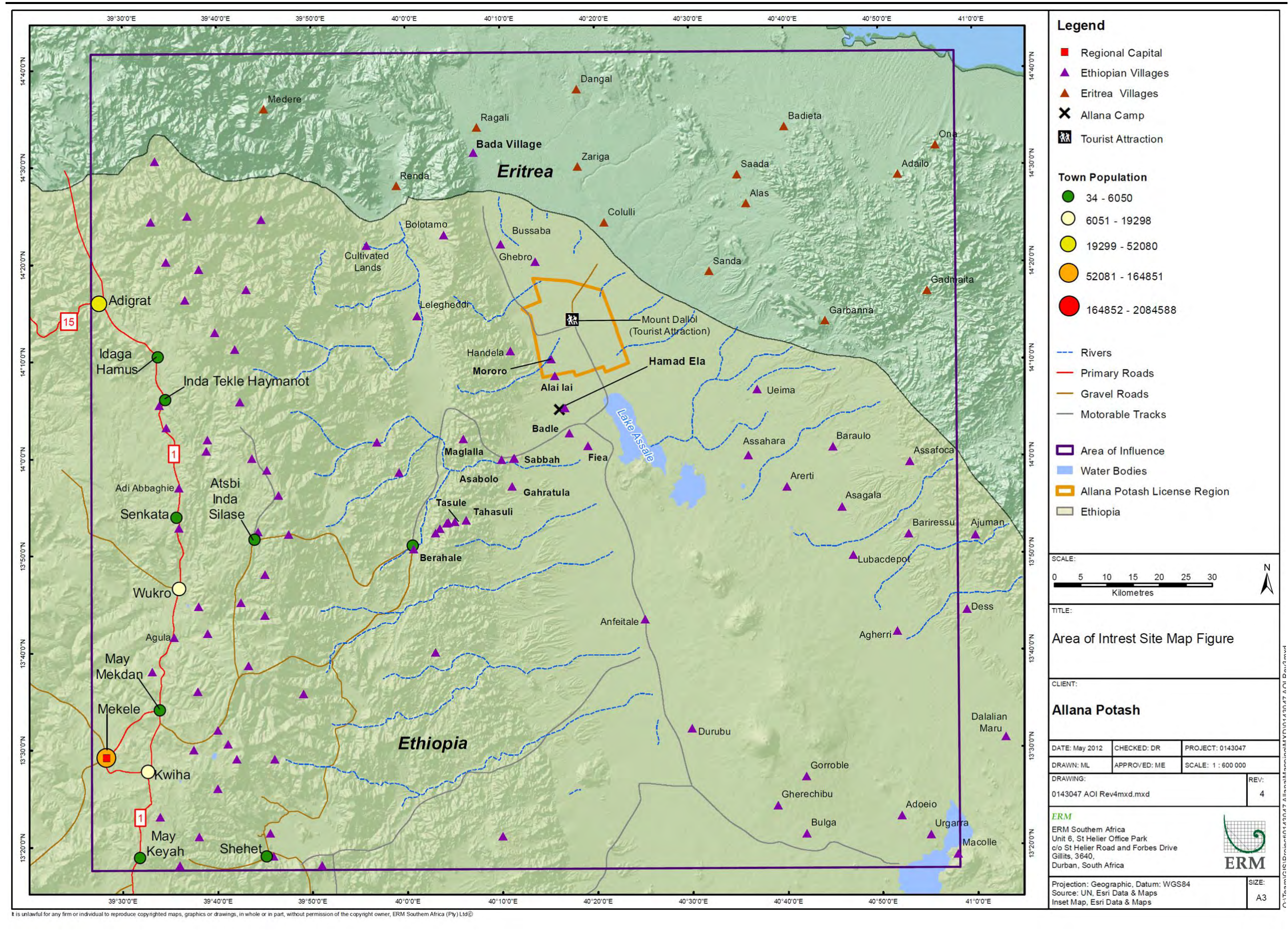
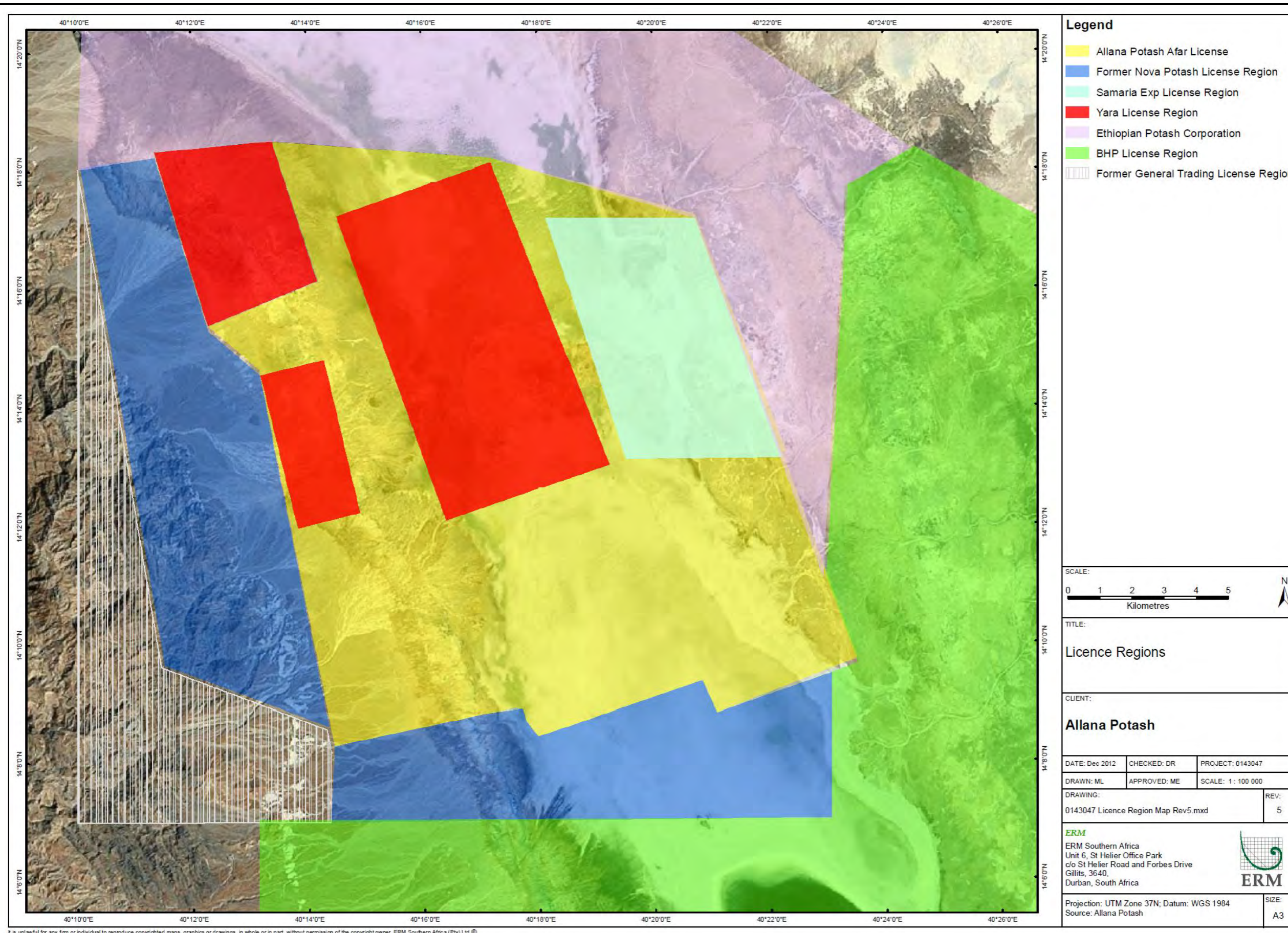


Figure 2.3 Concession Areas in the Danakil Depression



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Mining projects are developed in set phases, with each phase having a different combination of activities. For ease of reference, the proposed Project has been divided into the following phases:

- **Exploration and Prospecting;**
- **Planning;**
- **Construction;**
- **Operation (mining); and**
- **Decommissioning and Closure.**

Please Note - the scope of the Project associated with this ESHIA relates to the construction, operation and decommissioning phases.

The above mentioned Project phases are discussed below.

2.3.1 *Exploration and Prospecting Phase*

The exploration and prospecting phase commenced in 2010 and is still ongoing. This phase largely entailed field studies and testing of the mineral resources to determine the overall economic feasibility of the proposed Project. This phase was essentially divided into three main activities, namely geological investigation, the establishment of infrastructure including an exploration camp and the installation of test wells and associated evaporation ponds for pilot solution mining investigations.

Geological Investigation

The aforementioned prospecting and exploration licences give Allana exclusive rights in terms of exploring the mineral resources of Potash and related salts in the license (concession) area. Exploration activities undertaken to date includes 2D seismic surveys and diamond core drilling for sampling and resource definitions.

2D Seismic Surveys

In total five 2D seismic lines of 44.83km in length were completed during year 2010. Results from this survey indicate a number of reflecting horizons. Although the deposit horizons cannot be unequivocally identified, the overall continuity of the layering suggests that the salt deposit is continuous and horizontal. Results from the 2D seismic surveys are supplemented with information obtained through drilling (described below).

Drilling

Drilling data for the proposed Project arises from two sources, namely:

1. Historical data from holes drilled by The Ralph M Parsons Company (Parsons) potash exploration campaign (a total of 25 drill holes within the Allana License areas) during the 1960's.
2. Recent drilling completed by Allana during 2010 to Quarter 3 of 2012.

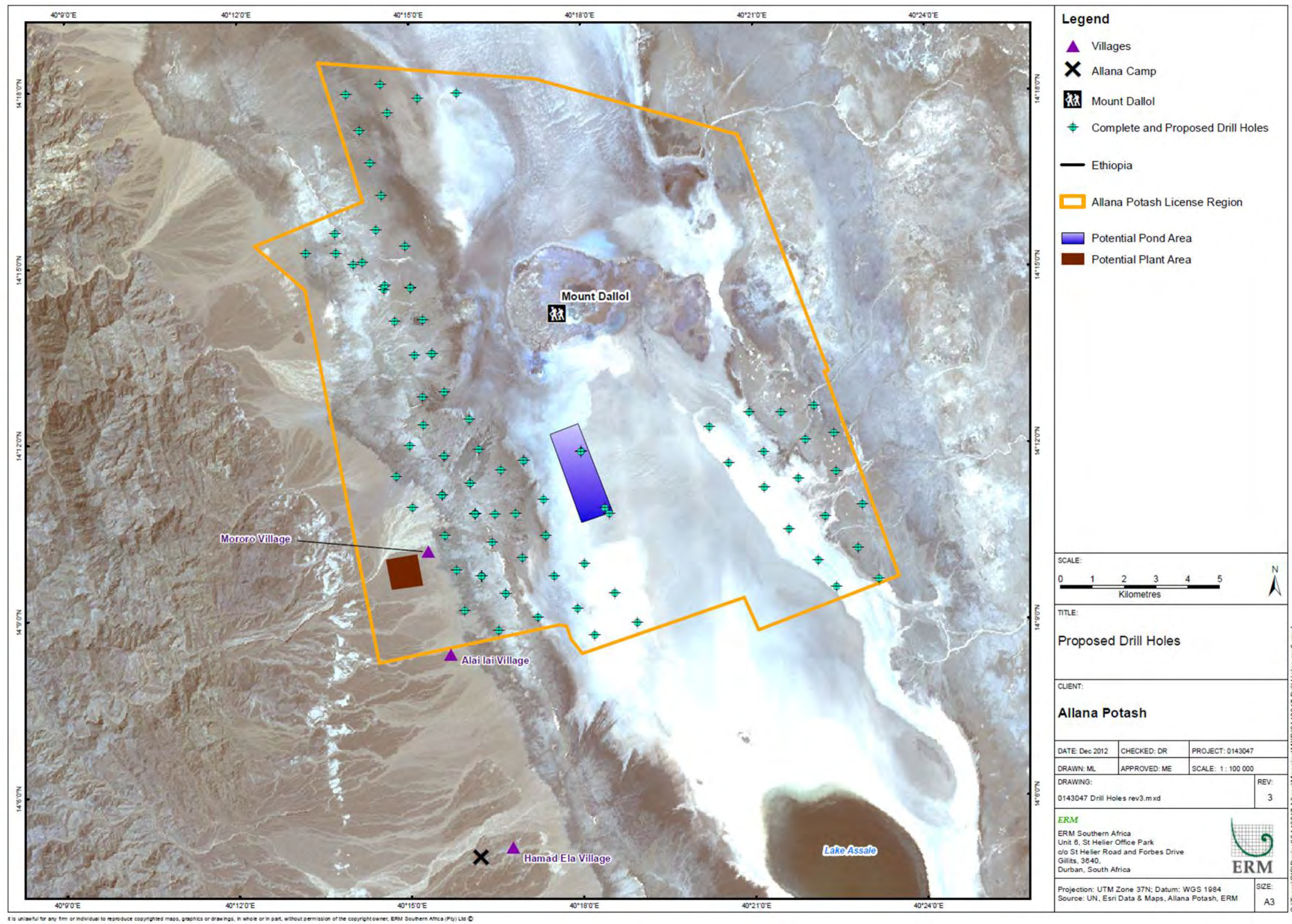
With regards to Allana exploration, three holes (refer to *Figure 2.4* for an example of an exploration drill site) were drilled in year 2010 in between the two western Sainik license areas in an accessible part of the concession area. The objective of these three drill holes was to confirm historical data from the Parsons campaign. Once these holes were completed, two more holes were drilled in the southern part of the concession area. These drill holes confirmed the existence of the potash bearing Houston geological formation (*Figure 2.1*) in the central region of the basin. To determine how far the Houston formation extends and the extent of the salt deposit, drilling extended to the west of the concession area. In June 2012 Allana released the most up to date resource estimate (estimates reported in *Table 2.1*). These results conform to the National Instrument 43-101 Canadian Standard and were based on drill holes within the concession area (refer to *Figure 2.5* for location of exploration drill holes) and results from the 2D seismic surveys. Geological mapping also identified four potash horizons (Sylvinitic, Upper Carnallitic, Lower Carnallitic and Kainitic members) rather than the two horizons identified by Parsons.

Figure 2.4 Example of an Exploration Drill Site



Source: Hickman, Allana Potash Corp. (2011)

Figure 2.5 Map Illustrating the Locality of Allana Exploration Drill Holes



Establishment of Infrastructure - Exploration Camp

In order to accommodate staffing requirements for exploration and evaluation activities, an exploration field camp to accommodate 130 people was established to the south of the concession area (*Figure 2.6*), within close proximity to the village of Hamad Ela. The exploration camp primarily provides accommodation, messing facilities, a laundry, a mechanical workshop, stores and offices for Allana employees and specialists whilst onsite. This camp will be used during the construction phase of the proposed Project.

Figure 2.6 *Allana Exploration Camp*



Dallol Camp February 2012

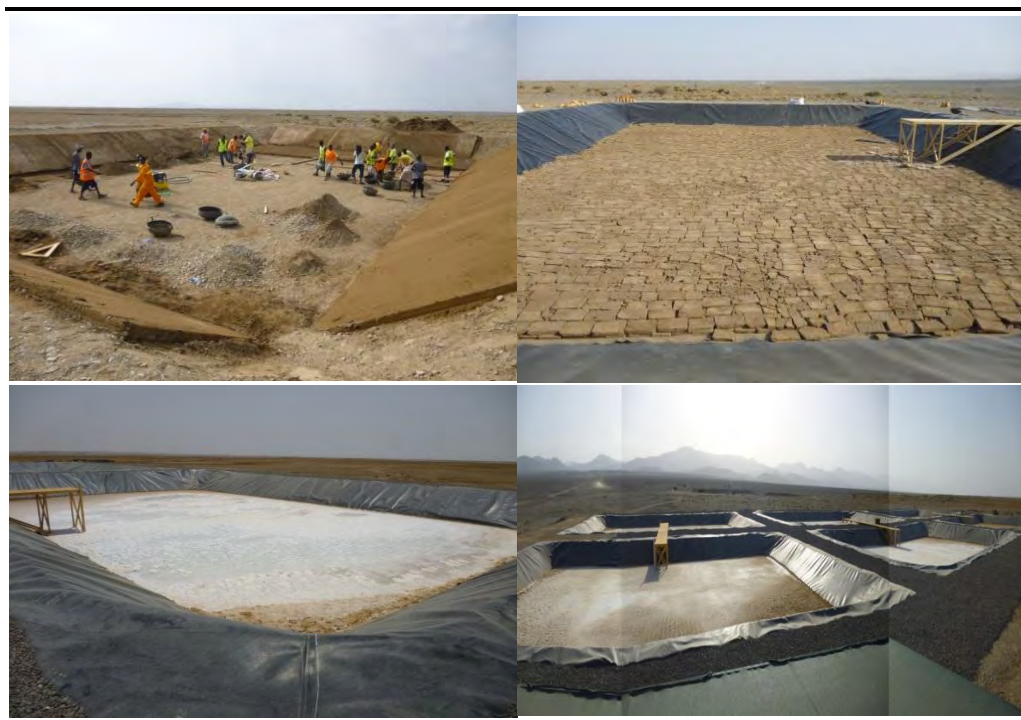


Dallol Camp October 2012

Source: Wilkinson, Allana Potash Corp. (2012)

In order to assess the feasibility of solution mining as a means of successfully extracting potash from the ground and creating a commercial product, Allana developed a series of pilot evaporation test ponds, each measuring 15m x 25m x 1.8m, in January of 2012 (*Figure 2.7*). Brine with a chemistry matching the Sylvinite zone was utilised to test evaporation characteristics at the Study Area and to create a crystal crop for preliminary flotation studies. Evaporation in the ponds proceeded rapidly, averaging approximately 1cm per day.

Figure 2.7 *Test Evaporation Ponds*



Source: Wilkinson, Allana Potash Corp, (2012)

Furthermore, Allana developed a trial Sylvinite solution well, which became operational in September 2012 (*Figure 2.8*). This trial well is utilising water from a fresh water production well installed by Fugro situated approximately 5km west in the alluvial fans. The brine from this trial well will be directed to the test evaporation ponds and results derived from the crystal crop will be used to finalise processing design.

Figure 2.8 *Trial Sylvinite Solution Well*



2.3.2 *Planning and Engineering Phase*

The exploration and prospecting phase is currently guiding the detailed planning and engineering phase, and it is during this phase that the ESHIA team worked closely with the engineering design team. This allowed possible Project process, layout and design alternatives to be investigated, and the assessment of impacts and identification of impact mitigations measures that will be incorporated into the overall Project design. These anticipated impacts and associated mitigation measures are presented in the form of an ESHIA Report (this report) and associated Management Plans (*Volume Three* of this ESHIA).

2.3.3 *Construction Phase*

The construction phase cannot commence prior to the completion of the planning phase and approval of the associated ESHIA (this report) by The Ethiopian Ministry of Mines (MoM). On the assumption that the mine will be established and that all relevant rights and permits will be obtained, it is assumed that construction will commence in 2013. The construction phase will likely include the following initial construction activities:

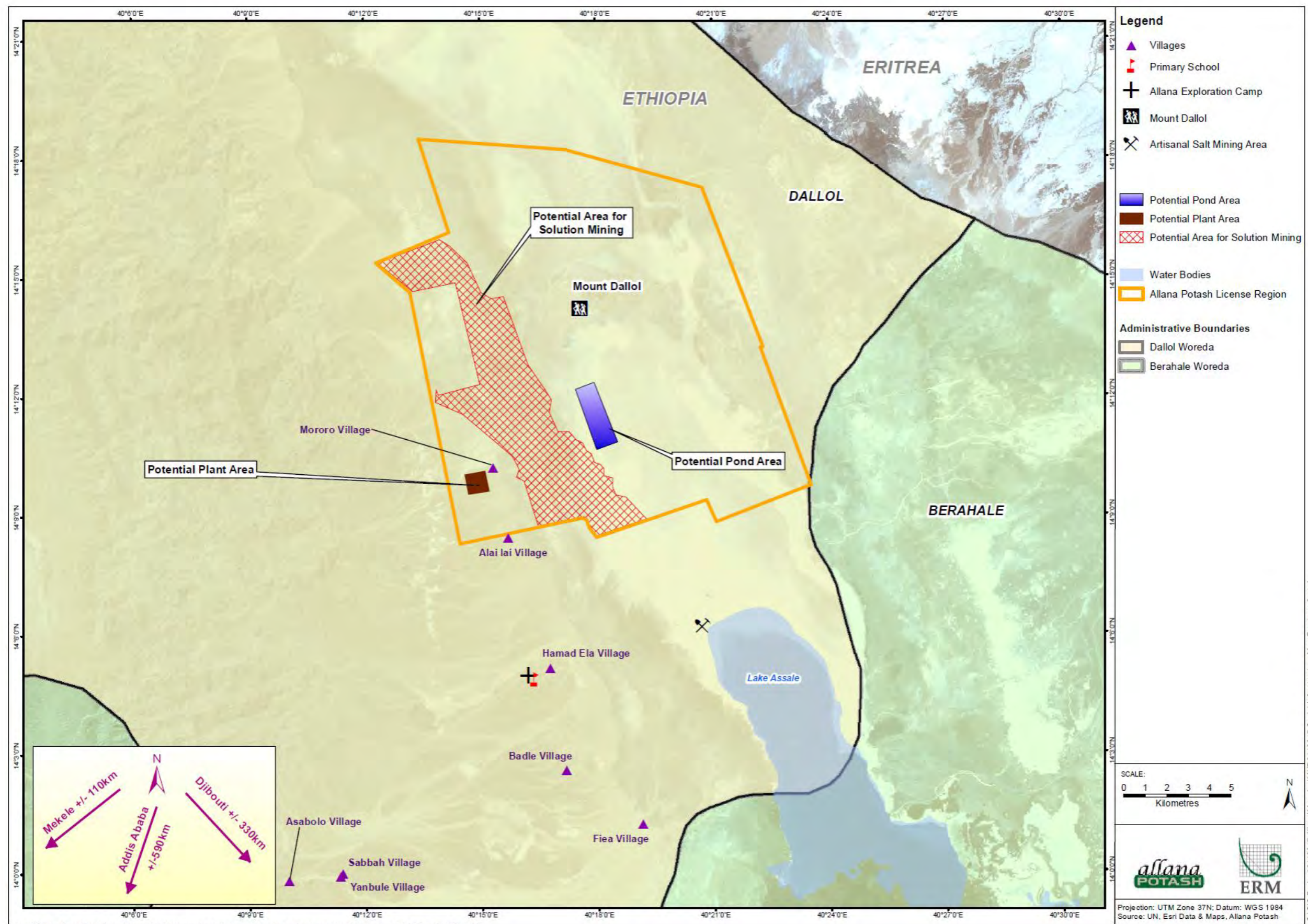
- Access road construction to the mining drill hole sites;
- Establishment of a staff village;
- Establishment of the permanent office and support facilities;
- Establishment of a mine processing facility;
- Continuation of test facilities;

- Establishment of evaporation ponds;
- Equipment and facilities establishment; and
- Solution mining preparation.

2.3.4 *Operational Phase*

Once the construction phase of the proposed Project is complete, the Phase 1 operational phase will commence in the area illustrated in red in *Figure 2.9* overleaf. Early estimates indicate a potential mine life of 19 to 30 years for the Sylvinite horizon with a potential to generate an indicated mineral resource of approximately 110.58 million tonnes containing 34.34 million tonnes of KCl, and an additional inferred mineral resource of 46.62 million tonnes containing 14.10 million tonnes of KCl (refer to *Table 2.1*).

Figure 2.9 Potential Area for First Phase Solution Mining within the Allana Concession Area



2.3.5 *Decommissioning and Closure Phase*

Decommissioning and closure occurs at the end of the mine life. A conceptual integrated mine closure plan has been prepared as part of this ESHIA (*Annex D of Volume Three*); however, this plan will be revised throughout the life of the mine and includes the following:

- Decommissioning and sale of mining equipment and infrastructure;
- Restoration and rehabilitation of disturbed areas; and
- Post closure monitoring.

2.4 *PROJECT DESCRIPTION – PREFERRED ALTERNATIVE*

The following section provides a description of the preferred Project alternative for this study. Other alternatives to the solution mining technique are described in *Chapter 4*.

This section begins by describing solution mining, the preferred mining method for the proposed Project; following which, the methods proposed for the processing of brine are discussed. The section then concludes by describing the infrastructure and services requirements for the proposed Project.

2.4.1 *Solution Mining*

Solution mining was validated as being the most economical and amenable mining method for the Project (Ercosplan, 2011). This method can only be employed when the product which is to be mined is not shallower than 80m below ground surface; the material being mined is more soluble than the surrounding materials in a selected solvent, the dissolution rate is high enough to achieve high concentrations of the required elements in a reasonable amount of time; and if there is enough solvent (fresh to brackish water) available. Furthermore, the dissolution rate needs to be high enough so that higher concentrations of the mined material can be achieved in a reasonable amount of time.

The mining method requires that a number of wells be drilled from the surface through to the deposit (Process 1 in *Figure 2.10*). The solvent (water or prepared brine) is injected through a leach string, which is positioned in the well, into a cavern in the deposit (Process 2 in *Figure 2.10*). Once in the deposit, the solvent dissolves the ore forming a brine solution; following which, the brine is removed from the resulting cavern and pumped through to the surface through use of a double leach string (Process 3 in *Figure 2.10*). At ground surface, the brine is transported through to the evaporation ponds for crystallisation (Process 4 in *Figure 2.10*) where brine is evaporated to form potash bearing crystals (Process 5 in *Figure 2.10*). Crystals are then removed from the evaporation ponds and crushed (Process 6 in *Figure 2.10*). Once crushed, the crystals are processed in the processing plant for extraction of the

KCl (Process 7 in *Figure 2.10*). With the exception of the wells, all infrastructure for the operation (*viz.* pumps, tanks, piping systems and processing plant) are located on the surface.

Figure 2.10 Solution Mining Process Flow



Mass and Volume Balances

The following presents a preliminary mass and volume balance for a typical cavern, which can be used as a base to estimate the required size of the brine field and assess the brine field dynamics.

As a first estimate, the area suitable for solution mining has been defined based on the following, where:

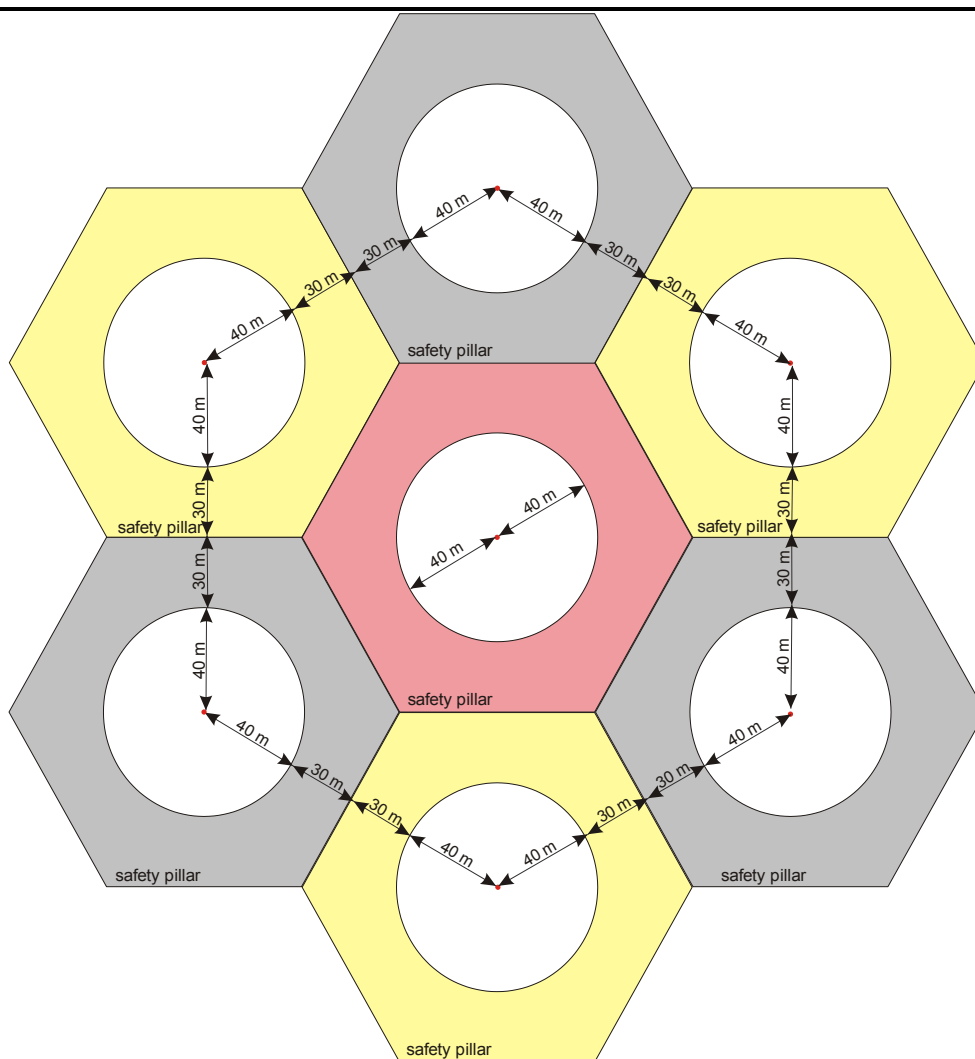
- (i) The deposit thickness is greater than two meters and Sylvinite content is over 15%, and
- (ii) The depth of the top of the deposit is at over 80m, to ensure that enough material remains above the caverns to avoid development of sink holes.

The resulting area (illustrated as Brine Field) is presented in *Figure 2.9*.

The planned configuration has to be verified and optimized by rock mechanical modelling using deposit specific data. The test work to obtain these data is currently underway. Within the planned mining area, the average Sylvinite deposit thickness is about 3.3m, which has been assumed as the average mineable thickness for solution mining. A simple single well cavern with a radius of 40m and a minimum distance between the caverns of 60m has been proposed (*Figure 2.11*). In this configuration a cavern with its pillar has an area of about 14,700m² and an ideal cavern has an area of 5,027m², resulting in an area extraction ratio of 34.2%.

With an average deposit thickness of 3.3m, each cavern has an ideal volume of about 16,500m³ at an average density (for the Sylvinite Member) of 2.15t/m³. This translates to an ore tonnage of about 35,500 tonnes per cavern and a KCl content of approximately 11,000 tonnes (Ercosplan, 2012).

Figure 2.11 Cavern Configuration



Source: Ercosplan, (2011)

An annual production of 1,000,000 tonnes of mined out product (MOP) at an assumed processing efficiency of 85% requires annual mining of 1.1 million tonnes of KCl. Given that each cavern is estimated to produce approximately 11,000 tonnes of KCl, 102 caverns will be required per year for the proposed Project.

Based on experience with other solution mining projects, the expected average KCl saturation of outflow brine, after dissolution within the cavern, will be between 75 and 80% at ambient deposit temperature of 40°C. The expected composition of brine is as follows:

- KCl - 125.0g/l
- NaCl - 255.0g/l
- MgCl₂ - 1.2g/l
- CaSO₄ - 3.0g/l
- H₂O - 842.0g/l

Please Note – the above mentioned composition still needs to be verified by dissolution testing from the deposit by *in-situ* solution mining test work. Work to achieve the actual (non-theoretical) brine composition of the dissolved Sylvinitic is on-going as part of the feasibility study. Brine will be produced from the well towards the end of 2012.

In order to produce 1.1 million tonnes of KCl annually, 8.9 million m³ of brine with 125 g/l of KCl will be required per year; this translates to 1,120m³ of brine required per hour (assuming that the brine field is run continuously, 24 hours a day, seven days a week, for a total of 8,000 hours per year).

Based on experience with other Sylvinitic solution mining projects, an average production brine flow rate of 40m³/h is expected per cavern, which indicates that on the brine field, 28 caverns have to be operated in parallel (Ercosplan, 2011).

Outline of the Mining Operation

A solution mining operation starts by sinking a well with a large diameter drill hole towards the Sylvinitic deposit. Once the well is sunk the following is undertaken:

Sump Leaching: material is dissolved from around the leach string after it is inserted inside the cemented casing. This is done to promote a good fluid flow around the string and also to create a depression at the base of the cavern around the leach string. This results in a settlement zone where insoluble material and any residual crystals and falling cement can settle inside the cavern so that the leach string is not blocked during undercut and production leaching.

Undercut Leaching: This process involves the dissolution of material below the Sylvinitic deposit, normally within the Upper Caranllitite and Intermediate Units, which allows a stable flow regime in the cavern to be established. Preparation leaching uses water as a solvent, and produces brine that is low in KCl and high in MgCl₂, NaCl, CaSO₄, and MgSO₄. Composition varies depending on the dissolved rock chemistry. This brine has to be transported away from the cavern, kept separate from production brine and disposed of into the settling ponds or used as pre-concentrated solvent in the solution mining operation. Average flow rates over the cavern development stage are in the range of 10 to 25m³ of brine per hour. It is expected that sump leaching for any given cavern will take between 6 and 9 months.

Direct Production Leaching: This process involves dissolution of the deposit to produce high grade KCl production brine. Direct production leaching uses water as the solvent and the resulting production brine is transported to the solar evaporation ponds. Flow rates during direct production leaching are in the range of 30 to 50m³ of brine per hour, with an expected average of 40m³/hour. When mass and volume balance calculations indicate that the cavern has reached its final diameter of 80m, solvent injection is stopped. At

this stage, the cavern contains an appreciable amount of brine. This brine can be extracted by carrying out either one of the following displacement techniques:

- Displacing the brine through the use of high density $MgCl_2$ rich brine which flushes the cavern.
- Displacing the brine from the cavern with NaCl rich brine, otherwise known as “Secondary Mining”. This NaCl rich brine is left in the cavern and can over time react with Sylvinite from the wall of the cavern to form brine with KCl, which is suitable for production. Continued injection of high density NaCl rich brine into the cavern will in time displace the less dense KCl rich brine during this “Secondary Mining” phase.

For the purposes of this study, displacement of brine through the use of NaCl rich brine is assumed to be the option that will be used.

An average cavern containing approximately 13,000 tonnes of KCl produces on average $104,000m^3$ of brine and has a lifetime of about 3 months at an average flow rate of $40m^3/h$.

On completion of a cavern, the leach string and well head are removed and reused in future well developments. The casing is cut near the top of the marker beds and the cavern sealed with a cement plug. As there is no use of the land surface above the well it is not planned to remove the surface casing.

Ground Surface Piping Requirements

A three tier piping system will be required during the operational phase of the proposed Project. This will include:

1. Main Lines (~ 6,000m):
 - A pipeline feeding water to the brine field from the processing plant;
 - A water feeding pipeline running directly through the centre of the brine field; and
 - A pipeline from the brine field to the evaporation ponds.
2. Branch Lines (~ 3,000m):
 - A central line from wells that connect to the pipeline directing brine to the evaporation ponds.
3. Feeder Lines (~ 7,000m):
 - Lines from the main line feeding water to the individual wells.

Required Equipment

Well Drill Rigs

Allana proposes on using two to four Atlas COPCO RD20 Oil and Gas drilling rigs, or similar for the drilling of solution wells (*Figure 2.12*).

Figure 2.12 *Example of an Atlas COPCO RD20 Oil and Gas Drilling Rig*



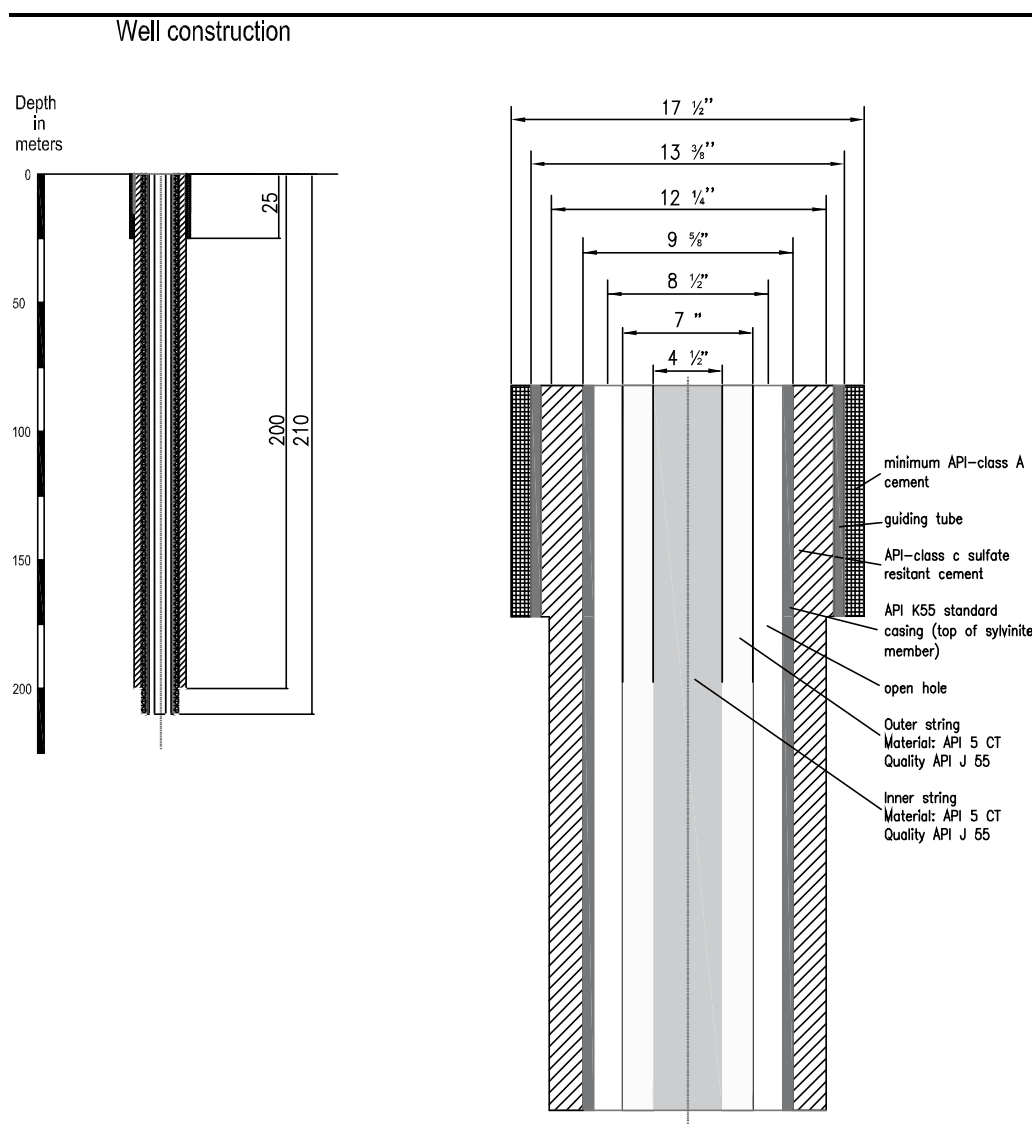
Source: Google Images, (2012)

Wells

The single well caverns planned will have separate access lines for solvent (bottom injection) and brine (top injection). The cavern will be controlled by use of an air blanket, which is created by forcing compressed air down into the cavern, which forms a blanket between the roof of the cavern and the brine waters in the cavern. For continuous blanket control an extra access hole besides the inlet of the solvent and outlet of the brine is required. For this reason a double leach string well, as shown in *Figure 2.13*, has been chosen.

On average, well depth will be 210m below the surface; however, this depth may vary depending on the exact position of the well within the deposit.

Figure 2.13 Preliminary Cavern Well Layout



Source: Ercosplan, (2011)

Surface Infrastructure at the Brine Field

The leach strings will be connected to a well head, which will be connected to a pipeline system. This pipeline system consists of a grid network that will connect the 50+ active wells, which distributes brine through to the evaporation ponds. The pipeline network will be constructed on top of berms approximately 0.5m in height. A pipeline bundle will typically consist of 7 or 8 pipes with a maximum diameter of approximately 0.5m.

Each well will have an independent solvent supply, which will consist of three 4,000m³ tanks containing water and eventual secondary mining brine.

As is mentioned earlier in this Chapter, on completion of a cavern, the leach string and well head need to be removed and reused in new well development. This requires the use of a drilling/work over rig. It is estimated

that four drilling/work over rigs with crew will be required to service the closing and opening of wells in the brine field.

2.4.2 *Brine Processing*

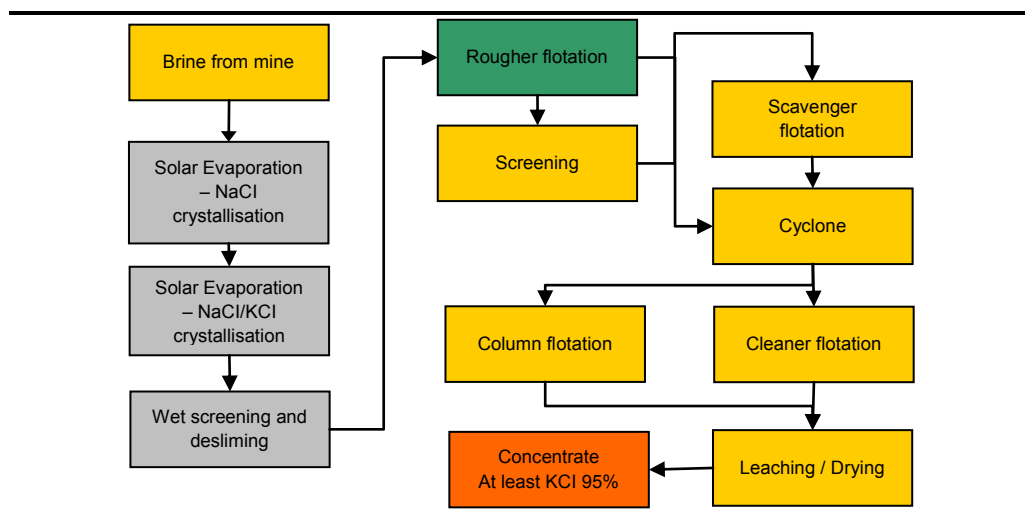
Brine is withdrawn from the wells and fed directly to the evaporation ponds via a pipeline. In order to reduce the costs and increase the efficiency of the operation, brine undergoes an initial stage of solar evaporation, where it is reduced in quantity by extracting NaCl from the brine. Following this pre-extraction of NaCl, the resulting brine is processed further to form a KCl by solar evaporation, complete crystallisation and flotation. The KCl material will be left in the pond until the moisture content is around 8 to 10%. This approach ensures that the material remains moist and therefore non-friable as this would result in loss of product. The harvested material will then be transported to the processing plant via an overland conveyor.

At the processing plant, the potash product will be separated from other residual salts. The resulting KCl product is anticipated to have a purity of at least 95%. The product will then be dried and loaded into covered trucks for transportation.

This process, shown diagrammatically in *Figure 2.14*, can be separated into the following nine phases:

1. Solar Evaporation;
2. Crystallisation;
3. Desliming;
4. Rougher flotation;
5. Cleaner flotation and leaching;
6. Scavenger flotation;
7. Reclaim brine and brine disposal;
8. Effluent flotation; and
9. KCl product debrining, drying and screening.

Figure 2.14 Simplified Process Flow



Source: Ercosplan, (2011)

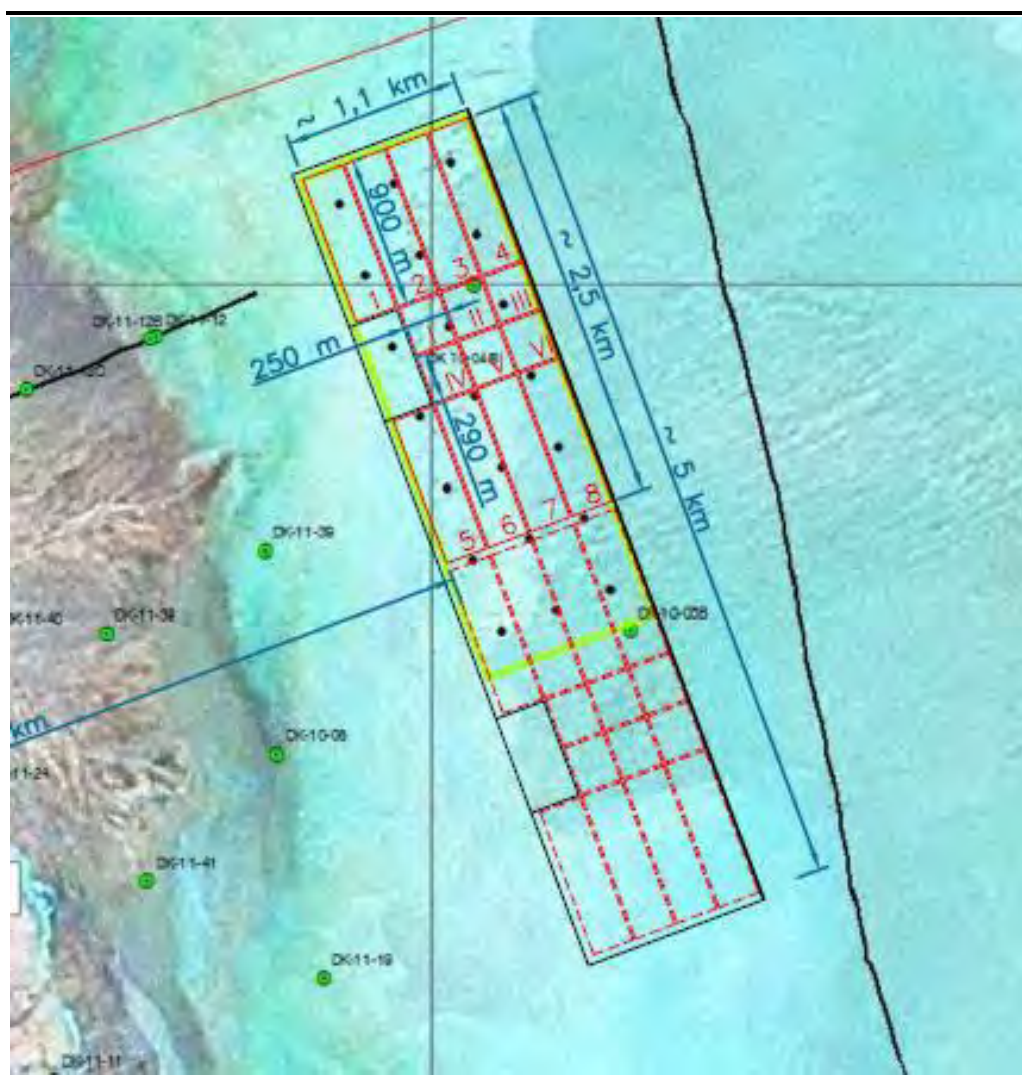
The processing of brine is expected to run continuously 24 hours a day, seven days a week, for a total of 7,500 hours per year. Approximately 52 days a year have been set aside for scheduled maintenance.

A description of the required brine process flow is provided below:

1. Solar Evaporation (Pre-plant Processing)

Brine has to be separated from the NaCl crystals (approximately 97% separation) before KCl saturation can be achieved. Brine from the brine fields is fed directly to the solar evaporation pond, which consists of five ponds for evaporation, a pond for the filling of brine from the brine field, a pond for harvesting intermediate product and a maintenance pond. These ponds are anticipated to accommodate an area of 1.1km x 5km (5.5km²) within the salt flats (Figure 2.15).

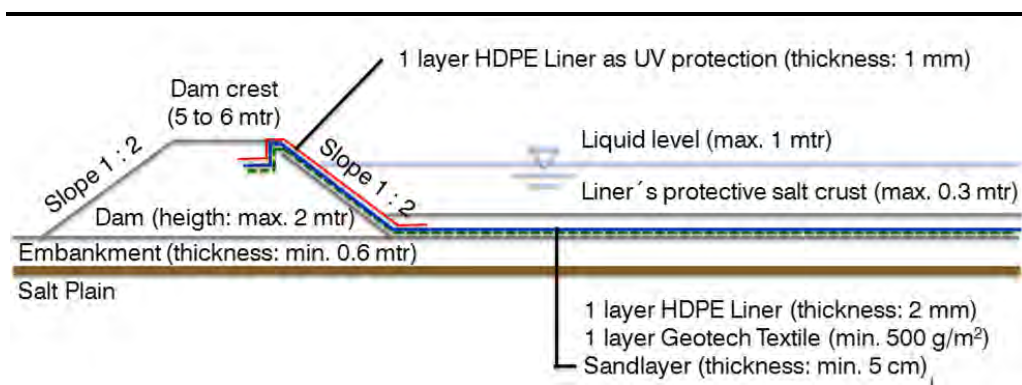
Figure 2.15 Layout and Design of Evaporation Ponds



Source: Ercosplan, (2012)

During solar evaporation, brine is concentrated and NaCl is crystallised out and allowed to drop down to the bottom of the pond as sediment. It is proposed to construct ponds on a platform that is approximately 0.6m in height, with berms along the perimeter ranging in height of approximately 1.3m (Figure 2.16).

Figure 2.16 Preliminary Design of Evaporation Ponds



Source: Ercosplan, (2012)

The solid NaCl crystalline sediment is a superfluous material and will remain in the individual pond for a period of time depending on the capacities available. Eventually the NaCl sediment has to be removed and stockpiled or used to backfill mined caverns. For this stage of the operation it is estimated that approximately 0.75km² of evaporation surface is required.

For the Sylvinite ponds it is estimated that approximately 2.25km² of evaporation surface is required. Solar evaporation tests are currently being performed to define the exact evaporation rate.

The Sylvinite mixture is harvested from the pond using Caterpillar PM200 Cold Planer surface miners (*Figure 2.17*), or similar, which will load the mixture onto trucks, which will load the intermediate product mixture onto a covered conveyor system which transports the mixture to the processing plant. The intermediate potash product from the evaporation ponds will have a moisture content of 8 to 10%. The amount of intermediate potash product that is to be transported from the evaporation ponds to the processing plant is expected to be 400 to 500 tons/hour.

Figure 2.17 Caterpillar PM200 Cold Planer

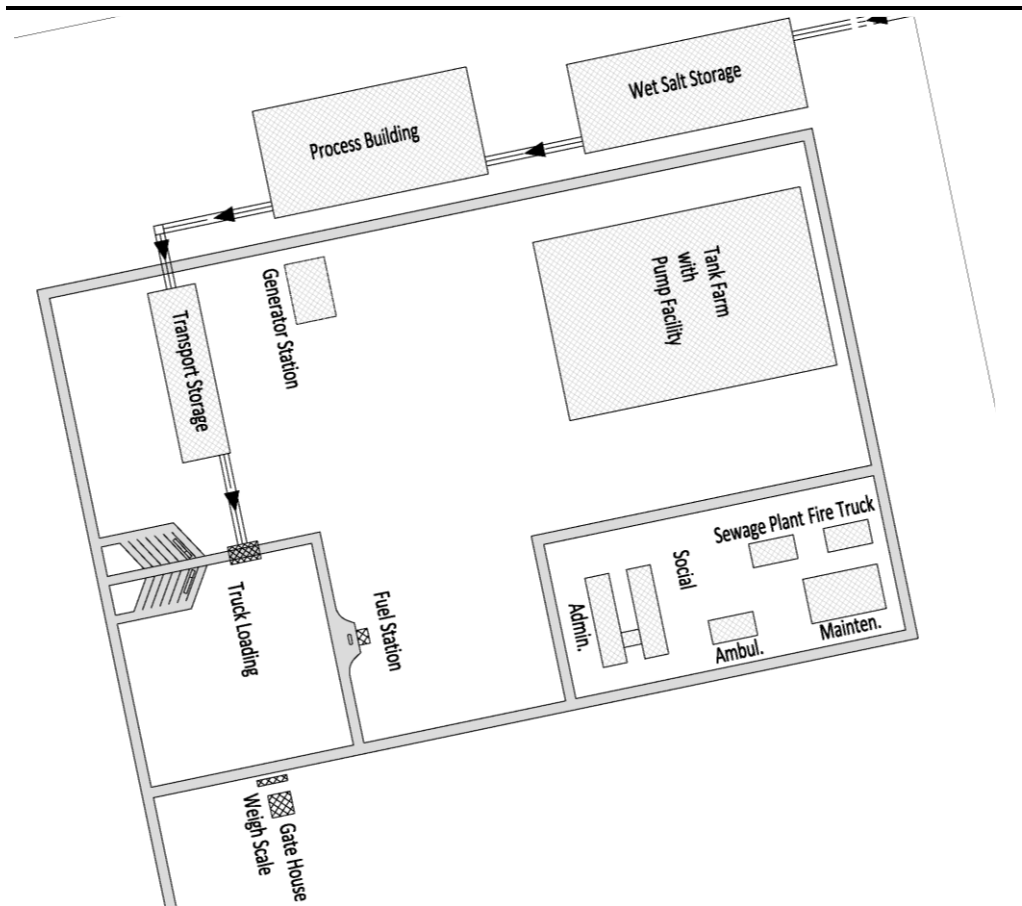


Source: Google Images

2. Crystallisation (Plant Processing)

The intermediate potash product is initially stored in a wet salt storage facility (*Figure 2.18*), so as to manage process loadings, following which it is processed in the process building.

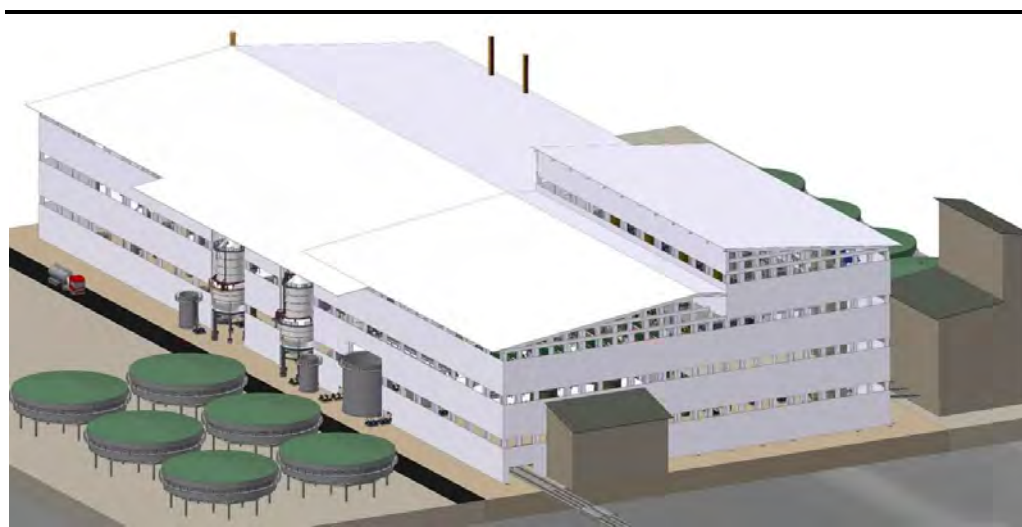
Figure 2.18 Processing building and associated Infrastructure



Source: Ercosplan, (2012)

The actual processing building is expected to have a maximum height of approximately 4 to 5 floors (32m in height) and will cover an approximate area of 8,208m² (114m x 72m) (refer to indicative example of processing plant in Figure 2.19 below).

Figure 2.19 Example of Processing Building proposed for Allana



Source: Ercosplan (2012)

As part of the proposed Project, the following buildings will be required (refer to *Figure 2.18*):

- *Administration building*: This will consist of a building with two to three floors.
- *Canteen*: This will provide food to staff working at the processing plant. It will consist of a cold store for food on the first floor as well as a big refectory and kitchens on the second floor.
- *Changing room facilities for employees*: A building with two to three floors will be constructed. The dressing rooms for staff working at the processing plant and the mine will be situated in separate sections of the building. The dressing rooms will be equipped with sanitary facilities. The plant and mine section of the changing rooms facilities will include dressing rooms with lockers for the workmen, the engineers, the management and visitors. The facility will also accommodate a laundry service and a medical station.

Other buildings associated with the proposed mine include:

- Generator Power Station (discussed later in this Chapter);
- Area designated for the loading of product onto trucks;
- Fuel station and associated above ground diesel storage tanks;
- Process water tank farm;
- Central laboratory;
- Ward building (clinic/emergency room);
- Warehouse;
- Maintenance Workshops;
- Plant security offices building; and
- Fire response building.

The first step of plant processing consists of screening and crushing of the crystallized material. Wet screening reduces the loading in the crushing phase, dividing up the raw material into a fraction for crushing and a fraction for direct repulping.

Crushing of the solid material is necessary in order to ensure optimal contact of collector molecules with KCl crystals during the later flotation process. The crushed solid material, which is to be floated, will mostly be inter-grown with other crystals (mainly NaCl), the main component of the crude salt. The crushed crude salt will be mashed with reclaimed brine and water. This will result in the dissolution of the contained Carnallite (i.e. KMgCl_3) and avoid the precipitation of fine decomposition KCl.

Following crushing to an appropriate size, the ore will be directed through to rougher flotation (refer to *4. Rougher Flotation* below). Prior to rougher flotation, the fine fraction may be directed to the desliming process (refer to 3.

Desliming below). The reason for this is that the fine insoluble material will decrease the purity of the concentrate solids during the rougher flotation process and hence the purity of the KCl product.

3. Desliming

The desliming process may be required to remove the majority of the insoluble material by a process called cyclone overflow. The underflow with less insolubles will then be directed to the rougher flotation phase (refer to 4. *Rougher Flotation* below). The fine undissolved solids in the overflow will then be settled, following which the overflow will be reused as reclaimed brine in the aforementioned crushing process (refer to 8. *Reclaim Brine and Brine Disposal*). The underflows from thickening will then be directed to effluent flotation and to a tails leach tank to recover fine KCl.

4. Rougher Flotation

The rougher flotation is the first flotation step. Intermediate product for this process will be derived from the crushing process, middle fractions of the repulping tank and underflow from the desliming process.

The intermediate product entering this step of the process will contain approximately 20% to 40% KCl in the solid form. The objective of rougher flotation will be to enrich the KCl in one mass flow and to separate most of the non-KCl solids. The concentrate emanating from this step will have a KCl content of over 80% in the solid.

The concentrate emanating from the rougher flotation process will then be directed to the cleaner flotation feed cyclone (see below).

5. Cleaner Flotation and Leaching

Mass flows which will contain a relatively high KCl percentage in the solids will be directed to the cleaner flotation for further enrichment of KCl in the solid phase. The KCl content of the solids in the flotation concentrate will be over 90%.

Prior to flotation, incoming intermediate product will be directed to the cleaner feed cyclone, which will separate fine solids from the overflow. This overflow is then fed to the effluent flotation. The underflow from the cleaner feed cyclone will be combined with an aqueous solution of flotation reagents and reclaimed brine for adjustment of solid content in the feed suspension.

The cleaner flotation concentrate will then be leached with water. This is necessary to dissolve excess NaCl. The suspension from leaching will then be directed to the product centrifuges for debrining (refer to 7. *KCl-product Debrining, Drying and Screening* below).

Tailings of the cleaner flotation will exhibit KCl content in the solids of over 20%. This makes it appropriate for re-use and will therefore be directed back to the rougher flotation process (refer to 4. *Rougher Flotation*).

6. Scavenger Flotation

The scavenger flotation will be fed with the tailing from the rougher flotation, which was subject to additional crushing. Although the KCl content in these solids will be relatively low, it is economically feasible to recover. The scavenger flotation will also separate the insoluble material from the remaining KCl in the solids.

7. KCl-product Debrining, Drying and Screening

The KCl product suspended from the leaching and scavenger flotation process will be directed to the product centrifuges for debrining, to reach a remaining water content of 5% in the wet solid.

Some solids will be recovered from the cyclones in the centrifuging process and will be directed back as cyclone underflow into the product centrifuges. Cyclone overflow containing fine KCl solids will then be directed to another flotation step, which concentrates the fine KCl from the solution. The product will then be dried.

The dry KCl product can be screened into a fine, standard and an oversize fraction. The standard and fine fractions will be transported to the respective storage areas or re-dissolved and brought back in the KCl crystallization ponds. The oversize fraction will be crushed and led back to the product screen.

KCl product will be stored in an asphalt covered area that has low walls for product containment. The area will have a storage capacity of up to 100,000t and will be connected by a conveyer system to the product loading area, which is anticipated to have a capacity of 150t/hour. Dry potash product is expected to have less than 1% moisture content. From here potash will be loaded onto trucks for transport offsite. It is expected that 155 trucks will be required to transport offsite, which equates to 310 truck movements on and off the site per day.

8. Reclaim Brine and Brine Disposal

Several steps during brine processing will result in an overflow that can be reused as reclaimed brine (a NaCl and KCl saturated solution). It is anticipated that this brine will be used in the aforementioned crushing and flotation processes. Excess reclaimed brine will however be produced. The surplus is discharged as disposal brine into the evaporation ponds.

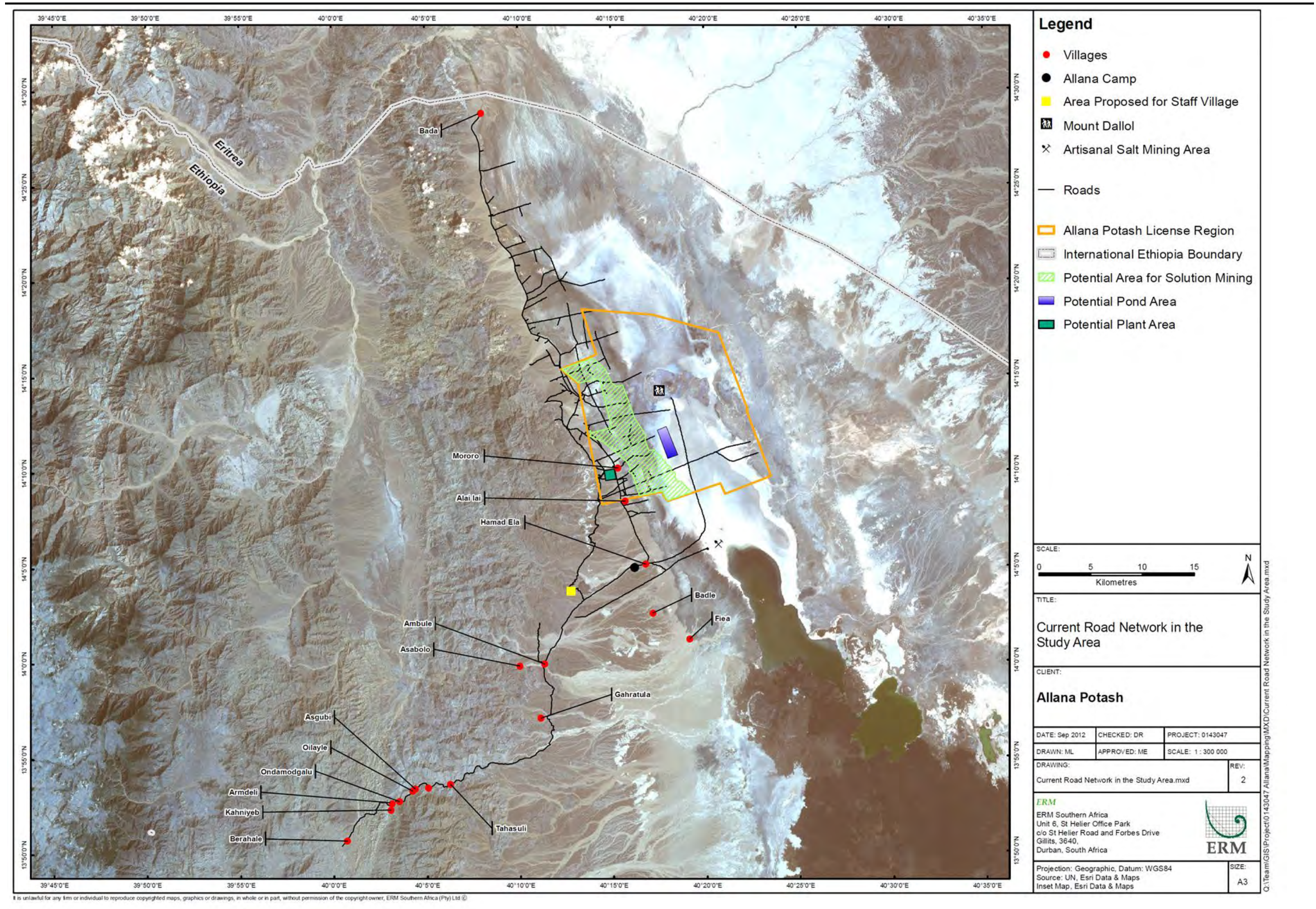
Staff Village

A staff village will be built with facilities to accommodate 500 staff at any one time (refer to yellow square illustrating locality of the proposed Staff Village in *Figure 2.20*). A minority of staff will be local Afar living in their own quarters in Hamad Ela or other nearby villages. Staff accommodation will be as follows:

- *Unskilled Staff*: These staff will share an apartment with four persons. It is assumed that one person is always working in shift and another is on rotation and is absent.
- *Semi-skilled Staff*: These staff will share an apartment with two persons.
- *Skilled Staff*: Have their own apartment.

Some apartments are kept in reserve for visitors. In total 200 apartments are planned to be constructed. Each apartment will have an area of 30m² and will be furnished with sanitary facilities, a kitchen and air-conditioning. The current plan envisages that apartments will be constructed in 10 separate buildings, each with two floors.

Figure 2.20 Area Proposed for Staff Village



Water Management

Mine Water

Solution mining in the Sylvinite layer will require 139,000m³ of fresh to brackish water per well. If on average 59 wells are constructed per year, a total amount of 16 million m³ of water will be required annually (1,020m³/hour - assuming an 8,000 hour working year).

Mine water can be fresh and/or brackish. The contained solubles must be low enough that Sylvinite and Halite salts can be dissolved from the solution caverns.

Fugro (a specialist geo-hydrological company), have drilled a number of water exploratory drill holes in the Study Area. Exploratory results have identified that sufficient water volumes exist in the alluvial fans on the western portion of the Study Area. The water bearing gravel zone in these fans can be situated up to 70m below ground surface and can be up to 35m in thickness. Flow and recharge rates are still currently being assessed.

Furthermore, *Chapter 8* provides a detailed description of baseline geohydrology in the Study Area.

Effluent Treatment

Due to the scarcity of water in the Study Area, efficient water management through use of water treatment and recycling is proposed on the Project Site. Wastewater from sanitary facilities at the contractor's camp, processing plant and mine sites will be treated and used as process water. Detailed designs for such treatment facilities are still in the design phase and will be finalised during the Project Detailed Engineering.

Potable Water

Potable water for the staff village and all non-processing purposes within the plant will be produced in a water treatment facility. A drinking water supply network will be built within the plant and staff village to supply all mining personnel at a rate of a 100L per persons per day.

Access Roads and Pipelines within the Mining Area

A number of exploration roads have already been constructed within the Allana area proposed for mining in order to provide access to exploration drill locations (refer to *Figure 2.20* and *Figure 2.21*).

Figure 2.21 Example of a Road Constructed for Exploration



The roads and above ground pipeline infrastructure to be constructed for the construction and operational phases of the proposed Project are yet to be determined. The exact locations of these roads will be based on the final designs to be determined by the final feasibility study. It is anticipated that the road construction will follow a grid pattern and will be spaced every 70m. It should be noted that the existing roads will be used as far as possible; however, new roads will be required for the construction and operation of the proposed Project. Furthermore, pipelines will be bundled and confined as much as possible to predefined corridors. In terms of access from the proposed staff village to the processing plant, it is proposed to use the government road. The government road is in the process of being constructed and will be paved (*Figure 2.22*). This road will extend from Berahale Town through to Bada Village in the north.

Figure 2.22 Government Road



For conservative reasons, this study assumes that all future roads constructed by Allana will be unpaved.

In terms of traffic volumes, the following is expected:

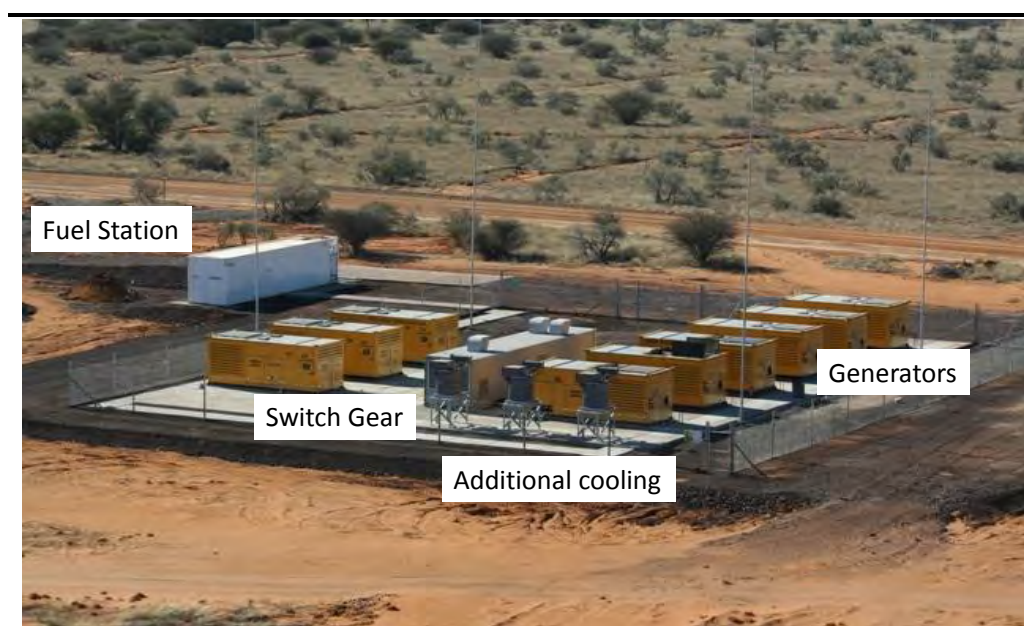
Vehicle Type	Number of Vehicles
40 Tonne Trucks for the transportation of product	155
Trucks for the transportation of supplies to site	8
Pick-up Trucks for operations around site	8
Busses to transport staff to and from the staff village to the processing plant	4
25 to 30 Tonne Trucks for transportation of drill equipment around the brine field	5

Energy Supply

Both electricity and fuel are required to run the processing plant and mining operation. Electricity is the major energy source for the operation. Total installed power in the processing plant is estimated at 14-20MW; however, as not all equipment will be operated in parallel, 14MW of power is required for the operations phase. This power requirement will be produced by diesel driven generators (7x 3.1MW Atlas COPCO diesel generator units, or similar – refer to Figure 2.23 below); diesel consumption is estimated at 4.0m³/h to produce these power requirements. The efficiency of each generator unit is about 35%, and thus has a rated power output of 1.1MW. Included in the power plant will be a diesel fuel station, a switch gear and cooling systems. It

is assumed that each generator systems will be fitted with a 3m stack. The diesel generator power plant will be constructed within the footprint of the processing plant (refer to *Figure 2.18*).

Figure 2.23 *Example of an Atlas COPCO Diesel Generator Power Plant*



Source: Ercosplan, (2012)

Diesel oil or heavy fuel oil will be delivered to the Project Site via tanker trucks. Fuel will be stored in four 2,000m³ above ground tanks near the plant site. A supply line will be installed from the storage tanks to the power generator station. Furthermore, a dispensing station is planned for diesel driven equipment.

Waste

The evaporation process will produce 1.2 million tonnes of tailings⁽¹⁾ per annum, which will be collected and placed on a central tailings stockpile, between the brine field and the evaporation ponds (*Figure 2.24*). Furthermore, solids emanating from the flotation process (2.2 million tonnes per annum) will be collected and directed to the tailings stockpile. Tailings will (as far as possible) be used as backfill for the caverns (approximately 2,150,000m³). As such, the annual tailings volume is expected to be 1,750,000m³ for a total of 18 years. It is assumed that the stockpile will take up an area of 12.5km² on the salt flats, with a height of approximately 2.5m.

(1) tailings will consist of extracted NaCl (pure salt), collected from the evaporation pond and crystallisation process in the processing plant

Waste disposal for the proposed Project will be carried out in accordance with Article 4 (Management of Hazardous Waste, Chemical and Radioactive Substances) and Article 5 (Management of Municipal Waste) of the Environmental Pollution Control Proclamation (n° 300 of 2002).

General Waste

To ensure that general waste is suitably disposed, bins will be strategically placed at various locations around the processing plant, active mining site and staff village and labelled as “Waste” in English and Amharic.

General waste from the above mentioned bins will be collected and temporarily stored in waste skips at the temporary general waste storage facility. Skips will be labelled so that recyclable ⁽¹⁾ and reusable items are separated out from wet waste designated for disposal at the licensed Mekele Sanitary Landfill Site ⁽²⁾.

Please Note: Allana will transport all general waste through to this landfill in the short-term; however, during detailed design of the proposed Project Allana will look at potentially establishing a general waste landfill onsite. This however will not form part of the scope of this ESHIA, and should Allana decide to establish a landfill within their Project Area, a separate environmental permitting process will be undertaken.

General waste will be recycled as much as possible (plastic, tyres, metals etc.). All general waste that cannot be reused or recycled will be disposed of. It is estimated the proposed Project will generate the following general (non-hazardous) wastes (Table 2.2).

Table 2.2 **General Waste Types**

Waste Type	End Use
General food and office waste	Disposal to landfill
Used uncontaminated personal protection equipment	Disposal to landfill
Paper and cardboard	Recycle
Steel Strapping	Recycle
Plastic	Recycle
Pallets	Reuse/Recycle
Wood	Reuse/Recycle
Conveyor belting	Disposal to landfill
Waste tyres	Recycle
Conveyor Idlers	Recycle
Electrical cables	Recycle
Steel rope	Recycle
General scrap steel	Recycle
Pipe work	Recycle
Chains	Recycle
Wire mesh	Recycle

(1) *Please Note* - recycling facilities that are certified to collect and recycle general waste products have not yet been identified. The identification of these third party persons will take place during the detailed design phase of

(2) The Mekele Sanitary Landfill Site has been in operation since 2008 and has an area of 21ha. The landfill receives over 201,606 tons of predominantly non-hazardous waste per annum.

Waste Type	End Use
Scrap drills	Recycle
Pumps	Refurbish/reuse
Winches	Refurbish /reuse
Electrical motors	Refurbish /reuse
Bearings	Recycle
Hoses	Recycle
Cutter tips	Recycle
Fluorescent tubes	Recycle
Fuses and electrical	Recycle

In the case of mechanical general waste, all hazardous materials (such as residual oil) will be drained, stored in the temporary hazardous waste storage facility and managed/disposed of in accordance with the section dealing with hazardous waste below.

Hazardous Waste

All wastes that are considered hazardous will be kept separately and stored in sealed containers designated for the storage of such waste. These containers will be stored in a bunded and roofed facility that is designated for the temporary storage of hazardous waste. All hazardous waste that can be recycled or reused will be regularly collected by certified waste processors ⁽¹⁾ for reuse. In the case of disposal, a licensed hazardous waste handling company ⁽²⁾ will be contracted for transport and disposal to a licensed hazardous waste disposal facility.

The area designated for the temporary storage of hazardous waste will be covered and bunded.

Hazardous waste types that may be generated during the proposed Project are detailed in *Table 2.3*.

Table 2.3 *Hazardous Waste Types*

Waste Type	End Use
Other hazardous waste: <ul style="list-style-type: none"> • Used filters • Used rags • Used spill kits • Hydraulic hoses • Seals • Waste solvents and degreasers • Aerosol cans • Hydrocarbon contaminated soil and water • Acids 	Disposal to hazardous waste company

(1) *Please Note* - suitable hazardous waste processors that are certified to collect, transport and reuse hazardous waste products have not yet been identified. The identification of these third party persons will take place during the detailed design phase of the proposed Project

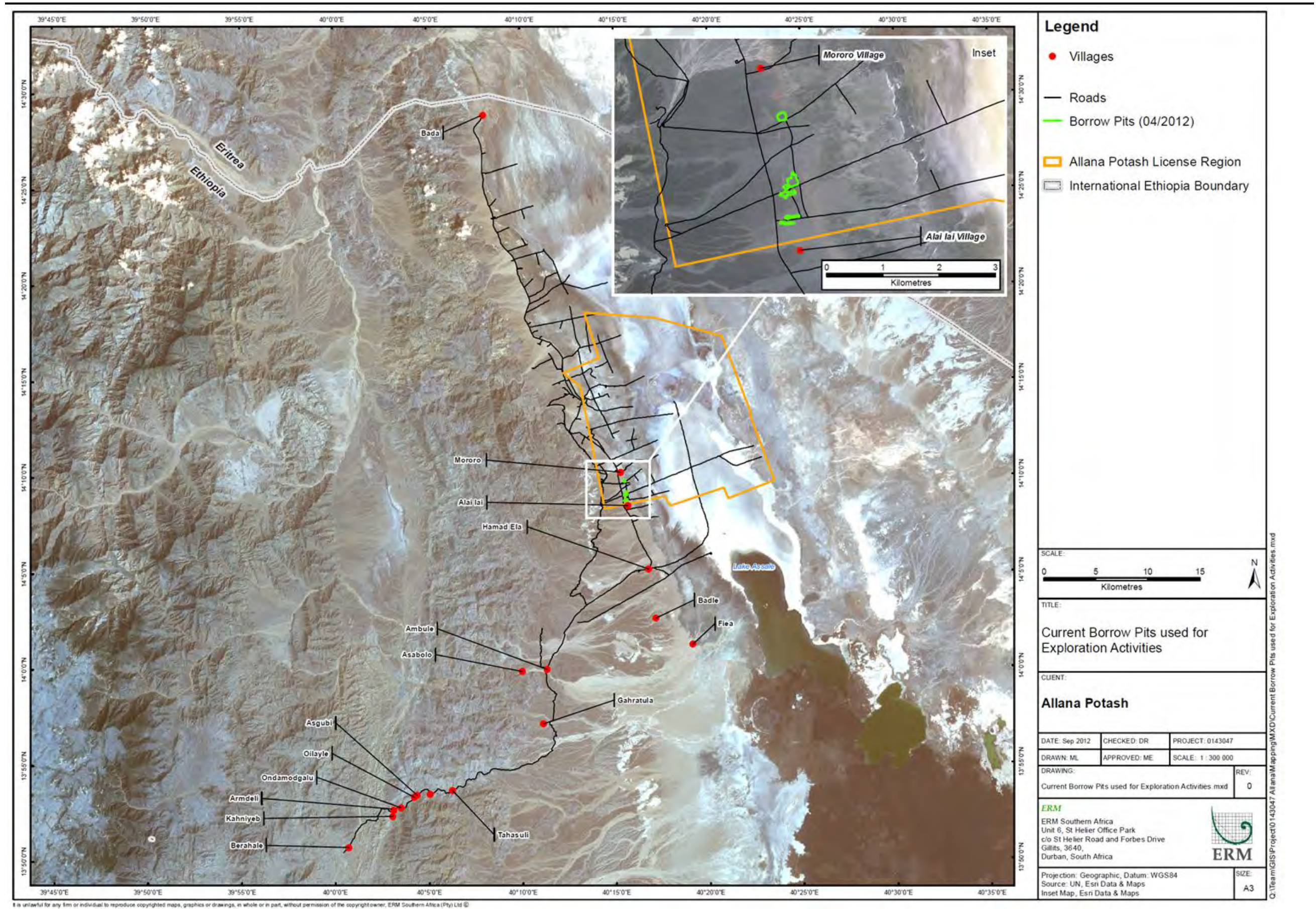
(2) *Please Note* - suitable hazardous waste disposal companies that are certified to collect, transport and dispose of hazardous waste products have not yet been identified. The identification of these third party persons will take place during the detailed design phase of the proposed Project

Waste Type	End Use
Waste oil (hydraulic and lubricating) and grease	Refine/reuse
Batteries	Recycle
Medical (first aid) wastes	Disposal to licensed disposal company

Borrow Material

Allana currently are utilising three borrow pits in the Study Area (*Figure 2.25*). Borrow material from these pits have and are currently being used for the construction of roads and drilling pads along the salt flats and other *ad hoc* exploration activities when and where required. Borrow material will be required during the construction phase of the Project for the construction of the evaporation pond platform, roads and civil works for the processing plant and staff village. At this stage it is anticipated that borrow material will be sourced in a similar area as the existing borrow pits. Furthermore, this ESHIA will identify critical to highly sensitive areas in which material must not be sourced.

Figure 2.25 Locality of Existing Borrow Pits in the Study Area



2.4.4

Personnel

The solution mining operation requires approximately 91 personnel, including management, maintenance and senior operators and field staff for brine field management. The plant operation requires 261 people in total, including management and maintenance. The auxiliary facilities, power plant and product loading/unloading require approximately 90 people.

As such, approximately 442 personnel will be needed on-site at any-one-time. This will consist of 13 high level expat skilled workers, 85 middle level expat and skilled Ethiopians and 344 lower skilled workers, of which approximately 100 will likely consist of Afar.

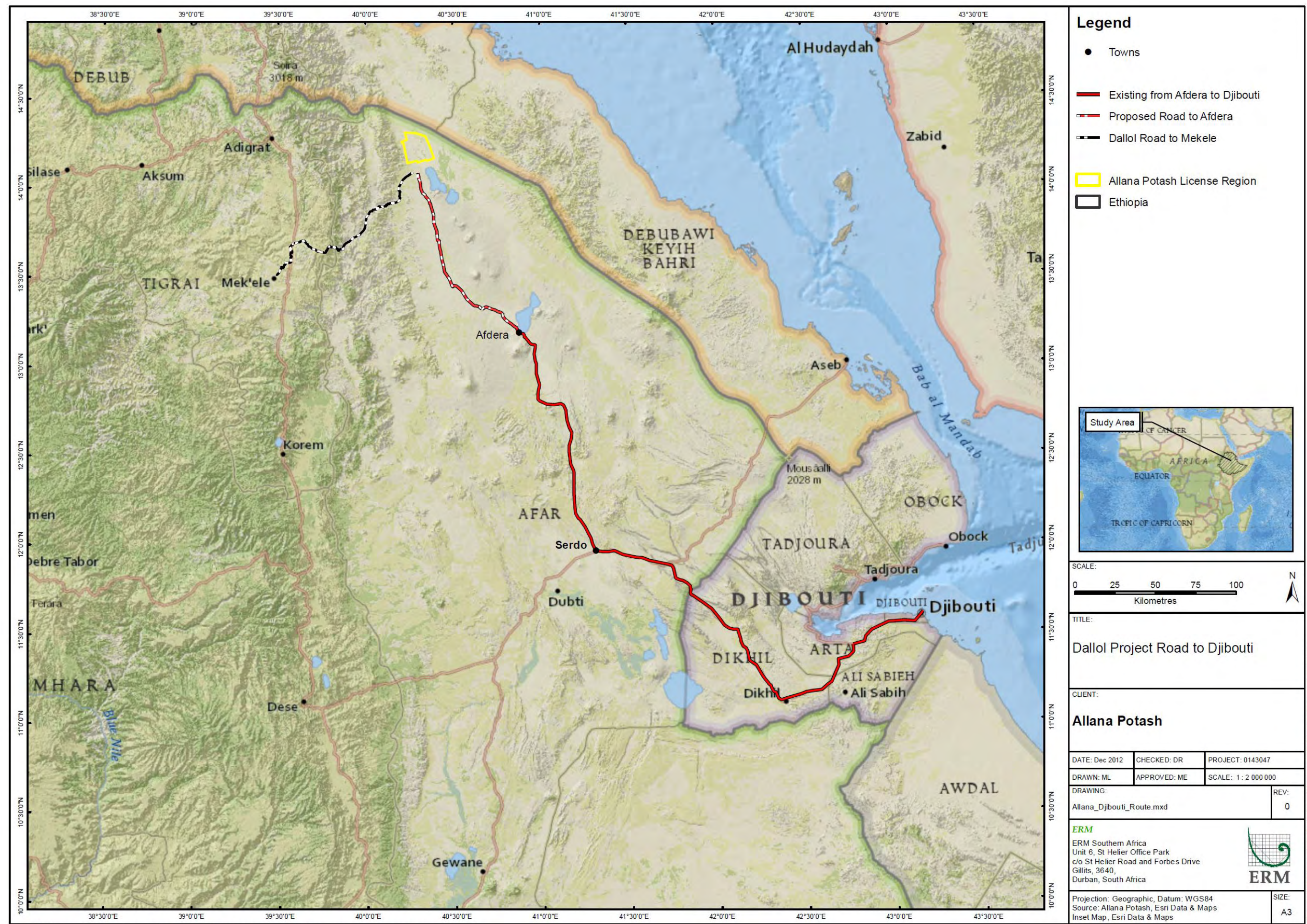
Furthermore, an additional 60 personnel will be required to run the mine village and associated infrastructure and additional contract staff for trucking and maintenance works will also be required.

2.5

SECONDARY PROJECT ACTIVITIES

At this stage of the Project all linear infrastructure, including transport routes outside of the concession area, have not yet been confirmed. The construction of a road connection from the site to Tadjoura Port in Djibouti is currently under discussion between Allana and the relevant Ethiopian government departments. A preliminary route has been identified by Allana for transportation of Potash offsite through to the port of Tadjoura (refer to *Figure 2.26* below). Currently it is proposed to construct a new access road (approximately 70km) that will run from the Project Site south-south-west to Afdera, through the Danakil Basin. This portion of the route has a relatively flat topography and is not characterised as having steep gradients and/or tight bends. The proposed route will then run south for approximately 180km along an existing road network through to the town of Serdo, following which it is proposed that the Ethiopian National Highway 2 (N2) will be used to travel eastwards from Serdo through to a section of the N2 that is situated just north of the town Lofefle. From here, another road segment of approximately 30km will be required from the N2 running east-south-east to the Djibouti/Ethiopian border, near to the town of Bahlo in Tadjoura, Djibouti. Once in Djibouti, it is proposed that the Djiboutian National Highway 11 (N11) and 12 (N12) will be used through to Tadjoura Port.

Figure 2.26 Preliminary Transport Route for Transportation of Potash Offsite



In addition, the Ethiopian government has already started the construction of a road from Mekele to the Danakil (the Dallol Road to Mekele), passing through the towns Berahale, Hamad Ela through to Bada (refer to *Figure 2.26*).

Following completion of this ESHIA, ERM will be carrying out a socio-environmental screening exercise of the transport route from the Project Site through to Tadjoura Port, as is described above. As part of the socio-economic screening exercise the following aspects will be screened:

- Social;
 - Health and Safety;
 - Cultural and Heritage;
 - Traffic and Road Conditions; and
 - Ecology.
- } **Social**

The objective of the screening study will be to identify potential risks and impacts along the proposed route and Tadjoura Port. Furthermore, any portion of the transportation route that is *constructed* by Allana will be considered under a separate scope of work and a separate environmental and social impact assessment process will be required should these roads be associated with the Project proposed in this ESHIA. Although this scope of work is not included in the scope of this Project it will be discussed in the cumulative chapter (*Chapter 13*) of this ESHIA.

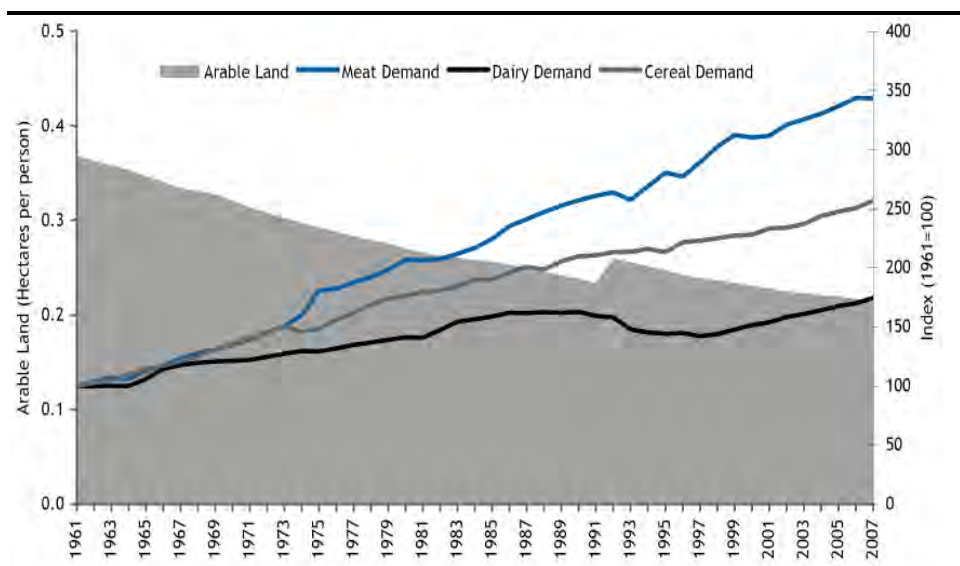
3.1 POTASH DEMAND

Approximately 90% of potash produced worldwide is used as fertilizer for commercial crop production, including corn, soybean, palm oil, sugar cane, and various fruits and vegetables (U.S. Geological Survey, 2008). The remaining supply of potash is used in the production process of various chemicals. As such, mainstream demand for potash is directly coupled with the demand for agricultural crops.

Global demand for agricultural products has increased over recent years (Figure 3.1). Drivers influencing this demand include (Allana Potash Corp, 2012):

- An increase in world *population*. The global population is expected to increase by over one-third by the year 2030.
- *Improving diets* in emerging markets. This has caused an increase in meat consumption in emerging markets and has resulted in an increased demand for pasture land, which in turn has increased the demand for potash as a fertiliser application.
- An increased rate of *urbanisation* and reduction in the total amount of arable land per capita. Consequently, this increases the necessity to increase crop yields on existing land.
- A recent increase in demand for agricultural crops for use in the production of *bio-fuels*.

Figure 3.1 Potash Demand Drivers



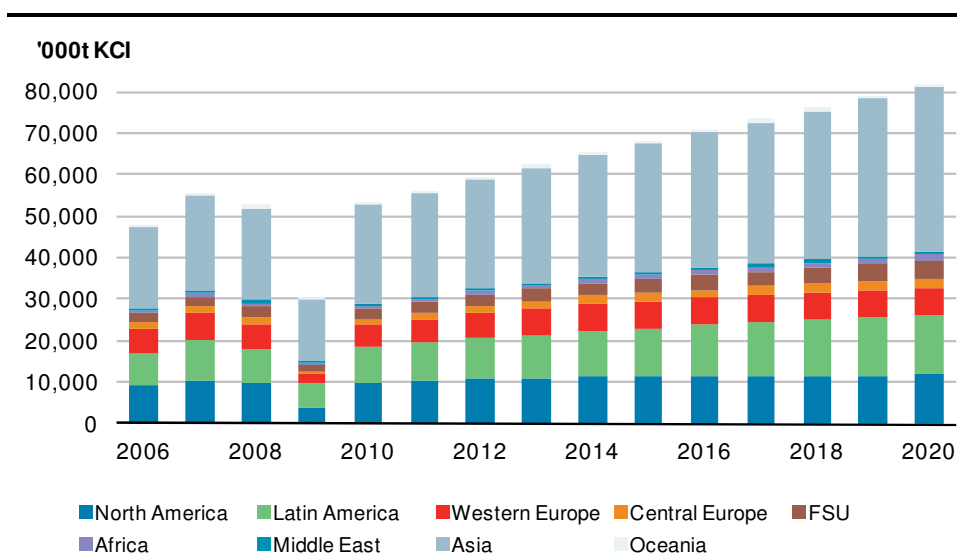
Source: United States Department of Agriculture, (2010)

In order to accommodate the increase in demand for agricultural crops, both the public and private sector are actively promoting the use of fertilizers, such as nitrogen, phosphate and potash, to improve crop yields (FAO, 2008). The expected total demand of world nitrogen, phosphate and potash consumption, and the annual growth of this consumption is shown in *Table 3.1*. From this table it is evident that East and South Asia have the highest share of world consumption for fertilizers (38.3% and 19.6% respectively), followed by North America (13.5%) and Latin America (6.3%).

During the period 1993 to 2008, the global demand for potash has grown at a steady rate, with a compounded annual growth rate of 3.3%, which is in line with global crop production. Although there was a drop in global potash demand during the years 2008/09, demand remained stable in 2010, recovered nicely in 2011 and has shown a resilient growth in 2012 thus far (Allana Potash Corp, 2012).

Global potash consumption is expected to expand by a further 25 million tons (Mt) from 2010, reaching 80Mt by 2020 (*Figure 3.2*). Asia has the highest historic and projected demand for potash; however, there are strong policy signals emerging from the Chinese and Indian markets, as significant potash subsidies were put in place (US\$ 15billion and US\$ 12billion respectively) during 2011 (Allana Potash Corp, 2012).

Figure 3.2 *Global Potash Demand*



Source: Market Reports, Retecon, (2011)

In 2007, the global demand for fertilizer totalled 195 million tons, with over 30 million tonnes attributed to potassium-based fertilizers (i.e. potash) (FAO, 2008). Many market analysts believe the demand for potash will continue to grow, which will continue to support current and future investment in potash exploration and development projects (Allana Potash Corp, 2012).

Table 3.1 *Regional and Sub-Regional Fertilizer Consumption 2007/8 to 2011/12*

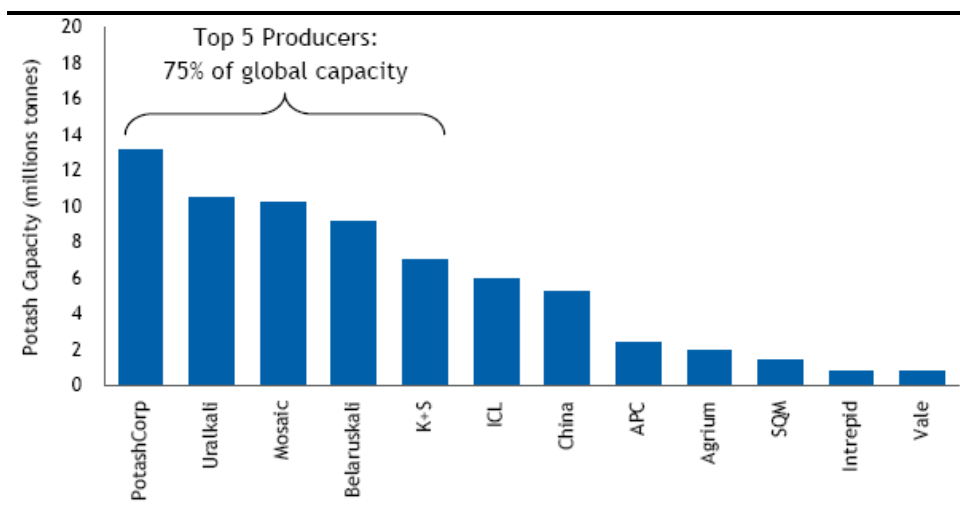
Nitrogen Regions and Sub-regions	N (%)		P (%)		K (%)	
	Share of World Consumption	Annual Growth	Share of World Consumption	Annual Growth	Share of World Consumption	Annual Growth
World		1.4		2.0		2.4
Africa	3.4	2.9	2.5	1.0	1.6	2.0
North America	13.5	0.3	12.0	0.5	17.1	0.7
Latin America	6.3	2.4	13.0	2.8	17.5	2.9
West Asia	3.5	1.7	3.3	1.0	1.4	2.4
South Asia	19.6	2.2	20.5	3.5	10.9	4.2
East Asia	38.3	1.3	36.1	1.9	35.2	3.3
Central Europe	2.7	1.8	1.5	1.2	2.4	1.0
West Europe	8.4	-0.3	5.6	-0.7	9.5	0.0
Eastern Europe and Central Asia	3.0	2.4	2.0	4.5	3.1	1.6
Oceania	1.4	4.9	3.5	1.7	1.3	2.1

Source: FAO, (2008)

According to the U.S. Geological Survey (2009), Canada, Russia, Belarus, Germany and Brazil hold the largest potash reserves, of which 80% are located in Canada and Russia (FAO, 2008). In 2007, Canada, Russia and Belarus were the largest potash producers in the world, producing 11 million tons, 6.3 million tons and 5.4 million tons, respectively (Allana Potash Corp, 2012).

The top-five potash producers (PotashCorp, Uralkali, Mosaic, Belaruskali and K & S) account for more than 75% of production capacity (*Figure 3.3*).

Figure 3.3 *Top Global Potash Producers*

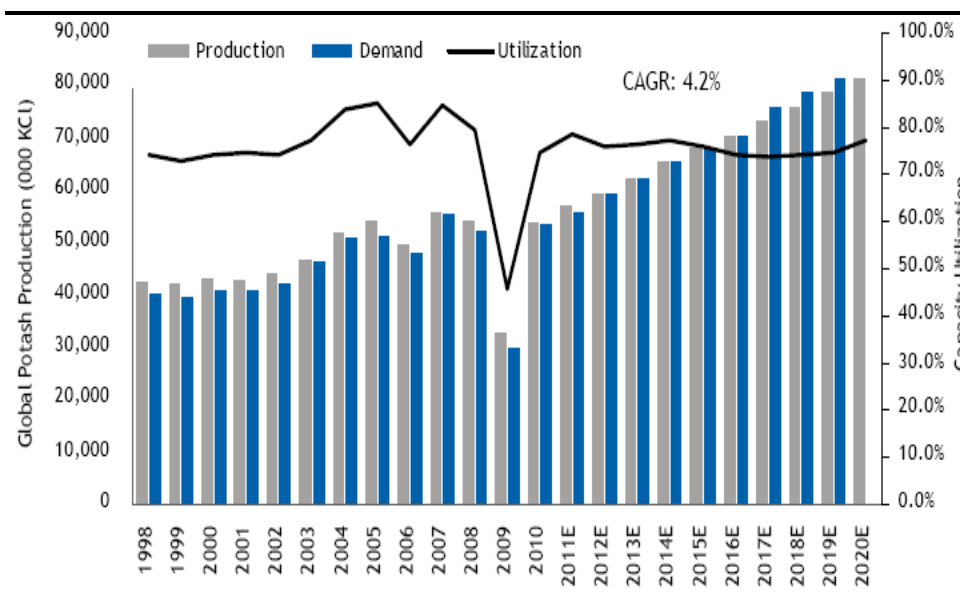


Source: Allana Potash Corp. (2011)

Capacity utilisation for potash has averaged 75% since 1990, as the majority of producers tend to supply potash only to meet current demand levels, thus mitigating the potential for surplus supply (Allana Potash Corp, 2012). Capacity utilisation dipped to approximately 45% in 2009 as a result of the global depression; however, utilisation levels have since stabilised, and are expected to be maintained at an average of 76% from 2011 to 2020 (*Figure 3.4*). Furthermore, potash production is expected to increase by an average of 4.2% per year (compounded annual growth rate - CAGR) from period 2010 to 2020.

In order to meet demand and maintain a suitable capacity ratio, existing potash producers are going to have to produce and supply larger quantities of potash. As such, existing potash producers will need to expand their current mining operations or plan new mining operations.

Figure 3.4 Historical and Projected Potash Market Balance



Source: Market Reports, Retecon, (2011)

3.3 FINANCIAL FEASIBILITY OF POTASH MINING

Due to the location of many potash deposits, potash mining and production is time and capital intensive. Potash is formed by the evaporation of sea water and the compression of the evaporated minerals by sediment layers, over time. As a result, potash is often found in deep underground deposits.

Despite the added effort and cost of potash mining, many potash projects are economical due to a certain and high global demand. Prices for potash are quoted on the spot market or contract market. In 2008, the contract price quoted was as high as US\$ 625/ton. The spot price for potash climbed as high as US\$ 1,000/ton in Belarus. Analysts continue to forecast a strong demand and therefore pricing for potash in the future (FAO, 2008).

3.4 POTASH MINING IN THE DANAKIL DEPRESSION

The Danakil Depression has been the target of several potash exploration programmes. These programmes have dated back to the early 1920's, with the first potash extraction programme initiated in 1929 by an Italian company near Mount Dallol. Towards the end of the 1950's, exploration activities intensified and major potash reserves were identified approximately 5km west of Mount Dallol. Since this time, mining concessions for the area have been transferred between public and private enterprises, and exploration activities in the Depression are intensifying (Ercosplan, 2011).

The location of the Danakil potash reserves is advantageous, as it is in relative close proximity to deep water port infrastructure in Djibouti, approximately 400km to the south east of the Danakil potash deposits. This would allow for

ease of export to India, which is the second largest importer of potash. Furthermore, the potash falling within Allana's prospecting license is large (673Mt measured), of high quality (18.7% KCl) and is relatively near the ground surface (approximately 200m). The low depth of the potash will result in a relatively low capital cost operation. The life of mine for the proposed operation is 19 to 30 years.

As indicated in *Figure 3.3*, there are a number of other companies' carrying out exploration projects in the Danakil Depression. Furthermore, across the Eritrean border, South Boulder started drilling in its Colluli property for potash salts and has reported positive results (Ercosplan, 2011).

3.5 **ETHIOPIAN ECONOMY**

The Ethiopian economy is largely dependent on the agricultural sector as a source of income. Over 85% of Ethiopians work in the agricultural sector, and the sector provides over 90% of the country's foreign exchange. In the early 1990's, Ethiopia had a relatively small investment in private sector businesses. The reason for this can be attributed to the actions imposed by the previous governmental regimes; however, since then, the current government has embarked on a programme of economic reform, whereby government owned properties have been transferred to the private sector (Ethiopia Business Forecast Report, 2011). The percentage of Ethiopia's Gross Domestic Product (GDP) from the private sector has increased from 20.4% in 1994 to 36.3% in 2010 (World Bank Group, 2012). Furthermore, the Ethiopian Government is becoming noticeably committed to foreign investment and supportive of mining initiatives (especially gold). This commitment became most noticeable in July 2010, when government enacted laws to regulate mining, and mining taxation. This in turn improved the country's attractiveness as a destination for mining investments (Ethiopia Business Forecast Report, 2011).

Unemployment in Ethiopia is 23.1%. This percentage is higher amongst females (31.2%) than in males (15.8%) (International Labour Organization, 2002). According to the World Bank, the percentage of the population that is impoverished was 38.9% in 2005. This percentage is less than the 1995 and 2000 levels, which were 45.4% and 44.2% respectively (World Bank Group, 2012).

3.6 **CONCLUSION**

An increasing global population, coupled with increasing rates of urbanisation and demand for agricultural crops, has resulted in an increased demand for and use of technologies like fertilisers (such as potash) in crop production. Furthermore, potash is an essential product in managing food security in developing countries. Global demand for potash is expected to increase by 320% during the period 2010 to 2020, and is expected to grow further longer term.

Increasing global demands have necessitated an increased level of supply. Supply is expected to grow at an average rate of 4.2% per year during the period 2010 to 2020. Current capacity utilisation of potash is approximately 80%. In order to meet increasing global demands, to maintain a suitable capacity utilisation ratio, and to allow for future price stability, existing potash producers will need to expand their current mining operations or plan new ones to meet this demand.

From a business perspective, potash mining is time and capital intensive. However, despite additional investment requirements, high demand and stable product prices make such business ventures economically viable.

Abundant potash resources have been delineated in the Danakil Depression of Ethiopia. With increasing support by the Ethiopian Government of investment into the private sector, commitments to foreign investment and the recent enactment of laws to regulate mining and mining taxation, Ethiopia can be characterised as having a stable investment environment for new mining ventures. Additionally, the proximity of Danakil potash resources to potential deep water port infrastructure in Djibouti allows for relative ease of export to the second largest importer of potash – India. Lastly, poverty levels in Ethiopia have decreased since the instatement of the Ethiopian government’s programme of economic reform (poverty levels decreased by 6.5% during the period 1995 to 2005). Future development in the mining sector in Ethiopia will enhance this, and will contribute to employment creation and poverty reduction.

This *Chapter* contains a description of the alternatives that have been identified for the proposed mining Project. For purposes of indicating whether alternatives are feasible and reasonable, a high level review is provided with general consideration to technical, environmental, economic and social advantages and/or disadvantages.

4.1 TECHNOLOGY ALTERNATIVES

Alternative mining methods considered, as opposed to solution mining, include open pit mining and conventional underground mining. This section presents the associated advantages and disadvantages of these mining methods.

4.1.1 Open Pit Mining (Alternative 1)

This method requires that the overburden overlying the targeted potash be removed through drill and blast methods. Once the overburden is removed the Potash ore is extracted through the use of blasting, loading and hauling.

The mined product would be loaded onto equipment similar to the 140 ton Caterpillar 785C haul trucks (*Figure 4.1*) through the use of a Caterpillar 992G wheel loader (*Figure 4.2*), and removed from the pit. These trucks would exit the pit via a ramp following which the mineralised material would be transported to the processing plant. Using open pit mining techniques, overburden would initially be stockpiled as close as is possible to the pit, before backfilling of this material in previously mined out sections of the pit, if possible and economically feasible to do so.

Open pit mining would require that the mineralised material is not deeper than 200m from the surface. As a result, open pit mining can only be used in the shallower portion of the Potash mineralised horizons, situated in the south of the concession area (refer to *Figure 4.3*). Mineralisation from each of the Potash horizons will need to be mined separately, and during the initial stage of the project only the Sylvinite horizon can be processed through the proposed process facility. The remainder of the Potash mineralisation (Carnallite and Kainitite) will either be left in the base of the open pit for future exploitation or removed and stockpiled around the project site for potential processing at a later stage. The thickness of the sylvinite member reserves minable by open pit methods is approximately 1.7m. The total ore tonnage in this area is approximately 85 million tonnes, with a sylvinite percentage of 25%. In order to achieve a production rate of 250,000 tonnes of KCl per year (at an 80% recovery rate), 316,000m² of mined area would be required, of which 1.2 million tonnes of ore would be extracted (550,000m³). This would result in a life of mine of approximately 17 years.

Figure 4.1 Example of a Caterpillar 785C Haul Truck (Capacity 140 tonnes per load)



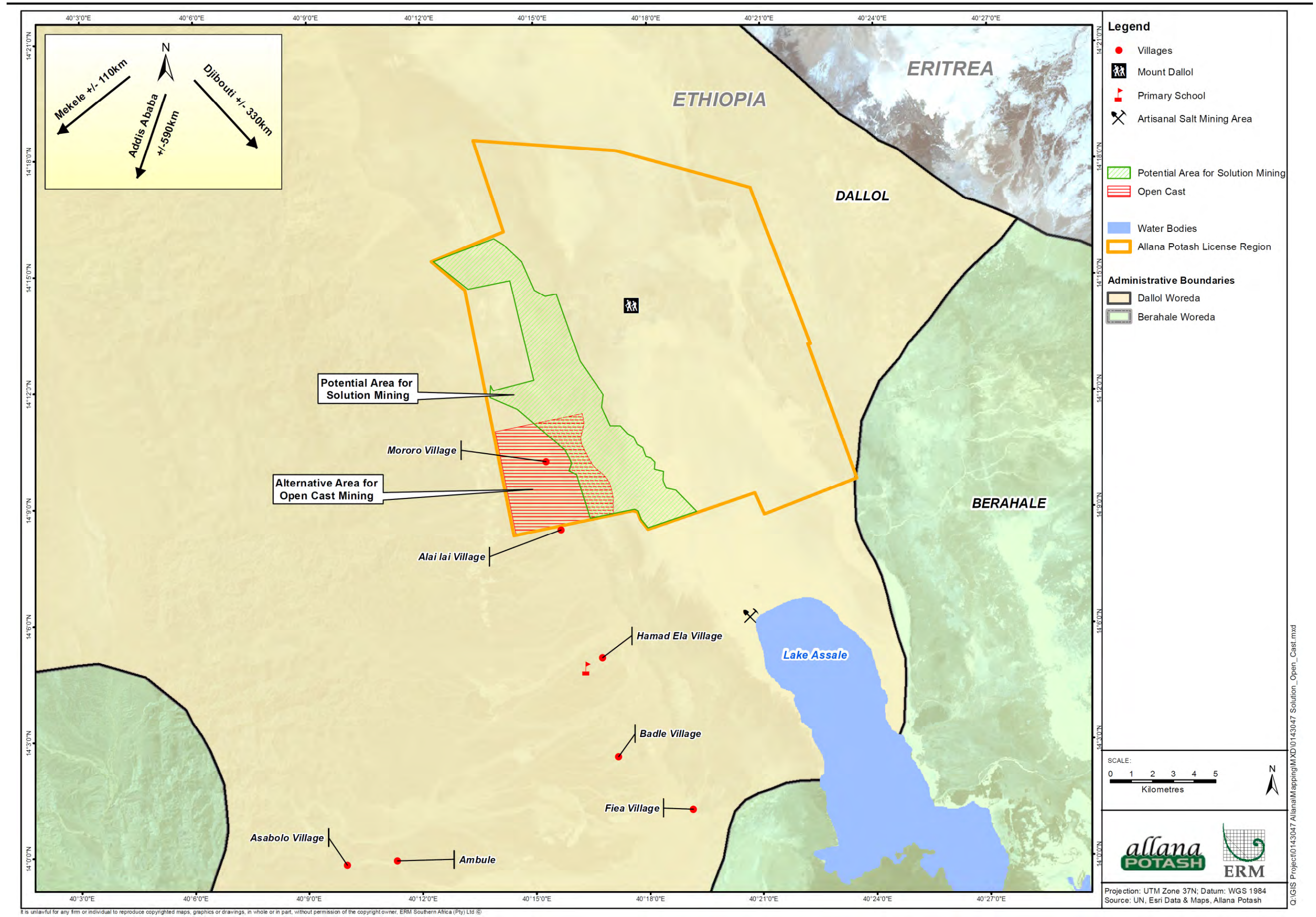
Source: Ercosplan, (2011)

Figure 4.2 Example of a Caterpillar 992G Wheel Loader



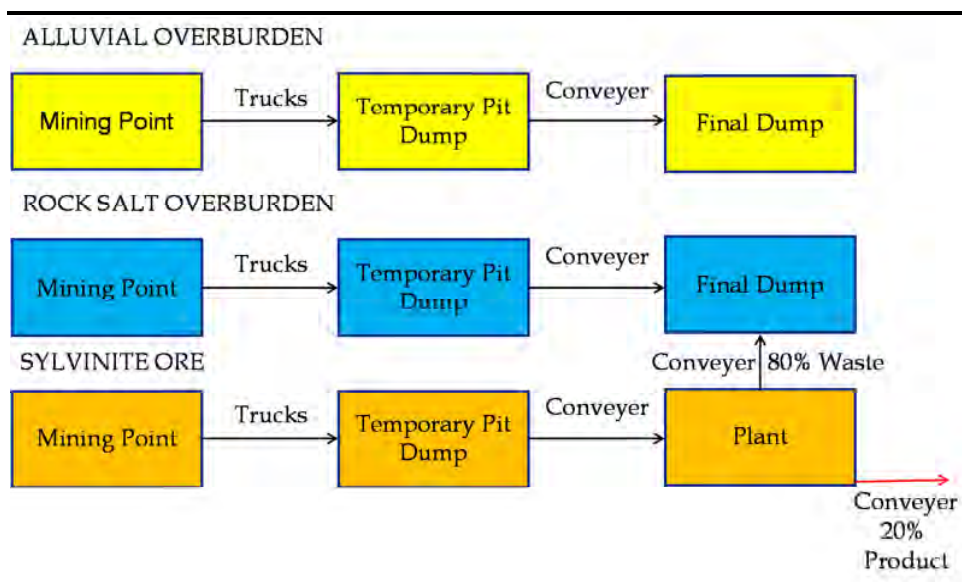
Source: Ercosplan, (2011)

Figure 4.3 Feasible Open Pit Mining Areas within the Concession Area



Under this alternative, alluvial and rock salt overburden would be transported via haul truck to two separate temporary pit dumps. These temporary pit dumps will need to accommodate two years' worth of overburden and will be approximately 103.2 and 284 million m³ in size for the alluvial and rock salt pit dumps respectively. Approximately 70% of material from the respective temporary dump sites could be re-deposited into the pit, thus sterilizing the underlying Carnallite and Kainitite resources, whilst 30% would need to be permanently stored on the surface (final dump sites). A conveyer would transport overburden to segregated final dump sites. Mined material from the Sylvinite layer would be transported to a separate temporary stockpile, following which it would be transported through the use of a conveyer to the processing plant. From the processing plant, 80% of non-KCl product would be transported via conveyer to the rock salt overburden final dump (Figure 4.4).

Figure 4.4 *Open Pit Mining Transportation Concept*



Source: Ercosplan, (2011)

With reference to *Table 4.1*, a minimum number of 116 Caterpillar 785C mining trucks and 58 Caterpillar 992G wheel loaders would be needed for the open pit mining alternative, as described.

Table 4.1 Truck and Loader Requirements

	Alluvial Overburden	Rock Salt Overburden	Sylvinite Ore Requirements
Annual volume required to be moved from the pit (m ³)	51.6 million	142 million	0.55 million
Annual tonnage required to be moved from the pit	108 million	309 million	1.2 million
Number of Caterpillar 785C haul trucks	30	84	2
Number of Caterpillar 992G wheel loaders	15	42	1

Source: Ercosplan, (2011)

With regards to conveyor requirements a total distance of 11.5km would be required (*Table 4.2*).

Table 4.2 Conveyor Requirements

	Alluvial Overburden	Rock Salt Overburden	Sylvinite Ore Requirements
Capacity (tons per hour)	18,000	51,500	820
Length (km)	3.5	4	4

Source: Ercosplan, (2011)

In addition to the above, the removal of overburden would require that 254 Atlas Copco (Roc L6 or Roc L8) drilling rigs (*Figure 4.5*) are purchased with 38 on standby.

The advantages and disadvantages associated with open pit mining are presented in *Table 4.3* overleaf.

Figure 4.5 Example of a 254 Atlas Copco L6 Drill Rig



Source: Ercosplan, (2011)

Table 4.3 Advantages and Disadvantages Associated with Open Pit Mining

Advantages	Disadvantages
High rate of recovery of the mineralised material.	<p>Unproven technology for salt mining. Open pit mining of Potash has never been completed on a large industrial scale; therefore this mining method for Potash comes with considerable technical risk.</p> <p>The costs associated with this option are high, as the ratio of material that has to be stripped compared to that that can be mined is high.</p> <p>Approximately 80 to 180m of overburden would need to be stripped to mine 1.7m of the Sylvinitic horizon.</p>

Advantages	Disadvantages
There is a low level of precipitation in the area; therefore, inconveniences associated with flooding of the mine works are minimised.	Strata containing groundwater above the mineralised material member may result in timely and costly efforts associated with removing water from the mine works. Previous mining attempts in the area reportedly shut down due to problems arising from water ingress.
Proven Technology exists for the processing of the mineralised material.	Although it is proposed to only mine the Sylvinite horizon at this stage, this alternative requires that 0.5m of Sylvinite be left in the base of the pit to avoid mining contamination caused from mixing the Sylvinite ore with material from the underlying Carnallitite horizon. Mixing of Sylvinite ore and Carnallitite material in the process facility would greatly reduce the mill process recovery, or render the final product unsalable.
Water requirements in this option are 80% less than that of solution mining.	To access the mineralised member deposit, overburden needs to be removed. This increases the mine waste to mineralised material ratio, thus resulting in higher capital costs (US\$ 2,303.97 million compared to US\$ 795.66 million for solution mining) and much higher operational expenditure costs throughout the life of mine. This in turn creates limits as to the depths to which open pit mining is economical.
	Equipment requirements. Number of haul trucks (116), wheel loaders (58) and drill rigs (254) are extremely high, with unknown availability from suppliers and high cost of purchase, import, operations and maintenance.
	Temperatures in the open pit are expected to exceed 60°C.

4.1.2 *Conventional Underground Mining (Alternative 2)*

This alternative requires a large amount of below surface infrastructure and working personnel. One or more access points to the depth of deposit (approximately 100m to 450m below the surface) would need to be constructed. These access points would consist of either vertical shafts, inclined ramps (adits) or a combination of these. The purpose of these access points would be to provide a transport system for mineralised material to reach the mine surface, ventilation shafts and transport of mine personnel.

The mineralised material would be mined from underground mining rooms. The dimensions of the mining rooms would need to be unique and would need to be adapted to variations in grade and seam thickness. Mining can take place at specific levels, so as to extract only the mineralised material, thus reducing the non-mineralised material to mineralised material ratio. From the mining rooms, mined mineralised material is transported on the surface by

truck or conveyor within the underground works into underground storage bunkers, following which it is transported by truck or conveyor to the production plant.

The advantages and disadvantages associated with underground mining are presented in *Table 4.4* below.

Table 4.4 *Advantages and Disadvantages associated with Underground Mining*

Advantages	Disadvantages
Proven technology in potash salt mining.	The construction of underground access points are at times constrained by groundwater bearing overburden.
Possible reduction in mining costs, compared to the open-pit mining option outlined in <i>Section 4.1.1</i> , as overburden does not need to be removed before mining can take place.	Normally, capital requirements associated with sinking shafts and the development of underground workings are large. This type of conventional mining method will also require a larger investment of time.
Mining can be selective in terms of what mineralised material is mined.	Requires an impermeable geological layer between groundwater bearing strata and underground workings of the mine. If the impermeable layer is penetrated or damaged this could result in complete loss of the mine through flooding. Geologically, the Sylvinite and Upper Carnallite horizons are more porous and permeable than the underlying Kainitite horizon and contain minor ground water. It is unlikely that these two mineralised horizons can be exploited fully by underground mining without a severe risk of flooding. To ensure the stability of the mine, 40% of the mineralised material needs to remain as pillars in the mine rooms. This will result in a lower mineralised material extraction ratio compared to open pit mining.
Conventional Processing options available with proven technology.	Individual Potash ores (Sylvinite, Carnallite and Kainitite need to be processed using differing processing routes, therefore three types of process plant options would be required.
Water requirements in this option are 80% less than that of solution mining.	Strata containing groundwater above the mineralised material member will result in timely and costly efforts associated with removing water from the mine works.
	Health and Safety issues: Current drilling operations have indicated that there is a potential but localised high risk associated with there being hot brines in proximity to where underground workings would be required.

Advantages	Disadvantages
	Mining will need to take place at a depth greater than 80m below ground surface. At such depths, high underground temperatures are prevalent and specialised cooling equipment is required; however, in the Danakil Depression, temperatures at these depths are almost approaching boiling point. This makes it virtually impossible to sufficiently cool underground working areas using any known technologies.

4.1.3 *Discussion of Mining Alternatives*

Solution Mining (Preferred Alternative)

To date the initial studies completed by Allana suggest that solution mining is the most economical method for extraction of potash in the area (the initial direct capital expenditure for solution mining is estimated to be US\$ 1,508,310,000 less expensive than open pit mining. The reason for this is that a large overburden layer does not need to be removed before mining of the target layer can take place. Furthermore, there is also no requirement to dewater the mining area and there is little or no impact on the chosen method due to water ingress from surface flooding or groundwater ingress.

In addition, solution mining may be capable of extracting the Sylvinite mineralisation member as well as the Carnallite and Kainitite mineralisation members at a later stage of the mine. This would ultimately allow the company to extract the maximum amount of Potash from the area, compared to the alternative mining methods.

Open Pit Mining (Alternative 1)

Open pit mining would be a reasonable option as approximately 60% of the known Sylvinite deposit is shallow enough for this mining alternative to be employed. The open pit would require a significant amount of dewatering and at all times during production, there remains a risk of flooding. Open pit mining would however sterilise the underlying Carnallite and Kainitite and would render this mineralisation unfeasible to extract at a later time in the life of mine.

From an occupational health and safety perspective, open pit mining is favoured over the conventional underground mining alternative, as personnel would not be exposed to hot brines, high ambient temperatures and potential cave-ins from wall collapse. Open pit mining would not be without risks to health and safety. The area is reported to be the hottest inhabited place on earth and temperatures inside the open pit are expected to rise above 60 degrees celcius.

The open pit mining option does not require water; however, the potential volumes of surface water, saline water intrusion and other groundwater that may enter the pit, and the costs associated with pit dewatering would potentially affect the financial feasibility of this alternative. A certain proportion of this water could however be used as process water (approximately 100m³/h).

Another factor rendering open pit mining unfeasible is the high capital and operating costs associated with the machinery fleet that would be required to remove the overburden.

The process facility associated with the Open Pit method would be capable of handling Sylvinitic only.

Consequently, although this alternative is reasonable, it is not a financially feasible option. **As such, this alternative will not be considered any further in this report.**

Conventional Underground Mining (Alternative 2)

Conventional underground mining would be a reasonable option in the shallow portion of the deposit from an operational perspective as it allows access to all the Potash mineralised horizons.

This mining option does not require water, only the disposal of water to keep the underground workings dry. A proportion of this water can be used in the process facility.

In comparison to solution mining and the open pit mining alternative, conventional underground mining presents a high risk to site personnel, who will be exposed to potential hot brines. Furthermore, personnel will be exposed to high ambient underground temperatures ranging from 35°C in the shallow portions to 90°C in the deeper portions of the deposit. As such, from an occupational health and safety perspective, conventional underground mining in the Danakil Depression is not a reasonable alternative. Furthermore, the absence of a well-defined (and proven) impermeable rock barrier above the mineralised material rock layer above the Sylvinitic horizon makes the risk of complete loss of the mine through flooding, high.

From a financial perspective, this alternative is more favourable than open pit mining, as the costs associated with removing overburden is not realised.

Consequently, although this alternative is reasonable and potentially more financially feasible than open pit mining, it is assumed not reasonable from an occupational health and safety and mine flooding perspective. **As such, this alternative will not be considered any further in this report.**

4.1.4 *Processing Alternatives*

The Sylvinite processing options for all the mining alternatives are similar. Small modifications to the process plant are required depending on the chosen mining method and the material that will be processed through the mill.

The processing options and the final method are currently being investigated by Allana as part of their Feasibility Study.

4.2 *NO-GO ALTERNATIVE*

As per ESHIA good practice, any comparative assessment of project alternatives must include a no-go option. For the purposes of this report, the no-go alternative will be that the proposed Project is not established within any time period.

In this alternative, there will be no direct social or environmental advantages associated with Allana not establishing a mine in the Danakil Depression. The reason for this is that if Allana did not establish a potash mine in the area then other mining concession holders would. However, if Allana did not establish a potash mine in the Danakil Depression then the severity of cumulative impacts associated with operational water supply and interference of the local salt trade would potentially be lessened. The key potential disadvantages associated with the no-go alternative include:

- Lost opportunity to supply an ever increasing global demand for potash.
- Short-term loss of utilisation of significant potash bearing reserves in the Danakil Depression.
- Loss of the opportunity of employment and development of the Afar.
- Loss of revenue streams in Ethiopia, which in turn will affect local, regional and national government revenues.
- Loss of opportunity for private investment within Ethiopia, which is a key initiative by the Ethiopian Government.
- Negative effects in managing global food security.
- Cumulative loss in supply could potentially increase potash prices, therefore affecting future price stability for potash and potentially agricultural food products ⁽¹⁾.

The no-go alternative is a feasible option; however, its selection would result in a reduced supply of potash, which will have negative effects in managing

(1) Mainstream demand for potash is directly coupled with the demand for agricultural crops.

global food security and could potentially contribute to future price instability for potash and associated agricultural products. **As such, this alternative is not considered reasonable and will not be considered any further in this report.**

This *Chapter* details the legislative and administrative framework for the ESHIA associated with the proposed Dallol Potash Project. Host country laws of Ethiopia relevant to the successful implementation of all components of the proposed Project were considered during the EIA process and all necessary licensing and permitting requirements have been identified based on current Project concepts and design.

In addition to the applicable regulations and norms of the government of Ethiopia, the proposed Project has committed to comply with the requirements of the IFC and the AfDB.

5.1

INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK

The Federal Democratic Republic of Ethiopia (FDRE) includes the Federal State and nine Regional State members (*Figure 5.1*). The nine member states of the FDRE include Tigray, Afar, Amhara, Oromia, Somalia, Benshangul/Gumuz, the Southern Nations, Nationalities and Peoples State, Gambela Peoples State and the State of the Harari People. The States are constitutionally endowed with equal rights and powers. The FDRE Constitution (Article 50) states that all these States have legislative, executive, and judicial powers. Ethiopia is then divided into 800 Woreda administrative divisions (or districts), which are managed by local government. These 800 Woredas are typically collected into Zones and consist of approximately 15, 000 Kebeles (wards), which are the smallest unit of local government in Ethiopia. The concession areas which Allana holds are located in the ANRS, Zone 2, in the Woredas ⁽¹⁾ of Dallol and Berahale (*Figure 5.2* and *Figure 1.2*).

The power and duties of the Federal, Regional and Local governments have been defined by Proclamations n^o 33/1992, 41/1993 and 4/1995 (refer to *Section 5.1.1* below). Under these proclamations, duties and responsibilities of Regional States include planning, directing and developing social and economic development programmes as well as the protection of natural resources.

(1) Please Note - Although the Allana concession is located almost entirely within the Dallol Woreda (as is illustrated in *Figure 1.2* in *Chapter 1*) these Woreda boundaries are under dispute. Discussions with both the Dallol and Berahale Woreda have indicated that Allana's concession is administered (including the payment of taxes) primarily by the Berahale Woreda Administration.

Figure 5.1 Federal Democratic Republic of Ethiopia

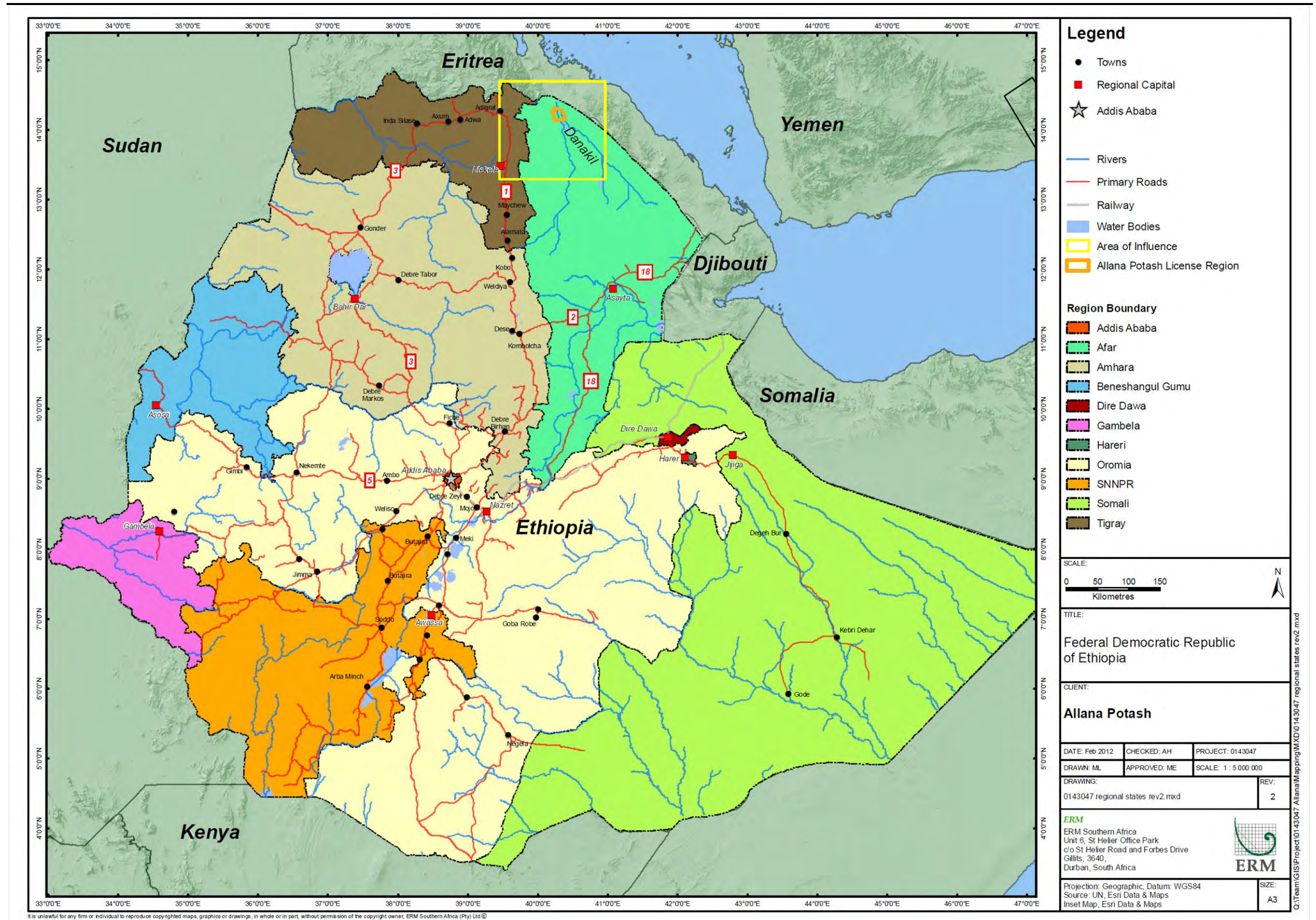
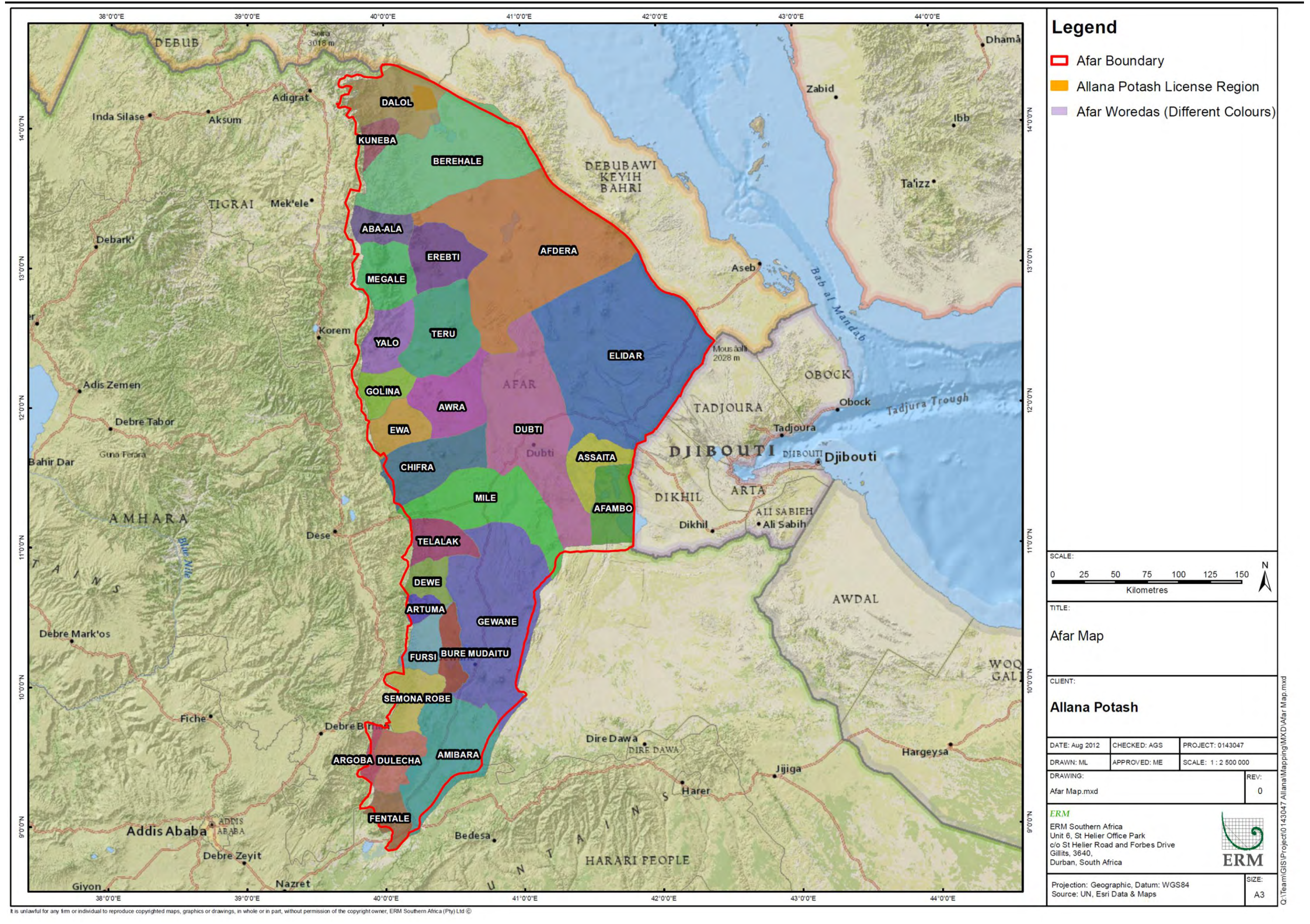


Figure 5.2 Local Administrative Structure of the Afar Region



5.1.1 *Regional Governments Establishment Proclamation*

The Regional Governments Establishment Proclamation (n^o 41/1993) recognizes the right of nations, nationalities and peoples to self-determination and to determine their own affairs by themselves as affirmed by the Transition Period Charter of Ethiopia and later by the Constitution.

The Executive Organs of the regional governments constitute several line bureaus parallel to that of the Executive Organs of the Federal Government. This kind of regional political organizational structure underpins major transformation in undertaking environmental and development issues at district and grass root levels.

Proclamation n^o 4/1995 - *Definition of Powers and Duties of the Executive Organs of the Federal Democratic Republic of Ethiopia* supports Proclamation n^o 41/1993 in that it provides a definition of the powers and duties of the executive organs of the federal democratic republic of Ethiopia.

5.1.2 *Environmental Protection Authority*

The Environmental Protection Authority (EPA) was first established in August 1995 under Proclamation n^o 9/1995, and re-established in October 2002 under Proclamation n^o 295/2002. It is an autonomous government body reporting directly to the Prime Minister.

The EPA has broad mandates covering environmental matters at federal level. The Proclamation also sets out the main responsibilities and broad organizational structures of the EPA, such as:

- Preparing policies and laws on environmental protection;
- Preparing directives and implementation of systems for evaluation of impacts of projects on the environment;
- Preparing environmental protection standards and implementation of directives on soil, water and air; and
- Enforcing implementation of the ESIHA process.

5.1.3 *Ministry of Mines*

The Ministry of Mines (MoM) is a federal government executive body responsible for the promotion and regulation of the mineral and petroleum resources in the country. The role of the Ministry is mainly to generate the basic geosciences data of the country, to promote the mineral and petroleum potentials of the country, to negotiate and issue licenses to the private investors and ensure that they conduct mineral and petroleum operations in accordance with their concession agreements.

Although the EPA is mandated to drive environmental impact assessment processes in Ethiopia, the MoM has within its department EPA representatives. Because the proposed Project is mining related, the EPA has delegated review and decision making authority to the EPA delegates within the MoM.

5.1.4 *Ministry of Water Resources*

The Ministry of Water Resources (MoWR) of Ethiopia is a federal organization established by Proclamation n^o 4/1995 to manage the water resources of Ethiopia. This involves development, planning and management of water resources, development of policies, strategies and programmes, development and implementation of water sector laws and regulations, conducting research and providing technical support to regional water bureaus.

5.1.5 *Ministry of Federal Affairs*

Ministry of Federal Affairs (MoFA) assists the regional states through trainings in policy issues to regional leaders as well as the public at large. It also strives to enhance their capacity and maintain peace and promote development, conflict management, and social and environmental awareness, among others.

The Regional Affairs divisions of MoFA focus mainly in supporting regions, which are relatively under developed and recently emerging. These include the pastoral regions of Somali and Afar and the semi-sedentary regions of Gambella and Benishangul-Gumuz. These enhance the capacity of the regional states to be prepared and respond to drought, and also contribute to vulnerability reduction and creating sustainable settled livelihoods for the people of the region.

5.1.6 *Ministry of Agriculture and Rural Development*

Proclamation n^o 300/2004 (issued on 13th January 2004) amended the proclamation for the reorganization of the Executive Organs of the FDRE, Proclamation n^o 256/2002. Thus, the Ministry of Agriculture and Rural Development (MoARD) replaced the former Ministry of Agriculture and Ministry of Rural Development. The powers and duties vested in the new ministry includes, among others, conservation and utilization of forest and wildlife resources, food security programmes, water harvesting and small-scale irrigation, monitoring events affecting agricultural development and early warning systems, enhancing market led agricultural development, issuance of guidelines and procedures for agricultural input evaluation and release, ensuring the distribution of high quality agricultural inputs to users, and establishing and directing training centres of agriculture and rural technology.

The MoARD strives to solve chronic problems associated with: deforestation, land degradation, lack of land use planning, decline in crop and animal

production, dependency on biomass fuels, and lack of alternatives livelihoods, etc.

5.2 NATIONAL LEGISLATION

5.2.1 *Constitution of the Federal Democratic Republic of Ethiopia*

The concept of Sustainable Development and environmental rights are enshrined in Articles 43, 44 and 92 of the Constitution of the FDRE.

In Article 43: the Right to development, where people's right to:

- Improved living standards and to sustainable development;
- Participate in national development and, in particular, to be consulted with respect to policies and projects affecting their community; and
- The enhancement of their capacities for development and to meet their basic needs, are recognised.

In Article 44: Environmental Rights, all persons are entitled to:

- Live in a clean and healthy environment; and
- Be compensated for loss, including relocation with adequate state assistance.

In Article 92: Environmental Objectives, it is declared that:

- Government shall ensure that all Ethiopians live in a clean and healthy environment;
- Programs and projects design shall not damage or destroy the environment;
- Peoples have the right to full consultation and expression of views; and
- Government and citizens have the duty to protect the environment.

The basis of social legislation for Ethiopia is derived from the Constitution of the FDRE. To support this, Regulation n^o 135/2007 (Payment of Compensation for Property Situated on Landholding Expropriated for Public Purposes Regulation) is intended to address the shortcomings of earlier resettlement programmes as a result of development. The consequences of these resettlement programmes were impoverishment, family disintegration and marginalization.

The Environmental Policy of Ethiopia (*Section 5.2.2* below) also makes provision for social aspects and provides for the protection of both natural and human environments. It also recognizes the importance of public participation in proposed developments.

However apart from the articles and policies mentioned above, Ethiopian legislation makes little provision for social aspects of any development.

5.2.2 *The Environmental Policy of Ethiopia, 1997*

The Environmental Policy of Ethiopia (EPE), 1997 was established by the EPA of Ethiopia in collaboration with the Ministry of Economic Development and Cooperation. Key elements of this policy that are of relevance to this project include the following:

- **Section 3.6: Mineral Resources:** The policy acknowledges that mineral resources are not renewable resources. The policy promotes environmental protection, environmental education and awareness for the public and safe mining methodologies. Terms and conditions of a contract should be utilised to ensure that all pre-development environmental impact studies, appropriate mitigation and reclamation measures are taken during and after the operations.
- **Section 4.9:** Requires an EIA to consider the physical, biological, social, socio-economic, political and cultural impacts and conditions of a development. For private sector developments, the developer has the ultimate responsibility to ensure that a preliminary and a full EIA are performed. Mitigation and contingency plans are compulsory elements in an EIA. The policy also requires that the EIA process involves independent review and public comments.

Consistent with Article 44 of the Constitution, the policy provides that the people are assured of their fundamental rights to an environment that is clean and healthy.

Allana has contracted ERM to carry out a detailed ESHIA (this document) for the proposed Potash Mine in the Danakil Depression. The ESHIA has been carried out in conformance to both the Ethiopian environmental legislation and International Finance Corporation (IFC) requirements.

5.2.3 *The Ethiopian Water Sector Policy, 2001*

The overall goal of the policy Water Sector Policy is to enhance and promote all national efforts towards the efficient, equitable utilisation of water resources of Ethiopia. Furthermore, the policy aims for optimised utilisation that allows for sustainable socioeconomic development.

Allana will need to consult with the MoWR with regards to what water permitting/licensing requirements ⁽¹⁾ will be necessary for the successful implementation of the proposed Project. This will include the attainment of the necessary water use permits/licenses (this is discussed in further detail in *Section 5.2.10*).

5.2.4 *Environmental Impact Assessment Proclamation*

Summary of Proclamation

The EIA Proclamation n^o 299/ 2002 came into force on 3rd December 2002. Any project listed in any directive issued pursuant to this Proclamation is to be subjected to an EIA. Project impacts must be assessed based on the size, location, nature, cumulative effect with other concurrent impacts or phenomena, trans-regional effects, duration, reversibility or irreversibility or other related effects of the project. The resulting EIA report should contain a description of the following:

- Nature of the project, including technology and processes to be used;
- Content and amount of pollutant that will be released;
- Source and amount of energy required for the operation;
- Information on potential trans-regional impacts;
- Characteristics and duration of all the estimated direct or indirect, positive or negative impacts;
- Measures proposed to eliminate, minimise or mitigate negative impacts;
- Contingency plan in case of accidents; and
- Procedures of self-auditing and monitoring during implementation and operation.

Applicability to Project

To date, the Scoping Report (Terms of Reference for the ESHIA) has been lodged with the MoM. On 4 May 2012 the MoM had acknowledged reviewing the Scoping Report and have found that the report was in accordance with the aforementioned EIA Proclamation. Furthermore, the MoM authorised the next stage of the overall ESHIA (*Annex A*).

An ESHIA ⁽²⁾ report (this report) will be submitted to the determining authority (in this case the MoM) and made available for public comment. The authority shall ensure that public comments, in particular comments from potentially affected communities, are incorporated into the final ESHIA lodged with the determining authority.

The process to be followed for environmental assessment in Ethiopia is outlined in *Chapter 1*.

(1) Please Note - the application for water permits/licenses is not part of the Scope of Work for this study.

(2) An Environmental, Social and Health Impact Assessment (ESHIA) report is essentially the same as an EIA report, the only difference is that in an ESHIA report there is as much emphasis on Social and Health aspects as Environmental aspects

5.2.5 *Environmental Pollution Control Proclamation*

Summary of Proclamation

The Environmental Pollution Control Proclamation (n^o 300/ 2002) came into force on 3 December 2002. The Proclamation advocates a “polluter pays” policy and the EPA or relevant regional environmental agency has the right to close or relocate any enterprise if the activity being carried out poses a risk to human health or to the environment. The Proclamation also states the EPA’s requirements on the management of municipal wastes, hazardous waste, and chemical and radioactive substances. Part Three of the Proclamation states the various types of environmental standards; however, no standards were established in the Proclamation (these standards are presented in *Section 5.4.1* below).

Applicability to Project

Management of general and hazardous waste as a result of construction and operational activities of the proposed Dallol Potash Project will need to be sufficiently dealt with in the overall Environmental, Social and Health Management System (ESH-MS). Waste management activities are associated with temporary onsite storage, recycling, transport and final disposal of waste.

5.2.6 *Prevention of Industrial Pollution Council of Ministers Regulation*

Summary of Regulation

The Prevention of Industrial Pollution Council of Ministers Regulation (n^o 159/2008) is directed to industry and in particular “factories”. Although the regulation and the aforementioned proclamation do not provide a clear definition of “factories” certain sections of the regulation can be deemed applicable to the proposed Dallol Potash Project. These sections include the need for emergency response systems and the need for monitoring of environmental safety.

Applicability to Project

Allana already have an emergency response plan in place for current exploration activities. As part of the ESHIA process the Allana emergency response plan has been reviewed and suitable provisions for gaps have been identified and addressed in the Emergency Response Plan (*Annex C of Volume Three*). Furthermore, social and environmental monitoring systems have been established for the proposed Project for use during operation.

5.2.7 *Water Resource Management Proclamation*

Summary of Proclamation

The Water Resource Management Proclamation (n^o 197/2000) addresses the protection and management of surface- and groundwater. It addresses the

requirement for environmental conservation and water resource protection measures to be incorporated into water resource planning and project development.

Applicability to Project

Water resource management measures associated with both surface and sub-surface features in the Study Area have been included in the Water Management Plan (*Annex G of Volume Three*).

Section 11, Part 4 of the Proclamation details the necessity of permits and professional licenses for water use and/or waste water discharge. Refer to *Section 5.2.10* for detailed legal review of water use permit applicability for the proposed Dallol Potash Project.

5.2.8 Water Resources Management Regulation

Summary of Regulation

The Ethiopian Water Resources Management Regulation (n^o 115/2005) was issued by the Council of Ministers in March 2005 (Regulation No. 115/2005). The objective of the regulation is to provide detailed provisions for the effective implementation of its parent legislation, the Water Resources Management Proclamation (mentioned in *Section 5.2.7* above). A review of the Regulation shows that it is mainly a further elaboration of the proclamation providing in detail the main requirements for the issuance of permits for different uses of water; construction works; waste water discharge as well as providing the conditions for the issuance, renewal, revocation etc. of such permits. It also provides provisions for fees for application or permits as well as the requirements of water charges to be paid for different uses of water, although the amount of charges payable are left to be determined by the Council of Ministers and issued in a subsequent regulation (Article 31.4).

Applicability to Project

Refer to Proclamation Applicability in *Section 5.2.7* above.

5.2.9 Water Resources Utilisation Proclamation

Summary of Proclamation

The Water Resources Utilisation Proclamation (n^o 92/1994) regulates the use of water resources, by requiring a government permit in respect of most water uses, with the exception of minor and traditional uses. The proclamation further lays down basic criteria for the permit-granting authorities to use in deciding on applications for permits.

Applicability to Project

Refer to Proclamation Applicability in *Section 5.2.7* above.

5.2.10

River Basin Councils and Authorities Proclamation

Summary of Proclamation

The objective of the River Basin Councils and Authorities Proclamation (n^o 534/2007) is to provide a formal mandate to promote and monitor the process of integrated water resources management for river basins in Ethiopia. Furthermore, the proclamation aims to use water resources associated with basins in a way that promotes socio-economic welfare for the people of Ethiopia and that allows for long-term sustainability of aquatic ecosystems.

The proclamation allows for federal government to designate its powers to other entities such as Basin High Councils and Authorities (Basin Authorities). For the purposes of water resource management, Ethiopia is subdivided into 12 basins. Amongst other things, the Basin Authorities are provided with the power to issue permits applicable to the basins water use. The Authority is also empowered to initiate policy measures, to ensure that projects, activities and interventions related to water in the basin is in line with the integrated water management process, and to collect water use charges. All permits should be compiled and lodged in accordance with the Water Resource Management Proclamation (refer to *Section 5.2.7*) and Regulations (refer to *Section 5.2.8*) ⁽¹⁾.

Applicability to Project ⁽¹⁾

Danakil is the basin applicable to the proposed Project; however, the Danakil Basin Authority has not yet been established. Although Article 2 (1) and 3 of the proclamation states that in some cases two or more river basins may be organised under a single Basin High Council and Authority, no such arrangement has been observed to date. To date, two water basin High Councils and Authorities have been established. These are the Abbay and Awash Basin High Council and Authorities (Regulation n^os 151/2008 and 156/2008 respectively).

Allana having secured mining rights for specific areas within the Study Area does not translate into sole water use rights for these areas. Allana are required by law to apply for and secure separate water use permits for land where water is intended to be used for mining operations. For the reason that the Danakil Basin Authority has not yet established, and also because the Ministry of Water and Energy has not yet issued any delegation to any other authority to issue permits, Allana will need to lodge water use permit applications to the Federal Ministry of Water and Energy for consideration.

As national water management is geared towards integrated water resource management, and as pre-allocation of water resources to a given purpose or its being planned, does not give priority over and above any other uses.

(1) Selassie. W. G. (2012). Memo - Regarding Water Use Rights of Allana Potash.

Therefore, if there was a water supply scarcity in the region, the authorities may tend to allocate available water resources rather than granting a sole water use right to Allana or any other user. As such, sole water use right for Allana in any given area is unlikely, as the law does not allow for it.

In terms of water exploration, Article 2 (18) of the Water Resources Management Proclamation (n^o 197/2000) (*Section 5.2.7*) defines **Water Works** as a means any man-made work constructed or to be constructed for the purposes of putting water to a beneficial use and includes (amongst other things) *investigation*. Furthermore, Article 11 (1) mentions that water permits are necessary for the construction of *water works*. As such, **should Allana require to carryout water exploration drilling activities in its mining concession area or outside of this area, a water use permit in accordance with the aforementioned legislation will be required.** These permits may be issued within sixty (60) days from the date of lodging the application.

5.2.11 *Public Health Proclamation*

Summary of Proclamation

The Public Health Proclamation (n^o 200/2000) prohibits discharging of untreated liquid waste generated from septic tanks, seepage pits and industries into water bodies or water convergences. It also prohibits the disposal of solid or liquid or any other waste in a manner which contaminates the environment or affect the health of civil society. Furthermore, the proclamation details occupational health control and use of machinery by employees of any given company.

Applicability to Project

As part of the overall ESHIA process Allana occupational health and safety (OHS) policies and procedures have been reviewed in terms of applicability to the proposed Dallol Potash Project, and suitable provisions for gaps have been identified. Furthermore, as was mentioned in *Section 5.2.5* above management of general and hazardous waste as a result of construction and operational activities of the Dallol Potash Project will have to be sufficiently dealt with in the overall ESH-MS.

5.2.12 *Labour Proclamation*

Summary of Proclamation

The Labour Proclamation (n^o 377/2003) obliges that an employer shall take the necessary measures to adequately safeguard the health and safety of the workers. In this proclamation the worker-employer relations are governed by the basic principles of rights and obligations with the goal to enable workers and employers to maintain industrial peace and work in the spirit of harmony and cooperation towards the all-round development of the country.

Applicability to Project

As part of the social assessment for the ESHIA, human resource policies that Allana have in place have been reviewed and assessed in terms of applicability to the proposed Dallol Potash Project. As is mentioned in *Section 5.2.11*, suitable provisions have been made for gaps in these policies and procedures. These gaps have been addressed in the Worker Management Plan (*Annex N of Volume Three*).

5.2.13 Mining Operations Proclamation

Summary of Proclamation

The Mining Operations Proclamation (n^o 678/2010) applies to and governs all mining operations and related activities in Ethiopia. The objectives of this proclamation are to promote socio-economic growth in Ethiopia in ensuring that the country's mineral resources are developed in a sustainable manner. The proclamation also promotes employment and an advance in the social and economic welfare of all Ethiopians. Furthermore, the proclamation provides for security of tenure for all investors in respect of exploration and mining operations.

Applicability to Project

Allana currently holds four potash concessions (exploration license Numbers - 2952 2954/2000, 2949 2951/2000, 2955 2957/2000, 1878/2002 from the Ethiopian Ministry of Mines). Once mineral resources have been verified and feasibility concerning the proposed Project is verified Allana will apply for a mining rights license for the area explored.

5.2.14 Mining Operations Council of Ministers Regulation

Summary of Regulation

The Mining Operations Council of Ministers Regulation (n^o 182/1994) provides rules relative to large-scale and small-scale mining operations. The rules concern, among other things: (a) the issue, renewal or revocation of a prospecting licence or an exploration licence; (b) notice of discovery of minerals; (c) verification and certification of a discovery; (d) rights and obligations of licensees; (e) fees, royalties and other payments; (f) offences and sanctions; (g) dispute settlement; and (h) powers and duties of the Controller.

Applicability to Project

Refer to Mining Operations Proclamation in *Section 5.2.13*.

5.2.15 *Payment of Compensation for Property Situated on Landholding Expropriated for Public Purposes Regulation*

Summary of Regulation

The purpose of the Payment of Compensation for Property Situated on Landholding Expropriated for Public Purposes Regulation (n^o 135/2007) is to provide a formal approach for the payment of compensation and to assist displaced persons to restore their livelihood.

Applicability to Project

The Social Impact Assessment (SIA) associated with the ESHIA has taken into account the requirements and procedures set out in the regulation. In particular around compensation for palms, permanent improvement on rural land, relocated property and burial grounds.

5.3 *NATIONAL STRATEGIES AND PLANS*

5.3.1 *Green Economy Strategy*

Summary of Strategy

Ethiopia aims to achieve middle-income status by 2025 by pursuing a sustainable economic development growth strategy. Following a conventional development path would, amongst other adverse effects, result in a sharp increase in greenhouse gas emissions and unsustainable use of natural resources. The strategy (The Green Economy Strategy) is currently being implemented and will require a boost in Ethiopia's Agricultural productivity, strengthening the industrial base and fostering export growth.

Applicability to Project

This ESHIA and in particular measures associated with mitigation or avoidance of socio-environmental impacts have considered Ethiopia's Green Economy Strategy. These measures have been structured in such a way that compliments and promotes the strategy.

5.3.2 *National Growth and Transformation Plan*

Summary of Plan

The National Growth and Transformation Plan (GTP) (2010/11 to 2014/15) is a medium term (5 year) strategic framework which sets out growth and investment targets for Ethiopia. The GTP is directed to achieving Ethiopia's long term vision and sustaining the rapid and broad based economic growth experienced during the past several years.

In order to realise this growth federal level government will need to build and focus on the economies of the various economic sectors (namely - agriculture

and rural development, trade and industry, mining and infrastructure development).

In the mining sector, the government main focus is to create a conducive environment for private investors to participate in exploring and developing the countries mineral resources (of which potash is included).

Applicability to Project

The proposed Dallol Potash Project in the Danakil Depression of Ethiopia is aiding the Ethiopian Government in achieving broad based economic development, especially within the mining sector.

5.3.3 *Plan for Accelerated and Sustained Development to End Poverty*

Summary of Plan

The Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06 to 2009/10) compliments the GTP. The main objective of the PASDEP aims to lay out the directions associated around accelerated, sustained and people centred economic development as well as to pave the ground work for the attainment of the Millennium Development Goals (MDG's) ⁽¹⁾ by 2015. The MDG's include:

- Building all-inclusive implementation capacity;
- A massive push to accelerate growth;
- Creating the balance between economic development and population growth;
- Unleashing the potentials of Ethiopia's women;
- Strengthening the infrastructure backbone of the country;
- Strengthening human resource development;
- Managing risk and volatility; and
- Creating employment opportunities.

Applicability to Project

The proposed Dallol Potash Project in the Danakil Depression of Ethiopia is aiding the Ethiopian Government in achieving broad based economic development, especially within the mining sector.

In addition, the social impact assessment and associated management plans have taken into account the social goals set out in the plan.

(1) The Millennium Development Goals (MDGs) are eight international development goals that all 193 United Nations member states and at least 23 international organizations have agreed to achieve by the year 2015 - UNDP, 2010

5.4 NATIONAL STANDARDS

5.4.1 *Environmental Standards for Industrial Pollution Control in Ethiopia*

Summary of Standards

The Ethiopian Federal Government has developed a list of environmental standards for the purposes of preventing significant industrial pollution. These standards present pollution limits for emissions to (i) atmosphere, (ii) water resources ⁽¹⁾ and (iii) noise emissions.

Applicability to Project

The above mentioned standards have been considered in the air quality, hydrological and noise impact assessments (*Chapter 10*). Furthermore, these limits will be used during monitoring to confirm Project compliance against these standards.

In terms of noise and air quality, the following will be applicable to the proposed Project and this ESHIA.

National Air Quality Standards

The national standards set out limits for emissions to air from fertiliser production. These limits are considered to be the most appropriate for operations associated with the proposed Project. In addition, the standards set out emission limits for other processes, including emission limits for total particulate matter and combustion processes which are relevant to this study.

There are no standards enforced in Ethiopia through national legislation that are applicable to ambient air quality (as opposed to emissions, as set out above). Therefore, the air quality guidelines advocated by the IFC will be utilised instead (refer to *Section 5.7.3*).

National Noise Standards

The aforementioned standards provide guidance for noise emissions covering three categories; industrial, commercial and residential. These guidelines are presented below (

(1) *Please Note* - as the proposed Project will have zero emission to water resources in the Study Area these standards will not be detailed or considered in this ESHIA.

Table 5.1). The noise standards applicable for the proposed Project include Area Code C – Residential Area.

Table 5.1 Ethiopian Standards for Noise

Area Code	Category of Area	Limits in dB(A) LAeq,15min	
		Daytime ¹	Night time ²
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45

1: Daytime 6.00 am to 9.00 pm
 2: Night time 9.00 pm to 6.00 am

Furthermore, noise from the source activity, measured at the specified noise sensitive location, shall not give rise to sound pressure levels (Leq, 15 minutes), which exceed the limit value by more than 2 dB (A).

5.5 REGIONAL PLANS

Both of the national plans (GTP and PASDEP) focus on areas that are particularly pertinent to the ANRS. It is the responsibility of the respective regional bureaus to align to national development strategies, in this case the Afar Bureau of Finance and Economic Development. The five year Development Plan devised by the Afar Bureau of Finance and Economic Development aligns with the national development plans.

5.6 INTERNATIONAL TREATIES, CONVENTIONS AND PROTOCOLS

Ethiopia is signatory to a number of international conventions and agreements relating to mining, environmental management and energy. In certain cases these have influenced policy, guidelines and regulations and have being complied with for this ESHIA and will also be taken into account for during the planning, construction and operation phases of the proposed Project.

Table 5.2 lists the relevant international conventions and protocols to which Ethiopia is a signatory.

Table 5.2 Dates of Ratification of International Conventions

Date of Ratification	Name of Convention
Ratified in 2006	<i>The UN Convention for the Safeguarding of the Intangible Cultural Heritage</i> - The Convention defines intangible cultural heritage as the practices, representations, expressions, knowledge and skills, as well as the associated instruments, objects, artefacts and cultural spaces that communities or groups recognise as part of their cultural heritage. The purpose of this Convention is to safeguard the intangible cultural heritage and ensure respect for the intangible cultural heritage of the communities, groups and individuals concerned. It also aims to raise awareness at the local, national and international levels of the importance of the intangible cultural heritage and of ensuring mutual appreciation thereof and provide

Date of Ratification	Name of Convention
	for international cooperation and assistance.
Ratified in 2008	<i>The UN Convention on the Protection and Promotion of the Diversity of Cultural Expressions</i> - This Convention defines cultural expressions as those expressions that result from the creativity of individuals, groups and societies and that have cultural content. The Convention is underpinned by eight principles. These include the principle of respect for human rights and fundamental freedoms, equal dignity of and respect for all cultures, equitable access, sustainability and complementarity of economic and cultural aspects of development.
Ratified in 1977	<i>The UN Convention Concerning the Protection of World Cultural and National Heritage</i> - The Convention defines the kind of natural or cultural sites, which can be considered for inscription on the World Heritage List. The Convention sets out the duties of States Parties in identifying potential sites and their role in protecting and preserving them. By signing the Convention, each country pledges to conserve not only the World Heritage sites situated on its territory, but also to protect its national heritage.
Accession in 1989	<i>The UN Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora 1973</i> - CITES is an international treaty that provides protection for wild animal and plant species in international trade. To date there are 120 nations that have become “parties” to this convention. By doing so, these countries have agreed to implement it in territories under their legal jurisdiction. To implement CITES all parties are required to develop wildlife protection laws in their countries and to establish a Management Authority to issue trade permits for wildlife products and a Scientific Authority to provide scientific expertise on the status of species considered for trade. Thus CITES is designed to promote the conservation of endangered species whilst still allowing trade in wildlife species that can withstand the pressure of trade.
Ratified in 2000	<i>Basel Convention on the Control of Transboundary Movement of Hazardous Waste</i> – The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as “hazardous wastes” based on their origin and/or composition and their characteristics as well as the types of wastes defined as “other wastes” (household waster, incinerator ash, etc). The provisions of the conventions centres around the following principles: (i) The reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes wherever the place of disposal; (ii) the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management and (iii) a regulatory system applying to cases where the transboundary movements are permissible.
Ratified in 1994	<i>UN Convention on Biological Diversity (Rio Convention) 1992</i> – The Convention on Biological Diversity was inspired by the world community’s growing commitment to sustainable development. It represents a dramatic step forward in; (i) the conservation of biological diversity, (ii) the sustainable us of its components (iii) and the fair and equitable sharing of benefits arising from genetic resources.
Ratified in 1994 and Protocol ratified in 2005	<i>United Nations Framework Convention on Climate Change, 1992</i> – The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognises that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. Under the convention, national governments (i) gathers and share information on greenhouse gas emissions, national policies and best practices, (ii) launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the

Date of Ratification	Name of Convention
	<p>provision of financial and technological support to developing countries and (iii) to cooperate in preparing for adaptation to the impacts of climate change.</p> <p>Kyoto Protocol – The Kyoto Protocol is an international agreement linked to the United Nations Framework on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialised countries and the European community for reducing greenhouse gas (GHG) emissions. These reductions amount to an average of five percent against 1990 levels over the five-year period 2008 to 2012.</p>
1994. Ratified in 1997	<p>UN Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification particularly in Africa – The objectives of this convention is to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa. Achieving this objective will involve long term integrated strategies that focus simultaneously on improved productivity of land, and the rehabilitation, conservation and sustainable management of land and water resources leading to improved living conditions, particularly on a community level.</p>

5.7

INTERNATIONAL GUIDELINES AND STANDARDS

The aim of following international guidelines and standards is to ensure all issues are considered and managed in line with international best practice. The Dallol Potash Project will conform to the World Bank Safeguard Policies and the International Finance Corporation (IFC) performance standards.

5.7.1

World Bank Group Operation Policies

The World Bank has 10 environmental and social “Safeguard Policies” that are used to examine the potential environmental and social risks and benefits associated with World Bank lending operations. These safeguard policies include the following:

1. Environmental Assessment;
2. Natural Habitats;
3. Forestry;
4. Pest Management;
5. Cultural Property;
6. Revised Draft Operational Policy 4.10: Indigenous People (replaces operational Directive 4.20 on Indigenous Peoples);
7. Involuntary Resettlement;
8. Safety of Dams;
9. Projects in International Waters; and
10. Projects in Disputed Areas.

Allana is in the process of applying for IFC funding and will strive to comply with these standards as well as and the World Banks’ safeguard policies. The policies relevant to the Project include 1, 2, 5, and 6 and are summarised below.

Environmental Assessment

Operational Policy 4.01 - Environmental Assessment (EA) evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimising, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation.

EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and transboundary and global environmental aspects.

Natural Habitats

Operational Policy 4.04 - Natural Habitats promotes the conservation of natural habitats. The World Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats. The Bank encourages borrowers to incorporate into their development and environmental strategies analyses of any major natural habitat issues, including identification of important natural habitat sites, the ecological functions they perform, the degree of threat to the sites, and priorities for conservation.

The Bank expects the borrower to take into account the views, roles, and rights of groups, including local non-governmental organizations and local communities, affected by any project involving natural habitats, and to involve such people in planning, designing, implementing, monitoring, and evaluating such projects. Involvement may include identifying appropriate conservation measures, managing protected areas and other natural habitats, and monitoring and evaluating specific projects.

Cultural Property

Operational Policy 4.11 - Cultural Property addresses physical cultural resources, which are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above or below ground, or under water. Their cultural interest may be at the local, provincial or national level, or within the international community. Any project involving significant excavations, demolition, movement of earth, flooding, or other environmental changes are to take cognisance of this policy in the EA.

Indigenous People

Operational Policy 4.10 – Indigenous People **is not considered to apply to the Project, as the Afar are not widely considered to be an indigenous group as defined under this safeguard policy, but rather constitute the majority of the population (approximately 90%)⁽¹⁾ in the Afar State.**

Involuntary Resettlement

Operational Policy 4.12 - Involuntary Resettlement is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimise and mitigate its adverse social and economic impacts.

It promotes participation of displaced people in resettlement planning and implementation, and its key economic objective is to assist displaced persons in their efforts to improve or at least restore their incomes and standards of living after displacement.

The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects.

5.7.2

The International Finance Corporation

Performance Standards

The IFC, a division of the World Bank Group that lends to private investors, has released a Sustainability Policy and set of Performance Standards on Social and Environmental Sustainability (January 2012) (see *Box 5.1*). These Standards replace the prior safeguard policies and are used to evaluate any project seeking funding through the IFC. The Equator Principles⁽²⁾ which reflect the application by major international banking institutions of IFC-inspired environmental and social best practice guidelines in the financing of large projects have been revised to adhere to the new IFC Performance Standards. However, the Equator Principles Financial Institutions (EPFIs) do not use the IFC's Sustainability or Disclosure Policy, as these were not adopted by the banks. The EPFIs have their own sustainability and disclosure policies, and take the same approach, e.g. the borrower's/client's project must comply with the Performance Standards and the applicable Environment Health and Safety (EHS) Guidelines.

(1)Source: IFC Draft ESRS # 29979 (March 2011)

(2) The Equator Principles are a financial industry benchmark for determining, assessing and managing social & environmental risk in project financing. As of 01/01/20011, they had been adopted by 70 major banking institutions. The Equator Principles reflect a common set of international, IFC-inspired best practices guidelines to manage social and environmental risks related to the financing of large projects.

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Resource Efficiency and Pollution Prevention;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.

The Performance Standards are directed towards providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate and, manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of direct investments for the IFC (including project and corporate finance provided through financial intermediaries), the IFC requires that its clients apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced (IFC, 2012).

The IFC Performance Standards, and each of their applicability to the proposed Project and this ESHIA are outlined in *Table 5.3* below.

Table 5.3 *International Finance Corporation (IFC) Performance Standards*

Performance Standards	Applicability to Project
<p>Assessment and Management of Environmental and Social Risks and Impacts Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project (any business activity that is subject to assessment and management).</p>	<ul style="list-style-type: none"> • To identify and assess environmental and social risks and impacts of the project. • To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimise, and where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment. • To promote improved environmental and social performance of clients through the effective use of management systems. • To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately. • To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.
<p>Labour and Working Conditions</p>	<ul style="list-style-type: none"> • To promote the fair treatment, non-

Performance Standards	Applicability to Project
<p>Performance Standard 2 recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by the protection of the fundamental rights of workers.</p>	<p>discrimination and equal opportunity of workers.</p> <ul style="list-style-type: none"> • To establish, maintain and improve the worker management relationship. • To promote compliance with national labor and employment laws. • To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the clients supply chain. • To promote safe and healthy working conditions, and health of workers. • To avoid the use of forced labour.
<p>Resource Efficiency and Pollution Prevention Performance Standard 3 recognises that increased economic activity and urbanisation often generate increased levels of pollution to air, water, and land and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.</p>	<ul style="list-style-type: none"> • To avoid or minimise adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related greenhouse gas emissions.
<p>Community Health, Safety and Security Performance Standard 4 recognises that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.</p>	<ul style="list-style-type: none"> • To anticipate and avoid adverse impacts on health and safety of the Affected Community during the project life from both routine and non-routine circumstances • To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimises risks to the Affected Communities.
<p>Land Acquisition and Involuntary Resettlement Performance Standard 5 recognises that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land.</p>	<ul style="list-style-type: none"> • To avoid, and when avoidance is not possible, minimise displacement by exploring alternative project designs. • To avoid forced eviction. • To anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. • To improve, or restore, the livelihoods and standards of living of displaced persons. • To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.
<p>Biodiversity Conservation and Sustainable Management of Living Natural Resources Performance Standard 6 recognises that protecting and conserving biodiversity,</p>	<ul style="list-style-type: none"> • To protect and conserve biodiversity. • To maintain the benefits from ecosystem services. • To promote the sustainable management

Performance Standards	Applicability to Project
maintaining ecosystems services, and sustainably managing living and natural resources are fundamental to sustainable development	of living natural resources through the adoption of practices that integrate conservation needs and development priorities.
<p>Indigenous Peoples Performance Standard 7 recognises that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalised and vulnerable segments of the population.</p>	<ul style="list-style-type: none"> • To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples • To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimise and/or compensate for such impacts. • To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. • To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project through the projects life-cycle. • To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. • To respect and preserve the culture, knowledge and practices of Indigenous Peoples
<p>Cultural Heritage Performance Standard 8 recognises the importance of cultural heritage for current and future generations</p>	<ul style="list-style-type: none"> • To protect cultural heritage from the adverse impacts of project activities and support its preservation • To promote the equitable sharing of benefits from the use of cultural heritage.

5.7.3

IFC Environmental, Health and Safety Guidelines

The Environmental, Health and Safety (EHS) Guidelines are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility. The EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to Performance Standard 3: Pollution Prevention and Abatement, as well as certain aspects of occupational and community health and safety.

When host country (Ethiopia) regulations differ from the levels and measures presented in the EHS Guidelines, projects will be expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is required.

General EHS Guidelines also exist which contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors are listed in *Box 5.2*.

Box 5.2

IFC General EHS Guidelines

<p><i>General EHS Guidelines</i></p> <p>1. Environmental</p> <p>1.1 Air Emissions and Ambient Air Quality</p> <p>1.2 Energy Conservation</p> <p>1.3 Wastewater and Ambient Water Quality</p> <p>1.4 Water Conservation</p> <p>1.5 Hazardous Materials Management</p> <p>1.6 Waste Management</p> <p>1.7 Noise</p> <p>1.8 Contaminated Land</p> <p>2. Occupational Health and Safety</p> <p>2.1 General Facility Design and Operation</p> <p>2.2 Communication and Training</p> <p>2.3 Physical Hazards</p> <p>2.4 Chemical Hazards</p> <p>2.5 Biological Hazards</p> <p>2.6 Radiological Hazards</p> <p>2.7 Personal Protective Equipment (PPE)</p> <p>2.8 Special Hazard Environments</p> <p>2.9 Monitoring</p> <p>3. Community Health and Safety</p> <p>3.1 Water Quality and Availability</p> <p>3.2 Structural Safety of Project Infrastructure</p> <p>3.3 Life and Fire Safety (L&FS)</p> <p>3.4 Traffic Safety</p> <p>3.5 Transport of Hazardous Materials</p> <p>3.6 Disease Prevention</p> <p>3.7 Emergency Preparedness and Response</p> <p>4. Construction and Decommissioning</p> <p>4.1 Environment</p> <p>4.2 Occupational Health and Safety</p> <p>4.3 Community Health and Safety</p>

Where applicable, the abovementioned EHS Guidelines were applied to the Allana Potash ESHIA. However, the Air Emission and Ambient Air Quality Guideline (1.1) and Noise Guideline (1.7) are of particular importance to this ESHIA. These are discussed in more detail below.

The ambient air quality standards set out in the guideline are based upon the World Health Organisation (WHO) Air Quality Guidelines for Europe 2000 and 2005 update. These are the principle air quality standards and guidelines utilised in this ESHIA (Table 5.4).

Table 5.4 Air Quality Standards and Guidelines

Pollutant	Averaging Period	WHO Guideline Value (µg/m ³)
SO ₂	24-hour maximum	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10-minute maximum	500 (guideline)
NO ₂	1-year mean	40 (guideline)
	1-hour maximum	200 (guideline)
TSP	1-year mean	No guideline
	24-hour maximum	No guideline
PM ₁₀	1-year mean	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour assessed as the third highest 24 hour period (99 th percentile)	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
PM _{2.5}	1-year mean	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour maximum	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)

With regards to dust deposition standards, there are several standards and guidelines published by various bodies. These are set out in Table 5.5 below.

Table 5.5 Dust Deposition Nuisance Criteria

Criteria definition	Measure of soiling (mg/m ² /day)	Data source
National Guidelines		
Possible Nuisance	350 (monthly mean)	TA-Luft (Germany)
Very Likely Nuisance	650	TA-Luft (Germany)
First Loss of Amenity	133 (monthly mean)	West Australia Nuisance Standard
Unacceptable reduction in air quality	333	West Australia Nuisance Standard
Serious nuisance	200	UK recommended nuisance dust deposition rate
Nuisance dust deposition	133	Malaysia air quality standard

Criteria definition	Measure of soiling (mg/m ² /day)	Data source
Evidence based guidelines		
Noticeable (urban)	95	Source 1
Possible complaint (rural)	119	Source 1
Objectionable	167	Source 1
Probable complaint	476	Source 1
Serious complaint	1191	Source 1

Note: Source 1: Cites:

Hancock, R. P., Esmen, N. A., and Furber, C. P. (1976) "Visual Response to Dustiness", Journal of the Air Pollution Control Association, 26 (1), 1976, pp54 -57;

Beaman, A. L. and Kingsbury, R. W. S. M. 1981) "Assessment of Nuisance from Deposited Particles Using a Simple and Inexpensive Measuring System". Clean Air, 11, 1981;

Bate, K. J. and Coppin, N. J. (1991) "Dust impacts from mineral workings", Mine and Quarry, 20 (3), 1991, pp31 - 35;

Hofschreuder, P. and Vrins, E. L. M. (1992) "Nuisance from coarse dust", Journal of Aerosol Science, 23 (S1), 1992, pp691 - S694;

Quality of Urban Air Research Group. (1996) "Airborne Particulate Matter in the United Kingdom: Third Report of the Quality of Urban Air Review Group", prepared at the request of the Department of the Environment. University of Birmingham, Birmingham.

As was mentioned above there are no National Ethiopian guidelines for Ambient Air Quality, thus for the purpose of this ESHIA report the IFC guidelines will be used. Furthermore, it can be concluded that there is no clear consensus as to the level of dust deposition (as is presented in *Table 5.5* above) that is likely to result in nuisance issues. However, on the basis of pragmatic consideration of the various criteria, the following magnitude criteria have been developed for this ESHIA relating to dust deposition:

- Negligible: <120mg/m²/day
- Small: 120 - 200 mg/m²/day
- Medium: 200 - 350 mg/m²/day
- Large: >350mg/m²/day

To supplement the above mentioned EHS Guidelines, the IFC have established industry specific EHS guidelines. The guidelines specific to this Project are presented in *Box 5.3* below.

International Noise Guidelines

The IFC General EHS Guidelines differentiate between two principal receptor categories; residential and industrial (*Table 5.6*). These guidelines make reference to noise from facilities and stationary noise sources, and are commonly applied as design standards for industrial facilities, and whilst this may imply that the guidelines relate to some threshold of noise effects in a

general sense, the IFC has indicated that they are not directly applicable to transport or mobile noise sources.

Table 5.6 *IFC/World Bank Noise Level Guidelines*

Receptor	Maximum Allowable Ambient Noise Levels, LAeq,1hr, dB(A) Free field	
	Daytime 07:00 - 22:00	Night-time 22:00 - 07:00
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Noise impacts should not exceed the levels presented in *Table 5.6*, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

The Ethiopian noise standards and the IFC define noise limits with different time periods. The Ethiopian noise standard (*Section 5.4.1*) defines the daytime period from 06:00 am to 09:00 pm and night time period from 09:00 pm to 06:00 am. Both, the Ethiopian noise standards and the IFC have the same allowable noise levels for daytime, 55 dB(A); and night time, 45 dB(A). As such, for the purpose of this assessment, the daytime period will be defined as 06:00 am to 09:00 pm and night time period from 09:00 pm to 06:00 am, as the IFC performance standard gives precedence to local standards and guidelines.

In addition to those the IFC air quality and noise guidelines presented above, further industry specific EHS guidelines applicable to the proposed Project are presented in the Box below.

Box 5.3 *The Industry Specific EHS Guidelines Applicable to the Dallol Potash Project*

<p>Industry Specific EHS Guidelines</p> <p>1. EHS Guidelines for Mining</p> <p>The EHS Guidelines for Mining are applicable to underground and open-pit mining, alluvial mining, solution mining, and marine dredging. Extraction of raw materials for construction products are addressed in the EHS Guidelines for Construction Materials Extraction.</p> <p>2. EHS Guidelines for Water and Sanitation</p> <p>The EHS Guidelines for Water and Sanitation include information relevant to the operation and maintenance of (i) potable water treatment and distribution systems, and (ii) collection of sewage in centralized systems (such as piped sewer collection networks) or decentralized systems (such as septic tanks subsequently serviced by pump trucks) and treatment of collected sewage at centralized facilities.</p>

The African Development Bank Group was founded in 1964 with the intention of promoting economic and social development in Africa. The Group comprises of the African Development Bank (AfDB), the African Development Fund and the Nigeria Trust Fund.

The AfDB provides funds to African governments and private companies investing in Africa. The objective of the overarching AfDB Group is to spur sustainable economic development and social progress in its regional member countries, and thus contributing to poverty reduction.

An in-depth review of the AfDB policies, procedures and guidelines was carried out as part of the ESHIA. This Section provides a detailed overview of those AfDB policies procedures and guidelines that are deemed relevant to this Project, these include:

- Environmental and Social Assessment Procedures for AfDB's Public Sector Operation (June, 2001).
- Integrated Environmental and Social Impact Assessment Guidelines (October 2003).
- Involuntary Resettlement Policy (November, 2003).

These are discussed in more detail below.

Environmental and Social Assessment Procedures for African Development Bank's Public Sector Operation (June, 2001)

The environmental and social assessment (ESIA) procedures set out by the AfDB's ensure that the Banks projects, programmes and plans have been designed to make them environmentally and socially sustainable, and that they have involved stakeholder participation and timely public disclosure.

For projects requiring a full ESIA (Category 1 projects), the Borrower must prepare a Terms of Reference (ToR) for the ESIA and must involve consultations with concerned government agencies, key local civil society organizations as well as representatives of affected groups, as appropriate.

The Borrower must retain independent environmental and social specialists to carry out the ESIA. The assessment work shall be completed in accordance with the Bank's policies and guidelines, country regulations and guidelines and agreed ToR. Primary and secondary stakeholders must be consulted during ESIA preparation and the draft ESIA report accompanied by a non-technical executive summary must be publicly released for consultation. Consultation findings shall be integrated and taken into account in the final ESIA Report.

Projects requiring the development of an environmental and social management plan must ensure that the number and complexity of measures required are proportional so as to ensure the project's environmental and social sustainability.

Integrated Environmental and Social Impact Assessment Guidelines (October 2003)

The AfDB completed a review of its environmental assessment procedures and integrated the bank's new vision and emerging priorities, particularly crosscutting themes. The new procedures, entitled Environmental and Social Assessment Procedures were produced and adopted in June 2001. Crosscutting issues prioritised by the bank include the following:

- **Poverty** – a multidimensional concept that covers income and non-income aspects. It is a state of livelihood characterised by material deprivation, food insecurity and lack of access to productive means.
- **Environment** - encompassing air, water, soil, flora, fauna, landscape, cultural heritage and human interactions and impacts on the biosphere.
- **Population** – demographics and factors influencing population growth. Population covers a broad range of issues such as population characteristics and dynamics (size, density, age and gender structure, ethnics, life expectancy, internal and international migration, rural/urban migration, etc.), education and health, economic growth and employment as well as agricultural and natural resources.
- **Health** - complete state of physical, mental, social, and spiritual well-being. Consequently many factors influence people's health, particularly economic opportunities, the social context and the natural environment.
- **Gender** – taking into account gender differences in roles, rights, priorities, opportunities and constraints.
- **Participation** – the goal of actively involving the project stakeholders, particularly those who stand to gain or to lose from a project.

Projects should enhance positive impacts and, in the following order, on prevention, minimise, mitigate or compensate adverse impacts. This approach implies that most of the measures should be related to project design, location and implementation rather than curative interventions that handle adverse outcomes after the emergence of the anticipated problems.

Involuntary Resettlement Policy (November, 2003)

The overall goal of the AfDB's policy on involuntary resettlement is to ensure that when people must be displaced they are treated equitably, and that they share in the benefits of the project that involves their resettlement. The policy has the following objectives:

- To avoid involuntary resettlement where feasible, or minimise resettlement impacts where population displacement is unavoidable, exploring all viable project designs.
- To ensure that displaced people receive resettlement assistance, preferably under the project, so that their standards of living, income earning capacity, and production levels are improved.
- To set up a mechanism for monitoring the performance of involuntary resettlement programs and remedying problems as they arise.

In order to meet these objectives, the borrower will need to develop a resettlement plan for projects where physical displacement and loss of economic assets is unavoidable. Displaced persons should be consulted early in the planning process and encourage to participate in the planning and implementation of the resettlement programme. Particular attention should be paid to the needs of disadvantaged groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, and ethnic, religious and linguistic minorities; including those without legal title to assets, female-headed households. Resettlers should be integrated socially and economically into host communities so that adverse impacts on host communities are minimized. Furthermore, displaced persons should be compensated for their losses at full replacement costs prior resettlement. The full cost of resettlement activities should be incorporated into the total cost of the project.

Applicability to Project

The above mentioned AfDB procedures, guidelines and policies are applicable to this Project and have been taken into account when developing the ESHIA and associated management plans.

5.8

ALLANA POTASH POLICIES, PLANS AND PROCEDURES

Allana has compiled the following policies, plans and procedures for exploration activities in the Danakil Depression. These have been reviewed and suitable provisions have been made in the respective management plans for gaps identified.

5.8.1 *Environmental Policy*

The purpose of Allana's Environmental Policy is to provide a measurable framework for the performance of their activities in an environmentally responsible manner, ensuring compliance by Allana and its employees with all applicable environmental regulations and commitments.

Allana recognizes that maintenance of environmental quality is vital to their existence, progress, and continued development. Allana will maintain high environmental standards and will adhere to World Bank guidelines limited only by technical and economic feasibility. Allana will take positive action to protect the safety of its workers, conserve natural resources, and minimize the impact of its activities on the environment through diligent application of appropriate technology and responsible conduct at all stages of exploration, mine development, mining, mineral processing, decommissioning, and reclamation.

5.8.2 *Health and Safety Policy*

Allana acknowledges that it is its duty to ensure, so far as is reasonably practicable, the health, safety and welfare of all who are affected by the way its undertaking is conducted. This refers to all permanent and temporary employees, sub-contractors, and members of the public who are, or may be, affected by its activities.

It is the policy of Allana to provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to health. To this end it will allocate sufficient resources and sound management systems to the fulfillment of this policy.

Allana and its subsidiary companies will comply with all relevant statutory provisions and appropriate Approved Codes of Practice, and follow the best current practice in all aspects of its undertaking.

Allana considers health and safety to rank equally with all other objectives in the performance of its business. To this end the health and safety responsibilities of all personnel have been defined and allocated. The Safety Management System is intended to affirm that Allana achieves its purposes in this area and is based on the philosophy that accidents can be prevented by the identification and management of risk. In particular, Allana acknowledges that the management of health and safety is an integral part of good management at all levels.

5.8.3 *Public Consultation and Disclosure Plan*

Allana recognises that potential social and environmental effects can be created through exploration and development of mining projects. Such effects may range from bad publicity reflecting perceived problems or issues arising from lack of communication and stakeholder engagement, to actual and

measurable environmental and social impacts resulting from poor design, construction, operation, or closure of specific exploration/mining developments.

Allana endorses the concept that communication with project stakeholders is an essential component of any environmental and socio-economic assessment process.

Allana is committed to a pro-active and ongoing dialogue with all agencies, organizations, and individuals with an interest in development of the proposed Project. The Allana Public Consultation and Disclosure Plan (PCDP), outlines and documents Allana's consultation and disclosure practices implemented for the Project. The PCDP includes details of public involvement activities which have already occurred and which are planned to take place later in the development life of the project:

- Before Allana acquired the Dallol exploration license;
- Activities subsequent to the acquisition of the license;
- The initiation of exploration activities;
- During implementation of a public involvement program designed to collaborate with stakeholders;
- During development of the Project;
- Continuing throughout the life of the Project.

Allana is a reporting issuer under Canadian securities laws and as such Allana's commitment to public consultation and disclosure pursuant to the PCDP shall at all-time be subject to applicable Canadian laws, including without limitation, applicable Canadian securities legislation.

5.8.4 *Grievance Procedure*

Allana is committed to working in partnership with the community in which it operates and to maintaining an open dialogue with all its stakeholders. It is inevitable that complaints and grievances will arise over the life of the Project and it is the company's intention to address legitimate concerns in a fashion, which is straightforward, timely and culturally appropriate.

It is important to ensure that all groups affected by the Project have a voice regardless of their levels of literacy. This includes vulnerable groups particularly women and the elderly.

5.8.5 *Archaeology Management and Chance find Policy*

Allana have put in place a policy that details procedures that have been implemented to avoid or reduce adverse effects to archaeological or heritage resources.

5.8.6

Applicability to Project

Allana's socio-environmental policies, plans and procedures have been reviewed as part of the ESHIA and suitable provisions for gaps have been identified. These provisions have been taken into account in the respective management plans (refer to *Volume Three* of this ESHIA).

6.1**INTRODUCTION**

The purpose of this ESHIA is to examine how the proposed Dallol Potash Project will lead to a measurable difference in the quality of the environment and the quality of life of impacted individuals and communities. Over the past decades, environmental impact assessments have expanded to include social and health impact assessments as well as public consultation/stakeholder engagement in the planning and decision-making process to avoid, reduce, or mitigate adverse impacts and to maximise the benefits of the project proposed. More recently, the emphasis has moved to the ESHIA producing robust social and environmental management plans which can effectively implement the recommended mitigation measures identified in the ESHIA during the life of the project and culminating with an effective decommissioning plan.

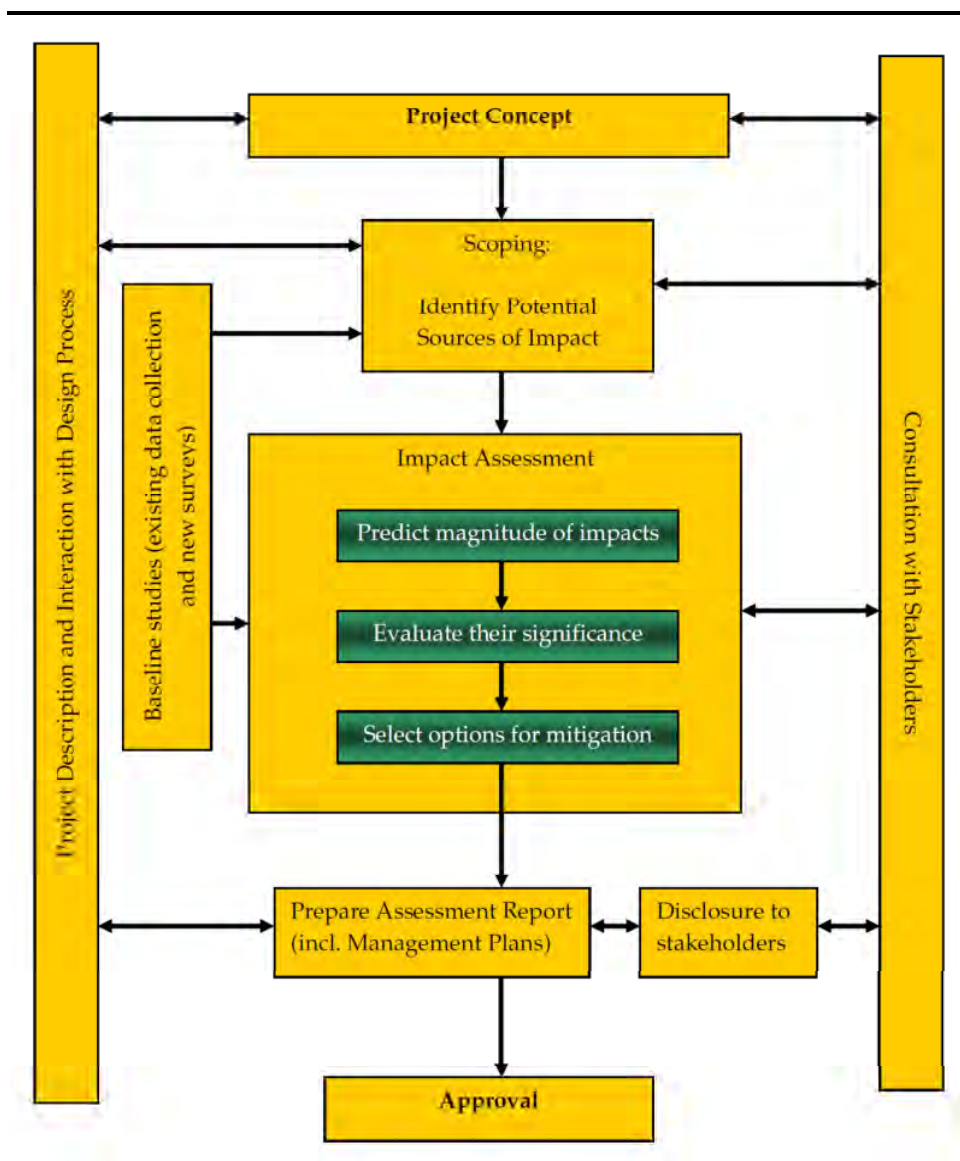
The key stages for this ESHIA are:

- Scoping (and site selection);
- Stakeholder engagement;
- Baseline data collection;
- Project description and interaction with design and decision-making;
- Assessment of impacts and identification of mitigation measures;
- Integrated management system and plans; and
- Reporting and disclosure.

Figure 6.1 illustrates a generic overview of the ESHIA process. This is, however, not a linear process, but one where several stages are carried out in parallel and where the assumptions and conclusions are revisited and modified as the proposed Project and ESHIA progress.

The following sections provide detail on how each stage of the ESHIA process was and will be applied to the proposed Project.

Figure 6.1 The ESHIA Process



6.2 SCOPING

The purpose of the scoping phase was to identify key sensitivities and those activities with the potential to contribute to, or cause, potentially significant impacts to environmental and socio-economic receptors and resources and to evaluate siting, layout and technology alternatives for the proposed Project. The key objectives of scoping were to:

- Identify the potentially most significant impacts;
- Obtain stakeholder views through consultation; and
- Develop the Terms of Reference for the ESHIA through consultation so as to ensure that the process and output are focused on the key issues.

Subsequent phases of the ESHIA process focus on these key issues through the collection of information on existing conditions, the engagement of stakeholders, understanding the impacts, and developing the measures to avoid/control and monitor these impacts.

The Terms of Reference for the proposed Project, which formed the basis for the scoping documents associated with this ESHIA, was developed and submitted to and approved by the Federal Democratic Republic of Ethiopia Ministry of Mines (Ref No. MA229/34), prior to initiation of the impact assessment phase of the ESHIA (*Annex A of Volume Three*).

Issues that were raised by stakeholders during the pre-feasibility and feasibility stages were taken into account in the Terms of Reference. A list of these issues is included in the Stakeholder Engagement Plan (SEP) (*Annex C of Volume Two*).

6.3 *STAKEHOLDER ENGAGEMENT*

The key principle of consultation is to ensure that the views of stakeholders are taken into account and reported in the ESHIA. The objective is to ensure the assessment is robust, transparent and has considered the full range of issues or perceptions, and to an appropriate level of detail.

Box 6.1 Definition of Stakeholders

Stakeholders include those individuals, groups or organisations who themselves could be directly affected by the proposed Project (Project affected people) and those individuals or organisations who, although not directly affected by the proposed Project, represent those affected or have a regulatory duty, an interest, influence or secondary involvement in the proposed Project (secondary stakeholders).

Stakeholder engagement started during the scoping phase and continued throughout the assessment ensuring that legislative requirements and Project standards were met, that stakeholder concerns were addressed in the assessment and that sources of existing information and expertise were identified.

Consultation has been undertaken at a number of stages during the evolution of the Project. An overview of the consultation programme that has been undertaken is described in the SEP (*Annex C of Volume Two*). A full list of stakeholders consulted throughout the ESHIA process is also given in *Annex C of Volume Two*.

The description of the baseline environmental, socio-economic and community health conditions provides information on receptors and resources that have been identified during scoping as having the potential to be *significantly* affected by the proposed Project. It also describes baseline conditions that have been used to make the assessment. The description of the baseline is aimed at providing sufficient detail to meet the following objectives:

- To identify the key conditions and sensitivities in areas potentially affected by the Project;
- To provide a basis for extrapolation of the current situation, and development of future scenarios without the proposed Project;
- To provide data to aid the prediction and evaluation of possible impacts of the proposed Project;
- To understand stakeholder concerns, perceptions and expectations regarding the proposed Project;
- To allow the Project proposed to develop appropriate mitigation measures later in the ESHIA; and
- To provide a benchmark to assess future changes and to assess the effectiveness of mitigation measures.

Baseline studies for the proposed Dallol Potash Project are outlined in *Chapters 8 and 9*.

The interaction between the ESHIA team and the design and decision-making process is one of the key areas in which an ESHIA can influence how a project develops. It includes involvement in defining the Project and identifying those activities with the potential to cause environmental, socio-economic and health impacts (e.g. physical presence, noise, workforce, traffic, local employment, procurement). Project planning, decision-making and refinement of the Project description continue throughout the assessment process as a result of the development of the proposed Project and in response to the identified impacts.

During the ESHIA process, there was extensive liaison between Ercosplan (the engineering and feasibility consultants for the Dallol Potash Project), Allana Potash and ERM with regard to identifying impacts and potential mitigation measures. Examples of key areas covered between ERM and Ercosplan include the:

- Placement of infrastructure (such as the processing plant) so as to avoid areas characterised as being critical to highly sensitive. Areas characterised as being critical to highly sensitive contained one or more of the following attributes – villages, significant burial sites, groundwater fed pools containing the rare Killifish species, the critical salt pan fringe habitat type or key tourist areas.
- Impacts to community livelihood and the biological environment as a result of groundwater extraction during the operational phase of the proposed project. This includes impacts attributed to potential loss of key resource areas such as the Salt Pan Fringe habitat type. This habitat type extends north-south across the Study Area and provides key livelihood materials for communities in the Study Area. From a biodiversity perspective, the habitat type accommodates the highest species diversity in the Study Area, and contains populations of the rare Killifish species in groundwater fed pools.
- Further studies required post ESHIA. This includes a socio-environmental study of potential transportation routing alternatives used to transport potash product off-site and the potential resettlement of villages (Alai lai and Mororo) that are currently located within the footprint of the proposed Project.

6.6

COMMUNITY HEALTH RISK ASSESSMENT

In this context health is understood to be a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. When considering health it is necessary to conduct specific risk assessment studies to contextualise potential impacts on worker and community health. In the case of the proposed Project this includes the contextualisation of potential impacts on community and worker health, safety and security as a result of proposed mining activities. Human health risk assessment is conducted in a holistic framework, which has to take into consideration all pathways and routes of exposure. Typical health impacts may include:

- Changes to prevalence or seasonality of communicable and non-communicable diseases;
- Changes to prevalence of respiratory and housing issues;
- Changes to prevalence of sexually transmitted infections;
- Changes to numbers of accidents and injuries;
- Exposure to potentially hazardous materials;
- Changes to nutritional status
- Impacts to health care and recreational facilities;
- Impacts psychosocial and lifestyles;
- Impacts to employee and worker labour, accommodation and working conditions; and
- Impacts to safety and security.

The health risk and impact assessment include the collection of a range of baseline data to understand existing health profile and infrastructure. This included collection of data on:

- Health infrastructure and health care system;
- Trained medical personnel per community;
- Traditional medicine and practices (midwifery etc.);
- Access / constraints to achieving health;
- Key health indicators – life expectancy, maternal mortality, infant mortality, etc;
- Morbidity and mortality data;
- Health profile (prevalence of diseases including vector borne, non-communicable and communicable diseases);
- Lifestyle indicators – smoking, alcohol use, drug use, etc;
- Road traffic and other accidents and emergencies;
- Health concerns affecting specific aspects of the population (e.g., farmers, fishermen, etc); and
- Self-reported health status and perceptions on overall well-being.

The health assessment considered the direct, indirect and induced consequences of the proposed Project to existing health baseline in relation to the specific vulnerabilities of potentially impacted stakeholders. Vulnerabilities may include:

- Groups suffering from existing acute / chronic illness;
- Frequent incidence/ high prevalence of health conditions;
- High rates of maternal/child mortality;
- Low life expectancy;
- Poor food security; and
- High instances of vector borne diseases.

6.7

ASSESSMENT OF IMPACTS AND MITIGATION

The impact assessment stage comprises a number of steps that collectively assess the manner in which the proposed Project will interact with elements of the physical, biological, cultural or human environment to produce impacts to resources/receptors. The steps involved in the impact assessment stage are described in greater detail below.

Please Note – the environmental impact assessment detailed below is an approach that combines *Impact Magnitude* and *Receptor Sensitivity* to determine **Impact Significance**. For determination of air quality and noise impacts however, one can usually predict noise levels quantitatively and compare them against Impact Assessment Standards that take into account Receptor Sensitivity and/ or the source of noise to develop suitable criteria.

For example, the IFC EHS Guidelines standard sets different levels for industrial areas than for residences. Other standards can be more prescriptive, offering numerical guidance to determine criteria and assessment of impacts, and can also be source specific. For example, industrial noise is different to road traffic noise, as is, rail traffic and aircraft noise. Thus the impact assessment process for air quality and noise will be different to that detailed in *Section 6.7.1* below. The air quality and noise impact assessment methodology is detailed in *Section 6.7.2* and *6.7.3* respectively.

Furthermore, the overall approach to the rating and evaluation of social (including visual and cultural heritage) impacts is similar to what is detailed in *Section 6.7.1* below; however, the impact criteria used to define social sensitivities is disparate, and is detailed in *Annex D* of *Volume Two* of this ESHIA.

6.7.1 *Impact Assessment*

The impact characteristic terminology to be used is summarised in *Table 6.1*.

Table 6.1 *Impact Characteristic Terminology*

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	Direct Indirect Induced
Extent	The “reach” of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.).	Local Regional International
Duration	The time period over which a resource / receptor is affected.	Temporary Short-term Long-term Permanent
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.)	[no fixed designations; intended to be a numerical value]
Frequency	A measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value]

In the case of *type*, the designations are defined universally (i.e., the same definitions apply to all resources/receptors and associated impacts). For these universally-defined designations, the definitions are provided in *Table 6.2*.

Table 6.2 *Designation Definitions*

Designation	Definition
Type	
Direct	Impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).

Designation	Definition
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).
Extent	
Local	Defined on a resource/receptor-specific basis.
Regional	
International	
Duration	
Temporary	Defined on a resource/receptor-specific basis.
Short-term	
Long-term	
Permanent	

In the case of *extent* and *duration*, the designations themselves (shown in *Table 6.1*) are universally consistent, but the definitions for these designations will vary on a resource/receptor basis (e.g., the definition of what constitutes a “short term” duration for a noise-related impact may differ from that of a “short term” duration for a habitat-related impact). This concept is discussed further below.

In the case of *scale* and *frequency*, these characteristics are not assigned fixed designations, as they are typically numerical measurements (e.g., number of acres affected, number of times per day, etc.).

The terminology and designations are provided to ensure consistency when these characteristics are described in an impact assessment deliverable. However, it is not a requirement that each of these characteristics be discussed for every impact identified.

An additional characteristic that pertains only to unplanned events (e.g., traffic accident, operational release of toxic gas, community riot, etc.) is *likelihood*. The likelihood of an unplanned event occurring is designated using a qualitative (or semi-quantitative, where appropriate data are available) scale, as described in *Table 6.3*.

Table 6.3 *Definitions for Likelihood Designations*

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (i.e., it is essentially inevitable).

Likelihood is estimated on the basis of experience and/or evidence that such an outcome has previously occurred.

It is important to note that likelihood is a measure of the degree to which the unplanned event is expected to occur, *not* the degree to which an impact or effect is expected to occur as a result of the unplanned event. The latter concept is referred to as *uncertainty*, and this is typically dealt with in a contextual discussion in the impact assessment deliverable, rather than in the impact significance assignment process.

In the case of impacts resulting from unplanned events, the same resource/receptor-specific approach to concluding a magnitude designation is utilised, but the 'likelihood' factor is considered, together with the other impact characteristics, when assigning a magnitude designation. There is an inherent challenge in discussing impacts resulting from (planned) Project activities and those resulting from unplanned events. To avoid the need to fully elaborate on an impact resulting from an unplanned event prior to discussing what could be a very low likelihood of occurrence for the unplanned event, this methodology incorporates likelihood into the magnitude designation (i.e., in parallel with consideration of the other impact characteristics), so that the "likelihood-factored" magnitude can then be considered with the resource/receptor sensitivity/vulnerability/importance in order to assign impact significance. Rather than taking a prescriptive (e.g., matrix) approach to factoring likelihood into the magnitude designation process, it is recommended that this be done based on professional judgment, possibly assisted by quantitative data (e.g., modelling, frequency charts) where available.

Once the impact characteristics are understood, these characteristics are used (in a manner specific to the resource/receptor in question) to assign each impact a *magnitude*. In summary, magnitude is a function of the following impact characteristics:

- Extent;
- Duration;
- Scale;
- Frequency; and
- Likelihood.

Magnitude essentially describes the degree of change that the impact is likely to impart upon the resource/receptor. As in the case of extent and duration, the magnitude designations themselves (i.e., negligible, small, medium, large) are universally used and across resources/receptors, but the definitions for these designations will vary on a resource/receptor basis, as is discussed further below. The universal magnitude designations are:

- Positive;
- Negligible;
- Small;

- Medium; and
- Large.

The magnitude of impacts takes into account all the various dimensions of a particular impact in order to make a determination as to where the impact falls on the spectrum (in the case of adverse impacts) from *negligible* to *large*. Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be regarded as essentially having no impact, and should be characterised as having a *negligible* magnitude. In the case of *positive* impacts no magnitude will be assigned.

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity/vulnerability/importance of the impacted resource/receptor. There are a range of factors to be taken into account when defining the sensitivity/vulnerability/importance of the resource/receptor, which may be physical, biological, cultural or human. Where the resource is physical (for example, a water body) its quality, sensitivity to change and importance (on a local, national and international scale) are considered. Where the resource/receptor is biological or cultural (for example, the marine environment or a coral reef), its importance (for example, its local, regional, national or international importance) and its sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered.

Other factors may also be considered when characterising sensitivity/vulnerability/importance, such as legal protection, government policy, stakeholder views and economic value.

As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity/vulnerability/importance designations are:

- Low;
- Medium; and
- High.

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterised, the significance can be assigned for each impact.

Impact significance is designated using the matrix shown in *Table 6.4*.

Table 6.4 *Impact Significances*

	Sensitivity/Vulnerability/Importance of Resource/Receptor		
	Low	Medium	High

Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor- or impact-specific considerations are factored into the assignment of magnitude and sensitivity designations that enter into the matrix. *Box 6.2* provides a context for what the various impact significance ratings signify.

Box 6.2 *Context of Impact Significances*

An impact of *negligible* significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of *minor* significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of *moderate* significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

6.7.2 *Air Quality Impact Assessment*

With regard to air quality, there is a need to make specific consideration of the guidance set out by the IFC when defining the significance of impacts, and applying these to the more general definition of impacts within the ESHIA approach.

The **magnitude** of impacts was quantified using predictive techniques based on detailed dispersion modelling. The magnitude of the impact is the 'Process Contribution (PC)'; this is the impact arising solely from project related emissions. In order to consider the significance of those impacts, consideration is required of the existing baseline. The PC added to the existing baseline is described as the Predicted Environmental Concentration (PEC).

The significance of the predicted impacts was ascertained by means of comparison to air quality standards and guidelines as set out in *Chapter 5*. The significance of impacts is primarily based upon whether or not the impacts result in air quality standards being exceeded or contribute a substantial proportion of airborne pollutants in the local airshed.

IFC make differentiation in the significance of impacts, based upon the existing baseline air quality in the vicinity of a proposed Project. Essentially, this is based upon whether there is a significant risk of the existing baseline air pollution to result in air quality guidelines being exceeded.

The IFC General EHS Guidelines state:

“Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- *Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognized sources*
- *Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed [i.e. in an undegraded airshed]”.*

And:

“An airshed should be considered as having poor air quality [degraded] if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly”.

The IFC guidelines further state:

“Facilities or projects located within poor quality airsheds, and within or next to areas established as ecologically sensitive (e.g. national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment.”

On the basis of the IFC guidance, a degraded airshed is therefore defined in this assessment as locations where the baseline air quality is already in excess of the air quality standards.

The significance of impacts is therefore defined in terms of the magnitude of impacts (i.e. the Process Contribution or PC), and whether the baseline pollution concentrations are above or below the air quality standards. Using this approach, the significance criteria for air quality have been defined. These are set out in *Table 6.5* below.

Table 6.5 Magnitude Criteria for Assessment of Air Pollutants

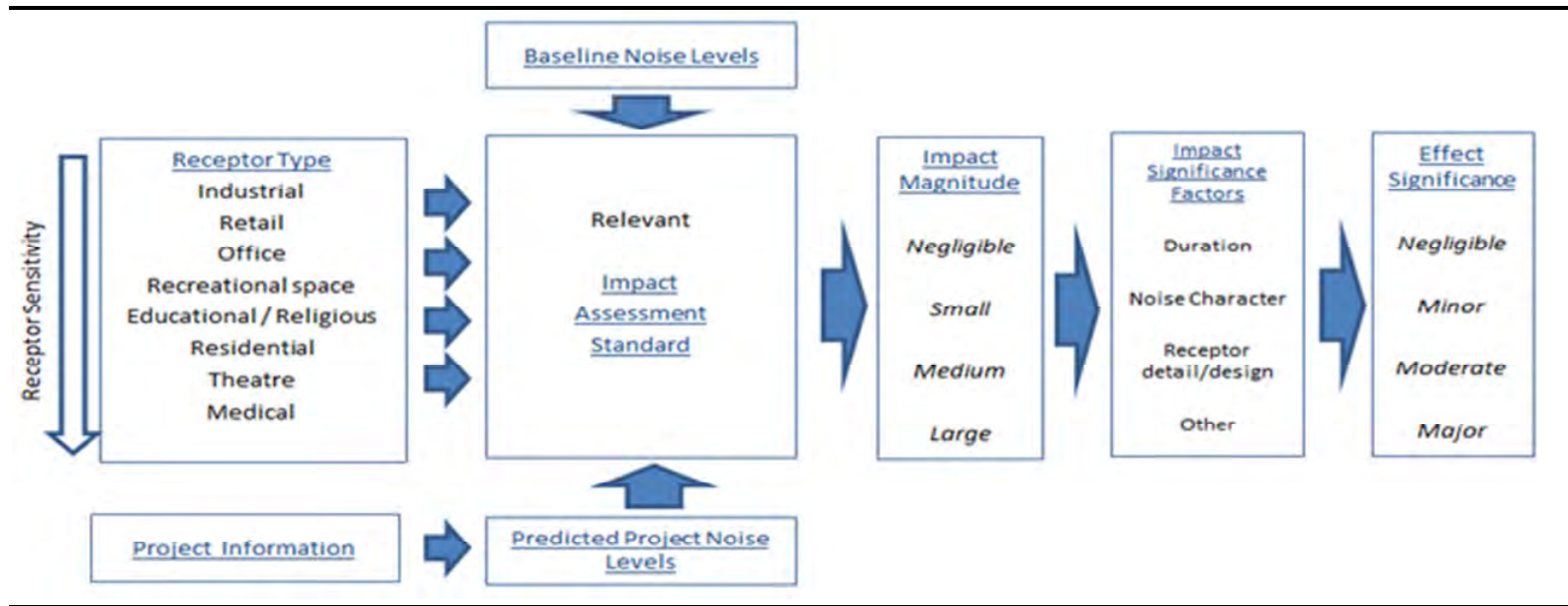
Magnitude of impact	Undegraded airshed (i.e. baseline < AQS)	Degraded airshed (i.e. baseline > AQS)
Negligible	PC <25% of AQS	PC <10% of AQS
Small	PC between 25% and 50% of AQS and PEC <100% of AQS	PC between 10% and 30% of AQS
Medium	PC between 50% and 100% of AQS, and PEC <100% AQS; or	PC between 30% and 50% of AQS
	PC between 25% and 50% of AQS, and PEC >100% of AQS	
Large	PC > 100% of AQS; or	PC > 50% of AQS
	PC > 50% of AQS, and PEC >100% of AQS	
PC: Process Contribution PEC: Predicted Environmental Concentration AQS: Air Quality Standard		

6.7.3 Noise Impact Assessment

Overview

The impact assessment process for noise is not a simple two dimensional matrix, and is better represented in *Figure 6.2* overleaf.

Figure 6.2 Noise Impact Assessment Process



Therefore, to determine noise impact magnitude, the type of receptor and relevant standards or guidance is required. The significance of the impact will then need to take into consideration any other influencing factors such as duration of the impact or meteorological conditions.

Noise standards and guidelines generally give threshold levels (criteria), or minimum noise changes, above which noise impacts are expected. In using such guidance, it is necessary to scale the degree of exceedence of the appropriate criteria into the impact magnitude ranges that are required for an impact assessment. There are various guidelines on responses to changes in noise levels and the probable response to excess change in noise levels (*Table 6.6*).

Table 6.6 *Noise Impact Magnitude Semantics*

Scale of Noise Exceedence OR Change in Noise Level	Impact Magnitude Classification EXCEEDENCE	Impact Magnitude Classification CHANGE	Comment
0 to 1 dB	Negligible	Negligible	Change in noise level would not be detected by most people
1 to 3 dB	Small	Small	Changes in environmental noise of less than 3dB are often not noticeable to a community
3 to 5 dB	Small	Medium	Noticeable change by some people
5 to 10 dB	Medium	Medium	Noticeable change by most people
>10 dB	Large	Large	A change of 10dB is often judged as subjectively twice as loud so may have additional significance, e.g. Very Large

Determining Significance

As indicated in *Figure 6.2*, the step from determining Impact Magnitude to Impact Significance involves consideration of other influencing factors. The following pairings between Impact Magnitude and Impact Significance can be used.

Table 6.7 *Noise Significance Semantic*

Impact Magnitude Classification		Impact Significance Rating
Negligible	Consider other influencing factors if necessary	Negligible
Small		Minor
Medium		Moderate
Large		Major

Factors that have the ability to increase or decrease noise emissions, propagation and the perception of noise that may influence significance, beyond impact magnitude include:

- **Duration;**
- **Operating Hours;**
- **Character of the Noise** – low frequency, tonality, impulsive, intermittent;
- **Receptor Detail or Building Design** – insulation, double glazing;
- **Existing Acoustic Environment;** and
- **Meteorological Conditions** – prevailing winds, temperature inversion.

The IFC EHS guidelines indicate that significant disturbance effects on people have a threshold of 55 dB LAeq,1hr, and 45 dB LAeq,1hr for daytime and night time respectively. However, where pre-project noise levels exceed these thresholds, a change of LAeq,1hr 3dB is the margin for significant impacts. From *Table 6.6*, a 3 dB change in Leq, above these thresholds, is rated as a *medium* magnitude. When assessing change in baseline noise levels, a minimum background noise threshold of 30 dB(A) is adopted.

Construction Noise Criteria

There is no relevant national guidance for construction noise. Furthermore, construction noise guidance is not addressed directly by IFC EHS guidance. For the construction phase of the proposed Project, the IFC and the Ethiopian noise standard's threshold levels of 55dB(A) for the daytime and 45dB(A) for the night time would be appropriate.

The significance of construction noise is assessed by establishing a threshold noise level at which significant impacts start to occur. It is appropriate to set significance thresholds for day and night time according to the duration of the noise, on the basis that the shorter the duration, the lesser impact.

Table 6.8 presents the impact assessment matrix relating to the noise level from the construction phase. Given the duration of construction for this proposed Project, a conservative approach has been taken, adopting the most stringent (>6 months duration) long term criteria.

Table 6.8 Construction Noise Impact Magnitude

Operating Period	Daytime Noise Level LAeq,1hr dB(A)				Night time Noise Level LAeq,1hr dB(A)			
	Negligible	Small	Medium	Large	Negligible	Small	Medium	Large
Temporary exposure < 1 month	<70	70 -75	>75 - 80	>80	<55	55 - 60	>60 - 65	>65
Short term exposure 1 to 6 months	<65	65 - 70	>70 - 75	>75	<45	45 - 55	>55 - 60	>60
Long term exposure >6 months	<55	55 - 60	>60 - 65	>65	<45	45 - 50	>50 - 55	>55

Operational Noise Criteria

Table 6.9 presents the impact magnitude assessment matrix relating to the noise level from the operational phase of the proposed Project. These are based on the IFC EHS Guidelines and the Ethiopian guidelines.

Table 6.9 Operational Noise Impact Magnitude

Operating Period	Daytime, LAeq, 1hr dBA				Night time, LAeq, 1hr dB			
	Negligible	Small	Medium	Large	Negligible	Small	Medium	Large
Noise Exceedence Impact Magnitude	<55	55-60	>60-65	>65	<45	45-50	>50-55	>55
Δ Baseline Impact Magnitude (LAeq, 1hr – LA90)	<10	10-15	15-20	>20	<10	10-15	15-20	>20

Road Traffic Noise Criteria

The IFC guideline will be adopted to assess the road traffic noise impacts as the road’s existence is fundamentally linked to the Project.

6.7.4 Mitigation of Impacts

Once the significance of a given impact has been characterised using the above mentioned methodologies, the next step is to evaluate what mitigation measures are warranted. In keeping with the Mitigation Hierarchy, the

priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

It is important to have a solid basis for recommending mitigation measures. The role of any given ESHIA is to help our clients develop a consentable project, and to help them achieve their business objectives in a responsible manner. Impact assessment is about identifying the aspects of a project that need to be managed, and demonstrating how these have been appropriately dealt with and have left us with good quality and appropriate development. As key influencers in the decision making process, the role of the impact assessment is not to stop development or propose every possible mitigation or compensatory measure that we can imagine, but rather to make balanced judgements as to what is warranted, informed by a high quality evidence base.

Additional mitigation measures should not be declared for impacts rated as not significant, unless the associated activity is related to conformance with an 'end of pipe' applicable requirement. Further, it is important to note that it is not an absolute necessity that all impacts be mitigated to a not significant level; rather the objective is to mitigate impacts to a as low as reasonably possible (ALARP) level.

Embedded controls (i.e., physical or procedural controls that are planned as part of the project design and are not added in response to an impact significance assignment), are considered as part of the project (prior to entering the impact assessment stage of the impact assessment process).

6.7.5 *Residual Impact Assessment*

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

6.7.6 *Dealing with Uncertainty*

Even with a final design and an unchanging environment, impacts are difficult to predict with certainty, but in projects such as the proposed Dallol Potash Project where the design process is currently in progress, uncertainty stemming from on-going development of the Project design is inevitable, and the environment is typically variable from season to season and year to year. Where such uncertainties are material to ESHIA findings, they are clearly stated and are approached conservatively ('the precautionary approach') in order to identify the broadest range of likely residual impacts and necessary mitigation measures.

Potential impacts may be assessed using tools ranging from quantitative techniques such as hydrodynamic modelling to qualitative techniques based on expert judgment and historical information. The accuracy of these assessment tools depends on the quality of the input data and available information. Where assumptions have been made, the nature of any uncertainties associated with the assumption is discussed. For qualitative predictions/assessments, some uncertainty is removed through consultation.

6.7.7 *Cumulative Impacts/Effects*

Cumulative impacts and effects are those that arise as a result of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect. These are termed cumulative impacts and effects.

The impact assessment process predicts cumulative impacts/effects to which the proposed Project may contribute. The approach for assessing cumulative impacts and effects resulting from the proposed Project and another activity affecting the same resource/receptor is based on a consideration of the approval/existence status of the 'other' activity and the nature of information available to aid in predicting the magnitude of impact from the other activity.

6.7.8 *Management Systems Integration*

Stakeholders and external decision-makers for the proposed Dallol Potash Project will rely on the findings of this ESHIA (e.g. as regards significance of residual impacts) in coming to their ultimate views. As an ESHIA is based on predictions made in advance of an activity taking place, it effectively makes assumptions that the project will implement certain controls and mitigation measures. If the controls do not happen, then the ESHIA is undermined as a tool for stakeholders and external decision-makers. It is important, therefore, that these 'assumptions', i.e. the mitigation measures, are commitments that will be implemented through the following management plans (contained in Volume Three):

- Air Quality Management Plan;
- Water Management Plan;
- Biodiversity Management Plan;
- Community Development Plan ;
- Worker Management Plan ;
- Sourcing Procurement and Recruitment Management Plan;
- In-Migration Management Plan;
- Community Health Safety and Security Management Plan;
- Archaeology and Cultural Heritage Management Plan;
- Emergency Response Plan;
- Spill Prevention, Control and Containment Plan;
- Integrated Mine Closure Plan; and
- Waste Management Plan.

It is also important that, over the life of the proposed Project, the vehicle by which the commitments of the Allana Potash ESHIA are turned into specific actions will be through the Allana Potash Environmental, Social and Health Management System. This System includes several management plans initiated during the ESHIA process and developed as the Project proceeds. The Environmental, Social and Health Management System is presented in *Chapter 13*. The implementation of such a system should ensure that any unforeseen impact or issues that may arise will be dealt with in an effective manner in accordance with the relevant Performance Standards, Environmental, Health and Safety Guidelines and the laws and regulations of Ethiopia. In this way, stakeholders and external decision-makers should have confidence in the ESHIA as a tool to aid their decision-making on the proposed Project.

Once potential impacts have been identified and mitigation measures developed and described in the ESHIA, their *integration* within the proposed Project is required in order to ensure their future implementation. In order for this to be successful, a statement of the responsibility, timing and reporting requirements associated with each measure or set of measures is generally issued. It is also required as part of the Environmental, Social and Health Management System to develop procedures by which these measures will be monitored and to include mechanisms that allow for their on-going development in order to minimise impacts to ALARP levels, or to achieve continuous improvement throughout the Project's duration.

6.7.9 *Reporting and Disclosure*

This ESHIA will be disclosed to the lenders and public. This report will include the various subsidiary management plans.

A Grievance Procedure, as required by the IFC Performance Standards and African Development Bank was established for the Project and will provide long-term input to the proposed Project.

6.7.10 *Uncertainty and Change Management*

As Project design is finalised, and as additional baseline data is gathered, a greater level of certainty regarding the impacts of the proposed Dallol Potash Project will emerge. Accordingly, Project design changes may occur that need to be accommodated by Allana and their contractors. Similarly, the organisational structure and roles and responsibilities provided under *Chapter 14* may also change as the Project progresses.

The ESHIA process does not stop with submission of the reports. Therefore, the ESHIA Management Plans will require a mechanism to manage change. At times these changes may be material, potentially influencing the original findings of the ESHIA, and hence, the basis for its approval. Such a mechanism to manage change, or a change management system, must ensure

that changes to the scope of the proposed Project are subjected to a robust assessment process. Any changes to Project scope will be evaluated for their degree of significance, and will be incorporated into the appropriate Allana documentation as follows:

- Minor changes will be reflected in updates to the applicable Management Plans; and
- Substantive changes (such as ancillary infrastructure associated with the proposed Project) that might potentially alter the ESHIA findings (i.e. those that result in changes to the predicted significance of environmental, socio-economic and health impacts) will be subject to re-assessment, further stakeholder consultation, supplementary reporting and revision of the Project's Environmental, Social and Health Management Plans. Typically, such substantive changes will be submitted as an addendum to this ESHIA.

This chapter presents a summary of the engagement activities undertaken as well as future engagement activities planned as part of the ESHIA process. It serves as a summary of a more detailed Stakeholder Engagement Plan (SEP) that has been compiled to present on the engagement approach to be adopted, the stakeholders to be included in engagement activities, and the mechanisms through which they will be engaged. The SEP also provides a means to document the historical stakeholder engagement process.

A summary of the SEP is presented in this chapter. The complete SEP, a list of stakeholders identified and key issues raised to date, are included in SEP (*Annex C of Volume Two*).

The engagement process has been designed to meet both Ethiopian legal requirements for public participation and international requirements for engagement.

7.1

OBJECTIVES

The objectives of engaging stakeholders during the ESHIA process include:

- **Ensuring understanding:** An open, inclusive and transparent process of culturally appropriate engagement and communication will be undertaken to ensure that stakeholders are well informed about the proposed development. Information will be disclosed as early and as comprehensively as possible and appropriate.
- **Involving stakeholders in the assessment:** Stakeholders will be included in the scoping of issues, the assessment of impacts, the generation of mitigation and management measures and the finalisation of the ESHIA report. They will also play an important role in providing local knowledge and information for the baseline to inform the impact assessment.
- **Building relationships:** Through supporting open dialogue, engagements will help establish and maintain a productive relationship between the ESHIA team and stakeholders. This will support not only an effective ESHIA, but will also strengthen the existing relationships between Allana and stakeholders.
- **Engaging vulnerable peoples:** An open and inclusive approach to consultation increases the opportunity of stakeholders to provide comment on the proposed Project and to voice their concerns. Some stakeholders, however, need special attention in such a process due to their vulnerability. Special measures will be considered to ensure that the perspectives of vulnerable stakeholders are heard and considered.

- **Managing expectations:** It is important to ensure that the proposed Project does not create or allow unrealistic expectations to develop amongst stakeholders about proposed Project benefits. The engagement process will serve as one of the mechanisms for understanding and then managing stakeholder and community expectations, where the latter will be achieved by disseminating accurate information in an accessible way.
- **Ensuring compliance:** The process is designed to ensure compliance with both local regulatory requirements and international best practice.

One of the key outcomes of engagement should be Informed Consultation and Participation (ICP) that focuses on an in-depth exchange of views and information with affected communities. The consultation process is designed to be an organised and iterative process that supports the ESHIA team identify appropriate ways to manage and mitigate impacts, tailor implementation, and identify appropriate mechanisms for sharing and capitalising on development benefits and opportunities.

7.2

APPROACH TO STAKEHOLDER ENGAGEMENT

The engagement process has been designed to align to the stages of the ESHIA, and involve five key phases:

- Screening;
- Notification and Scoping;
- Baseline Data Gathering;
- Engagement on the Draft ESHIA; and
- Final ESHIA Disclosure.

A summary of the objectives and activities for each phase is listed in *Table 7.1*. The Screening, Scoping, Baseline Data Gathering and engagement on the Draft ESHIA have been undertaken in November 2011, March and May 2012 and January 2013 respectively. More information about the engagement activities undertaken during each of these phases as well as the outcomes of these visits are described in SEP and its associated Annexes. *Table 7.1* below also identifies the objectives for upcoming phases.

Table 7.1 Phases of Engagement

Phase	Objective	Key Activities	Key Outputs
Screening	<ul style="list-style-type: none"> To gain a preliminary understanding of the scope of the Project, its likely impacts and relevant stakeholders. 	<ul style="list-style-type: none"> Inception meeting with Allana and in-country sub-consultants involved in the stakeholder engagement activities; Screening field visit; Preliminary meetings with selected local stakeholders; and Stakeholder identification process. 	<ul style="list-style-type: none"> Engagement plan for the ESHIA; and Summary of issues raised during engagement with key stakeholders (Appendix B, C and D of the SEP).
Scoping Engagement	<ul style="list-style-type: none"> To meet key stakeholders and introduce them to the proposed Project and ESHIA; To generate feedback on the Draft Scoping Report, including the scope, approach and key issues to be investigated further for the ESHIA; and To consult key stakeholders on the next steps in the ESHIA process. 	<ul style="list-style-type: none"> Notification and communication on the proposed Project and associated ESHIA through: <ul style="list-style-type: none"> Meetings and workshops with key stakeholders at the federal, regional and local level; Distribution of draft Scoping Report to key stakeholders directly and via project website; and Dissemination of a non-technical summary of the draft Scoping Report and posters/presentations describing the proposed Project. 	<ul style="list-style-type: none"> Updated SEP (<i>Annex C of Volume Two of the Draft ESHIA Report</i>); Engagement tools and proof of their dissemination; Final Scoping Report with record of stakeholder issues; and Non-technical presentation and posters summarising the draft Scoping Report including list of preliminary identified impacts.
Baseline Data Gathering	<ul style="list-style-type: none"> To collect baseline data through detailed surveys using participatory appraisal methods. 	<ul style="list-style-type: none"> Household survey with a random selection of households; Focus Group Discussions (FGD) with select stakeholders; and Key Informant Interviews (KII) with key stakeholders. 	<ul style="list-style-type: none"> Updated SEP (<i>Annex C of Volume Two of the Draft ESHIA Report</i>); Engagement tools; and Socio-economic baseline.

Phase	Objective	Key Activities	Key Outputs
Draft ESHIA Disclosure Engagement	<ul style="list-style-type: none"> To discuss the identified impacts and proposed mitigation measures with stakeholders allowing for their input; and To provide stakeholders with the opportunity to comment on the Draft ESHIA report. 	<ul style="list-style-type: none"> Dissemination of the Draft ESHIA to key stakeholders directly and via project website; Dissemination of a non-technical summary of the draft ESHIA Report; and Meetings and workshops at the national, regional and local level. 	<ul style="list-style-type: none"> Draft ESHIA Report; Non-technical summary of identified impacts and mitigation measures; and Draft Stakeholder Engagement Strategy (SES).
ESHIA Disclosure Engagement	<ul style="list-style-type: none"> Obtain community sign-off on a position on the proposed Project and associated process; and To notify stakeholders of the submission of the final report to regulators. 	<ul style="list-style-type: none"> Disclosure of the Final ESHIA Report with stakeholders; and Meetings at local, regional and federal levels to gain stakeholder sign-off on a position about the Project and endorsement of the process. 	<ul style="list-style-type: none"> Final ESHIA Report; Endorsement letter from regional authorities verifying: <ul style="list-style-type: none"> the outcomes of the stakeholder process reflect the true and unbiased opinions of local stakeholders; Stakeholders have been provided the opportunity to voice their opinions; and Have agreed and are satisfied with the EMP Final SES.

The key issues identified during the engagement sessions conducted during the screening, scoping and baseline phases are summarised in *Table 7.2*.

These issues together with the findings of the Baseline Data Gathering have been considered when compiling the Social Impact Assessment (SIA).

Table 7.2 Issue Categories and Groups (as of October 2012)

Issue Category	Issue Category	Detailed Concerns
Negative Impacts	Concerns about Anticipated Impacts	Effects of increased traffic and construction of roads. In particular regarding possible disturbance to salt areas, traffic accidents and pollution arising as a result of increased traffic.
		Impact to the salt trade including concerns over changes in current process and transportation, degradation of cultural significance of salt trade and impact to the key economic activity in the area.
		Impact on palm resources including economic significance to women, value to <i>Arho</i> members and cultural importance.
		Impact on tourism identified to be both potentially positive and negative. Key concerns included maintaining the aesthetic beauty, minimising pollution and disturbance to attractions and to enable locals to benefit from the industry.
		Sites of cultural significance have been identified on several occasions including village graves, Mount Assale and Mount Dallol. Clear expression that sites should not be disturbed and remain accessible to people.
		Impact on ground and surface water resources specifically regarding Allana's water requirements and impacts to local people's water availability, availability to livestock and impacts to the salt replenishment process.
		Effects of influx, including challenges to Afar culture and norms, and non-Afar groups benefiting more from opportunities related to influx.
		Impact on wildlife and biodiversity including impacts to the habitat of the critically endangered African Wild Ass, and impacts to the migratory route of important bird species.
		Effects of disturbance, including pollution that has been identified to already be issues. Concern that in particular dust, noise and effluent discharge will increase with the proposed Project.
		Concerns over impacts to health including the increase in communicable and vector borne disease including STIs, and emissions of chemicals from the proposed Project.
Impact on pastoralism, and proposed Project impacts to areas used for livestock grazing.		

Issue Category	Issue Category	Detailed Concerns
		Impact on land use and access including potential limitation on areas available and access to areas for local villages, tourism operators and extent of land take for mining that may create a monopoly.
		Impact of mining to the geology and geological activity of the area.
		Impact on tensions and conflict arising due to reduced natural resources, influx and reduced mobility for local people.
		Concerns regarding the resilience of local Afar people to adapt to social, cultural and economic changes that occur rapidly.
	Issues with Existing Impacts	Several issues raised by local stakeholders on Allana's approach to employment and labour practices.
		Issues with disturbance related to exploration activities that stakeholders feel have not been adequately communicated or addressed.
		Existing issues with traffic and road related impacts include loss of livestock, disturbance to areas used for salt and palm collection.
Positive Impacts	Expectations around Anticipated Benefits	Anticipated benefits in particular around employment opportunities, tax revenue, investment in social and physical infrastructure and other community development initiatives.
	Expectations around Existing Benefits	Appreciation of existing benefits delivered by Allana was acknowledged. There are expectations that benefits will be scaled up going into construction and operation.
Process	Expectations regarding Engagement	Requirements and expectations in terms of approach and methodology including a more consistent and thorough approach acknowledging the structure of Afar communities and traditional governance systems.
	Recommendations around planning and co-ordination	Recommendations around co-ordinated planning between mining companies in the area, and alignment of Allana's engagement and activities with federal, regional and local strategies and plans.
Project	Project related	Requests for information and enhanced communication around proposed Project activities.

7.3 *STAKEHOLDERS*

For the purposes of this plan, a stakeholder is defined as any individual or group which is potentially affected by the proposed Project or who has an interest in the proposed Project and its potential impacts. *Figure 7.1* presents a graphic of the different stakeholder groups that have been identified through the process at national, regional and local levels. A detailed database of the proposed Project stakeholders is appended to the SEP as Appendix A.

7.4 *ENGAGEMENTS DURING THE DRAFT ESHIA PHASE*

Engagement during the draft ESHIA phase will be undertaken through a two week trip in January 2013. The broad objective of the engagement will be to provide stakeholders with information on the outcomes of the specialist studies and draft ESHIA report with the aim to:

- Highlight the key impacts identified in the draft ESHIA report, and proposed mitigation;
- Identify stakeholder concerns and opinions on the impacts identified;
- Involve stakeholders in assessing the efficacy and appropriateness of the proposed mitigation measures; and
- Identify revisions or additions to the draft ESHIA report where necessary.

In addition, where relevant, the engagement may support Allana in identifying stakeholders who can support the development and implementation of mitigation measures.

Table 7.3 presents the set of stakeholders being engaged on the draft ESHIA. This includes a set of directly affected federal, regional and local stakeholders which have been identified based on the issues identified through previous rounds of engagement as well as the impacts identified in the ESHIA. In addition, a set of technical specialists have been identified for inclusion in engagement, where the objective of involving these experts is to invite them to assess the efficacy of the mitigation measures proposed in the draft ESHIA.

Special efforts will be undertaken when engaging directly impacted stakeholders and particularly vulnerable stakeholders. Further details on the groups identified as vulnerable or likely to be directly affected by the proposed Project are included in the SEP.

Figure 7.1 Stakeholders across the Federal, Regional and Local Level

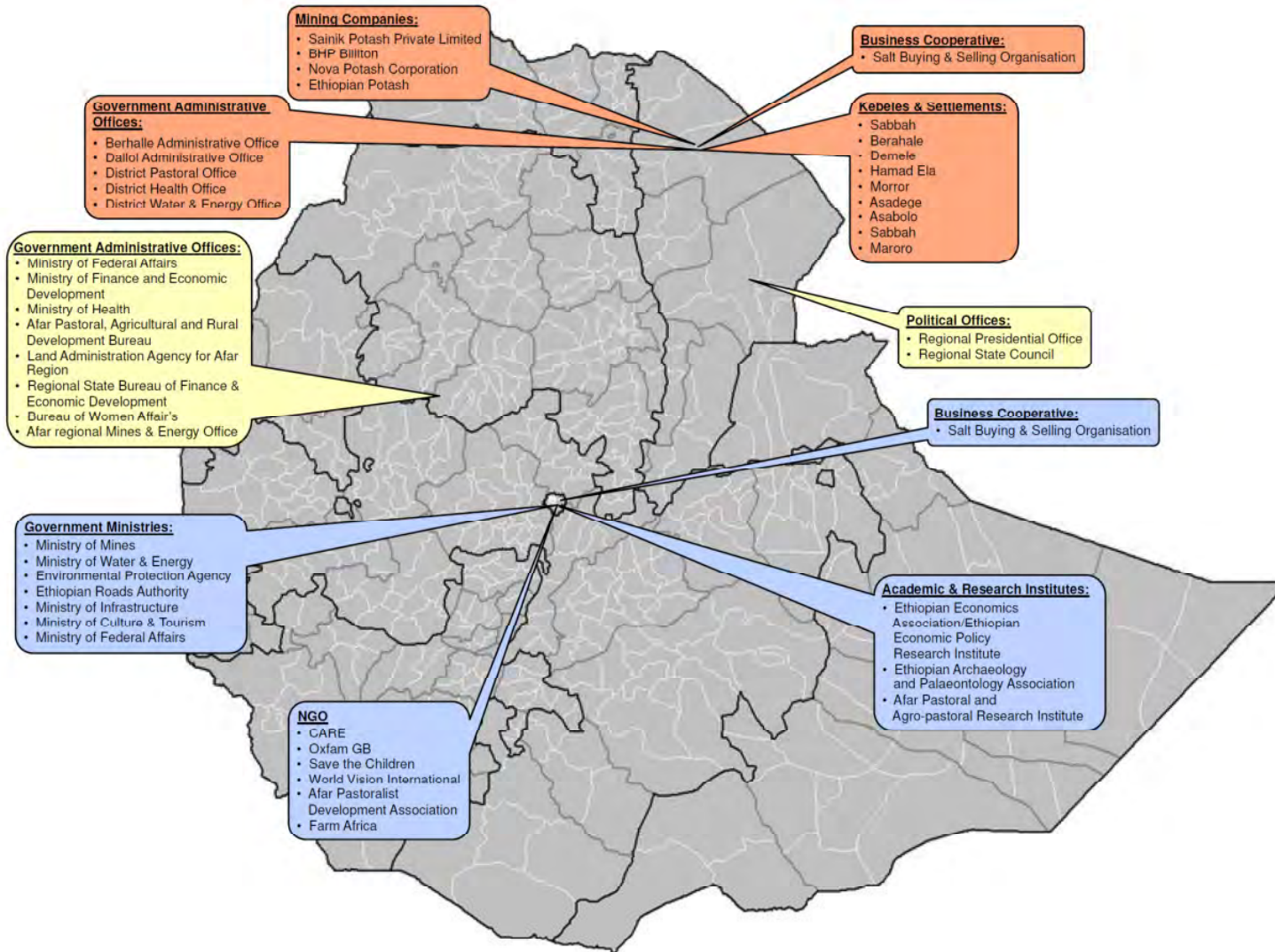


Table 7.3 Stakeholder Groups Identified for Engagement at the Draft ESHIA Phase

Stakeholder Categories	Stakeholder Groups	Stakeholder
Government	Federal, regional and local government: Political	<ul style="list-style-type: none"> • Afar Regional State Council • <i>Woreda</i> administrators for Dallol and Berahale • <i>Kebele</i> leaders for Sabana Demale and Bada Admerug
	Federal, regional and local government: Administrative and technical	<ul style="list-style-type: none"> • Ministries at Federal level (including Ministry leads and technical support) • Bureaus at Regional level • Bureaus at <i>Woreda</i> level
	Government agencies	<ul style="list-style-type: none"> • Ethiopian Roads Transport Authority • Ethiopian Wildlife Conservation Authority • Ethiopian Road Construction Corporation • Sustainable Development of the Protected Area System of Ethiopia (SPDASE)
Directly Affected Stakeholders*	Customary authorities (per village)	<ul style="list-style-type: none"> • Clan and religious leaders • Elders
	Community associations (per village)	<ul style="list-style-type: none"> • Women’s Federation • Youth Groups • Palm Association (<i>engwa mehaber</i>)
	Community members, including men, women, youth, artisanal salt workers	<ul style="list-style-type: none"> • Alai lai • Mororo • Hamad Ela • Asabolo • Ambule • Morror • Fiya • Badle • Berahale Town
Business	Mining companies in the northern Danakil	<ul style="list-style-type: none"> • Sainik Potash Private Ltd • Ethiopian Potash
	Salt related businesses	<ul style="list-style-type: none"> • Berahale Salt Selling • Mekele Salt Buying Associations • Subsidiary services including local restaurants, hotels, accommodation in Berahale, Asabolo, Hamad Ela
	Tourism operators	<ul style="list-style-type: none"> • Operators based in Addis Ababa • Operators based in Mekele • National Tourism Operator and Travel Agency (NTO)
Civil Society	Federal and regional environmental NGOs	<ul style="list-style-type: none"> • Forum for the Environment

Stakeholder Categories	Stakeholder Groups	Stakeholder
	Federal and regional social and health NGOs	<ul style="list-style-type: none"> • MELCA • GIZ • Afar Pastoralist Development Association
	Academics and research institutes	<ul style="list-style-type: none"> • Authority for Research and Conservation of Cultural Heritage • Addis Ababa University, Department of Archaeology and Heritage Management • Semera University

**Settlements in and near the concession areas and other affected areas/routes*

7.5

NEXT STEPS IN THE STAKEHOLDER ENGAGEMENT PROCESS

Following dissemination of the draft ESHIA and associated engagement during this phase, there will be a four week comment period for stakeholders to provide comments on the findings in the draft ESHIA. These will be considered as the ESHIA is finalised and, where appropriate, adjustments will be made to the ESHIA. Responses will also be generated to all comments received through the comment period as well as through the engagements undertaken during the draft ESHIA phase.

The next step in the engagement process will be to disclose the final findings of the ESHIA report to stakeholders at the federal, regional and local level. It is anticipated that this will be conducted through a field visit where local stakeholders will be engaged first, followed by regional and national stakeholders. During these engagements, local stakeholders will be required to sign-off on their position in response to the proposed Project as well as to endorse the engagement process undertaken. This is as per the Ethiopian requirements.

7.6

FEEDBACK MECHANISM

Allana has put in place and will continue to maintain a complaints mechanism and grievance procedure for the overall Project. In addition, a feedback mechanism has been implemented by the ESHIA team to ensure that stakeholders affected by the proposed Project can present their inputs (e.g., opinions, requests, suggestions and grievances) about the project or the ESHIA process for consideration and, if required, redress. The following feedback channels are available to stakeholders through the course of the ESHIA:

- Electronic and telephonic feedback, where email and telephonic contact details have been made available to stakeholders both for the SA and UK based ERM team as well as for the in-country sub-consultants; and
- Engagement activities undertaken directly with stakeholders during the draft ESHIA and Disclosure phases.

The ESHIA team commits to receiving and recording any issues or grievances raised, generating responses which will be communicated through the final ESHIA as well as through the disclosure round of engagements. ERM also commits to monitoring this feedback mechanism to ensure it is working effectively.

7.7

MONITORING AND REPORTING

Stakeholder engagement will be monitored and reported through the following means:

- Updates to the stakeholder database;
- Recording of all consultations held; and
- Updates to the issues and responses table.

These records will be updated throughout the ESHIA and appended to each iteration of the SEP. Thus the SEP and the records that are created as a result will serve as a tool, not only to plan future engagements but also to record previous phases of the process.

It is important to gain an understanding of the physical, biological and social attributes of the Danakil Depression and its surroundings, as it will provide for a better understanding of the receiving environment in which the Project is being considered.

The description of the baseline environment is essential in that it represents the conditions of the environment before the construction of the proposed Dallol Potash Project. The description of the baseline environment therefore provides a description of the current environment against which the impact of the proposed Project can be assessed and future changes monitored.

The information presented in *Chapter 8* and *9* has been collected from desktop studies and supplemented with seasonal site visits to the Study Area. It must, however be noted that very little secondary data is available for the Afar Region as a whole, and in many instances, data is currently wholly unavailable. As such, the objective of primary data collection served to minimize these significant data gaps. The methodologies used to aid data collection are discussed in the respective sections below; however, for ecological and social baseline data collection, these are detailed in *Annex B* of *Volume Two*).

Chapter 8 and *9* describe the physical and biological characteristics and the socio-economic and health characteristics of the receiving environment respectively. The two chapters are organised as follows:

Chapter 8:

- Physical Environment:
 - Climate;
 - Topography and Geomorphology;
 - Geology and Soils;
 - Hydrology;
 - Geohydrology;
 - Air Quality; and
 - Noise;

- Biological Environment:
 - Vegetation Classification;
 - Conservation Priorities;
 - Terrestrial and Aquatic Habitat;
 - Terrestrial and Aquatic Fauna;
 - Issues of Conservation Concern; and

- Ecosystem Services.

Chapter 9

- Key Physical and Biological Sensitivities:
 - Social Area of Influence and Social Study Area;
 - Governance and Administration;
 - Demographic Profile;
 - Social Infrastructure, Resources and Services;
 - Education;
 - Health Profile;
 - Cultural Heritage;
 - Landscape and Visual;
 - Livelihoods and Socio-economics;
 - Human Rights and Vulnerability;
 - Stakeholder Perceptions, Attitudes and Needs;
 - High Level Needs Analysis; and
 - Socio-environmental Sensitivities.

8.2 *PHYSICAL ENVIRONMENT*

8.2.1 *Climate*

National Climate

Ethiopia is located in the tropical zone lying between the Equator and the Tropic of Cancer. The highland plateau ranges between 2,000 to 3,000 meters above sea level (masl) and is dissected by the Great Rift Valley and various escarpments. These variations in altitude results in the country being divided into three broad climatic zones; namely, *Kolla* (hot zone) found at 1,500 masl, the *Weyna Dega* (mid highland zone) found between 1,500 and 2,400 masl and the *Dega* (highland zone) at 2,500 masl. The mean annual temperature and annual rainfall in these zones are as follows (*Table 8.1*):

Table 8.1 *Mean Annual Temperature and Annual Rainfall*

	<i>Kolla (Hot Zone)</i>	<i>Weyna Dega (Mid Highland Zone)</i>	<i>Dega (Highland Zone)</i>
Mean Annual Temperature (°C)	23 - 33	16 - 29	10 - 16
Mean Annual Rainfall (mm)	< 510	510 - 1530	1270 - 1280

Reference: SANA, (2010)

Ethiopia experiences two main climatic seasons, a dry season (October to May) and a rainy season (June to September). However, from an agricultural perspective, the country has the following four distinct seasons:

- *Kiremt* or *Meher* (Summer) – June, July and August are considered the summer months with heavy rainfall being a defining characteristic of the season;
- *Tseday* (Spring) – September, October and November make up this season and it is during this period when the harvesting of crops takes place;
- *Bega* (Winter) – December, January and February make up this season, it is dry with morning frost especially in January; and
- *Belg* (Autumn) – March, April and May are the autumn months with occasional showers.

Obviously ranging altitudes tend to add a number of variations to these seasons. In general lowland areas usually experience hotter temperatures and less rainfall in comparison to the highlands.

Local Climate

The Study Area (located within the *Kolla* zone) can be characterised as having a hot and arid climate, and is commonly known as the hottest inhabited place (hottest average temperature) on earth. The area receives little to no rainfall for most of the year even during the summer months, with annual rainfall averaging between 100 to 200mm, with even lower averages towards the east. This low average rainfall also indicates a low humidity in the hot season.

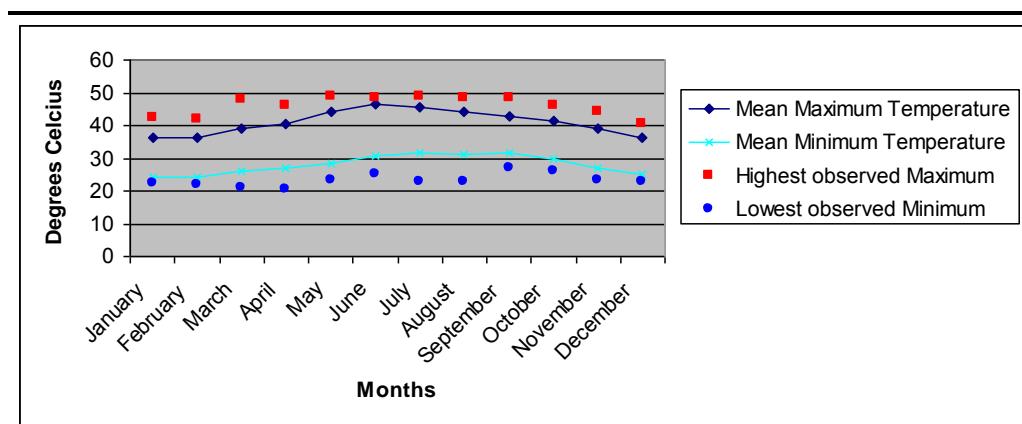
Temperature

Pedgley (1967) acquired air temperature data at the site of the then Ralph M Parsons Company, which was situated on the Dallol Mountain in the Danakil Depression, in the 1960's (*Figure 8.1*).

The mean maximum air temperatures recorded are high, not because the hottest months are particularly hot, but because the coolest months are so warm (the minimum temperature never fell below 20°C). Over a wide part of the northern African continent, for example, many places experience temperatures in their hottest months that are comparable to those experienced in the Dallol; however, their coolest months are commonly cooler (Pedgley, 1967).

Pedgley (1967) suggests that mean monthly maximum temperature exceeds 37.8°C in all months of the year; including January and February, which are the coolest months of the year. The fact that the mean temperature is generally 11.7°C to 14.7°C cooler than the mean monthly maximum suggests that daily maxima occupy a narrow range of values in any one month (Pedgley, 1967). June shows the smallest difference between the mean monthly maximum and the daily maximum of 5.9°C.

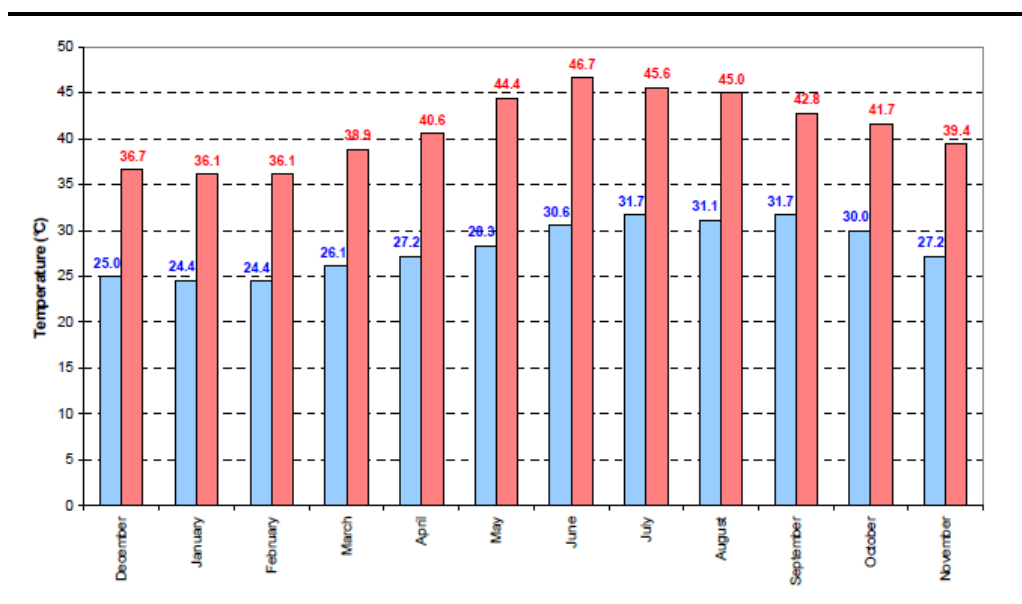
Figure 8.1 Mean Highest and Lowest Observed Temperatures (Period 1960 to 1966)



Source: Pedgley, (1967)

The lowlands of the Danakil Depression are hyper-arid, with monthly mean temperatures varying from 24.4°C during the wet season (June to September) to 46.7°C in the dry season (October to May) (Figure 8.2). Despite having a distinct wet season, the area receives little to no rainfall for most of the year.

Figure 8.2 Averages of Monthly Means for Minimum and Maximum Temperatures: Daloil Depression, Ethiopia



Source: Ercosplan, (2011)

Please Note - “Red Bars” illustrate average monthly means for maximum temperatures and the “Blue Bars” illustrate the average monthly means for minimum temperatures.

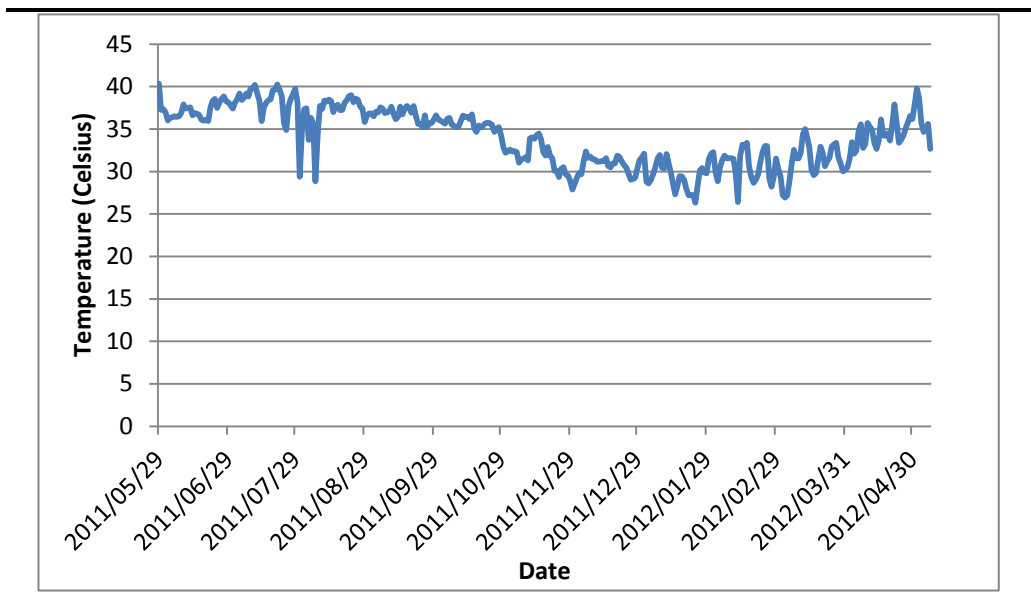
8.2.2 Primary Baseline Meteorological Data in the Study Area

The meteorological conditions in the vicinity of the proposed Project are an important consideration. Monitoring of meteorological conditions is currently being undertaken at the Allana weather station at Hamad Ela Village, with data recordings between May 2011 and May 2012 being currently available. A

second weather station at the proposed evaporation pond location was erected in September 2012. The results of the Hamad Ela meteorological monitoring, in terms of ambient temperature, rainfall, average daily wind speed, maximum 15 minute daily wind speed and daily mean wind direction are set out in *Figure 8.3* to *Figure 8.7* below.

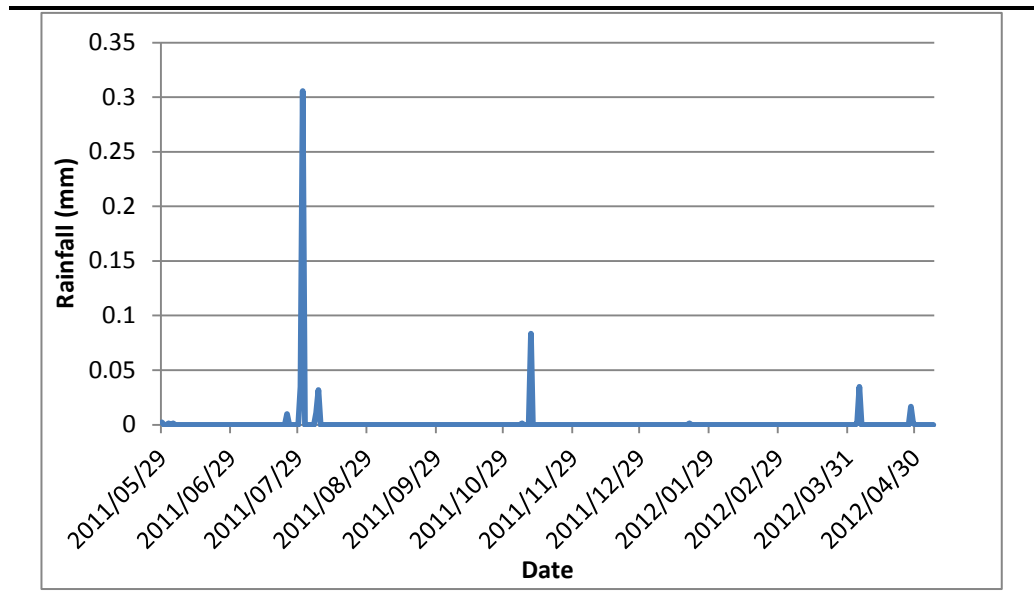
Figure 8.3 demonstrates a high average temperature with daily mean temperatures ranging between 26°C and 40°C, with higher temperatures between April and September. Furthermore, the mean monthly minimum temperatures seem slightly cooler than the mean maximum and minimum temperatures recorded by Pedgley (24.4°C to 46.7°C) over the 6 year period.

Figure 8.3 *Ambient Daily Temperature*



Rainfall events are rare, with only eight rainfall events being recorded in eleven months, with none greater than 0.4mm (*Figure 8.4*). The surface of the depression is, however, more frequently wet, as a result of the flooding from rainfall events in the mountains to the west.

Figure 8.4 24 Hour Rainfall



The wind speed data illustrates that overall wind speeds are elevated, with the lowest 24 hour mean wind speed being around 2.5 m/s (Figure 8.5). The analysis of the maximum 15 minute wind speed in every 24 hour period demonstrates that the daily peak wind speed is between 8 and 12m/s, with peak 15 minute wind speeds of greater than 18m/s on occasion (Figure 8.6).

Figure 8.5 Average Daily Wind Speed

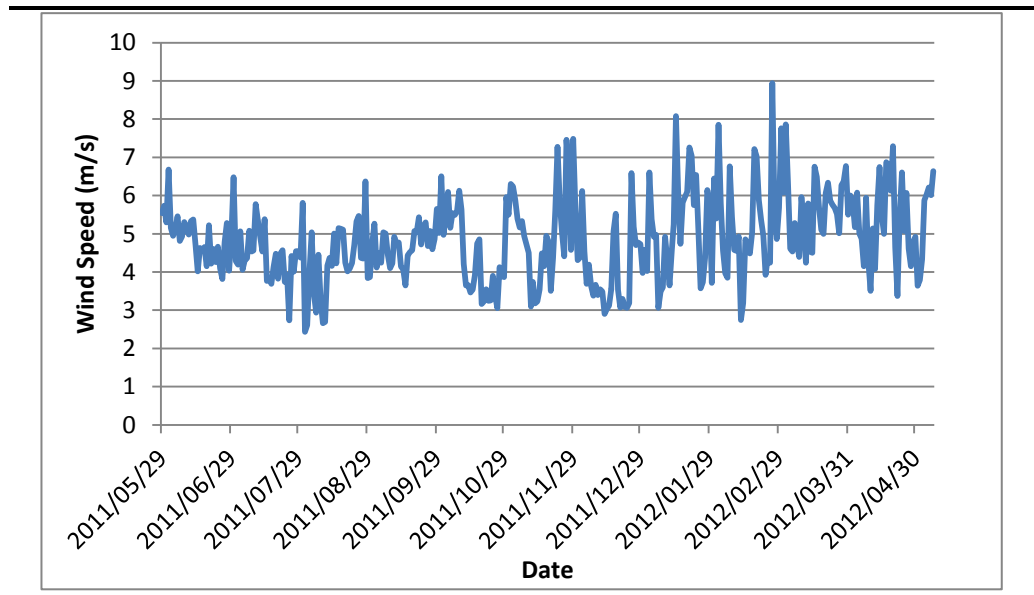
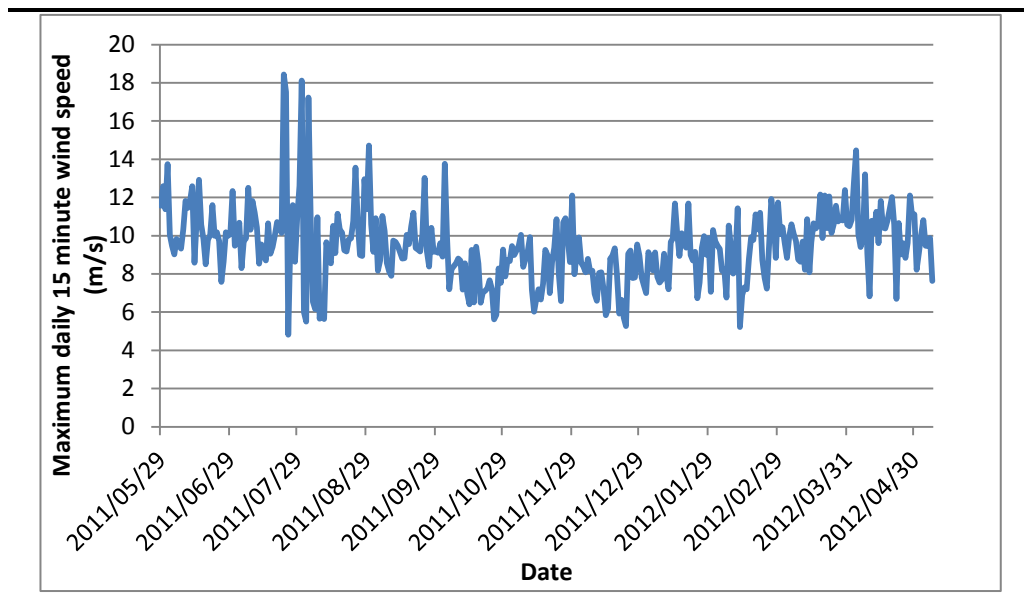
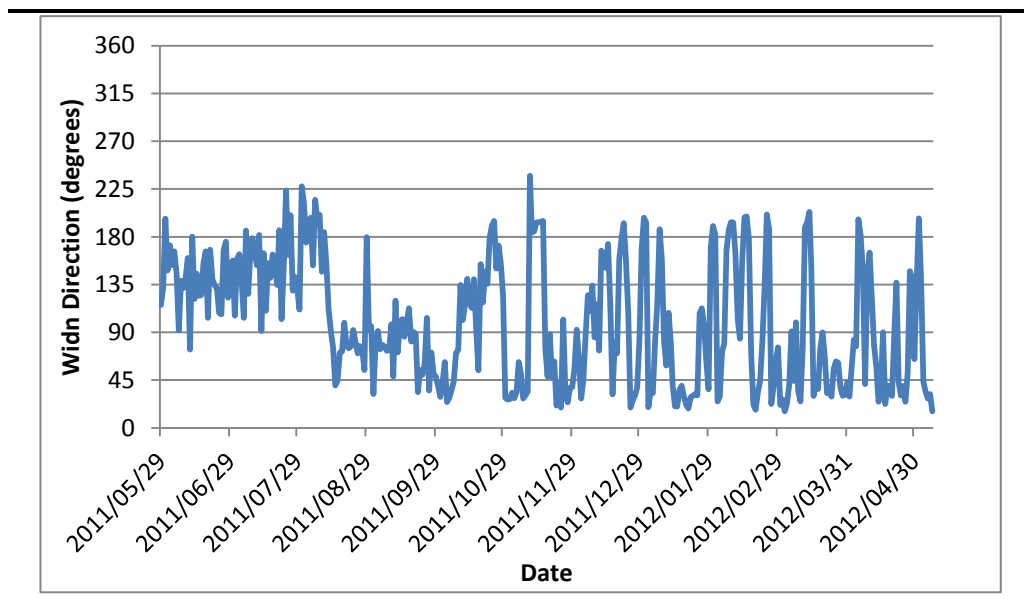


Figure 8.6 Maximum 15 Minute Daily Wind Speed



The wind direction data (Figure 8.7) illustrates that the winds are primarily from the northeast, east and southeast, with no daily mean wind direction from the south, west or north. The winds from the northeast and east are associated with hot, dry, dusty air carried over the Red Sea from the Arabian Peninsula.

Figure 8.7 Daily Mean Wind Direction



8.2.3 Topography and Geomorphology

The Study Area is situated in the Danakil Depression, 100 to 125m below sea level (Figure 8.8). Tectonically and morphologically, the Danakil Depression represents a typical graben structure which is oriented north-north-west/south-south-east. The depression increases in width from the north

(10km width) to the south (70km width) with the northern region having the lowest altitude (50 to 128m below sea level) (*Figure 8.8*).

The Danakil Depression is bordered to the north east by the Danakil Alps, which elevates up to 1,000m above sea level. The Alps have a width of approximately 40 to 70km, extend from north-north-west to the south-south-east and separate the depression from the Red Sea. The south west border of the Danakil Depression is the transition area to the Ethiopian Highlands, which are approximately 2,000m above sea level (*Figure 8.8*). The foothills to the highlands are characterized by the presence of large alluvial fans, which extend into the depression (Ercosplan, 2011).

The depression is a result of the presence of a tectonic triple junction (the Afar Triple Junction) where the spreading ridges that are forming the Red Sea and the Gulf of Eden emerge on land and meet the East African Rift. The point of emergence for these three pieces of the Earth's crust is around Lake Abbe. As a result of the rift, the Danakil Depression is one of the lowest places on the African continent. The floor of the Depression is below sea level, with the exception of a few volcanic hills interspersed on the floor of the rift. The central part of the Depression is characterized by thick evaporite deposits that include potash and common salt. The floor forms wide flat salt plains with brine ponds and a lake overlying the salt deposits (*Figure 8.9*) (Beyene and Abdelsalam, 2005).

Figure 8.8 Elevation Map of the Study Area

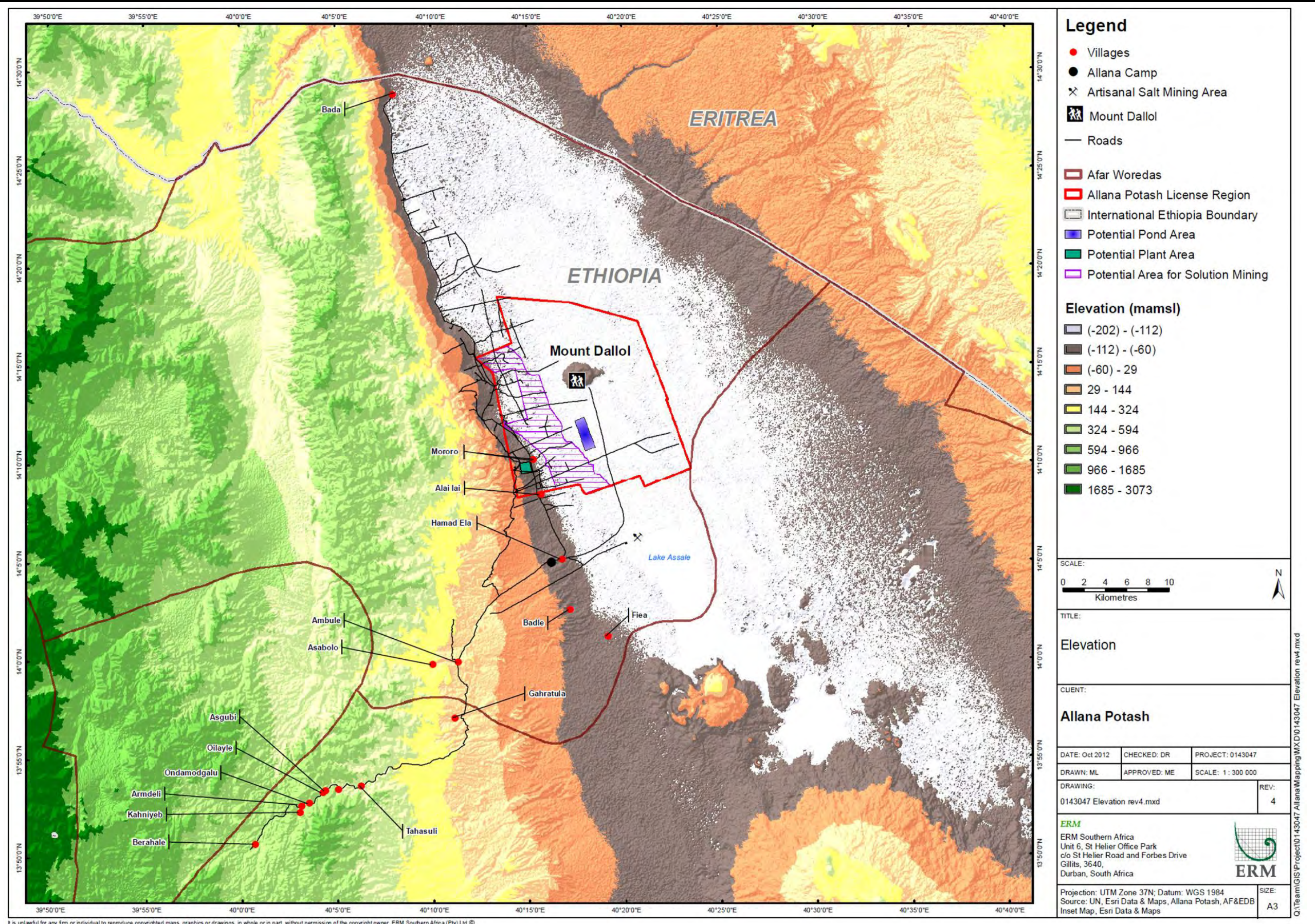


Figure 8.9 *The Floor of the Danakil Depression*



Source: Marais ERM (2011)

The geomorphology of the region is characterized by the rugged and dissected rift scarps in the west, flat lying plains in the centre and the tertiary Danakil volcanic ridges in the east. Major physiographic features existing on the top of the salt plains are; the 60m high Mount Dallol (*Figure 8.8 and Figure 8.10*), which is interpreted to be formed by an uplift due to the existence of magmatic intrusion beneath, and the 20m high reddish grey mountain (locally called Ashe Ale) which is made up of salt and mud mixtures (*Figure 8.10*) (Gebresilassie, *et. al*, 2011).

Figure 8.10 *Ashe Ale and Mount Dallol*



Ashe Ale

Salt Pillars at Mount Dallol

National Geology

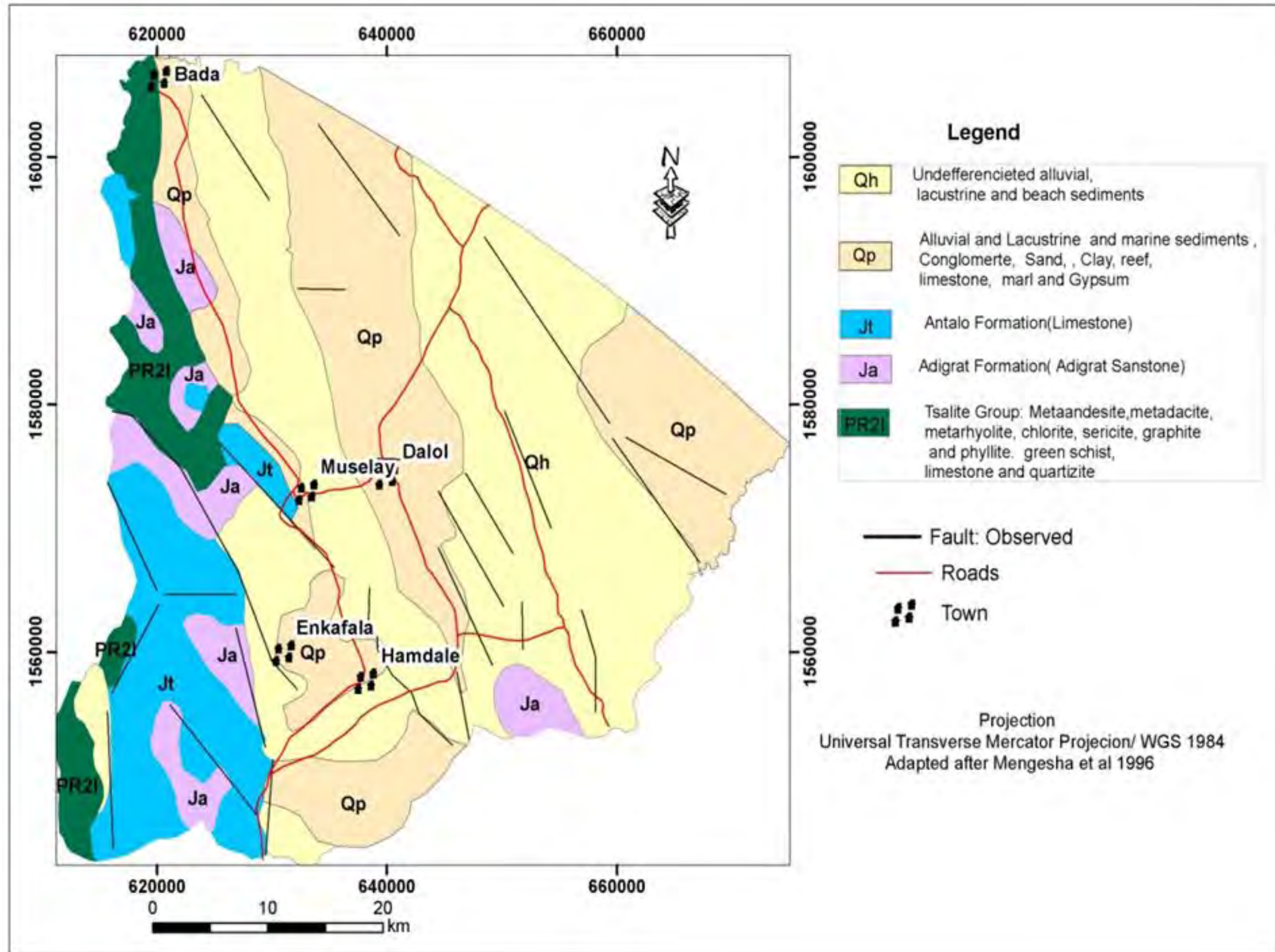
The oldest rocks in Ethiopia are of Precambrian age. These rocks form the Basement Complex and are widespread in northern, southern and western Ethiopia. Rocks in northern Ethiopia are mostly upper Proterozoic in age. During the upper Precambrian, rifting occurred in the eastern part of Africa resulting in marine incursion and sea floor spreading (Kazmin, 1972 and 1975, Senbeto, et al. 1981, Mengesha et al. 1996, and Goodwin, 1996). Sub-marine volcanics and sediments of the area were metamorphosed in the Neoproterozoic Pan-African Mozambique orogeny as a result of continental collision. Most of the east-west lying earlier structures in the region were transposed in meridional trend during this orogeny, while younger sediments and volcanic were deformed to develop foliation trends parallel to the meridional trend and metamorphosed at low grades. These low metamorphic grade rocks of northern Ethiopia are known as the Arabo-Nubian Shield (ANS) and are continuous into Egypt and parts of Arabia (Goodwin, 1996).

Low metamorphic grade volcano-sedimentary rocks such as marbles, schists, phyllites and slates of Neoproterozoic age characterize Northern Ethiopia. These were intruded by syn- to post-tectonic plutons during the Upper Precambrian. The composition of these plutons varies from mafic to acidic. Granitic and granodioritic intrusions are common in the region.

Regional Geology

The generalised geology of the Danakil Depression is presented in *Figure 8.11*. Large regional faults are evident within the rift floor and in the escarpment. Most of these structures are aligned parallel and sub-parallel to the axis of the rift. Transverse east-west running faults are also present. The Precambrian meta-sediments forming the western escarpment and mountains in part have clearly visible structures such as folds and faults. In the flat plains the faults are not clearly defined. In general, the region is characterized by a complex structure and stratigraphy, with rocks having a wide range of ages as described below.

Figure 8.11 Generalised Geology of the Danakil Depression



In the area under investigation, the metamorphic rocks are dominantly chlorite phyllite with minor marbles. These low grade metamorphic rocks are assumed to belong to Tsaliyet Group metavolcanics. They show meridional foliation and variable dips, have been intruded by diorites locally, and variably covered by basalts.

During many periods of the Paleozoic, Africa was above sea level and subject to erosion. The upper Paleozoic was characterised by sedimentation of glacial sediments such as tillite which comprise the Edaga Arbi Glacials (Dow *et al.* 1971). Non-metamorphosed continental sedimentary rocks such as sandstone, shales, siltstones and conglomerates were formed in northern Ethiopia and constitute the Enticho Sandstone (Dow *et al.* 1971).

Fragmentation of the southern continent caused downwarping of the Horn of Africa and contributed to the deposition of shallow marine sandstone and shelf to deep sea sediments including limestone of Jurassic age. Many parts of Ethiopia were inundated by the sea during the Mesozoic, resulting in the deposition of Adigrat, Urandab, Antalo, Agula and Amba Aradom Formations, which are common in the highlands of Tigray (Mengesha *et al.*, 1996). Sea levels receded in the Cretaceous and early Tertiary resulting in the deposition of sandstone of the Amba Aradom Formation.

East-west extension of the Arabo-Nubian and Arabo-Somalian plates during uplift produced tension fractures. The meridional fractures/ faults formed with deep roots became conduits through which flood basalts erupted during the opening of the Red Sea and Gulf of Aden (Zanetten, 1974). These formed the Ashanghi, Aiba, Alajae and Termaber basalts on many parts of Ethiopia Kazmin (1972 and 1975), Merla (1979), and Mengesha (1996). Later in the upper Miocene, the East Africa Rift formed the Main Ethiopian Rift (MER) and Afar rift. The Danakil Group sediments were deposited within the Afar Rift. Rift-in-rift structures caused some grabens such as Asale-Afdera grabens in the Pliocene. Deposition during the Quaternary included fans, evaporites and clay beds, while the Holocene was characterized by the presence of solfatras and the eruption of basalts in and volcanic craters in the center of the Asale rift.

According to Garland (1980), thick deposits of evaporate are a result of syn-depositional basin subsidence. There are recent north-north-west faults cutting Holocene basalts in the center of Asale Rift. These are associated with active volcanism and the formation of craters and salt diapirs on Dallol Mountain.

According to the geological map of Ethiopia the regional stratigraphy is as follows.

- **Basement Complex Rocks** - These are the oldest rocks in the region and consist essentially of sericite and chlorite schists with some slates and marbles. These rocks were intruded by granite, diorite, and by sills and irregular masses of basalt and andesite. Volcanic rocks such as lavas altered tuffs, cinders and agglomerates are also present.

- ***Post-Precambrian to Pre-Triassic Rocks*** - This period is represented by a sequence of massive limestones which are locally closely folded and sheared. These rocks are referred to as the Bunni Limestone and are unconformably overlain by Triassic sandstones. The outcrops are small and located mainly in the southern part of the Balakia Range.
- ***Triassic Sandstone*** - This formation consists of three major units: arkosic sandstone, cross-bedded sandstone and lenticular ferruginous sandstone. Numerous dykes and irregular intrusions of andesite, basalts and gabbro cross-cut this formation.
- ***Triassic-Cretaceous*** - These thin-bedded limestone, marls and calcareous shales are common the western escarpment adjacent to the alluvial fans that extend up to the Danakil Depression.
- ***Tertiary Conglomerates*** - This unit consists of mainly of poorly sorted pebbles and boulders, fine to coarse-grained sandstones, shales, and thin clay beds. Tuffs and lava flows of andesite and basalt containing pillow structures occur within the sequence.
- ***Quaternary Formations*** - These include both sedimentary and volcanic rocks. The sedimentary rocks are of three types:
 - The salt, gypsum and clay deposits filling the evaporite basin;
 - The coralliferous limestone formations; and
 - The true alluvial deposits of unconsolidated gravels, sands, and silts which form terraces and alluvial fans.

The volcanic rocks occur with well pronounced volcanic structure and form. Well preserved cones with craters and associated flows are also common features in the rift floor.

These rocks are faulted by both north-south and east-west trending faults.

Local Geology

The Danakil Depression is a down-faulted block within the Northern Ethiopian Rift Valley bounded by the Balakai Mountain Range in the west and the uplifted block of the Danakil Alps in the east. Rock formations ranging in age from the Precambrian to Quaternary are exposed in these areas. The salt plain (which occupies a large part of the Danakil Depression) is surrounded by a belt of marine sediments, mainly salt and gypsum, which were formed during invasion by the Red Sea. Gravel terraces and large alluvial fans occur at higher levels and recent lava flows and unconsolidated alluvium occur over some part of the salt plain.

The stratigraphy of the Danakil Depression and adjacent highlands includes the following units (from oldest to youngest):

- ***Precambrian Basement Rocks (Pc)*** - The Precambrian basement rocks occupy the eastern and western escarpments down-faulted during the formation of the Afar rift. Much of these faulted rocks are hidden below basalts of the rift and younger sediments. The Western Belakiya horst consists of low grade Upper Proterozoic rocks. The eastern Danakil horst is dominated by Mesozoic Antalo limestone and with lesser quantities of low grade Upper Proterozoic rocks (*Figure 8.12*).

The basement rocks comprise a thick succession of phyllites developed from volcanic tuffs. They are mainly chlorite phyllites of the Tsaliet Group. These low grade rocks are exposed in many areas up to Berahale town and extend to the west of it. The Tsaliet Group dominantly contains metavolcanic rocks, derived from basalts, dacites and rhyolites with associated metasediments of shallow water origin. Minor sheared marbles are present along the foot slope of the escarpment north of the Sabah River.

- ***Dolerite Dykes (Td)*** - Minor doleritic dykes intrude the low metamorphic grade Neoproterozoic basement phyllites. These dykes are thin and have a northerly trend (*Figure 8.12; Garland, 1980*).
- ***Danakil Group (Dgm)*** - These sedimentary units were previously known as the Red Series (Kursten *et al.* 1968, Bannert *et al.* 1970 in UNDP, 1973), Red Beds (Garland, 1980) and Garst Formations (Red beds) (Tesfaye, *et al.* 1082); however, these have been renamed, the Danakil Group (Mengesha *et al.*, 1996). They consist of conglomerates, and sandstones intercalated with basalt flows that are several meters thick.

In the area of interest, (within the plain at the foot slope of the Belakiya Mountain range) sandstone is exposed. This is often intercalated with basalt flows and is underlain by conglomerates. These bedded soft sediments are unconformably overlain (angular unconformity) by alluvial fan deposits measuring 10 to 15 meters thick.

Sandstone was deposited in lithoral lacustrine and/or lagoonal environments; however, the thick conglomerate was deposited as fan deposit by fluvial migrating rivers near the coast. The K/Ar ages of the interbedded basalt from the bottom and top are 24 to 5.4 million years respectively, indicating early Miocene to Pliocene age (Mengesha *et al.*, 1996).

- ***Anhydrite Bed (AB)*** - This thin (± 35 m thick), distinct white evaporitic sequence was previously known as Enkafala Formation or White Series and consists predominantly of anhydrite beds which are exposed to the west of the salt plain. They are situated below the sandstone and form discontinuous layers due to the erosive character of the rivers forming the alluvial fan. The anhydrite is light grey to white and fine to medium

grained. At places the anhydrite fibers grow to more than 3 centimeters radially.

- ***Halite Formation (Hf)*** - Evaporitic formation of bedded halite, gypsum and potash salts was previously named Salt Formation, (Garland 1980) and Dallol Formation (Tesfaye *et al.* 1982). This unit covers the lowest part of the Danakil Depression, which is mostly below sea level (-120 to -155 meters). This salt deposit is the result of high temperatures and subsequent evaporation of the Red Sea.

The halite is white and mostly horizontally stratified. Due to impurities the color often changes to brownish-white. Furthermore, prolonged exposure to sun light often produce desiccation polygons. Towards the south the halite formation is bounded by Lake Assale and to the west by alluvial fans. To the east and north the formation is bounded by clay layers (mud flats). Salt diapirs often form hillocks within the salt plain.

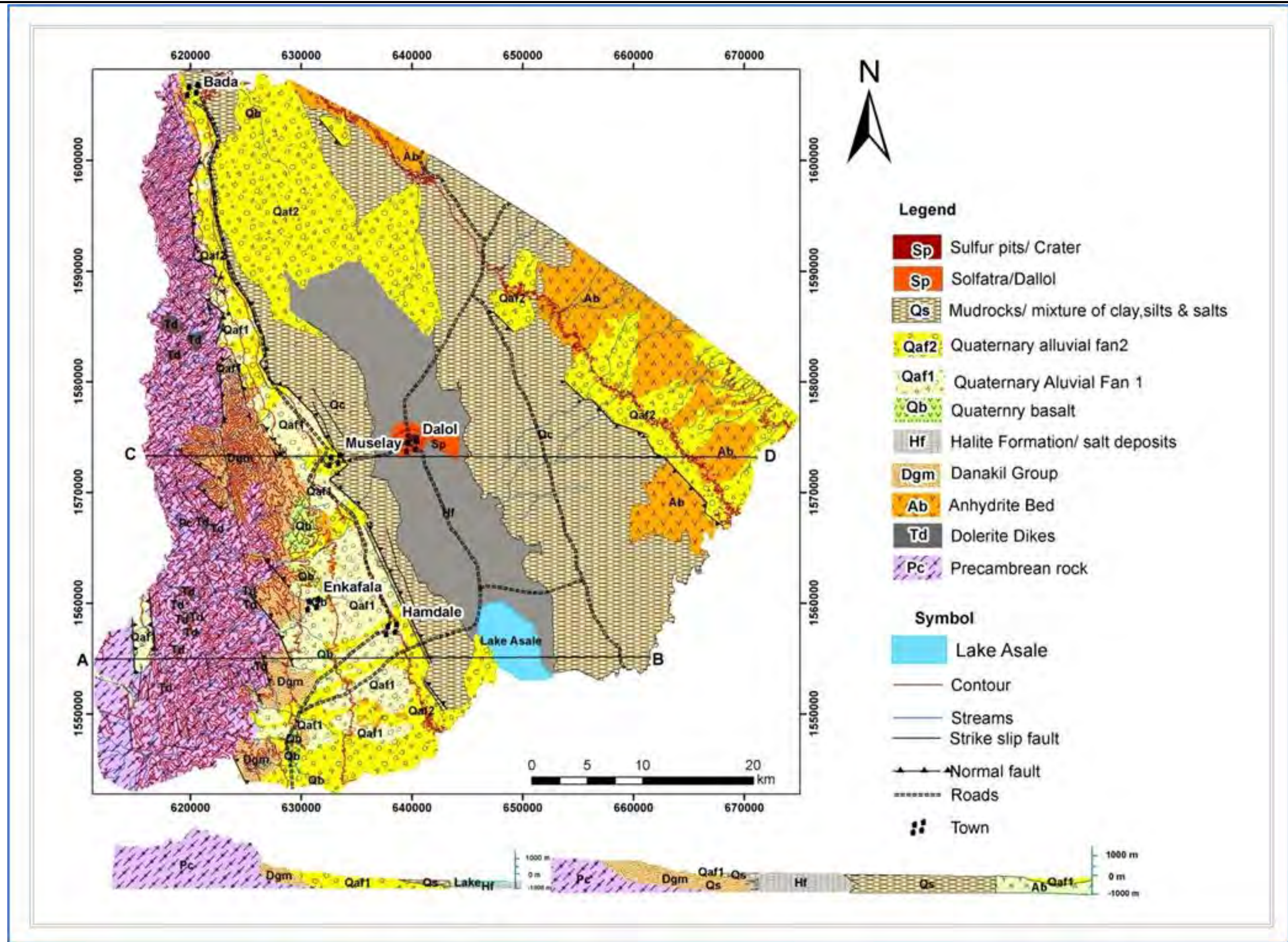
Results from Allana's potash exploration drilling has shown in the centre of the basin that the top upper halite is up to 700m thick, followed by up to 100m of bischofite (transparent), kisserite and kainite and other halite to another depth. According to previous exploration activities in the Study Area, the salt deposit exceeds 1,000 meters in thickness.

- ***Quaternary Alluvial Fan1 (Af1)*** - The alluvial fans are heterogeneous deposits of unsorted materials. These are deposited at the foot of hillslopes of Belakiya and Danakil horsts. The deposits are aligned perpendicular to the longest axis of the salt plain and are formed by shifting fluvial deposits becoming distributary nearer the salt plain.

The alluvial fan (Af1) unit represents the younger deposit cutting the older fans in recent times (Holocene). The alluvial fan deposit contains stratified boulders, cobbles, pebbles, and rarely sand and silt. The rock fragments are transported from the Danakil and Belakiya Mountain ranges by fluvial activity. The fragments (sandstone, basalts, and phyllites) from loose unconsolidated deposits, and originate from the escarpment through runoff. The grain size of the sediments decreases towards the salt plain.

- ***Quaternary Alluvial Fan2 (Qaf2)*** - These are relatively younger deposits that originated through Holocene fluvial activity. The fan is narrow at the beginning or the upper course, but becomes wider and distributary nearer the salt plain. It consists of loose boulder conglomerate, cobble conglomerate and pebble conglomerate with gravels, but becomes finer closer to the salt plains. The finer materials were deposited from suspension near the salt flats to form clay flats. It is on these clay flats where vegetation is at its densest in the Study Area.

Figure 8.12 Simplified Geological Map of the Study Area and East-west Cross Sections



- **Mudflat Sediment (Qs)** - This unit is exposed adjacent to the Halite Formation. It consists of detrital sediment derived from the highlands and mostly contains clay-sized materials. Clays are transported further east in suspension, while boulders and gravels remain further westwards. The playa to the west or east of the salt deposit is covered by fine grained unconsolidated sediments, which are formed from different river flows from the escarpment and carried distally in the flood plains and bound the salt flats.
- **Quaternary Basalt (Qb)** - Basalt is exposed towards the southern and southwestern part of the Study Area in the vicinity of the Sabah River. Basalt is a dark grey, fine grained, massive, compact and often vesicular volcanic rock. Basalt formations form small continuous mountains which represent fissural eruptions from deep seated faults.

The basalts are at places cut by northwesterly younger faults. Due to shearing, brecciation and silicification, chert like fault rocks (mylonite) occur along fault lines. To the north around Bada, central type basalt eruption has been encountered and scoriaceous basalts are exposed. This AA-type basalt resembles younger lava flows around Metahara.

- **Solfatra (Sp)** - Certain places within the salt plain such as Dallol Mountain contain fumaroles which emit sulfur to the surface. These volcanic fumaroles are located forwards to the centre of the Danakil Depression and constantly emit acidic hot liquids due to the heat of the underlying magma. They form minor pits with sulfur fountains at the center of the salt plain. Some authors report with the native sulfur, impurities such as SO₂, CO, CO₂ and NH₃ compounds also coexist.

Geologic Structures

The area is part of the East African Rift, affecting Kenya, Ethiopia and Eritrea. The Afar rift is a triangular depression affecting northeastern Ethiopia, and is known as the Afar Depression. This rift has been dated to the early Miocene (25 ma; Barberi *et al.* 1975). The structural evolution of Afar is not continuous, but is marked by several separated episodes of tectonic and igneous activity. These tectonics are extensional in nature and are part of the plate-tectonics affecting the Arabo-Ethiopian, Arabo-Somalian plates.

The faults in the Asale Rift are a continuation of those faults around Lake Abe and exhibit a NNW-SSE trend. The rifts in Asale area are a direct continuation of the Tendaho-Dobi graben and trend northwest-southeast. This structure truncates the axial graben rift which extends from the Main Ethiopian Rift, implying that the Asale - Afdera rift is younger than the axial graben of the Main Ethiopian Rift (MER).

The Mesozoic limestone dips moderately to the SW, and continues on many down-faulted blocks of limestone east of Berahale. The low grade Neoproterozoic phyllites also show similar dip but trend NE, an orientation

inherited from older structures. The main boundary fault of the rift obliquely cut both Mesozoic and Precambrian trends and is covered by Neogene and Quaternary sediments.

Marine invasion occurred at about 100,000 to 200,000 years ago. During this period, marine sediments were deposited around the margins and within the depression during evaporation periods (Faure *et al.* 1969, in UNDP 1973).

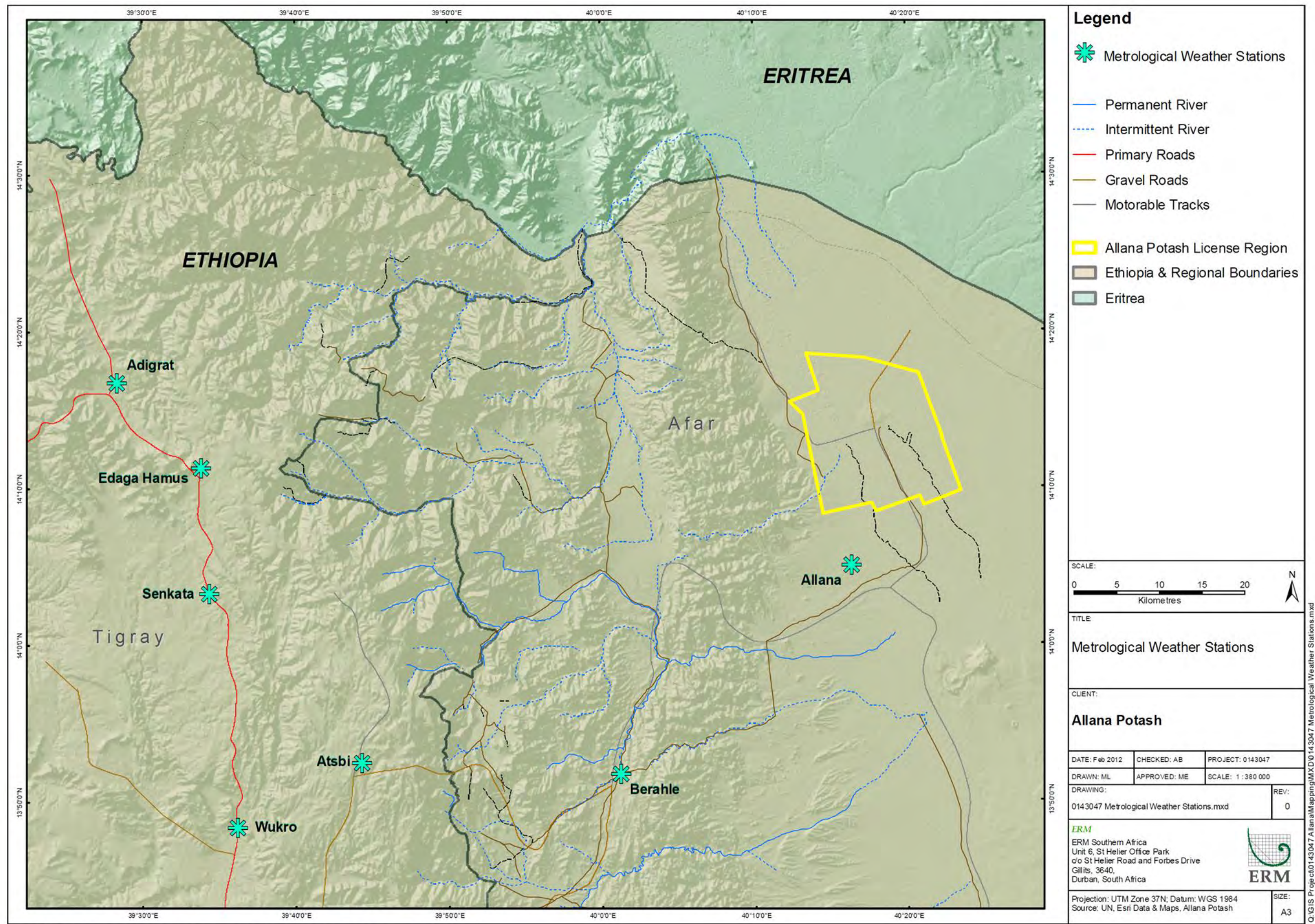
8.2.5 *Hydrology*

Background

The Danakil Depression is a closed drainage basin and a tectonically active region due to extensional earth crust movement at the northeast of Ethiopia. The margins of the basin are the Danakil Highlands to the east with elevations up to 1,000 m.a.s.l. and the Ethiopian Highlands with elevations >2,500 masl. The northern Danakil reaches from Lake Badda in the North (Eritrea) down to Lake Assale / Lake Bakili to the south. The Lakes mark the deepest parts of the Danakil with elevations of about -120 m.b.s.l. The Kebrit Ale - Erta Ale - volcano range limits the northern Danakil to the south. The highest mountain is formed by the volcano Ummuna (986 m.a.s.l.).

The Study Area is situated where annual rainfall regime is dominated by warm-season rainfall. There are five meteorological stations in and around the Study Area (*Figure 8.13*), of which Atsibe and Allana stations are first class stations equipped with a range of meteorological instruments. The data from these stations was used to show the mean monthly climatological characteristics of the Study Area (*Figure 8.14*). The records at Senkata (*Figure 8.14 (a)*) and Edaga Hamus stations (*Figure 8.14 (c)*) indicate that the rainfall pattern of the Study Area is bi-modal type (the Belg and Kiremt rainfalls). However, about 80% of the rainfall occurs in July and August at all locations and the remaining 20% of the rainfall occurs in the dry season (March to May). The area receives a mean annual rainfall of 592mm at Atsibe, 547mm at Sankata, and 662mm at Edagahamus. Berhale indicates an annual rainfall of 135 mm in the year 2008 when a continuous data record was available (*Figure 8.14(e)*). Rainfall records for the Allana exploration camp (June 2011 to November 2012) are presented in *Figure 8.14 (d)* below. Rainfall at the Project site is extremely variable; for example, over 45mm of rainfall was recorded in August 2011, yet less than 5mm has been recorded to date (as of end November) for 2012.

Figure 8.13 Location of Rainfall Stations within the Broader Region of the Study Area

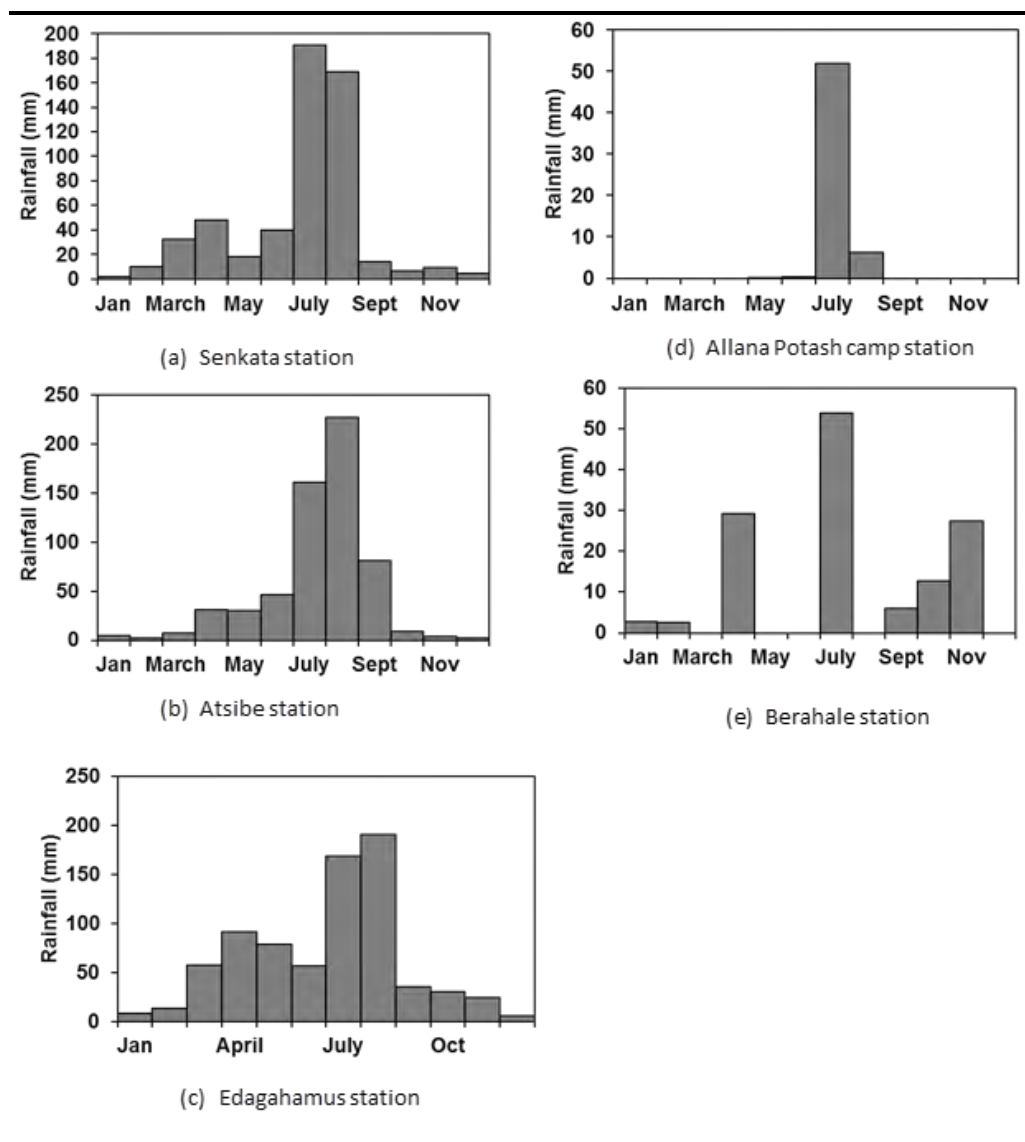


The rainfall in the highlands is considerably higher than in the salt plain and temperatures (and therefore evaporation) considerably lower. Therefore, the main water source for the surface water bodies in the Study Area is due to rainfall in the highlands located to the west of the Project Area.

River Systems, Catchments and Wadis

As a result of the intermittent rainfall in the highlands to the west of the Project Site, the majority of the rivers in the Study Area are ephemeral. The potential drainage lines for rivers are presented in *Figure 8.15*. The drainage line of the Bosi River enters the Project Area to the west (*Figure 8.15*). In the northern Danakil Depression only a few perennial rivers occur. These are the Regali River along the Eritrean-Ethiopian borderline, the Sabah River to the west of Lake Assale, and Wadi Ainallah (25 km south of the Sabah River). According to calculations based on the ASTER (from NASA's TERRA satellite) digital elevation model (DEM), the catchment area of the Regali perennial river system measures 4,000 km², the southern Sabah River system has a catchment area of 1,100 km². The surface areas of the smaller catchments in the Study area range between 70 to 80 km². Currently there is no flow data for the ephemeral rivers in the Study Area.

Figure 8.14 Mean Monthly Rainfall at Stations Close to the Project Area



Flow in the Sabah River is presented in Figure 8.16. Flash floods are common in the region of the Study Area. This is evident in Figure 8.17, where the road crossing the Sabah River between the Dallol and Berahale Village was washed away on 24th of November 2011.

Figure 8.15 Regional Surface Water Drainage Lines and Catchment Areas (Also Showing Water Quality Monitoring Locations)

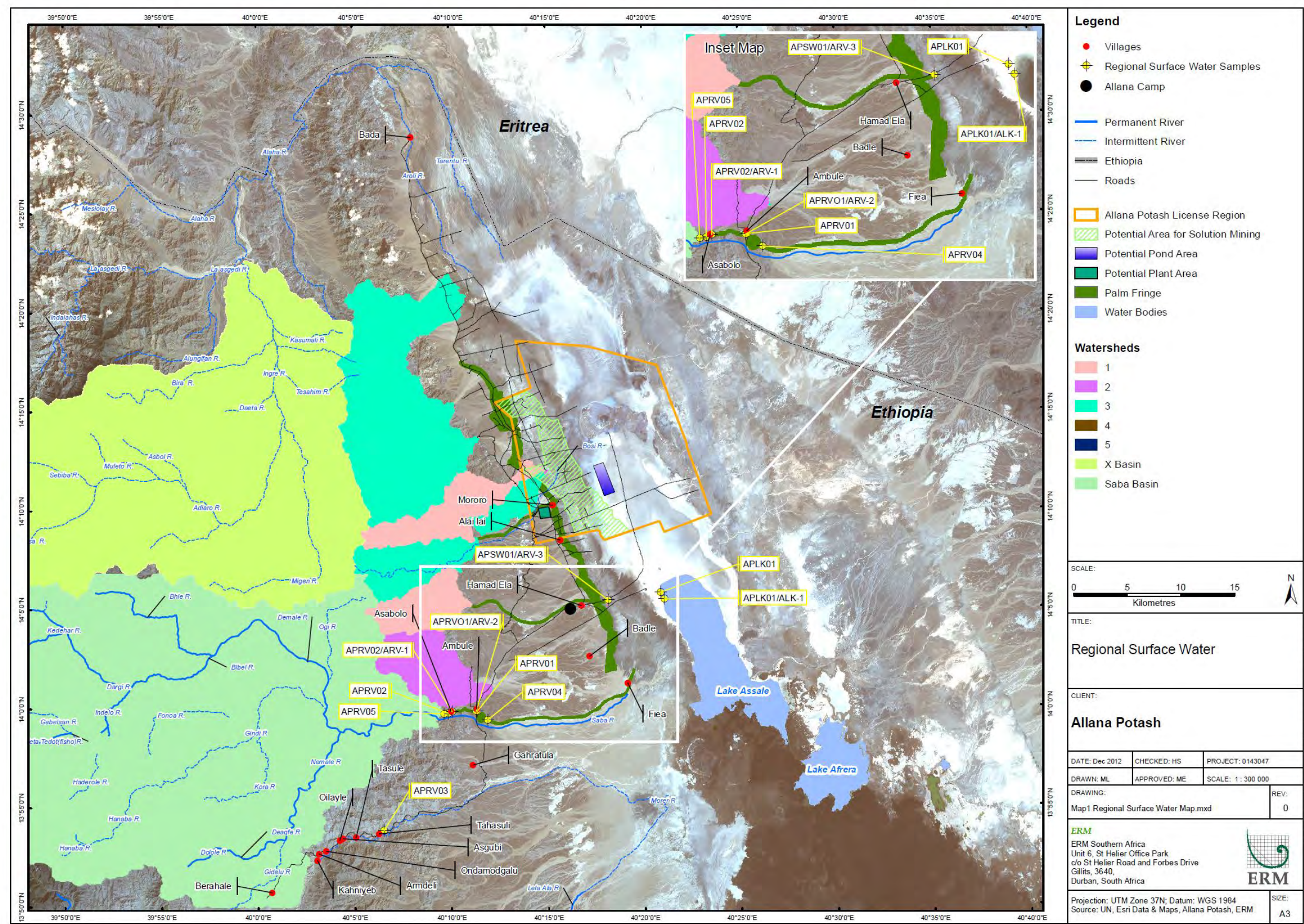


Figure 8.16 Sabah River Flow



Figure 8.17 Flash Flood Event in the Sabah River between Dallol and Berhale y



Prediction of Flows

Other than a single flow measurement taken on 24th of July 2012 at the Sabah River (estimated at 158 liters/s), no data exists for flows in the surface water bodies around the site. Therefore some initial modelling was undertaken by Beles Engineering to provide an indication of mean annual flow.

The surface water flows generated from the highland watersheds were calculated by dividing the watersheds into the Sabah River watershed in the south western part of the depression, the watersheds of the alluvial fans, a number of small watersheds (which are draining to the apex of the alluvial fans as one unit), and the Gabala River watershed in the North Eastern part of the depression near Bada village.

The Conservation Service Curve Number (SCS CN) method was used to estimate the runoff from the catchments above. The SCS CN method was developed by the US department of agriculture and is a widely accepted method of determining runoff for catchments. The inputs to the model are listed below; due to the lack of real data these inputs were modelled or determined from broad scale mapping:

- Rainfall;
- Soil Properties;
- Land cover; and
- Evaporation.

In addition to the above, transmission losses were estimated and included in the calculations. The input parameters and results are described below.

Rainfall

There are a limited number of meteorological stations near and within the Study Area. Importantly, there is no representative station in the north, north-east and eastern part of the Study Area ⁽¹⁾. Therefore it was not possible to use measured rainfall data; rather modelled rainfall data was used.

The mean annual rainfall grid data was generated using data of the Tropical Rainfall Measuring Mission (TRMM) from King's College, London. The mean annual rainfall extracted from the TRMM grid was downscaled to mean monthly rainfall using the mean monthly rainfall distribution predicted using the measured daily rainfall records of the ground based stations depicted in *Figure 8.13*. This provided twelve months of rainfall data for the desired watersheds.

(1) Although one years' rainfall data for the Allana Project site was used as reference, this length of record is not sufficient to estimate Mean Annual Precipitation (MAP).

Soil Type and Land Cover

The soil type in the area was estimated using the FAO-UNESCO soil map. The dominant soil types in the watersheds were predicted to be Eutric Cambisols, Lithic Leptosols, Calcisols and Vertisols.

The land cover in various parts of the catchments was estimated from the Globcover derived national land cover databases for Africa (GLCN, 2010) and field observations. The results are as follows:

- 13% of the watershed is used for cultivation during rainy season;
- 65% of the watershed is dispersed shrub or bare land; and
- 22% has dense shrub land and forest at the higher altitudes.

Evaporation

The evaporation in the watershed was estimated using the Hargraves Method based on temperature measurements and short wave radiation values. Evaporation was estimated to be between 152 and 303 mm/month.

Transmission Losses

Transmission losses (infiltration to the ground) were estimated by a widely used method developed by Lane (1983), which is based on soil characteristics. During the field visit it was identified that the Sabah River has a gravel and sand mixture with very low silt clay content. This is classified as a high rant loss with an estimated hydraulic conductivity of 55.8 mm/h.

The SCS CN Method

The SCS-CN model was run with the above inputs, also accounting for the transmission losses. The model predicted that the Sabah River, Gabala River and the small watershed at the apex of the alluvial fans have a mean annual runoff volumes of 290 Mm³, 385 Mm³, and 30 Mm³ respectively. These flows will run off into the Danakil Basin.

Prediction Confidence

The prediction confidence of the modelling exercise is considered low. This is due to the fact that the predictions are based on modelled rainfall data, broad scale soil data, calculated evaporation and calculated transmission losses with minimal field verification. **As such, the outcomes of this model should be considered as indicative only.**

Surface Water Quality

Surface Water Quality Guidelines

The water quality guidelines used in this ESHIA were the South African National Standards (SANS, 2001) and the World Health Organisation Drinking

Water Guidelines (WHO, 2011) (Table 8.2). The majority of parameters measured in the studies were major ions (sodium, calcium, magnesium, potassium, chloride and Sulphate). There are no WHO guidelines for these parameters at “normal” ground and surface water concentrations. As such, the negative impact of these parameters is typically related to aesthetic values of water rather than health issues. Likewise, the SANS guidelines for these parameters are based on aesthetic values. So although not directly related to health, the guidelines provide a basis for comparison. In addition, as the concentration of major ions in some samples is highly elevated, the approximate sea water concentrations are presented for reference.

Table 8.2 Water Quality Guidelines used in the Assessment

Water Standards		SANS Drinking Water, 2001		WHO, 2011	Approximate Concentration of Sea Water
		Class I	Class II		
		Acceptable	Max Allowable	Health-based Guideline Value	
Physical and Organoleptic Requirements					
Colour	mg/ℓ Pt	20	50	<15 TCU	-
pH at 25C	pH Units	5.0 - 9.5	4.0 - 10.0	6.5 - 8.5	-
Turbidity	NTU	1	10	<1	-
Chemical Requirements - Macro Determinants					
Nitrate and Nitrite as N	mg/ℓ	10	20	3	-
Ammonia an N	mg/ℓ	1	2	1	-
Fluoride as F-	mg/ℓ	1	1.5	1.5	-
Calcium as Ca	mg/ℓ	150	300	-	400
Magnesium as Mg	mg/ℓ	70	100	-	-
Potassium as K	mg/ℓ	50	100	-	400
Sodium as Na	mg/ℓ	200	400	-	10,000
Sulphate as SO ₄ ²⁻	mg/ℓ	400	600	-	910
Chloride	mg/ℓ	200	600	-	19,000
Chemical Requirements - Micro Determinants					
Antimony as Sb	µg/ℓ	10	50	20	-
Arsenic as As	µg/ℓ	50	200	10	-
Boron as B	µg/ℓ			2,400	-
Cadmium as Cd	µg/ℓ	5	10	3	-
Chromium as Cr(VI)	µg/ℓ	100	500	50	-
Copper as CU	µg/ℓ	1,000	2,000	2,000	-
Lead as Pb	µg/ℓ	50	100	10	-
Mercury as Hg	µg/ℓ	2	5	6	-
Nickel as Ni	µg/ℓ	150	350	70	-
Selenium as Se	µg/ℓ	20	50	40	-
Uranium as U	µg/ℓ			30	-

Regional Water Quality

The measured surface water quality in the region is presented in *Table 8.3* and the locations are presented in *Figure 8.15*.

All samples exceed the SANS Class I guideline for one or more parameters. The exceedances are predominantly for the major ions (sodium, calcium, magnesium, sulphate and chloride) and therefore relate to the aesthetic properties of the water.

Major ion concentrations in the samples were within the Class II SANS guidelines with the following one exception Sample APRV03 exceeded the Class II guideline for sulphate. All samples reported sodium and chloride concentrations orders of magnitude below that of sea water.

Three of the samples (APRV02, APRV03 and APRV04) exceed the WHO nitrate guideline which is toxicity related guideline; of these one exceeds the less stringent SANS guideline. Based on this, the water is not suitable for long term consumption.

The concentrations of fluoride, aluminium, manganese, iron and copper are all within the SANS Class I and the WHO guidelines.

Table 8.3 Regional Surface Water Quality

Site ID	APRV02	APRV02/ARV-1	APRV03	APRV04	APRV05	APRVO1/ARV-2
Site Type	River	River	River	River	River	River
Site Description	Sabah River at Asabolo river		Sabah River east of Berahale town	Sabah River before joining Lake Assale	Upper stream of Sabah river	Sabah at the crossing
Season	Dry	wet	Dry	dry	Dry	wet
pH (pH units)	8.2	7.94	7.9	8.2	8.4	6.87
EC (mS/m)	229	250	260	223	240	240
TSS (mg/l)	2	2.69	7	2	4	2.6
Calcium (mg/l)	142	118	135	357	133	122
Magnesium (mg/l)	36.3	35.5	30.3	75.2	28.8	40.1
Sodium (mg/l)	248	269	236	108	227	300
Potassium (mg/l)	12.8	6.98	6.69	9.25	9.36	8.34
Chloride (mg/l)	488.	533	113.2	465.15	501.54	554
Sulphate	337.02	412	1330	325.81	335.18	427
Nitrate (mg/l)	3.05	1.88	11.8	3.375	2.46	1.92
Fluoride (mg/l)	0.37	0.35	0.82	0.3	0.36	0.37
Aluminium (mg/l)	0.02		0.02	0.02	0.0335	
Iron (mg/l)	0.015		0.015	0.286	1.16	0.0169
Manganese (mg/l)	0.0486		0.002	0.0131	0.0572	0.00635
Copper (SABS) (mg/l)	0.002	0.00802	0.002	0.002	0.002	0.00882
Lead (mg/l)	0.0005		0.0005	0.0005	0.0005	
Zinc (mg/l)	0.005		0.005	0.0053	0.0089277	0.00545

Note: Red indicates an exceedance of the SANS Class II standard, Green indicates an exceedance of the SANS Class I standard and Blue indicates an exceedance of the WHO health related guideline.

Surface Water Quality at the Project Site

Currently the only surface water samples within the Study Area are from a pond in the south-west of the Study Area (*Figure 8.18*). The water quality in the pond was within all SANS and WHO guidelines with one exception. The concentration of major ions was below that measured in the regional surface water samples.

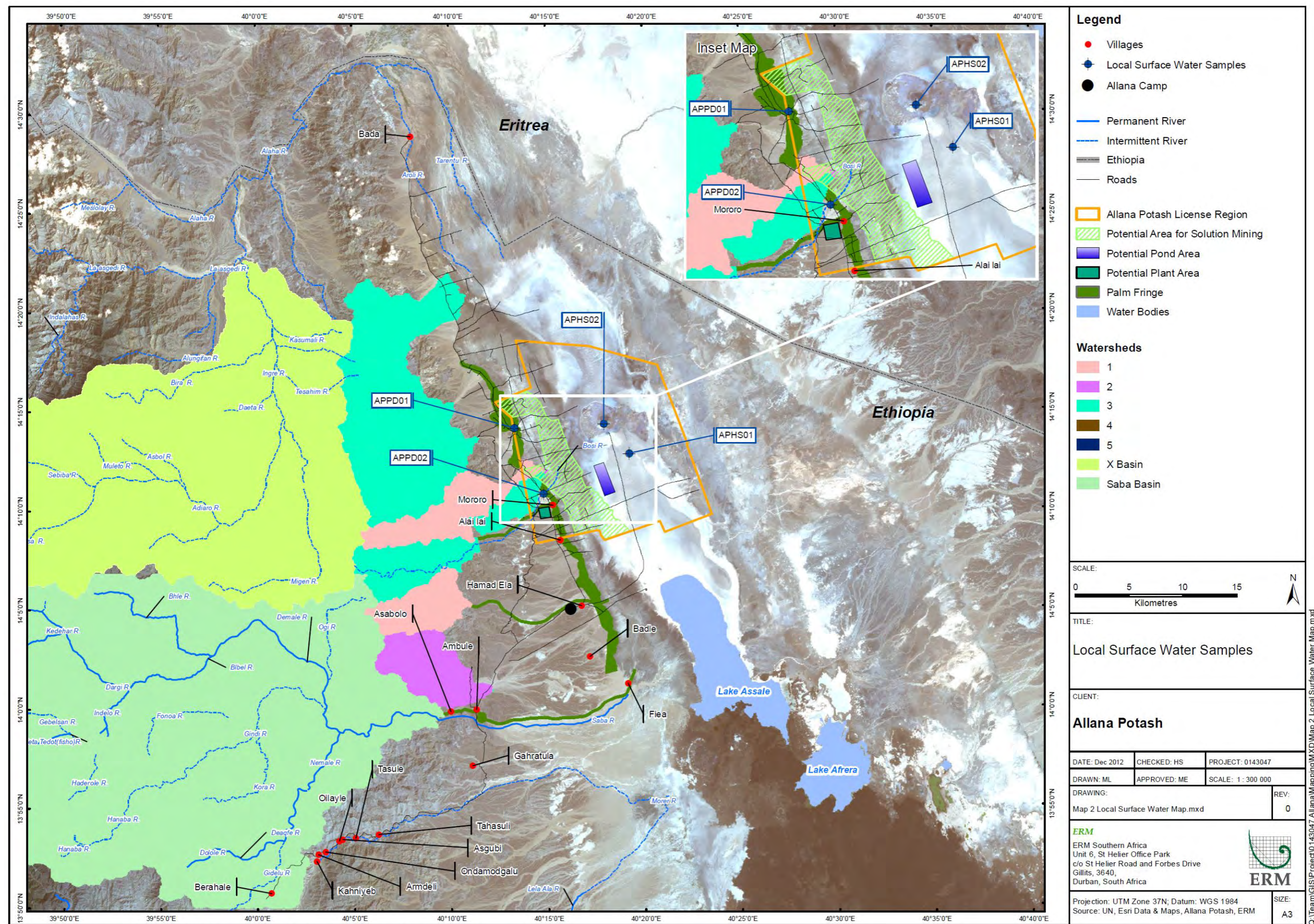
The nitrate concentration of the sample exceeded the WHO guideline and based on that would not be suitable for long term consumption.

Table 8.4 *Surface Water Quality in the Project Area*

Site ID	APPD01	APPD02
Site Type	Pond	Pond
Site Description	Pond close to Sainik trench	Pond north of Amadale
Season	Dry	Dry
pH	8.1	8
EC (mS/m)	54.5	54.2
TSS (mg/l)	3	6
Calcium (mg/l)	61.1	67.3
Magnesium (mg/l)	3.47	3.27
Sodium (mg/l)	33.3	12.6
Potassium (mg/l)	5.13	3.58
Chloride (mg/l)	50.52	21.5
Sulphate (mg/l)	121.06	177.25
Nitrate (mg/l)	1.86	4.72
Fluoride (mg/l)	0.0766	0.33
Aluminium (mg/l)	2.18	0.02
Iron (mg/l)	0.0786	0.015
Manganese	0.0040	0.002
Copper (mg/l)	0.0005	0.0063
Lead (mg/l)	0.0005	0.0005
Zinc	-	0.0075

Note: Blue indicates an exceedance of the WHO health related guideline

Figure 8.18 Local Water Quality Monitoring Locations



The main objective of the hydrogeological investigation is to identify potential water bearing zones for the Dallol Potash Project and to prepare baseline data for the ESHIA study. The hydrogeological investigation was supported by:

- Geophysical surveying using both Transient and Slingram electromagnetics;
- Detailed hydrological assessment and remote sensing and Geographic Information Systems (GIS) techniques, which involve satellite spectral data analysis and integration and spatial analysis using GIS to map potential faults and fault systems, which may play a role in the transportation of groundwater from the western mountains towards the Danakil Depression;
- A drilling programme for both observation and test production wells;
- A pump test programme; and
- Groundwater isotope and quality analyses.

This section presents the regional and local hydrogeology of the Project Area. The descriptions made here are based primarily on data obtained by Fugro Consult GnbH (Fugro), who are responsible for the specialist hydrogeological investigation for the Allana Potash project, the main objective of which was to establish the feasibility of using groundwater in the Study area as a source of water supply for Allana's solution mining and processing plant needs.

Regional Hydrogeology

The hydrogeological regime of a given area is controlled by a number of factors, the most important ones of which are precipitation, geomorphology, geology and the amount and distribution of recharge. All of these factors exhibit a wide spatial variation in the Study Area. The region is located in the driest of the twelve major river basins of Ethiopia, commonly called the Danakil Dry Basin. Physiographically, the basin can be divided into the following three major sub-regions (zones); (refer to the regional elevation map provided in *Figure 8.8*):

- **Rugged Mountainous Highland (located within the Afar Regional State)**
-This zone is characterized by elevated and rugged mountainous areas dominated by Mesozoic sediments and Precambrian low metamorphic grade rocks. The rocks form a rugged mountain range oriented parallel to the axis of the rift. It has limited lateral extension, in contrast with the western adjacent Tigray highlands, which are covered with thick Mesozoic sedimentary rocks. Although, the rainfall and recharge potential is relatively high, due to the steep slope and limited lateral extension of rock units, the groundwater retention capacity is low in the highlands. Evidence of this exists in the absences of springs in the adjacent escarpments. In the central Ethiopian rift where the adjacent highlands are laterally extensive, springs are common in the transitional escarpments. The Danakil Alps which form the boundary between Ethiopia and Eritrea

are located to the east. These mountains are situated within the rift and are predominantly volcanic in composition. The rainfall is low in this area and hence their hydrogeological significance to the rift aquifers is very low.

Unlike in many other mountain ranges in the highlands of Ethiopia, these mountains are void of seepage zones and springs. This is one of the reasons why this vast region has no human settlement. The geology is dominated by low-grade metamorphic rocks and argillaceous sediments intercalated with limestone, dolomite and sandstone. For the most part in the hilly uplands the rocks are characterized by low permeability. The steep slopes short lateral extent and general impermeability of this sub-regions' geology and soils mean that these highland areas have a very low groundwater retention potential. Therefore, from a groundwater potential point of view, this vast region can be considered as insignificant.

- **Steep Western and Eastern Escarpments** - The escarpment is characterized dominantly by volcanic and Precambrian basement rocks with very steep slopes, from which the runoff is very high. Few seepage zones are present even during the wet season. Unlike the rift escarpment of central and southern Ethiopia, there are no large springs emanating along contact zones and faults. This is most likely due to the presence of impermeable basement complex rocks, and low short-duration rainfall. Both the highlands and the escarpment have low groundwater potential. Only very low-discharge springs and seasonal streams can be expected.

The western escarpment contains relatively thick anhydrite deposits. Alluvial fans are common and the water quality in this area is likely to have a high salinity. The geomorphology of the eastern escarpment is not well defined. Satellite images and verbal information suggest that there is no trace of surface water in the eastern escarpment. In general the marginal rift escarpment has little hydrogeological significance except in areas in the middle and toe of alluvial fans and seasonal wadis which are close to the floor of the rift.

- **The Rift Floor (Danakil Depression)/ Alluvial Fans** - The rift floor is characterized by wide salt flats in the middle, bounded to the east and west by gently sloping land associated with flat plains and mudflats.

It is also characterized by many alluvial fans which are clearly visible from satellite images. The alluvial fans are located at the base of the highlands between the highland and the salt plains. The alluvial fans and wide plains covered with thick alluvial sediments are believed to hold the best potential for groundwater. Accordingly these areas were selected for geophysical investigation and borehole siting. There is also potential for groundwater on the salt flats, but the water is extremely saline.

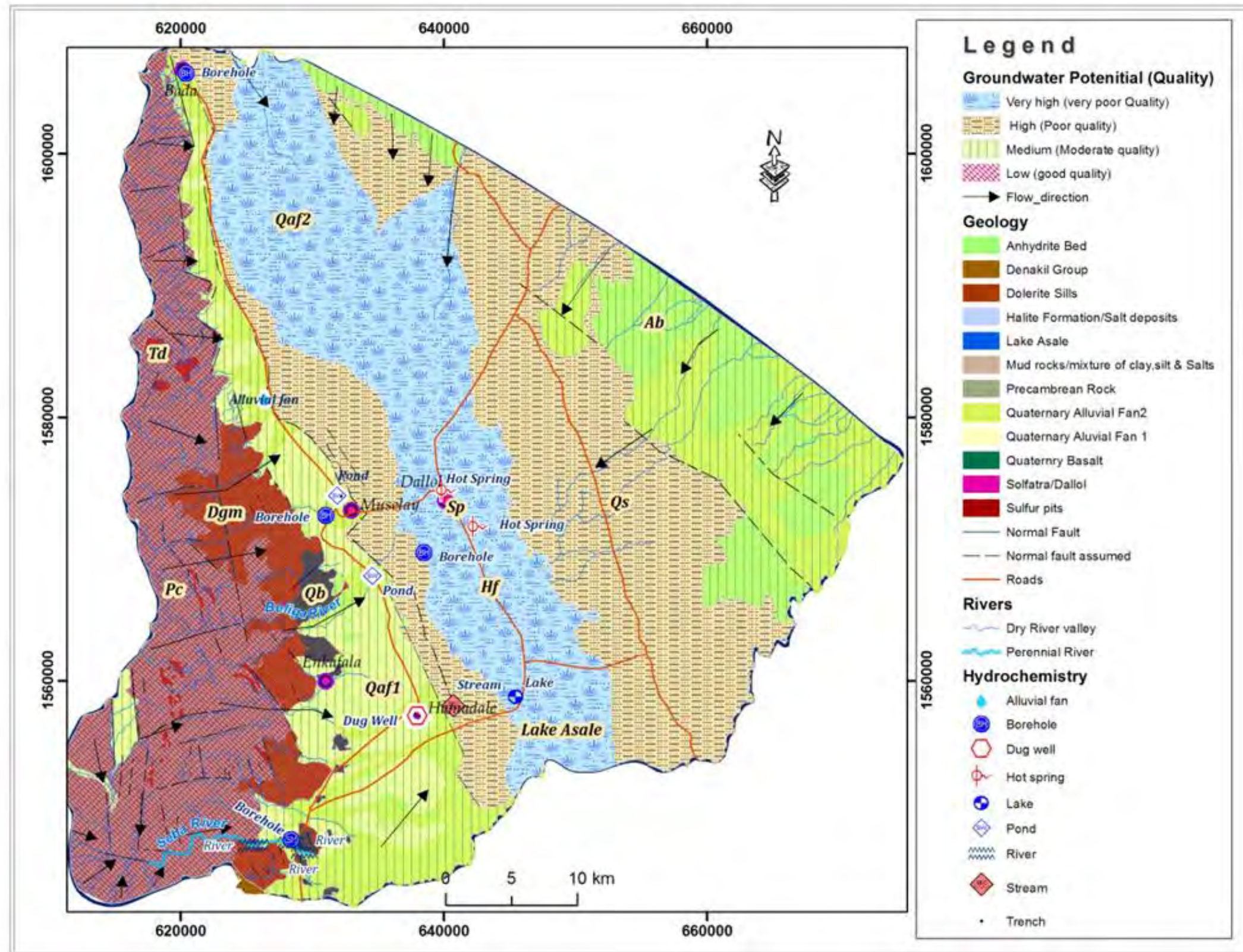
Local Hydrogeology

The local hydrogeological system in the area under investigation consists of a number of hydrostratigraphic units. Hydrostratigraphic units are rock formations and/or sediments which have similar hydrogeological characteristics. The hydrostratigraphic classification was made based on field hydrogeological observations, satellite image interpretations, geophysical surveying, drilling and pump testing and water point inventories. A brief description of the hydrostratigraphic units and aquifers are given below and their distribution is shown in *Figure 8.19*.

The following hydrostratigraphic units have been identified in the Study Area:

- **Top soil** – This unit consists of loose, sandy and silty soils which are a few meters thick and not laterally extensive. These are common along river courses in the rift floor. The escarpment and highland areas are characterized by a thin veneer of soils over the volcanics and Precambrian basement rocks and Mesozoic sedimentary rocks. This unit is not important for the hydrogeology.
- **Quaternary alluvial sediments (alluvial fans)** – This unit is believed to be the major and most productive aquifer in the area. These fans form extensive porous media aquifers, with high permeability. The presence of groundwater in these units is supported by direct evidence of groundwater in trenches and hand-dug wells, which supply water to communities in these areas. The village of Hamad Ela and the Allana Potash exploration camp receive water from boreholes in these Quaternary sediments.
- **Weathered and fractured basement complex rocks** – These rocks underlie the Quaternary deposits and are believed to be mainly metamorphic and sedimentary. The thickness and lateral extent of these rocks are not known, however, they extend to the highlands where low-grade metamorphic rocks and associated sedimentary rocks such as sandstones, dolomites and limestones outcrop. These rocks are extremely faulted and folded and may form fractured aquifers in escarpment areas, however due to topographic constraints in the highlands and escarpments, these may not be extensive. Therefore, they are considered as low productive hydrostratigraphic units.
- **Volcanic Rocks** – These rocks form scattered volcanic hills and sub-active and active volcanoes in the rift floor. To the northwest they form mountains of the watershed boundary. They also form parts of the Danakil Alps to the east. These units may not form extended aquifers, however they are known to locally form productive aquifers along regional faults and in areas where large dykes intruded into the unit. In general these units have a low groundwater potential in the study area.

Figure 8.19 Simplified Local Hydrogeological Map



- **Low Permeability Units** - These units include some massive carbonate and clastic rocks, shale, non-carbonate metamorphic rocks and basement complex intrusive rocks, such as granites, granodiorites and gabbro. These units are expected to exist at greater depths in mountainous areas and have a low groundwater potential.

Geophysics Investigation

The interpretation of the geological and hydrogeological desktop data predicted the alluvial fans are the most productive aquifer in the region and was thought to be the most suitable source of water for the proposed solution mining process. The water in the alluvial aquifers was thought to be brackish with highly elevated major ion concentrations. Therefore the alluvial fans to the west of the salt plains were the target for the geophysical investigation.

Geophysical survey methods utilise measures of resistivity and electrical conductivity to determine the approximate locations, depths and thicknesses of aquifers in the ground. This exploits the higher electric conductivity and lower resistivity of water compared to geological units in which the aquifer is located. The surveys provide a broad estimate of groundwater location which must then be confirmed and refined using drilling and aquifer testing. To date two geophysical surveys have been undertaken in 2012; one by Beles and one by Fugro.

Beles Geophysical Survey

The Beles survey was undertaken using two methods. Firstly, Vertical Electrical Sounding (VES) was used to estimate the change in resistivity with depth and therefore estimate the depth of the groundwater. Secondly, lateral profiling was used to determine the change in resistivity laterally, providing an indication of the lateral extent of the groundwater

A total 28 sites were selected for VES. Based on the VES results, eight sites were selected for vertical profiling.

The resistivity study using both VES and lateral profiling indicated that groundwater depth in the alluvial fans was typically between 5m and 250m below the surface. The depth to groundwater in the alluvial fans was also predicted to be between 5 to 280m.

Fugro Geophysical Survey

The Fugro survey used an electromagnetic method. A Transient electromagnetic method (TEM) was used for the depth interval of 40-300m and Slingram electromagnetics (EM) was used for depths up to 40m. Electromagnetic methods use electromagnetic fields to induce a secondary field in an electrical conductor such as water. The electromagnetic method used by Fugro exploits the differences between shallow brackish water and deeper salt water and was used to delineate the depth of the brackish water to be used for production.

In the case of the electromagnetic survey, long lines for the electromagnetic conducting coils are installed on the surface of the area to be investigated and the electromagnetic field applied on the surface.

The Fugro study estimates that the thickness of the target aquifer to be between 30 and 40m, the thickness profile is presented in *Figure 8.20*. The depth of the base of the target aquifer is estimated to be 35m in the western parts of the fan structure getting deeper further to the west, where predicted depth is 100m. The northern portion of the fans is estimated to have depths of 140m or greater.

Based on the evaluation of the TEM/EM-profiles (*Section 8.1.8*), the medial thickness of water bearing sediments in these units can be estimated at 30 - 40 m between the basement rock of the westerly mountain range and the salt plain in the Danakil depression. Fugro (2012) surmise, that in all probability, a groundwater reservoir exists between the Musley-Fan and the Saba-River-Fans with a length of ca. 20 km and a median width of 2 km. With these figures a potential groundwater reservoir can be conceptualized: the geometrical proportions (Length: 20 km, width: 2 km, average thickness of aquifer (water filled): 30 m) and a drainable porosity of 15 % (conservative estimate) would lead to a groundwater volume in the fans to the west of the Study area of approx. **180,000,000 m³**.

The geophysical survey was an important step for optimizing the positioning of drilling sites.

Project Water Quality Requirements

The usable volume of water identified in the potential groundwater reservoir could however be influenced by quality parameters such as chlorides which may render the water too brackish for use in solution mining.

The water quality requirements for solution mining and processing water are different. A range of acceptable water quality compositions, based on the analytical results of water sampled from wells drilled during the water exploration campaign, are given in *Table 8.5* below.

Processing Water for the plant should have a low mineralisation. For solution mining the requirements are less stringent and mixing of different mineralized waters is possible, but overall mineralization should not exceed about 140 ms/cm, with the summed Ca and Mg content below 10 g/l (ErcosPlan, 2012).

Table 8.5 *Allana Water Quality requirements for Processing water and for Solution Mining*

	Process Water	Process Water	Solution Mining	Solution Mining
	Good	Acceptable	Acceptable	Barely Acceptable
Na	0.012 g/l	0.083 g/l	14.5 g/l	34.2 g/l

	Process Water	Process Water	Solution Mining	Solution Mining
K	0.014 g/l	0.094 g/l	0.70 g/l	1.85 g/l
Mg	0.039 g/l	0.110 g/l	1.10 g/l	2.76 g/l
Ca	0.280 g/l	0.370 g/l	3.38 g/l	7.32 g/l
Cl	0.220 g/l	0.980 g/l	28.0 g/l	64.3 g/l
SO ₄	0.598 g/l	1.21 g/l	2.08 g/l	1.57 g/l
Conductivity	2.05 ms/cm	5.54 ms/cm	70 ms/cm	141 ms/cm

Source: ErcosPlan (2012)

Aquifer Characteristics

Following the geophysical survey, drilling was undertaken to determine groundwater depths, thickness and testing of the aquifer such that likely yield and reservoir volume can be determined. Fugro (through their sub-contractor NBB) have to date drilled a total of 18 observation wells at 9 locations, 3 pumping wells and 2 solution wells. The location of these sites is provided in *Figure 8.22*.

Aquifer testing has been undertaken by Fugro on the newly drilled boreholes. The results of the test results are presented in *Table 8.6*. The hydraulic conductivity in all these wells varied between $7 * 10^{-3}$ and $4.8 * 10^{-5}$ m/s, with an average of $1.2 * 10^{-3}$ m/s.

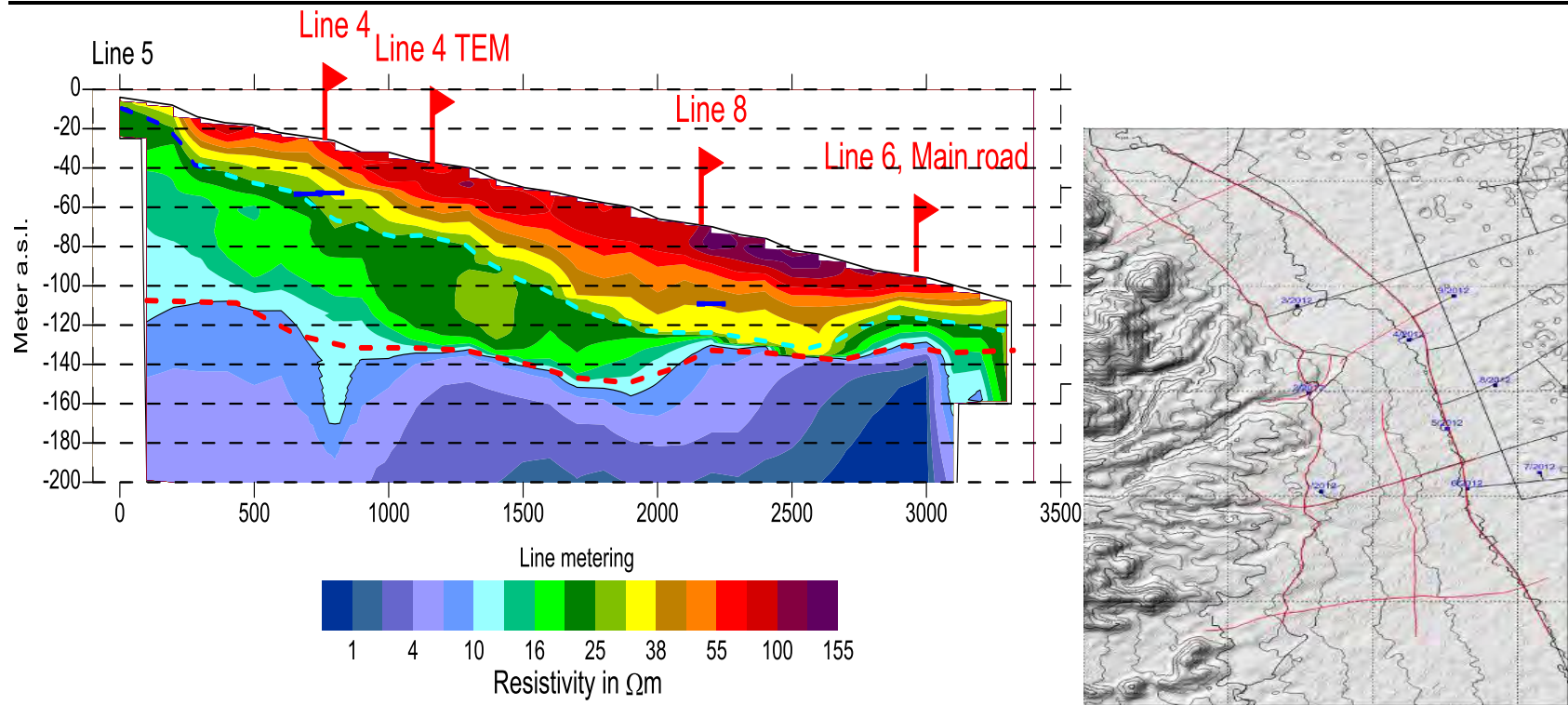
Table 8.6 *Characteristics of Aquifer Testing Boreholes*

Well ID	Hydraulic Conductivity K(m/d)	Transmissivity (m ² /d)
HyDal 1-Ilm/2012	112	279
HyDal 1-Ib/2012	12.	376.
HyDal 2-Ib/2012	43.	1,529
HyDal 2-It/2012	63	1,321
HyDal 3-Ib/2012	44	1,451
HyDal 3-It/2012	603	11,664
HyDal 4-Ib/2012	256	6,428
HyDal 4-Im/2012	132	3,144
HyDal 5-Ib/2012	25	205
HyDal 6-Ib/2012	59	2,021
HyDal 6-It/2012	67	2,298

Source: Fugro (2012)

Long term pump tests were conducted at the pumping well (HyDal-20-PW) which lasted 168 hours. Pumping tests were carried out with a capacity of up to 110 m³/h in each production well. These long term pump tests show that the groundwater table recovers completely at the end of the test (*Figure 8.21*).

Figure 8.20 Depth Profiles from Furgo Geophysical Study

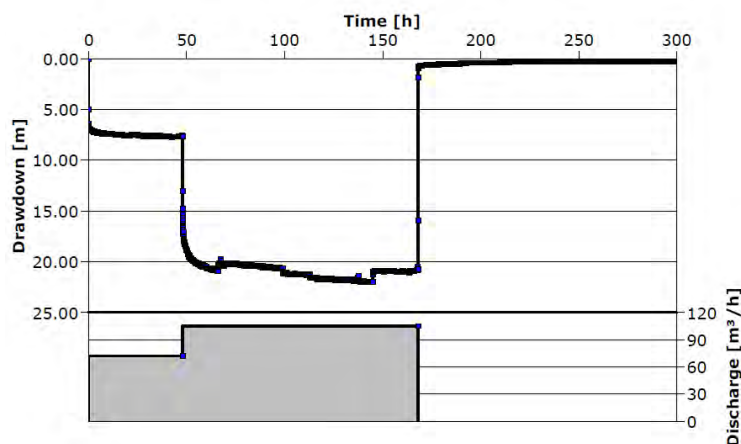


Source: Fugro, (2012)

Note:

- Resistivity of <1 to 10 represents saline conditions
- Resistivity of 10 to ~ 45 represents expected freshwater saturation
- Resistivity of > 45 represents partially saturated to dry conditions

Figure 8.21 Longer term (168h) Pump Test Results



Depth to Groundwater

The depth to water in the drilled boreholes (the locations of which are shown in Figure 8.22) have been measured by Fugro regularly since March 2012. Furthermore 10 data loggers have been in operation since June 2012, which automatically log depth to groundwater.

Using measured water levels in all available wells, a water table contour map has been constructed for the water bearing area between the western mountains and salt depression in the east. The water level falls from -114 masl to -126 m masl, 12 m over a distance of approximately 2.5 km (Figure 8.23).

Figure 8.22 Local Groundwater Sampling Points

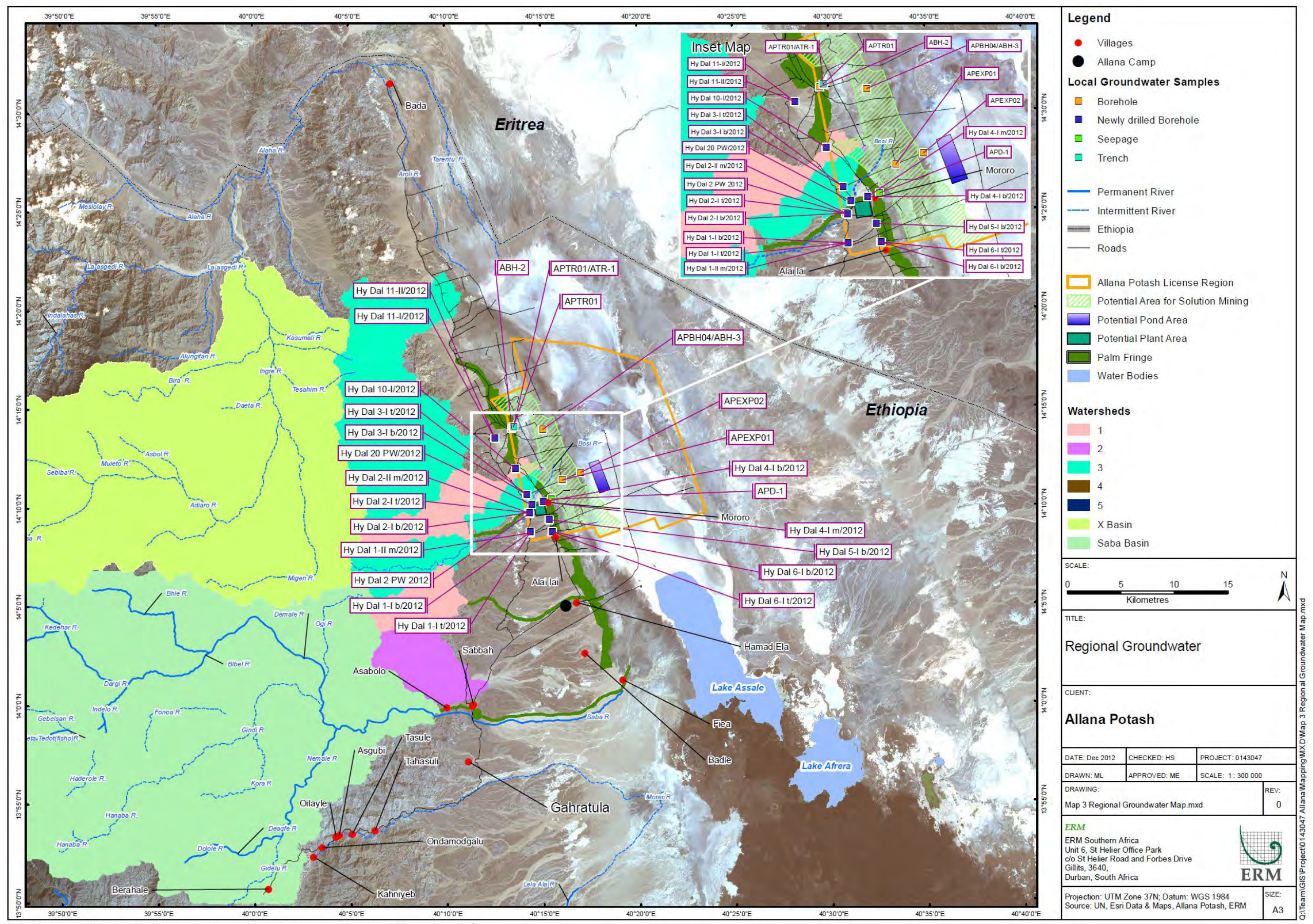
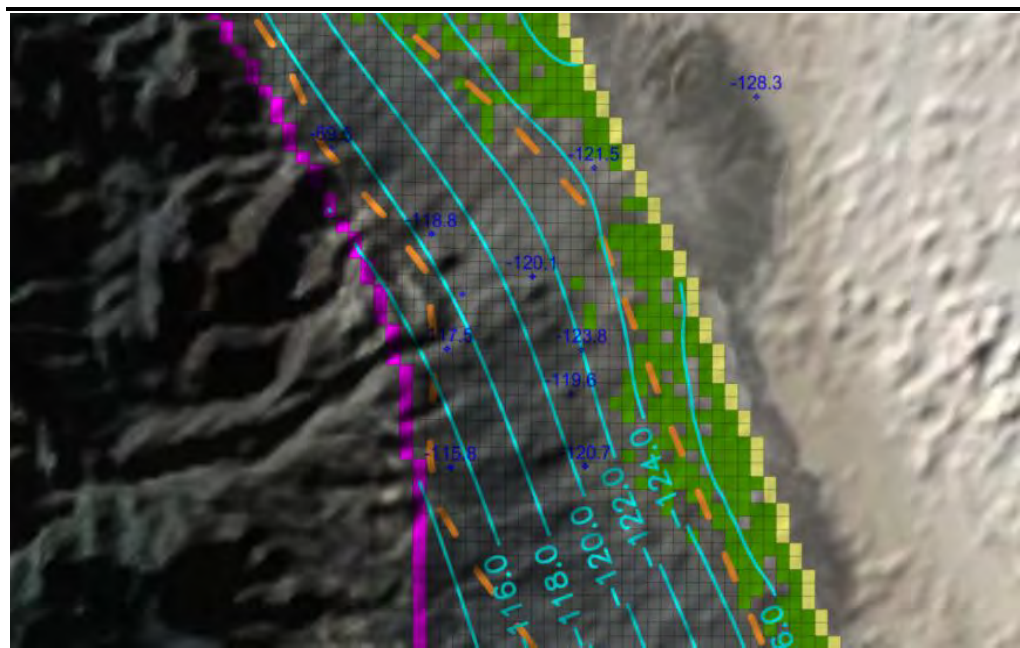


Figure 8.23 Water Table Contours in the Study Area



During the period of depth to groundwater monitoring (October 2011 to December 2012), there was little to no precipitation in the Study area and there was no surface flow in the dry riverbeds to the west of the Study area. However, a steady water level and gradient was observed during this period. This stable ground water gradient is an indication of a permanent subsurface influx to the groundwater bearing fan structures. This conclusion is strengthened by the 168 hour pump test undertaken on HyDal-20-PW (Figure 8.21), which showed that the aquifer recovered completely after this long-term pump test.

This data indicates, therefore that recharge from the west and western catchment areas into the groundwater bearing alluvial fan structures through large fault structures is likely.

In order to quantify recharge, Fugro (2012) developed a conceptual geo-hydraulic model, with the following structure and parameters:

- One layer (2D);
- One hydraulic conductivity of 7×10^{-4} m/s (the average rate from all the pumping tests conducted);
- A geological base of -145 m masl;
- Varying evaporation rates up to 3600mm to a depth of water table of 0,5 m; and
- No direct recharge caused by precipitation in the fan area.

Due to the uncertainty with regards the evaporation rate and depth of evaporation influence; this input into the model was tested using various evaporation rates.

The conceptual model results indicated that in order to maintain the detected hydraulic gradient, a subsurface influx (recharge) from the west of between **35.7 Mm³/a and 55.2 Mm³/a** is required. This result is an important indication of a considerable influx (recharge) into the alluvial fans through large fault structures, and serves to confirm recharge indicated by initial long term pump test and longer term groundwater depth measurements.

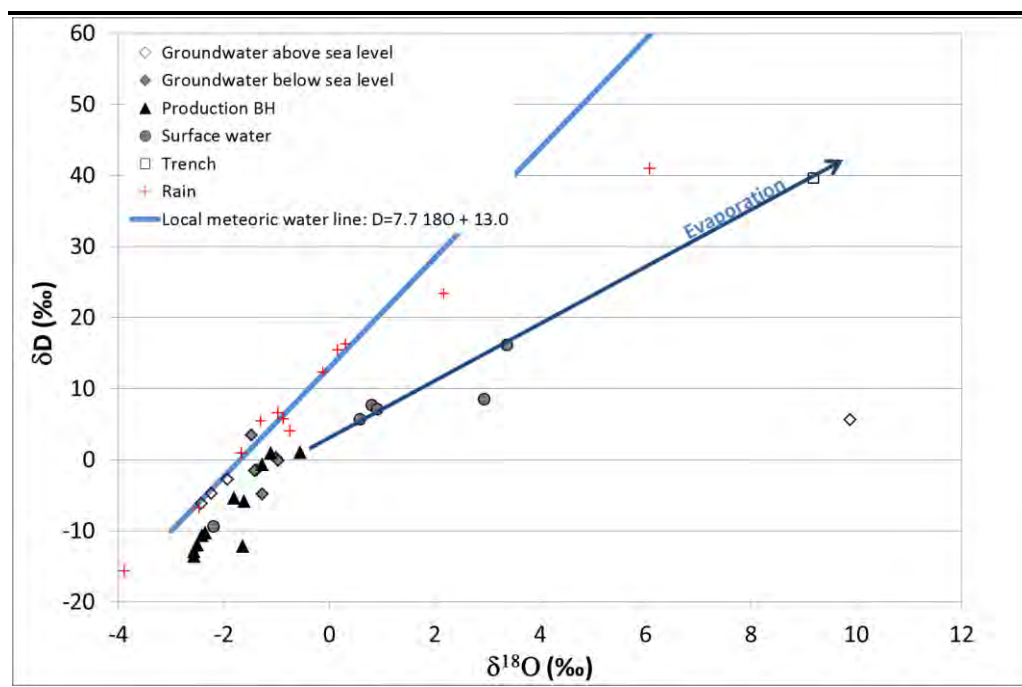
Stable Isotope Study

The stable isotopes of oxygen and hydrogen can be used to investigate the relationship between groundwater and surface water and the processes to which the water has been subjected. The oxygen isotope ¹⁸O and the hydrogen isotope deuterium (²H or D) were analysed in selected hydrocensus samples. The ratio of the heavy to normal isotope in the sample was compared to the same ratio in a standard (SMOW - Standard Mean Ocean Water) and the $\delta^{18}\text{O}$ and δD values were calculated in permil ⁽¹⁾. A relationship is found between $\delta^{18}\text{O}$ and δD in precipitation on a global scale which defines a line known as the Meteoric Water Line (MWL). On a local scale, a local MWL can be defined using data collected for local precipitation. Deviations from the MWL can be used to identify processes such as evaporation.

A total of 38 environmental isotope results from the wet and dry season sampling events are plotted on a δD - $\delta^{18}\text{O}$ plot in *Figure 8.24* and compared to the local MWL supplied by Beles (see *Figure 8.24*). In addition, rainwater isotope data was sourced from the Adu Bariye and Weldiya stations of the Global Network of Isotopes in Precipitation (GNIP) database (IAEA/WMO, 2006) and included on the plot. Adu Bariye is located approximately 150km to the south-east of the future production well field, and is at an altitude of 1,832 m.a.m.s.l, and Weldiya is located approximately 200km south-east of the future production well field at altitude of 1,920 m.a.m.sl.

(1) Permil is defined as follows - a tenth of a percent or one part per thousand

Figure 8.24 Stable Isotope Results.



These data show the following:

- Groundwater sampled from hydrocensus wells and production boreholes, in general plots on or close to the local MWL, and in a similar area to rainfall samples from Adu Bariye. The slight shift to the right of the meteoric water line for production boreholes and groundwater sampled from boreholes located below sea level could be due to the difference in altitude between the source of the recharge to these wells, and Adu Bariye.
- Surface water samples define an evaporation trend originating from rainwater/groundwater. The trench sample appears to be the most highly evaporated water.
- One sample taken from above sea level shows highly elevated $\delta^{18}O$ values. The reason for this is not known.

Based on the results, the following conclusions can be drawn:

- The Deuterium/18O results of the ERM-investigation indicate mainly old mineralized water types. The Tritium analyses confirm this for groundwater in the deeper parts of the aquifer and closer to the salt plain. Due to the low Tritium input level in this region an older recharge with an age from 40 up to 150 years is not distinguishable from very old fossil water.
- Some of the wells clearly indicate the presence of young water.

A supplemental survey using the C14 method is recommended to manage the resource in a safe and sustainable way.

Groundwater Quality

Regional Groundwater Quality

The water quality results for groundwater sources or seepages (these represent groundwater rather than surface water) are presented in *Table 8.7*. The samples are from boreholes and hand dug wells across the Study Area (*Figure 8.22* and *Figure 8.25*). The depth to groundwater is unknown; however, it is likely that the samples are from shallow groundwater.

With the exception of AHW-2 and APBH02, the water quality in the groundwater samples exceeded at least one SANS Class I guideline for major ions; however, all but one sample were within the SANS Class II guideline for the major ions. APDW01 exceeded the SANS class II guideline for magnesium.

All samples exceeded the WHO guideline for nitrate and sample APBH03 exceeded the WHO guideline for fluoride; health related guidelines making the water unsuitable for long term consumption.

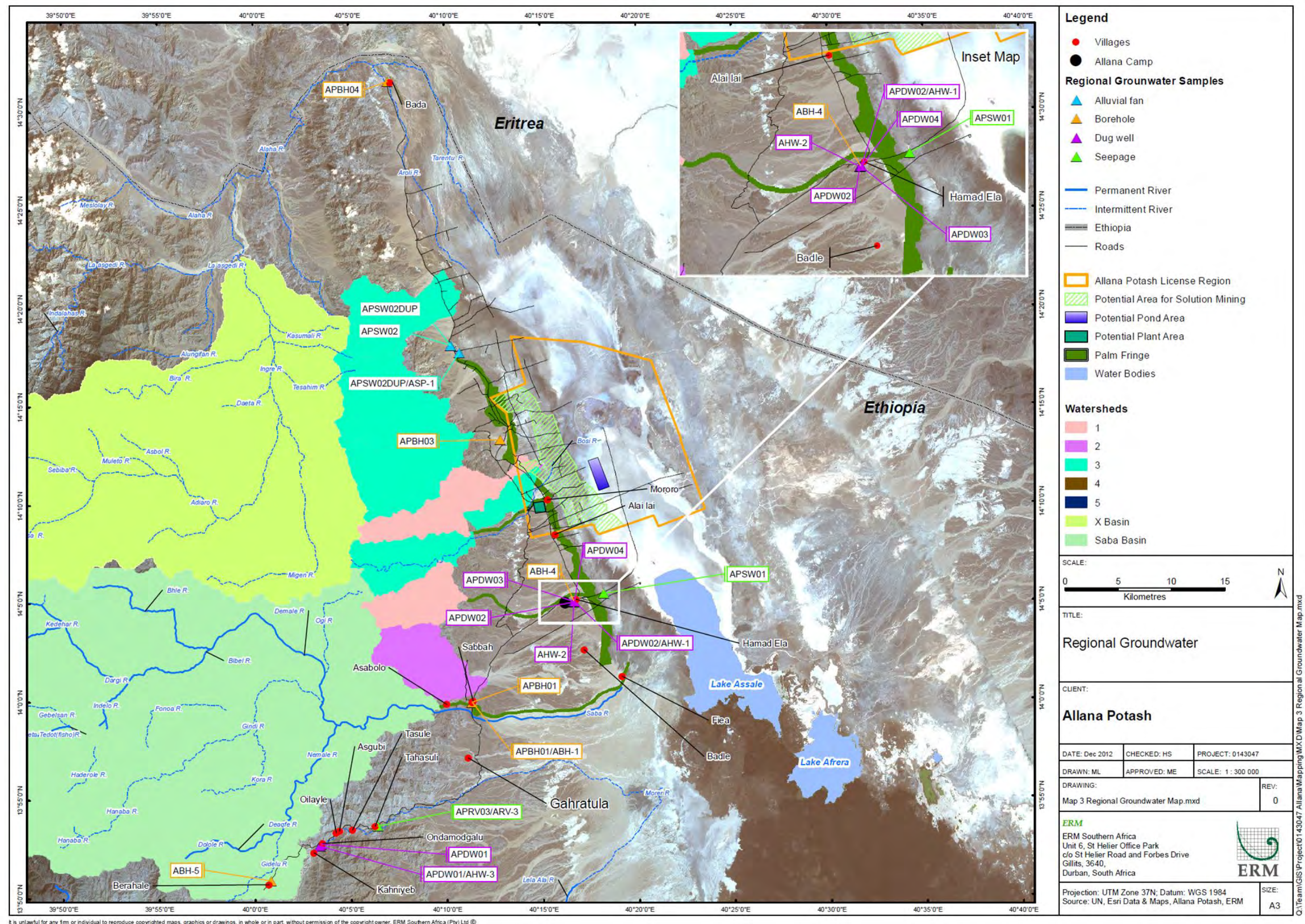
The concentrations of aluminium, iron, manganese, copper and lead and zinc were all below the SANS and WHO guidelines.

Table 8.7 Regional Groundwater Quality

Site ID	AHW-2	APBH01	APBH01/ ABH-1	APBH02	APBH03	APBH04	APDW01	APDW01/ AHW-3	APDW02	APDW02/ AHW-1	APDW04
Site Type	Dug well	Borehole	Borehole	Borehole	Borehole	Borehole	Dug well	Dug well	Dug well	Dug well	Dug well
Site Description	Old Hamad Ela well	Defence well close to Sabah River	Defence Construct ion Borehole	Borehole water from reservoir	Sainik borehole	Bada reservoirs pumped from borehole	Hand dug well inside Ondamod galu	Mororo village river bed hand dug well	Hamad Ela dug well	Red Cross Hamad Ela well	Hamad Ela well
Season	Wet	dry	Wet	dry	dry	dry	dry	wet	dry	wet	dry
pH (pH units)	7.5	7.3	7.35	7	7.4	8	7.6	7.23	7.2	7.65	7.9
EC (mS/m)	130	227	270	99.6	168	328	398	370	153.5	230	193
TSS (mg/l)	0	3.6	0	89	7	6	16	41.45	4	0	335
Calcium (mg/l)	146	126	146	87.9	122	195	274	176	154	188	172
Magnesium (mg/l)		35.9	41.4	24.1	31.5	73.3	106	95.3	14.8	25.7	22.8
Sodium (mg/l)	97	248	267	46.6	147	298	390	373	140	187	149
Potassium (mg/l)	6.82	6.25	6.68	3	19.7	26.7	11.7	7.07	14.8	22	20.1
Chloride (mg/l)	146	470.13	565	28.19	208.63	532.19	340.24	244	135.72	298	257.63
Sulphate (mg/l)	428	340.44	436	105.31	271.17	845.75	1630.1	1210	350.55	630	510.15
Nitrate (mg/l)	26	13.58	5.67	4.37	14.6	16.78	13.09	14.1	34.4	11.1	17.73
Fluoride (mg/l)	0.8	0.36	0.28	0.77	1.58	0.3	0.37	0.83	0.87	1.49	1.1
Aluminium (mg/l)		0.02		0.02	0.108	0.0253	0.02		0.378		0.0941
Iron (mg/l)		0.015	0.0503	0.015	5.29	0.82	0.45		12.4	0.025	3.41
Manganese (mg/l)		0.002		0.0448	0.208	0.0395	0.454	0.0381	0.484		0.123
Copper (mg/l)	0.00316	0.00265	0.0143	0.002	0.0091	0.002	0.002	0.00387	0.0283	0.00838	0.0043778
Lead (mg/l)		0.0005	0.00063	0.000509167	0.0005	0.0005	0.0005		0.0005		0.0005
Zinc (mg/l)	0.00565	0.143	0.813	0.0689	0.0377	0.0543	0.006111111		0.0455	0.117	0.0135

Note: Red indicates an exceedance of the SANS Class II standard, Green indicates an exceedance of the SANS Class I standard and Blue indicates an exceedance of the WHO health related guideline.

Figure 8.25 Regional Groundwater Sampling Points



Alluvial Fan and Seepage Groundwater Quality

The water quality measured in the newly drilled wells within the Study Area in the alluvial fans is presented in *Table 8.8*. These samples are referred to as the "Alluvial Fan Water". In addition water quality results from seepages in the alluvial fans or seepages near the edge of the salt plains near the project area, are presented in *Table 8.9*. These samples are referred to as the "Seepage Water". The location and chemistry of these seeps suggests that they are representative of water quality in the alluvial fans, in and around the project site. These sampling locations are illustrated on *Figure 8.22*.

The Alluvial Fan Water and the Seepage Water have two distinct water qualities. Sites Hy Dal 5-Ib, Hy Dal 6-Ib, Hy Dal 6-It, Hy Dal 4-Ib, Hy Dal 4-I (*Table 8.8; Figure 8.22*) have highly elevated major ion concentrations and exceed all the Class II SANS guidelines for all major ions. These samples were all taken from Observation wells located closer to the salt plain and are representative of Seepage Water. The concentrations of sodium and chloride in these samples were above the concentrations found in sea water and would be unsuitable for drinking. These sites are considered highly saline. In addition to the major ions, ammonia was highly elevated and exceeded the SANS standards for drinking water. The exceedance of ammonia above SANS and WHO guidelines indicates that the water would not be suitable for long term consumption.

Major ion concentrations at sites Hy Dal 2-Ib, Hy Dal 1-It, Hy Dal 2-It, Hy Dal 2-PW, Hy Dal 3-It were considerably lower than the highly saline water (see above). These boreholes and Observation Wells are located away from the salt plains in the alluvial fans, and are referred to as "Alluvial Fan Water". These sites all have concentrations of sodium and chloride that are one or two orders of magnitude lower than the Seepage Water and sea water. There were still some exceedances of some SANS Class I or Class II standards for calcium, chloride and sulphate. In contrast to the highly saline samples, the concentrations of sodium, magnesium and ammonia were below the SANS guidelines and the concentrations of ammonia are all below the WHO and SANS guidelines limits in the Alluvial Fan Water.

The Seepage Water quality exceeds the SANS Class II standards for calcium, magnesium, potassium, sodium and chloride and the concentrations of these elements are similar to the Alluvial Fan Water although more variable. Unlike the Alluvial Fan Water the concentration of nitrate in all Seepage Water samples exceeds the WHO guideline for nitrate; a health related guideline and the water would not be suitable for long term consumption. This difference is likely to be due to oxidation of the reduced ammonia species to nitrate at surface.

The concentrations of aluminium, iron, manganese, copper, lead and zinc were all below the SANS and/or WHO guidelines in the Seepage Water samples.

The concentrations of major ions in the Alluvial Fan Water and the Seepage water are considerably higher than those found in the regional groundwater and the surface water samples.

Table 8.8 *Groundwater Quality from points within the Alluvial Fans and Seepage Areas, within the Project Area*

Sample ID	Boron	Calcium	Potassium	Magnesium	Sodium	Ammonia	Chloride	Iodine	Nitrate	Sulfate
Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Class 1	N/A	150	150	70	200	<1	200	N/A	10	400
Class 2	N/A	300	300	100	400	1-2	300	N/A	20	600
WHO									3	
Hy Dal 5-Ib/2012	13.5	7300	1550	2150	18000	5.9	37700	0.4	<1	1260
Hy Dal 6-Ib/2012	58	14100	4900	6760	36000	48.5	57320	1	<1	955
Hy Dal 6-It/2012	13	4500	1160	1840	8900	3.9	21750	0.3	<1	1490
Hy Dal 4-Ib/2012	22.7	7320	1850	2760	34200	7.5	64300	<0.1	<1	1570
Hy Dal 4-Im/2012	13	3380	700	1100	14150	2.8	28000	<0.1	<1	2080
Hy Dal 2-Ib/2012	0.7	510	39	133	440	0.2	1510	<0.1	<1	810
Hy Dal 3-Ib/2012	27.2	4810	2130	3220	21400	6.1	44700	<0.1	<1	2110
Hy Dal 3-It/2012	1.0	370	94	830	830	0.07	980	<0.1	<1	1210
Hy Dal 1-Imm/2012	20.5	12200	965	1580	19300	10.1	49200	<0.1	<1	794
Hy Dal 1-Ib/2012	17.2	10000	765	1260	15100	8.6	40500	<0.1	<1	877
Hy Dal 2-It/2012	0.4	276	13.9	39	120	<0.05	221	<0.1	<1	598
Hy Dal 2-PW/2012	0.4	321	15.2	48.5	151	0.06	354	<0.1	<1	654
Hy Dal 2-PW2/2012	0.6	186	58.3	7.5	82.9	0.25	441	<0.1	<1	659
Hy Dal 1-It/2012	2.1	852	80	63	873	0.14	3000	<0.1	<1	1150
Camp Well	1.39	253	78.8	25	250	<0.05	250	<0.1	<1	1120

Note: Red indicates an exceedance of the SANS Class II standard, Green indicates an exceedance of the SANS Class I standard and Blue indicates an exceedance of the WHO health related guideline.

Table 8.9 Water Quality from Alluvial Fan Seepages

Site ID	APSW02	APSW02DU P	APSW01 ¹	APSW01/AR V-3	APSW02DU P/ASP-1
Site Type	Alluvial fan	Alluvial fan	Stream	River	Alluvial fan
Site Description	Seepage at the edge of mudflats	Hamad Ela dug well	Accumulated seepage at the edge of salt plain	Accumulated seepage at the edge of salt plain	Seepage in the mudflats of J & P concession area
Season	Dry	Dry	dry	Wet	Wet
pH (pH units)	7	7.1	7.3	7.2	6.05
EC (mS/m)	4,620	4,740	7,540	10,940	20,000
TSS (mg/l)	116	147	302	8.2	6.84
Calcium (mg/l)	5,430	5,420	7,910	8030	31,400
Magnesium (mg/l)	1,050	1,160	4,220	4050	10,500
Sodium (mg/l)	5,560	6,280	11,900	11400	40,500
Potassium (mg/l)	729	764	2,060	2090	6,810
Chloride (mg/l)	23,200	23,500	46,900	52300	216,000
Sulphate (mg/l)	11,19.34	1,098.23	1,650	1984	205
Nitrate (mg/l)	3.43	10.72	1.64		12.4
Fluoride (mg/l)	0.5		1.73		8.43
Aluminium (mg/l)	0.02	0.319	0.0331		
Iron	0.0617	8.25	0.168	0.0809	0.092
Manganese (mg/l)	2.1	2.31	0.002		2.74
Copper (mg/l)	0.0055833	0.0238	0.0089583	0.0165	0.0444
Lead (mg/l)	0.0005	0.0005	0.0005		
Zinc (mg/l)	0.0073111	0.0288	0.0055583		0.0161

Note 1: Sample APSW01 is located at the base of the Palm fringe. Based on location and water quality it is likely that these samples are representative of seepage from the alluvial fans.

Note 2: Red indicates an exceedance of the SANS Class II standard, Green indicates an exceedance of the SANS Class I standard and Blue indicates an exceedance of the WHO health related guideline.

Existing Groundwater Users

Due to the hostile climate, the Danakil Depression is not densely inhabited as most people live in the highland areas. With reference to the Social Baseline (Chapter 9), the majority of households surveyed access water through central taps (22.3%), hand dug wells (19.8%) or from the seasonal river channels (19.8%).

Only Berahale, Hamad Ela and Ambule have access to communal water taps (pumped from a borehole). The villages of Mororo and Alai Lai primarily source their water from a hand dug well (Figure 8.26), although these villages have recently been supplied with water from the Ethiopian military. An example of a communal water tap, located just off the Sabah River near the Road Construction camp, is illustrated in Figure 8.27.

Figure 8.26 Varying Water Sources for Villages



Figure 8.27 Communal tap within the Study Area



Other users of water are other mining companies in the Region, who are currently exploring for potash and gold deposits within the Danakil Depression. These companies are utilizing water for their current exploration programmes. The demand for water will increase substantially if and when these mining companies commence their operational mining phases. This is discussed more fully in the cumulative impacts section of the ESHIA (*Chapter 12*).

Summary

As a result of the intermittent rainfall in the highlands to the west of the Project Site, and the almost total lack of rainfall on the Project Site, only ephemeral river systems exist within the Project area. Alluvial fans, located at the base of the highlands between the highland and the salt plains, and which are covered with thick alluvial sediments, hold the best potential for groundwater. These alluvial fans were therefore selected for geophysical investigation and borehole siting to establish these areas as a source of water for the Allana Potash project.

Based on the results of geophysics studies, Fugro (2012) estimate that a groundwater reservoir exists between the Musley-Fan and the Saba-River-Fans, with a groundwater volume of approx. **180,000,000 m³**.

Drilling studies (to date a total of 18 observation wells at 9 locations, 3 pumping wells and 2 solution wells) indicate the hydraulic conductivity in all these wells varies between $7 * 10^{-3}$ and $4.8 * 10^{-5}$ m/s, with an average of $1.2 * 10^{-3}$ m/s. Long term pump tests at the pumping wells (HyDal-20-PW) and depth to groundwater monitoring (October 2011 to December 2012) indicate a permanent subsurface influx to the groundwater bearing fan structures.

In order to quantify recharge, Fugro (2012) developed a conceptual geo-hydraulic model. Results from this model indicate that in order to maintain the detected hydraulic gradient, a subsurface influx (recharge) from the west of between **35.7 Mm³/a and 55.2 Mm³/a** is required. This result is an important indication of a considerable influx (recharge) from the west and western catchment areas into the groundwater bearing alluvial fans through large fault structures, and serves to confirm recharge indicated by initial long term pump test and longer term groundwater depth measurements.

The volume of water in the potential groundwater reservoir available for Allana's water requirements is dependent on the water quality, particularly of chlorides, for solution mining. Processing Water for the plant should have a low mineralisation. For solution mining, the requirements are less stringent and mixing of different mineralized waters is possible, but overall mineralization should not exceed about 140 mg/cm, with the summed Ca and Mg content below 10 g/l (ErcosPlan, 2012).

The water quality measured in the newly drilled wells in the alluvial fans, which are located away from the salt plains (“Alluvial Fan Water”), when compared to the water quality results from seepages in the alluvial fans or seepages near the edge of the salt plains (“Seepage Water”) have two distinct water qualities.

Seepage Water (the water found closer to the salt plain) generally has highly elevated major ion concentrations; the concentrations of sodium and chloride in these samples were above the concentrations found in sea water, and these sites are considered highly saline and not fit for human consumption. Major ion concentrations at sites within the Alluvial Fan boreholes and Observation Wells were considerably lower than the highly saline Seepage Waters; these sites all have concentrations of sodium and chloride that are one or two orders of magnitude lower than the Seepage Water and sea water. This water is generally within the SANS Class II guidelines for drinking water, and is generally suitable for use in solution mining. In some cases, blending of water may be required to reach the desired water quality for solution mining purposes.

The concentrations of major ions in the Alluvial Fan Water and the Seepage water are however considerably higher than those found in the regional groundwater and surface water samples taken over the wider Study area.

Given the estimated volume of the groundwater reservoir (180 Mm³) within the targeted alluvial fan aquifers, and estimated recharge of between 35.7 Mm³/a and 55.2 Mm³/a, Fugro (2012) conclude that it is highly probable that there is sufficient water for Allana’s needs (16 Mm³/a). Water within the alluvial fan aquifers, although of variable water quality, is also suitable for solution mining requirements.

8.2.7

Air Quality

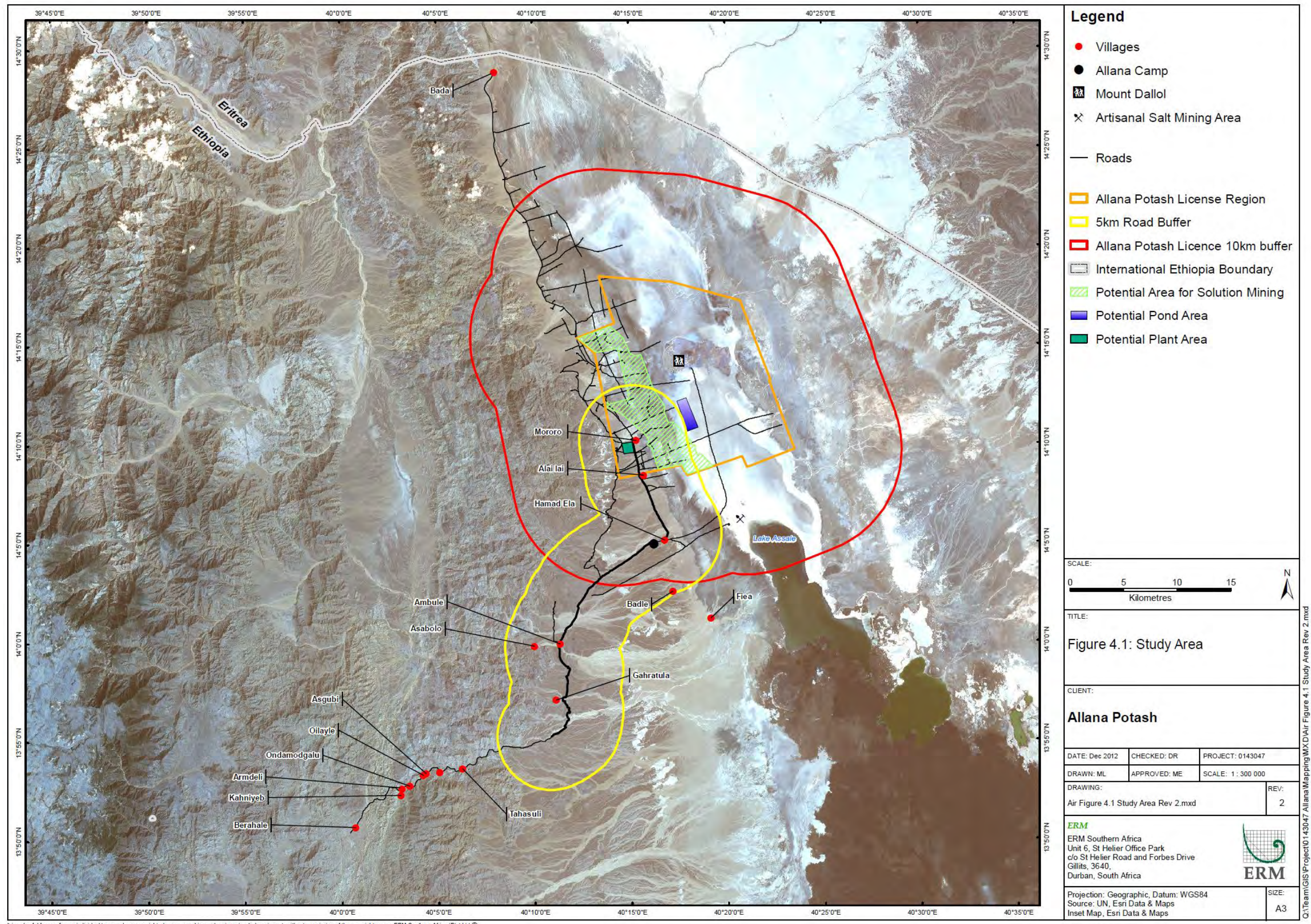
Air Quality in the Study Area

The Study Area is defined in terms of areas where direct and indirect impacts may occur as a result of the construction, operation or decommissioning of the proposed Project. In terms of air quality, the study considers only direct impacts to sensitive receptors. The Study Area pertains to the area proposed for solution wells, evaporation ponds, processing plant and the staff village. This is defined as an area of approximately 100km. In terms of road transport, this is defined as an area within 5km of the proposed haul roads used to transport the potash ⁽¹⁾. The haul road itself is not the subject of this ESHIA; however, the potential impacts relating to transport emissions are considered in close proximity to the processing plant, nominally, 10km from the plant, as this is the point to which significant in-combination impacts are considered to be potentially significant. The definition of the Study Area captures the

(1) Please Note - although the exact route to transport potash off-site is unknown at this stage, it is assumed that the proposed haul road will pass the villages of Mororo, Alai lai, Hamad Ela and Ambule.

potential for dust emissions to travel a considerable distance from source. The definition also captures the potential for emissions from road vehicles to arise in the vicinity of haul roads used to access the mine, from the processing plant until joining the main road network (*Figure 8.28*).

Figure 8.28 Air Quality Study Area



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Air Quality Baseline

The location of the proposed Project is characterised by a flat or slightly contoured, largely featureless landscape for much of the surrounding area, with substantial hills and mountains rising in the west (refer to *Section Error! Reference source not found.* above).

The meteorological conditions are extreme and are characterised by extremely arid conditions with very little rainfall and high temperatures throughout the year. In addition, the Study Area is subject to elevated wind speeds, exacerbated by the lack of ground features (refer to *Section 8.2.1* above).

In terms of sensitive human receptors, there are a small number of receptors in the vicinity of the area proposed for the processing plant, primarily residents of Mororo and Alai lai Villages, and in the vicinity of existing access routes (Hamad Ela Village, the current Allana exploration camp and Ambule being the key villages). The development of the haul road will divert traffic away from these receptors to some extent and therefore these receptors will be less impacted by the proposed operations. In addition, there are a number of human receptors in the salt flats just north of Lake Assale who harvest salt. These people are present for ten months of the year, being absent for only the hottest part of the year in July and August. These activities take place within 10km of the area proposed for the processing plant, and furthermore, the camel trains used to transport the salt to Berahale Town will, at some point, cross the proposed haul road.

At present, in addition to Allana's exploration activities, there are a number of other mining companies undertaking exploration within the broader project area, as discussed in *Chapter 2*. As a result, the existing conditions are not a true baseline, but are influenced by the presence of these activities within the Study Area.

In terms of air quality, the existing baseline concentrations of oxides of nitrogen, nitrogen dioxide and sulphur dioxide will be substantially below IFC air quality standards. This reflects the absence of any significant local sources of emissions. The potential reason for these low concentrations could be attributed to villages not having to have fires for heating purposes and there only being a small number of vehicles, as the primary means of transport remains camel or donkey. Baseline concentrations of dust, PM₁₀ and PM_{2.5} are elevated to concentrations that are likely to be above the air quality standards at all locations. The baseline concentrations are dominated by natural sources, associated with localised emissions of particulate matter arising as a result of the high aridity, high wind speeds and little or no vegetation cover to act as a wind break. However, as previously discussed, the baseline conditions at sensitive receptors are influenced by the existing exploratory activities. In these locations, these activities contribute a substantial proportion of the baseline PM₁₀, PM_{2.5} and dust.

A bespoke monitoring campaign has been undertaken to capture baseline air quality in the Study Area; at nearby sensitive receptors (Alai lai, Mororo, Hamad Ela, Ambule, Tahasuli and Berahale). These receptors are considered to be sensitive as they are susceptible to airborne emissions arising from mining activities and associated transport activities.

Two continuous monitors monitoring TSP, PM₁₀, PM_{2.5} and PM₁ were deployed at the mine site and rotated every month between eight measurement sites. This approach allows seasonal variations in baseline conditions to be captured at locations that are remote from any human activity, around sites where there is human activity (for example local villages and towns), and at locations already affected by other indigenous activities in the vicinity of the proposed mine. The continuous monitors provide measurements of ambient airborne particulate matter on a continuous basis, allowing meaningful comparison with short term and annual mean air quality standards. The monitoring results also allow short term trends to be identified, and therefore the weather conditions which promote dust generation can be identified.

Bergerhoff dust deposition gauges were deployed at eight locations in the vicinity of the mine and in the vicinity of the haul route. These gauges provide long term monitoring of dust deposition. The monitoring allows longer term trends to be identified, and allows a greater spatial distribution than using the continuous monitors alone.

The measurement of the above mentioned parameters spanned a six month period (December 2011 to May 2012). Monitoring locations are illustrated in *Figure 8.29* overleaf.

No monitoring was undertaken for NO₂, NO_x and SO₂, as ambient baseline concentrations are anticipated to be negligible. The results of the baseline dust deposition monitoring are set out in *Table 8.10*, and the results of the baseline real-time monitoring are set out in *Table 8.11*. *Figure 8.30* illustrates the results of the real time monitoring, including the peak concentrations monitored at each location.

Figure 8.29 Air Quality Baseline Monitoring Locations

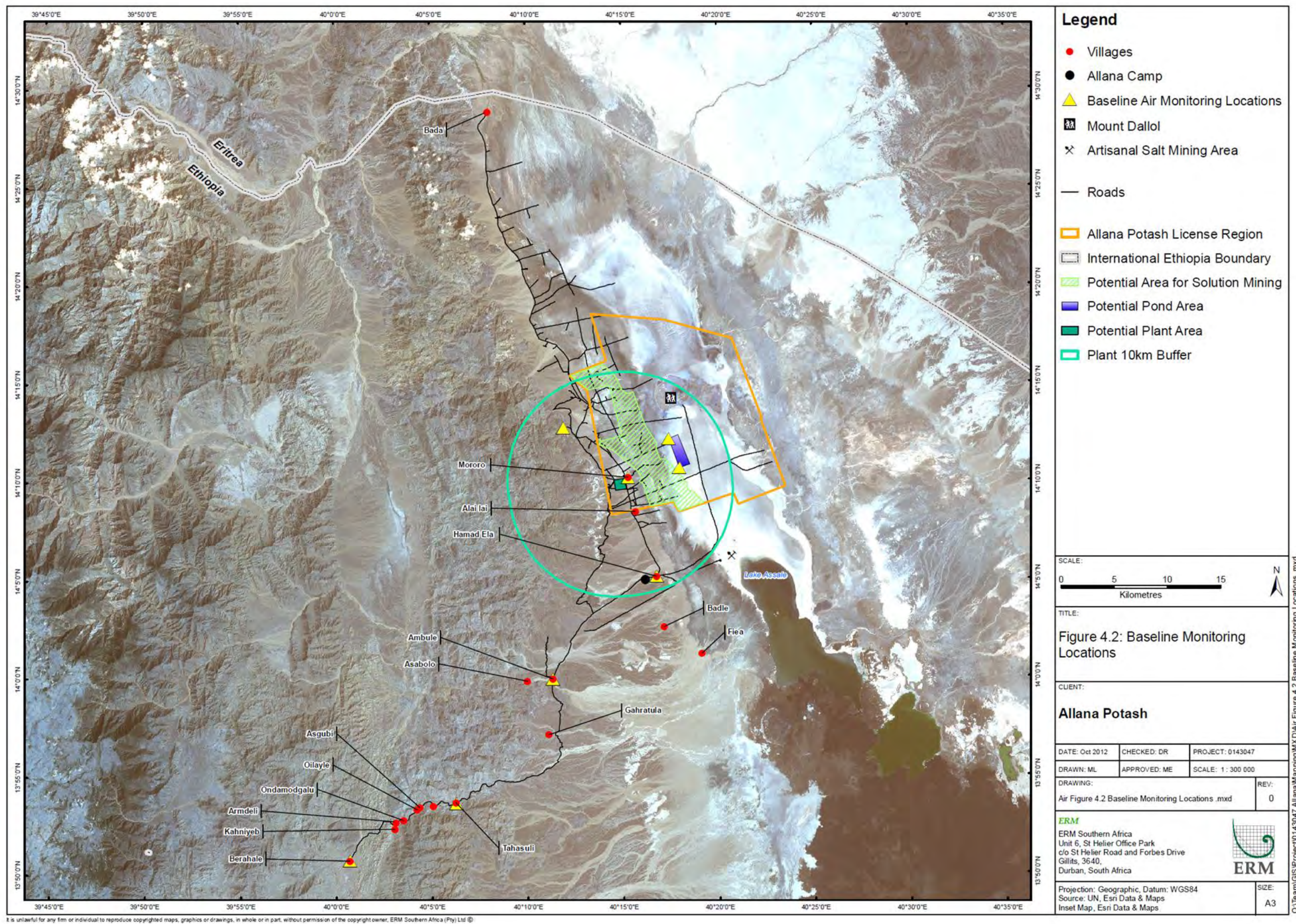


Table 8.10 Summary of Dust Deposition Baseline

Site	Dust Deposition (mg/m ² /day) ¹				
	22/11/2011	03/01/2012	31/01/2012	28/02/2012	03/04/2012
Deployed					
Collected	03/01/2012	31/01/2012	28/02/2012	03/04/2012	01/05/2012
Allana Camp/Hamad Ela Village	178	419	367	300	528
Mororo Village	269	588	428	314	2235
Ambule Village	411	257		486	650
Tahasuli Village	461	365		251	383
Berahale Town	945	1416		1029	1518
Evaporation pond DK11-25	102	348	233	129	191
Evaporation pond DK11-16	79	399	217	153	124
Baseline site	150	436	304	270	294

¹ - Please note that the following magnitude criteria (relating to nuisance levels) have been developed relating to dust deposition:

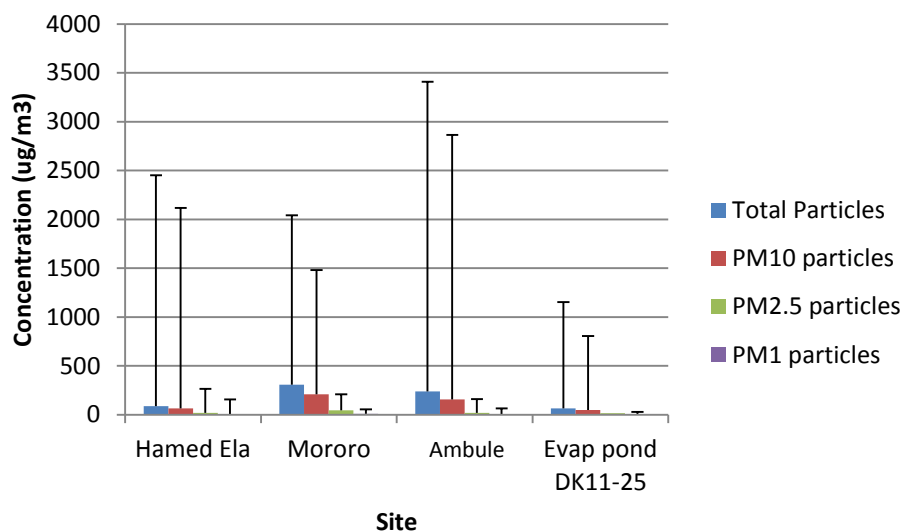
- Negligible: <120mg/m²/day (Pink)
- Small: 120 - 200 mg/m²/day (Yellow)
- Medium: 200 - 350 mg/m²/day (Orange)
- Large: >350mg/m²/day (Red)

Table 8.11 Summary of Real-Time Monitoring

Site	Average Total Particles (µg/m ³)	Average PM ₁₀ particles (µg/m ³)	Average PM _{2.5} particles (µg/m ³)	Average PM ₁ particles (µg/m ³)
Air Quality standard (annual mean) (µg/m³)	n/a	20	10	n/a
Hamad Ela Village	87.8	64.9	19.3	5.4
Mororo Village	307	209	45.6	9.4
Ambule Village	238	155	20.7	6.6
Evaporation pond DK11-25 (located to the east of Mororo)	64.9	47.4	15.5	3.8

Please Note - Red illustrates an exceedances of the air quality standard.

Figure 8.30 Summary of Real-Time Monitoring



The baseline monitoring set out in *Figure 8.30* illustrates that the short term peak concentrations are many times higher than the average concentrations, and peak concentrations are many times greater than the short term air quality standards for PM₁₀ and PM_{2.5}. The data reflect the effect of existing localised emissions from vehicles moving over unpaved roads arising at Hamad Ela, Mororo and Ambule. The monitoring undertaken at the site proposed for the evaporation ponds is more representative of the true baseline; however, at the said site the baseline concentrations are still in excess of the air quality standards and show elevated peak concentrations.

The baseline monitoring illustrates that the dust deposition guidelines and air quality standards are already extensively exceeded at all monitoring locations. This finding is likely to be ubiquitous throughout the region due to the high level of naturally occurring dust associated with the extremely arid climate, high wind speeds and lack of vegetation. In addition, the data illustrate that at those sites situated in close proximity to unpaved roads used to access the Danakil, in particular Hamad Ela, Mororo and Ambule, airborne dust and particulate matter concentrations are particularly elevated.

On the basis of the baseline monitoring, and review of existing sources, in terms of dust deposition, PM₁₀ and PM_{2.5}, the existing airshed is described as **degraded**. In terms of NO₂ and SO₂, the existing airshed is described as **un-degraded**.

Given the largely rural nature of the Study Area and the almost total lack of industrial, transport or construction activity (apart from the current exploration activities currently taking place), noise levels are generally low. However, noise baseline data was collected at noise sensitive receptors in the Study Area. A description of noise sensitive receptors and baseline noise levels is discussed below.

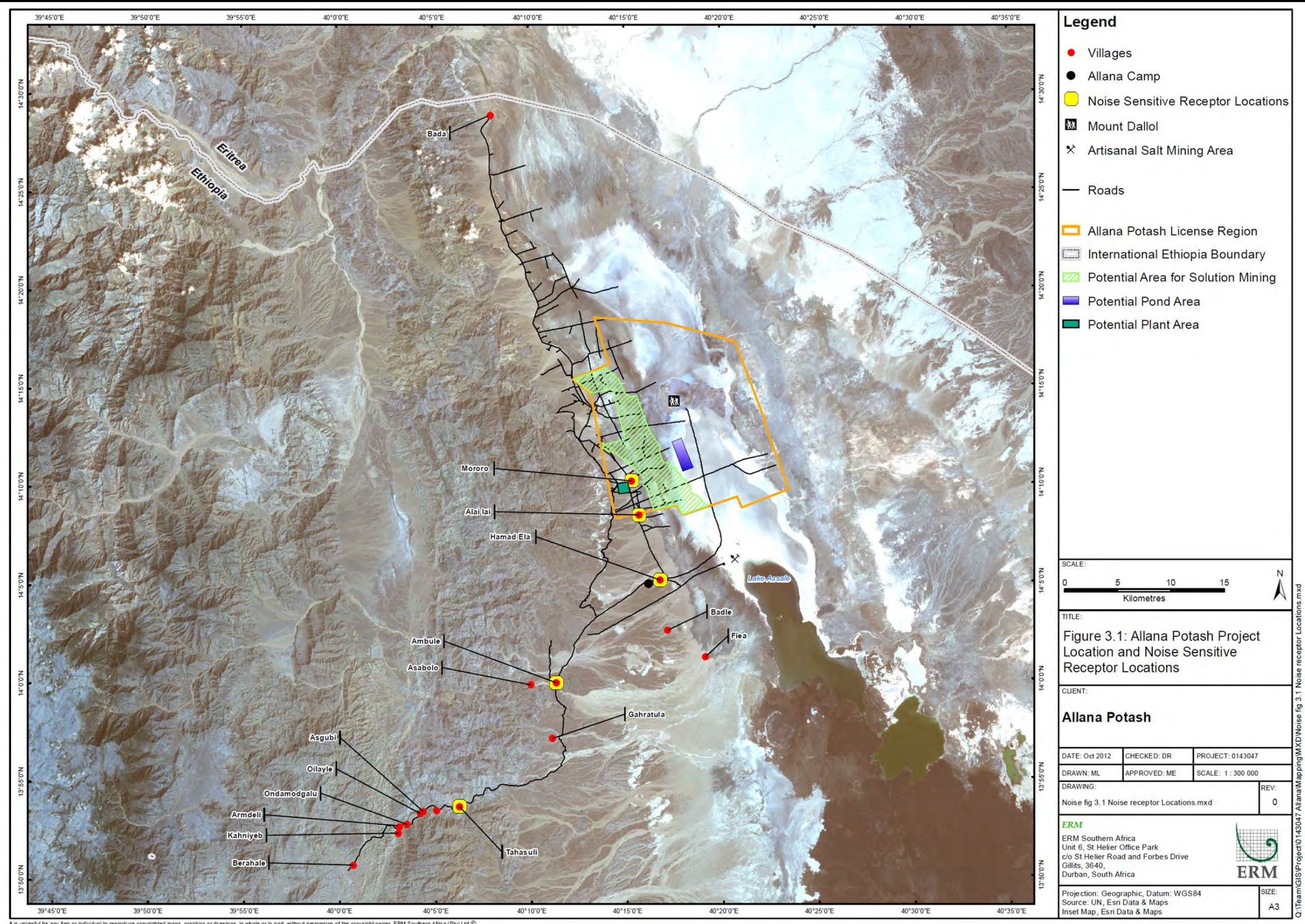
Sensitive Receptors

The Study Area is currently being used by the nomadic Afar people, mining companies carrying out exploration activities and occasional tourists. There are a number of sensitive human receptors that may potentially be affected during all phases (construction, operation and decommissioning) of the proposed Project. These include villages located in close proximity to the road from Berahale Town to the Project site and villages within the concession area (refer to *Figure 8.31* below), including:

- Berahale Town;
- Morrro Village;
- Ambule Village;
- Mororo Village;
- Alai lai Village; and
- Hamad Ela Village.

The only permanent noise sensitive receptors (NSR) in the area proposed for mining activities and infrastructure include: the small villages of Mororo, Alai lai and Hamad Ela, as well as isolated shepherd's posts. Mororo Village is situated within Allana's concession area and Alai lai Village is situated just outside of the concessions southern border (*Figure 8.31*).

Figure 8.31 Noise Sensitive Receptors in the Study Area



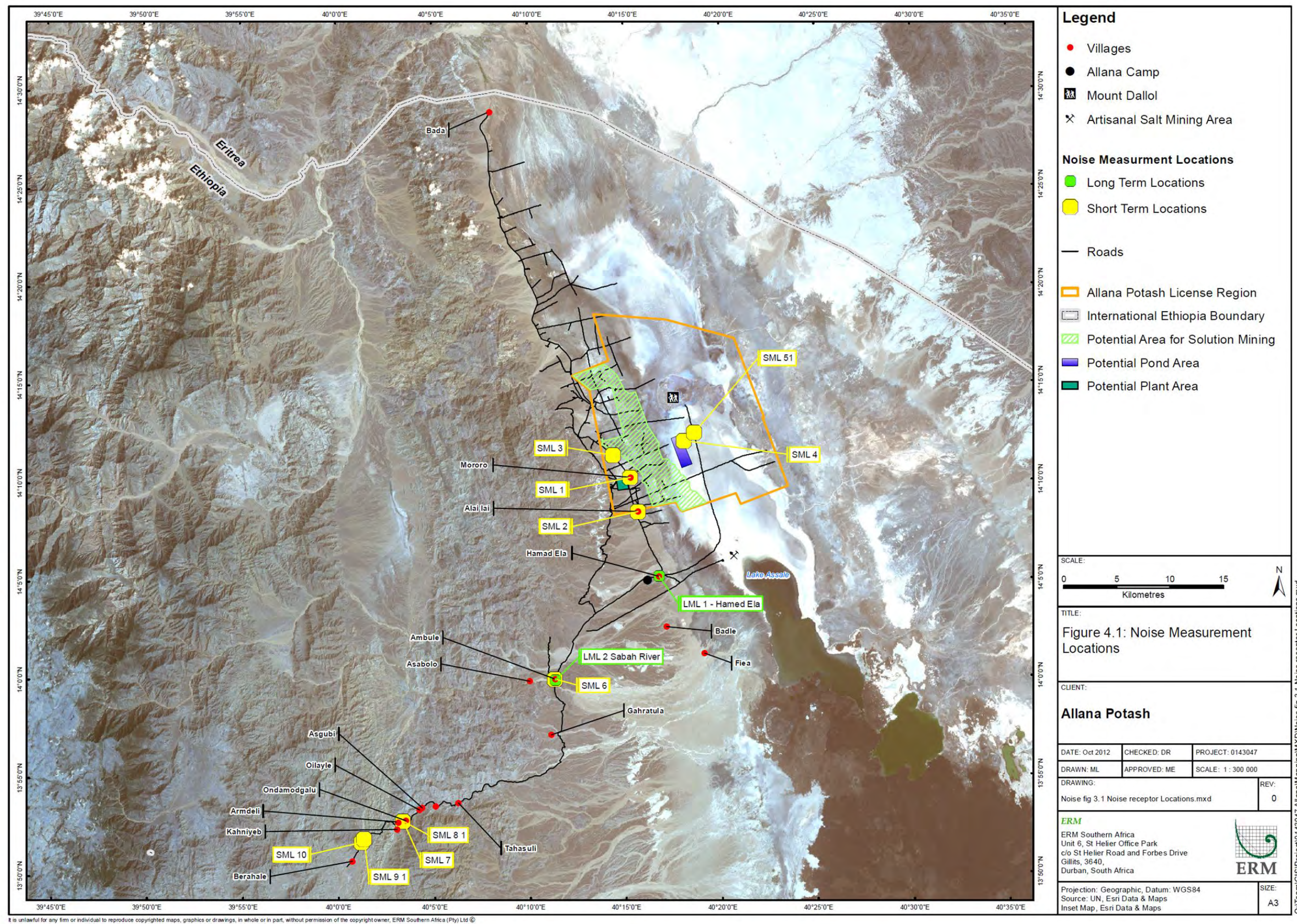
Baseline Noise Levels

An overview of the Study Area highlighting the location of the proposed Project, baseline noise measurement locations and noise assessment locations are shown in *Figure 8.32* and are listed in *Table 8.12*.

Table 8.12 *Existing Ambient Noise Levels in the Study Area*

Location ID	Village	Population	Distance from Concession Area Boundary (m)	Nearest Noise Survey Location (distance)
NSR1	Mororo Village	32	Inside the concession boundary	SML1 (110 m)
NSR2	Alai lai	32	200	SML2 (340 m)
NSR3	Hamad Ela Village	3,000 to 200 people (from peak to low season)	6,500	LML 1 (340 m)
NSR4	Ambule Village	200	16,600	SML 10 (200 m)
NSR5	Tahasuli Village	~250	34,500	SML 6 (180 m)

Figure 8.32 Baseline Noise Measurement Locations within the Study Area



Ambient noise has been measured to determine background noise levels for the Study Area, by undertaking long-term measurements (LML) during the day and night and a series of attended short-term measurements (SML) during the day over the period 17 to 22 May 2012. The techniques and results of each of these measurements are discussed below.

Long Term Unattended Measurements (LML)

LML were collected at a total of two locations (refer *Figure 8.32*). LML 1 is situated south of the Study Area and LML 2 to the south west. These two locations were representative of the acoustic environment, located in and around the Study Area.

At each long term location, a minimum of 24 hours continuous noise monitoring was conducted to provide a description of the noise levels and to understand the variation between the daytime and night time periods.

The results of measurements recorded at the two long-term noise monitoring locations (LML 1 and LML 2) are summarised in *Table 8.13* below.

Table 8.13 Unattended (Long-term) Noise Monitoring Results

Measurement Location	Measurement Parameter, dB(A)		
LML 1 - Hamad Ela Village	LA10,T	LAeq,T	LA90,T
Daytime	55	53	39
Night time	50	49	35
LML 2 - Ambule Village	LA10,T	LAeq,T	LA90,T
Daytime	51	48	42
Night time	45	44	37

LA10 - The percentile sound pressure level exceeded for 10% of the measurement period with 'A' frequency weighting calculated by statistical analysis.

LAeq,T - Equivalent continuous sound pressure level with 'A' frequency weighting - The value of the sound pressure level of a continuous steady noise that, a measurement interval of time (t), has the same mean square sound pressure as the sound under consideration whose level varies with time.

LA90 - The percentile sound pressure level exceeded for 90% of the measurement period with 'A' frequency weighting calculated by statistical analysis.

The acoustic environment at Hamad Ela (LML 1) is typical of the type of village environment where daytime levels are higher than night time when there is usually less activity. Night time noise levels are relatively low, and are dominated by human activity.

Noise levels at Ambule Village (LML 2), are 4 to 5 dB lower than Hamad Ela Village during the daytime and night time. These lower levels are generally because the village is smaller.

Short Term Attended Measurements (SML)

A series of attended short-term (day time) measurements (10 locations) were undertaken to identify the nature, character and dominant noise sources surrounding and within the Study Area (refer *Figure 8.32* above). Short-term measurements were also undertaken at one long-term (LML 2) location to verify the long-term measurement. The results of these measurements are presented in *Table 8.14* below.

Table 8.14 *Attended (Short-term) Noise Monitoring Results*

Location ID	Description	GPS Co-ordinates	LAeq dB(A)	LA90 dB(A)	LA10 dB(A)	LAmix dB(A)
SML 1	Mororo Village	N 14 10' 08.3" E 040 15' 16.3"	33	22	37	44
SML 2	Alai lai Village	N 14 08' 14.9" E 040 15' 40.6"	25	16	27	45
SML 3	Northern Concession	N 14 11' 19.8" E 040 14' 25.2"	33	27	35	47
SML 4	Existing Weather Station	N 14 12' 00.7" E 040 18' 07.6"	27	16	30	47
SML 5 ¹	Salt Flats	N 14 12' 25.5" E 040 18' 39.9"	58	47	61	73
SML 6	Sabah River	N 13 59' 53.3" E 040 11' 19.5"	45	35	48	64
SML 7	Tahasuli 1	N 13 52' 44.3" E 040 03' 25.3"	54	29	53	84
SML 8 ¹	Tahasuli 2	N 13 52' 44.3" E 040 03' 25.3"	44	39	52	60
SML 9 ¹	South Berahale Town	N 13 51' 48.9" E 040 01' 21.1"	38	33	47	52
SML 10	Middle Berahale Town	N 13 51' 41.2" E 040 01' 15.7"	53	41	55	72

¹: high winds during these measurements were present and cannot be considered as representative and have not been used in this assessment

Measured noise levels at SML 1, SML 2, SML 3 and SML 4 are considerably lower than the other measurement locations. These locations have the lowest measurements and have similar noise environment, composed mainly of natural sounds from the wind and livestock (goats) with very little human influence. Whereas, noise levels at SML 6, SML7 and SML 10 were observed to be considerably higher and were dominated by human activity and village infrastructure such as water pumps children, talking and trucks passing by on nearby roads.

8.3 *BIOLOGICAL ENVIRONMENT*

8.3.1 *Vegetation Classification*

Limited information is available about the vegetation of Ethiopia but the most reliable sources estimate the total number of plant species in the country to be

between 6,500 and 7,000, with 12% of these being endemic (Convention on Biodiversity, 2009). The Conservation Strategy of Ethiopia (CSE, 1997) identifies the following broad vegetation types in Ethiopia (Lemenih and Kassa, 2011):

1. Dry Evergreen Afromontane Vegetation;
2. *Combretum* – *Terminalia* (broad-leaved) Deciduous Woodlands;
3. *Acacia* – *Commiphora* (small-leaved) Deciduous Woodlands;
4. Lowland Dry Forests;
5. Riparian (wetland) Vegetation;
6. **Lowland Semi-Desert and Desert Vegetation**; and
7. Evergreen Scrubs.

The above classification places the Study Area within the **Lowland Semi-Desert and Desert Vegetation Type**, which dominates the dry areas and consists mostly of stunted deciduous trees, shrubs (*Acacia* and *Commiphora* sp.) and tough grass species (Ash and Atkins, 2009; CBD, 2009). Succulent species of the stapeliad group and *Euphorbia* sp. have been reported to grow on limestone outcrops (Friis and Ryding, 2001). Plant diversity is low and is a reflection of the low rainfall for the region as well as extremely high temperatures. Few areas however, are completely devoid of any vegetation. Occurring at altitudes below 500m, this unit extends from the Afar Depression to Ogaden, around Lake Chew Bahir and the Omo Delta. Some characteristic species for the vegetation type are listed in *Table 8.15*.

Table 8.15 *Floral Species Characteristic of the Lowland Semi-desert and Desert Vegetation Type*

Growth Form	Species
Trees & Shrubs	<i>Acacia brichettiana</i> ; <i>Acacia oerfota</i> ; <i>Acacia stuhlmanii</i> ; <i>Acacia tortilis</i> ; <i>Acacia walawlensis</i> ; <i>Balanites aegyptiaca</i> ; <i>Boswellia ogadenenesis</i> ; <i>Commiphora longipedicillata</i> ; <i>Commiphora staphyleifolia</i> , <i>Hyphaene thebaica</i> .
Succulents	<i>Euphorbia doeloensis</i> ; <i>Euphorbia ogadensis</i> ; <i>Aloe</i> sp.
Grasses	<i>Chrysopogon aucheri</i> ; <i>Dactyloctenium aegyptim</i> ; <i>Panicum turgidum</i> .
Sources: CBD (2009); Friis & Ryding (2001)	
Bold text indicates species identified on site	

8.3.2 Conservation Priorities

The IFC Performance Standard 6 requires an understanding of conservation initiatives in the areas surrounding the Study Area of influence. Understanding these conservation activities can have an influence on the classification of Modified, Natural and Critical Habitats¹.

¹ GN57 further presents examples of internationally and/or nationally recognised areas of high biodiversity value will likely qualify as critical habitat.

Proximity of Areas of Conservation Importance to the Study Area

The proximity of the Project Area to areas of conservation importance have been discussed below. In accordance with IFC PS6, internationally and nationally recognised areas of high biodiversity value will qualify as Critical Habitat. Critical Habitat includes Key Biodiversity Areas which encompass inter alia Ramsar Sites, Important Bird Areas (IBAs), Important Plant Areas (currently none recognised in Africa) and Alliance for Zero extinction Sites (AZE). The definition of Critical Habitat can also extend to areas determined to be irreplaceable or of high priority/significance based on systematic conservation planning techniques carried out at the landscape and/or regional scale by governmental bodies, recognized academic institutions or other relevant qualified organisations.

Protected Areas and Forest Reserves

No protected areas occur within or near the vicinity of the Study Area of influence. The nearest protected area is the Dessa A Forest Reserve, approximately 40km south-west of the Allana Concession. This reserve is located within mountainous habitat that will not be affected by activities associated with the proposed Project.

The Mille-Serdo Wildlife Reserve (8,766km²) occurs approximately 230km south of the Study Area. This reserve is continuous with the Yangudi Rassa National Park (4,730km²) and controlled hunting areas that form a vast protected area complex. This vast reserve includes extensive habitat that shows a resemblance to the Study Area in an un-impacted state, supports African Wild Ass, Beisa Oryx and a population of African Lion (Conservation Force, 2002).

Approximate boundaries of protected areas in northern Ethiopia are presented in *Figure 8.33* based on the Protected Planet website (2012); however, the accuracy of protected area boundaries could not be verified.

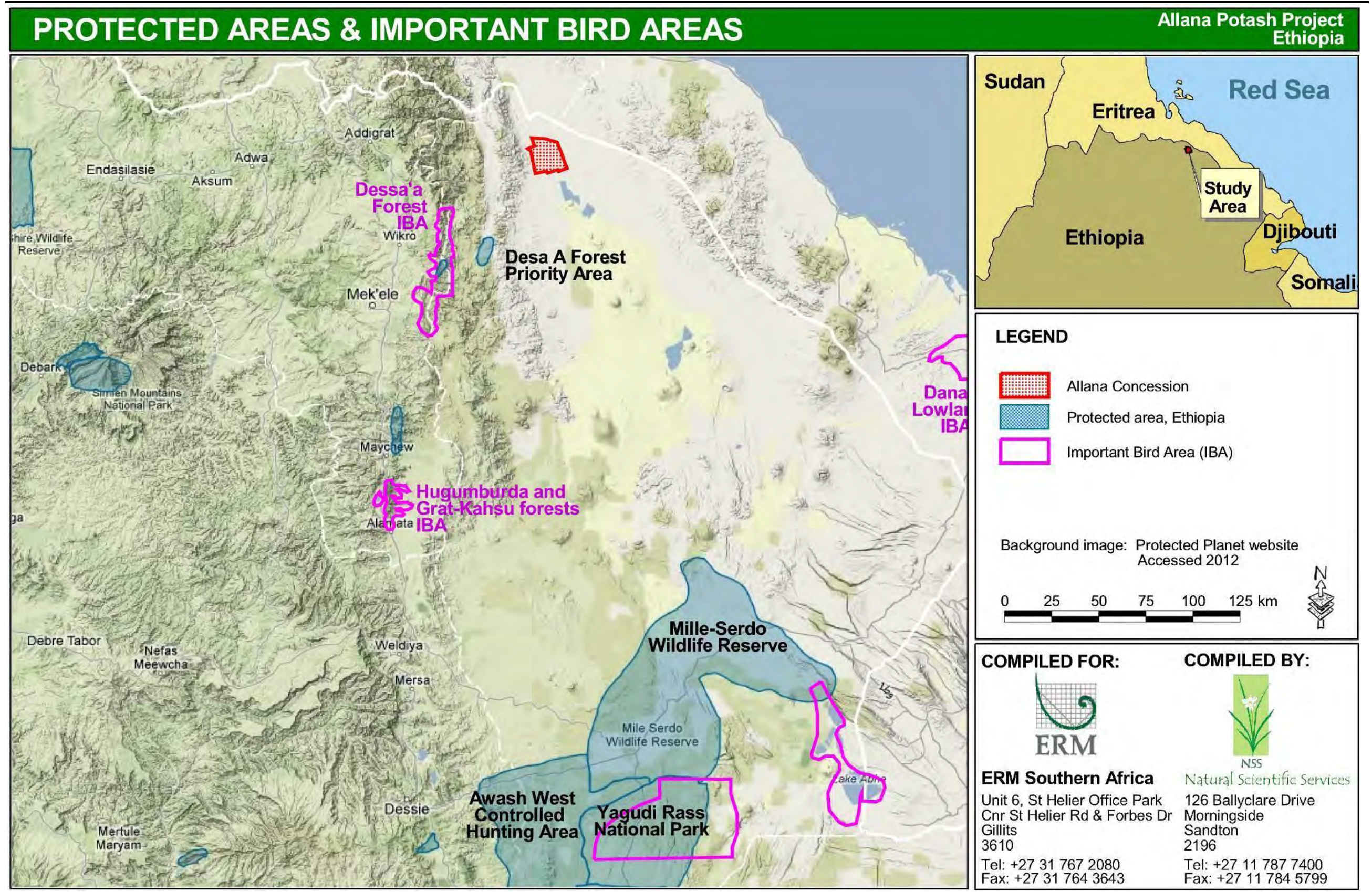
Important Bird Areas

A total of 69 Important Bird Areas (IBAs) are recognised within Ethiopia, but are restricted to the highlands, southwards towards the Djibouti border and the Mille-Serdo Wildlife Reserve. IBAs in the greater vicinity of the Allana Concession are illustrated in *Figure 8.33*. The closest IBAs to the study site are associated with the Desa A Forest Priority Area. Others occur along the Red Sea coast within Eritrea. No IBAs will be affected by development of the Dallol Potash Project.

Ramsar Wetlands

Ethiopia was not a signatory to Ramsar at the time of this study, and no Ramsar wetlands are of relevance to the Allana Study Area.

Figure 8.33 Protected Areas and Important Bird Areas of Northern Ethiopia Relative to the Allana Concession



Source: NSS, (2012)

Alliance for Zero Extinction Sites

The Alliance for Zero Extinction (AZE) is an IFC recognised initiative of non-governmental conservation organisations that identifies locations where species evaluated to be endangered or critically endangered are restricted to single remaining sites, thus providing a tool to defend against many of the most predictable species losses.

Five AZE sites are recognised within Ethiopia for the protection of the Walia Ibex, Ethiopian Amphibious Rat, Yalden's Desmomys (rodent), Haremma Shrew and the Liben Lark. None occur within the Danakil Depression and there would be no impact on AZE species due to the proposed Project.

Horn of Africa – Biodiversity Hotspot

Biodiversity hotspots (areas of high ecological importance) cover large areas on a regional scale and are not included within the criteria for designation of critical habitats. The Horn of Africa is recognised internationally as a biodiversity hotspot (Conservation.org website, 2012) and is of interest to this ESHIA. This hotspot is centred on the arid horn, east of the Ethiopian Highlands, and also covers the Rift Valley that divides the Ethiopian Highlands into two major blocks, the xeric bush lands of north-eastern Kenya and the southern coastal parts of the Arabian Peninsula. Politically, this area includes most of Somalia, all of Djibouti, parts of Ethiopia where the study area is located, Eritrea, Kenya, Yemen and Oman, and a small piece of eastern Sudan (*Figure 8.34*). Also included in this hotspot are the Socotra Archipelago off the coast of north-eastern Somalia, and a few hundred tiny islands in the Red Sea.

The Horn of Africa is one of only two hotspots that are entirely arid, the other being the Succulent Karoo in south-western Africa. It is believed that these two arid regions were formerly united by an “arid corridor” during drier and colder periods in the Pleistocene, and possibly also in the earlier Tertiary.

Figure 8.34 Extent of the Horn of Africa Biodiversity Hotspot



Source: Conservation.org website, (2012)

A relatively large portion of the aforementioned biodiversity hotspot has very limited flora (for example, the Danakil Depression), and most of the plants known from the region actually occupy only a small percentage of the area. The dominant vegetation type is *Acacia-Commiphora* bushland, although various other vegetation types do occur.

Nearly 220 mammal species are found in the Horn of Africa, although only about 20 are endemic to the hotspot, and of the 697 bird species regularly recorded there, 24 are endemic. The Horn of Africa's highest levels of endemism occur among reptiles, with more than 90 of around 285 species found nowhere else on earth. Amphibians are however relatively poorly represented. There are an estimated 100 species of freshwater fish in the Horn of Africa, about 10 of which are endemic.

The Horn of Africa is under heavy pressure from anthropogenic impacts and is one of the most degraded hotspots in the world, with only about 5% of original habitat in relatively pristine condition. Nearly all of the land area is used for grazing, mainly by camels, goats and sheep. Overgrazing and subsequent land degradation is a problem in large areas of the hotspot, particularly near watering points. A serious barrier to conservation activities in this hotspot is the lack of governance and political instability, while uncontrolled hunting, particularly of ungulates, presents a serious threat.

Potential Species of Conservation Concern

A desktop analysis of faunal species that could potentially occur in the Study Area has been hampered by a general lack of literature on the biotic environment of the Danakil Depression. Lists were nevertheless compiled for various faunal groups, with the results summarised in *Table 8.16*. Prominent Red Data species are discussed thereafter.

Table 8.16 *Overview of Potential Diversity of Species and Number of Red Data Species for the Danakil Depression*

Faunal Group	Potential Diversity	Potential Red Data Species
Mammals	75	8
Birds	59	6
Reptiles	24	not relevant
Fish	6	2

Potential Red Data Mammals

Table 8.17 presents a list of Red Data mammal species (excluding bats) that could potentially occur in the Danakil Depression, based on data extracted from the IUCN Red Data List (2012). Two of these species, Striped Hyena and Dorcas Gazelle were observed to be present within the Allana Concession (*Section Error! Reference source not found.*). Habitat exists for African Ass and Beisa Oryx and the proposed Project is located within their natural range, but they are only known to occur further south. Habitat exists for leopard, which adapt well to desert environments but their presence in the Study Area was not confirmed.

Table 8.17 Red Data Mammals with a Possible Occurrence in the Danakil Depression

Species Name	Common Name	Status	Potential Occurrence
<i>Hyaena hyaena</i>	Striped Hyena	NT	Present
<i>Panthera pardus</i>	Leopard	NT	Possible
<i>Gazella dorcas</i>	Dorcas Gazelle	VU	Present
<i>Nanger soemmerringii</i>	Soemmerring's Gazelle	VU	Unlikely
<i>Oryx beisa</i>	Beisa Oryx	NT	Unlikely
<i>Equus africanus</i>	African Ass	CR	Unlikely

Bold text indicates species known to be present

NT - Near Threatened with Extinction – a classification used on the IUCN Red List for non-threatened species.

VU - Vulnerable to Extinction – a classification used by the IUCN Red List for threatened species.

CR - Critically Endangered with Extinction – a classification used by the IUCN Red List for highly threatened species.

Possible Red Data Bird Species

A total of six Red Data birds could potentially occur within the Study Area of influence based on data presented in the IUCN Red Data List (2012), of which five species are vultures (Table 8.18). Egyptian Vultures (*Neophron percnopterus*) were observed in the Study Area of influence feeding on an old camel carcass. Vultures are typically wide-ranging birds and a variety of species could occur at a large fresh camel carcass and their presence is thus considered possible.

Table 8.18 Red Data Birds with a Possible Occurrence in the Danakil Depression

Species name	Common name	Status	Potential occurrence
<i>Emberiza cineracea</i>	Cinereous Bunting	NT	Unlikely
<i>Gyps africanus</i>	White-backed Vulture	EN	Possible
<i>Gyps rueppellii</i>	Rueppell's Griffon	EN	Possible
<i>Necrosyrtes monachus</i>	Hooded Vulture	EN	Possible
<i>Neophron percnopterus</i>	Egyptian Vulture	EN	Present
<i>Torgos tracheliotos</i>	Lappet-faced Vulture	VU	Possible
<i>Phoeniconaias minor</i>	Lesser Flamingo	NT	Unlikely

Bold text indicates species known to be present

Shallow soda lakes are preferred feeding and breeding grounds of Lesser flamingos (*Phoeniconaias minor*), and these birds are well known for frequenting lakes within the rift valley of Ethiopia but no evidence of their presence in Lake Assale has been found in the literature. It is possible that the salinity levels of Lake Assale exceed the habitat requirements for the crustaceans that flamingos depend upon, and their presence is thus not considered possible in the Study Area of influence.

Possible Red Data Reptiles

A conservative list of 24 reptile species was compiled for the Danakil Depression, but the true diversity of reptiles could potentially be much higher. Insufficient assessment of the threatened status of reptiles has been conducted throughout Africa and it is not possible to present a list of Red Data species that could potentially occur there.

Possible Red Data Fish

A total of three fish species were documented in the literature with a possible occurrence in the Danakil Depression; however, three species not included in that list were identified in the Study Area of influence (Table 8.19).

Table 8.19 Red Data Fish with a Possible Occurrence in the Danakil Depression

Species Name	Common Name	Status	Potential Occurrence
<i>Danakilia franchettii</i>	-	EN	Unlikely
<i>Aphanius stiasnyae</i>	Lake Afdera Killifish	EN	Possible
<i>Aphanius dispar</i>	Killifish	NE	Present
<i>Barbus bynni bynni</i>	Nile Barb	LC	Unlikely
<i>Garra dembecha</i>	-	LC	Present
<i>Garra dembeensis</i>	Dembea Stone Lapper	LC	Present

Bold text indicates species known to be present

8.3.3 Terrestrial and Aquatic Habitat

The vegetation and aquatic systems in the Study Area have been separated into the following three broad terrestrial habitats¹ and three aquatic habitats:

1. Bare Lands.
2. Alluvial Habitats.
3. Hyphaene-Cyperus Salt Pan Fringe.
4. Salt Pan, Lake Assale (saline water).
5. Sabah River (freshwater).
6. Groundwater Fed Ponds and Streams.

Some of these are separated into variations and classified as either natural or modified habitats as listed and illustrated in Table 8.20 and Figure 8.35 respectively. These habitat types are also described in the paragraphs that follow thereafter.

¹ PS6 (see par 5) places emphasis on habitats which are classified as Modified, Natural or Critical Habitat. This classification has a prominent influence on the subsequent need for mitigation measures to address potential impacts.

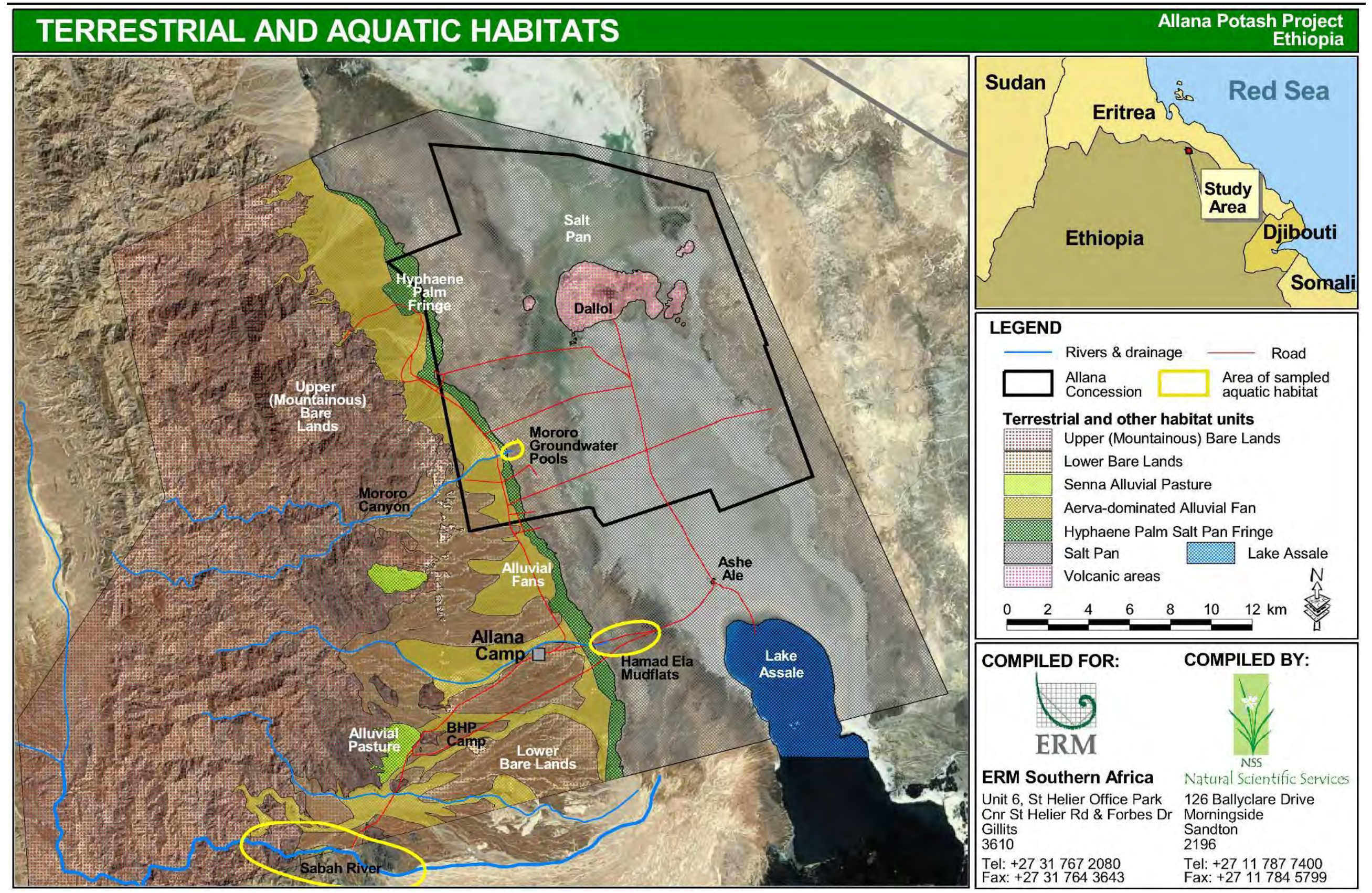
GN11 states that a classification and mapping of habitats is required in a Baseline Assessment.

Table 8.20 *Habitats Identified On Site, Extent of Coverage and Natural/Modified State*

Habitat Unit	Coverage Within The Allana Concession	Natural/ Modified State
Terrestrial Habitats		
Bare Lands		
• Upper (Mountainous) Bare Lands	0	Natural
• Lower Bare Lands	232.1ha (0.9%)	Natural
Alluvial Habitats		
• <i>Senna</i> Alluvial Pasture	0	Natural
• <i>Aerva</i> -dominated Alluvial Fans	970.4ha (3.8%)	Natural
<i>Hyphaene-Cyperus</i> Salt Pan Fringe	604.0ha (2.3%)	Natural
Aquatic Habitats		
Salt Pan, Lake Assale (and Dallol)	23 984.0ha (93%)	Not applicable
Sabah River (freshwater)	-	Modified
Groundwater fed ponds and streams		
• Mororo Groundwater ponds	-	Natural *
• Hamad Ela Mudflats	-	Natural *
* Includes Critical habitat		

Plant species diversity was low with 13 species recorded from 8 families. A continuously blowing hot wind, the ‘fire wind’, translated from the local term *hahaita harrur*, imposes significant heat stress on local plant species found within the Study Area (Aerts *et al.* 2006). Plants found here are adapted to withstand harsh environmental conditions and exhibit pubescent leaf properties as well as dwarfed growth form.

Figure 8.35 Habitats Identified in the Study Area of Influence



Bare Lands

Vast expanses of exposed rocky terrain border the outer periphery of the vegetated areas of the Study Area and support little to no vegetation, as observed on all the field visits (Figure 8.36). A few small populations of *Asparagus africanus* (Table 8.21 and Figure 8.36) were however, found to be growing on the more undulating parts of the Bare Lands. This habitat has been separated into the Upper Bare Lands which comprise a rugged mountainous terrain and the Lower Bare Lands consisting of rocky gentle hills and undulating plains. These two units are botanically similar with a virtual complete absence of vegetation apart from occasional *Asparagus africanus* plants, but have been mapped separately in Figure 8.35.

Figure 8.36 Bare Lands Habitat



Table 8.21 Plant Species found in the Bare Lands Habitat

Family	Species	Common Name
ASPARAGACEAE	<i>Asparagus africanus</i> Lam.	Wild Asparagus

Limited infrastructure has been created that traverses this habitat; however, anthropogenic (man-induced) impacts have not disrupted primary ecological functions or species composition over the majority of the area. This habitat is therefore classified as **Natural Habitat**¹.

Senna Alluvial Pasture

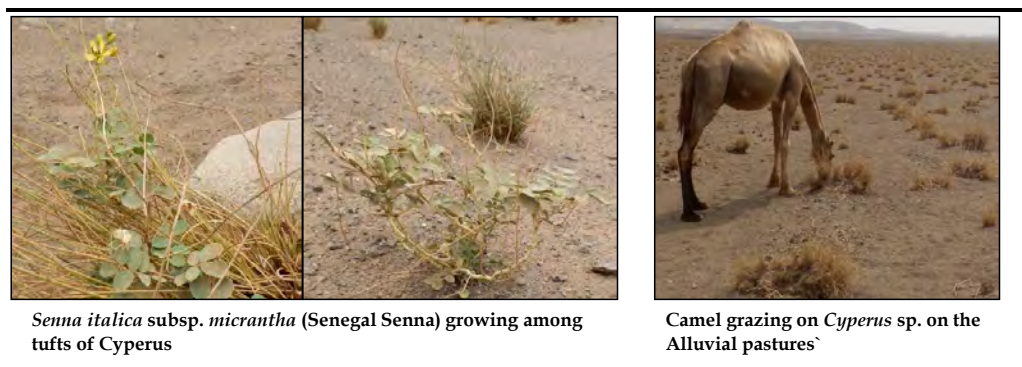
Adjacent to the Bare Lands (towards the east) is an area of fine sandy alluvial deposits unique to that of the surroundings with regard to its geology. This vegetation starts at the foot of gentle hills and consists of an open pasture lacking tall woody species. Confined to sandy soils, it supports a community of sedges (Table 8.22) and a small woody legume species, *Senna italica* subsp. *micrantha* (Figure 8.37). Legumes of the *Senna* genus are generally favoured food plants for camels (Figure 8.37) and many individual plants of this species show evidence of heavy utilisation. *Senna italica* is widespread and native to many African countries and is commonly found in grasslands as well as in disturbed areas.

¹ Classification of Natural Habitat according to PS6 (par 13)

Table 8.22 *Plant Species found in the Senna Alluvial Pasture*

Family	Species	Common Name
CYPERACEAE	<i>Cyperus</i> sp. (2 species)	Sedges
FABACEAE	<i>Senna italica</i> subsp. <i>micrantha</i>	Senegal Senna

Figure 8.37 *Senna Alluvial Pasture Habitat*



This habitat is well vegetated and the species are moderately palatable. The presence of *Senna italica* attracts livestock and the area is considered important for grazing. This species is not reported to offer particularly high nutritional value or palatability but may be preferred by livestock owing to the absence of other more suitable graze. The sedges are also grazed upon, although to a lesser extent, and the average plant height was approximately 0.4m.

This habitat covers a limited extent and is interrupted by the Allana airstrip and an important access road. The habitat is used as an important grazing area for camels and goats of the local Afar communities (Figure 8.37). Anthropogenic impacts have possibly disrupted some of the primary ecological functions but the area does not support a large proportion of plant or animal species of non-native origin. This habitat is therefore classified as **Natural Habitat¹** although it is partially modified.

Aerva-dominated Alluvial Fans

This habitat type exhibits minimal plant diversity, dominated primarily by herbaceous shrubs with occasional woody species (*Acacia* sp.) scattered throughout (Table 8.23). There is an obvious distinction between the loose pebbly soil that is typical of the Bare Lands habitat and the rocky, mixed-origin gravel that is derived from the alluvial fans (Figure 8.38). The latter is relatively well vegetated and provides habitat for monospecific stands of *Aerva javanica* (Figure 8.38), a hardy, erect shrub that is typically found in arid localities. *Aerva javanica* is both a halophyte (plant tolerant of high salinity) and a xerophyte (tolerant of dry conditions) and is widespread in arid and semi-arid localities in Africa and the Arabian Peninsula (Abideen *et al.* 2011;

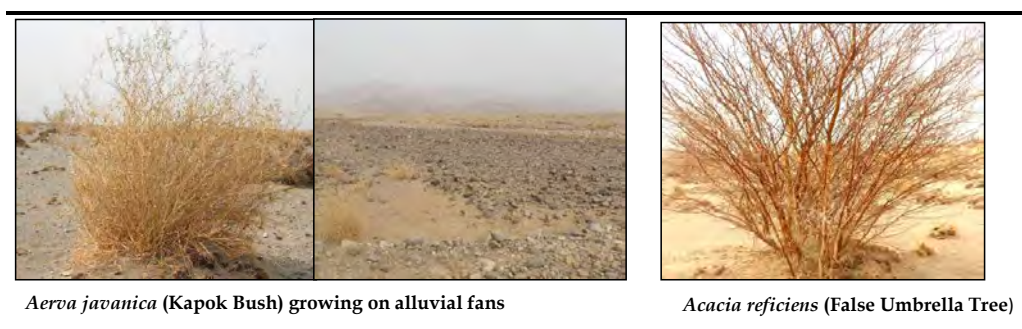
¹ Classification of Modified and Natural habitats according to PS6 (par 11 & 13)

Zahran and Willis, 2008). This species is naturalised in Australia. The average plant height in this unit was 0.4cm.

Table 8.23 *Plant Species found in the Aerva-dominated Alluvial Fans*

Family	Species	Common Name
AMARANTHACEAE	<i>Aerva javanica</i> (Burm.f.) Juss. ex Schult.	Kapok Bush
FABACEAE	<i>Acacia reficiens</i> (Wawra.)	False Umbrella Thorn
FABACEAE	<i>Acacia tortilis</i> (Forssk.) Hayne	Umbrella Thorn

Figure 8.38 *Aerva-dominated Alluvial Fans Habitat*



This habitat type can be considered as moderately palatable and the habitat offers some grazing potential. The potential for grazing is however comprised of a single dominant species that is generally only grazed upon when other, more palatable species are not available. *Aerva javanica* has been reported to be suitable graze for gazelles and goats but camels find it distasteful and will only consume it when faced with no alternative (Mahmoud, 2010). Camels are chiefly browsers rather than grazers and will consume the thorny twigs and leaves of the *Acacia* sp.

This habitat is the primary grazing grounds for livestock of the local Afar communities and supports important resources for wildlife. Primary access roads and lesser tracks traverse this area and are used by Allana and other mining operators in the area. Anthropogenic impacts have possibly disrupted some of the primary ecological functions but the area does not support a large proportion of plant or animal species of non-native origin. This habitat is therefore classified as Natural Habitat¹ although it is partially modified.

Hyphaene-Cyperus Salt Pan Fringe

Plant species diversity and abundance in this habitat type is high in comparison to other regions of the Study Area. This is owing to the relative abundance of groundwater that is channelled by a linear clay bed running in a southerly direction, allowing water to flow eastwards and up to the surface.

¹ Classification of Modified and Natural habitats according to PS6 (par 11 & 13)

Sedges and grass cover the majority of the area interrupted by clumps of Doum Palm, *Hyphaene thebaica* (Figure 8.39). Clumps of *H. thebaica* allow for wind born sediment accretion at their base, causing an increase in elevation around them. Large isolated clumps thus develop and create micro-habitats that provide refuge for small mammals and reptiles that can shelter under palm fronds.

Sedges and grasses are replaced towards the eastern periphery of this vegetation unit by linear monospecific stands of Salt Cedar, *Tamarix aphylla* (Figure 8.39). Soil conditions here are more saline in proximity to the salt pans. *T. aphylla* is a hardy shrub that is halophytic and develops deep taproots to access water. *Acacia* sp., although occurring as patches in most parts of the habitat type, were excluded from this margin as they are less tolerant of such high salinities.

Some parts of this habitat were dominated with stands of *Acacia* trees and shrubs that provide browse and cover for wildlife and livestock. Many of these *Acacia* shrubs were extensively browsed by camels, which play a significant role as a mega-herbivore in landscaping the habitat. Browsing by goats also occurs but has a lesser landscaping effect.

Populations of *Hyphaene thebaica* reached an average plant height of 2m with a maximum in excess of 4m and the *Tamarix aphylla* trees reached an average of 1.5m. Grazing potential for this habitat type is regarded as moderate. Fronds of *H. thebaica* are browsed by goats and this plant is used for sale as animal fodder. *Panicum turgidum* (Figure 8.39) is reported to be consumed by all livestock and seeds are also grazed on by seed-eating birds (Heneidy and Waseem, 2007). *T. aphylla* offers low protein and mineral content but has been reported to be browsed by camels. Species identified in this unit are listed in Table 8.24.

Figure 8.39 *Hyphaene-Cyperus Salt Pan Fringe Habitat*

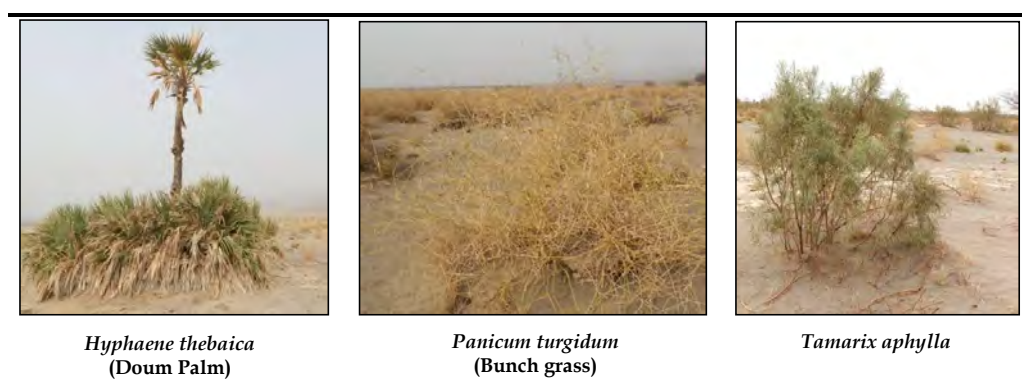


Table 8.24 *Plant Species found in Hyphaene-Cyperus Salt Pan Fringe*

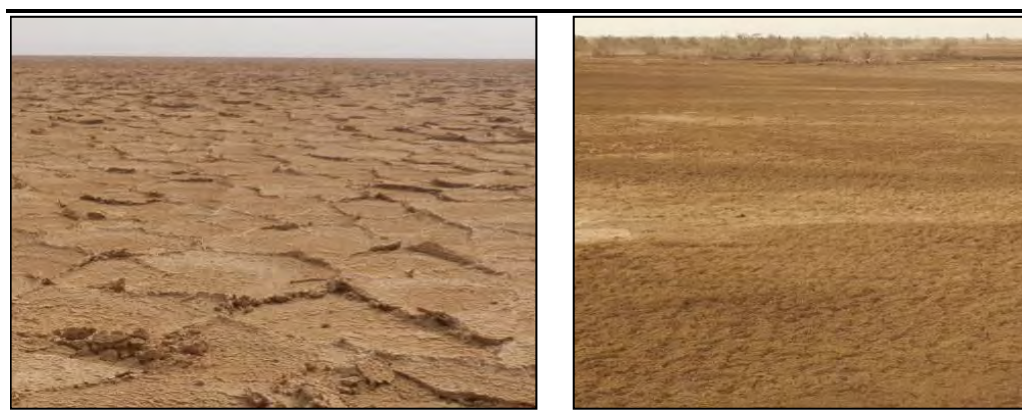
Family	Species	Common Name
AMARANTHACEAE	<i>Aerva javanica</i> (Burm.f.) Juss. ex Schult.	Kapok Bush
ARECACEAE	<i>Hyphaene thebaica</i> (L.) Mart.	Doum Palm
CAPPARACEAE	<i>Cadaba</i> sp.	
CYPERACEAE	<i>Cyperus</i> sp.	
FABACEAE	<i>Acacia reficiens</i> (Wawra.)	False Umbrella Tree
FABACEAE	<i>Acacia tortilis</i> (Forssk.) Hayne	Umbrella Thorn
FABACEAE	<i>Acacia</i> sp.	
POACEAE	<i>Panicum turgidum</i> Forssk.	Bunchgrass
TAMARICACEAE	<i>Tamarix aphylla</i> (L.) Karst.	Salt Cedar

The local Afar communities depend on this habitat for a variety of natural resources, including grazing. This habitat provides the surrounding buffer for restricted but important aquatic habitats on the salt pan edge. Limited pilot evaporation ponds have been developed by Allana within this habitat. Anthropogenic impacts have possibly disrupted some of the primary ecological functions but the area does not support a large proportion of plant or animal species of non-native origin. This habitat is therefore classified as **Natural Habitat¹** although it is partially modified.

Salt Pans

The *Tamarix aphylla* stands define the border the edge of the *Hyphaene-Cyperus* Salt Pan Fringe before being completely replaced by open salt pans. This salt pan habitat is extensive and completely devoid of any vegetation (*Figure 8.40*), as salinities here far exceed the range of tolerance for halophytic plant species. This area is however, not completely uninhabited, and small arthropods are reported to be found here in abundance after rains.

Figure 8.40 *Salt Pan Habitat*



¹ Classification of Modified and Natural habitats according to PS6 (par 11 & 13)

The Salt Pan habitat does not support any detectable biodiversity values and has thus not been classified as **either a Natural or modified habitat**.

Aquatic Habitats

As is mentioned in *Section 8.2.3* above, the following four aquatic systems were present in and around the Study Area (*Figure 8.35*):

- Hyper-saline groundwater pools at Mororo Village;
- Hyper-saline mudflats south of Hamad Ela Village;
- Sabah River (freshwater); and
- Lake Assale.

Hyper-saline Groundwater Pools at Mororo Village

This small aquatic system on the edge of the salt pan consists of a series of four small pools up to 1.5m deep. The site is surrounded by low-growing *Tamarix* bushes that form the eastern edge of the Salt Pan Fringe habitat (*Figure 8.41*). There was no noticeable flow into the pools and they must therefore be supplied by groundwater flows emanating from the Mororo Canyon that originates in the mountainous terrain over 20km away. The water is hot due to the limited volume and high ambient temperatures. The salinity was also noted to be high, although some variation was encountered.

The small Afar settlement of Mororo Village has established nearby with a large herd of goats. Considerable faunal activity was apparent with evidence of Striped Hyena, Desert Sand Fox and Gazelle, but may not have been directly attributable to the presence of the pools. These ponds support viable populations of little Killifish (*Apahnius dispar*) and a diversity of aquatic invertebrates. These observations provide evidence that ecological functions have not been disrupted and the habitat is thus classified as **fully Natural**¹.

Figure 8.41 *Hyper-saline Groundwater Seepage Pools at Mororo Village*



¹ Classification of Natural habitat according to PS6 (par 13)

Hyper-saline Mudflats South of Hamad Ela Village

This small stream sustained by groundwater flows from the mountainous areas extended into the salt pan in the greater vicinity of Hamad Ela Village. A limited flow was noticeable in the upper stretches of the stream at the time of the study. Salinity levels were high but there were abundant fish and a limited diversity of invertebrates. Lower stretches of the stream were characterised by extended pools of standing water greater than 1.5m deep (Figure 8.42). The salinity levels there exceeded the capacity of available equipment for *in situ* measurements and there was no evidence of any fish or invertebrates.

The stream is located alongside the camel route used to transport vast quantities of salt from the pan through to Berahale Town; however, the high salinity would render the water unpalatable for camels and salt harvesters. Extensive litter and informal latrines were observed in the near vicinity of the stream. Abundant evidence of Striped Hyena and Desert Sand Fox were observed in the near vicinity. These observations thus suggest that this habitat is not pristine however natural ecological functions continue in the upstream stretches of this habitat. The lack of living forms in the lower stretches is the result of natural influence of the high salinity emanating from the adjacent salt pan. This habitat is therefore classified as **Natural Habitat¹** although some modifications occur.

Figure 8.42 *Hyper-saline Mudflats South of Hamad Ela Village*



Sabah River

The Sabah River is a fast eastward-flowing perennial freshwater river with a very different character from other aquatic systems in the Study Area. The river bed was dominated by gravel, sand and cobbles and there was evidence that the river dramatically increases in volume during flood events, which occurred within a week of the wet season baseline was completed. The water was well oxygenated due to the healthy flow. Riparian vegetation consisting of large palms (*Hypaene thebaica* and *Phoenix* sp.) and sedges were present but discontinuous along the banks.

¹ Classification of Modified and Natural habitats according to PS6 (par 11 & 13)

The abundant availability of freshwater resulted in significant community settlement with some cultivation (Figure 8.43). Road crossings and vehicle washing were having an impact on the integrity of the system, to the extent that this is described as a **Modified Habitat**¹.

Figure 8.43 Sabah River



Lake Assale

The northern edge of Lake Assale, also known as Lake Karum, was visited during the study but no evidence of any living forms was evident there. The lake is known to be deeper in the south but no data has been found on the average depth of Lake Assale. It has a vast shallow component within the Study Area of influence (Figure 8.44) that fluctuates in extent in response to rainfall, groundwater flows, flooding of the Sabah River and possibly also geological activity. The lake bottom consists of extensive salt crusts and the salinity level there is expected to be similar to levels recorded at Aquatic sites AP05 and AP06 which were located in the salt pan. No literature is available on biodiversity associated with this lake and it is unlikely that any species would tolerate the high salinity. This habitat was not assessed in the field and the **Natural/Modified state** has therefore not been classified.

Figure 8.44 Northern Edge of Lake Assale



¹ Classification of Modified and Natural habitats according to PS6 (par 11)

8.3.4

Terrestrial and Aquatic Fauna*Mammals*

A limited diversity of mammal species was observed, evidence of their presence seen or reliably reported to be present within the Study Area of influence. The list of species detected is presented in *Table 8.25* and *Figure 8.45* locations of important sightings are shown in *Figure 8.46* and descriptions presented thereafter. This map shows the majority of the mammal sightings were associated with the Salt Pan Fringe where the highest vegetation density occurred. This correlation is possibly due to the best food and prey resources being available there, and the greatest availability of cover for refuge purposes.

Table 8.25 *Mammal Species Observed within the Study Area*

Family	Species	Common Name	Conservation Status & (Pop. Trend)	Identification Method
HYAENIDAE	<i>Hyaena hyaena</i>	Striped Hyaena	NT (decreasing)	Spoor
HYAENIDAE	<i>Proteles cristata</i>	Aardwolf	LC (stable)	Reported *
CANIDAE	<i>Vulpes pallida</i>	Desert Sand Fox	DD (unknown)	Sighting
CANIDAE	<i>Vulpes rueppellii</i>	Rüppell's Fox	LC (unknown)	Sighting
BOVIDAE	<i>Gazella dorcas</i>	Dorcas Gazelle	VU (decreasing)	Sighting
EQUIDAE	<i>Equus africanus</i>	African Wild Ass	CR (decreasing)	Reported offsite
MURIDAE	<i>Gerbillus dunni</i> *	Somalia Gerbil	LC (unknown)	Trapped
MURIDAE	<i>Gerbillus pusillus</i> *	Least Gerbil	LC (unknown)	Trapped

Identification: Kingdon (1997)

* Low level of confidence on the identification / presence

Figure 8.45 Mammal Species Observed within the Study Area



Spoor of Striped Hyena (*Hyaena hyaena*)



Desert Sand Fox (*Vulpes pallida*)

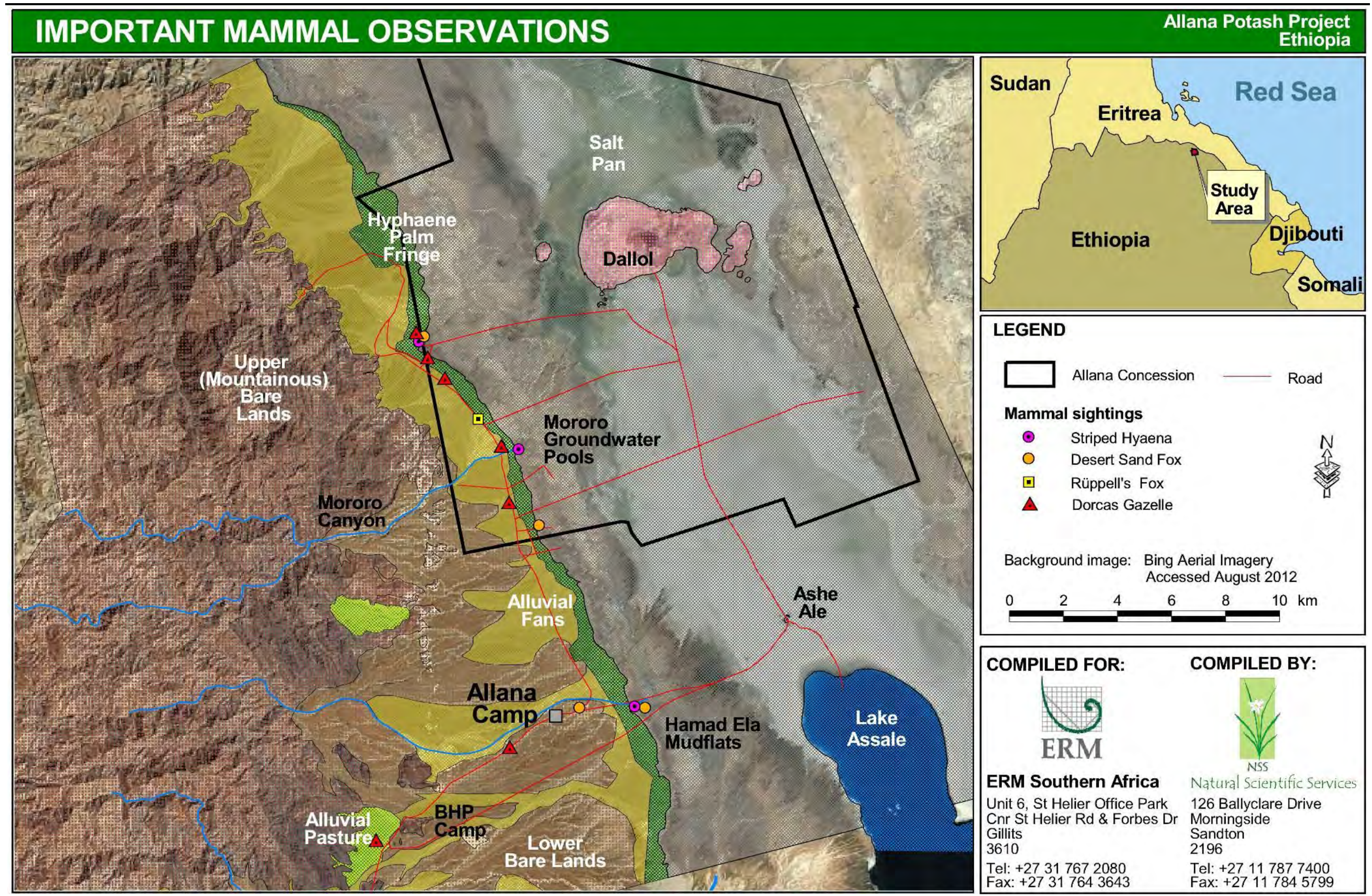


Dorcas Gazelle (male)
(*Gazella dorcas*)



Small [Least] Gerbil
Gerbillus [pusillus]

Figure 8.46 Locations of Important Mammal Sightings within the Study Area



Birds

A limited diversity of birds restricted to only 13 species was observed in the Study Area of influence during the current study. Combined with photographs and confident sightings made by Allana staff and contractors has expanded the bird list for the study area to 24 species (Table 8.26, Figure 8.47 and Figure 8.48).

Table 8.26 *Bird Species Observed within the Study Area (with additional observations reliably reported to be present)*

Common Name	Species	Conservation Status & (Pop. Trend)	Identification Method & Photo Credits
Somali Ostrich	<i>Struthio molybdophanes</i>	NE	Observed A. Hickman, M. Smith (Allana)
Great White Egret	<i>Egretta alba</i>	NE	Photo D. Hutton (ERM)
Little Egret	<i>Egretta garzetta</i>	LC (increasing)	Photo J. Wilkinson (Allana)
Western Reef Heron	<i>Egretta gularis</i>	LC (stable)	Photo M. Smith (Allana)
Grey Heron	<i>Ardea cinerea</i>	LC (unknown)	Photo M. Smith (Allana)
Goliath Heron	<i>Ardea goliath</i>	LC (stable)	Photo M. Smith (Allana)
Common Sandpiper	<i>Actitis hypoleucos</i>	LC (decreasing)	Photo M. Smith (Allana)
African Sacred Ibis	<i>Threskiornis aethiopicus</i>	LC (decreasing)	Observed (NSS)
Black Stork	<i>Ciconia nigra</i>	LC (unknown)	Photo M. Smith (Allana)
Egyptian Goose	<i>Alopochen aegyptiaca</i>	LC (decreasing)	Photo (NSS)
Garganey	<i>Anas querquedula</i>	LC (decreasing)	Photo J. Wilkinson (Allana)
Northern Shoveller	<i>Anas clypeata</i>	LC (decreasing)	Observed M. Smith (Allana)
Egyptian Vulture	<i>Neophron percnopterus</i>	EN (decreasing)	Photo (NSS)
White-backed Vulture *	<i>Gyps africanus</i>	EN (decreasing)	Photo M. Smith (Allana)
Black Kite	<i>Milvus migrans</i>	LC (unknown)	Photo M. Smith (Allana)
Augur Buzzard *	<i>Buteo augur</i>	LC (stable)	Observed M. Smith (Allana)
Corn Crane	<i>Crex crex</i>	LC (stable)	Photo M. Smith (Allana)
Three-Banded Plover	<i>Charadrius tricollaris</i>	LC (unknown)	Photo M. Smith (Allana)
Kentish Plover	<i>Charadrius alexandrinus</i>	LC (decreasing)	Photo M. Smith (Allana)
Chestnut-bellied Sandgrouse	<i>Pterocles exustus</i>	LC (stable)	Photo D. Rodewald (ERM)
Spotted Sandgrouse	<i>Pterocles senegallus</i>	LC (stable)	Photo (NSS)
Lichtenstien's Sandgrouse	<i>Pterocles lichtensteinii</i>	LC (stable)	Observed (NSS)
Speckled Pigeon	<i>Columba guinea</i>	LC (stable)	Photo (NSS)
Cape Turtle Dove	<i>Streptopelia capicola</i>	LC (increasing)	Photo (NSS)
Laughing Dove *	<i>Spilopelia senegalensis</i>	LC (stable)	Photo M. Smith (Allana)
Namaqua Dove	<i>Oena capensis</i>	LC (increasing)	Observed (NSS)
Short-Eared Owl	<i>Asio flammeus</i>	LC (decreasing)	Observed M. Smith (Allana)
Nightjar (2 species)	<i>Caprimulgidae sp.</i>	-	Photos M. Smith (Allana)
White-rumped Swift	<i>Apus caffer</i>	LC (increasing)	Photo: M. Everett (ERM)
Eurasian Hoopoe	<i>Upupa epops</i>	LC (decreasing)	Observed M. Smith (Allana)

Common Name	Species	Conservation Status & (Pop. Trend)	Identification Method & Photo Credits
Malachite Kingfisher *	<i>Alcedo cristata</i>	LC (stable)	Observed M. Smith (Allana)
Yellow-breasted Barbet *	<i>Trachypous margaritatus</i>	NE	Photo: M. Everett (ERM)
Greater Hoopoe-lark	<i>Alaemon alaudipes</i>	LC (decreasing)	Photo (NSS)
Black-crowned Sparrow-lark	<i>Eremopterix nigriceps</i>	LC (increasing)	Photo (NSS)
Barn Swallow	<i>Hirundo rustica</i>	LC (decreasing)	Observed (NSS)
White Wagtail	<i>Motacilla alba</i>	LC (decreasing)	Photo M. Smith (Allana)
Yellow Wagtail	<i>Motacilla flava</i>	LC (decreasing)	Observed M. Smith
Fan-tailed Raven *	<i>Corvus rhipidurus</i>	LC (decreasing)	Photo M. Smith (Allana)
White-rumped Babbler *	<i>Turdoides leucopygia</i>	LC (stable)	Observed M. Smith (Allana)
Somali Bulbul *	<i>Pycnonotus somaliensis</i>	NE	Photo M. Everett (ERM)
Common Redstart	<i>Phoenicurus phoenicurus</i>	LC (increasing)	Observed M. Smith (Allana)
Pied Wheatear	<i>Oenanthe pleschanka</i>	LC (stable)	Photo J. Wilkinson (Allana)
Isabelline Wheatear	<i>Oenanthe isabellina</i>	LC (stable)	Photo M. Smith (Allana)
Spotted Flycatcher	<i>Muscicapa striata</i>	LC (decreasing)	Photo M. Smith (Allana)
Southern Grey Shrike	<i>Lanius meridionalis</i>	NE	Photo (NSS)
Shrike sp. (Juvenile)	<i>Lanius sp.</i>	-	Photo J. Wilkinson (Allana)
House Sparrow *	<i>Passer domesticus</i>	LC (decreasing)	Photo M. Smith (Allana)

* Photographed at Berahale Town in a different habitat to the study area
Identification: Sinclair & Ryan (2003); G. Lockwood (pers. comm.)

As mentioned earlier in this report, the environmental conditions in the Study Area are extremely hot, which is not conducive to supporting an abundant diversity of birds. Birds are warm-blooded but lack the ability to sweat and thus cannot regulate their body temperature.

Figure 8.47 *Bird Species Observed within the Study Area (with additional observations reliably reported to be present)*



Great White Egret
Egretta alba



Black-crowned Sparrow-lark
Eremopterix nigriceps



Yellow-breasted Barbet
Trachypous margaritatus



White-rumped Swift
Apus caffer



Southern Grey Shrike
Lanius meridionalis



Cape Turtle Dove
Streptopelia capicola



Pied Wheatear
Oenanthe pleschanka



Garganey
Anas querquedula
(found dead at Mt. Dallol)



Barn Swallow
Hirundo rustica

Figure 8.48 *Bird Species Observed within the Study Area (with additional observations reliably reported to be present)*



Reptiles

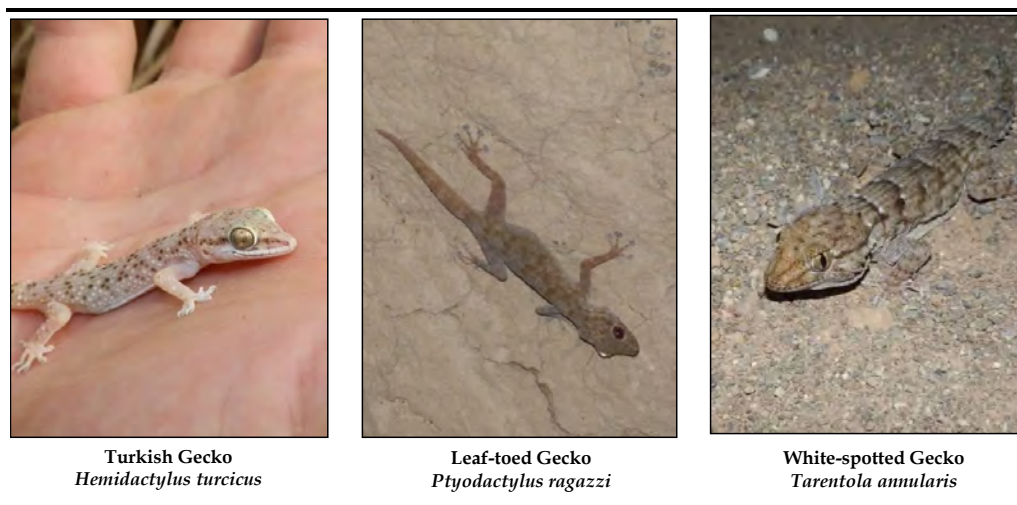
Few reptiles were seen; however, reptiles are notoriously difficult to comprehensively detect over short surveys. Most reptiles are elusive and actively avoid human encounters, and a species can frequently remain undetected within an environment for years despite active and detailed herpetological surveys. The diversity of reptiles detected is presented in *Table 8.27* and *Figure 8.49*.

Table 8.27 Reptile Species Observed within the Study Area

Family	Species Name	Common Name	Conservation Status & (Pop. Trend)
AGAMIDAE	<i>Agama annectens</i>	Agama Lizard	LC (unknown)
GEKKONIDAE	<i>Hemidactylus turcicus</i>	Turkish Gecko	LC (increasing)
GEKKONIDAE	<i>Ptyodactylus ragazzi</i>	Leaf-toed Gecko	NE
PHYLLODACTYLIDAE	<i>Tarentola annularis</i>	White-spotted Gecko	NE

Identification: www.ethiopia-herpetology.com

Figure 8.49 Reptile Species Observed within the Study Area



Frogs

A frog species (*Figure 8.50*) was found along the Sabah River and further south close to Berahale Town. Identification has not been confirmed; however, the species could belong to either the *Ptychadena* or *Amietia* genera. This species was abundant at both sites, but no evidence of any frogs was observed in or within the vicinity of the Study Area. All water sources in the Project Area had high salinity levels which are not tolerated by frogs due to their thin membranous skins. There is a possibility of some toad species, but these would only be detected after significant rains have fallen. Frogs are however not considered to be an important component of the faunal community in the vicinity of the Study Area, which is consistent with the description of the greater area.

Figure 8.50 Frog (*Ptychadena* or *Amietia* sp.) Photographed on the Sabah River



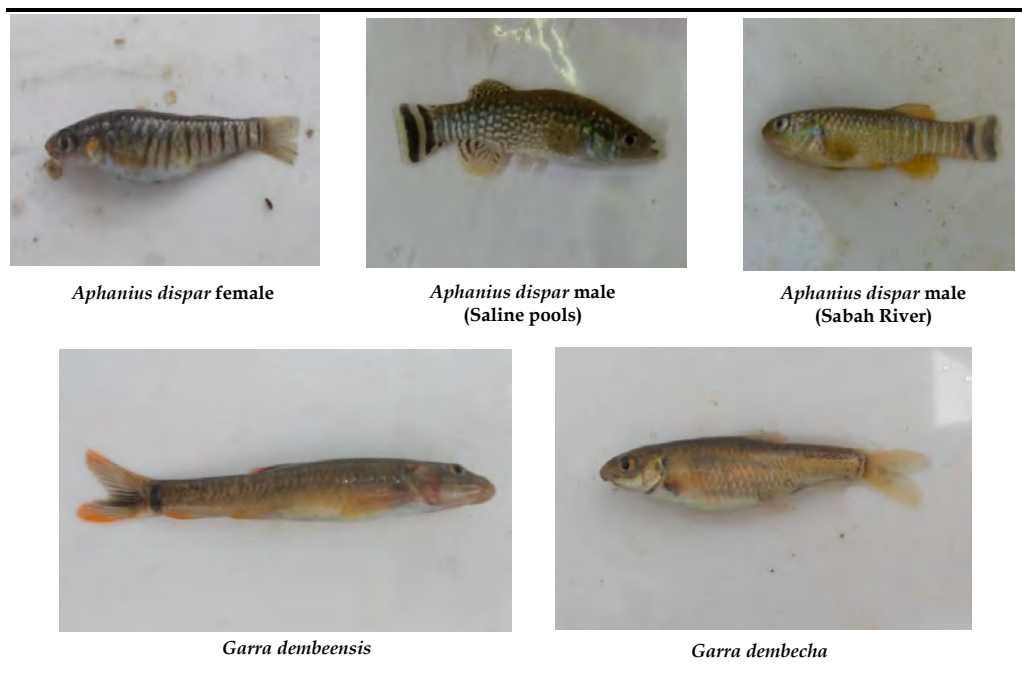
Fish

During the survey few fish species were found within and around the Allana Concession (Table 8.28 and Figure 8.51). The low diversity of fish species is due to the extreme salinity and general environmental conditions of the Study Area.

Table 8.28 *Approximate Fish Numbers per Species Sampled within the Study Area*

Sample Site	Fish Species, Conservation Status and Habitat Requirements		
	<i>Aphanius dispar</i> NE	<i>Garra dembecha</i> LC	<i>Garra dembeensis</i> LC
	Saline pools and flowing freshwater	Rocky habitats in flowing waters	Rocky habitats in flowing waters
Mororo Groundwater Pools			
AP01	26	-	-
AP02	19	-	-
AP03	40	-	-
Hamad Ela Mudflats			
AP04	36	-	-
AP05	-	-	-
AP06	-	-	-
Sabah River			
AP07	-	20	30
AP08	-	25	27
AP09	-	-	-
AP10	6	-	-

Figure 8.51 Fish Species Sampled within the Study Area



Invertebrates

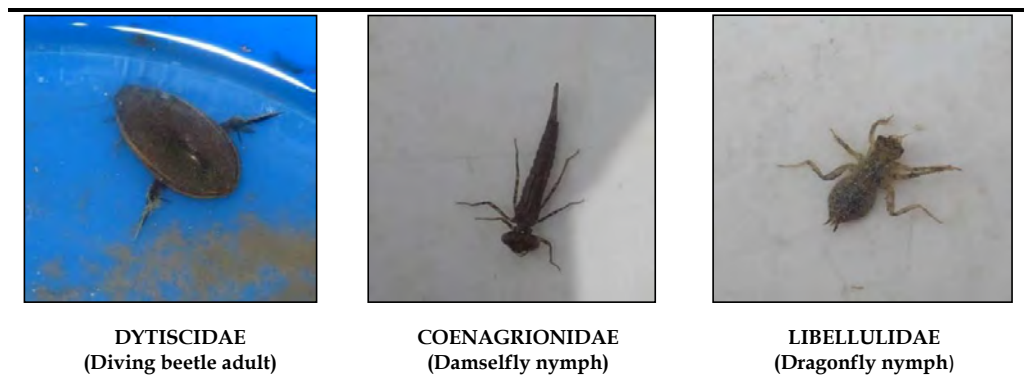
Aquatic Invertebrates

The aquatic invertebrate integrity in the Study Area was considered to be natural, with few changes that can be attributed to anthropogenic impacts. Only hardy species were detected due to the extreme environmental conditions experienced. There was a greater diversity (seven families) present in the Sabah River where conditions were more conducive to life (Table 8.29 and Figure 8.52). At each of the sites, the natural community variation was primarily based on habitat availability with a few site specific trends.

Table 8.29 Macro-invertebrate within the Study Area

DIVERSITY OF TAXA
Mororo Groundwater Pools
<ul style="list-style-type: none"> • COENAGRIONIDAE (Damselflies), • DYTISCIDAE (Diving beetles), • GOMPHIDAE (Dragonflies), • HYDRAENIDAE (Minute moss beetles). • LIBELLULIDAE (Dragonflies).
Hamad Ela Mudflats
<ul style="list-style-type: none"> • HYDRAENIDAE (Minute moss beetles)
Sabah River
<ul style="list-style-type: none"> • OLIGOCHAETA (Aquatic worms), • BAETIDAE (Mayflies), • CAENIDAE (Mayflies), • GOMPHIDAE (Dragonflies). • LIBELLULIDAE (Dragonflies) • CORIXIDAE (Water boatmen), • CHIRONOMIDAE (Midges).

Figure 8.52 Macro-invertebrates



Terrestrial Invertebrates

Few terrestrial insects were seen, which is thought to be due to the hot dry conditions that prevailed at the time of the survey. The diversity of insects is expected to increase dramatically following the rains, with many species having a short-lived adult phase. The dominant terrestrial insects observed were small black beetles of the TENEBRIONIDAE family (Figure 8.53) that scurry over the surface of the sand. These were abundant in the Salt Pan Fringe habitat where they presumably feed on vegetation detritus in the sand.

A single Praying Mantis (MANTODEA) was found in the salt pan fringe habitat and occasional dead moths were seen out on the pan (Figure 8.53). A dead African Monarch butterfly (*Chrysippus danaus*) was found in the vicinity of Mount Dallol, but is thought to have been a vagrant blown in from elsewhere.

Large Solifuge / Camel spiders (Figure 8.53) were found to be abundant throughout the Study Area, and numerous individuals were captured in all of the trap sites in the salt pan fringe. These spiders were also present in the camp, up on the barren hills and even at Mount Dallol where no evidence of any other living creatures was seen.

Two scorpion species were observed (Figure 8.53). Three individuals of the Middle Eastern Scorpion (*Microbutus pusillus*) were caught in pitfall traps. This is a small scorpion with the biggest individual observed was approximately 2 cm in length. A single small *Uroplectes* species was found dead close to Mororo Village (Figure 8.53).

Figure 8.53 Examples of Insects and Arachnids Observed within the Study Area



Tenebrionid Beetle in a pitfall trap
Family: TENEBRIONIDAE

Praying Mantis
Order: MANTODEA

Moth; Order: LEPIDOPTERA
[Family: GEOMETRIDAE]

Thick-tailed Middle East Scorpion
Microbuthus pusillus

Dead scorpion
Uroplectes sp.

Large Camel Spider
Solifugae sp

8.3.5 Issues of Conservation Concern

No data has been found justifying any particular plant species identified on the site or possibly occurring there and being of conservation concern. A number of plant species have medicinal or other ethno-botanical uses. These are discussed in Section 8.3.6 below as part of the ecological services offered by the environment. A number of terrestrial and aquatic faunal species are of conservation concern as discussed below.

Mammals

Striped Hyena (*Hyena hyena*): Is listed as Near Threatened as the global population size is estimated to be below 10,000 mature individuals.

Dorcas Gazelle (*Gazella dorcas*): Numbers have been in decline for some time mainly due to hunting, and have worsened with more intensive motorized hunting. Habitat degradation resulting from overgrazing by livestock and drought has also had negative impacts.

Desert Sand Fox (*Vulpes pallida*): Widely distributed in the semi-arid Sahel region of Africa. Although apparently widespread, it is rare and little is known about the species' biology, ecology or threats. It is provisionally listed as Data Deficient, but with the availability of further information it may be shown the species warrants listing as Least Concern (IUCN Red Data website, 2012).

African Wild Ass (*Equus africanus*): First classified as Endangered in 1986, but raised to Critically Endangered in 1996. In Ethiopia, there has been a severe population decline, greater than 95% in the last 35 years and the only remaining population is in the Afar Region of Ethiopia and Eritrea.

Birds

Egyptian vulture (*Neophron percnopterus*): A long-lived species that qualifies for an Endangered status owing to a recent and extremely rapid population decline in India, severe long-term declines in Europe and ongoing declines through much of its African range.

Aquatic

Killifish (*Aphanius dispar*) – The IUCN Red Data Status has not yet been evaluated; however, it is considered to be Endangered in Saudi-Arabia (IUCN Red Data website, 2012). The Seriously Fish (2012) website suggests that the species is present in salt lakes of the Danakil Depression, however limited data is presented and their presence there needs to be verified. The same website and Teimori *et al.* (November, 2012) speculate that the *Aphanius dispar* taxon needs to be separated into a number of species. Many populations have been isolated from one another over extremely long periods that can be best described on a geological timescale. It is expected that the populations within the highly saline groundwater fed pools in the study area and within the freshwater of Sabah River deserve to be recognised as separate species. The same taxon is currently described for marine environments, but is expected to be recognised as another species in the near future. The conservation status of the *Aphanius dispar* taxon has not been evaluated by the IUCN but will certainly qualify for a high Red Data classification. Pending an IUCN evaluation, the Endangered status ascribed to this species in inland populations within Saudi Arabia is used within this report.

Alien Species

In terms of the presence of alien species, no invasive alien floral or faunal species were detected within the Study Area of influence and none are expected considering the extreme climatic conditions. However, this said, the Afar communities keep donkeys as beasts of burden and these interbreed with the local African Wild Ass population, which is considered a threat posed to the African Wild Ass population (IUCN Red Data website, 2012). Many donkeys were seen around the Hamad Ela Village and south along the Sabah River. Some of these donkeys show stripes on their lower legs which suggests there may be some African Wild Ass genes present (*Figure 8.54*).

Figure 8.54 *Domestic Donkey in Hamad Ela Village showing Leg Stripes that Suggests Interbreeding with African Wild Ass (Equus africanus)*



8.3.6 *Ecosystem Services*

The IFC Performance Standard 6 defines ecosystem services as “*the benefits that people, including businesses, obtain from ecosystems*”. Ecosystem services are related to biophysical processes in the environment, but are services only when there is a person or group of persons benefiting from the process. The beneficiary might be on the local, regional or even global scale. ¹

The PS6 requires that ecosystem services are further separated into the following two types: ²

- **Type I:** Provisioning, regulating, cultural and supporting ecosystem services, over which the client has direct management control or significant influence, and where impacts on such services **may adversely affect communities.**

¹ PS6 requires an assessment of ecosystem services to be included in a Baseline Assessment. Ecosystem services are also incorporated into PS4 (par 8), PS5 (par 5 & 25-29), PS7 (par 13-17 & 20) and PS8 (par 11).

² GN136 provides the criteria for separation of Type I and Type II ecosystem services.

- **Type II:** Provisioning, regulating, cultural and supporting ecosystem services, over which the client has direct management control or significant influence, and on which **the project directly depends for its operations.**

Description of Ecosystem Services per Habitat

The following section provides a description of the ecosystem services per habitat type as defined in *Section 8.3.3*.

Bare Lands

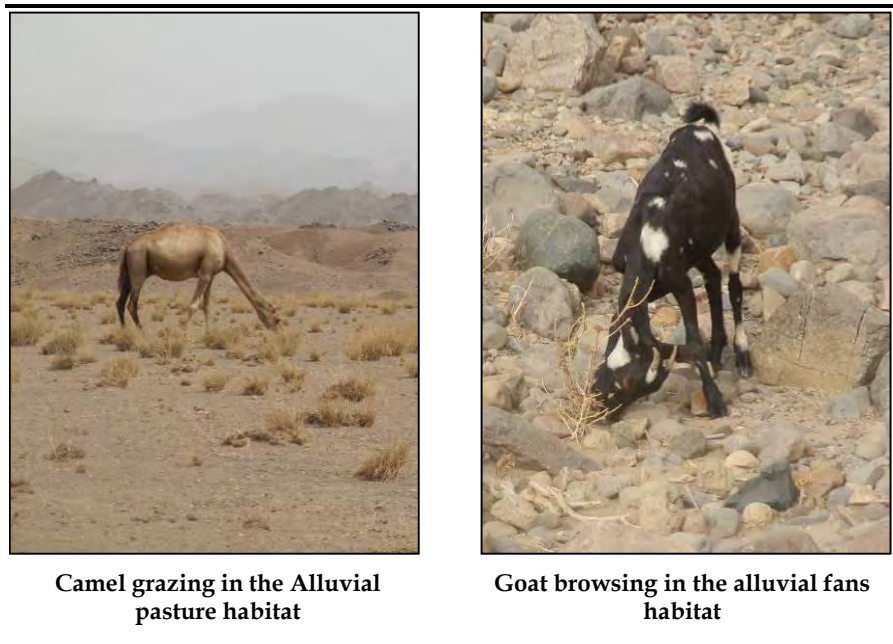
The bare lands, particularly the upper mountainous habitat, provide a vast inhospitable wilderness that isolates the Afar people from other communities and has thus allowed the development of their culture into its current unique form. The habitat provides sparse grazing resources that are utilised by goats and camels. Some valleys and isolated areas, such as the Alluvial Pasture habitat offer localised sources of better quality grazing. Probable hunting of gazelles and the collection of ostrich eggs is presumed to occur within this area, and the vastness of the habitat provides some buffering capacity against over-utilisation of these species. Isolated Acacia trees provide shade and offer a source of wood for building and fuel, and also provide browse resources for camels.

Bare lands cover an extensive area and thus contribute the largest water catchment area that sustains the ecological services in all the other habitats of interest to this study. Water availability is the limiting resource that will determine the scope of the Allana mining activities. Provision of water is thus considered a Type II ecological service. The runoff capacity from the bare lands is enhanced by the numerous steep slopes and extensive rock cover. The habitat does not get flooded during heavy rains and is thus favoured for settlements and burial sites for the Afar.

Alluvial Fans and Pastures

The Alluvial Fan habitat supports extensive fields of the small *Aerva javanica* bush, which provides browsing opportunities for goats, but is apparently not eaten by camels. This is the preferred habitat for gazelles due to the same browsing opportunities offered by the small *Aerva javanica* bush. This habitat occasionally gets flooded when heavy rains fall in the adjacent bare lands, and is thus not suitable for settlements and few burial sites are located here. Some burial sites were however seen within this habitat on the outskirts of Hamad Ela Village. Soils of the alluvial fans are sandy and include of a mixture of rock types brought by stormwater flows from the aforementioned Bare Lands. These sediments are trapped in this habitat and thus prevented from displacing vegetation in the more sensitive salt pan fringe habitat. Subterranean water flows from the bare lands provide a limited Type II service.

Figure 8.55 *Grazing in Alluvial Fans and Pastures Habitat*



Hyphaene Palm Salt Pan Fringe

The vegetated salt pan fringe is an important area for providing community access to sources of groundwater, although the water sources there have a saline content. This habitat supports the greatest density and diversity of vegetation including Doum palms (*Hyphaene thebaica*) and sedges which are used by the local communities for building and medicinal purposes (Figure 8.56). Isolated and prominent Acacia trees have some cultural significance, and numerous goat legs were found hanging in selected trees. The habitat includes a fringe of Tamarisk bushes on the eastern side, which is presumed to offer limited uses for structural supports and sticks, but the species is not palatable to livestock. This habitat provides cover for large and small faunal species and is the focus for biodiversity in the area. This habitat is thus considered a potential source of protein for local communities, through growth of livestock and hunting of indigenous species. Numerous rodents originate from this habitat, which have become pests in the camp site and presumably also in houses in the local villages.

Figure 8.56 Provision of Resources in *Hypaene Palm* Salt Pan Fringe Habitat



Aquatic Habitats

The aquatic habitats provide a broad range of ecosystem services to the local communities and biodiversity of the region. The Sabah River is a source of freshwater within the Study Area of influence (Figure 8.57) and numerous Afar families have settled there as a result. The river provides a key source of water for communities, their livestock and limited irrigation projects, but more importantly, the river provides a focal point for gathering of Afar communities for many generations and has become a key point for the development of culture. Riparian vegetation growing along the banks of the Sabah River supports the largest Doum Palms (*Hypaene thebaica*) (Figure 8.57) seen in the study and many Afar were observed harvesting from these plants. The Sabah River and other aquatic systems flow into Lake Assale and contribute towards the seasonal fluctuations in water levels that are required to replenish the salt resources harvested from the salt pan. All the aquatic habitats are associated with extensive drainage lines that pass through the vast barren lands to the west of the Study Area. These drainage lines provide biodiversity corridors that are important for maintaining ecosystem and genetic health of a wide diversity of populations.

Figure 8.57 Ecosystem Services in Aquatic Habitats



The Sabah River is a local source of fresh water



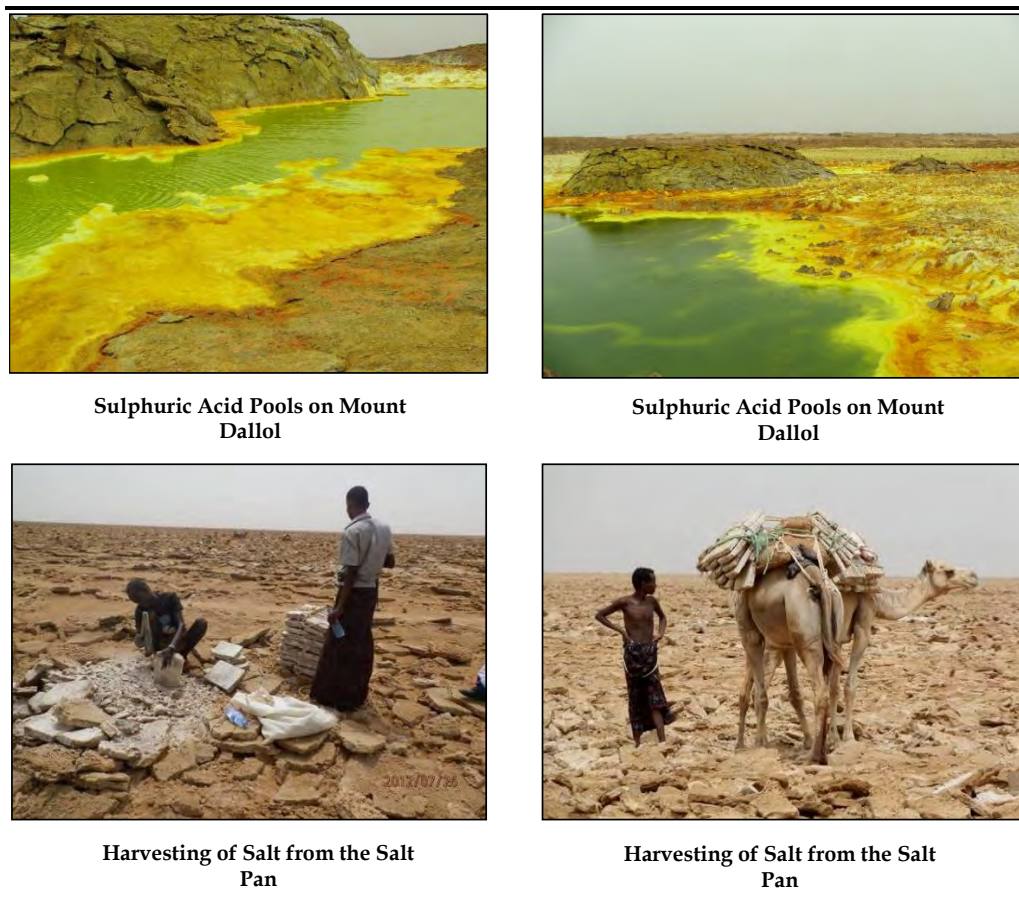
Riparian growth of Large *Hyphaene* palms

Salt Pan

The large salt pan does not sustain any reliable sources of biodiversity, but is the primary source of income to local communities through the harvesting salt blocks (Figure 8.58). The salt pan surface is restructured and replenished with salt annually with flooding of Lake Assale, which in part is dependent on surface and groundwater inflows from adjacent catchments, most notably the Bare Lands. An entire economy exists based on salt harvested from the pan, and this economy dates back over centuries and extends throughout Ethiopia and possibly neighbouring countries. Importance of the trade has declined and the salt blocks are now used primarily for provisioning of salt for livestock. The salt pan provides the primary attraction for the local Afar communities to settle there and for the presence of camels, which are important for shaping the landscape. There is a strong heritage value associated with the salt trade; however, this aspect is covered in greater detail in (Chapter 9).

Furthermore, the Salt Pan incorporates Mount Dallol, where strong sulphuric acid pools have developed due to volcanic activity (Figure 8.58). This area attracts tourism which provides economic support for the local communities; however, there is no biodiversity-related links relevant to this report. These issues will be addressed further in Chapter 9.

Figure 8.58 Ecosystem Services in the Salt Pan



Ecosystem services in the Study Area are discussed further in the Social Baseline Chapter (*Chapter 9*).

8.4

KEY PHYSICAL AND BIOLOGICAL SENSITIVITIES

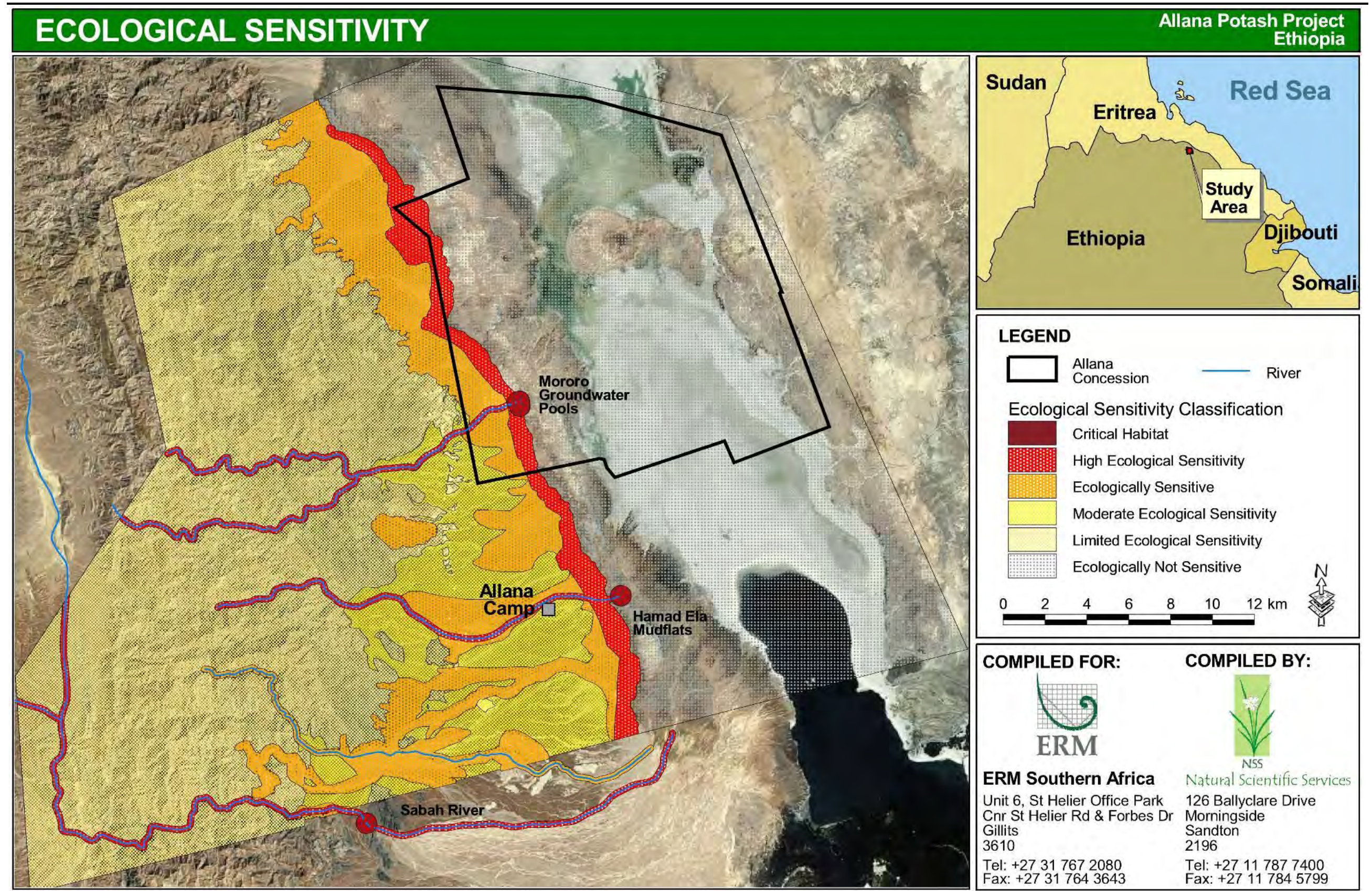
As per the description of the physical and biological environmental baselines, the key sensitivities identified for these baseline descriptions are summarised below.

- ***Climate*** -low rainfall occurrence, elevated wind speeds (where dusty air is carried over the red sea from the Arabian Peninsula) and the absence of topographical features in the Study Area has implications for the transport of airborne emissions (dust, PM_{2.5} and PM₁₀) significant distances.
- ***Topography*** - a flat landscape which is fairly monotonous which makes for a low visual absorption capacity.
- ***Hydrology*** - the current siting of the proposed mining infrastructure in relation to the Bosi River potentially makes the proposed Project prone to flooding events.

- **Geohydrology** – water requirements during the operational phase may potentially result in a drawdown to the upper aquifer, which will have a direct impact on groundwater users and vegetation in the Salt Pan Fringe Habitat type. Furthermore, recharge of the groundwater system is still unknown.
- **Air Quality** – as dust, PM_{2.5} and PM₁₀ concentrations in the baseline air quality environment exceed the WHO Air Quality Guidelines, the airshed is considered as having poor air quality (degraded). As such, according to the IFC, any increase in pollution levels will need to be as small as feasible.
- **Noise** – the noise environment in the Study Area can be considered to be relatively low, especially for smaller villages such as Mororo and Ali lai. It is also these smaller, quieter villages that will be most affected by a activities associated with the proposed Project (as they are located in close proximity to the sites associated with proposed mining activities).
- **Biological Environment** – the biological environment has the following sensitivities:
 - The Study Area is located in the Horn of Africa, which is under heavy pressure from anthropogenic impacts and is one of the most degraded hotspots in the world, with only about 5 percent of original habitat in relatively pristine condition. A serious barrier to conservation activities in this hotspot is the lack of governance and political instability, while uncontrolled hunting, particularly of ungulates, presents a serious threat.
 - Majority of mammal sightings took place in the more densely vegetated Salt Pan Fringe habitat type. This correlation is possibly due to the best food and prey resources being available there, and the greatest availability of cover for refuge purposes. This can therefore be considered a key habitat in the Study Area.
 - The Killifish species (*Aphanius dispar*) IUCN status has not been evaluated; however, it is considered to be endangered in Saudi-Arabia. Furthermore, this fish species has not yet been recorded in Ethiopia.

The sensitivity of the Study Area of influence from a biological perspective is illustrated in *Figure 8.59* below.

Figure 8.59 Ecological Sensitivity Map for the Study Area



Sensitivity Description per Habitat Type

Upper (Mountainous) Bare Lands

The Upper Bare Lands cover an extensive area within and beyond the Study Area of influence that is unlikely to be impacted by developments in the foreseeable future. These areas support low species diversity but offer a variety of intangible ecological services to the local communities. Striped Hyena have a low level of dependence on the Upper Bare Lands; however, this habitat is thus considered to have a **Low Ecological Sensitivity**.

Lower Bare Lands

The Lower Bare Lands similarly support a low floral and faunal diversity. This habitat is important from an Ecological Services perspective as most of the local communities are accommodated here. The extensive coverage of this habitat both within and beyond the Study Area of influence results in this ecological service not being restricted. The habitat is utilised as a refuge for terrestrial faunal species such as the Striped Hyena that forage extensively in the adjacent Alluvial Fan and Salt Pan Fringe habitats. This habitat is considered to be **Moderately Ecologically Sensitive**.

Alluvial Pastures

The Alluvial Pasture is considered **Ecologically Sensitive** as this habitat covers a restricted area and supports an unusual combination of species that provide important grazing resources to the local communities.

Alluvial Fans

The Alluvial fan habitat provides important grazing resources for both livestock and wildlife, and thus is also important for the maintenance of carnivore populations in the Study Area of influence. The habitat does not cover an extensive area but supports important ecological services and moderately high species diversity. The habitat is therefore considered **Ecologically Sensitive**.

Hyphaene Palm Salt Pan Fringe

The Salt Pan Fringe dominated by *Hyphaene* Palms and Acacia trees is restricted to a narrow band along the western edge of the salt pan. This area is the focus of biodiversity activity and provides essential ecological services to the local communities. This habitat is therefore considered **High Ecological Sensitivity** and incorporates a buffer that protects Highly Sensitive aquatic habitats described below.

Salt Pan

The Salt pan is considered **Not Ecologically Sensitive** as it covers an extensive area that supports no detectable biodiversity. From a social perspective, the specific areas of the salt pan where artisanal mining takes place will be considered sensitive. This is discussed further in *Chapter 9*.

Sabah River

The Sabah River is the sole source of freshwater within the Study Area of influence. This water source sustains a range of biodiversity and is vitally important to local communities established there. The river provides a biodiversity corridor for species unable to penetrate the adjacent inhospitable bare lands. The Sabah River habitat is therefore considered to have a **High Ecological Sensitivity**.

Mororo Groundwater Pools

The Mororo Groundwater Pools are small and provide essential habitat for the rare *Aphanius dispar* Killifish that could possibly be considered Endangered. This habitat is therefore classified with a **High Ecological Sensitivity** based on these few results.

Hamad Ela Mudflats

The Hamad Ela Mudflats extend out into the Salt Pan where the salinity levels exceed the tolerances of any normal living creatures; however, the upstream parts of the habitat support a population of Killifish (*Aphanius dispar*). This habitat is therefore classified as **Ecologically Sensitive**.

Please Note – In *Chapter 9*, these ecological sensitivities are overlaid with social sensitivities to produce an overall socio-environmental sensitivity map of the Study Area. Social sensitivities presented and illustrated in *Chapter 9* include:

- The presence of villages;
- Cultural heritage sites and associated significance rankings;
- Areas used by artisanal salt minors; and
- Key tourist features (Mount Dallol and Ashe Ale).

9.1

INTRODUCTION

To determine the social receiving environment ERM has conducted a series of detailed social studies including:

- Cultural heritage survey and assessment;
- Visual and landscape assessment;
- Health data collection and assessment;
- Socio-economic assessment including a household survey, Focus Group Discussions (FGDs) and Key Informant Interviews (KII).

This Chapter presents an overview of the social receiving environment within the Study Area of the Dallol Potash Project. For the purposes of this Chapter, the term '*social*'⁽¹⁾ will include demographics, socio-economics, cultural heritage, health and human rights etc. *Box 9.1* explains a definition of '*social*' in relation to social impacts.

Box 9.1**Defining 'Social'**

For the purposes of this document it is understood that the term '*social*' when referring to social impacts includes impacts received by the following aspects:

- Settlements, dispersed villages, solitary dwellings and mobile / semi-mobile groups (including temporary and permanent human residents with both formal and informal tenure of land/structures);
- Population dynamics including population size, structure, settlement pattern and migration;
- Tangible and intangible cultural heritage sites and items, including archaeological heritage;
- Ecosystem services, including provisioning services, regulating services, supporting services and cultural services used by human receptors;
- Social infrastructure including both tangible (i.e. schools, community centres, electricity and potable water services) and intangible items (i.e. meeting places, shaded areas);
- Individual and communally owned assets (i.e. farm animals and/or grazing land);
- Livelihoods, formal and informal businesses;
- Community groups including civil society groups;
- Gender;
- Human rights;
- Employee and worker labour, accommodation and working conditions; and
- Community health, safety and security (including wellbeing).

(1) As defined by ERM to include the characteristics included in *Box 1.1*.

This social baseline study seeks to:

- Understand the existing environmental and socio-economic context, and provide a benchmark of pre-Project conditions to help predict proposed Project induced changes and inform impact predictions (positive and negative), and assessments of the ability of receptors and stakeholders to benefit from, adapt to and accept change;
- Provide comparative data, so that proposed Project affected areas can be compared to national and regional averages and, where appropriate, each other;
- Understand the existing socio-economic development context in the Study Area and the extent to which the proposed Project supports and is aligned with local development and environmental protection objectives, and any potential alignment opportunities in future;
- Feed into proposed Project design and tailoring of mitigation measures;
- Provide a basis for monitoring from which to evaluate actual residual impacts, and the success of mitigation measures following implementation;
- Identify individual stakeholders and stakeholder organizations that may have roles and responsibilities with regard to implementation of the proposed Project (e.g. local administrators and politicians) as well as stakeholders who are sensitive to the proposed Project or able to support in the implementation of information disclosure and mitigation measures;
- Inform Allana on how best to disseminate information and collect feedback from stakeholders, including vulnerable groups;
- Provide a context for understanding feedback from stakeholders, specifically verifying what is reported by stakeholders and beginning to understand the differences between stakeholders' perceptions of impacts and actual impacts; and
- Better understand the local context, potential vulnerabilities and stakeholder perceptions.

9.2

SOCIAL AREA OF INFLUENCE AND SOCIAL STUDY AREA

This section discusses the potential geographic extent of social impacts related to the proposed Project (Social Area of Influence) and the geographic extent of the area where social baseline data was collected (Social Study Area).

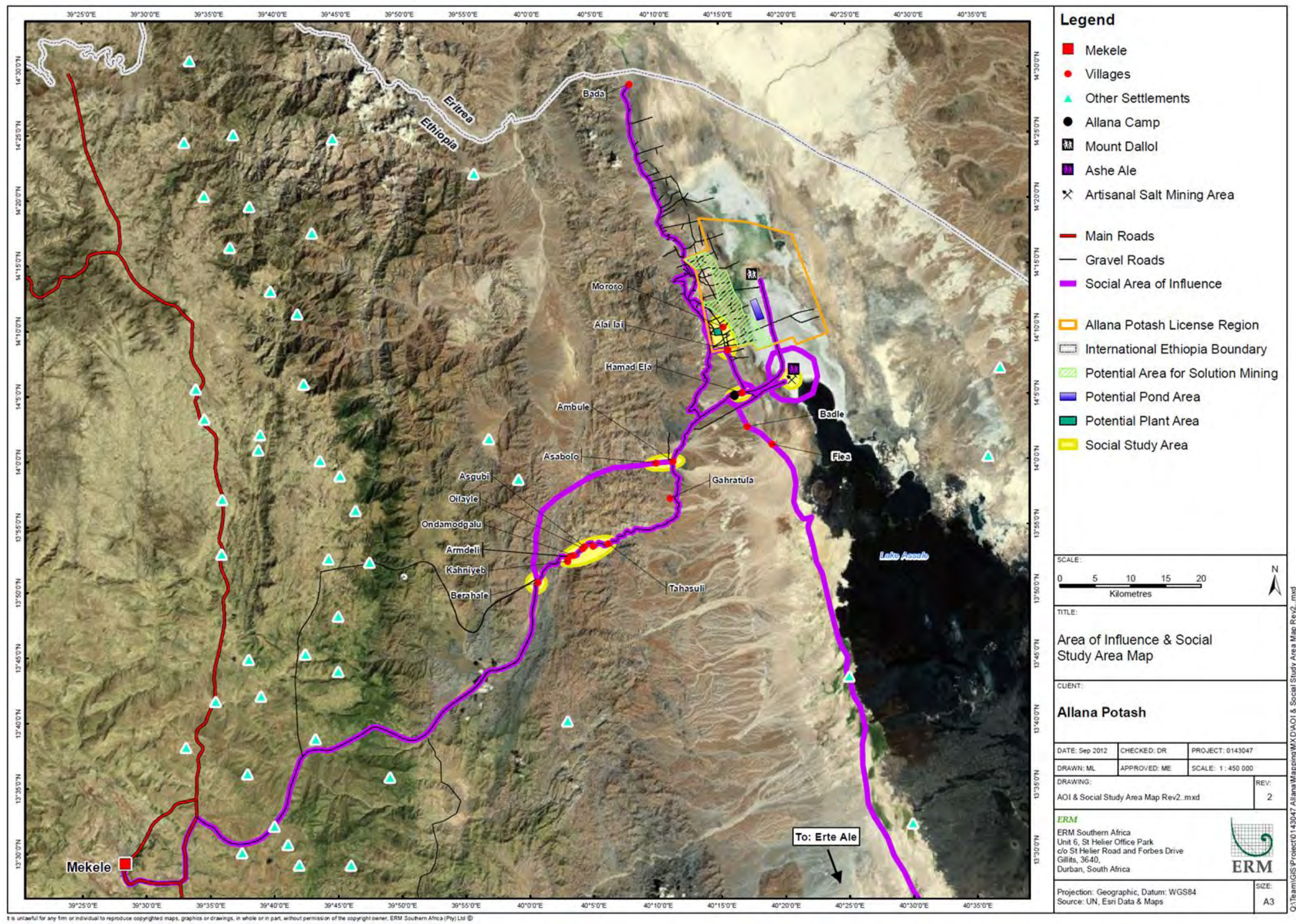
The proposed Project is situated in Zone 2 across the *Woredas* (district administrative boundaries in Ethiopia) of Berahale and Dallol in the Afar National Regional State (ANRS), located in north-eastern Ethiopia. Berahale *Woreda* is divided into nine *Kebeles*, and the proposed Project is partly located in the *Kebele* of Sabana Demale. The portion of the proposed Project that is located in the *Woreda* of Dallol is within the *Kebele* of Bada Admerug.

The Social Area of Influence (AoI) is indicative of the potential geographic extent of social impacts that may occur due to the proposed Project. This has been developed based on the prediction of social impacts during the scoping phase of the ESHIA.

The geographic extent of the social baseline has been developed based on an assessment of the AoI, and seeks to mirror the anticipated scope of impacts and to provide suitable context to the Project. The Social Study Area (SSA), the area where baseline data was collected, was therefore developed to gather a representative indication of social conditions across the Social AoI. Due to a series of logistical limitations discussed in greater detail in the Baseline Methodology (*Annex B in Volume Two*), primary data was not collected in all of the Social AoI; however, an approach was developed that included data collection in a representative section of potentially impacted areas.

Figure 9.1 shows the Social AoI and SSA including the proposed Project infrastructure and relevant villages. The village of Morrur is an amalgamation of several small villages along the road including Tahasuli, Asgubi, Oilayle, Ondamodgalu, Armdeli and Kahniyeb as shown in *Figure 9.1*.

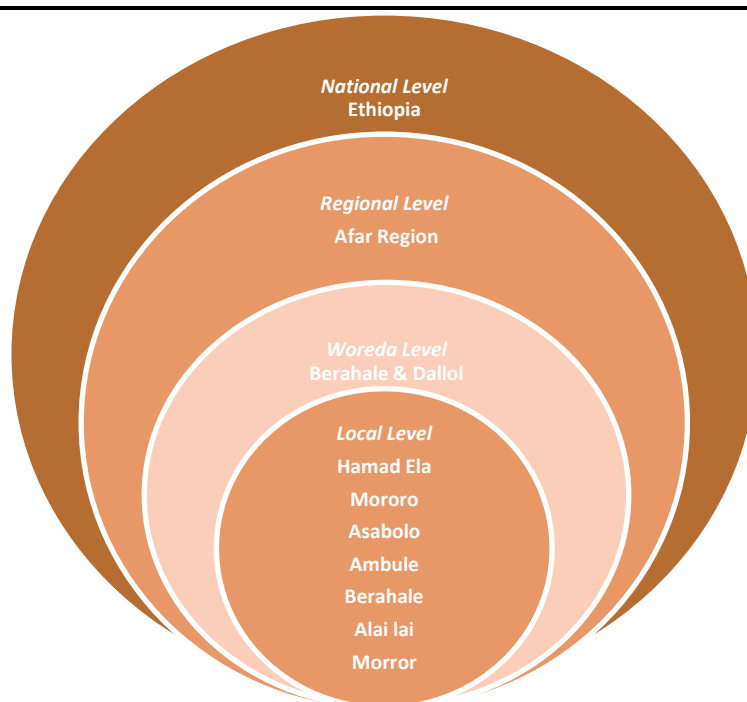
Figure 9.1 Social Area of Influence and Social Study Area



In order to provide context to the potentially impacted area, the social baseline includes data presented at the national and regional level. This commentary will provide comparative data, so that areas potentially affected by the proposed Project can be compared to national and regional averages and, where appropriate, each other. This will allow a better understanding of the local context, potential vulnerabilities and stakeholder perceptions.

Figure 9.2 shows the extent of the spheres of influence of the proposed Project, ranging from a local village level, including villages directly surrounding the area for the proposed Project, to the wider region that spans from Dallol and Berahale *Woreda* located in Zone 2 of the ANRS.

Figure 9.2 *Project Spheres of Influence*



This Chapter will present the socio-economic and health characteristics of the receiving environment and is structured as follows:

- Governance and Administration;
- Demographic Profile;
- Social Infrastructure, Resources and Services;
- Education;
- Health Profile;
- Cultural Heritage;
- Landscape and Visual;
- Livelihoods and Socio-Economics ⁽¹⁾;
- Human Rights and Vulnerability; and
- Stakeholder Perceptions and Attitudes.

(1) Assessment of tourism in the Study Area is included within the Livelihoods and Socio-Economics section.

Gender related analysis has been incorporated into various relevant chapters of the report, including Governance and Administration, the Demographic Profile and Human Rights and Vulnerability.

9.3 GOVERNANCE AND ADMINISTRATION

This section explains the governance and administrative structure relevant to the proposed Project including informal and formal leadership structures.

9.3.1 Formal Administration Structure

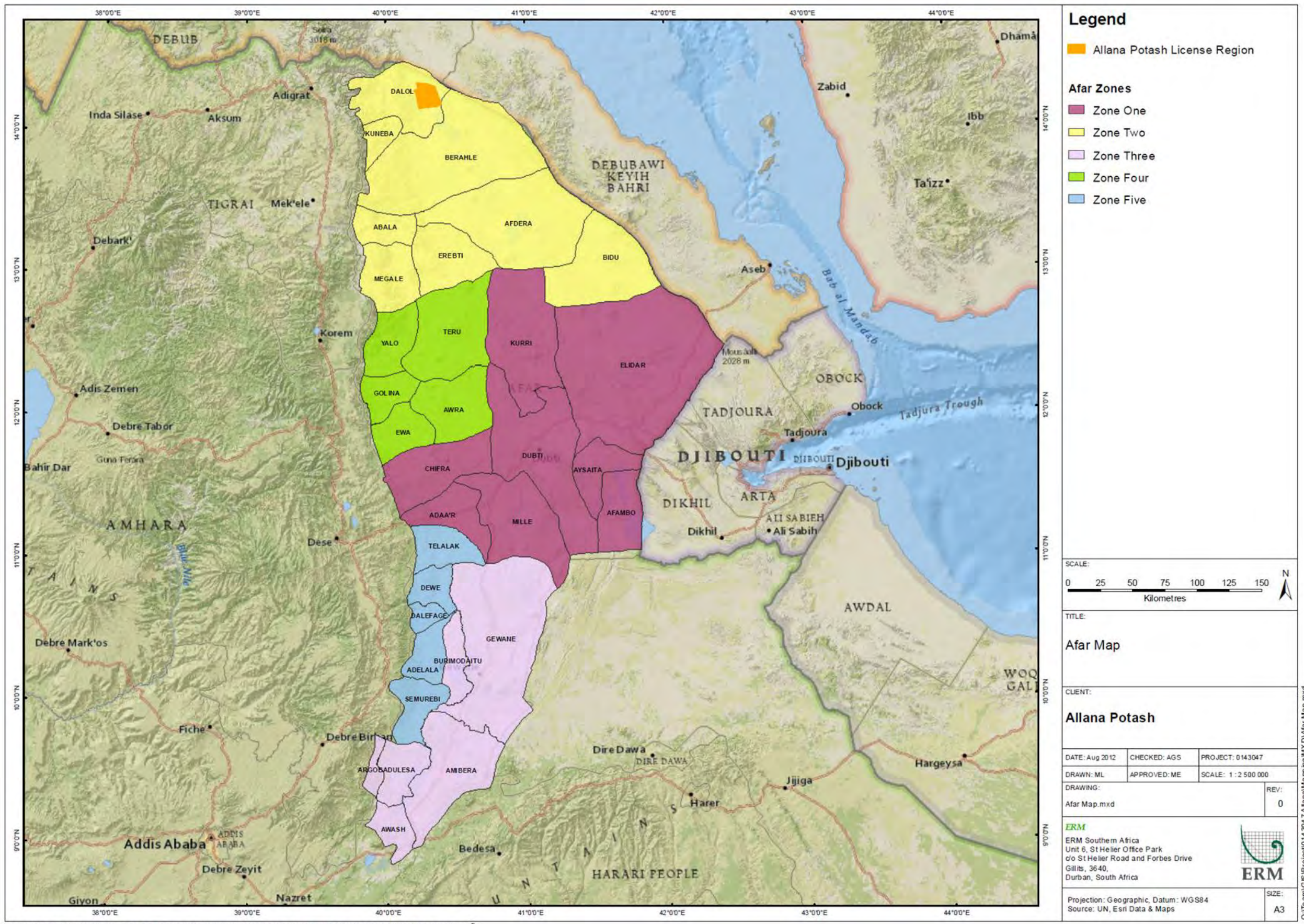
In the early 1990s Ethiopia experienced substantial political change. Historically Ethiopia was ruled by monarchs; however, in 1974 the Provisional Military Administrative Council (known locally as the *Derg*) overthrew the country's last monarch, Emperor Haile Selassie. A one-party communist state fronted by Colonel Mengistu Haile Mariam was established and ruled the country for 15 years. Mengistu was overthrown by the military and a coalition of rebel groups under the umbrella of the Ethiopian People's Revolutionary Democratic Front (EPDRF). The EPDRF assumed state power, initially as a transitional government, and has continued to govern the country. Its' adoption of the constitution in 1995 established the Federal Democratic Republic of Ethiopia (FDRE) with a pluralist political system (African Development Bank - AfDB, 2009).

The FDRE is headed by a Constitutional President and the government by an Executive Prime Minister. The prime minister is elected for six years by the parliament which is divided into two houses; the House of People's Representatives and the House of the Federation. The House of People's Representatives is elected by the public on a five year basis whilst the latter is elected by the Council of Ministers.

The change to a federal system resulted in the decentralisation of power and administration. Ethiopia is now divided into nine regional states and two city administrations. Each state is drawn along ethno-linguistic lines and is endowed with a degree of self - rule. Each state is headed by a state president which is elected by the state council. These states are further divided into 103 Zones (sub-regions), 800 *Woredas* (districts), and 15,000 *Kebeles* (the lowest administrative units) (Government of Ethiopia, 2011). As a result of this political change the two largest pastoral societies, the Afar and Somali now have their own regional governments.

The Study Area is situated in the ANRS, located in the north-eastern part of Ethiopia. Like the other eight regions of Ethiopia, the Afar region is structured into five Zones (sub-regions), 29 *Woredas* (administrative districts), 28 towns and 401 rural and urban *Kebele* administrations (local village administrations). *Figure 9.3* shows the location of the Allana Potash concession area in Zone 2 of the ANRS, and the eight *Woredas* located in Zone 2.

Figure 9.3 Zones and Woredas in the Afar Region



Zones

Zone administrations act as mediators between the regional state offices and the Woredas. They are active administrative institutions that oversee the function and activities of the Woredas by co-ordinating development activities, providing public services and technical assistance. Zonal governance structures vary; in some states zones elect councils which also form executive committees, in others, no such councils exist and zonal executive committee members are appointed by the Regional Council and include those from its own ranks (Yilmaz and Venugopal, 2008).

Woredas

Woredas are responsible for planning and implementing development activities and social programmes within their areas. They oversee the *Kebeles* that come under their jurisdiction. Each *Woreda* has a council and an executive committee; the council consists of elected representatives from the *Kebele* and the committee consists of approximately 12 members, namely bureau sector chiefs (Yilmaz and Venugopal, 2008).

Kebeles

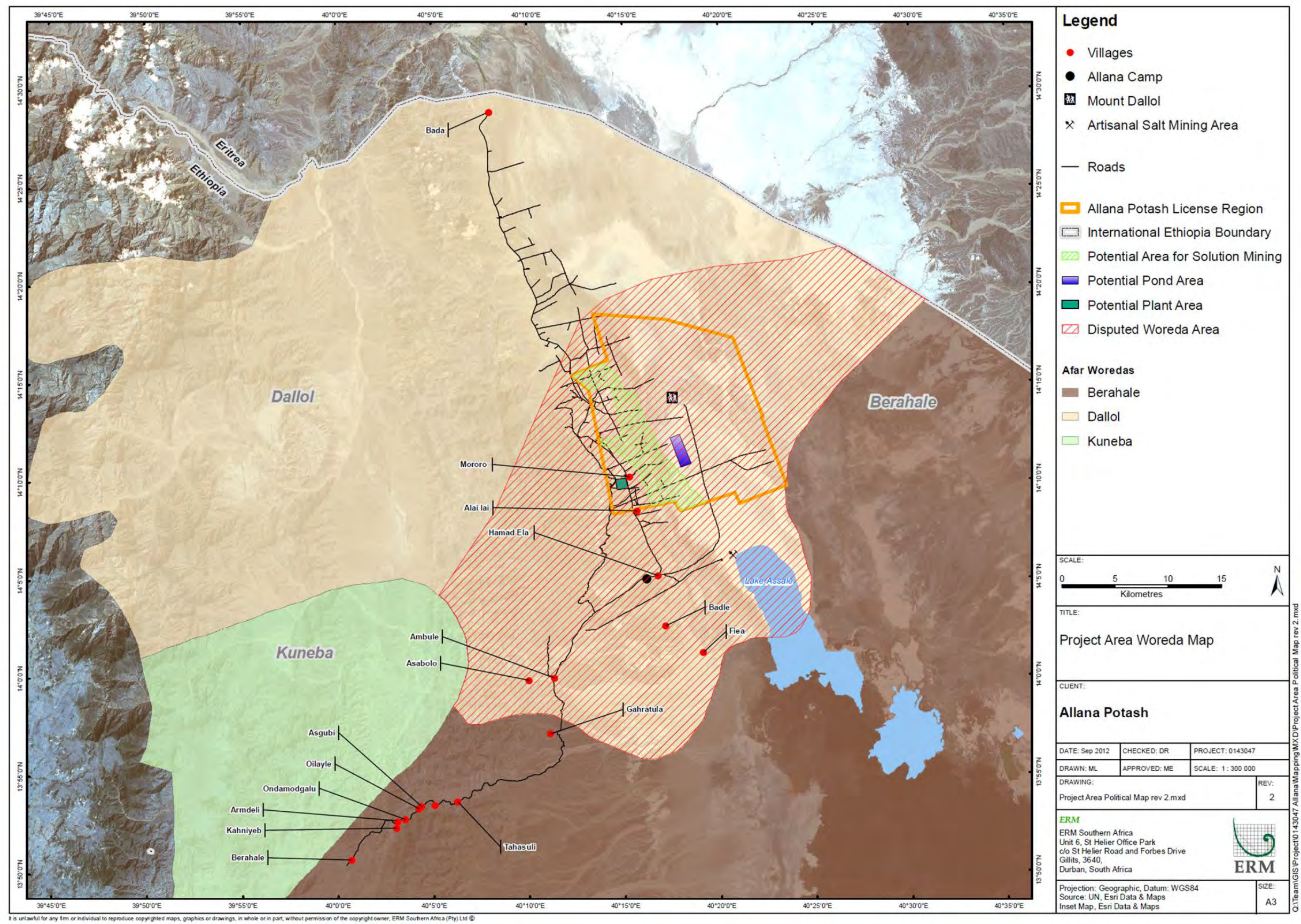
Kebeles are the lowest government administration units; however, alongside the Woredas and religious leaders; they were identified by FGD participants to be one of the most important decision makers and institutions for the villages in the SSA. Each Kebele Administration (KA) has an elected leadership which includes a Council, a Cabinet and a Court. The latter is composed of a chairperson, an executive committee and a social justice committee. *Kebeles* act as mediators between local government authorities and local villages and are charged with:

- Mobilising village members for communal work, such as the construction of roads or waterworks;
- Communicating government programs and policies to village members;
- Presenting village requests to formal government institutions (e.g. district administration); and
- Enlisting the support of clan or traditional leaders to recognise the *Afar Ada* (customary law).

Figure 9.4 shows the Study Area *Kebele* boundaries. The delineation of the *Woreda* boundary between Dallol and Berahale *Woredas* continues to be contested. Official government mapping illustrate the majority of the concession to fall under Dallol *Woreda*. Regional officials also identified the majority of the concession area to fall under the *Woreda* of Dallol. However discussions with various stakeholders in the SSA have indicated that the majority of the concession area is identified to fall under Berahale *Woreda*. In

addition Allana's concession area is primarily administered (including payment of taxes) by Berahale *Woreda*.

Figure 9.4 Study Area Woreda Map



As is discussed in *Section 5.3 of Chapter 5*, Ethiopia is committed to becoming a middle income and carbon neutral economy by 2025, and is putting in place several strategies to achieve this. Two key development strategies that are contributing to Ethiopia's unprecedented economic growth over the past consecutive years are the five year Growth and Transformation Plan (GTP) and the Plan for Accelerated and Sustained Development to End Poverty (PASDEP).

Ethiopia's GTP is a medium term strategic framework for the five-year period 2010 to 2015. The PASDEP is the first five year phase plan aimed at achieving the goals and targets set out in the Millennium Development Goals (MDG) ⁽¹⁾ at a minimum. The core priorities of the GTP and PASDEP are outlined in *Box 9.2*.

Box 9.2***Tenants of the GTP and PASDEP***

The key objectives of the *Growth and Transformation Plan* are to:

- Maintain at least an average real Gross Domestic Product (GDP) growth rate of 11% and meet the Millennium Development Goals;
- Expand and ensure the quality of education and healthcare services thereby achieving the MDGs in the social sectors;
- Establish favourable conditions for a sustainable state building through the creation of a stable democratic and developmental state ; and
- Ensure growth sustainability by realizing all the above objectives within a stable macroeconomic framework.

The three key pillar strategies developed under *PASDEP* are:

1. Enhancing expansion and quality of infrastructure;
2. Enhancing expansion and quality of social development; and
3. Promoting women and youth empowerment and equitable benefit.

Source: Ministry of Finance and Economic Development, (2010)

Both the GTP and PASDEP focus on areas that are particularly pertinent to the ANRS. It is the responsibility of the respective regional bureaus to align to national development strategies, in this case the Afar Bureau of Finance and Economic Development. The five year Development Plan devised by the Afar Bureau of Finance and Economic Development aligns with the national development plans and has identified tailored development strategies for key areas including health, education and access to water and sanitation facilities; all of which pay attention to pastoralists areas.

The Economic Sector Development Plan outlined in the GTP identifies water resources development as key for both livestock and human consumption in pastoral areas. Water resources development will be accomplished together with the improvement of pasture land and irrigation scheme development. In addition, settlement programs will be executed in order to enable pastoralists

(1) The Millennium Development Goals (MDGs) are eight international development goals that all 193 United Nations member states and at least 23 international organizations have agreed to achieve by the year 2015 - UNDP, 2010.

to settle and base their livelihood on a sedentary lifestyle, carried out on voluntary basis.

PASDEP has also developed tailored programmes for pastoralist areas in Ethiopia which is of particular relevance for the ANRS where a significant proportion of the population were pastoralists. Key strategies are included in *Box 9.3*.

Box 9.3

Key Strategies for Pastoral Areas under PASDEP

- **Healthcare** - mobile outreach health services;
- **Infrastructure** - improvement of roads, communication, and small scale irrigation to improve current conditions, and to facilitate the slow transition for households which want to shift towards a sedentary lifestyle;
- **Education** - a network of informal community based schools and teaching arrangements;
- **Water Resources** - water points will be constructed adjacent to range areas for dry season utilization;
- **Livestock** - programs to provide improved veterinary services, and strengthen livestock breeds, marketing, and early-warning systems; and
- **Pastoralist Institutions** - developing participatory land use and ownership policy based on traditional communal land use system, establishment of Pastoralist Councils and helping pastoralist villages benefit from investment, tourism and other industries in their areas.

Source: Ministry of Finance and Economic Development, (2006)

9.3.3

Traditional Administration Structure

The traditional governance system remains a strong and respected parallel administrative structure in many parts of Ethiopia. Although the powers of traditional leaders are reported to have declined in recent times (over the past 10 to 15 years), the rituals and respect that surround these positions remain strong, and these leaders are reported to retain significant influence over their people.

Traditionally, the Afar society is structured in a series of sultanates; tribes, clans, lineages and families. The various sultanates located across Djibouti, Ethiopia and Eritrea have generally been recognised as centres and providers of political and spiritual leadership. However, the influence and integrity of the sultanates is declining due to interaction with external political and economic systems (Berhe and Adaye, date unknown).

Furthermore, tribal leadership was also previously used primarily during times of conflict with non-Afar neighbours. Today, this is also virtually non-existent. Accordingly, FGD participants reported that it is clans rather than tribes that provide the strongest and most effective leadership structures at the village level.

In Afar society the clan is formed by an extended group of families. It is the most important political and social unit in the Afar culture. Traditionally, the clan as a social organisation serves as a nucleus for administration and co-operation to conduct social activities among clan members. The clan is also the lowest social unit to which communal property rights over land and other natural resources are defined.

Whilst numerous Afar clans exist, the four most important, as identified by residents in the Study Area, were Dahimela, Damoyta, Hadarmo and Hadu. Historically the Damoyta clan were considered Afar royalty and, as a result its' leaders are typically involved in conflict negotiations, regardless of whether a clan member has been involved in the conflict or not. FGD participants highlighted that the majority of the Afar in the Study Area originate from the Dahimela clan.

Clans have a three tiered system comprised of clan leaders, a council of elders and a sanction executing unit. The clan leader known locally as *makabans* is the external representative of the clan and interacts on behalf of the group with the government administrations and other clans. He is also the arbiter of intra-clan disputes.

The council of elders or *daar-edola* are the second most powerful leaders in a clan, and function as the judges of the internal affairs of a clan. They are often elected to their post due to their characteristics of wisdom, impartiality and an ability to make peace. They also act as the chief authority in marriage arrangements and negotiate dowries.

The sanction-executing unit (*fimaa/finna*) is a multi-purpose institution whose size and number often varies between clans. The *fimaa* leaders carry out basic village tasks including the execution of sanctions passed by clan leaders, the supervision of more junior *fimaa* members and, in collaboration with clan elders, help to maintain good relations within the clan.

Grading of clans and lineages as young/small/junior (*hundah*) and elder/bigger/senior (*kaddah*) is typical amongst the Afar. Different roles are allocated to each lineage: a senior lineage of a clan provides political leadership while a junior one provides ritual leadership or leadership of the sanction-executing unit (*fimaa*). Typically members of the council of elders (*daar-idola*) and members of *fimaa* are recruited from all lineages of a clan.

Despite pressure from the central government, the traditional Afar social and political organisation is still effective at the local level and continues to strongly govern Afar social, economic and political life. The traditional system often overlaps with the formal administration system, both formally and informally with clan leaders and village elders commonly representatives on the *Kebele* board. In the Study Area, the Sabana Demale KA is formed by both government representatives and representatives of the traditional authorities.

9.3.4

Governance and Women

The Afar are a patriarchal society; leadership roles are largely assigned to men and women are generally confined to primary care or domestic tasks such as childcare, cooking and fetching water. Although the Constitution grants men and women equal rights in matters of inheritance, traditional customs usually pass land to sons on the basis that daughters will tend to move to their husband's homes (The OECD - Social Institutions and Gender Index, 2012).

In recent years the Ethiopian Government has made some progress towards promoting women's social, economic and cultural empowerment, through the incorporation of gender issues into its various national policies such as health, education and training, the stipulation of women's rights in its Constitution and the establishment of a Ministry of Women's Affairs. However, gender disparities are still prevalent throughout Afar and Ethiopia in general. Although female representation in the federal parliament is higher than it has ever been, (in the 2012 parliament, women held 112 out of a total of 547 seats, an increase from the 42 seats they held during 2005 parliament) , women's leadership roles are limited (Reda, 2011). FGDs indicated that a woman's role in governance in the SSA is restricted to elections and community development work. Further details regarding gender equity in Ethiopia and the Afar area are included in *Section 9.11.3*.

9.3.5

Land Tenure and Ownership

In Ethiopia land was nationalised following the end of the *Derg* rule, and the state has retained ownership of the land since. Land can be leased to private individuals; however, they are not entitled to ownership. The constitution established equal access, use, transfer and administration over land stating that all inhabitants have a right to access land for their livelihood. Farmers and pastoralists are guaranteed with lifetime 'holding' rights giving them rights to the land except for its sale and mortgage (Ambaye, 2012).

Afar Land Tenure

Kinship among the Afar is a key instrument for securing access to and use of resources. As with other pastoral societies in Ethiopia, common property regimes are the norm and land and other resources are typically common property administered at the clan level. Each clan tends to manage its resources collectively based on customary principles. Although each clan member has an inalienable right of land and resource use, intra-clan customary laws regulate these rights (Hundie and Padmanabhan, 2008).

Afar traditional institutions allow for two types of resources users: clan members with primary rights (*Waamo*) and neighbouring pastoralists who have secondary rights (*Isso*) (Hundie, 2006). *Waamo* defines exclusive and inalienable rights of a member of a specific Afar clan or lineage. *Waamo* rights bestow a given clan or lineage with primary rights to a specified territory, whereas *Isso* defines secondary inalienable rights which are granted to non-members. As well as imposing certain restrictions on to holders, *Isso* (literally

meaning 'lease') are limited in scope and in time. For example, right holders are prohibited from cutting down certain trees and are only entitled to a defined grazing land for a specified time period.

In the SSA, whilst all land is allocated by the *Kebele* of Sabana Demale, informal land tenure systems also hold a powerful position within the villages. For example, FGD participants revealed that it is only the Afar who can hold land in the area; visiting or resident highlanders can only rent it. This is further supported by the results of the household survey that show all of the non-Afar groups living in the SSA rent houses, and none were reported to own houses. The majority of the Afar in the household survey stated that they owned their house (94.7%) in addition to holding the land they live on.

It is interesting to note that numerous FGD participants in Hamad Ela have begun to notice (in the past year or so) a change in the land tenure arrangements. Previously it was common for Afar residents in Hamad Ela to rent houses to non-Afar migrants as a source of income particularly during the salt trade season. However participants noted that increasingly highlanders involved in the salt trade are reserving land and building houses in time for the start of the salt trade season. This may indicate a shift away from informal land tenure systems and increasing formalisation of land tenure arrangements in the Study Area, whereby migrants are beginning to rent / lease land from the local government.

It should be noted that when directly questioned the reservation and marking of land of land was reported to be conducted by local people looking to expand their family homes.

9.4 DEMOGRAPHIC PROFILE

This section describes the demographic conditions within the SSA. Furthermore, this section includes a discussion of national and regional (Afar / Zonal) level demographic information, as well as an analysis of local (*Woreda / Kebele / community*) level demographics.

9.4.1 National Level Demographics

Table 9.1 summarises some key statistics for national level demographics for Ethiopia.

Table 9.1 National Level Demographics for Ethiopia

Socio-Economic Indicator	National Level	Year	Source
Population (million)	83	2010	World Bank http://databank.worldbank.org/Data/Views/Reports/TableView.aspx

Socio-Economic Indicator	National Level	Year	Source
Population growth (annual %)	2.1	2010	World Bank http://databank.worldbank.org/Data/Views/Reports/TableView.aspx
Net migration rate ⁽¹⁾ (migrants/1,000 population)	-0.2	2012	International Organisation for Migration http://www.iom.int/jahia/Jahia/ethiopia
Age structure	0 to 14 years: 45% 15 to 64 years: 51.9% 65 years plus: 3.2%	2007	Population and Housing Census 2007
Human Development Index (HDI) value ⁽²⁾	0.363	2011	UNDP International Human Development Indicators http://hdr.undp.org
Birth rate (measure of fertility per 1,000 population)	31.4	2010	World Bank http://databank.worldbank.org/Data/Views/Reports/TableView.aspx
Death rate (measure of mortality per 1,000 population)	9.6	2010	World Bank http://databank.worldbank.org/Data/Views/Reports/TableView.aspx

In 2010 (the date of the last national census) the total population of Ethiopia was estimated at 83.0 million, ranking it as the second most populated country in sub-Saharan Africa. The annual population growth rate was 2.1 % (World Bank, 2010), in line with the average population growth rate (2.0%) for Low Income Countries (LIC) (World Bank, 2010 - defined by World Bank as Gross National Income of \$1,005 or less) in 2010. In 2007, the census results show that the population grew at an average rate of 2.6%, a decrease of 0.2% from the average annual growth rate over the period 1984 to 1994. The declining population growth rate can be attributed to the Government of Ethiopia's (GoE) objective of tackling the country's high population growth rate under the Five Year GTP and PASDEP, through key strategies including enhancing human resource development, increasing access to education and strengthening Ethiopia's infrastructure and services, including reproductive health services in urban and more importantly in rural areas.

The net migration rate for Ethiopia is equal to -0.2 per 1,000 people of the population, illustrating an excess emigration. Internally the country is also witnessing growing rural-to-urban migration which is contributing to rising

(1) The difference between the number of persons entering and leaving a country during the year per 1,000 persons (estimated over the period 2010 - 2015).

(2) The Human Development Index (HDI) is a summary measure of human development. It measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. The HDI is the geometric mean of normalised indices measuring achievements in each dimension, 1 shows high human development whilst 0 shows low human development.

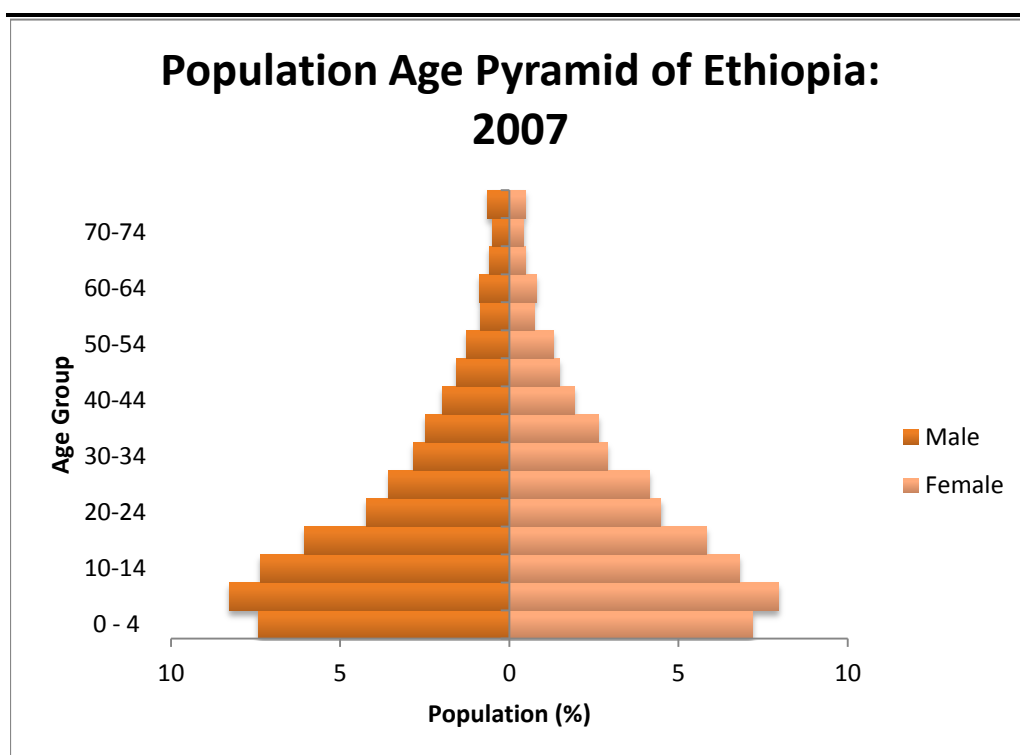
urban unemployment, with consequent results on increased international migration.

At the national level the male population was slightly higher (50.5%) than the female population (49.5%); however, this is well within the typical range.

Ethiopia has a pyramidal age structure, with the broad base depicting the significant proportion of the population that are under the age of 15 (45%). This is a feature typical of developing countries; demonstrating younger populations due to high birth rates, limited family planning and poor access to health infrastructure. The percentage of the population falling in the age group 0 to 4 is slightly lower which may be as a result of infant mortality due to low levels of infant and child healthcare.

The majority of Ethiopia's population fall within the working age group of 15 – 60 ⁽¹⁾ (51.9%) as shown in *Figure 9.5*. Between 1994 and 2007 the proportion of the population that fell within the working age group increased (0.5%) along with a decline in the proportion of the population falling under the age of 15 (0.4%) (Population Census Commission, 2008). The International Organisation for Migration (IOM) indicates that the growing economically active population poses a significant challenge for the GoE with regards to youth unemployment (International Organisation for Migration, 2010).

Figure 9.5 *Population Age Pyramid - 2007*



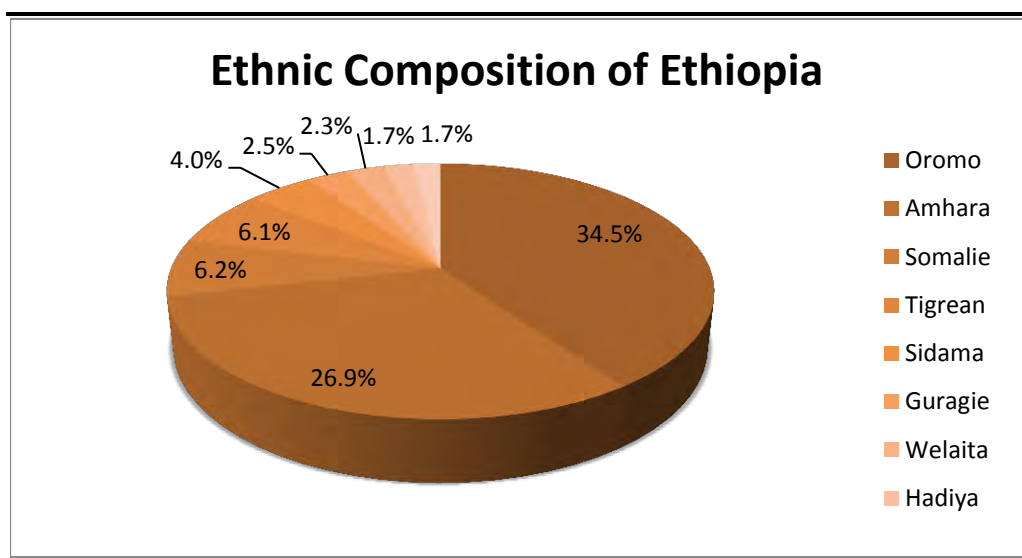
Source: Population Census Commission, (2008)

(1) The Ethiopian Labour Proclamation sets the minimum age for employment at 14 and the minimum age for hazardous work at 18. Official retirement age according to the Ministry of Labour and Social Affairs is 60.

Ethiopia's HDI value (0.363) falls below both the average HDI value for countries in the low human development group (0.456), and the average value for Sub-Saharan African countries (0.463) (UNDP, 2011). Furthermore Ethiopia is ranked 174th out of 187 countries in the 2011 UNDP rankings, placing it in the low human development group and providing an indication on the population's low income levels and access to basic services. Out of the 46 countries in the low human development group Ethiopia ranks 33rd, countries of a similar ranking are Afghanistan (172), and Zimbabwe (173).

As shown in *Figure 9.6* the two largest ethnic groups in Ethiopia, the Oromo and Amhara, constitute over 61% of the population. The third and fourth largest ethnic groups are Somali and Tigreans ⁽¹⁾. In 2007 three other ethnic groups (Sidama, Weleita and Guragie) had populations measuring over 1 million. The Afar, the predominant ethnic in the Study Area number approximately 1.4 million persons.

Figure 9.6 *Ethnic Composition of Ethiopia*

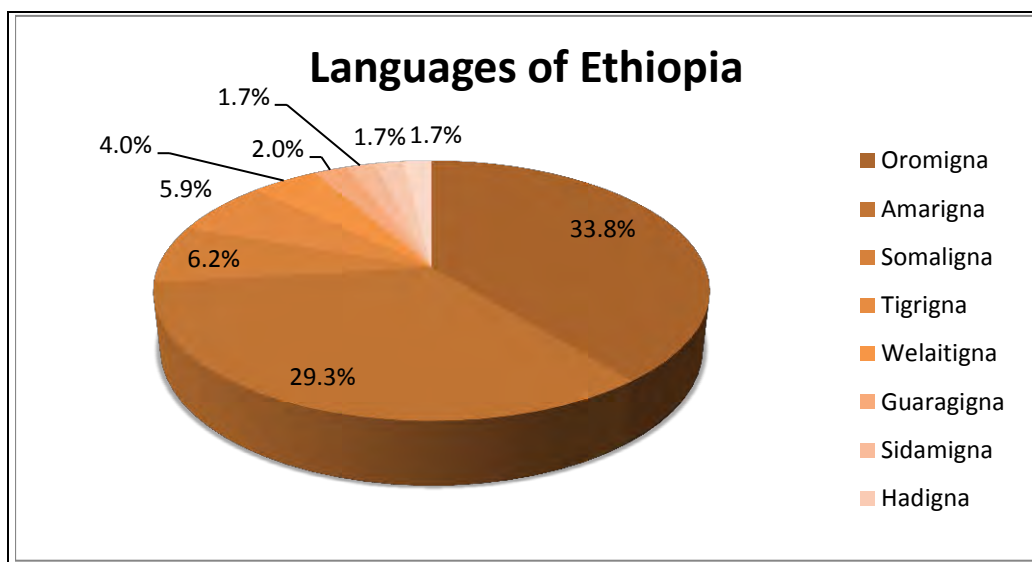


Source: Population Census Commission, (2008)

The majority of ethnic groups in Ethiopia have their own language, and as shown in *Figure 9.7* in line with the ethnicities outlined above Oromigna (33.8%), Amarigna (Amharic, 29.3%), Somaligna (6.2%) and Tigrigna (5.9%) are the four most commonly spoken languages. Amharic is the official language of Ethiopia, and the working language of the Federal government; however, each regional state is allowed to choose its own working language (Habtu, 2003). Afarigna, the predominant language in the Study Area is spoken by approximately 1.7% of respondents of the 2007 Housing and Population census.

(1) Some sources indicate the Tigray ethnic group being the third largest ethnic group - Habtu, 2003.

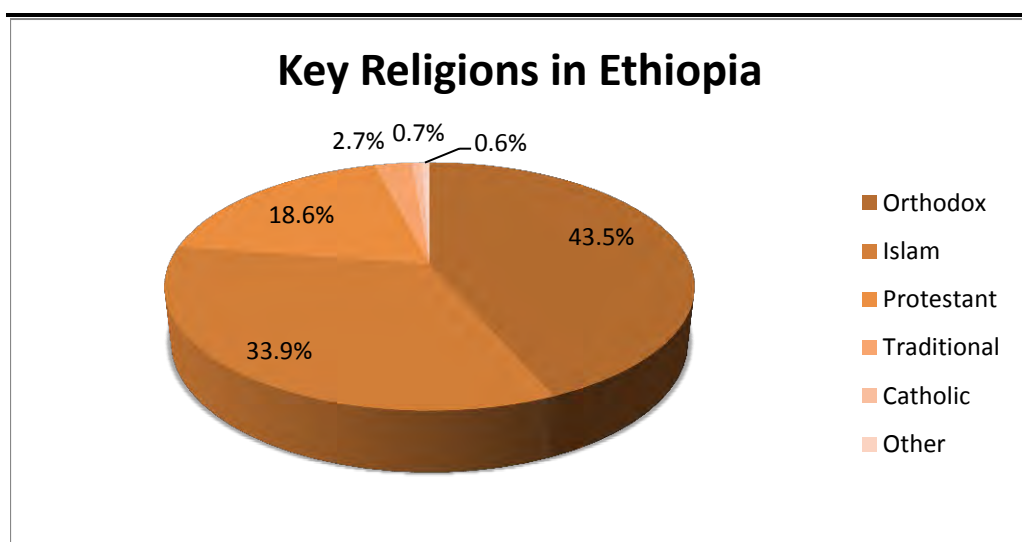
Figure 9.7 Languages of Ethiopia



Source: Population Census Commission, (2008)

As shown in Figure 9.8 the predominant religion in Ethiopia is Christianity, more specifically the Ethiopian Orthodox Church (43.5%). The second most common religion is Islam (33.9%), followed by Protestant Christians (18.6%). Followers of traditional belief systems⁽¹⁾ constitute 2.6% of the population; however, this type of faith system is typically underrepresented in censuses. This may be largely due to the fact that many groups that practice traditional belief systems practice them alongside religions that are more widely recognized (Ethiopian Orthodox and Islam), and part of mainstream Ethiopian culture.

Figure 9.8 Key Religions in Ethiopia



Source: Population Census Commission, (2008)

(1) The traditional belief systems practiced across Ethiopia vary according to region and ethnic group. Key documented traditional belief system is animism.

9.4.2

Regional Level Demographics

According to the 2007 census, the Afar Region has a total population of 1.4 million people, where 56% of the population are men and 44% are women. A comparison of key regional demographic variables, including Zone 2 against national figures is included in *Table 9.2*.

Table 9.2 *Regional Demographics*

Demographic Variable	National	Afar Regional	Zone 2
Population	82,950,000 (2010)	1,410,000 (2007)	350,111 (2007)
Population growth rate (% per annum)	2.1 (2010)	2.2 (2007)	-
Urban population (% of population)	17.6 (2010)	13.4 (2007)	7.5 (2007)
Population below age of 15 (% of population)	45 (2007)	43.2 (2007)	48.1 (2007)
Gender (% of population)	50.5 male, 49.5 female (2007)	55.7 male, 44.3 female (2007)	55.8 (male), 44.2 (female)
Ethnicity (%)	Oromo 34.5, Amhara 26.9, Somalie 6.2, Tigray 6.1, Sidama 4, Guragie 2.5, Welaita 2.3 (2007)	Afar 90.0, Amhara 5.2, Argoba 1.6, Tigray 1.2, Oromo 0.6, Welaita 0.6, Hadiya 0.2(2007)	Afar 96.0, Tigray 3.3, Amhara 0.5 (2007)
Religion (%)	Ethiopian Orthodox 43.5, Muslim 33.9, Protestant 18.6, Traditional 2.7, Catholic 0.7, Other 0.6 (2007)	Muslim 95.3, Orthodox 3.9, Protestant 0.7, Catholic 0.1, Traditional 0.03 (2007)	Muslim 96.5, Orthodox 3.4, Protestant 0.02, Catholic 0.02, Traditional 0.01 (2007)

Source: World Bank, 2010 and Population Census Commission, (2008)

The Afar Region had the second highest population growth rate in Ethiopia (based on calculations between 1994 and 2007), and slightly a higher rate than the national average. The proportion of the Afar population living in urban areas constituted 13.4%; significantly lower than the average proportion of urban dwellers nationally, indicating the slow rate of urban development in the region. The average household size for the region was 5.7 people, with rural households housing on average 6.1 people and urban households housing 3.9 people. The age distribution demonstrates that approximately 43% of the population are below the age of 15, which is slightly lower than the national average of 45%. However in Zone 2, 48% of the population are under the age of 15.

The region has an estimated density of 15 people per square kilometre (km²), a low population density compared to the national population density of 83 people per km².

The predominant ethnic group in the Afar Region is the Afar followed by Amhara, Arogha and Tigrean, with smaller numbers (less than 1%) of Oromo, Welaita and Hadiya as illustrated in *Table 9.2*. In Zone 2 the ethnic composition of the population varies slightly showing a higher proportion of Tigrean people. The Amhara group are the third most prevalent ethnic group forming 0.5% of the population. The remaining ethnicities fall below 0.1% of the total population.

Zone 2 is the centre of the salt trade, potentially resulting in the higher presence of Amhara and Tigrean groups (traditionally involved in the artisanal salt mining industry). In addition the Ethiopia - Eritrea war has resulted in the displacement of people along the border including Eritreans who are predominantly from the Tigrean ethnic group. Zone 2 is aligned to the north-eastern Eritrean border potentially allowing for easy access from Eritrean Tigreans into Ethiopia.

The Afarigna language is predominantly spoken in the region and the overwhelming majority of census respondents (on average 95.9%) indicated that they are Muslim both across the region and in Zone 2 (Population Census Commission, 2008).

Anecdotal evidence indicates that the majority of non-Afar groups have migrated from the neighbouring highland areas and are involved in a variety of activities including small-scale trade, working as local government employees and construction. In-migration of non-Afar groups has been particularly documented in the southern Zones of the ANRS where large commercial farms have been established. Non-Afar groups mainly reside in the major urban centres, and small towns in the region.

9.4.3 *Local Demographics*

Allana's concession is split across two *Woredas*; Berahale *Woreda* and Dallol *Woreda*. Information on local level demographics is presented in the following sections.

Population Size

Berahale *Woreda* has nine *Kebeles* with a total population of 78,881 people (Population Census Commission, 2008). In 2007, urban inhabitants accounted for 7.7% of the total population of the *Woreda*. The total number of housing units ⁽¹⁾ in Berahale *Woreda* was 11,401, housing on average 6.9 people per unit. Urban areas house on average 7.4 people per unit in comparison to the rural areas where a unit houses 6.9 people on average.

(1) A housing unit is defined as a separate and independent place of abode, either intended for habitation or not intended for habitation but occupied as a living quarter by a household - Population Census Commission, 2008.

Table 9.3 shows the distribution of Berahale *Woreda's* population across the nine *Kebeles* including in Sabana Demale, the *Kebele* in which the proposed Project is located.

Table 9.3 Berahale Woreda Population Distribution

<i>Kebele</i> Administrations/Town	Both Sexes	Male	Female	No. of Households	No. Housing Units
<i>Sabana Demale</i>	9,517	5,711	3,806	1,432	1,410
Berahale	2,954	1,712	1,242	401	389
Kora	8,222	4,674	3,548	1,137	1,094
Dear	6,797	3,981	2,816	913	871
Bure	9,941	5,690	4,251	1,571	1,540
Ala	13,823	7,779	6,047	2,178	2,137
Lela Ala	10,751	6,251	4,500	1,601	1,558
Goben	5,896	3,274	2,622	949	930
Serea	4,882	2,869	2,013	661	649
Rural Total	72,783	41,941	30,845	10,843	10,578
Berahale Town (Urban Total)	6,098	3,563	2,535	863	823
Total (Rural +Urban)	78,881	45,501	33,380	11,706	11,401

Source: Population Census Commission - Statistical Report for Afar, (2008)

The population of Dallol *Woreda* (83,930 people) is slightly higher than Berahale *Woreda*. The majority of the *Woreda* is considered to be rural with Dallol Town listed as the only urban centre constituting 2.1% of the total population. Table 9.4 shows the distribution of this population. There are a total of 12,989 household units, with higher densities in rural areas (6.5 people per unit) than in urban areas (5.3 people per unit). The population distribution across Dallol *Woreda* is shown in Table 9.4.

Table 9.4 Dallol Woreda Population Distribution

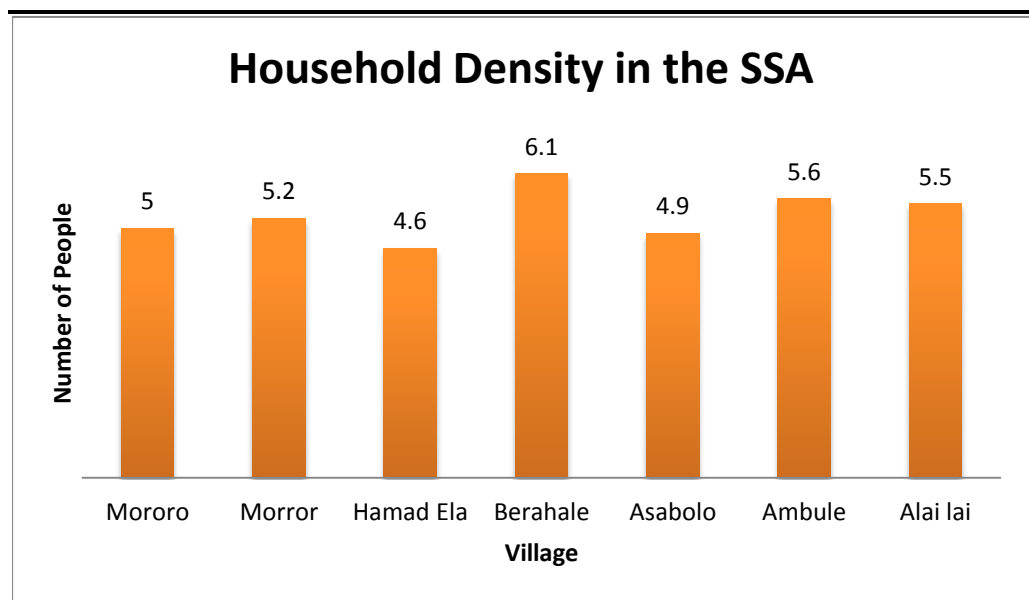
<i>Kebele</i> Administrations/Town	Both Sexes	Male	Female	No. of Households	No. of Housing Units
Iynedeb	9,001	4,940	4,061	1,603	1,567
Leasgedi	2,842	1,646	1,196	462	444
Ma Awo	7,309	3,921	3,388	1,293	1,259
Sabiba	4,659	2,534	2,125	782	774
Berih	9,001	5,040	3,961	1,422	1,386
Adiaro	5,361	2,833	2,528	964	953
Asegara	8,039	4,736	3,063	1,225	1,212
Adkuwa	8,968	5,282	3,686	1,258	1,239
Simbilali	3,725	2,023	1,702	677	670
Alefan	3,314	1,840	1,474	506	506
Bheyta	3,405	1,835	1,570	455	426
Garsat	5,893	3,336	2,557	703	687
<i>Bada Admerug</i>	3,730	2,079	1,651	581	570
Bada Ramile	6,926	3,878	3,048	988	973
Rural Total	82,173	45,923	36,250	12,910	12,655
Dallol Town (Urban Total)	1,757	1,050	707	371	334
Total (Rural +Urban)	83,930	46,973	36,957	13,281	12,989

Source: Population Census Commission, (2008)

The Study Area is situated within the Semana Demale *Kebele* (Berahale *Woreda*) and the Bada Admerug *Kebele* (Dallol *Woreda*). Sabana Demale is the fourth most populated *Kebele* in Berahale *Woreda*, constituting 12.1% of the *Woreda* population and has the second highest number of people per household unit (an average of 6.7 people). Conversely Bada Admerug is one of the least populated *Kebeles* in the Dallol *Woreda*, with an average of 6.5 people per household unit.

Village level demographics are based on the household survey where a total of 114 households were surveyed, including a total of 592 people, equating to an average of 5.2 people per household unit. A comparison of household density across the seven villages is shown in *Figure 9.9*, and all values fall below the estimated density for the *Woreda* (6.9). The highest household density is in Berahale Town which correlates with secondary data sources demonstrating higher densities in urban areas.

Figure 9.9 Household Density in the Social Study Area



Source: ERM Household Survey, 2012

The slightly lowered household density may be related to the reduced availability of water and other natural resources in the villages within the Study Area. Household density may also be influenced by the seasonal nature of the salt trade, where household density may increase in villages such as Hamad Ela.

Population Structure

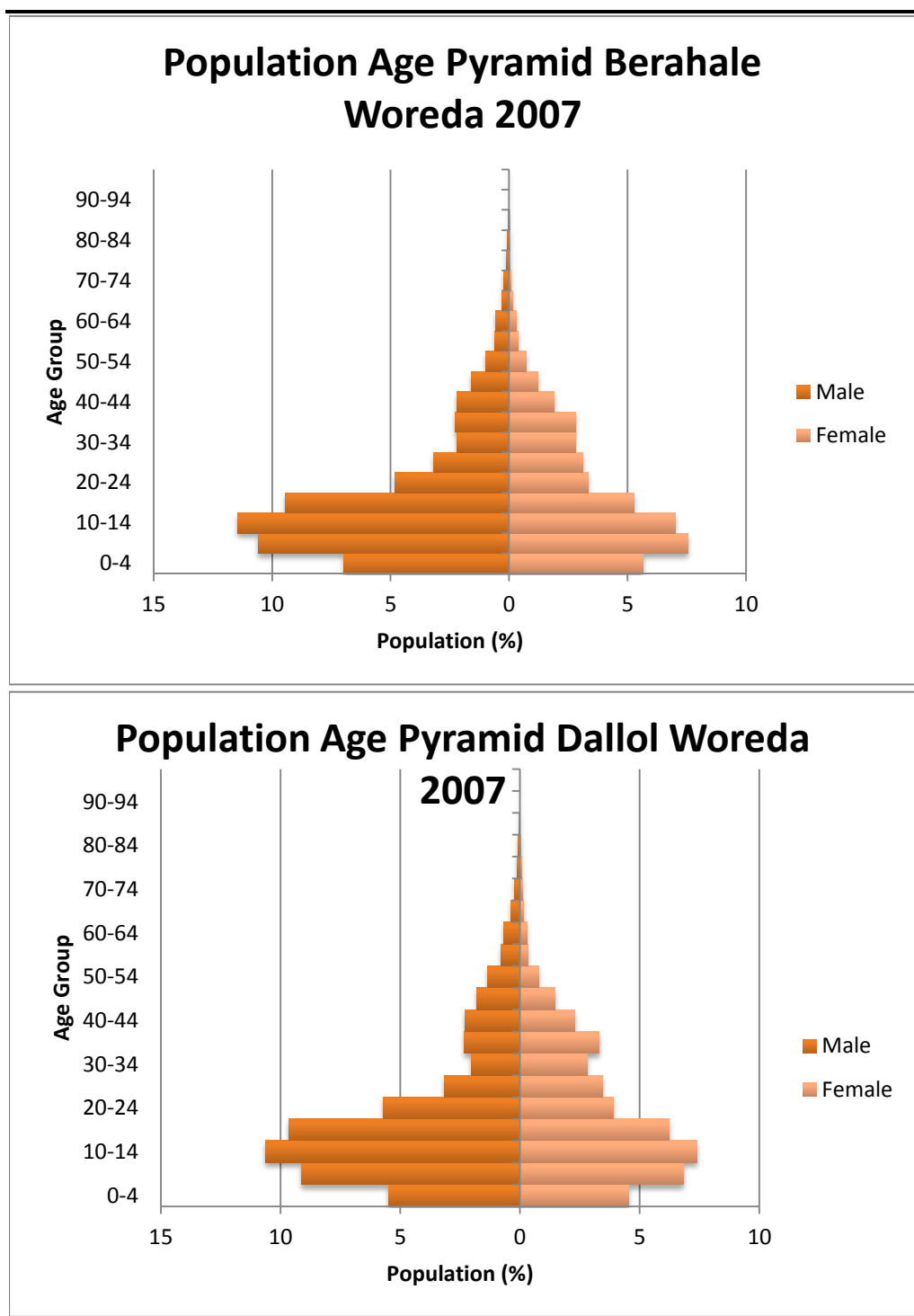
As depicted in *Figure 9.10*, children under the age of 15 accounted for 50% of the population in Berahale *Woreda*. Approximately 48.8% of the population falls within the working age group of 15 to 60, with only 1.1% of the population above the age of 65. A similar age distribution is evident in Dallol

Woreda with approximately 44% of the population younger than 15. In addition 54.7% of the population were between the ages of 15 to 64.

Figure 9.10 also illustrates the skewed gender distribution, particularly between the ages of 4 to 24, with a disproportionately higher number of boys compared to girls. Research conducted by the Ministry of Agriculture's Pastoral Extension Team (using the results of the 1994 census) indicated that in the Afar region the ratio of men to women was 1.4:1 based on a population of 725,000 men and 531,000 women. This indicates that there were 194,000 "missing women" in Afar alone (International Institute for Environment and Development - IIED, 2009) in 1994 with mortality attributed to the high prevalence of gender based violence including female genital cutting (FGC) ⁽¹⁾, domestic abuse and bridal abduction (frequently involving rape) thereby forcing women into marriage (International Institute for Environment and Development - IIED, 2009). This topic is discussed in greater detail in later in this Chapter.

(1) Both female genital mutilation and cutting are used to refer to the practice of removing parts of female genitalia for non-medical reasons. The practice is referred to female genital cutting in this report as it is a more neutral term. The Special Rapporteur (ECOSOC Commission on Human Rights) identify it as a less emotive and judgemental term to use.

Figure 9.10 Population Age Pyramid Berahale and Dallol Woreda



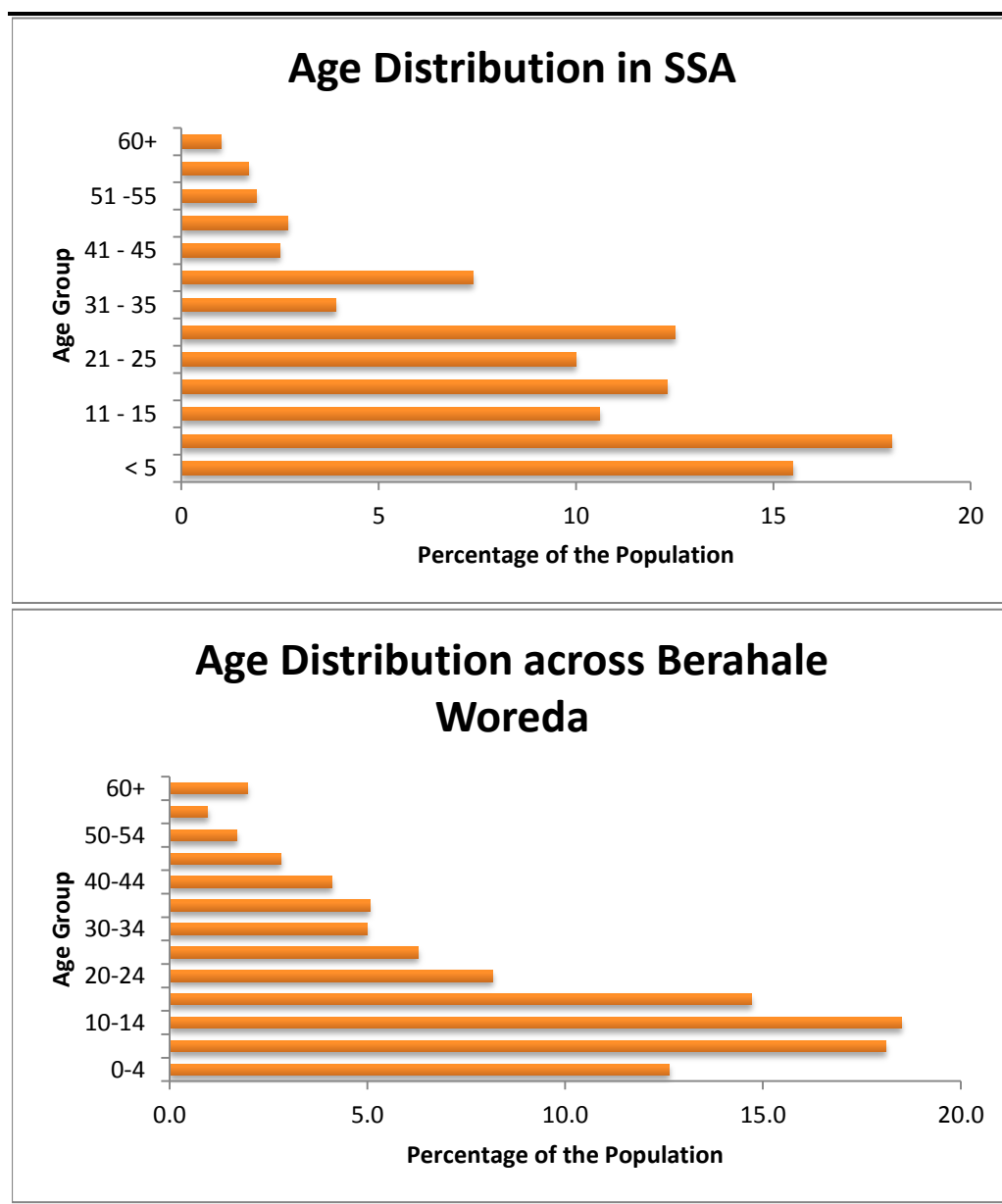
Source: Population Census Commission, (2008)

Further evidence of the skewed gender distribution can be found in the results of the household survey which demonstrates that there are a higher percentage of men compared to women, with men accounting for 53.5% compared to women accounting for 46.5%. This may indicate that migration, FGC and domestic violence are contributing to a disproportionate gender balance within the Study Area, with the former two causes potentially contributing to higher female mortality rates.

A comparison of the age distribution from the SSA and Berahale *Woreda* is included in *Figure 9.11*⁽¹⁾. Overall the age distribution is similar in both figures; however, there is noticeable decline in the number of people falling in the age group of 11 to 15 in the SSA. During FGDs participants referred to a severe outbreak (citing cholera and tuberculosis) that occurred several years ago, particularly impacting children aged between 6 to 14 years. The household survey results indicate that this outbreak may have affected the population distribution.

The proportion of the population that are economically active⁽²⁾ in the SSA is slightly higher (54.9%) than in the Berahale *Woreda* (48.8%), possibly indicating a high birth rate which is typical of rural settlements.

Figure 9.11 *Age Distribution*



(1) The differences in age categories is due to data being collected from varying data sources.

(2) Identified to range between the ages of 15 - 60. The Ethiopian Labour Proclamation allows for employment (non-hazardous) from the age of 14.

Ethno-Linguistic Characteristics

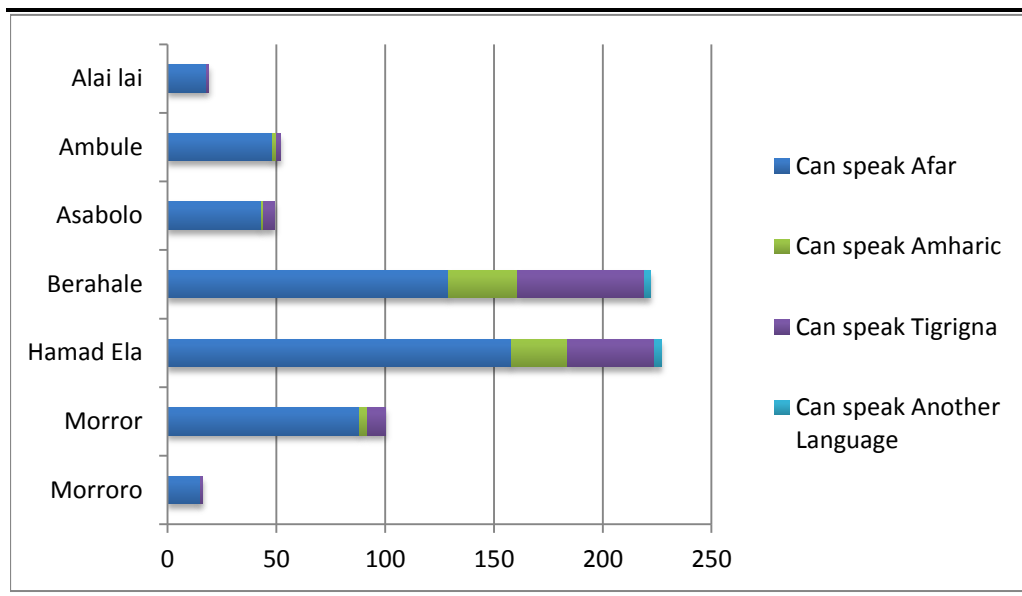
The majority of the villages in the SSA typically have homogenous ethno-linguistic characteristics. The household survey identified that the majority of people living in rural villages belong to the Afar ethnic group (97%); however, the ethnic composition varies during the year due to the influx of non-Afar groups during the salt mining season.

Across the SSA 2.2% of people surveyed were from the Tigray ethnic group (Tigrean people), and 0.8% were Amhara. These non-Afar ethnic groups were only located within Berahale and Hamad Ela. According to the results of the household survey 4.9% of respondents in Hamad Ela were Tigray and 1.1% were Amhara. In Berahale 2.5% of people surveyed were from Tigray and 1.9% were Amhara. This slight diversity in ethnicity in a largely homogenous area may be explained in Hamad Ela by seasonal in-migration; Hamad Ela is the main village in which salt workers stay, in addition the area is a centre for sex workers and the military, all of whom account for non-Afar groups. Ethnic diversity in Berahale is believed to be facilitated by the comparatively extensive government and transport infrastructure in the settlement.

Afarigna is the major language, if not the sole language spoken in the SSA. However it is common for Afar populations residing closer to neighbouring Tigray *Woredas* to also speak Tigrigna. *Figure 9.12* shows the language distribution of respondents to the household survey who indicated they could speak (note, not read or write) Afar, Amharic, Tigrigna or other languages. The results of the household survey indicate that 25.5% had some working knowledge of Tigrigna and 26.2% Amharic ⁽¹⁾.

(1) The ability to speak, read or write.

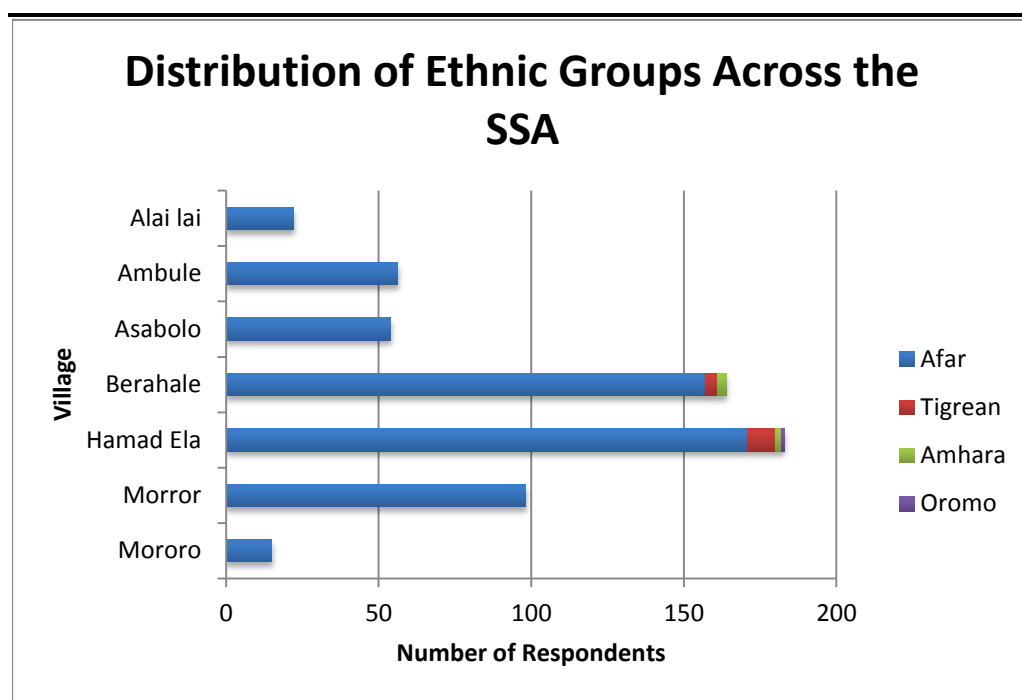
Figure 9.12 Language Speaking Distribution in the SSA



Source: ERM Household Survey, (2012)

The prevalence of Tigrigna speakers is mainly due to long-established social, economic and political interactions and relationships between the local Afar and the neighbouring Tigrean group. Non-Afar ethnic groups, including local government employees, traders, and salt trade workers reside mainly in the larger towns and villages. *Figure 9.13* shows that Hamad Ela and Berahale are the only villages surveyed that were recorded to have non-Afar resident groups at the time of the household survey. Hamad Ela had the highest number of non-Afar groups in the SSA, with the highest number of people from the Tigray region. Berahale, the only other town in which non-Afar resident groups were found had the highest number of people from the Amhara region.

Figure 9.13 Distribution of Ethnic Groups across the SSA



Source: ERM Household Survey, (2012)

The predominant religion across both Berahale and Dallol *Woredas* is Islam (98.9% and 96.7% respectively). There are a greater percentage of Orthodox Christians in Dallol *Woreda* (3% compared to 1% in Berahale *Woreda*), in addition to higher percentages of Protestant Christians and traditional belief systems in Dallol *Woreda*. In the SSA the majority of the surveyed population practiced Islam accounting for 97.6%. The remaining 2.4% of the population surveyed were Christian Orthodox and were only found in Hamad Ela and Berahale, accounting for 3.8% and 4.7% respectively.

Population Migration Patterns

The majority of the people (81.8%) surveyed were born within their villages; 10.8% were born elsewhere in Berahale *Woreda*; 4.2% outside of Ethiopia; 2.7% elsewhere in Ethiopia and 0.5% elsewhere in the ANRS. People born outside of Ethiopia ranked as the third highest group to be surveyed, which demonstrates the extent to which people may have migrated or have been displaced as result of the Ethiopian - Eritrean war. The majority of people born outside of Ethiopia were born in Eritrea and Djibouti.

In 1999, 27,720 people were reported as displaced in the ANRS, and a further 94,242 people at risk of displacement due to the border conflict (UNDP, 1999). As a result the ANRS issued a *Contingency Plan for the Displaced People* which provided relief support for already displaced people and people at risk for six months. Relief provided comprised of the following: water supply and environmental sanitation; education; health and nutrition; transportation; food, shelter and household utensils (UNDP, 1999).

Across the villages surveyed one village (Mororo - shown in *Figure 9.14*) reported that they had moved due to the border conflict and therefore could be identified as Internally Displaced Persons (IDPs) (UN OCHA, 2004) ⁽¹⁾. Although only one village was identified to have recently relocated, the regional level statistics indicate it is likely that there is a larger group of IDPs within the Study Area. Furthermore a camp for IDPs is located in Berahale, and the Afar Disaster Prevention and Preparedness Bureau (DPPB) reported 2,720 displaced people (both from Eritrea and Ethiopia) existed in Berahale (UNDP, 1999).

Figure 9.14 Alai lai (top) and Mororo (bottom) Villages

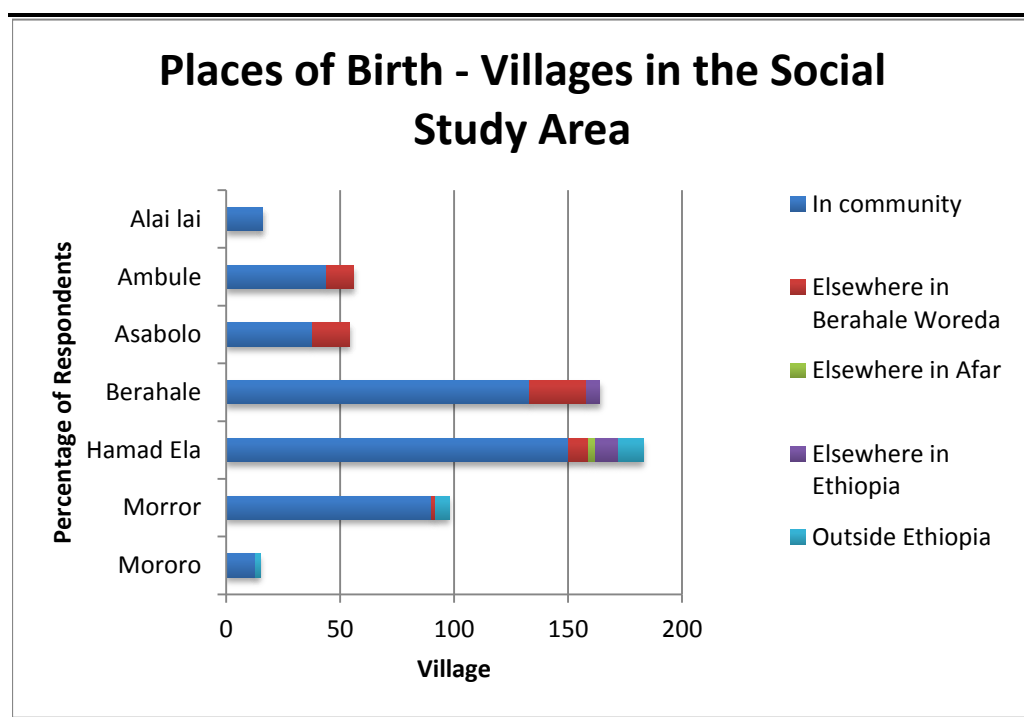


(1) Persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human made disasters, and who have not crossed an internationally recognised State border.

A contributing factor to the potential movement of displaced persons is the geographic spread of the Afar area. The Afar people have a distinct cultural and linguistic identity and inhabit a well-defined territory in the African Horn; an area commonly referred to as the Afar Triangle which is divided between Ethiopia, Eritrea and Djibouti (Yasin, 2008). Prior to the Ethiopia – Eritrea war the Afar were documented to migrate across the two countries, and several respondents in the Study Area stated that it is common for the Afar to migrate to Ethiopia and Djibouti largely for economic reasons. Several people interviewed in the Study Area stated that they were born or had lived in Djibouti, illustrating that the Afar people continue to live and migrate across the three countries.

Figure 9.15 shows the places of birth for residents across the SSA. The residents of Alai lai were all born within their community; however, the FGDs indicated that the village had moved at least two times in the past 10 years, and had lived in Badile and Hamad Ela previously. The village of Mororo also reported to have moved from the Ethiopia - Eritrean border due to the 1998 border war. Hamad Ela had the highest percentage of people born outside of the ANRS; with 6% born outside of Ethiopia and 5.5% elsewhere in Ethiopia. The higher percentage of residents born outside of the ANRS in Hamad Ela is supported by the higher percentage of non-Afar groups that were found to reside in the village during the household survey.

Figure 9.15 Places of Birth of Respondents

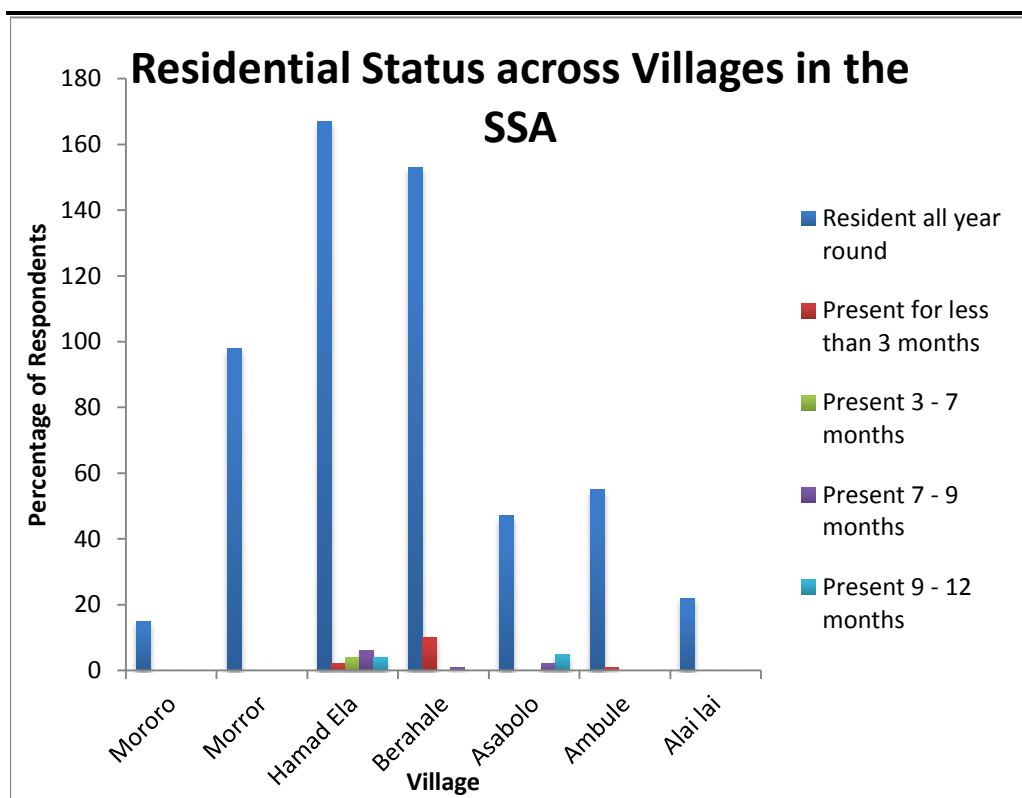


Source: ERM Household Survey, (2012)

Across the seven villages in the SSA the majority of households surveyed were resident all year round. Figure 9.16 shows that Berahale had the highest percentage of residents present for less than three months of the year followed by Hamad Ela. The results of the household survey, and the number of

residents present for less than a year may vary during the peak of the salt trade season.

Figure 9.16 Residential Status of Villages in Social Study Area



Source: ERM Household Survey, 2012

The majority of households involved in an economic activity identified their primary occupation as working for the government in Berahale. Of this group it can be inferred from field observations that a significant proportion were non-Afar and are seconded to the area, which may account for the higher percentage of households living in Berahale for less than three months a year. Hamad Ela had the highest number of people that were not resident all year round. Apart from residents that were present all year round, the majority of people lived in Hamad Ela between 7 to 9 months. This is likely due to the salt trade and its seasonal nature, and specifically the high temperatures during the summer months (June to end August) making it difficult to live in the area.

Population Change in the Local Area

During FGDs participants indicated that they have perceived that the population has increased in Berahale *Woreda* over the past two decades. In particular participants of the FGDs in Hamad Ela and Berahale reported noticeable population increase in the recent years, attributing the growth to one or all of the following factors:

- The end of the civil war in 1991;
- The construction of the gravel road from Mekele to Berahale and Hamad Ela;

- Foreign tourists visiting the Danakil Depression including Erte Ale and Mount Dallol;
- The recent appearance of Mining companies in the area; and
- The influx of Eritrean refugees following the Ethiopian-Eritrean war.

9.5 SOCIAL INFRASTRUCTURE, RESOURCES AND SERVICES

This section discusses the quality and availability of social infrastructure, resources and basic services for stakeholders at a national, regional and local level. Educational and health infrastructure and services are discussed in greater detail in *Sections 9.6* and *Section 9.7*.

9.5.1 National and Regional Infrastructure and Provision of Services

Access to and availability of infrastructure is a key indicator (and cause) of the general welfare and socio-economic condition of a population. This section will use data from the 2011 Demographic and Health survey and 2007 Census to discuss the standard of infrastructure and services at a national and regional level.

A comparison of infrastructure and services across the national, regional and zone level is included in *Table 9.5*. Information presented for the ANRS and Zone 2 does not include data on rural areas unless stated in *Table 9.5*. This is because the 2007 census only provides information on urban areas in the ANRS. The information collected illustrates that the standard of infrastructure and services in the ANRS and Zone 2 fall below national levels. The limited access to basic services and infrastructure has resulting implications on the health status and wellbeing of people in both the region and Zone 2. For instance a household's reliance on wood as a cooking fuel increases by an average of 13.7% at the regional and local level, potentially putting households at a higher risk of respiratory disease.

The welfare of a household in the ANRS, and more so in Zone 2 is compromised due to their reduced access to basic services such as drinking water and sanitation. Only a third at the regional level, and approximately a quarter of households in Zone 2 have access to an improved source of drinking water ⁽¹⁾, compared to 53.7% of households at the national level. In addition the majority of households at both levels still do not have access to an indoor toilet facility and revert to open field defecation.

Table 9.5 Comparison of Infrastructure and Services

Indicators for Infrastructure and Services (all stated as percent)	National	Regional (Afar)	Zone 2
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(1) These include a piped source within the dwelling, yard, or plot; a public tap/stand pipe, or borehole; a protected well; spring water, rainwater or bottled water - WHO and UNICEF Joint Monitoring Program for Water Supply and Sanitation, 2010.

Indicators for Infrastructure and Services (all stated as percent)	National	Regional (Afar)	Zone 2
Access to electricity	41.2	72.2 (urban) 2.3 (rural)	59.8
Cooking fuel	<ul style="list-style-type: none"> Wood 77, Charcoal 7.7, Animal dung 7.0 	<ul style="list-style-type: none"> Wood 89.7, Charcoal 19.4, Animal dung 10.0 	<ul style="list-style-type: none"> Wood 91.6, Charcoal 12.9, Dung 9.7
Water			
Access to improved drinking water	53.7	31.7	28.8
Source of improved drinking water	<ul style="list-style-type: none"> Public tap 23.3 Tap in compound 10.1, Protected spring /well 9.0 ⁽¹⁾ 	<ul style="list-style-type: none"> Public tap 14.7, Protected spring / well 8.2, Tap in compound (shared) 4.3 	<ul style="list-style-type: none"> Protected spring / well 13.0, Public tap 11.6, Tap in compound (shared) 1.9
Waste Management			
Improved toilet facilities ⁽²⁾	<ul style="list-style-type: none"> Pit latrine with slab (shared) 6.3, Composting toilet (private) 3.0, Pit latrine with slab (private) 2.5 	<ul style="list-style-type: none"> Pit latrine with slab (shared) 4.3, Pit latrine with slab (private) 1.9, Ventilated pit latrine (shared) 1.3 	<ul style="list-style-type: none"> Pit latrine with slab (shared) 1.5, Pit latrine with slab (private) 0.7, Ventilated pit latrine (shared) 0.3
Non-improved toilet facilities	<ul style="list-style-type: none"> Open pit 43.5, Bush / field 38.3, Flush not to septic tank / pit latrine 0.1 	<ul style="list-style-type: none"> Bush / field 90.7 ⁽³⁾ 	<ul style="list-style-type: none"> Bush / field 97.1
Telecommunications (household possession)	<ul style="list-style-type: none"> Mobile phone 24.7, Telephone 4.5 	<ul style="list-style-type: none"> Telephone 9.2 	<ul style="list-style-type: none"> Telephone 7.0
Household possessions	<ul style="list-style-type: none"> Radio 40.5, Television 10.4, Refrigerator 3.7 	<ul style="list-style-type: none"> Radio 51.1, Television 22.0 	<ul style="list-style-type: none"> Radio 48.1, Television 8.8
Household characteristics - flooring material	<ul style="list-style-type: none"> Earth / sand 50.7, Dung 34, Vinyl / asphalt 6.2 	<ul style="list-style-type: none"> Mud 81.7, Cement 15.6, Tiles 1.6 	<ul style="list-style-type: none"> Mud 76.1, Cement 22.3, Tiles 1.4

Source: Population Census Commission, 2008 and Central Statistics Agency (2011) ⁽⁴⁾

(1) The spring is typically protected from runoff, bird droppings and animals by a "spring box", which is constructed of brick, masonry, or concrete and is built around the spring so that water flows directly out of the box into a pipe or cistern.

(2) A household is classified as having an improved toilet if it is used only by members of one household (that is, it is not shared) and if the facility used by the household separates the waste from human contact - WHO and UNICEF, 2010.

(3) Identified in the 2007 Census as 'no toilet facility'. Therefore inferred as open field / bush.

(4) All numbers indicated in the table are the percentage of total households in the respective population. Housing characteristics for the ANRS and Zone 2 are only provided for towns in the ANRS, data for rural areas is not presented in the 2007 census.

Access to Electricity and Sources of Fuel

In Ethiopia a household's access to electricity is largely determined by whether it is located in an urban or rural area. In 2011, 23% of households across the nation had access to electricity, the majority (85.2%) of which were households located in urban areas. In the same year only 4.8% of rural households had access to electricity. The Universal Access to Electricity Program is an arm of the PASDEP that aims to increase electricity access to households particularly in rural areas. Between 2000 and 2005 the proportion of households with access to electricity in urban and rural areas rose by 10% and 1.5% respectively. Access to electricity in the ANRS is lower than the national average of 41.2% and was recorded at 37.3%. However of this percentage, very few households in the ANRS in rural areas had access to electricity (2.3%). Data for total electricity access in Zone 2 is not available, and is only reported for towns in the 2007 Census, indicating the limited availability of electricity in rural areas.

Only 10% of Ethiopia's total energy consumption is supplied by electric power, the rest is derived from a variety of sources including wood, charcoal and dung ⁽¹⁾. *Table 9.5* shows the top three sources of cooking fuel, and the percentage of households using each across the national, regional and zonal level. It should be noted that the data presented in *Table 9.5* illustrates that it is common for households to use more than type of fuel source listed, and for example a household may use both charcoal and wood. For the majority of households in Ethiopia (77%) wood is the key cooking fuel. In rural areas 86% of households use wood as a means to prepare food, and in urban areas nearly half of the households use this source of fuel (45.9%). Charcoal (29.9%) and kerosene (10.1%) (Central Statistics Agency, 2005) are also used in urban households, in contrast to the use of animal dung and agricultural crops in rural households (8.3 and 2.2% respectively). The availability of wood, charcoal and animal dung in rural areas, in addition to the lack of necessary infrastructure may explain the widespread use of these fuel sources.

The key types of cooking fuel for an Afar household (Region and Zone 2) are similar to those at the national level, with an increase in the proportion of households that use wood, charcoal and dung (Demographic and Health Survey, 2005).

Access to Water

In assessing a household's access to water the trend in disparity between urban and rural households continues. The results of the 2011 Demographic and Health Survey, as illustrated in *Table 9.5* indicate that approximately half of the Ethiopian population had access to an improved source of drinking water, with access in urban areas considerably higher than in rural areas (94.5% and 41.7% respectively).

(1) Dung is dried and used to create circular 'patty' structures that are then combusted.

The most common source of drinking water varies according to the region. At the national level approximately a third of households (33.4%) used piped water both in urban and rural areas. Only a third of households in the ANRS had access to an improved source of drinking water, and an even lower proportion in Zone 2. *Table 9.5* shows that in the ANRS, and Zone 2, reliance on protected springs and wells increases. In Zone 2 the latter is the primary source of safe drinking water but only accounts for 13% of households. The use of protected springs and wells in rural areas is likely influenced by the low cost of implementation and the limited availability of other water related infrastructure.

The majority of households in Ethiopia (90.2%) do not treat their drinking water; with a higher percentage (14.5%) of urban households treating their water compared to rural households (9.2%). The most common forms of water treatment are adding chlorine, boiling and straining through a cloth. Access to drinking water is limited in rural areas with the majority of households (62.4%) having to travel more than 30 minutes to fetch water, in comparison to urban households where half (50.4%) have water on their premises or within their compound.

Waste Management

National statistics indicate the scarcity of toilet facilities and general sanitation at the household level. More than a quarter (38.3%) of the Ethiopian population does not have access to a formal toilet facility (indoor). Urban households are more than four times as likely to have access to improved toilet facilities in comparison to rural areas ⁽¹⁾. The most common type of toilet facility (un-improved) is an open pit latrine.

In the Afar region 90.7% of households use a bush / open field. Almost all households (97.1%) in Zone 2 use the open field for disposal of human waste.

Telecommunications and Transportation

Ethiopia is reported to have one of the lowest road densities in Africa. Over a period of nine years (1991 to 2010) road networks increased from under 20,000km to over 48,800km. In addition, road density has increased from 29km per 1,000km² to 44.4km per 1,000km² between 2001 and 2012 (The World Bank Group, 2012).

The latest census does not provide data on the availability of public transport, which may be an indication of the general lack of public transport, particularly in rural areas. However, field observations demonstrate that a considerable proportion of urban inhabitants utilise public transportation systems as their main means of transport. Ethiopians are not likely to own a private means of

(1) A household is classified as having an improved toilet if it is used only by members of one household (that is, it is not shared) and if the facility used by the household separates the waste from human contact (WHO and UNICEF, 2010).

transportation, with bicycles and animal drawn carts as the most common form of private transportation (2.3% and 1.0% of the population respectively).

Only 4.5% of the Ethiopian population own a telephone, and the majority of households are found in urban areas, where 19.0% of the households owned a telephone compared to 0.2% in rural areas. Furthermore, five times more households owned a mobile phone compared to a telephone. The growth in mobile phone usage in Ethiopia is mirrored by trends across the continent. In 2011, there were 600 million mobile subscribers in Africa, more than Europe and America (The Economist, 2011). However possession of a mobile phone (as indicated in the 2007 Census) is not a clear indication of the availability and quality of mobile phone network in Ethiopia. Research indicates that mobile phone network coverage and expansion in Ethiopia is still one of the lowest in Africa (Aker and Mbiti, 2010).

Afar Household Characteristics and Physical Conditions

Data on household characteristics in the ANRS and Zone 2 are only available for urban areas; however, this may be a reflection of the semi-mobile lifestyle of some rural inhabitants. In urban areas the majority of houses in the ANRS and Zone 2 had floors consisting of mud (81.7% and 76.1%), and walls constructed of wood and thatch (67% and 65.2%).

Radios were the most common household possession in both the ANRS and Zone 2 with approximately half of households owning a radio. Data was not provided on the ownership of refrigerators, illustrating the limited number of households which own a refrigerator, with resulting implications for the storage of food and medication.

9.5.2

Local Infrastructure and Services

From the baseline data collection conducted in May 2012 it can be stated that infrastructure and basic services such as sanitation, water, electricity, telecommunication, police and emergency services are largely absent in the villages surveyed.

Of the services and infrastructure available the majority provide a low level of service for the local population's needs. For instance the Health Centre in Hamad Ela is not functional, lacking both healthcare professionals and equipment thereby forcing residents to travel to Berahale for healthcare. In addition the levels of facilities at the local schools are very low with a shortage of basic requirements including stationery, books, blackboards and teachers. The schools in Hamad Ela and Berahale are better equipped in comparison to other villages such as Ambule; however, the local Education office has commented that resources are limited, books are outdated and not aligned to the national curriculum, and there are frequent power cuts. Health and educational infrastructure are discussed in full separately in *Sections 9.6 and 9.7*.

Table 9.6 summarises the levels of social infrastructure and services available in the SSA with a cross indicating the availability of infrastructure in each village.

Table 9.6 *Summary of Infrastructure in the Social Study Area*

Village	School (ABS ⁽¹⁾ , 1 st (2), 2 nd (3) or 3 rd (4) cycle)	Potable Water	Public Sanitation	Village Electricity	Telecommunications (mobile phone, TV, radio)	Police Station	Bank	Market	Health Centre	Health Post	Shops	Mosque
Berahale	X	X	X	X	X	X	X	X	X	X	~ 10	X
Morror	X											
Ambule	X				X							
Asabolo												
Hamad Ela	X	X	X	X	X						~ 3	X
Mororo												
Alai lai												

Access to Electricity

In the SSA, of the seven villages included within the household survey, only Berahale and Hamad Ela were noted to have a limited access to electricity. Electricity supply is intermittent in Berahale with frequent power cuts, and the generator used to supply electricity in Hamad Ela often does not work. The majority of households (79.0%) surveyed across the SSA indicated that they did not have supply of electricity or that the supply was unsatisfactory. However some electricity is available amongst the households surveyed, where 17.1% of households were recorded as using electricity (from a generator or the grid) for lighting, and 6.1% were recorded to use electricity for cooking.

The source of electricity supply in Hamad Ela comes from a diesel powered generator that was donated by a gold exploration company in the area (right hand structure in *Figure 9.17*); however, the majority of houses visited at the time of the baseline study did not have access to the electricity. Houses with access to electricity were identified to be the local shops, mosque and houses of the village elders that were powered by the village generator.

Local residents stated that the existing electricity supply was erratic, and the supply of diesel is also limited. It is understood that the diesel is bought from

(1) ABS are schools designed to suit the special needs and constraints of pastoral life.

(2) Grade 1-4 equates to ages 6-10.

(3) Grade 5-8 equates to ages 11-14.

(4) Grade 9-12 equates to ages 15-18.

Berahale, which is brought in by truck from further afield including Mekele; however, the supply is not stable nor is it reliable.

The military camp also have a generator however its functionality and supply of diesel was also reported to be erratic.

Figure 9.17 Diesel Generator in Hamad Ela

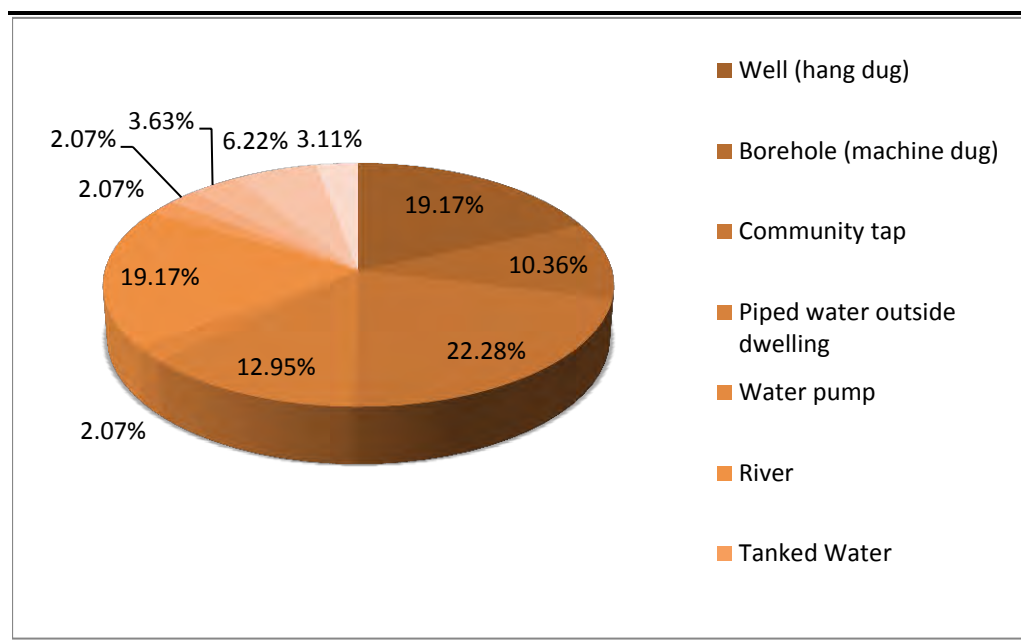


Access to Water and Sanitation Facilities

The majority of households surveyed access water through central taps (22.3%), hand dug wells (19.8%) or from the seasonal river channels (19.8%).

Figure 9.18 shows the distribution of water sources used by respondents in the household survey.

Figure 9.18 Water Sources Accessed by Surveyed Households



Source: ERM Household Survey, (2012)

Based on field observations of the villages within the SSA only Berahale, Hamad Ela and Ambule have access to a communal water tap (pumped from a borehole). Residents reported that the communal water taps were constructed by international aid organisations (the International Red Cross). The provision of water taps was reported to be a noticeable improvement in both villages’ water sources as they previously relied on wells and seasonal river water. For some households this would have also involved travelling further distances to fetch water.

The different types of water sources across villages in the SSA are shown in *Figure 9.19*. The villages of Mororo and Alai Lai primarily source their water from a hand dug well (top left-hand photo) and an open pool (top right-hand photo). An example of a communal water tap in Berahale (bottom left-hand photo) and the Sabah River (bottom right-hand photo) also feature as water sources for villages in the SSA.

Figure 9.19 Varying Water Sources for Villages in the SSA



It is assumed that the remaining five villages in the SSA access water through hand-dug wells usually located on the periphery of the community, with women and girls typically responsible for fetching water. Most of the villages visited reported water shortages, as existing wells do not provide water all year round. In the event of a water shortage, members have to walk to the next closest village to fetch water. From field observations the quality of water in the hand-dug wells was poor and considerably saline, with participants closer to the Sabah River commenting on the increasing levels of pollution of the water due to road construction, and the increased number of people and vehicles in the area. The poor quality of water is further emphasised by the results of ERM's hydro-census and water sampling, taken in 2012, which demonstrating that the majority of water samples (groundwater and surface water samples) were identified as 'non-potable water sources' according to WHO and South African Department of Water Affairs and Forestry criteria.

When questioned in the household survey, 52.6% of households indicated that water provision was not available or deemed it unsatisfactory. Water shortages were reported to be a serious concern during the survey where 27.2% (the second most common response) of households indicated that it was the greatest concern in their village, and 28.0% indicated it would be the largest problem they faced in the future. The large volume of waste plastic water bottles in Hamad Ela (*Figure 9.20*) is an indication of the extent to which people in the Study Area prefer to drink bottled water as it is usually their only source of potable water. However the pollution caused by dumping of water bottles is an increasing problem in Hamad Ela. Key sources of bottled water in area are tourists that bring water bottles into the area, in addition to

the presence of mining companies in the area that use bottled water as their primary source of drinking water.

Waste Management and Sanitation

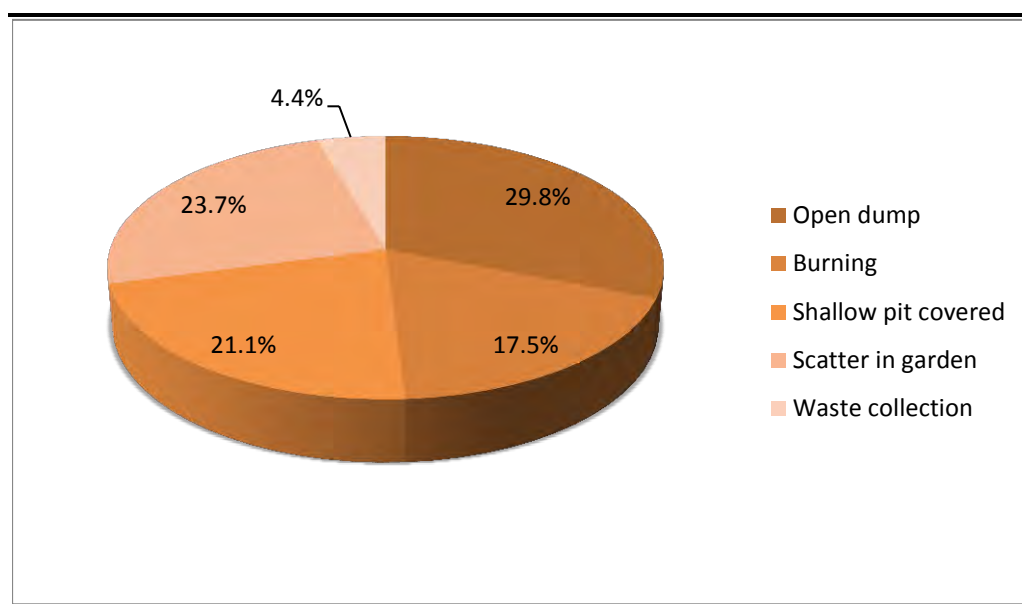
The low level of sanitation and waste management facilities in the area is supported by Ethiopian statistics on general access to sanitation facilities across the country. During field trips it became evident that waste disposal facilities do not exist in the majority of villages, and were only witnessed in Berahale. Berahale was observed to have better access to communal areas where waste could be disposed; however, dumping of waste in open spaces, and make-shift disposal facilities are common as shown in *Figure 9.20* which shows an area for plastic bottles which Allana organised in Hamad Ela as part of a recycling programme.

Figure 9.20 *Waste Disposal Means in Hamad Ela*



Households within the SSA reported using a range of informal waste disposal techniques (*Figure 9.21*) for general waste in the household survey including dumping in unused areas (29.8%), scattering close to the household (including gardens) (23.7%) and disposing in shallow pits (21.1%).

Figure 9.21 Distribution of Waste Disposal Techniques



Source: ERM Household Survey, (2012)

Households surveyed in the SSA (88.6%) indicated they felt solid waste disposal facilities were not available or unsatisfactory, demonstrating the lack of waste infrastructure in the SSA.

The lack of waste infrastructure is mirrored in the management of human waste. Within the villages included within the SSA, only Berahale and Hamad Ela were identified to have access to pit latrines (however Hamad Ela only had one latrine constructed in 2012 with assistance provided by the Red Cross to the *Woreda*). The remaining villages do not have any formal toilet facilities, and defecation in waste areas is the only option. These observations were backed up by the household survey which indicated that 61.4% of households surveyed indicated that they have no access to toilet facilities and defecate in unused areas. Other toilet facilities that were reported to be used by households include toilet facilities located outside of the dwelling (22.8%) and pit latrines (14.9%), which may have been misunderstood as the same criteria by respondents. Furthermore 87.7% of respondents indicated that sanitation and toilet facilities were not available or unsatisfactory.

Communications and Transportation

Within the SSA, the villages of Ambule, Morrh, Hamad Ela and the town of Berahale are positioned in close proximity to the main road (unpaved) which links the Study Area to Mekele (top photo of *Figure 9.22*). In addition to the paved road there is a road being constructed by the GoE which is proposed to connect Mekele to Hamad Ela (bottom photo of *Figure 9.22*). The alignment of this road is not clear at the time of writing however it is believed that it will not entirely replace the existing road. This road is planned to be an improved surface asphalt road and is planned to be completed during 2013.

Figure 9.22 *Current Main Road and Government Road in the Social Study Area*



Commercial bus services run to Berahale, and provide weekly transportation for goods and people between Berahale and Mekele at the price of ETB 50 (approximately 2.8 USD)⁽¹⁾ for a single journey. Commercial buses do not service the area along the road north of Berahale reflected by the fact that not a

(1) At the time of writing USD 1.00 was equal to approximately ETB 18.00.

single household referred to spending money on public transport on a monthly basis. For the majority of villages in the SSA the main means of transport is walking or hitchhiking on vehicles that pass. The majority of local people identify the construction of the Government road as positive as they believe it will increase business opportunities for local residents, in addition to increasing the connectivity of the area to neighbouring areas such as Mekele. Several respondents of FGDs indicated that they would move their villages closer to the road following its completion.

Access to transport infrastructure is shown to be low within the SSA where 31.3% of respondents indicated they relied on motorised transport (cars or public buses) and 67.0% indicated that they rely on walking.

Of the seven villages surveyed, including Berahale Town, all villages were identified to have access to the national mobile telephone network except the village of Asabolo. However, this is only a recent change; prior to March 2012 the villages of Mororo, Alai lai and Hamad Ela did not have access to the national network. As a result of a Base Transceiver Station (BTS) in Hamad Ela (*Figure 9.23*) being activated in March 2012 mobile phone coverage has increased in the area. Of the villages surveyed 38.4% reported that they have access to mobile telephone network which was the most common source of communication identified in the household survey. Some residents have stated that apart from the construction of the road, the introduction of mobile phone network has been the biggest positive change in their life, enabling them to communicate with neighbouring residents and family members elsewhere in Ethiopia. In addition residents stated that they are able to access and receive information more readily.

Figure 9.23 *Base Transceiver Station in Hamad Ela*

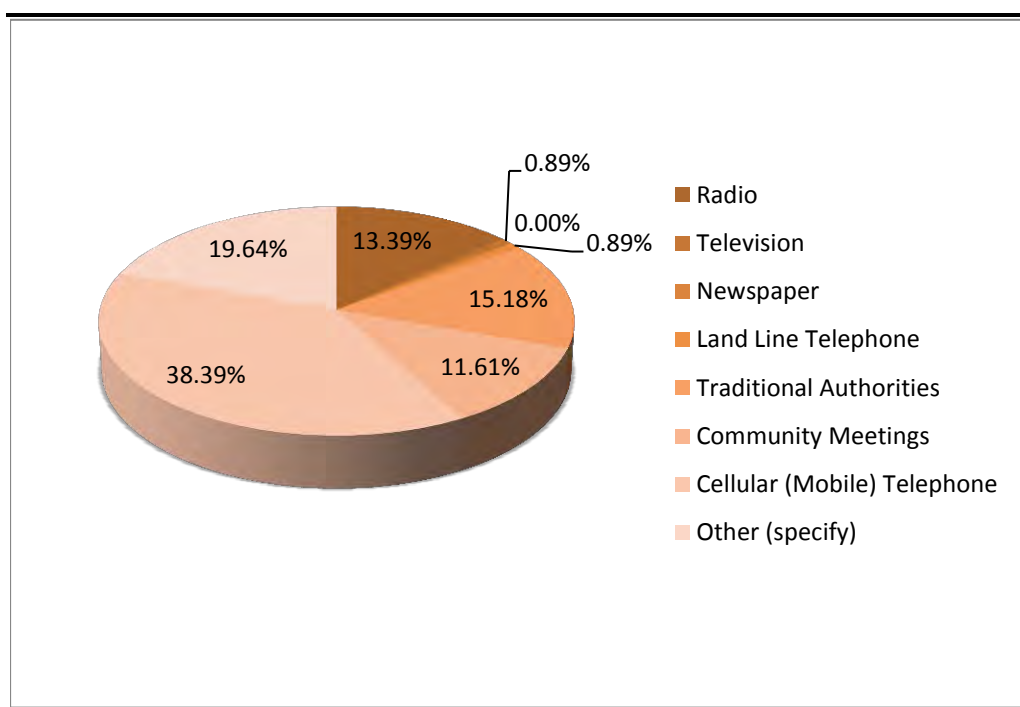


A considerable proportion of participants (with the exception of Berahale) stated that although they had access to the national network they did not own a mobile phone, and therefore at present their modes of communication had not changed. In addition respondents noted that the network was not always reliable, and there is frequent loss of signal in all villages including Berahale town.

In addition respondents in Berahale commented that improved access to telecommunications has changed the way in which the Salt Selling Association operates, as they are now able to negotiate salt prices with the Salt Buying Association in Mekele over the phone.

Figure 9.24 shows the distribution of communication methods as described by the respondents to the household survey. The traditional method of communication relies upon people travelling between villages, with village elders being the key messengers in villages. This form of communication was identified by some FGDs to still be a key mechanism for communication but it is observed to be changing due to the introduction of the national network. It should be noted that after mobile telephones the most common communication method identified includes village meetings and the traditional authorities. Based on field observations and comments from respondents, the Afar tradition of passing 'news' to people you pass while walking is believed to account for the high number (19.6%) of households who reported relying on 'other' types of communication. When this is considered in combination with the reliance on traditional authorities (15.2%) and village meetings (11.6%); it can be assumed that traditional Afar communication techniques are still prevalent in the area.

Figure 9.24 *Distribution of Communication Methods*



Source: ERM Household Survey, (2012)

Opinions on the adequacy of telecommunication in the area were very mixed; however, the majority (63.2%) of respondents indicated that telecommunications were not available or unsatisfactory.

Commerce

From the FGDs conducted it was identified that small scale commerce is most common in Berahale and Hamad Ela, in the form of small scale shops. The limited subsistence activities available in the SSA mean that the reliance on these shops to provide food and other items is pronounced.

Berahale has the widest distribution of small scale shops selling a variety of goods, mainly imported from Mekele. From field observations shops are operated by both highlanders and local Afar. Berahale is the central town into and through which goods are imported. In addition there is a weekly market in Berahale that draws residents from the other six villages in the SSA.

There are approximately three shops in Hamad Ela selling a range of products including clothes and shoes, batteries and dry food products (wheat, sugar and coffee). The shops in Hamad Ela (structures on the right hand side of *Figure 9.25*) source the majority of their goods from shops in Berahale; however, one of the main shops in Hamad Ela stated that they purchase a significant proportion of their non-perishable goods from traders in Bada and other towns in the Tigray region. In addition all food purchased and consumed in Hamad Ela is imported from Berahale or other areas, indicating that the village is not self-sustaining. Local residents have also commented on experiencing food shortages at the beginning of the annual salt trade due to the influx of people.

Figure 9.25 *Shops in Hamad Ela (towards the right of the image)*



The local tea / coffee shops in Hamad Ela which are run by women from the highlands are also involved in small-scale commerce usually selling tea, coffee and popcorn (dried product). In addition, women who have migrated from the highlands are reported to participate in sex work using both activities as a source of income.

Recreation and Amenity

A lack of recreational facilities was noted in the area. *Figure 9.26* is the meeting hall in Berahale which is used for village meetings, and celebrations. A festival hall is also available in Berahale which is used for religious holidays and other celebrations.

Apart from the festival hall in Berahale one of the main ways in which local people enjoy themselves is at local coffee houses; however, these are only present in Berahale and Hamad Ela. As indicated in Hamad Ela it was noted that a considerable proportion of the coffee houses were run by sex workers. During informal interviews in Hamad Ela some of the sex workers indicated that the number of women migrating from the highlands to work as sex workers and run coffee shops is highest at times of influx mainly related to the beginning of the salt trade.

The other recreational facility available for local people are mosques in the villages of Hamad Ela, Ambule and Berahale; however, the women in the FGDs indicated that they do not attend mosque for daily prayers, and only men attend prayers in the mosque. In all of the other villages there were no recorded recreational facilities.

Figure 9.26 *Meeting Hall in Berahale*



This section analyses the profile of educational infrastructure and achievement within Ethiopia at a national, regional and local level.

9.6.1 *National Education Profile*

The Ethiopian educational system consists of four cycles; two cycles of primary and two cycles of secondary schooling.

Primary education is provided for children aged between seven and 14 years. Upon completion of the second primary cycle (grades five to eight), students are required to take the Eighth Grade National Examination. The results of this determine secondary school placement. The first cycle of secondary school (grades eight to ten) terminates in the 10th Grade National Examination. A pass allows students to progress to the second cycle of their secondary education. Those who fail receive either technical or vocational education training, normally at an agricultural college, teacher training college, engineering and technological institute or a health and commercial institution. The second cycle of a secondary education entails a further two years of schooling and culminates in the Ethiopian Higher Education Entrance Examination (Ministry of Education, 2012).

As shown in *Table 9.7*, public spending on education accounted for 5.5% of GDP from 2005 and 2010. The pupil-teacher ratio for primary schools is 1:54; a decrease from 1:62 in 2008. The ratio for secondary schools is slightly lower at 1:43. Both figures fall short of the standards set by the MDGs which advises that the student-teacher ratio should be no more than 40:1 (UNDP, 2010).

Table 9.7 *Key National Education Indicators*

Indicator	Value
Education expenditure (% of GDP) (2005 to 2010)	5.5
Pupil-teacher ratio, primary (2010)	54
Pupil-teacher ratio, secondary (2010)	43
Literacy rate, adult total (% of people ages 15 and above) (¹) (2008)	29.8

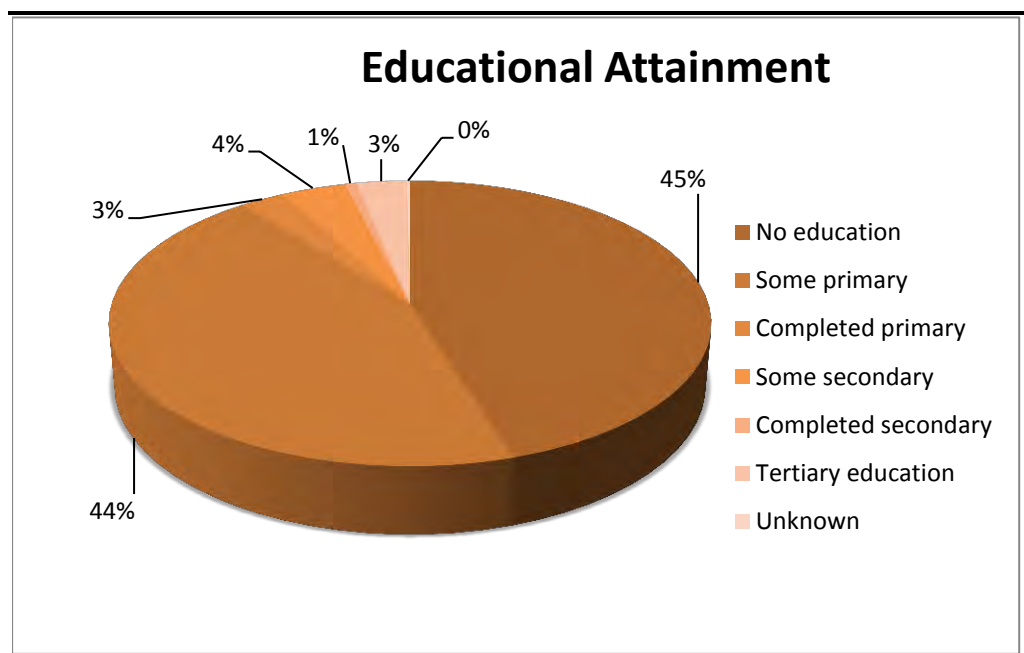
Source: The World Bank Group, Databank, (2011)

According to the 2011 Demographic and Health Survey (DHS) and as shown in *Figure 9.27*, the majority of Ethiopians have little or no formal education; 45.2% have never attended school and 44.2% have received only a few years of primary schooling as their highest level of education received. In 2011, only 2.7% of the population had completed their primary school education. These figures demonstrate a marked improvement from 2005 when over half of the

(1) Expressed as a percentage - the number of children enrolled in primary school who belong to the age group that officially corresponds to primary schooling, divided by the total population of the same age group.

population (59.5%) had never received any form of formal education (Central Statistics Agency, 2011).

Figure 9.27 *Highest Level of Schooling Attended or Completed*



Source: Central Statistics Agency, (2011)

It is not unexpected that educational attainment is significantly higher amongst urban in comparison to rural inhabitants. In urban areas 21.4% of the population had never received an education compared to 50.9% of the rural population. Furthermore, only 0.1% completed secondary school in rural areas compared to 3.2% in urban areas (The Central Statistics Agency, 2011).

Boys are generally better educated and more literate than girls. At the national level 52.1% of girls had never received an education in comparison to 38.3% of boys. For 39.1% of girls, primary schooling (partial or complete) is the highest level of education received, whereas for boys 10% more had received a primary school education. The difference in educational attainment is starker when rural and urban populations are compared.

Literacy rates differ considerably between the sexes. According to the DHS, 62% of women above the age of 15 are illiterate ⁽¹⁾, compared to 35% of men. Again, differences between urban and rural populations exist, with illiteracy more prevalent amongst the latter. Age is also a determinant; the older the individual the less likely he or she will be able to read. For example, only 13.0% of females aged 45 to 49 are literate, compared to 64.0% aged 15 to 19. This is largely due to the Government’s initiatives to improve the educational system.

(1) Literacy is determined by EDHS according to whether individuals have attended secondary school or higher or, are able to read part or whole of a given sentence.

9.6.2

Regional Education Profile

Literacy and education levels for the ANRS are considerably lower than the national averages. In 2011, 61.3% of the population have never received an education; accounting for 69.3% of females and 53.4% of males. Whilst 25.0% of females have only ever received a few years of primary schooling, only 1.6% have completed primary school and 0.3% completed secondary school. For males, these figures are 35.3% and 3.4% respectively, with 1.2% having completed secondary school (Central Statistics Agency, 2011).

Whilst school enrolment is increasing, the proportion of people who can read or write in ANRS is lower in comparison to both the national average and other administrative regions within Ethiopia (Central Statistics Agency, 2011). As a result, the region has recently become the focus of a number of NGO campaigns to enhance school enrolment and attendance (Sonne International, 2011).

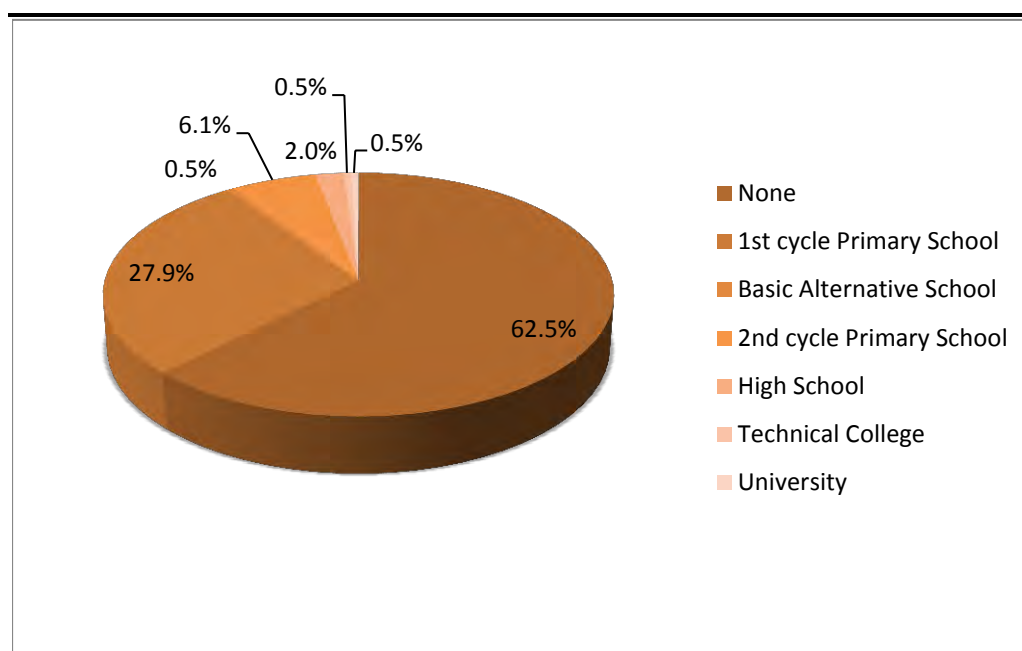
The literacy rate for females in ANRS is 38.4% whereas for males it is 52.5%. It is presumed that the pastoralist and semi-mobile lifestyle of the Afar people is the main factor that prevents children from attending school. The greatest barriers to school enrolment for females in rural areas as ascertained by research undertaken by the Population Council (The Population Council, 2010) is family disapproval (54%), marriage (23%), lack of schooling facilities (18%), poverty (17%) and too many domestic / farming / herding duties (11%). With regards to dropping out of school, marriage is the most common reason for women (accounting for 39% of cases), followed by domestic duties and poverty (22% and 19% respectively).

9.6.3

Local Education Profile

In the SSA, the majority of respondents to the household survey (62.5%) have not received any form of formal education (*Figure 9.28*). For 27.9%, the highest level of education received is the completion of the first cycle of primary school, whereas for 6.1%, it is completion of the second cycle.

Figure 9.28 Education Attainment in the Social Study Area



Source: ERM Household Survey, (2012)

Educational attainment varies slightly amongst villages. In Mororo none of the survey respondents had received a formal education. Berahale is home to the most educated residents, and is the only village in the SSA that has university educated residents. More than a third (37.8%) have completed first cycle primary school as their highest level of education, 15.9% have completed second cycle primary school, 2.4% high school, 1.8% technical school and a further 1.8% have been to university. Berahale's higher educational status is presumed to be linked to its enhanced access to educational facilities, and the presence of government workers usually originating from the highland areas.

Whilst the major language spoken in the SSA is Afarigna, literacy in the language is not prevalent. Only 10.1% of survey respondents above the age of ten years know how to read and write in Afarigna. Despite the low levels of schooling received by its residents, Alai lai has the highest proportion of residents (19%) who reported that they can read and write in Afarigna, closely followed by Asabolo and Berahale (17% and 15% respectively). In Mororo, there were no recorded cases of individuals who could read and write Afarigna, possibly reflecting that none of the residents have received any form of schooling. Literacy in other languages varied throughout the SSA; on average 12.0% of respondents can read and write in Amharic, 5.8% in Tigrigna and 6.42% in English.

Educational campaigns by NGOs in the area may have gone some way to increase the perceived value of education in the area. At FGDs participants spoke about the value of education as a channel through which to obtain higher paid employment positions in both government and non-government offices in the Woreda. In addition, residents noted that livestock production was no longer as viable as it had been previously; recurrent climatic shocks,

degradation of pasture resources and spread of livestock diseases have led to increased vulnerability to food shortages. As a result, youth are seeking additional income streams, with education viewed as such one path to access further opportunities.

Educational Infrastructure

Data collected from Berahale *Woreda* indicates that there are 20 Alternative Basic Schools (ABS) ⁽¹⁾, 14 first cycle schools, 10 second cycle schools and one secondary level school in the *Woreda* (refer to *Table 9.8*).

The total number of students attending an educational institution in the *Woreda* was measured at 6,004 in 2010. The average student - teacher ratio was 1:35. In the Sabana Demale *Kebele* there are three ABS, four first cycle schools (the highest number across all *Kebeles* in Berahale *Woreda*), and one second cycle school with an average student - teacher ratio of 1:34.

Table 9.8 *Educational Infrastructure and Facilities Berahale Woreda*

<i>Kebele</i>	School Types and Levels				Students	Teachers
	ABS	Formal Schools				
		1 st Cycle	2 nd Cycle	3 rd Cycle		
Berahale (urban and rural)	3	3	1	1	1,587	46
Sabana Demale	3	4	1		721	21
Kora	1	1	1		402	10
Dear	1	1	1		348	11
Bure	1	2	1		692	16
Ala	6	2	1		1,103	26
Lela Ala	1	1	1		431	19
Goben	2		1		450	15
Serea	2		1		270	9
Total	20	14	10	1	6,004	173

Source: Berahale *Woreda* Administration, (2010)

Berahale Town is the only settlement in the SSA with a secondary school, therefore in order to attend secondary school; children in the SSA have to travel to Berahale which is over 50km for the villages of Morrora, Alai lai and Hamad Ela. In the absence of any public transport this can be a time-consuming commute. The reliability and quality of educational infrastructure is reported to be poor impacting on the educational achievement in the area. This is further supported by the regional statistics which indicate poor literacy levels.

In addition, the results of the household survey indicate that the low educational levels in the SSA reflect the lack of school facilities in the area, the early marriage of girls, the semi-mobile lifestyle of the Afar people and the overall cost of attending school. Whilst schools can be found in Ambule,

Hamad Ela, Morrur and Berahale, not all grades are taught. In Ambule, the school caters for children aged five to nine years old (grades one - four); in Morrur, the school has two teachers and grades one and two are taught in the morning and grade three in the afternoon. Berahale has both a primary school and the only secondary school in the Study Area. Because of the limited options for secondary schools and the large commutes required, people within the SSA reported that those families who want their children to attend secondary school must arrange for room and board for their children in Berahale.

During FGDs, participants highlighted the inadequacy of the school facilities available in their villages, with limited text books, libraries, desks, benches, toilets and water supplies cited as examples of this. In addition, the long distance needed to reach schools and the money required to cover the costs of accommodation, food and transport for secondary school student were cited as barriers to attendance at schools. *Figure 9.29* shows the buildings used as a school in Ambule and Hamad Ela. At the time of visit the school in Ambule was not in use.

Figure 9.29 *School in Ambule (top) and Hamad Ela (bottom)*



The unavailability of night school for adults was also identified as a problem; participants at FGDs in Hamad Ela noted that the provision of a night school would allow them to pursue their education while maintaining income. Such issues, combined with the limited educational facilities in the villages are likely to account for the levels of dissatisfaction with educational infrastructure and facilities in the area; 61% of survey respondents rate them as either 'unsatisfactory' or 'not available'.

Allana have been conducting a community and social responsibility initiative in the local area which is important to document within the Social Baseline in order to understand the existing infrastructure and facilities in the area. Allana's key initiatives include:

- **The Berahale Education Scheme:** a computer centre has been established at Berahale's high school that provides access to computers for 30 students. Allana have also contracted a full time teacher to train both students and other community members (in the evening) on the use of computers.
- **The Hamad Ela Education Scheme:** since 2010 Allana have committed to paying the salary of the local teacher at Hamad Ela's primary school, in addition to providing a daily meal to the children who attend the school. Since the start of the scheme Allana have reported an increase in school attendance from 8 students to 65 students.
- **The Hamad Ela Health Post:** Allana have agreed to refurbish the Health Post in Hamad Ela which is currently not in use. Allana have also committed to purchasing medication and equipment once the Health Post is operational, and housing two nurses at Allana's camp working with the Afar Bureau of Health.

9.7 *HEALTH PROFILE*

This section describes the national, regional, and local health profile for the Study Area. This includes an analysis of the current health context and prevalent diseases, as well as a discussion on the standard and availability of health infrastructure across the three levels.

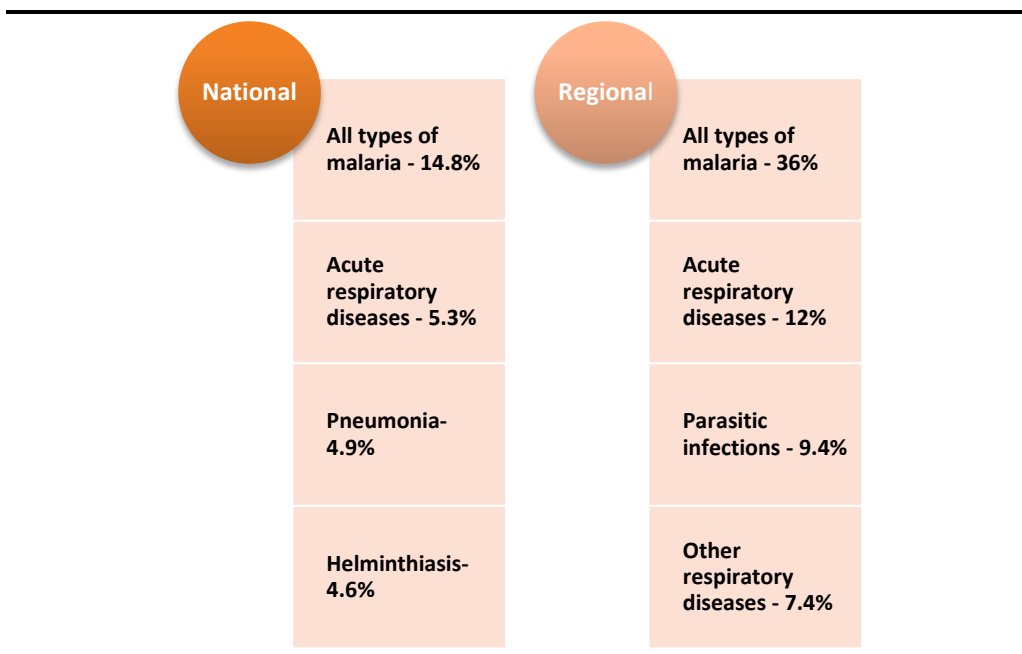
9.7.1 *National and Regional Health Context*

As Africa's second most populous country, Ethiopia has a predominately large and rural population with poor access to safe water; housing; sanitation; food; and health services. These factors result in a high incidence of communicable diseases, including tuberculosis; malaria; respiratory infections; diarrheal diseases; and nutritional deficiencies. Human Immunodeficiency Virus (HIV) / Acquired Immunodeficiency Syndrome (AIDS) prevalence is highest in urban and transport corridor settings, largely driven by a lack of awareness or mobility, as well as high risk behaviour such

as interactions with sex workers and absence of condom use (Global Health Initiative, 2010).

The major health priorities in the country are reported to be maternal health; communicable diseases; hygiene and sanitation; and malnutrition (refer to *Figure 9.30*). Current key health concerns include HIV/AIDS; malaria; tuberculosis; meningitis; and diarrhoeal diseases.

Figure 9.30 *National and Regional Causes of Morbidity*



Source: Ministry of Health, (2009)

Of the leading diseases that cause morbidity and mortality in Ethiopia, 60 - 70% are preventable diseases mainly caused by poor nutrition, unsafe water supply, and poor hygiene and sanitation. The Expanded Program on Immunisation currently focuses on six vaccine preventable diseases (tuberculosis, diphtheria, pertussis, tetanus, polio and measles) (WHO, 2012) with coverage reaching 72.3% of the population. However, immunisation varies greatly from region to region.

Currently, Ethiopia is implementing the fourth Health Sector Development Programme (HSDP-IV) (2010 to 2014) which proposes long term goals for the health sector and targeted interventions against poverty related diseases. These have particularly improved maternal health; reducing child mortality; combating HIV/AIDS; malaria; and tuberculosis. The ultimate aim of the HSDP- IV is to introduce an innovative health service programme called the Health Extension Program, which is aimed at reaching universal coverage of primary health care and improving the quality of health services across the country. The regional Health Bureau has also developed its own HSDP-IV (2010 to 14) in alignment with the national HSPD-IV.

Leading Causes of Morbidity and Mortality

Mortality is defined as the number of deaths occurring in the population over a specified time period, in case the year 2011. The top five typical leading causes of mortality, at both the national and regional level are reported to be:

- Pneumonia;
- Tuberculosis;
- Violence and other intentional injuries;
- Malaria; and
- HIV/AIDS (Afar Regional Bureau of Health, 2011).

The leading causes of morbidity (the rate of incidence of a disease) at national and regional levels are illustrated in *Figure 9.30*. Malaria features as the most common source of morbidity, both across the national and regional level, followed by acute respiratory diseases. It is clear from *Figure 9.30* that the prevalence of the diseases listed is higher in the ANRS compared to the national level, indicating a potential range of shortfalls in the regional healthcare system, including lack of infrastructure and facilities; shortage of healthcare professionals; and low cure/treatment rates.

Malaria

Malaria is one of the most common health problems in Ethiopia where 75% of the country is susceptible, and an estimated 70% of the population is considered at risk from malaria (Ministry of Health, Malaria Strategic Plan, 2009). The disease has been consistently reported as one of the top three leading causes of morbidity over the past four years (The Ministry of Health, 2009). In 2011, the numbers of households in malaria epidemic prone areas were 8,250,388 (50%) and 204,077 (74%) at the national and regional level respectively (The Ministry of Health *Woreda* Health Sector Programme, 2011). Furthermore, households with access to indoor residual spray (WHO, 2006) ⁽¹⁾ numbered 4,771,672 (58%) and 54,500 (27%) (*Woreda* Health Sector Programme, 2011) respectively, illustrating that not every household can protect themselves against malaria, particularly at the regional level.

The WHO has identified long lasting insecticide-treated nets as the preferred method to combat malaria as they are more cost effective and their application does not require specialist expertise. Data for the presence of long lasting insecticide-treated nets shows that in 2011, households that received at least one long lasting insecticide-treated net in malaria epidemic prone areas, were approximately 3,420,000 (41.4%) at the national level and 52,565 (25.7%) at the regional level. The current cumulative number of households with at least one functional ⁽²⁾ long lasting insecticide-treated net is 136,113 (66.6%) for the Afar region (The Ministry of Health *Woreda* Health Sector Programme, 2011).

(1) Indoor residual spray is the application of long-acting chemical insecticides on the walls and roofs of all houses and domestic animal shelters in a given area, in order to kill the adult vector mosquitoes that land and rest on these surfaces.

(2) Long lasting insecticide treated nets maintain effective levels of insecticide for at least 3 years further to which they decrease in their ability to kill mosquitoes.

The low household coverage of long lasting insecticide-treated nets is evidence of the high rate of malaria in Ethiopia. With 70% of the nation at risk of malaria, only approximately 41% of households have access to long lasting insecticide-treated nets, and just more than half of the population have access to indoor residual spray.

The Centre for Disease Control and Prevention states that to be effective, at least 80% of households in an area must be treated with indoor residual spray, which is far higher than the current national coverage across the nation. The WHO identifies a lack of adequate resources for control interventions and epidemic response, and a weak disease surveillance system as the main challenges to the malaria control programme (WHO, 2009).

Sexually Transmitted Infections and HIV/AIDS

HIV/AIDS prevalence is recorded to be slightly higher at a national level compared to the ANRS. This may be attributed to the higher prevalence rates in urban areas, reduced access to healthcare services, including testing facilities, and general low awareness of HIV/AIDS at the regional level. Nationally, HIV/AIDS prevalence in adults is 2.4% compared to 2.2% in the ANRS. The HIV prevalence among children younger than 15 years was reported at 0.2% nationally and 0.17% at regional level. Furthermore, the HIV prevalence among pregnant mothers was 3.0% nationally and 2.7% in Afar state (Ethiopia Health and Nutrition Research Institute (EHNRI), 2012).

The main HIV/AIDS prevention and control programmes include prevention of mother to child transmission; antiretroviral therapy; and voluntary counselling and testing. Currently HIV/AIDS counselling and testing services reach 9,448,880 (11.4%) nationally and 301,103 (21.4%) of people within the ANRS (The Ministry of Health, 2009). Although a higher number of people receive counselling at the regional level than at the national level, a lower proportion of people living with HIV/AIDS actually receive antiretroviral therapy (37%), compared to the national level where 62.3% are receiving antiretroviral therapy (The Ministry of Health, 2009). In addition, the lack of infrastructure also impacts upon a patient's ability to access treatment. There are only 52 healthcare facilities that offer voluntary counselling and testing in the ANRS, and four health centres in Zone 2. Furthermore, only 15 health centres in the ANRS and two in Zone 2 offer prevention of mother to child transmission treatment (Woreda Health Sector Programme, 2011).

Epidemics

The major causes of epidemics in Ethiopia are typhoid fever; dysentery; measles; meningitis; and acute watery diarrhoea. According to the Integrated Disease Surveillance and Response report in 2011, there were 140,867 cases of

dysentery with a case fatality rate⁽¹⁾ of 0.01% (School of Public Health University of California Los Angeles, 2012). In addition, there were 323,008 cases of typhoid fever (0.004% case fatality rate) and 38,288 suspected cases of measles (0.5% case fatality rate). Meningococcal meningitis had one of the highest case fatality rates of 2.9% from 1,324 cases.

In the same period in the Afar region, 2,688 cases of dysentery and 1,229 cases of typhoid fever were reported.

Maternal Healthcare

Maternal healthcare services include family planning; antenatal care; delivery and postnatal care; and prevention of mother to child transmission of HIV. In 2011 the number of women (non-pregnant) eligible for family planning at the national level was equal to 16,144,673. At the regional level and in Zone 2 this was equal to 303,729 and 91,548 (The Ministry of Health Woreda Health Sector Programme, 2011). A comparison of key indicators for maternal health is shown in *Table 9.9*. The status of maternal health is lower in the ANRS and Zone 2 compared to the national level.

The number of pregnant women with HIV / AIDs in Zone 2 is higher than both at the regional and local level. Although the percentage of pregnant women with HIV / AIDs is higher in Zone 2, their level of treatment (prevention of mother to child transmission) is higher than that of women at the regional level.

Table 9.9 *Status of Maternal Health*

Indicator	National	Regional	Zone 2
Women using modern contraceptive methods	61.1%	20.5%	8.0%
Women receiving antenatal care	87.5%	31.5%	14.5%
Deliveries attended by skilled birth attendant	21.2%	12.5%	3.7%
Pregnant women with HIV/AIDs	2.1%	1.6%	2.7%
Women receiving prevention of mother to child transmission counselling	39.5%	17.5%	20%

Source: Ministry of Health, 2009 and Ministry of Health, 2012 Annual Performance Report

Child Healthcare

A key focus of child healthcare is the treatment of preventable communicable disease through vaccination services. In 2011, 1,879,536 (66.8%) of Ethiopian infants eligible for immunisation received all doses of infant antigens before their first birthday, compared to 35.7% of children in the ANRS.

(1) Usually expressed as the percentage of persons diagnosed as having a specified disease who die as a result of that illness within a given period.

At the national level, 33.6% of children under the age of three suffered from moderate malnutrition ⁽¹⁾ (ACF International, 2012), and 3.6% suffered from severe acute malnutrition (WHO, 2012 and Action against Hunger, 2010). ⁽²⁾ In the ANRS, the percentage of children suffering from moderate malnutrition was not considerably higher than national levels; however children were 15.5% more likely to suffer from severe malnutrition in the ANRS in 2010 (The Ministry of Health Woreda Health Sector Programme, 2011).

Nationally, the top five leading causes of mortality among children below the age of five are pneumonia (16%); malaria (9%) ⁽³⁾; other or unspecified perinatal diseases (6%); neonatal sepsis (6%); and birth asphyxia (5%). Studies have indicated that in areas where FGC is conducted, birth asphyxia is a common problem, and therefore the occurrence in the ANRS and at the local level is likely to be higher than the national level (The Ministry of Health Woreda Health Sector Programme, 2011).

The leading causes of child morbidity are reported to be diarrhoea (15%); pneumonia (13%); malaria ⁽⁴⁾ (12%); acute upper respiratory infection (10%); and falciparum malaria (4%). (The Ministry of Health Woreda Health Sector Programme, 2011).

Hygiene and Sanitation

One of the key factors that dictate the prevalence of disease outbreak is levels of access to clean water and sanitation. At the national level, household access to clean water is recorded at 73.3%, compared to 68.1% at the regional and local level (The Ministry of Health Woreda Health Sector Programme, 2011).

Water, sanitation, and hygiene programmes are mainly focused on households that have access to a safe water supply and excreta disposal (basic indoor toilet facilities). This however does not address the common problem across Ethiopia, and in particular the ANRS where the majority of households do not have access to basic sanitation facilities.

Road Traffic Accidents and Fatalities

In 2007/2008 there were approximately 19,000 road traffic accidents that occurred in Ethiopia, claiming over 2,500 lives and property worth USD 56 million (WHO, 2009). According to the WHO, at least 70 people die in every 10,000 vehicle accidents annually in Ethiopia. The average fatality rate for Sub-Saharan Africa is 60 per 10,000 vehicles (Integrated Regional Information Networks - IRIN, 2011).

(1) Moderate acute malnutrition (MAM), also known as wasting, is defined by a weight-for-height indicator between -3 and -2 z-scores (standard deviations) of the international standard or by a mid-upper arm circumference (MUAC) between 11 cm and 12.5 cm

(2) Severe acute malnutrition is defined by a very low weight for height (child's weight/height measurement is less than 70% of the normal range), by visible severe wasting, or by the presence of nutritional oedema.

(3) Clinical malaria without laboratory confirmation.

(4) Clinical malaria without laboratory confirmation.

A comparison of traffic fatality across the continent in 2007 is shown in *Table 9.10*. Of the countries listed in Sub-Saharan Africa, Ethiopia has the second highest number of vehicles in use. However, it had one of the lowest death rates (per 100,000 population) due to road traffic accidents ⁽¹⁾.

There are no reports of road and traffic related accidents in the Afar region, although it is likely that this is due to an absence of data collection.

Table 9.10 *Traffic Fatality Across Sub-Saharan Africa*

Region	Income Level	Country	Vehicles in Use	Deaths per 100,000 Population
Sub-Saharan Africa	Low income	Ethiopia	121,179	2.3
	Low income	Rwanda	26,554	4.5
	Low income	Senegal	136,471	5.7
	Low income	Sierra Leone	12,693	1.2
	Low income	Uganda	120,048	5.5
	Lower middle income	Swaziland	83,446	22.8
	Upper middle income	South Africa	6,549,901	26.8
North Africa	Upper middle income	Morocco	1,643,978	12.2
	Upper middle income	Tunisia	945,054	15.4

Source: Lagrade, (2007)

Drug and Alcohol Abuse

Substance abuse is reported in Ethiopia, relating to the use of alcohol; marijuana; prescription medication (narcotics, barbiturates and benzodiazepines); heroin; and khat (a leaf with amphetamine-like properties that is chewed). The Ethiopian government does not control or monitor the production of locally brewed alcoholic drinks, making it difficult to provide estimates on the volume of alcohol production and consumption in Ethiopia or the Afar region.

Wellbeing and Perceptions of Welfare

The Ethiopian Welfare Monitoring Survey has been conducted four times over the period 1995 to 2004. The Welfare Monitoring Survey focuses on a wide range of socio-economic indicators that reflect the non-income dimensions of poverty. The survey places emphasis on indicators including health; education; nutritional status and childcare; household access to selected facilities/services; and food security. Information on health, education and household access to infrastructure and services builds upon and draws information collected in the Ethiopian censuses. However, the Welfare Monitoring Survey also provides information on a household's access to food, financial capacity and vulnerability to shock.

(1) All road related accidents including vehicle-vehicle collision and pedestrian accidents.

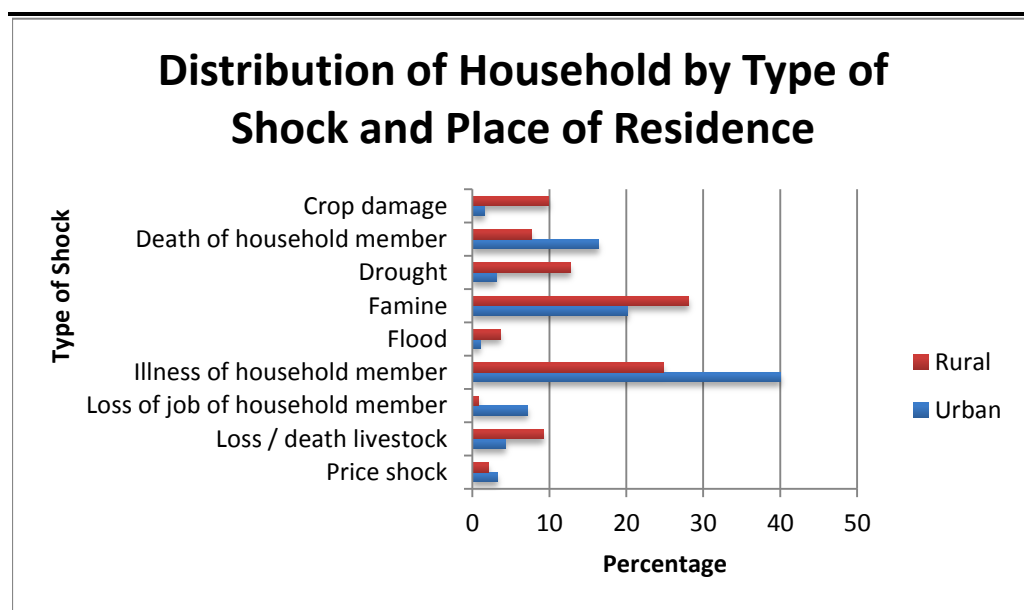
In light of the GoE's poverty reduction strategies, a system of monitoring and evaluation was put in place along with the implementation of the Welfare Monitoring Survey in 1995. It is worth noting that the Welfare Monitoring Survey does not cover the Gambella region, or the non-sedentary populations of the Afar and Somali regions.

According to the latest Welfare Monitoring Survey (2004), over 30% of households in the country reported having difficulty satisfying food needs during the 12 months prior to the survey. As indicated in *Figure 9.31* higher proportions (34.2%) of households in rural areas suffer from food shortage compared to 14.8% of urban households (Central Statistics Authority, 2004). This is in likely correlation with the ability rural households have to access food markets. The 2004 Welfare Monitoring Survey shows that almost all urban households in Ethiopia (93%) have access to food markets within a 5km radius, compared to only 44% of rural households.

Household financial capacity was also measured, according to its ability to raise ETB 100 (USD 5.6) within a week under unforeseen circumstances. More than a third of the households at the national level (36.9%) are unable to produce ETB 100 within a week. Financial capacity differs among rural and urban households. The proportion of rural and urban households unable to raise ETB 100 within a week is 35.7% and 43.1% respectively.

The key types of shocks a household is most likely to experience are shown in *Figure 9.31*. Among the major shocks encountered, about 39% of households across the country collectively suffered from famine and drought. More than 34% of households encountered shock as a result of death and illness of a household member, while about 18% suffered from crop damage and death or loss of livestock. Households in rural areas are more vulnerable to shocks related to impacts on natural resource or livelihoods, including floods, loss of livestock, and crop damage.

Figure 9.31 *Distribution of Households by Type of Shock and by Residence in Ethiopia*



Source: Central Statistics Agency, (2004)

National health statistics reported in the Welfare Monitoring Survey indicate that of the total population covered in the survey, 23.8% reported that they had suffered from health problems at least once over the two month period prior to the date of interview. The results of the survey also revealed that more women face illness compared to men. The most prevalent disease reported was malaria, followed by diarrhoea.

According to the results of the survey, out of the total children under 18 years of age, about 12% were found to be orphans, with 7.7% orphaned by their father, 3.0% by mother, and 1.3% due to losing both parents (Central Statistics Authority, 2004). Regional distribution reveals that the proportion of children orphaned by their mother is highest in the ANRS. This may be linked to higher mortality rates of women in the region due to complications during childbirth (including FGC) and other violence faced by women in the household.

9.7.2 *National and Regional Level Health Infrastructure*

The Ethiopian healthcare system is structured across a three tier delivery system characterised by:

1. A primary health care unit which comprises five satellite health posts, one Health Centre and a primary hospital that serves 5,000, 25,000 and 100,000 people respectively;
2. A general hospital with population coverage of 1 million people; and
3. A specialised hospital which is expected to serve 5 million people.

Health services are managed through a decentralised structure, with the overall responsibility for health policy and regulation undertaken by the federal Ministry of Health, while the Regional Health Bureau is responsible for health service delivery. The management of healthcare facilities, personnel, and health training institutions within the ANRS is undertaken by the Regional Health Bureau who are supported by health departments in the corresponding Zones, and *Woreda* Health Offices.

Statistics provided by the Ministry of Health on the current standards of basic health services illustrate the lack of health infrastructure and services, particularly within the Afar region. National Health Centre coverage is 81.3% and Health Post coverage is 91.1%, however, both Health Centre and Health Post coverage within the ANRS and in Zone 2 is considerably lower when compared to national averages. Health Centre service coverage is 82% and 30% respectively, and Health Post coverage is 88% and 49% respectively. This deficit is also reflected in the total number of hospital beds available in the ANRS - 122, compared to a total of 15,111 available beds at the national level (The Ministry of Health, 2009). This is equal to 0.0002 beds per capita at the national level compared to 0.00009 beds per capita in the ANRS.

A comparison of available healthcare infrastructure, facilities, and healthcare professionals across the national, regional and local level is presented in *Table 9.11*. At the national level, the availability of basic infrastructure such as health centres and Health Posts are limited, and a comparison across the three different levels demonstrates a noticeable decline in the standard and availability of health infrastructure at the regional and local level. For instance, there are no physicians or midwives in Zone 2 in which both Berahale and Dallol *Woreda* are located.

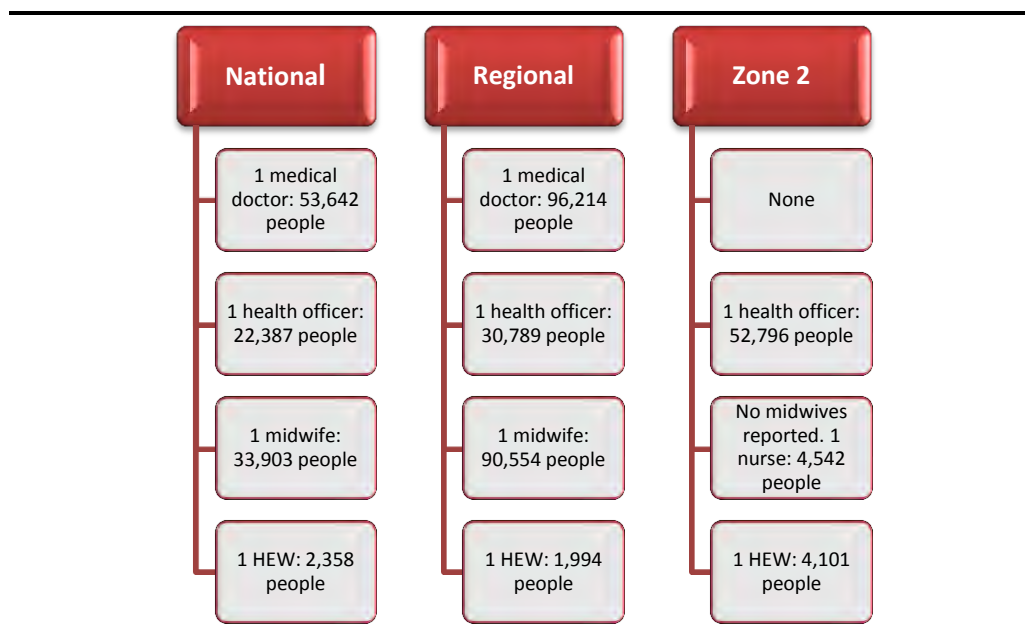
Table 9.11 *Healthcare Services and Infrastructure*

Health Services and Infrastructure	National	Regional	Local to the Proposed Project Area	
			Berahale	Dallol
Hospitals	122	4 (general hospitals)	No hospital at local level	No hospital at local level
Health Centres	2,660	50	1	5
Health Posts	15,095	272	10	37
Healthcare Professionals	National	Regional	Local	
			Berahale	Dallol
Physicians (general practitioners and specialists)	1,544	16	9 Certified Health Professionals (CHP)	13 (CHPs)
Health Officers	3,702	50	1	1
Nurses (Diploma and BSc holders)	29,550	511	13	22
Midwives	2,416	17	-	-
Pharmacy Professionals	4,157	63	2	2
Medical Laboratory Professionals	4,137	63	1	3
Village Health Workers (Health Extension Worker (HEW))	Rural HEW: 30, 948 Urban HEW: 3,777 Total: 34,725	Rural HEW: 772 Total: 772	20	16

Source: Afar Regional Bureau of Health and Ministry of Health, 2011

Ethiopia's infrastructure challenges are aggravated by the lack of trained professionals, particularly in rural areas. The Health Extension Programme is working to address this through the training and deployment of health extension workers, however as *Figure 9.32* demonstrates, the ratio of healthcare professionals at the regional level is considerably lower than at the national level, and even lower in Zone 2. Although a key aim of health extension workers is to provide basic preventative healthcare in rural villages, in Zone 2 there is only one health extension worker for every 4,101 people, and even fewer at the *Woreda* level.

Figure 9.32 Ratio of Health Professionals to the Population



Source: Ministry of Health, (2009)

Further data that illustrates the ANRS' lack of health infrastructure is the health service utilisation rate. This is measured according to outpatient department ⁽¹⁾ attendance per capita, and is used to determine health seeking behaviour. Per capita health facility visits were recorded at 0.3 nationally and 0.09 for the Afar region, demonstrating that the population of the Afar region have less access to, or make limited use of the infrastructure available compared with the wider population of Ethiopia.

Traditional Health Services

There has been minimal data collection regarding traditional health services at the national or regional level, and the sector is mainly serviced by traditional healers with very few registered practitioners.

The traditional Ethiopian pharmacopoeia includes counter-irritants (burning of the skin over the affected part of the body), bleeding, and cupping. Surgical procedures in traditional healthcare include trepanation ⁽²⁾ and performing caesarean sections. Often traditional healers in Ethiopia are most attributed for their bone setting skills, and among the most prominent practitioners are bone-setters (*wogeshas*), herbalist's (*kitel betash*) and traditional birthing attendants.

In connection with traditional medical practices, harmful procedures are still widely practiced in the country, including FGC; removal of tonsils using rudimentary tools; uvula cutting; and the removal of healthy children's teeth.

(1) A facility, often associated with a hospital or medical school, that is devoted to the diagnosis and care of patients who are not staying overnight in a hospital.

(2) The surgical opening of the skull performed with primitive tools and techniques - The University of Illinois, 2012.

Recently the Ministry of Health has been attempting to integrate traditional medicine into the official healthcare system, particularly due to the level of dependency on their services in rural areas.

9.7.3 *Local Health Context*

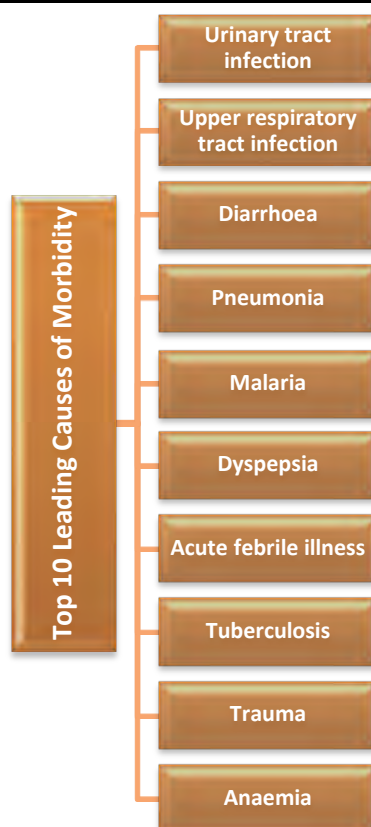
The key health priorities in Berahale *Woreda* are maternal health, communicable diseases, and hygiene and sanitation (Afar Regional Bureau of Health, 2011). The leading communicable diseases across both Dallol and Berahale *Woreda* are:

- HIV/AIDS;
- Sexually transmitted infections;
- Tuberculosis;
- Malaria;
- Measles;
- Meningitis;
- Parasitic infections;
- Respiratory diseases; and
- Diarrhoeal diseases.

Of the major causes of morbidity and mortality in the Berahale *Woreda*, 70 to 80% are preventable diseases that are caused primarily by unsafe water supply, poor hygiene, and sanitation and vaccine preventable diseases.

The top 10 leading causes of morbidity over the past year (September 2011 to June 2012) in Berahale *Woreda* are shown in *Figure 9.33*.

Figure 9.33 Top 10 Leading Causes of Morbidity in Berahale Woreda



Source: Berahale Health Centre, (2012)

The number of cases reported over the same period of time for Berahale Woreda (largely resulting from the diseases identified in Figure 9.33) are shown in Table 9.12.

Table 9.12 Cases of Recorded Diseases/Illnesses in Berahale Woreda

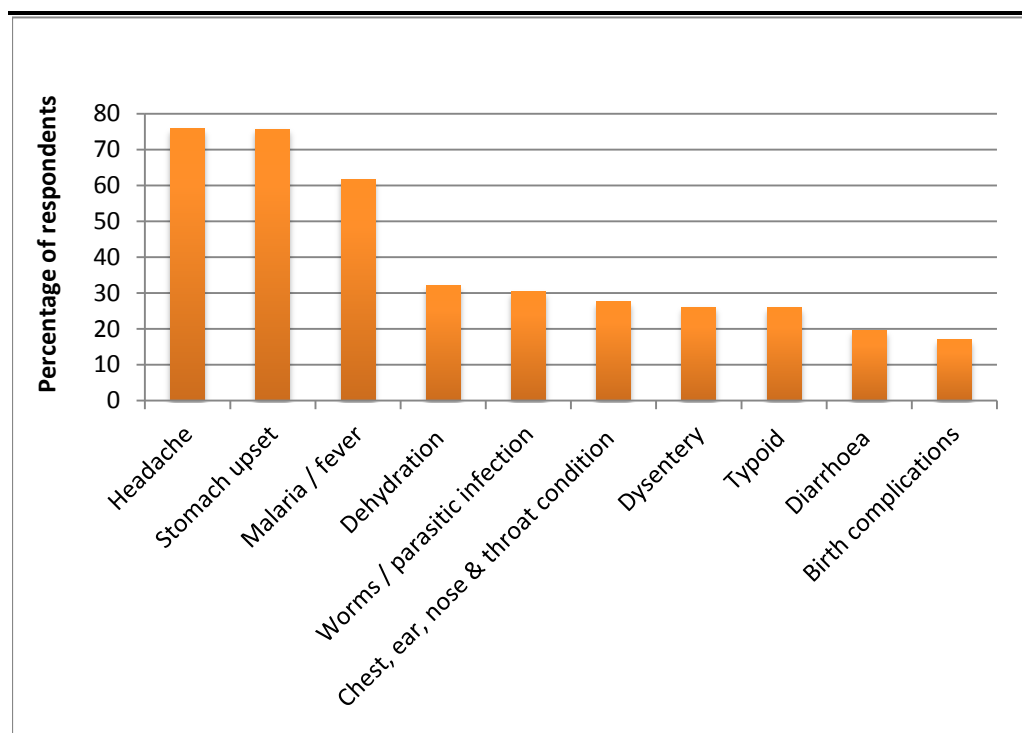
Disease / Illness	Number of Cases
Diarrhoea	581
Acute Upper Respiratory infection	550
Acute febrile illness	249
Malaria	229
Bloody diarrhoea	209
Urinary tract infection	133
Pneumonia	73

Source: Berahale Health Centre, (2012)

Data comparison of the causes of morbidity and cases of disease reported (Figure 9.33 and Table 9.12), with the responses provided by respondents of the household survey, show similarities. For example, malaria, diarrhoea and dysentery were identified as key health problems by both sources. Respondent’s identification of chest, throat and nose conditions is assumed to be linked to upper respiratory tract infections reported by the local health centre. The majority of respondents in the household survey complained of

headaches as being a common problem, which is most likely a symptom of other illnesses.

Figure 9.34 *Top Ten Health Problems in the Social Study Area*



Source: ERM Household Survey, (2012)

Of the health problems identified by households responding to the household survey, there were mixed responses regarding the increase or decrease of the prevalence of health problems. More than three quarters of households (79.8%) stated that stomach related problems had increased in the past three years, and 69.3% of households reported that the number of members suffering from headaches had also increased over this period.

Approximately half of the households surveyed indicated that crime and violence had decreased in their village in the past three years; possibly related to the cessation of hostilities during the Ethiopian – Eritrean war.

In FGDs, women identified children as the most vulnerable, with a high mortality rate under the age of five, malaria being the most common issue among children.

Nutritional Status and Diet

The frequent drought reported across the Afar region and the low socio-economic status of the villages in the SSA has resulted in a low nutritional status at the household level. Traditionally, milk and bi-products formed key components of the local diet, as livestock production was the predominant source of food. Increasingly, this is being replaced by a less balanced and

nutritious diet of bread and porridge, derived from the wheat supplied by the Productive Safety Net Programme (PSNP).

The PSNP is a programme implemented by the national government in response to persistent food shortage within the SSA. The PSNP is administrated through the *Kebele* administration. The PSNP provides food aid to households that suffer from chronic food shortages. Food is either given directly to vulnerable households (World Bank, 2011) ⁽¹⁾ or is attained through participation on a labour based public work programme, such as the cleaning of villages or the building of gabions ⁽²⁾. In many regions of the country, the PSNP is used to support soil and weather conservation activities.

According to local government workers, Berahale *Woreda* is responsible for the physical distribution of food aid to the respective *Kebeles*. The *Kebele* administration is then responsible for overseeing the distribution to households. Food via PSNP is distributed every other month to qualifying households. Currently, all nine *Kebeles* in Berahale *Woreda* participate in the PSNP. In Hamad Ela and Berahale, bags of wheat identical to those distributed for food aid were also observed to be sold in the local shops, although when asked, shop owners declined to comment.

All of the participants of the FGDs identified that at one point they had, or continue to rely on the PSNP, stating that on average at least 50% of a household's source of food comes from the PSNP. Approximately 50kg of wheat is consumed for a household of six to ten people over a period of 15 days. The wheat is typically used to make a type of porridge (*gunfo* - Figure 9.35) or bread which forms the basis of the local diet. Participants identified that their reliance on the PSNP has increased due to the recurrent droughts in the area, causing a change in local people's diets. The reliance on the PSNP for food indicates the high level of food insecurity in the area, and the challenges that households face in securing food.

(1) Vulnerable households are defined as households who have received food aid assistance in the past three years.

(2) Structures usually constructed of stone and wire, used to prevent soil erosion or to channel water.

Figure 9.35 Local Afar Woman Making Gunfo



Due to their position in Afar society and in the household, women are identified to be most susceptible to malnutrition and therefore susceptible to disease. In Afar culture, women are expected to eat after men, children, and guests are served. This assumed susceptibility to malnutrition or food shortages for women is supported by information provided by the local *Woreda* Health Centre, which reported that women and children are most likely to suffer from malnutrition. In the last year, over a period of nine months, 307 cases of severe acute malnutrition for children under the age of five were reported (Berahale Health Centre, 2012).

Wellbeing and Mental Health Status

From the KII it was identified that youth unemployment is a growing problem within the SSA. It is increasingly reported to be leading youngsters to consume khat and smoke tobacco. Interviewees stated that the lack of employment opportunities is a key source of stress and insecurity for young people in the Study Area, noting that projects like the proposed Allana Potash Mining Project may assist in addressing this.

Due to the low socio-economic status of Berahale *Woreda*, the general wellbeing of people is low, exacerbated by factors such as low education levels, high unemployment, and lack of savings.

The results of the household survey also indicate that across the households surveyed, 15% had a member that suffered from a physical / mental health illness. Interestingly, when asked about the condition of their household health status the majority (69.4%) of respondents stated it was good.

Sexually Transmitted Infections and HIV/AIDS

In Berahale *Woreda* two healthcare facilities provide voluntary counselling and testing, with one facility providing antiretroviral therapy and treatment for the prevention of mother to child transmission. The current HIV/AIDS counselling and testing service is targeted to provide services to 89,000 patients, to provide 151 adults with antiretroviral therapy, and manage 458 cases of sexually transmitted infections. However, there is no accurate data to reflect the achievement of this.

Healthcare professionals interviewed at the clinic and Health Centre in Berahale indicated that there has been an increase in the number of people, including sex workers, migrating into the Study Area. This is reported to have been driven by the increase in companies, including road construction companies into the area. Local health professionals also indicated an increasing trend of cases of sexually transmitted infections. However, data was not provided to support this.

In addition, some participants of the FGDs identified that the consumption of khat was more common in the larger villages namely Hamad Ela and Berahale town, while alcohol consumption is reported to be uncommon, largely due to religious reasons.

Infectious Diseases

Prevention and control of malaria is reported as one of the health successes in Berahale *Woreda*. This is largely due to the use of insecticide-treated nets, indoor residual spray, and the early detection and treatment of malaria cases. In the last nine months of 2012, 137 clinical malaria cases and 92 falciparum malaria cases were diagnosed in the *Woreda* (Berahale Health Centre, 2012). Malaria is the fourth leading cause of morbidity locally, despite the decline in incidence and preventative measures being taken.

In the same period, there were 150 cases of tuberculosis reported in Berahale *Woreda*. Only 18% (The Ministry of Health *Woreda* Health Sector Programme, 2011) of tuberculosis cases reported that received treatment completed their full course of medication. Treatment of tuberculosis takes at least six months and medication must be taken following a strict daily regime, proving difficult with the lack of healthcare infrastructure and services in the *Woreda*. Furthermore, Directly Observed Therapy Short Course (DOTS) treatment, the

internationally recommended strategy for tuberculosis control, is not provided at the local health post.

Family Planning and Maternal Healthcare

At the local level, the maternal health services include family planning, antenatal care, and prevention of mother to child transmission. Across the *Woreda* 17,566 (The Ministry of Health *Woreda* Health Sector Programme, 2011) non-pregnant women of reproductive age ⁽¹⁾ are eligible to receive family planning, and the contraceptive acceptance rate is 10% (The Ministry of Health *Woreda* Health Sector Programme, 2011). From the FGDs conducted, the majority of women, except those in Berahale Town, stated they had never heard or accessed family planning services. In the FGDs conducted in Berahale Town, the majority of women indicated that they had accessed or heard of family planning services. This is largely a result due to the proximity of the local health centre.

The eligible number of pregnant women to receive antenatal care was 2,801 in 2012. Out of those eligible, only 112 were reported to have received antenatal care, with coverage in the *Woreda* being low at just 4%. Only 66 deliveries were attended by a skilled birth attendant, and current access to a skilled birth attendant stands at 2% of households (The Ministry of Health *Woreda* Health Sector Programme, 2011).

Of the total number of pregnant women recorded in the *Woreda*, 2.7% received counselling in prevention of mother to child transmission. Of this group 2.7% tested HIV positive (The Ministry of Health *Woreda* Health Sector Programme, 2011). All mothers and their children who attend prevention of mother to child transmission counselling are provided with prophylaxis.

Of the households surveyed in May 2012, 32.5% had at least one member in the household who had given birth in the past two years. 61% of women had used the local Health Centre and 33.3% had relied on a traditional birthing attendant. Of those who had given birth in the past two years, just over half (53.8%) had not received antenatal care.

According to the household members interviewed, 20% of women who had given birth in the past two years indicated that they had experienced problems. In every FGD conducted with women, they identified complications during childbirth as a key problem, referencing FGC as the common cause. It is likely that the lower percentage reported in the survey is a result of men (commonly the head of household) completing the questionnaire. In addition, it was evident from working in the field with local women that they do not openly disclose information concerning their reproductive health.

(1) Aged 15 - 49

The *Woreda* has no institutions or facilities aimed at youth to provide education on sexually transmitted diseases.

Child Health

According to the local Health Office and Health Centre, 60% of children in the *Woreda* received full immunisation before their first birthday. This rate is higher than that of Zone 2. FGDs participants identified that although healthcare professionals will attend / monitor childbirths and administer vaccinations, the follow-up rate for vaccinations is low. It was also reported that 62% of children (ages 24 - 59 months) were treated for deworming (The Ministry of Health *Woreda* Health Sector Programme, 2011).

The top five leading causes of morbidity among children under five years were reported to be diarrhoea; malaria; pneumonia; acute upper respiratory infection; and malnutrition (The Ministry of Health, 2011). The top five leading causes of mortality among children under five years of age were pneumonia; malaria; neonatal sepsis; and birth asphyxia (The Ministry of Health *Woreda* Health Sector Programme, 2011).

Hygiene and Sanitation

Further analysis of levels of hygiene and sanitation at the local level are included in *Section 9.5.2*. The results of the household survey indicated that 61.4% of households do not have access to toilet facilities. The data provided by the local Health Centre further emphasises the low levels of hygiene and sanitation with only 6% of households in the *Woreda* having access to a basic latrine. In addition, it was reported that local *Kebeles* do not allow open field defecation. However, from field observations, it was evident that the majority of villages visited did not have any indoor facilities and are therefore compelled to use open fields.

Cultural Influence on Health

In Afar there are three key cultural aspects that influence health status. *Dague* is an information exchange system used among the Afar which relies upon verbal communication between villages. In the *dague* system, care is taken not to distort the message, and to ensure that both the content and context of the message are clearly understood by the receiver. Key informants interviewed identified that *dague* has potential to create awareness within a short period of time, and can be used to improve health related behaviour. *Dague* also helps in the early detection and control of epidemics, in addition to its application in health advocacy programmes. The health extension workers and health professionals in the area indicated that most village members are aware of the cause of water borne and communicable diseases due to the communication between villages. In contrast to the advantages of the *dague*, health extension workers indicated that the side effects of drugs, treatment failure or death at a healthcare facility are propagated through the *dague*, creating distrust and resistance to the healthcare system.

Another characteristic common to the Afar is the sharing of resources and close support of one another. Elders interviewed in Hamad Ela commented that in Afar '*there is no one that is rich, and there is no one that is poor*', illustrating the extent to which resources are shared among villages. Despite overall poverty levels, this risk sharing behaviour helps to ensure that people facing difficulties are looked after by village members.

The key role of elders and religious leaders in Afar society was also identified as a means of increasing basic health education in the area. Involving traditional leaders in the formal healthcare system was identified as a potentially effective means of changing health behaviour, feasibly reducing harmful health practices such as FGC and unequal allocation of food in a household according to gender.

Community Training

All the households in Berahale are eligible for training on the government's Health Extension Programme, however, to date, only 469 households out of a total of 11,401 are reported to have completed the training (Berahale Bureau of Health, 2012). The programme involves both theoretical training and practical implementation. The local Health Centre indicated that of the houses that have completed the theoretical training, the majority are not able to implement the training as they cannot treat their water, or do not have access to basic sanitation facilities including latrines. The lack of supporting transport infrastructure is also a barrier to health extension workers, preventing them from reaching all households in the *Woreda*.

Road Accidents and Injuries

There are no official reports of road accidents in Berahale *Woreda*, although respondents raised concerns about the increasing number of trucks on the road, with reported increases in dust pollution and road accidents involving animals.

9.7.4 *Health Infrastructure at the Local Level*

The basic health service provision in Berahale *Woreda* includes two health centres and 10 health posts. A Health Post is a satellite health facility supported by a Health Centre that is responsible for providing preventive and basic curative health services. Of the healthcare facilities identified in the SSA, the most accessible to villages in the SSA were reported to be the health centre in Berahale town. A Health Post also exists in Hamad Ela, however is not currently functional (*Figure 9.36*). The majority of the local villages do not have frequent access to transport and therefore have to walk to Berahale.

Figure 9.36 Health Post in Hamad Ela



Villages usually receive vaccinations in Berahale at the Health Centre, and due to the long distances travelled to reach the Health Centre, vaccination coverage (particularly follow up) is poor. Currently there is no hospital in the *Woreda* and residents have to travel approximately 70km to Mekele to receive hospital treatment.

Allana's on-site clinic also provides emergency general healthcare services to tourists and locals in the area. In the past this has also included providing deworming and vaccination to the residents in Hamad Ela. However, provision of healthcare services is now reported to be restricted to Allana employees.

The estimated service coverage for the health centres in Berahale is currently 56%. The health extension workers in Berahale Town reported that on average, it takes a minimum of four hours to travel to a village due to the scattered distribution of the population. The high temperatures in the areas make it even more difficult for health professionals to travel to villages, and to transport medication. The head of the Health Centre reported that weather conditions and long distances hinder the ability of the local healthcare professionals and health extension workers to reach all required households and conduct follow up visits.

The healthcare professionals available in Berahale *Woreda* include:

- 1 BSc trained nurse;
- 1 BSc trained environmental health professional;
- 21 diploma trained nurses;
- 2 diploma trained midwives;
- 3 diploma trained lab technicians;

- 1 diploma trained pharmacy technician;
- 14 HEWs; and
- 9 front line health workers (Berahale Health Centre, 2012).

In 2012, approximately half of the experienced healthcare staff are reported to have left the Berahale Health Centre (Berahale Health Centre, 2012). Key reasons provided were lack of motivation, no payment for duty, and no recognition of expertise or support from the local *Woreda* office.

Health extension workers are only trained for six months. Their main responsibilities focus on providing training on the Health Extension Programme, which includes training on hygiene and sanitation packages. The health extension workers interviewed expressed their frustration over the low acceptance and commitment shown by local villages. In addition, health extension workers stated that the lack of transport to access villages, along with limited equipment, led to villages losing trust in a health extension worker's ability to provide healthcare assistance. One of the health extension workers interviewed responsible for Mororo Village stated that it is often difficult to travel to the village due to the distance from Berahale town, reducing the health extension worker's ability to provide assistance with childbirth. The health extension worker stated that villages therefore prefer to rely on a traditional birthing attendant.

Frontline health workers in the *Woreda* were trained on basic curative and first aid skills over a period of six months in 2001. They are yet to receive further training, required to update them on developments in health service delivery.

Emergency Services

Across the SSA the only emergency services reported were a police station and Health Centre in Berahale (although Hamad Ela is reported to have a small police station with two officers). Given the distance of the villages from Berahale, particularly those in close proximity to the Allana mining concession area, it can be inferred that most villages do not have access to the police and are likely to rely on more traditional systems of authority for emergency support. In addition, the local military clinic treats emergency cases and some minor cases, although this is on an *ad hoc* basis.

The local Health Centre reported that they have a system to manage medical emergencies, but there is no ambulance or means to transport patients to the Health Centre or the closest referral hospital in Mekele. In the case of pregnancy related complications, the local Health Centre usually borrows a vehicle from the *Woreda* offices and assigns a nurse to escort the patient to Mekele. In other cases, families are known to rent out an available vehicle.

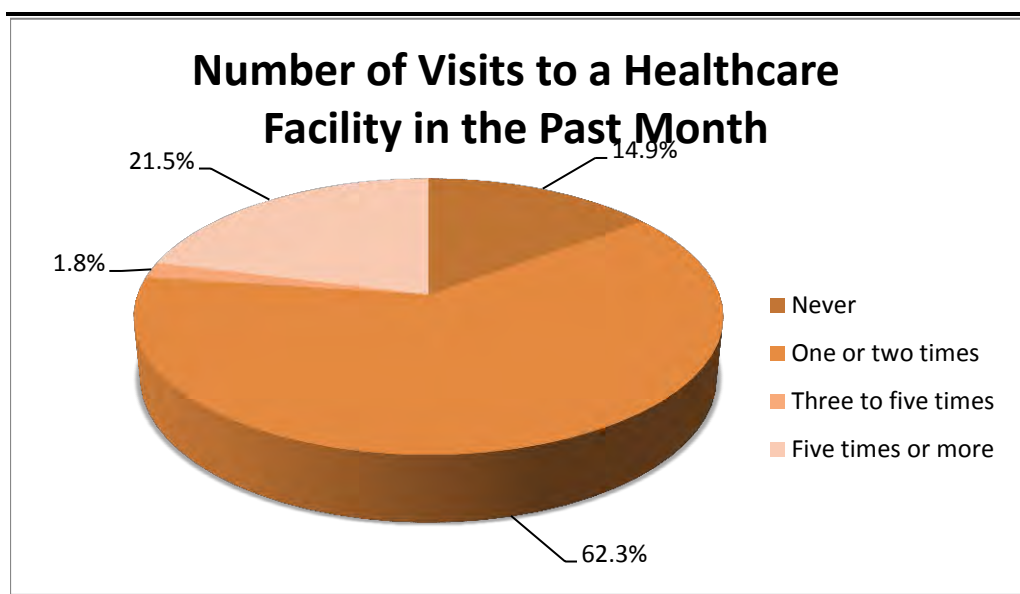
Anecdotal evidence gathered from the Allana medic indicates that many residents in Hamad Ela (less than 100m from the Allana camp) rely / expect to use the company's health service.

Health Seeking Behaviour

In the last year, 10,860 new and repeat patients attended one of the two HCs in Berahale *Woreda* (Berahale Health Centre, 2012). The outpatient department attendance rate was 0.12 per person, far below the annual two visits per person set by WHO standards (Ministry of Health, 2011). In Berahale, the low service utilisation rate reflects the long distances villagers have to travel to access healthcare, the low awareness of the services available, and the poor quality of healthcare provided in the health centres.

The results of the household survey show that the majority of households visited a facility one to two times in the last month (*Figure 9.37*). The inability of the local healthcare system to address local health problems is illustrated by the fact that the most commonly visited healthcare facility was a regional Health Centre. The regional Health Centre is most likely a healthcare facility in Mekele, as this was the most commonly referenced healthcare service by local residents.

Figure 9.37 Visits to a Healthcare Facility in Berahale *Woreda*



Source: ERM Household Survey, (2012)

The local professionals at the Health Centre indicated that patients are frequently impatient and reluctant to stay longer than half an hour when they visit. In addition, they noted that local village members often persuade the healthcare professional to bypass the diagnosis process, asking them to prescribe medication based on their previous illness and medication they have received in the past.

The status of women in Afar society is reported to act as a barrier to their access to healthcare. It is common for women to refuse treatment from a male health practitioner, and due to FGC practices in the area, reproductive health problems are common amongst women. All women interviewed identified that complications during childbirth, particularly for young women and the

consequences of FGC, are the most serious health problems they face. In addition, local Afar women will not openly discuss reproductive health issues. Therefore, any training or programmes provided are only realistically available to men.

Traditional Health Services

It is estimated that there are approximately 45 traditional healers in Berahale Town, in addition to 20 traditional birth attendants in Berahale Woreda. All of the traditional birth attendants identified within the *Woreda* have received basic training on childbirth and delivery, and are increasingly working closely with health extension workers, referring complicated cases as early as possible to the local health centre.

The health professionals at the Health Centre stated that traditional healers are particularly effective at healing fractured or dislocated bones. Traditional healers commonly travel between villages and rely upon the *dague* system to identify people who require their assistance, and to also publicise their presence in a village. The Health Centre also identified that traditional healers have started dispensing modern medicine (antibiotics, anti-pain and anti-parasite medication). Furthermore, it was acknowledged that traditional healers are usually more aware of religious and cultural practices than the conventional health practitioners, and are therefore favoured by local people.

In addition, it was reported that villages in the area regularly rely on the salt from Mount Assale for digestive and skin ailments.

NGO Activity

Compared to other areas in the region, or elsewhere in the country, only a few NGOs operate in Berahale Woreda. The four NGOs operating in the Woreda are the International Training and Education Centre for Health (ITECH); Red Cross; TARGET; and UNICEF. UNICEF works to provide support to households with malnourished children and the Red Cross aids in the building of village latrines. TARGET run the Afar Mobile Hospital which has a team comprised of physicians that provide basic health services. Lastly, ITECH supports HIV/AIDS prevention in the local area. It is reported that there is no alignment between the respective NGOs to tackle the identified key health priorities by the Woreda, and to maximise utilisation of resources.

9.8

CULTURAL HERITAGE

This section describes the national, regional, and local cultural heritage context for the proposed Project. The national cultural context presents information on the prehistory and history of Ethiopia and the regional cultural context focuses on the Danakil Depression. The local cultural context presents the results of the cultural heritage baseline surveys of the Study Area.

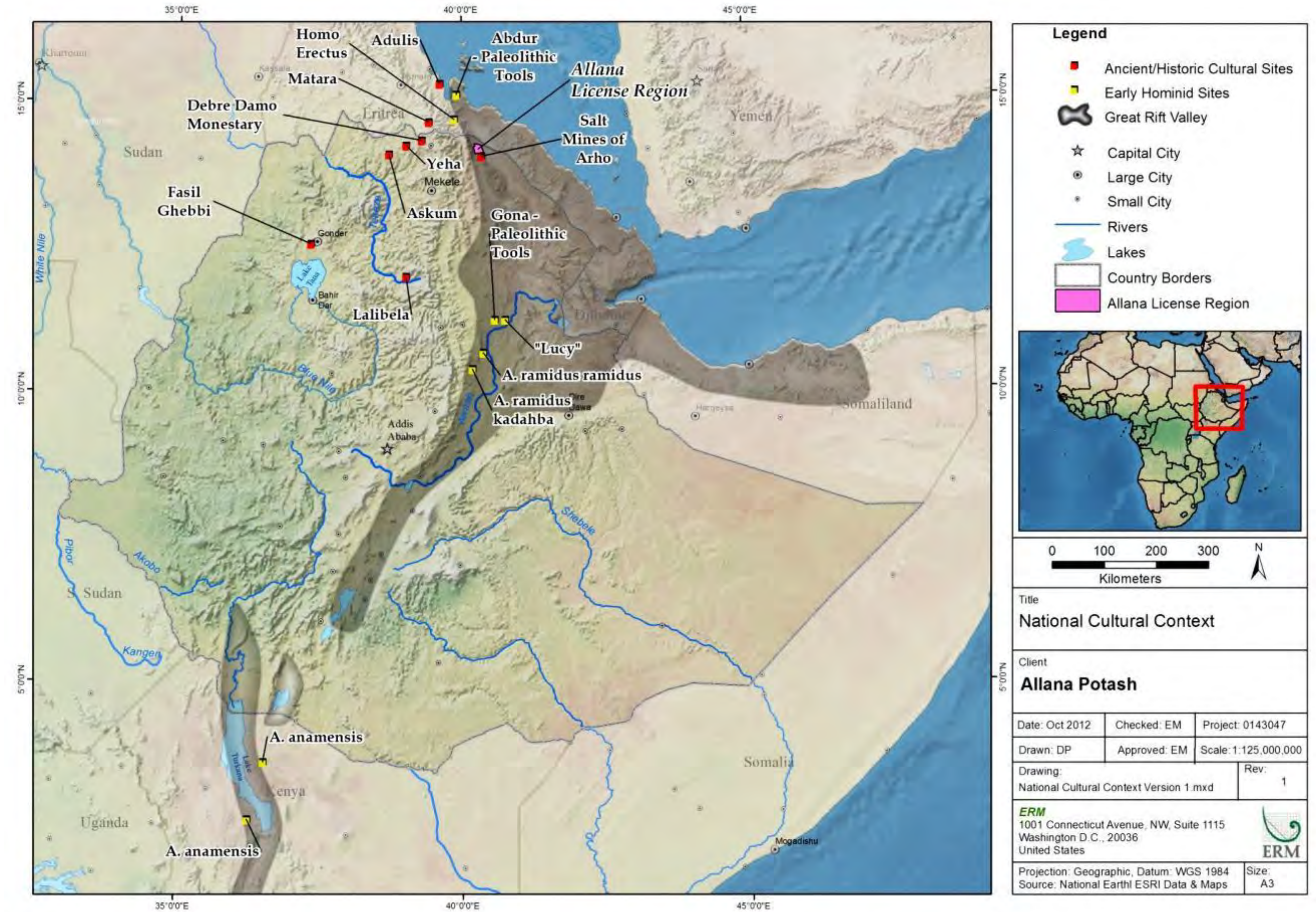
9.8.1

National Cultural Context

Ethiopia's cultural heritage resources include Palaeolithic sites, early states, empires and civilizations while also presenting a rich modern history. The region's importance can be, on one hand, tied to its location between the ancient civilizations of Pharaonic and Ptolemaic Egypt, the Swahili trading cultures of East Africa, Arabian civilizations, ancient Hindu States, European Medieval kingdoms and colonial powers, the Kingdom of Punt, and perhaps even Great Zimbabwe. On the other hand, Ethiopia's ancient civilizations actively developed unique styles of architecture, cuisine, and social governance while participating in the ancient cosmopolitan cultural system of the Red Sea and beyond.

Figure 9.38 shows the locations of some of Ethiopia's significant cultural heritage items.

Figure 9.38 National Cultural Heritage Context



Human Origins (4.2-2.6 Million Years Ago – MYA)

Ethiopia's Middle Awash valley contains the fossilized remains of early hominid species believed ancestral to modern humans, including: *Australopithecus (Au.) anamensis*, *Au. africanus*, and *Au. afarensis*. A unique early hominid discovery from the Middle Awash Valley was a 3.2 million-year-old *Australopithecus* skeleton AL 288-1, better known as *Lucy*, discovered in 1974 near the town of Gona (Johanson et al., 1982). The same research region also produced AL 333, a 3.2 million year old site containing thirteen *Au. afarensis* individuals. The aforementioned discoveries provide important information concerning early hominid diet, sexual dimorphism and species evolution (Johanson and White, 1979).

Early, Middle, and Late Stone Ages (2.6 MYA to 1,000 B.C.)

The world's oldest stone artefacts come from the site of Gona in Ethiopia. Dating between 2.6 and 1.5 million years ago, the Gona findings provide information on the earliest tool-using hominid populations, the technological development of stone tool production and use, as well as the evolution of early cultural patterns (Semaw, 2000). There are a number of additional Stone Age sites found across the Great Rift Valley from Kenya to Eritrea, including the Middle and Late Stone Age site of Mai Ba'ati near the north-eastern Ethiopian city of Mekele, and the Late Stone Age site of Agherri in the far eastern Danakil region (Aerts et al., 2010).

Aside from stone tools, Late Stone archaeological sites also provide genetic evidence that the early cultivated barley did not diffuse to northeast Africa from the Middle East, raising the possibility of independent domestication of the crop within the Horn of Africa (Orabi et al., 2007).

Pre-Abyssinian Civilization (1,000 B.C.-A.D. 100)

Towards the end of the Late Stone Age a number of ancient Ethiopian cultural groups slowly established permanent settlements. The shift from a highly mobile to settled society is widely believed to have fostered more complex forms of socio-political organization. The early stages of increasing cultural complexity in Ethiopia developed hand-in-hand with those in the Arabian Peninsula and the seafaring economic networks of the Red Sea. Early Egyptian texts mention a kingdom known as *Daamat*, which represents the first written account of Ethiopian heritage, but the nature and extent of the kingdom remains little researched (Fattovich, 2009). The most important archaeological site during the Pre-Abyssinian period is a city known as *Yeha*, located about 100 km west of Aksum and 265 km west of the Study Area (Figure 9.39). While *Yeha* remains largely unexplored by archaeologists, it boasts monumental architecture and unique building styles.

Figure 9.39 *Yeha Temple of the Moon*



Kingdom of Aksum (A.D. 100-1000)

The Kingdom of Aksum (or Axum), also known as the Aksumite Empire, was a highly developed civilization most widely known today for its impressive local architectural traditions. *Figure 9.40* illustrates examples of such architecture from Aksum, located approximately 165 km west of the Study Area. The Kingdom of Aksum minted its own coins and was the first major empire to convert to Christianity in the third century AD. Recent research at Aksum suggests a possible early first millennium AD exploitation of salt from the Danakil Depression (Sernicola and Philippson, 2011). Domestication of the coffee bean occurred around the 6th century AD in Ethiopia's highland regions. Its later discovery by Arabic traders in the 13th century led to a global trading phenomenon (Pendergrast, 2000).

Figure 9.40 *Architecture of Aksum: Tomb of the False Door (right), King Azana's Obelisk/ Stele (middle), and the Remhai Stele (left)*



The Aksumite Empire participated in extensive regional and superregional exchange networks that reached as far as China. Exported goods included agricultural products, salt, gold, iron, ivory and livestock. The Hindu text known as *Periplus Maris Erythraei* (Circumnavigation of the Red Sea), edited in the first century AD, states that Egyptian clothing, wraps from Arsione, cloaks, cotton, and linens, as well as glass, brass, copper, iron, silverware and gold ware, wine from Laodicea and olive oil from Italy were imported at the Aksumite port of Adulis, (central Eritrea). Exports from Adulis included

ivory, tortoise shells, salt and rhinoceros horns from the interior of the northern Horn of Africa (Sernicola and Philippon, 2011).

Ethiopian Medieval Period (A.D. 1000-1800)

Some anthropologists believe intensive agricultural activities, and an increasing population, caused irreparable damage to soil stability during the Aksumite Empire, eventually leading to its collapse (Lightfoot, 1996). The following historical period, known as the Ethiopian Medieval Period, witnessed multiple wars and invasions from outside forces, resulting in the destruction of many Aksumite structures and churches.

The Zagwe dynasty ruled over much of modern Ethiopia and Eritrea during the 12th and 13th centuries AD. Surviving structures erected during this dynasty can be seen at Lalibela (located 270 km southwest of the Study Area) and upon a number of well-hidden mesas (*Figure 9.41*). The fortress city of Fasil Ghebbi in Gondar, residence of the Emperor Fasilidas and his successors during the 16th and 17th centuries, contains palaces, churches, monasteries and unique public and private buildings marked by Hindu and Arabic influences. There are even structures built in the European baroque style, brought to the region by Jesuit missionaries.

Figure 9.41 *The Bete Medhane Alem Church Complex at Lalibela*



The first sustained direct relations between Ethiopia and Europe began in the early 16th century when the Portuguese joined the Ethiopian army to quell an armed uprising known as the Ethiopian-Adal War. It is considered one of the first proxy wars fought between the Ottoman Turks and Portugal. However, during the mid-17th century Ethiopia began to fade away from European attentions after Emperor Fasilides expelled all Europeans from his kingdom for attempting to convert the population to Roman Catholicism from Ethiopian Orthodox Christianity.

Modern Period (A.D. 1900-Present)

During the second half of the 17th century through the 18th century, Ethiopia remained isolated from much of the Western world. This period of isolation ended with a British alliance in the mid-19th century. During the late 19th and early 20th centuries, the Italian government, keen on participating in the

European colonial pursuit, led three invasions of the region: Eritrea in 1890 and Ethiopia in 1895 and 1935, all of which were ultimately unsuccessful. As a result of the Italian colonial aspirations, numerous forts were built along the border between Ethiopia and Eritrea.

The Italian government's failed military actions eventually gave way to private economic investments in the region. During the 1920s an Italian company established the first industrial scale mining at Mount Dallol, which was later redeveloped by the US based Parsons potash company between 1958 and 1967.

Modern Ethiopia is widely believed to begin during the reign of the Emperor Menelik II (1889-1913) who is recognized as a great builder and organizer, as well as a famous statesman. Violent disputes between northern Ethiopia and southern Eritrea intensified after the Second World War and into late 20th century. Periodic droughts and famine exacerbated the already tense situation, the worst drought occurring between 1984-5 (Clay and Holcomb, 1986). However, on 18 June 2000 both countries agreed to a comprehensive peace agreement and binding arbitration of their disputes under the Algiers Agreement. While tensions between the two governments remain high, the border regions have remained largely calm.

As a useful aid in understanding Ethiopia's cultural timeline, *Table 9.13* presents a chronological chart itemizing each cultural period mentioned above with specific dates and events.

Table 9.13 *General Timeline of Ethiopian Prehistory and History*

Period	Dates	Important Cultural Heritage Locations and Events	Comments
Human Origins	5 to 3 Million Years Ago	Their remains have been discovered in the following locations: Middle Awash Valley and Northern Afar, Ethiopia. Early hominids evolved in Ethiopia during the late Pliocene.	Evolution of early hominids. Early hominids found in Ethiopia include <i>Australopithecus</i> (<i>Au. anamensis</i> , <i>Au. africanus</i> and <i>Au. afarensis</i>).
Early Stone Age	1 to 3 Million Years Ago	Early Pleistocene human remains have been discovered in the following locations: Middle Awash Valley and Northern Afar, Ethiopia; Bay of Zula, Eritrea.	Earliest stone tool use on earth evidenced at Gona. Appearance of Oldowan tools associated with members of the genus <i>Homo</i> . Global spread of <i>Homo erectus</i> Acheulian stone tools.
Middle Stone Age	1 Million to 40,000 BC	Middle Stone Age hominid and early human populations lived in Ethiopia's great rift valley during the mid to late Pleistocene. Fossils and stone tools have been found in the following locations: Mai Ba'ati in northern Afar, Agherri in far eastern Danakil Depression.	Appearance of fully modern humans (<i>Homo sapiens sapiens</i>). Dense scatters of Middle Stone Age tools found across the northern Afar Valley in Ethiopia and parts of the eastern Danakil Depression.
Late Stone Age	40,000 to 1,000 BC	Late Stone Age human populations lived during the end of the Pleistocene and into the Holocene. Artefacts and small settlements from this cultural period are located at: Buri Paleolake, southern Eritrea; Bay of Zula, southern Eritrea.	Late Stone Age settlements and monumental structures found in Eritrea, and recently in the Danakil Depression, consisting of stone circles and associated artefact scatters.
Pre-Abyssinian Period	1,000 BC to AD 100	Establishment of Kingdom of Daamat and important site of Yeha in northeast Ethiopia.	Possible domestication of barley in Ethiopia. Rise of socio-political complexity and early states.
The Aksumite Period	AD 100 to 1,000	Aksum, long distance trade with regions as far as China, mineral extraction, the first empire to convert to Christianity and development of monumental architecture.	Rise and fall of the Aksumite Kingdom. Domestication of coffee.
Ethiopian Medieval Period	AD 1,000 to 19th century.	Establishment of the Zagwe Dynasty and the rock-cut churches of Lelilbela, Aksum, Fasilidas' Palace at Chebbi, Ethiopian-Adal War.	Period of violence and war punctuated by periods of isolation from the outside world. Uneasy relations with the West through aggressive missionary work and later colonial.
Modern Period	19th century to present	Emperor Menelik II came into power in 1888, Italian invasions in the 19th and 20 th centuries. Serious drought and famine. Communist takeover of the government. Border conflicts with Eritrea, the eventual Ethiopian Eritrean War and signing of a peace agreement. Subsequent growth and stability.	Documented mining of salt and potash minerals in Danakil Depression.

The prehistory and history of the Danakil Depression is a microcosm of broader events that took place in Ethiopia during the last 4.2 million years (see *Figure 9.43*). During the Early through Late Stone Age, the area was an important migration route out of Africa, both for modern humans and earlier hominids (Abate et al., 2010). In fact, recent expeditions into the southern Eritrean side of the Danakil Depression have uncovered new evidence of early hominid occupation in the area, such as the one-million-year-old hominid cranium at Buia between the Bay of Zula and Mount Dallol (Abate et al., 1998). The presence of Early and Middle Stone age tools are documented along adjacent mountain slopes and alluvial fans to both the east and west of the Danakil (Roubet, 1970).

Evidence of Late Stone Age occupations in the Danakil Depression and adjacent parts of Eritrea suggest climactic conditions were, at that time, more humid. A number of impressive Late Stone Age site complexes have been identified on the shores of Eritrea's Buri Paleolake and the Bay of Zula. The Buri Paleolake sites are composed of a dense and expansive cluster of various types of stone circles and monuments. Artefact scatters of Late Stone Age tools covering over 10,000 square meters have been documented at these sites (Lightfoot, 1996).

On 14 October, 2012 an ERM archaeologist and a local Ethiopian archaeologist visited the lower north-western slope of Mount Assale, an active volcano that sits upon the southern shore of Lake Assale. This location, approximately 18 kilometres south of the Project basecamp (well outside of the Allana Project area, was identified as a potentially archaeologically significant area during the April 2012 archaeological desktop baseline analysis. An intensive remote sensing effort identified hundreds of densely clustered and large archaeological features upon old basalt flows.

Figure 9.42 A Selection of Stone Monuments Recently Found Along the Western Slopes of Mount Assale



The archaeological team discovered that the potential archaeological features found through remote sensing were in fact large ancient monuments. Many of the features measured up to 4.5 meters tall and 13 meters wide at their base. Within the 2.5km long site, the team recorded nearly 1,000 monuments.

In and around these monuments lay a number of artefacts, these included: 1) stones tools made from high quality obsidian, 2) seashells left at pyramid bases and 3) river cobbles are found placed on top of the stacked circular features. No ceramics were recovered which suggests the population who built these features belonged to a pre-pottery tradition.

All monuments at Mount Assale are constructed from local basalt stones. It is currently not understood what function they served, but it is likely that some are tombs. The stone tools found at Mount Assale are of a similar Late Stone Age technology common to southern Eritrea. This finding presents circumstantial evidence that a number of the Mount Assale monuments might date to the Late Stone Age. Similar, yet significantly smaller, monuments exist within the Project area as well. The discovery of the Mount Assale sites has helped to construct a rough chronological framework that helps date a number of sites found in the Project area.

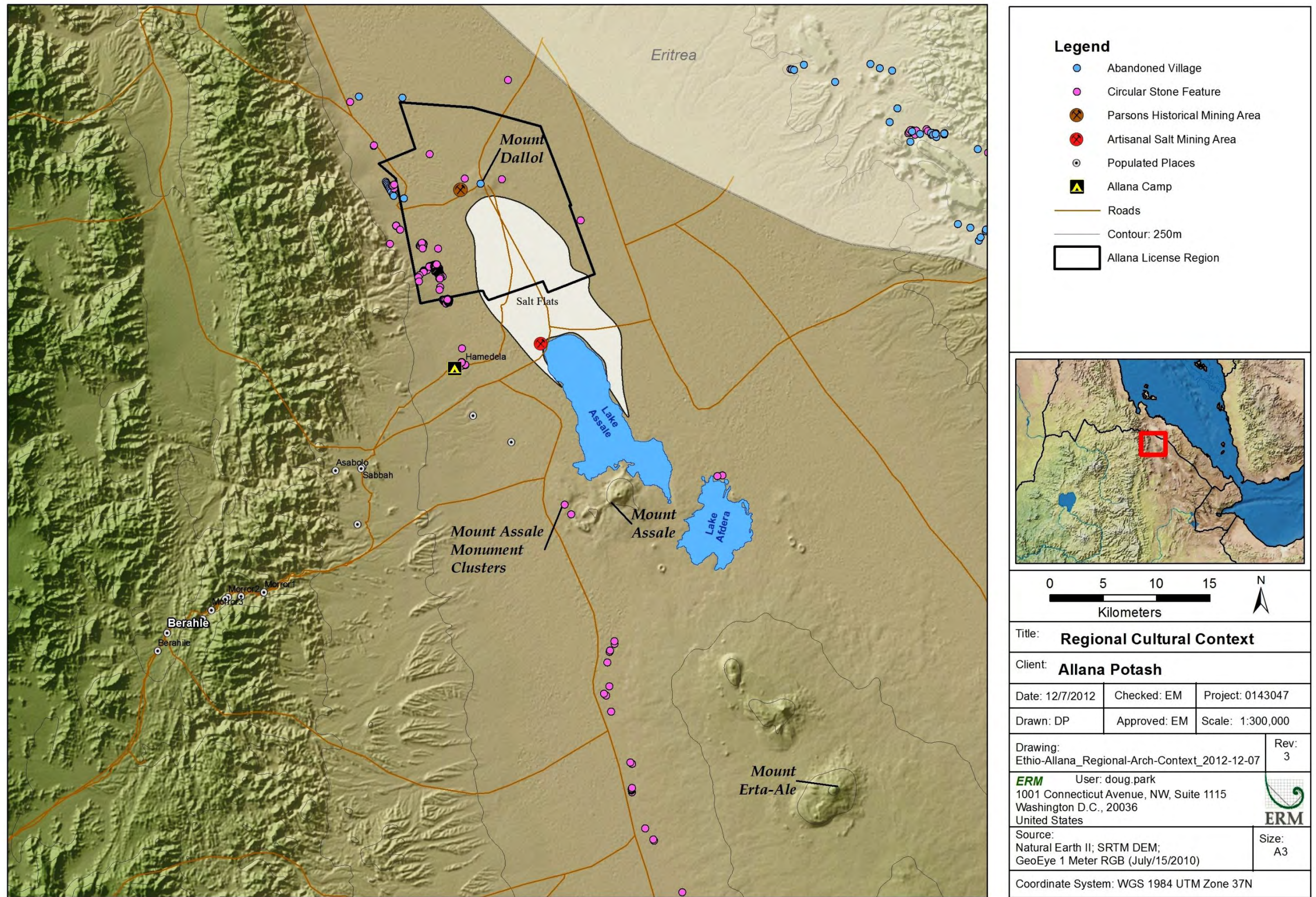
During the Abyssinian period, and perhaps even earlier, the Danakil Depression acted as an important conduit for trade with the Red Sea and Arabia. Moreover, it is likely that Aksum exploited the natural salt resources

located across the Danakil for trade with Upper Egypt and Sudan. It is highly unlikely that potash was mined from Mount Dallol during this period.

Very little is known about the Danakil Depression during the 1st and 2nd millennia AD. Historical accounts of various European expeditions into the Danakil offer some information. A notable example is the 1625 expedition of the Jesuit Jeronimo Lobo's crossing of the Danakil (Smith, 2011). Unfortunately, Lobo provides little pertinent information concerning cultural heritage in his account, which focuses primarily on a detailed description of the natural landscape.

Figure 9.40 illustrates the cultural heritage resources identified within the Afar region both from field surveys and from desktop remote sensing. The resources include stone features scattered across proposed Project area including to the east and the west of the salt flats.

Figure 9.43 Map of Cultural Heritage Resources within a Regional Context



In 1928 the British explorer L.M. Nesbitt led a small expedition across the Danakil Depression from south to north, traveling over 800 miles during a period of three and a half months. The Nesbitt expedition along the Danakil Depression provides information on cultural and economic activities practiced in the region during the early 20th century populations. Nesbitt documented intensive salt mining at the shores of Lake Assale, just south of Mount Dallol, and the associated tension between various ethnic groups competing over this important natural resource. The expedition guide commented that conflict over the particularly rich deposits at Fia near Lake Assale had been going on for hundreds of years.

In June 1928, the Nesbitt expedition reached Mount Dallol and met up with an Italian mining company. There he noticed numerous structures upon the mountain occupied by miners. These mining camps documented by Nesbitt are visible on satellite images of the region. *Figure 9.44* shows a small and abandoned mining town upon the crater of Dallol, and an abandoned road and linear village settlement system seven kilometres west of Dallol. There are a number of other abandoned towns surrounding Dallol, which may represent early 19th through 20th century mining settlements, some of which might belong to the 1950's potash exploration activities of Parsons, a US based company.

9.8.3

Cultural Heritage Resources Identified at the Project Site

Archaeological Cultural Heritage Sites

Two field survey visits supplemented by satellite imagery review identified 876 potential Archaeological Cultural Heritage (ACH) sites within the Project license area (refer to *Figure 9.45*). Detailed review confirmed 145 of the sites as cultural heritage, which are defined as ancient, historic or modern sites of varying importance that represent human settlements, ritual structures, burials, specialized activity areas or artefact scatters. The remaining 731 sites were found not to be cultural heritage sites and are of negligible importance. Site locations and descriptive information for the 145 ACH sites are listed in *Annex E in Volume Two*.

The majority of the 145 ACH sites are *cairns*, or manmade piles of stone (*Figure 9.47*). The greatest density of *cairn* structures exist around the villages of Mororo, Hamad Ela, and Alai lai. The only proposed Project component to overlap with ACH sites is the proposal Plant area, which contains 7 *cairn* features. The remainder of the sites identified during the field survey were found outside the footprint of the Project components. The only artefact recovered during the field survey was a single Middle Stone Age tool apparently not in primary context (*Figure 9.46*).

Figure 9.44 *Cultural Heritage Sites around Mount Dallol*



The top image is of some abandoned equipment located at the historic mining town. The image on the bottom left appears to be the remains of that town. The image on the lower right shows abandoned roads (yellow arrow); linear abandoned village settlement system (red arrows); and an associated cultural habitation mound typical of medieval and prehistoric northern Africa (blue arrow).

Figure 9.45 Locations of Known Potential Sites within and Near the Project License Area: Identified During the First Cultural Heritage Baseline Survey

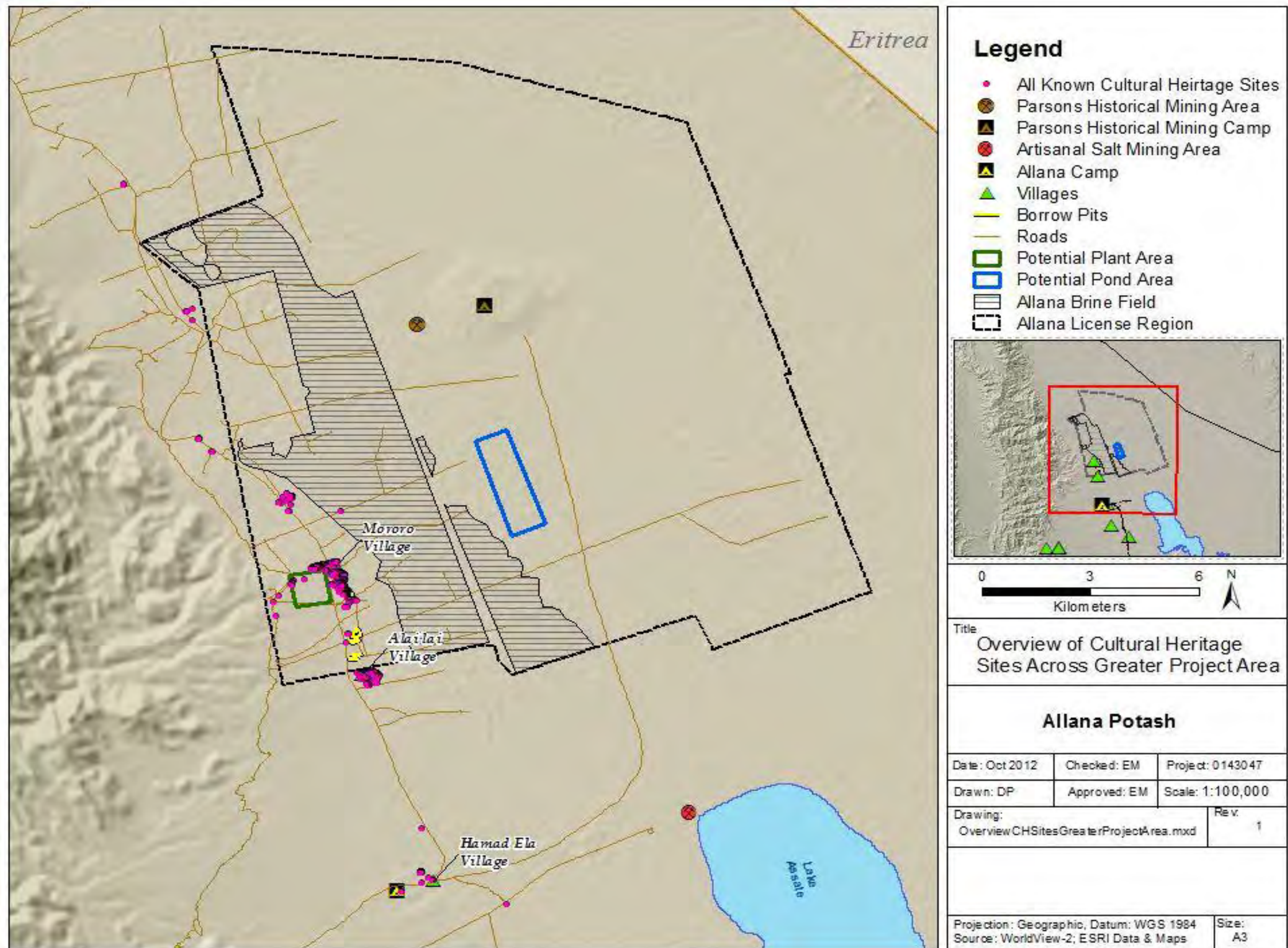


Figure 9.46 *Possible Middle Stone Age tool found in Project area near Alai lai Village*



Figure 9.47 *Examples of Each of the Five Categories of Archaeological Cultural Heritage Sites within the Allana Concession Area*



Circular Cairns



Stacked Circular Cairns



Conical Cairns



Modern Graves



Military Shooting Blinds

Because no archaeological work preceded ERM’s baseline field survey, a system of classification had to be developed from field observations. Five general categories of site type are now known to exist within the Project area (See *Figure 9.47*):

- Circular Cairns;
- Stacked Circular Cairns;
- Conical (or Pyramid) Cairns;
- Modern Burials; and
- Modern Military Shooting Blinds.

The modern burials and shooting blinds are relatively easy to interpret as their functions are known to the modern populations. As for the *cairn* structures, their function is unknown. Modern populations provided a variety of conflicting interpretations as to the functions of the *cairn* structures. From a scientific perspective, it is likely that the *cairn* structures are of significant age as they are similar to larger, and potentially, Late Stone Age monuments found on the north-western slopes on Mount Assale.

The archaeological team recorded and mapped all five types of ACH sites within the Project license area with GPS. Part of the field assessment also involved a preliminary assessment of the cultural or scientific importance of each ACH site (refer to *Table 9.14*). The combined results from the two archaeological field seasons are displayed on *Figure 9.48* and *Figure 9.49*.

Table 9.14 *Cultural Heritage Importance Rating Criteria*

Cultural Heritage Site Importance		
Low	Medium	High
Defining Characteristic(s): Site is not specifically protected under local, national, or international laws or treaties; Site can be moved to another location; replaced by a similar site; or type of site common in surrounding region; site has limited or no cultural value to local, national, or international stakeholders; site has limited scientific value or similar information can be obtained at numerous sites.	Defining Characteristic(s): Site is specifically or generically protected by local or national laws but laws allow for mitigated impacts; Site can be moved, replaced, or data and artefacts recovered in consultation with stakeholders; Site has considerable cultural value for local and/or national stakeholders; Site has substantial scientific value but similar information can be obtained at a limited number of other sites.	Defining Characteristic(s): Site is protected by local, national, and international laws or treaties; Site cannot be moved or replaced without major loss of cultural value; Legal status specifically prohibits direct impacts or encroachment on site and/or protection zone; Site has substantial value to local, national, and international stakeholders; Site has exceptional scientific value and similar site types are rare or non-existent.

Living Cultural Heritage Sites

In addition to the graves, the artisan salt mines of Ashe Ale, which falls outside of the concession area, was identified as one of the key living cultural heritage sites in the Study Area. The local community uses salt from Ashe Ale for curing illnesses, believing it has healing properties. In addition Ashe Ale is

believed to be the 'mother of all salt', with local people believing that if any harm comes to Ashe Ale the production of salt will cease. Ashe Ale is a protected site by the locals and only village elders or leaders are able to take salt from it. Anyone else that causes damage to or removes salt from Ashe Ale is fined by the village elders who are responsible for executing fines and punishment. It is understood that any local Afar will report any damage / removal of pieces from Ashe Ale to the village leaders. Several community members have indicated that spirits exist beyond the land past Mount Dallol. There are several local stories of people disappearing and being taken by spirits that live around Mount Dallol.

Figure 9.48 Cultural Heritage Sites in the Vicinity of the Plant Area

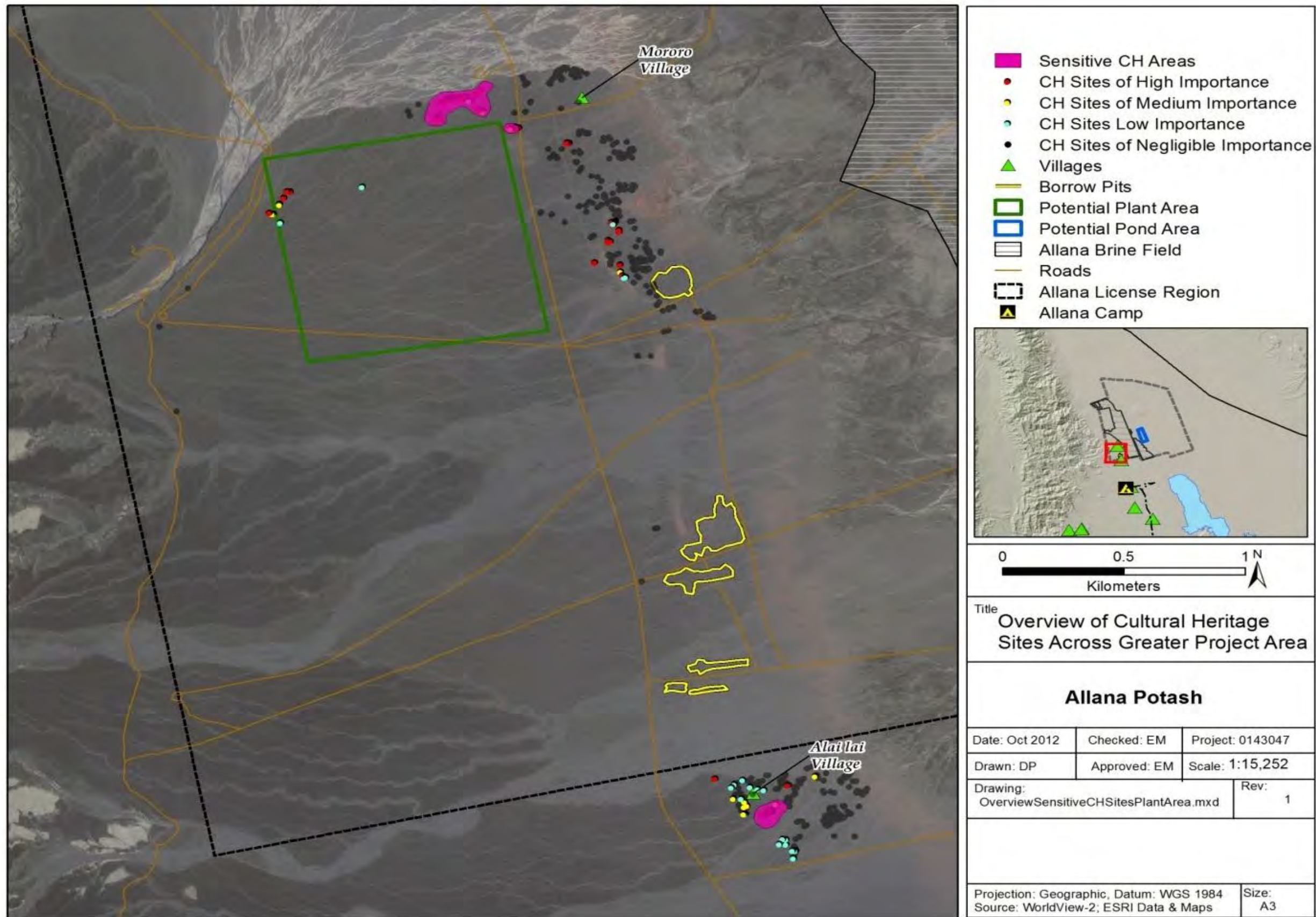


Figure 9.49 Detailed View of Archaeological Cultural Heritage Site Types in the Vicinity of the Plant Area

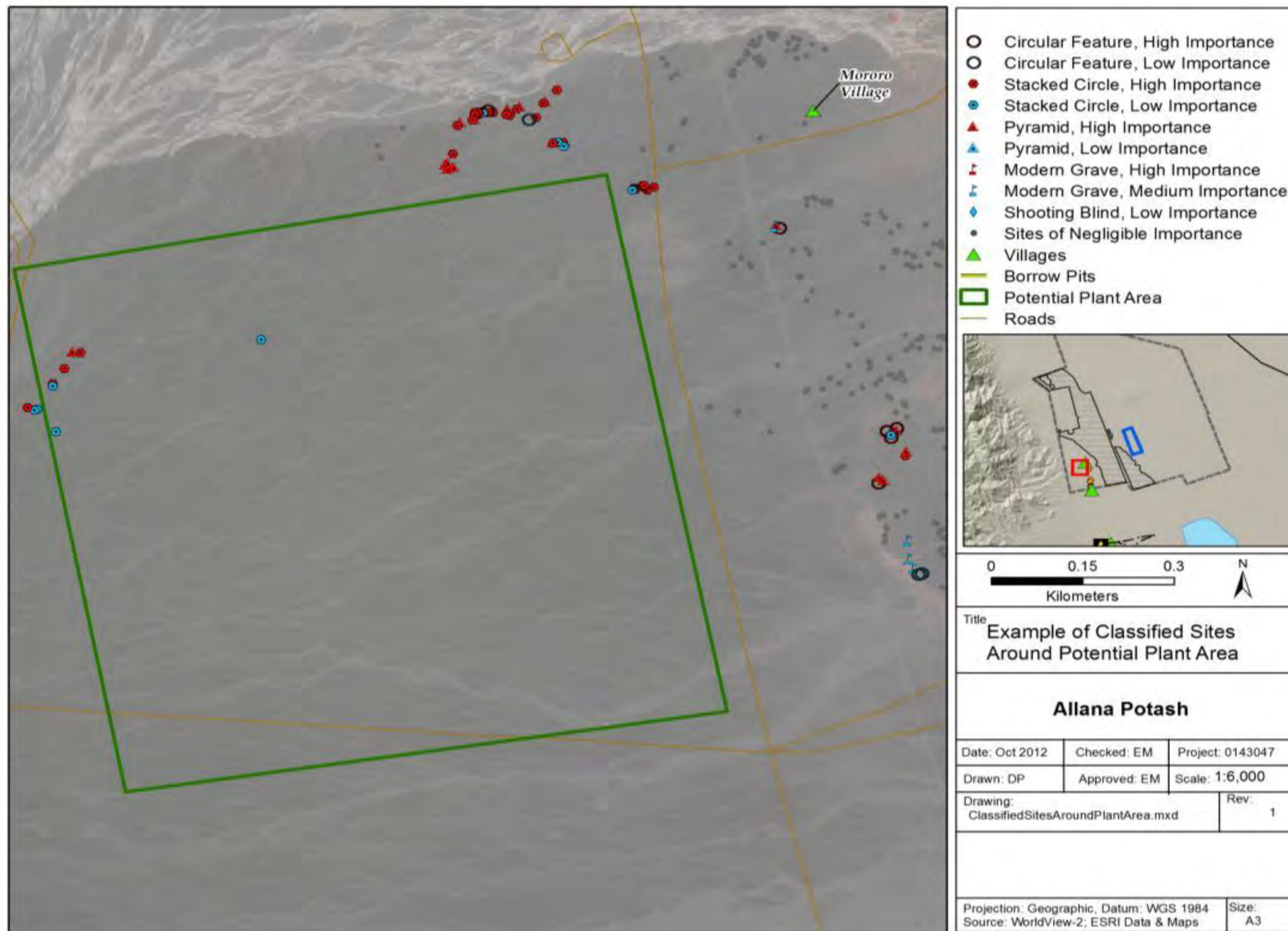


Figure 9.50 *Ashe Ale*



9.9 *LANDSCAPE AND VISUAL*

9.9.1 *Background of the Study Area*

The Danakil Depression is commonly known as the hottest place (highest average annual temperature) on earth, and the Study Area experiences an extremely hot and arid climate. The lowlands of the Danakil Depression are hyper-arid with monthly mean temperatures varying between 24.4°C during the wet season (June to September), and 46.7°C in the dry season (October to May).

These extreme heats cause ‘heat shimmer’ which mean that, at further distances, it is unlikely that visibility is high, even though the landscape is flat and is sparsely vegetated in most areas. This is often worsened by the presence of dust.

9.9.2 *Legislative Planning Requirements*

The Study Area and its surrounds do not have any statutory designations with respect to planning, and there are currently no land use plans in place within the site or in surrounding areas. It is understood that while Development Plans for the wider region are in the process of being prepared, these are strategic and generic and are not specific to the Landscape and Visual Impact Assessment.

Baseline Landscape Character and Resources

Landscape Characteristics in the Wider Region

The Study Area is dominated by lowland saline plains with a minimum altitude of 120m below sea level, corrugated by horsts and graben ⁽¹⁾, and rare local high relief peaks representing shield volcanoes. To the east and west are relief peaks which are visible from the Study Area. On the north-eastern edge of the depression, maritime hills border a hot, arid, and treeless strip of land 16 to 80km wide. These coastal hills drain inland into saline lakes, from which commercial salt is extracted by artisanal means. The majority of the depression is clear open land, and vegetation witnessed in the area is mainly low lying vegetation.

Site Area and Immediate Surrounding Profile

Allana's proposed concession area covers an area of approximately 158km². The village of Mororo is identified to fall within the concession area, and the village of Alai lai is located on the southern outer boundary of the concession area.

The immediate surroundings to the site are:

- Open bare land to the north, east and west;
- Highlands to the west, relief peaks to the east and maritime hills to the north east;
- Ashe Ale to the south east;
- Lake Assale and the salt flats to the south;
- Mount Dallol within the concession; and
- Alai lai and Hamad Ela villages located further south of the concession area.

The majority of the land in the surrounding area is open bare land with sparse vegetation, particularly to the east of the concession area. The only area observed to be significantly more vegetated is the salt pan fringe running along the west of the concession area where palms are the dominant floral species. Small shrubs and occasional Acacia trees are also evident in the alluvial fans to the west of the concession area (refer to *Figure 9.51*).

(1) In geology, horst and graben are terms referring to regions that lie between normal faults and are either above or lower than the area beyond the faults. A horst represents a block pushed upward by the faulting, and a graben is a block that has dropped due to faulting.

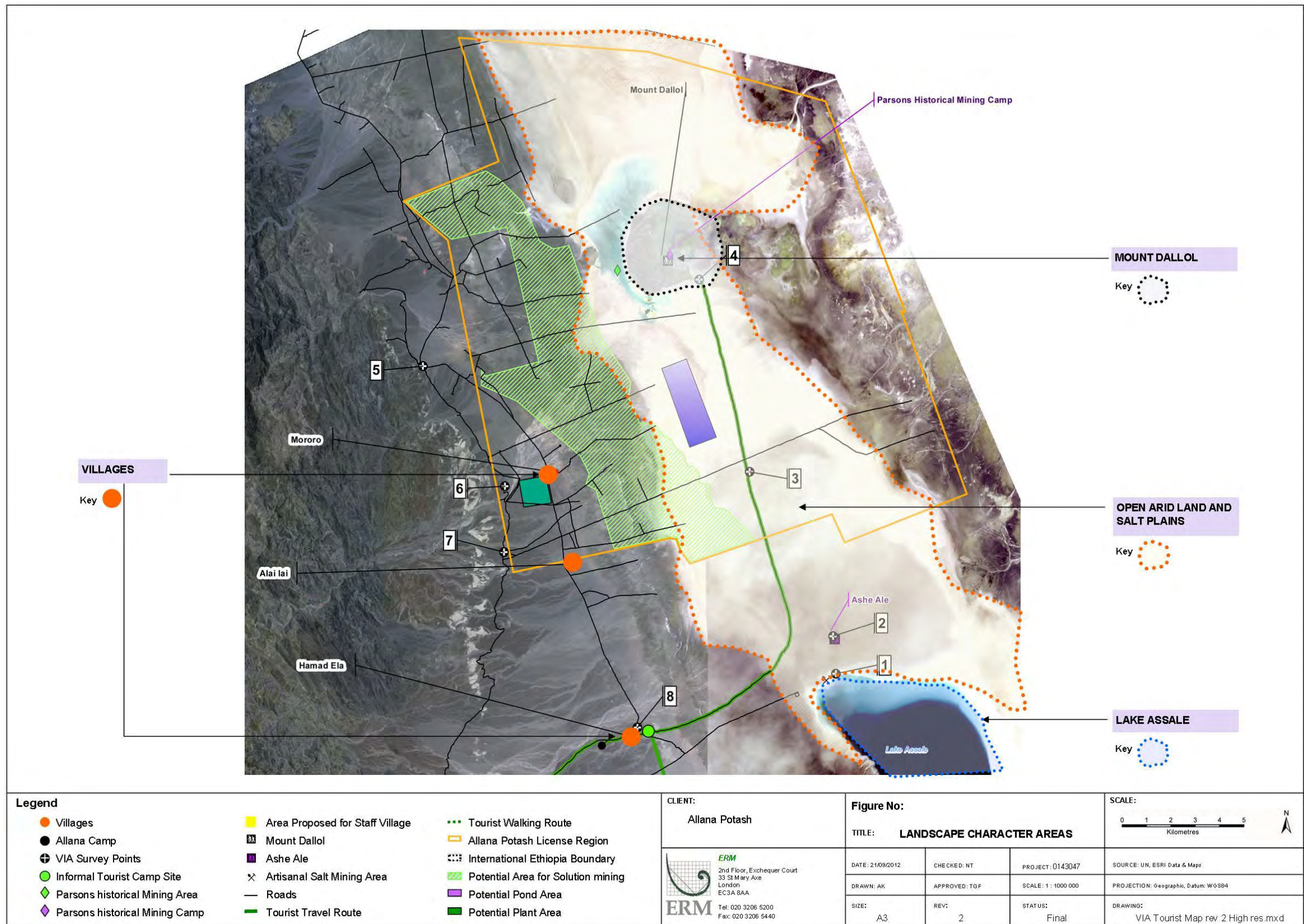
Figure 9.51 Vegetated Area along Salt Pan Fringe



From the social baseline data collection conducted in May 2012 it can be stated that infrastructure and basic services such as water, sanitation and electricity are largely absent in the SSA. However physical developments are evident in the Study Area, the most noticeable of which is the construction of the Government road connecting Mekele to Bada. The presence of mining companies in the Study Area has also lead to increased activity in the area. In addition to the main road and Government road there are several dirt roads within the Study Area that have largely been created for use by the construction and mining companies.

In essence the area's 'sense of place' is derived mainly from its 'arid desert setting' with few scattered settlements. The characteristic landscape features within the proposed Project Study Area have been illustrated in *Figure 9.52* and are briefly described in the following section.

Figure 9.52 Landscape Characteristics



The following landscape character areas have been identified in the Study Area:

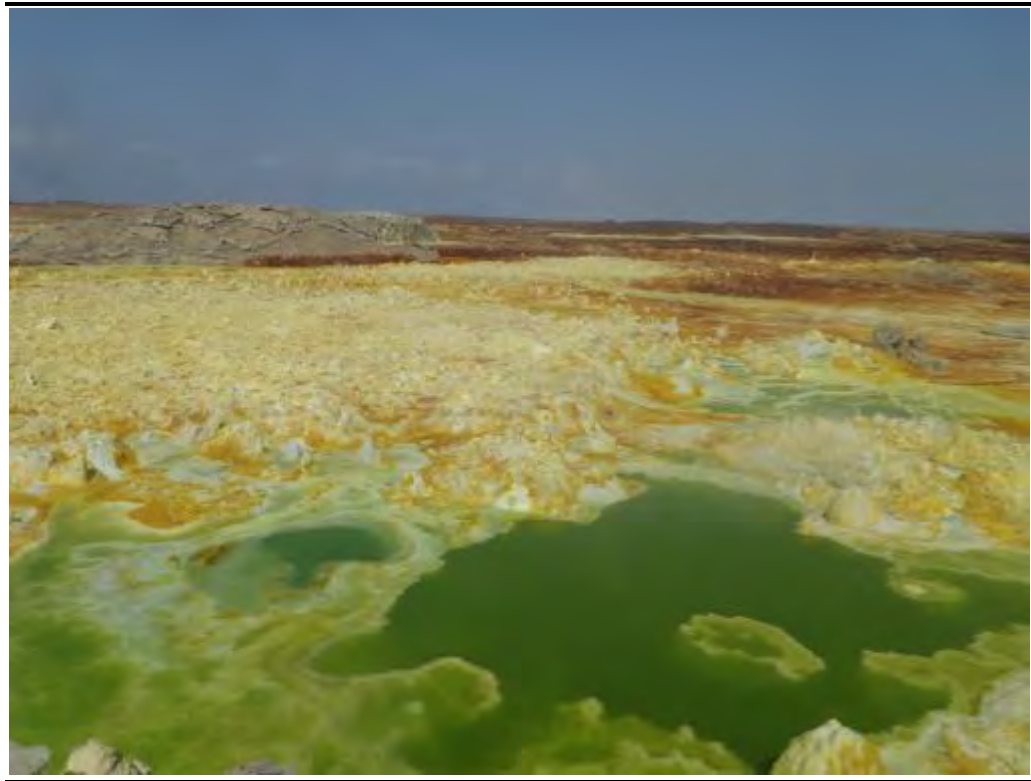
- **Open Arid Land and Salt Plains:** the land surrounding the Study Area is largely composed of open gravel and saline plains with sparse vegetation. The area does not fall under any statutory landscape designations, and there are few scattered villages in the surrounding area with one village within the concession area (refer to *Figure 9.53*).

Figure 9.53 Open Arid Land



- **Mount Dallol:** Mount Dallol (refer to *Figure 9.54*) is a hydrothermal field located in the salt pan. It is an important site for tourists and is internationally recognised. Mount Dallol is most famous for its hot brine springs, sulphur formations and multi-coloured salt deposits. Furthermore Mount Dallol is among one of the lowest volcanoes located on land in one of the lowest elevations on earth (approximately 116 m below sea level). Mount Dallol is a key tourist attraction in the Study Area.

Figure 9.54 *Mount Dallol*



- **Lake Assale:** Lake Assale (*Figure 9.55*) is located approximately 8km to the south of the concession area. Lake Assale and the neighbouring salt flats have been the site of artisanal salt mining for centuries, where local Afar and other ethnic groups work to extract salt manually. The sensitivity of Lake Assale is typically open, deserted with no vegetation and is uninhabited.

Figure 9.55 Lake Assale



- **Existing Infrastructure and Villages:** currently villages represent scattered semi-organised residential built up areas. The majority of the villages in the SSA are small villages comprising small vernacular dwellings made of dried palm and wood products (*Figure 9.56*). However the town of Berahale and village of Hamad Ela illustrate an increased variety of dwellings including contemporary dwellings made of corrugated iron and cement. It can be assumed that contemporary dwellings are purely functional having little or no aesthetic value within their design. Furthermore the residential areas have progressive organic

growth (natural development in absence of a coordinated development plans). It should be noted that traditional Afar houses were reported during the baseline survey to be a source of pride and identity for the local Afar. In this area the built forms are very basic, and there are almost no facilities and infrastructure. The closest receptors to the Project Area are the village of Mororo, which is located within the concession area and the village of Alai lai adjacent to the concession boundary. Hamad Ela is also currently located close to the existing Allana Potash Exploration camp and features as a common tourist stop-over.

Figure 9.56 *Typical Household in the Social Study Area*



- **Ashe Ale:** Ashe Ale (*Figure 9.57*) is a living cultural heritage site in the Study Area, and the local Afar believe the salt derived from Ashe Ale has healing properties. Ashe Ale is protected through an informal and customary reporting system, whereby local residents will report anyone who damages or removes salt from Ashe Ale to local elders and village leaders. Ashe Ale is also a common attraction on the tourist route.

Figure 9.57 Ashe Ale



Existing Views and Visual Environment

Photographs were taken from eight different viewpoints which are shown in *Figure 9.58* and *Figure 9.59* illustrating various views of the site and the surrounding areas.

Figure 9.58 Viewpoint Photographs

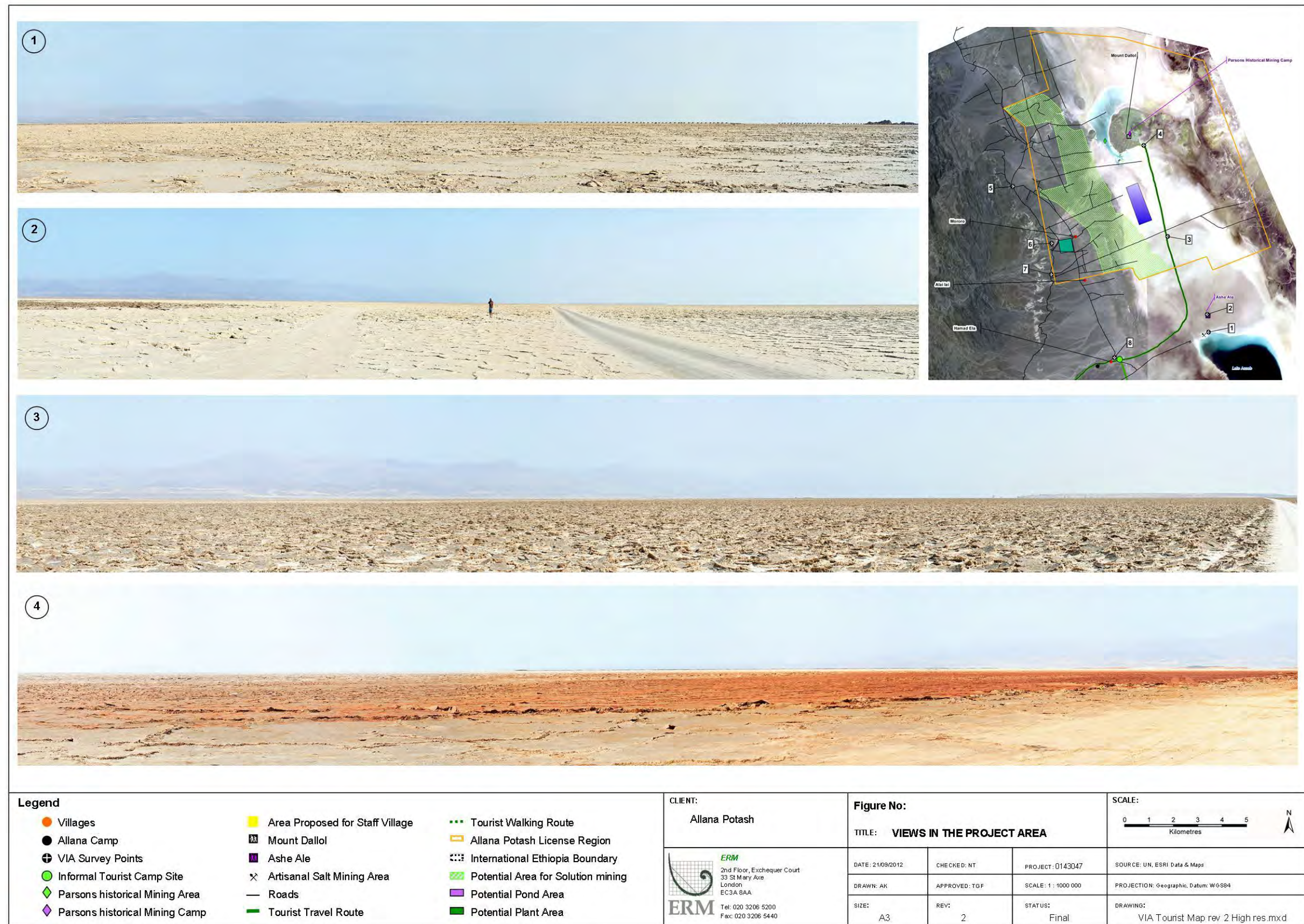
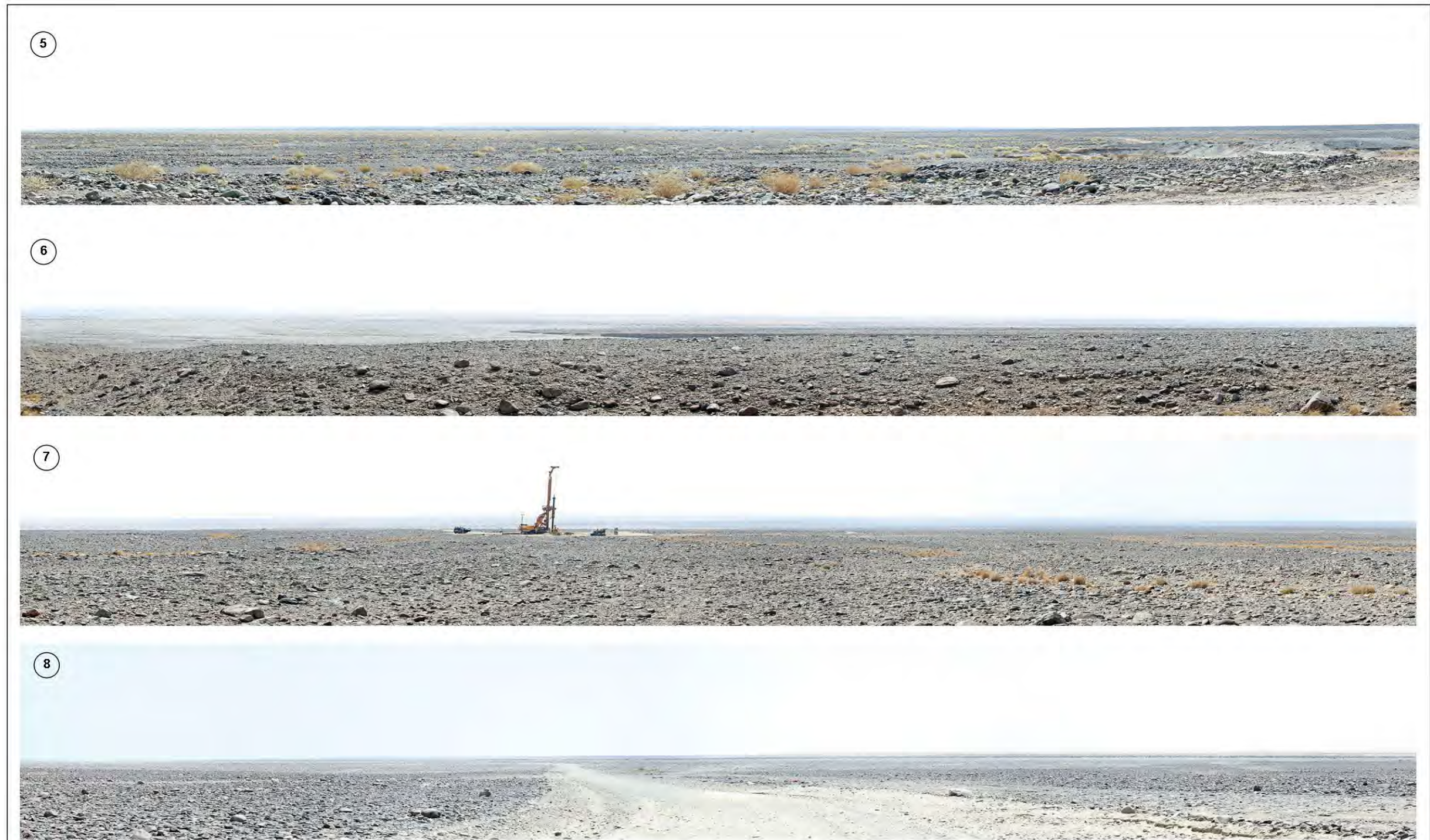

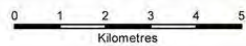



Figure 9.59 Viewpoint Photographs



Legend <ul style="list-style-type: none"> ● Villages ● Allana Camp ⊕ VIA Survey Points ● Informal Tourist Camp Site ◆ Parsons historical Mining Area ◆ Parsons historical Mining Camp ■ Area Proposed for Staff Village Ⓜ Mount Dallol ■ Ashe Ale ⊗ Artisanal Salt Mining Area — Roads — Tourist Travel Route ⋯ Tourist Walking Route ▭ Allana Potash License Region ⋮ International Ethiopia Boundary ▨ Potential Area for Solution mining ▭ Potential Pond Area ■ Potential Plant Area 			CLIENT: Allana Potash  ERM 2nd Floor, Exchequer Court 33 St Mary Ave London EC3A 8AA Tel: 020 3206 5200 Fax: 020 3206 5440	Figure No: TITLE: VIEWS IN THE PROJECT AREA <table border="1"> <tr> <td>DATE: 21/09/2012</td> <td>CHECKED: NT</td> <td>PROJECT: 0143047</td> </tr> <tr> <td>DRAWN: AK</td> <td>APPROVED: TGF</td> <td>SCALE: 1 : 1000 000</td> </tr> <tr> <td>SIZE: A3</td> <td>REV: 2</td> <td>STATUS: Final</td> </tr> </table>	DATE: 21/09/2012	CHECKED: NT	PROJECT: 0143047	DRAWN: AK	APPROVED: TGF	SCALE: 1 : 1000 000	SIZE: A3	REV: 2	STATUS: Final	SCALE:  0 1 2 3 4 5 Kilometres 
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SIZE: A3	REV: 2	STATUS: Final												
SOURCE: UN, ESRI Data & Maps PROJECTION: Geographic, Datum: WGS84 DRAWING: VIA Tourist Map rev 2 High res.mxd														

Analysis of data from topographical surveys, Zone of Theoretical Project Visibility (ZTVs) and aerial photo data, viewpoints across the Study Area have been selected to represent the range of views and types of viewer likely to be affected by the proposed Project. These have been described in *Table 9.15*.

The ZTVs identify and map the areas within which the proposed Project might theoretically have an influence or an effect upon landscape character and visual amenity, in other words where it can be seen. ZTVs have been created using the current proposed location of the processing plant and a proposed plan height of 15m (refer to *Figure 9.60*) and a stack height of 65m (refer to *Figure 9.61*).

Table 9.15 *Selected Viewpoints (refer Figure 9.58 and Figure 9.59)*

Viewpoint Number	View Location	Sensitivity
Vp 4	View from base of Mount Dallol (approximately 3km from site)	Considering the distance and very small number of tourists the sensitivity is considered to be <i>medium</i>
Vp 6	View from western gravel foothills (similar views will be available from Mororo village (approximately 500 m))	Considering the distance, and very small number of residents and workers the sensitivity is considered to be <i>low-medium</i>
Vp8	View from Hamad Ela village (approximately 6.2 km)	Considering the distance and the small number of residents and tourists the sensitivity is considered to be <i>medium</i>

There are no designated views or views of international, or national and local importance within the concession area or in the immediate areas. However, locally Ashe Ale is identified to be an important site of living cultural heritage to the local Afar people. However, views of the salt deposits from Mount Dallol are internationally renowned.

Figure 9.60 Zone of Theoretical Project Visibility - Processing Plant

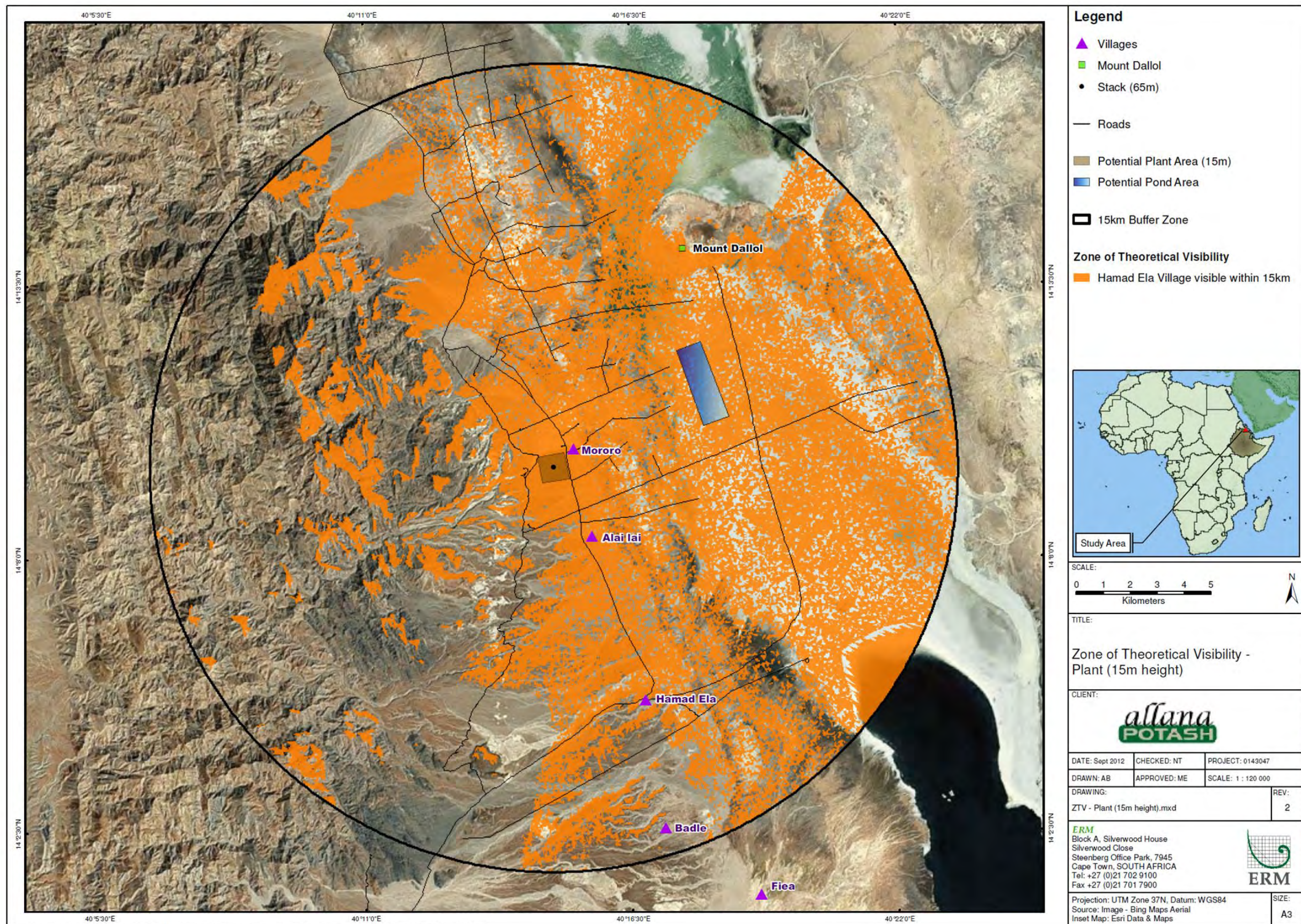
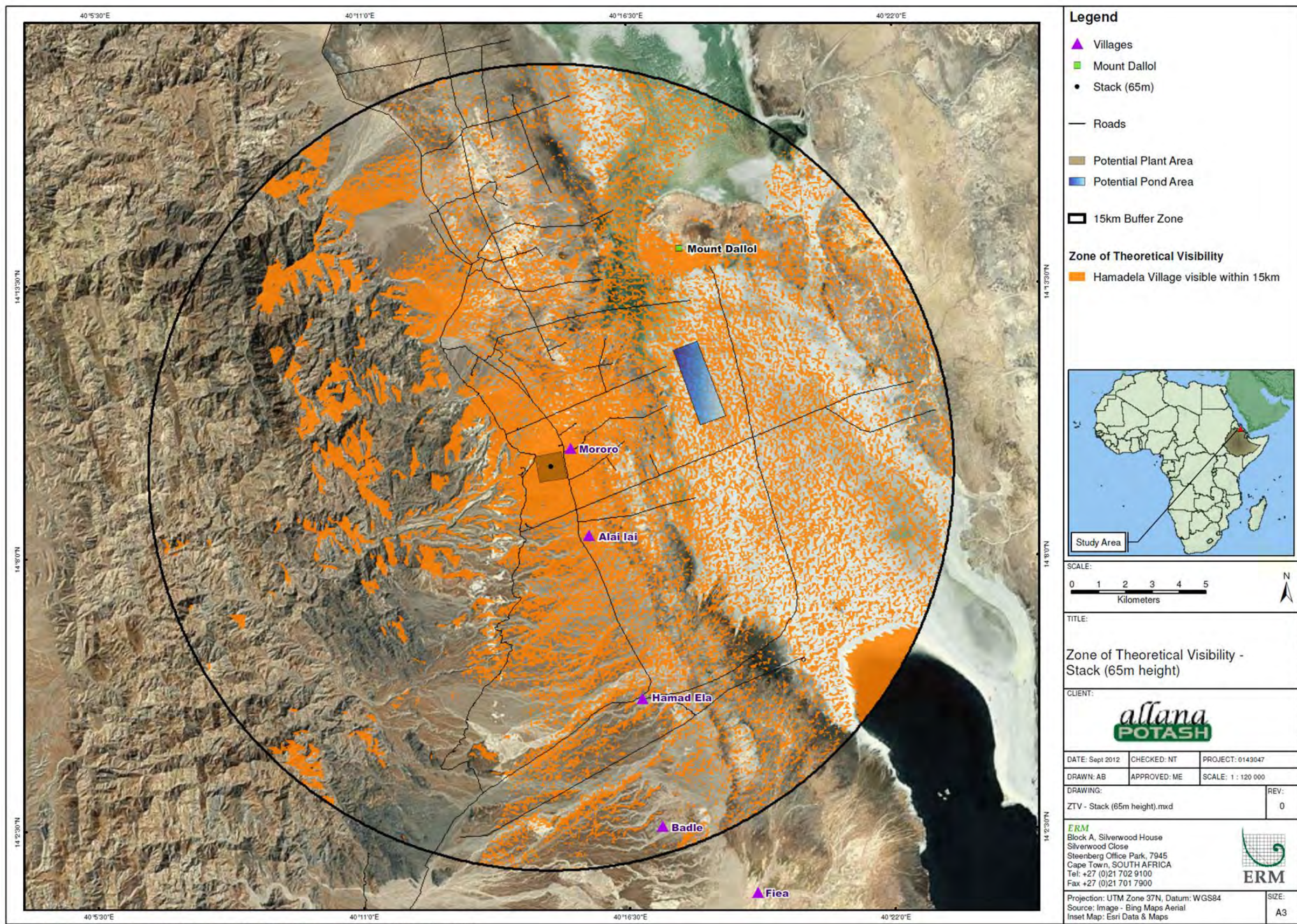


Figure 9.61 Zone of Theoretical Project Visibility - Stacks



9.10.1

National Context

Ethiopia has a largely agrarian economy and agriculture accounts for 47.7% of the GDP (World Bank, 2012). Agriculture employs approximately 80% of the working population and accounts for approximately 90% of exports. Industry accounts for 14.3% with manufacturing and services accounting for 5.2% and 38% of the national GDP respectively (World Bank, 2012). The sales and services sector is the second largest employer in Ethiopia.

Over the past six years the Ethiopian economy has been on a high growth trajectory, continuing strongly into 2011. Growth has been broad-based, with the services and the manufacturing sectors growing at faster rates than any other sector. The AfDB indicates that this growth momentum is expected to continue into 2012 and 2013. Ethiopia's five year GTP focuses on agricultural transformation and industrial development as the key drivers of growth (African Economic Outlook, 2012).

Nevertheless, Ethiopia still displays some of the lowest economic productivity figures in the world with per capita gross national income (GNI) in 2010 of USD 380 ⁽¹⁾, ranking 206th out of 215 countries. This is comparable to nations such as Guinea and Niger with GNI values of USD 380 and USD 360 respectively.

Regional Context

The Afar region is predominantly pastoral with approximately 90% of people depending on subsistence livestock production. However livestock productivity is reported to be rapidly declining due to recurrent droughts and land degradation, particularly in Zones 1, 2 and 4 (Philbott et al., 2005). Camels and goats are more resilient to harsh environmental conditions and these are reported to be more common in the particularly drought ridden and unproductive areas.

In herding their livestock, the Afar use a team of people termed *Eddo* to monitor the state of the rangeland before allowing herds to use it, and to guide the movement of people and their herds. The movement may not involve the entire household and certain family members may remain sedentary throughout a year or succession of years (Tefay and Tafere, 2004).

In the southern Zones of the Afar region, agro-pastoralism (after traditional mobile pastoralism) is increasingly significant. The Awash River basin and the Mile River basin have been used for large scale mechanised farming, predominantly by the Ethiopian government and individual private investors. Common crops include cotton, sorghum and vegetable production. Although

(1) World Bank, 2010 - GNI per capita is calculated using the Atlas method. GNI calculated in national currency is converted to USD. To smooth fluctuations in prices and exchange rates, a special Atlas method of conversion is used by the World Bank. This applies a conversion factor that averages the exchange rate for a given year and the two preceding years.

large-scale farms have created employment opportunities, the involvement of the Afar is reported to be low and much of the workforce and profits are reported to leave the area.

Changes in livelihood activities have also been noticed in northern Afar where many Afar have shifted away from pastoral livestock production systems to selling charcoal and firewood. This shift from the typical livelihood of mobile or semi-mobile pastoralism is reported to be due to the combined effects of human and climatic (drought) pressures (Tesfay and Tafere, 2004).

9.10.2 *Local Livelihoods and Occupations*

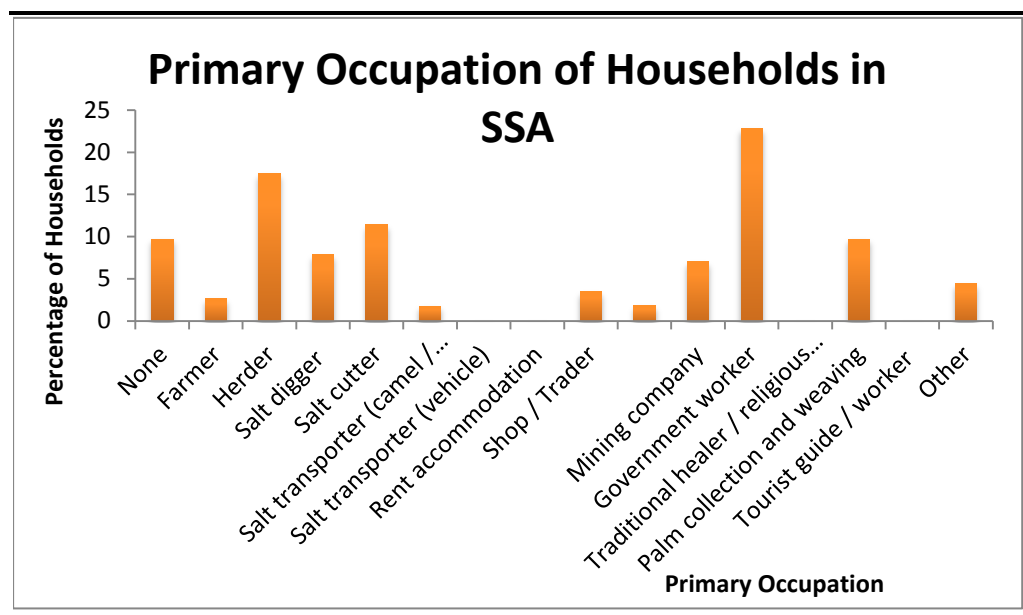
According to the results of the household survey, and as illustrated in *Figure 9.62* the primary occupations ⁽¹⁾ among households in the SSA include working for the local government (22.8%), the salt trade (21%) and livestock rearing (17.5%).

As expected, the majority of government workers are found in Berahale Town, given that the *Woreda* offices are located there. Cutting salt is the most common primary occupation of households involved in the salt trade, followed by digging salt. Only 1.8% of households surveyed were involved in the transportation of the salt. The household survey was conducted in May nearing the end of the salt trade, and when the number of salt trade workers is lowest. In particular the majority of diggers and transporters (referred to locally as *Arho*) migrate from the highlands to work in the salt trade and will have returned to the highlands by May / June indicating the lower numbers.

Almost 10% of household heads surveyed reported no primary economic activity, and at the time of the survey none of the respondents were involved in renting accommodation or tourism related activities as a primary occupation.

(1) A primary occupation is an occupation where the majority of regular income is derived and / or time is spent, and as determined by the respondent. Secondary occupations are practiced in conjunction with or to supplement primary occupations.

Figure 9.62 Primary Occupations of Households Surveyed



Source: ERM Household Survey, (2012)

As a result of the baseline data collection activities it is apparent that there are distinct gender divisions within the livelihood roles of Afar men and women in the Study Area. Men are involved in the main artisanal salt mining, fetching firewood and some were reported to work for companies in the area as labourers and guards. During FGDs women reported that they were typically involved in palm (*eungwa*)⁽¹⁾ collecting and the creation of woven palm products including *selen*⁽²⁾. In some areas women are also involved in small scale trade and the (small scale) salt mining industry. Small scale salt mining takes place along the peripheries of the salt flats, and is mainly conducted by women in the villages of Mororo, Alai lai and to some extent Hamad Ela. Women in the FGDs indicated that the salt is collected by hand and is mainly used for household consumption, with some being sold to neighbouring households and salt trade workers that pass by. It is acknowledged that in Afar culture, women are not allowed to partake in the main salt trade (digging, cutting or transporting), and therefore small scale salt mining is a woman's only means to access salt in the area, and derive a potential income from it.

From discussions in the field it was reported that women tend to work longer hours than men (with women working up to 13 hours a day in comparison to an average of seven hours for men). Longer hours for women are due to carrying out domestic duties, in addition to involvement in palm collecting and processing (further detail included in the *Palm Collecting and Processing* section).

(1) Local Afar term for palms grown in the area.

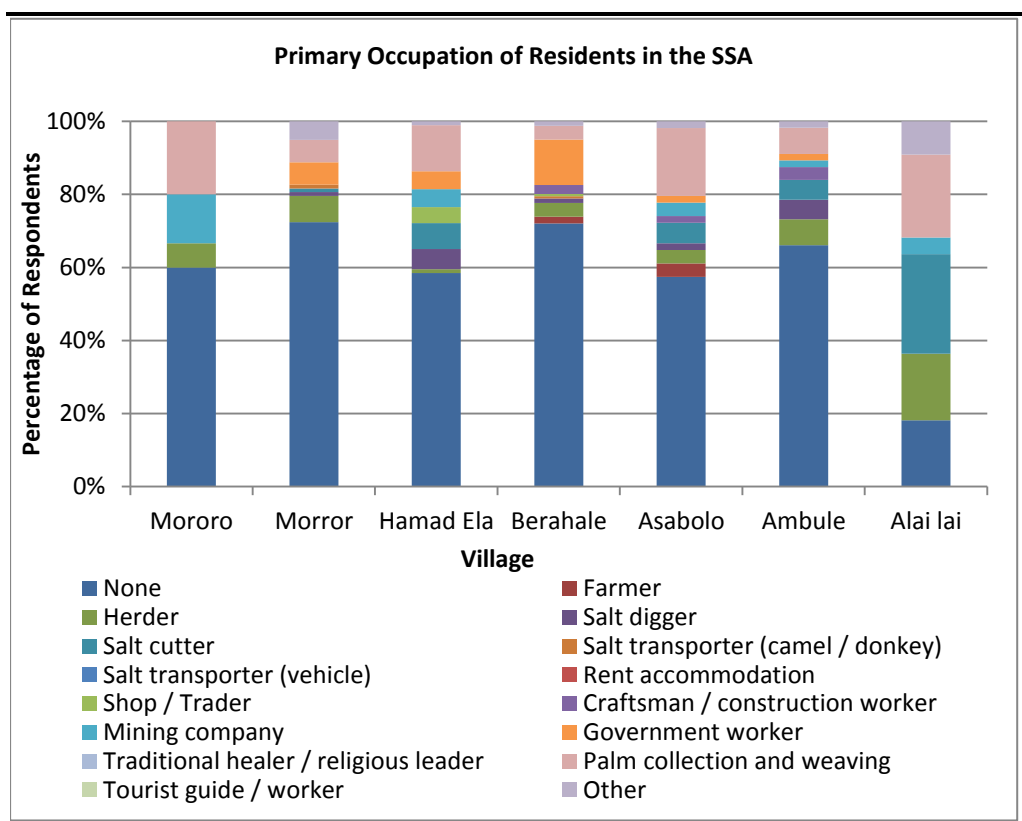
(2) A type of woven mat material made from the fibres of a palm shrub that grows in the area.

Figure 9.63 shows that the key economic activities conducted by all respondents captured in the household survey are palm collection and processing, artisanal salt mining, working for the government and herding livestock.

All of the villages in the SSA are involved in palm collection and weaving, with a total of 9.6% of people involved in the activity. Hamad Ela had the highest number of people involved in palm collection and weaving followed by Asabolo, Morrор and Berahale. However of the total number of people surveyed per village, the villages with the highest percentage of people involved in the activity were Alai lai, Mororo and Asabolo. Involvement in the salt trade was the second most common livelihood in the SSA. A total of 36.8% of households surveyed stated that they or someone in their household was involved in the salt trade. Of this group more than half (57.8%) were salt cutters, 37.8% were diggers and 4.4% were members of the *Arho*.

Although 6.3% of respondents worked for the government in the SSA, it is worth noting that 54.1% of these were located in Berahale. Excluding Berahale, working for the government would rank as the fourth most common livelihood (rather than third) in the SSA. Livestock is the fourth most common economic activity in the SSA accounting for 4.4% of people surveyed. Alai lai, Ambule, Morrор and Mororo had the highest number of people involved in livestock rearing as their primary occupation at 18%, 7.1% and 6.7% respectively.

Figure 9.63 Primary Occupations in the Social Study Area



Source: ERM Household Survey, (2012)

Of the households surveyed, 27.2% were involved in a secondary occupation. The most common secondary livelihood activities were herding livestock (39%) and cutting salt (23%). The results of the household survey indicate that the two livelihood activities are the most common and interchangeable in the Study Area. The majority of salt cutters (61.5%) were engaged in a secondary occupation, the most common of which was herding livestock. Similarly 60% of people who herd as a primary occupation also engage in a secondary occupation, and 25% of herders are salt cutters as a secondary occupation.

Although tourism related activities and renting accommodation did not feature as primary occupations, 9.7% and 3.2% of people involved in secondary occupations engaged in these livelihood activities. All of the people involved in tourism as a secondary occupation lived in Hamad Ela, and their primary occupation was either working for the government or involvement in the salt trade.

Qualitative information regarding the perceived importance of livelihood activities was also gathered through a livelihood importance matrix to support the quantitative identification of key livelihoods in the SSA. FGD participants were asked to identify and prioritise their main livelihoods and economic activities, ranking their significance in terms of income, subsistence, and cultural value. Results of the livelihood ranking activity are shown in *Table 9.16*.

Table 9.16 *Livelihood Importance Matrix*

Value to Household*					
Activity	Income	Subsistence	Cultural Value	Total	Combined Rank
Artisanal Salt Mining					
Men	5	5	5	15	29
Women	4	5	5	14	
Livestock					
Men	3	3	-	6	15
Women	5	4	-	9	
Mining Companies					
Men	1	-	-	1	2
Women	-	-	-		
Palm Collection and Products					
Men	4	4	-	8	19.5
Women	3.5	4	4	11.5	
Tourism					
Men	2	-	-	2	4
Women	2	-	-	2	

Source: ERM Household Survey, (2012)

**Livelihood significance was ranked on a numerical scale of 1 to 5, with 1 being least significant and 5 being most significant.*

It is important to note that all the livelihood activities identified to be important for subsistence were not direct 'hand to mouth' subsistence, but

rather activities that were identified to be key for the daily survival of a household in terms of income generated to purchase subsistence items including food, water and clothing requirements. This is significant given that agricultural production in the area is low (due to environmental conditions) demonstrating the significance of income generating activities to allow for the purchase of food.

Artisanal salt mining was identified as the most important livelihood from an income generation and subsistence perspective, in addition to its cultural value for the local Afar people. Both men and women ranked artisanal salt mining as the most important livelihood for subsistence, identifying it to be a reliable source of revenue to purchase basic subsistence items. Men also ranked artisanal salt mining as the most important livelihood from an income generating perspective i.e. the livelihood that the ability to generate the highest level of income. Women ranked livestock as most important for income generation.

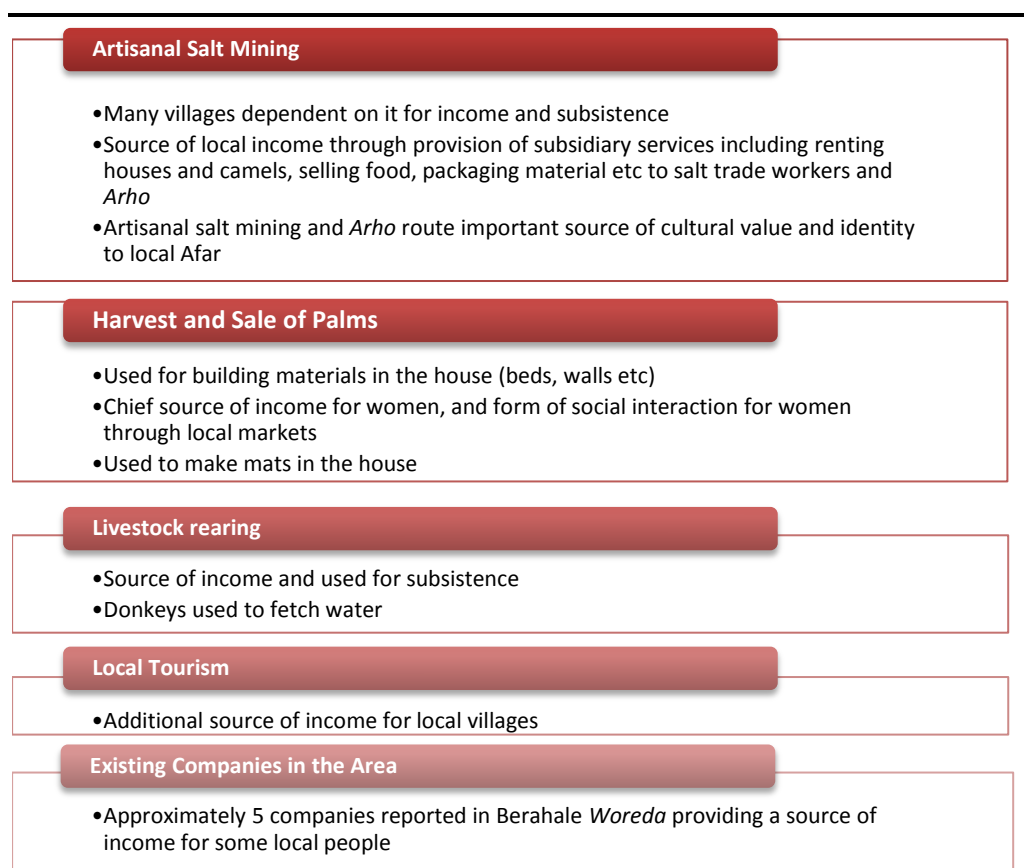
There was general agreement across FGDs that livestock are a key source of financial capital, and generate a considerably higher cash income than other activities. Livestock were also viewed as the only form of savings available for many households. Women have more involvement with livestock rearing activities compared to artisanal salt mining, which may explain the higher importance of livestock rearing for income amongst women compared to men's perception of it.

Collection of palms and sale of palm products was identified as the second most important livelihood activity. Men and women identified it as being equally important from a subsistence perspective (due to the ability to generate household items and sell the items for money to buy food); however, women ranked it slightly lower for income generation. Working for a mining company and tourism ranked lowest; however, women did not rank working for a mining company as they identified it to be irrelevant.

The low ranking for tourism may be related to the fact that of those surveyed only a few were involved in related activities as a secondary occupation. In addition only one FGD with youth was able to be conducted, and it is the youth on the whole that engage in tourism related activities in the area by working as guides.

The FGD participants also explained the importance of each economic activity. The results of the discussions are summarised below in *Figure 9.64*.

Figure 9.64 Importance of Local Livelihoods



Source: ERM Household Survey, (2012)

Table 9.17 is a representation of the seasonal calendar developed by participants during FGDs. Key livelihoods and their occurrence during the year are illustrated, in addition to other significant events.

The seasonal calendar illustrates the extent to which the wet and dry seasons dictate the timing of the *Arho* ⁽¹⁾, the salt industry and the interrelated economic activities. The artisanal mining of salt, reliant on the movements of the saline lake (Assale) for the replenishment of salt, ceases during the dry months when the heat can be extreme (in excess of 50°C).

Sensitivity to the changes in the salt trade in Hamad Ela is illustrated by the food shortages the village experiences at the beginning of the salt season. Residents in Hamad Ela indicated that they experience food shortages following the arrival of the *Arho* (in September) due to the influx of people, and the resultant increased demand for food and limited supply (all of Hamad Ela’s food requirements are met by shops importing food mainly from Berahale). Residents noted that as the months progress (from September onwards) food supplies adjust to meet the increased demand. During the

(1) In Afarigna means camel caravan but commonly used to refer to the transportation aspect of the salt trade including the caravans.

hottest months (May through to August) residents that can afford to move will relocate towards the highlands in search of cooler temperatures.

Table 9.17 Seasonal Calendar

Activity	January	February	March	April	May	June	July	August	September	October	November	December
Rainy season												
Dry season												
Salt Mining (cutting, digging, transportation)												
Tourism												
Palm collecting												
Sale of palm products												
Food shortage												
Malaria, dysentery, measles												

Note: From the month of May the salt trade and associated activities start to decline

Small Scale Cultivation

The cultivation of crops was not mentioned during FGDs or widely observed as a significant livelihood activity in villages close to the salt flats. The only villages that were observed to be involved in small-scale cultivation were Asabolo and Ambule, made possible by their proximity to the seasonal Sabah River. *Figure 9.65* show tomatoes being grown in the village of Asabolo, and land cleared for cultivation in Ambule.

The household survey shows that the majority of households involved in agriculture were found both in Berahale and Asabolo, and two households who reported to be involved in agriculture were located in Ambule. It can be assumed that the latter two households are involved in agriculture on land closer to the Sabah River. A total of seven households were involved in agriculture accounting for 6.7% of respondents.

The majority of households involved in agriculture cultivate maize (66.7%), palm fruits (16.7%) and identified that they owned / inherited the land on which they cultivated crops.

Small scale cultivation is not a key economic or subsistence activity due to the extreme temperature and saline environment close to the Study Area. This means that almost all subsistence items (particularly for the villages closer to the salt flats) are required to be imported into the area and / or purchased. A third of the households that are involved in small scale agriculture are reliant on the crops entirely for subsistence. The remaining households (66.7%) sell between 15 to 75% of their crops and will receive between ETB 100 to 550 (USD 5.60 – 30.60) a year.

Figure 9.65 *Small Scale Cultivation in Asabolo (left) and Ambule (right)*



Livestock and Pastoralism

The household economy of the Afar is typically based on the raising of livestock; cattle, camel, sheep and goats for subsistence (*Figure 9.66*). The Afar typically split the responsibility for pastoral stocks into several groups. Goats (*bokole*) are generally tended by young children close to the centre of the village, immature livestock flocks including kids and lamb (*rihid*) are tended by older boys and girls at further distances from villages, and adult goats (*kada*

wodar) or other livestock are tended by the eldest boys and girls at the furthest distances from the village (Tesfay and Tafere, 2004).

Women are also involved in livestock related activities; overseeing the children who graze the livestock, and guiding where they graze. Pastoralism and the raising of livestock is often cited as intrinsically linked to the socio-cultural status and identity of the Afar; with the size of a herd representing wealth and status. However, despite the cultural link to pastoralism the environmental conditions around the Study Area mean that large-scale cultivation of livestock is not possible.

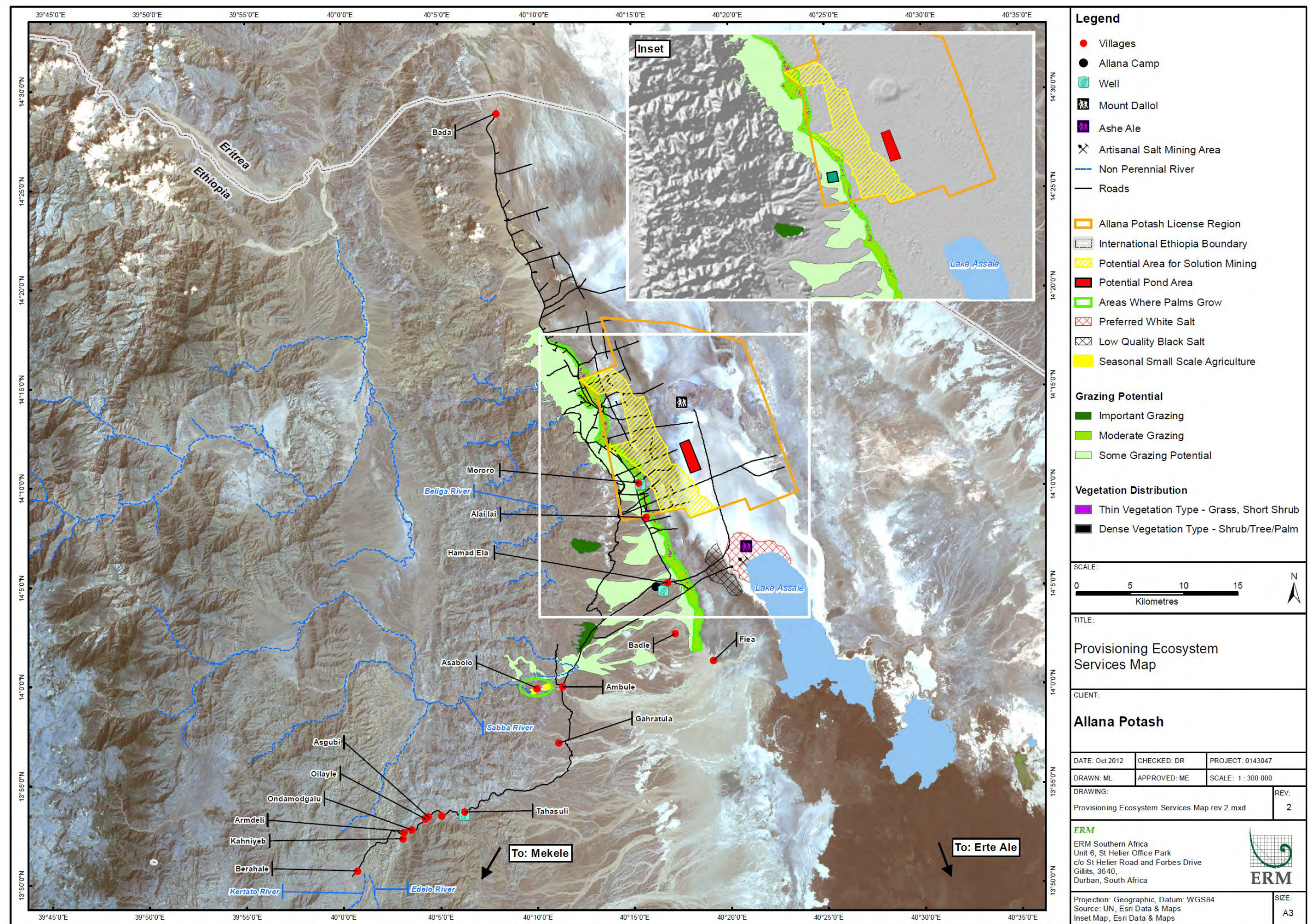
Figure 9.66 *Goat Herding*



The area surrounding Allana's concession consists, to a large extent of a harsh and inhospitable environment, and low annual rainfall means that minimal natural pasture is available. Livestock feed on the available shrubs and bushes. Available vegetation does increase as the altitude rises; however, fodder for livestock is still reported to be scarce. The areas in which villages graze their goats is shown in *Figure 9.67*, in addition to other key natural resources and provisioning ecosystem services ⁽¹⁾ in the area.

(1) As part of the wide range of benefits people obtain from an ecosystem, provisioning ecosystem services are products obtained from ecosystems, including food, fibre, fuel.

Figure 9.67 Provisioning Ecosystem Services in the Social Study Area



Livestock normally graze on land in closer proximity to the village however depending on the availability of vegetation, herders may travel further afield. As the altitude rises there are higher densities of shrubs, bushes, and woody vegetation and the occurrence of browsers (such as goat and camel) are observed in higher numbers. Cattle, typically the highest status animals in Afar society, are less resilient to drier environments and are rarely observed in the SSA. This is supported by the results of the household survey, where only a total of eight cattle were reported to be owned by the surveyed households compared to 495 goats and 34 donkeys (the most numerous livestock).

There is also a common understanding among the villages as to where each village / household can graze their livestock, and it is usual among the Afar to share resources which includes the use and access to land for grazing. In particular the villages of Mororo and Alai lai identified that they had moved several times due to the decline in available pasture, and were able to access different pastures due to the sharing of resources and land by the Afar. In addition respondents noted that villages will allow access to their resources including water and grazing land if another village is facing difficulties due to decreased availability of resources.

Of the 114 households surveyed across the seven villages, 45.6% stated that they owned livestock. *Table 9.18* shows the percentage of households surveyed in each village that own livestock. Mororo and Asabolo had the highest percentage of households that own livestock, with all of the households surveyed in Mororo owning livestock.

Table 9.18 *Livestock Ownership in the Social Study Area*

Village	Percentage of Households in each Village Owning Livestock
Berahale	48.1%
Hamad Ela	22.5%
Mororo	100%
Morrer	68.4%
Ambule	30%
Asabolo	81.8%
Alai lai	50%

Source: ERM Household Survey, (2012)

The majority of the households that owned livestock owned goats (82.4%) and donkeys (61.5%). None of the households in the SSA owned poultry, reportedly due to the harsh climatic conditions. Although the Afar are commonly linked to their ownership of camels only 15.4% of the households with livestock owned camels. Asabolo had the highest number of sheep anecdotally recorded during the baseline data collection activities. The ownership of sheep is likely related to the cooler climate in which the village is located, the higher presence of vegetation and availability of water (Sabah River).

On average households use 77.2% of their livestock for subsistence purposes and only 10.3% will be sold for income. Of the households that sell livestock, in a good month households will receive on average ETB 38 and ETB 70 (USD 2.1 and USD 3.9) for the sale of meat and skins and dairy products. This can decrease down to ETB 19 and ETB 22 (USD 1.1 and USD 1.2) in a bad month.

Artisanal Salt Mining

Artisanal salt mining in the SSA is based on the salt flats located north of Lake Assale. Salt is created from the annual patterns of water flow and subsidence from the hyper-saline Lake Assale. *Figure 9.68* shows Lake Assale.

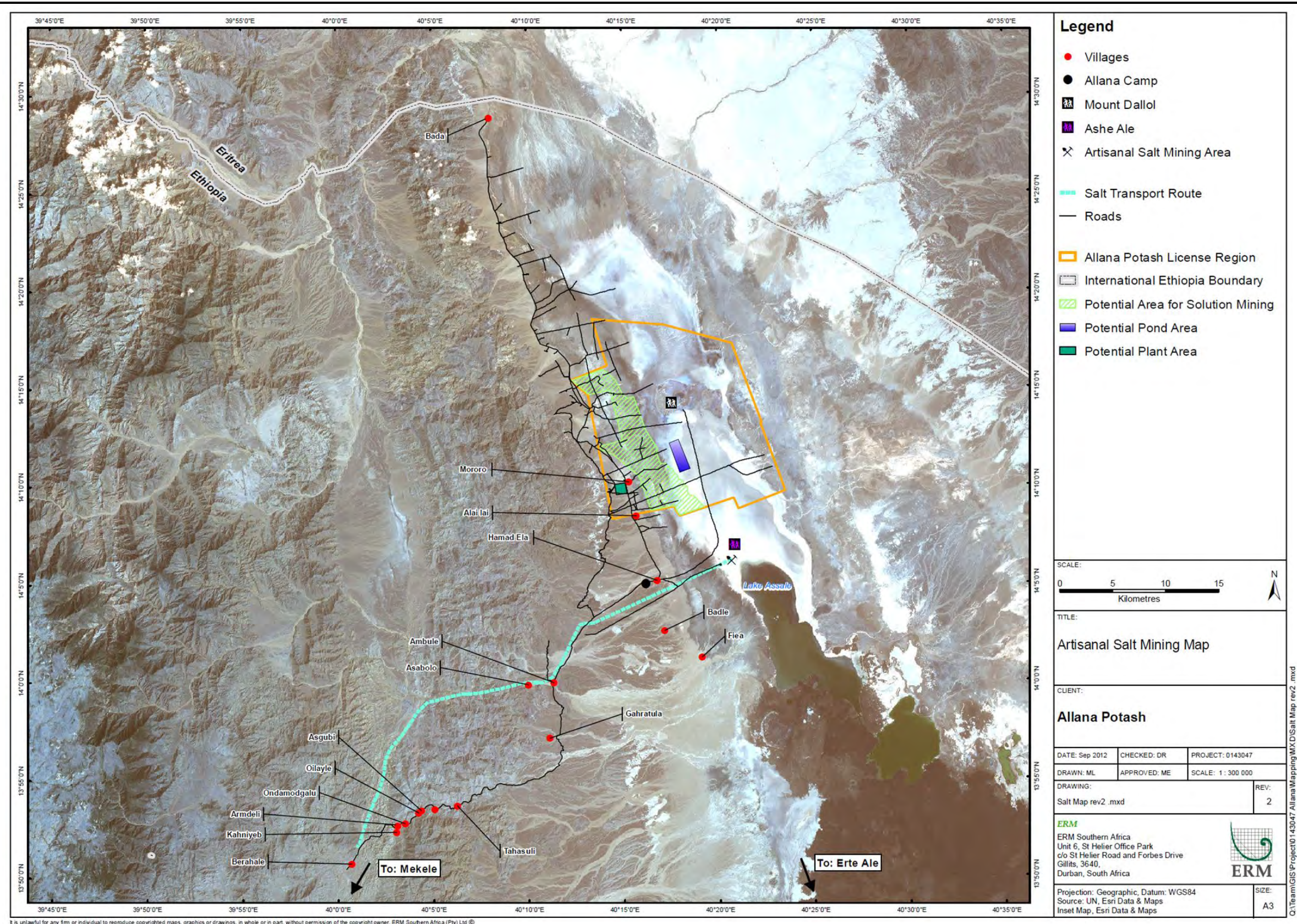
Figure 9.68 *Lake Assale*



During the wet season the flow of water into the salt flats increases the size of the lake, submerging the salt cutting areas. As this water evaporates it replenishes and 'cleans' the salt stocks.

The salt mining season extends between September and July, and is dependent on the retreat of the water from Lake Assale. During the wet season (July - end August) the high temperatures on the salt pan (50 to 60°C) makes salt mining impossible. Literature sources and local people in the area reference a variety of dates from which the artisanal salt mining and trade began; however, it is widely acknowledged that it is an activity that spans several centuries, geographic locations and ethnic groups. *Figure 9.69* illustrates the location of salt resources and where the salt trade begins along with the transport routes including the villages through which the *Arho* pass.

Figure 9.69 Salt Resources and Salt Trade in the Social Study Area



The distances that people travel to be involved in the salt trade is a reflection of its significance in the northern Ethiopian salt industry. Salt cutters are reported to travel for considerable distances to work on the flats, and travel from the Woredas of Afdera, Dallol, Koneba, and Aba Ala to do so. Diggers are reported to come from a variety of places including the Woredas of Dallol, Koneba, Berahale, Aba Ala, Erebeti, and regions of Tigray and Amhara. The majority of the camel owners are reported to originate from the Tigray region (including Raya in particular).

Artisanal Salt Mining as a Livelihood

Artisanal salt mining was reported to be the most significant livelihood in the area and is a principal source of income for local residents. At the time of the household survey 36.8% of households had one or more people involved in the salt trade either engaged in digging and/or cutting salt blocks, or the transportation of salt.

People involved in the salt trade work for a varying number of months, with salt cutters and diggers working for approximately the same amount of time (6.3 and 6.1 months respectively). A salt cutters time ranged between two to 10 months, and a salt diggers time ranged between two to nine months.

Salt transporters (via camel) are involved in the salt trade for an average of three months of the year, and are the only group to work in the salt trade one month of the year. Several participants in FGDs reported that it is common for the majority of transporters to migrate from the highlands making several journeys back and forth and usually balance two livelihoods: one in the Danakil and another in the highlands, thus potentially explaining the fewer number of months transporters were identified to spend in the salt trade.

When the duration spent working in the salt trade is compared to income received from involvement there is a direct correlation; transporters were recorded to have the lowest income, and cutters the highest (*Figure 9.70*).

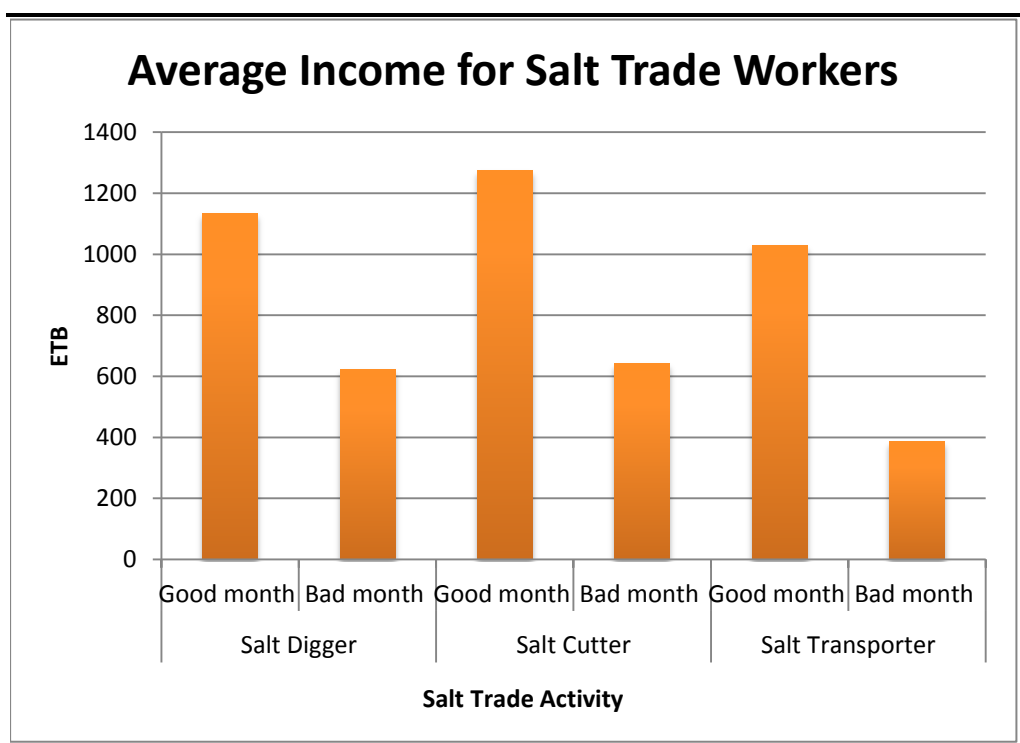
On average a salt cutter will earn more than a transporter or digger in both a good and bad month ⁽¹⁾. *Figure 9.70* shows that of those captured in the household survey a salt cutter can earn between ETB 100 to 4,000 (USD 5.6 and USD 222.2) in a good month. In a bad month this ranges between ETB 50 to 2,000 (USD 2.8 and USD 111.1). On average a salt digger will earn ETB 1,134.7 (USD 63.0) in a good month and ETB 623.1 (USD 34.6) in a bad month. The maximum amount a salt transporter was reported to earn in a good month is ETB 5,000 (USD 277.8), earning on average ETB 1,028.6 in a good month. In a bad month transporters earn an average of ETB 286.0 (USD 21.4).

As indicated previously the lower income for a salt transporter is reflected in the shorter duration a transporter is likely to work in the salt trade. In addition

(1) A good versus bad month were not defined by the ERM survey team, but rather defined according to what a household survey respondent identified to be a good or bad month.

a transporters' income ranges the most between a good and bad month, in comparison to a salt cutter whose income will range the least between a good and bad month.

Figure 9.70 *Income from the Salt Trade Activities across Good and Bad Months*



Source: ERM Household Survey, (2012)

It was reported in Berahale that the sector is growing; however, anecdotal evidence indicates that camel shortages (reportedly due to sale of camels to traders in Sudan) and shortages in fodder are understood to be reducing the outputs of the salt trade. This is further supported by the perceptions of salt trade workers captured in the household survey. Of the households involved in the salt trade the majority (80.5%) stated that the activity had shown a decline in the past two years.

The Salt Mining Process

On the salt flats the work is organised along ethnic divisions; the Tigray group are typically responsible for digging out the salt, referred to as *fucolo*. The Afar are the only ethnic group responsible for cutting and preparing salt blocks. Several respondents stated that this has been strictly adhered to from the beginning of the salt trade; it is a means through which the Afar can maintain their salt cutting skills passing it on from father to son; and the Afar state that it is their inherited right to mine the salt ⁽¹⁾.

The stages of the salt trade are shown in *Figure 9.71*.

(1) The direct translation from Afarigna to English is "blood price".

Figure 9.71 Stages in the Production and Transport of Salt Blocks



* Source: Frank Janssens, (2012)

Salt cutters receive direct orders from transporters and partner with diggers establishing a relationship to serve the orders or 'contracts' from transporters. Cutters reported that they only work to orders placed by transporters and will not usually cut additional blocks unless an order (at an agreed price) has been placed in advance.

The strenuous nature of *fucolo* requires diggers to work in groups of three, with the capacity to load up to 40 camels per day. The diggers are reported to charge approximately ETB 14 (USD 0.8) for one camel load and agree fees in advance. Although some Afar do work as diggers the task is predominantly carried out by Tigreans or other groups who have migrated into the area.

Salt blocks are cut and shaped into either *gollo* (large) or *gareweny* (small) stated in Berahale to cost ETB 19 and 14.5 respectively (USD 1.1 and USD 0.8), and on the flats stated to cost ETB 3.0 and 2.0 (USD 0.2 and USD 0.1) respectively. Note that these prices may vary according to seasonality, quality of salt, colour and texture.

The highest quality salt is considered to be the most 'unpolluted'; that salt that has no grit or dirt mixed into it, and is judged by its white colour. During FGDs respondents identified that there are clear areas for 'black' salt where cars are allowed to drive over, and 'white' salt (*Figure 9.69*) that cannot be disturbed or polluted, and are key to the salt mining. On the salt flats salt cutters charge ETB 2.5 per small block and ETB 3 per large block (USD 0.1 and USD 0.2), and on average a cutter will cut up to 400 blocks per day.

Figure 9.72 shows some of the tools commonly used by salt cutters and a salt block.

Figure 9.72 Salt Cutting Tools



The transporter is responsible for paying both the salt cutter and digger. Transporters may be the camel owners themselves but are also reported to rent camels from camel owners to take down into the Danakil. *Figure 9.73* illustrates some of the salt producing and transporting processes.

Figure 9.73 The Artisanal Salt Trade at Assale, South of the Study Area



Source: Hickman (2011), Allana Potash Corp.

A camel typically holds between 16 and 30 blocks although 20 is the average number. Every laden camel that leaves Hamad Ela must pay a tax of ETB 25 (USD 1.4) and a donkey must pay a tax of ETB 13 (USD 0.7). The *Woreda* administration collects these taxes and 70% is allocated to the central Federal Government, and the remaining 30% is allocated to the *Woreda* Government.

Once loaded, the camels will begin their journey back to the salt warehouse in Berahale. The journey will take approximately two to three days by foot with the *Arho* stopping over at villages along the way. The salt transportation route is key for some of the villages in the SSA including Asabolo and Asadege, and villages located in the mountain range through which the *Arho* and tourists pass. Villages along the route of the *Arho* provide food, salt packing materials and accommodation. The *Arho* are a key customer for the local women who sell them *selen* and ropes. The *Arho* route is shown on *Figure 9.69* and is closely linked to the transportation of palm products to the Berahale market, and the tourist route. The trade of goods and services extends from Hamad Ela to Berahale. Apart from the obvious sale of goods and services it is also common, for instance, for women in Berahale who own a restaurant or hotel to have sons working on the salt flats. A mother will reportedly give a salt trade worker a discounted rate if he agrees to carry water down to the salt flats for her son.

Upon arrival in Berahale, salt will be recorded and sold at the Salt Selling Associations warehouse. The salt is then stored at the warehouse until it is transported out of Berahale by truck to other regions of Ethiopia.

The Berahale Salt Selling Association

Based in Berahale the Salt Selling Association administers the salt traders and transport from Berahale to other destinations. A private organisation established in 2010, the Association is reported to have no support from government and is stated to be the first regional cooperative in Afar. A member of the Management Committee reported that the Association is worth approximately ETB nine million (USD 500,000) in capital, turning over approximately 20,000 blocks per annum (which can be estimated to be worth approximately USD 1,500 to 2,000). The minimum input to buy into the Association is ETB 1,000 (USD 56) and a maximum recorded input of ETB 10,000 (USD 560); however, membership has been closed for approximately six months from late 2011.

Profits from the cooperative are divided amongst shareholders every three months dependent on financial input into the Association. The Association is made up of approximately 3,700 members who must be based in Berahale *Woreda* and must be familiar with the rules and regulations of the salt trade (as defined by the Association) to join. Significant decisions are taken through a democratic voting system where members with higher contributions to the Association have a higher percentage stake. The Association is managed by a Management Committee whose members are first nominated and then

elected. The Committee and the Association are administered by a formalised series of laws and regulations, and is audited by auditors in Mekele where their funds are banked.

Shares and stakes in the Association are inherited as designated by the deceased. There are reportedly no gender restrictions on membership of the Association; however, based on assumptions regarding the socio-economic status of women, they generally do not have access to significant funds or income generation opportunities to save sufficient funds to join. The founder of the Association, who is a woman, noted however that for women who are members (mostly in Berahale) it has fundamentally changed their household saving habits and access to money. Female members are able to access and manage money more efficiently, which is uncharacteristic in rural Afar areas. In some cases the founder reported that women have opened bank accounts as a result of joining the Association. A considerable proportion of the members are based in Berahale, and in Hamad Ela it was reported that approximately 10 to 15 people are members of the Association. The restrictions for joining were reported to be shortages of savings and insufficient income to save.

Protection of the Artisanal Salt Trade

Prior to the establishment of the Association salt was allowed to travel straight out of the local area to Mekele and beyond. Since its formation the Association is able to control the movement, and to some extent production of salt. Mekele is a key destination for the salt, and the Selling Association negotiates prices with the Buying Association (formed of approximately 80 buyers in Mekele) prior to its transportation to Mekele. Vehicles are prohibited from transporting the salt directly from the salt flats but are allowed to transport salt from Berahale to the highlands via truck. The founder of the Selling Association reported that trucks had been introduced to transport the salt from its source; however, this mode of transport had been rejected by several groups as the services (food, accommodation etc.) provided by the villages would be lost, the operation of the *Arho* would cease and according to the founder the trucks would pass straight through Berahale without stopping, rendering the Selling Association redundant. However recent developments in the area from other exploration companies have caused some changes to the accessibility of the salt flats. This includes a road and drill pad that has been constructed and, at the time of writing, not rehabilitated, and has the potential to encourage vehicles to travel all the way to the edge of the salt mining area.

Maintaining the use of donkeys and camels for transport to and from the salt plains appears to be a conscious decision by the Afar people, in addition to the Tigray transporters as a means to maintain control over the salt industry. There appears to be awareness that many Afar do not have the knowledge, capital, experience or maintenance skills to recruit a fleet of trucks to transport the salt and mechanised transport would mean that they would be removed from the economic chain. In addition, the use of camels maintains tourist interest in the area and increases income for small shops, hotels and bars. Further self-protection measures include the 'salt mining rules' that explicitly

state that Ethiopians of other ethnic groups are prohibited from the salt cutting activities, and the rejection of attempts to mechanise the local salt production. According to local respondents previous attempts to introduce semi-mechanised systems, such as pumping saline water from the lake to evaporation ponds for a project funded by entrepreneurs from Mekele (refer to *Figure 9.74*), were fiercely rejected by both the local villages and local government, and the activities were stopped.

Figure 9.74 *Previous Semi-Mechanised Salt Projects (pumped saline pipeline to evaporation ponds)*



There is general agreement among local people, and a fear that Lake Assale and the artisanal salt mining should not become 'like Lake Afdera' where salt is mechanically produced, and has been an area of common conflict over both water and salt.

Subsidiary Services

The salt trade is key to the sustainability of the subsidiary services such as the provision of food, salt packing materials and accommodation to Tigray and Amhara migrants. It has established a considerable service sector within Hamad Ela which is fuelled further by tourism. Approximate prices for food and accommodation were stated to range from ETB 40 to 50 (USD 2.2 to 2.8) per day dependent on the desire to consume meat with injera or vegetables). Hamad Ela, a stop-over point for salt traders and tourists, displays a considerable number of structures disproportionate to its reported population and multiple shops and restaurants, not observed in the surrounding settlements. Previously it was common for Afar residents to rent out houses to the *Arho* during the salt trade season providing a source of income for the Afar in Hamad Ela. However several participants of the FGDs in Hamad Ela stated that *Arho* members are increasingly 'reserving' land to build houses rather than rent from local Afar residents.

In addition to the larger scale salt mining, small scale salt mining by women in Mororo and Alai lai is also conducted (Section 9.10.2).

Palm Collecting and Processing

Hyphaene thebaica (commonly referred to as palms in this document, and locally referred to as *engwa*) are a local floral species that grow in the SSA. It was evident from field observations that the palms only grow in particular areas and are not widespread in nature; they grow along the muddy liminal areas of the salt flats (Figure 9.75).

Figure 9.75 *Palms in the Social Study Area*



The collection of palms and processing of palm fibres is a key livelihood in the SSA, and is *the* primary livelihood for local Afar women. Figure 9.76 shows a local Afar woman collecting palms, and Figure 9.77 shows an Afar women producing *selen*.

Figure 9.76 Local Afar Woman Collecting Palms



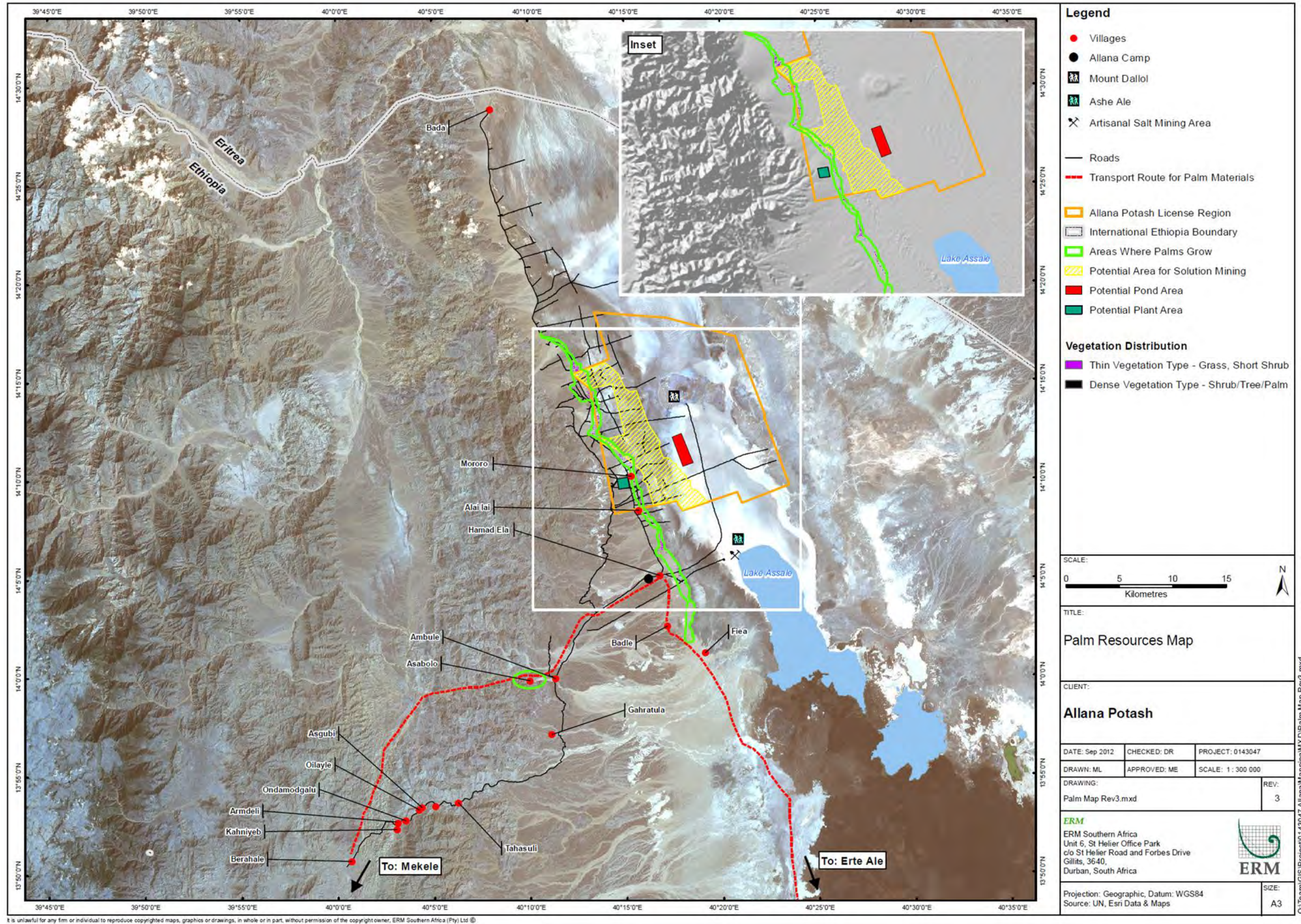
Men do not engage in palm collection and processing into products (apart from the construction of beds that rely on palm products). Women from other ethnic groups are also reported not to engage in the activity, and the livelihood is the principal means through which Afar women gain access to income and are able to support their household. The collection and processing of palms by Afar women is documented in other areas of the ANRS. In areas around the Awash National Park the palm has been reported to be the primary source of income for approximately 500 households (Flintan, 2008). In the same area groups of Afar women have put in place rules of use and temporary bans in order to conserve the resource.

Figure 9.77 Local Women Producing Selen



The areas in which the resource can be found are shown in *Figure 9.78*, which also shows that in addition to the specific areas in which palms are collected, routes have been developed that allow for women to travel between villages and access to markets. The palm routes are closely linked to the *Arho* route as salt trade workers are a key customer for the women. In addition women in the SSA are known to use the *Arho* as a means of transporting palm products. Women have also been observed transporting palm products using the camels from the salt trade on the road to Berahale.

Figure 9.78 Palm Resources in the Social Study Area



The majority of the women in the SSA collect the palms themselves from areas indicated in *Figure 9.78*, although it is important to note that women in Alai lai stated that they prefer to buy the palms from women in Hamad Ela. When this was queried the women stated that it was easier to buy the palms from Hamad Ela than collect the palms themselves.

Once collected the palm fibres are dried in the sun, and individual fronds are separated using a small wooden instrument. The individual strands are then braided together and arranged into thin strips which are then sown together to assemble larger mats / *selen*. The basic process through which *selen* is made is shown in *Figure 9.79*.

Figure 9.79 *Palm Collection and Processing*



Palm fibres are also processed into a variety of other products including ropes and brooms. The collection and processing is a traditional day-to-day activity for Afar women, and occupies a significant portion of a woman’s day. Women in the FGDs identified that the livelihood activity is not only important from an economic perspective, but also serves as a means for women to sit together and socialise. The products created are stylistically unique to the Afar including products such as *selen* and the Afar dome shaped houses. Afar women derive a sense of pride and identity from the livelihood.

The household survey results demonstrate that 59.8% of respondents are involved in making crafts, the majority of whom (94.2%) are involved in the production of *selen*. Other crafts made include palm fibre ropes (2.9% of households) and goatskin water bags (1.5% of households).

Women in the SSA have organised themselves into groups which form part of an informal institution termed *mehaber* in Amharic ⁽¹⁾. The majority of the women in the SSA are members of the *engwa mehaber* (palm association). Women who collect and process palms can become members of the *engwa mehaber* upon requesting to enter. However entry into the *mehaber* is largely determined by a woman's social connections. Usually monthly contributions are made by each member, pooled together and allocated to a different woman each month. It was indicated that certain amounts are set aside by a recognised / senior member of the *mehaber* and are used for times of emergency. Women are recognised for their skills within the *mehaber*, for instance women who are particularly skilled in dyeing and decorating *selen* are chiefly involved in production of the coloured *selen*.

Women commented that not all women have to participate in the *engwa mehaber*; however, participation translates into financial benefits, and women are able to receive support from other members when they are facing difficulties (financial, health etc.). The *mehaber* also serves as forum for women to discuss and solve any challenges that they are facing in the household.

Figure 9.80 *Example of Woven Palm Beds in Hamad Ela*



The products that are derived from palms that generate the highest income for women are indicated in *Table 9.19*. In a good month a household will earn on average ETB 239.4 (USD 13.3) from the sale of products, compared to ETB

(1) In Amharic *mehaber* means local association or organisation, traditionally formed for religious groups but the term has grown to include other social and economic functions

105.6 (USD 5.9) in a bad month. The income received from crafts ranges considerably both in a good month (ETB 40 to 500 approximately USD 2.2 to 27.8) and in a bad month (ETB 15 to 280 approximately USD 0.8 to 15.6). Women in the FGDs indicated that although they are the sellers of palm products, and buy the majority of items in a household, the man maintains control and ownership over income.

Table 9.19 *Income Generated via Palm Products*

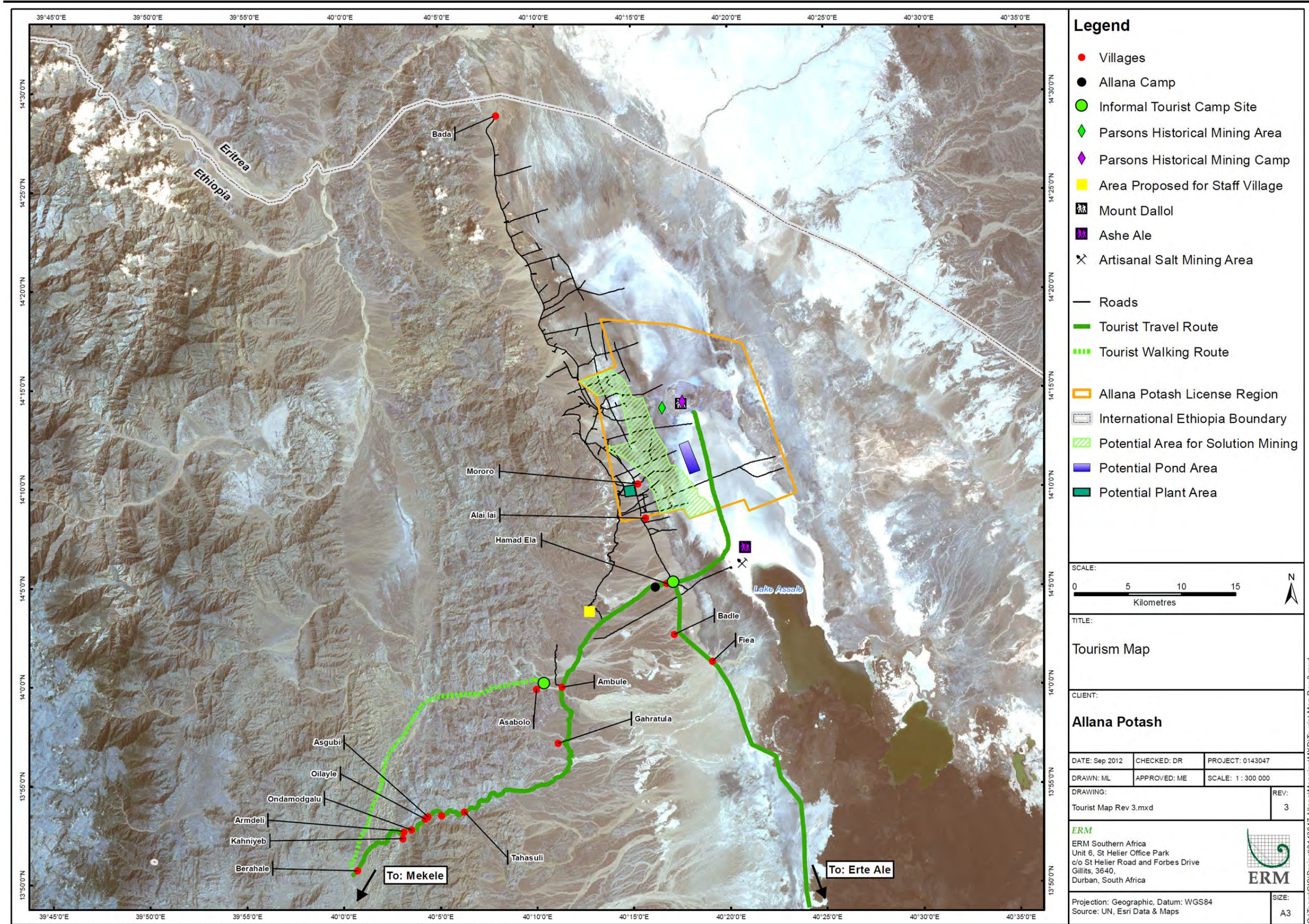
Palm Products	Revenue	Additional Information
<i>Selen</i>	Plain sold for ETB 50 (USD 2.8) Coloured sold for ETB 400 (USD 22.2)	On average 30 <i>selen</i> sold a month per women
Beds (refer to Figure 1.42)	Rent for ETB 50 (2.8) Sold for ETB 1,000 (USD 55.6)	The men are responsible for collecting and carving the wood
Rope	ETB 70 (USD 3.9) per roll	Mainly supplied to <i>Arho</i>

Approximately half of the households surveyed stated that their income from sale of products had stayed the same over the past two years, and 35.3% indicated that their income had decreased over the same period of time.

Tourism and Associated Services

The Danakil Depression is most renowned for its soaring temperatures and unique geological formations. It is one of the hottest places on earth and has been described by National Geographic as one of the '*cruellest and most inhospitable places on the planet*' (Virginia Morell for National Geographic, 2005). The most common and popular tourist destinations in the Danakil Depression, some of which fall within the Study Area include Lake Assale and the artisanal salt mining area, Mount Dallol and Parsons Mining Camp, Ashe Ale and Erte Ale Volcano (Figure 9.81).

Figure 9.81 Tourist Routes and Key Tourist Locations in the Social Study Area



Tourists Visiting the Danakil

Given the harsh climatic conditions the majority of tourists who visit the area are 'adventure tourists' who come to witness the geographical wonders of the Danakil Depression, including the salt column formations and hot springs on Mount Dallol. Mount Dallol and Parson Mining Camp, Hamad Ela and Asabolo (where the *Arho* and salt trade workers are known to stay), Lake Assale and the salt plains are the key tourist attractions within the proposed Project Area (Figure 9.82).

The regional Bureau for Culture and Tourism stated during interviews that the majority of tourists visiting the region and area originate from Europe citing Germany, Italy, Sweden and Spain as common countries. During the baseline data collection trip tourists from Spain and Israel were staying in Hamad Ela. The tourists indicated that they were travelling as part of a package arranged by an operator in Addis Ababa, and had driven down from Mekele. Interviews with tourists in the area and with residents of Hamad Ela indicate that on average tourists stay in the Danakil Depression for approximately four days. In addition from field observations the majority of tourists appear self-reliant with adequate supplies of water and food; however, they are known to purchase small food items, tea, coffee and water in the area.

Figure 9.82 *Tourists Visiting the Village of Asabolo and Mount Dallol*



Source: Hickman, Allana Potash Corp, (2011)

A variety of secondary and primary sources (tourist websites and interviews with the tourism operators, and the regional and local Bureaus for Tourism) indicate that tourists will usually follow an established tourist route as shown

in *Figure 9.81*. It is common for tourists to commence their tour of the Danakil Depression from Mekele driving down into the Depression. A few tourists also choose to trek through the Balakiya Mountain range and follow the river bed where they are able to follow the *Arho* route.

Tourists typically stay in villages located close to the Sabah River including the village of Asabolo, where residents stated that tourists frequently stay in or near their village usually in timing to see the passing of the *Arho*. Tourists are also known to travel with and follow the *Arho* up to Hamad Ela where they will stay overnight, renting accommodation from local residents and buying *selen* and occasionally locally made beds. While staying in Hamad Ela tourists will visit Lake Assale and the salt plains to view the artisanal salt mining. From Hamad Ela tourists usually progress onto Mount Dallol and the Erte Ale volcano. Mount Dallol is also the site of several historical mining attempts dating back to the 1920's when an Italian company Compagnia Mineraria Coloniale was active in the area. In the 1960's the Parsons Group also conducted exploratory works, the remains of which can still be seen today and are indicated on *Figure 9.81* as Parson Historical Mining Area.

Having visited Erte Ale tourists drive southwards towards Mile and Addis Ababa, where they conclude their tour of the Danakil Depression.

Alternatively tourists will travel the route indicated in *Figure 9.81* in the reverse order, beginning their journey from the south (driving through Awash National Park).

Nature of Tourism

Tourism in the Danakil Depression is reported to have increased in the last twenty years in line with the establishment of the current government in 1991, and reportedly following a BBC documentary on the area. The regional Bureau of Culture and Tourism indicated that the Ethiopian - Eritrean war led to a decline in the number of tourists; however, local government officials indicate that tourism has been on the rise again in the past two to three years. Occasional security issues, such as the kidnap and attack on a tourist group in March 2012 continue to destabilise what is perceived to be a growing industry.

A tourism operator interviewed at the federal level stated that the Danakil Depression has potential to develop into a key tourist destination in Ethiopia. Furthermore he stated that the Danakil Depression was increasingly being incorporated into tourism packages for Ethiopia, usually forming the last leg of a tourist's journey after having travelled north through the Ethiopian highlands visiting popular tourists destination such as Bahir Dar, Lake Tana and Lalibela. In addition tourists also travel to Lake Afdera and Hadar, the site at which Lucy (*Australopithecus afarensis*) was found. However the condition of the road and limited road access were identified as constraints to tourism in the area. However, local residents have commented on the degree to which the condition of the main road has improved in the past couple of

years, largely due to clearing activities for the construction of the Government road, and the higher number of vehicles using the main road.

Significance of Tourism

Though the income from this industry is collected mainly at the federal and regional levels, local people earn some income from tourists who visit the area. Local villages rent out houses or rooms, sell tea and coffee, and young men usually serve as guides and interpreters to the tourists, supplementing other income streams. However, it was reported that the tourist groups are typically fairly self-sufficient, bringing supplies and camping equipment into the area by vehicle and do not rely on services in the area. This is largely due to the fact that the majority of tourists use tourism operators based in Addis Ababa, which minimises the potential benefit of tourism for local people. Berahale *Woreda* commonly advises tourists and other people travelling into the area to notify the *Woreda*, and for groups to be accompanied by informal security (militia) whilst travelling through.

In the results of the household survey 6.1% of households surveyed stated that they or someone within their household was involved in tourism services. All households involved in providing tourism services identified it to be a secondary occupation. At the time of the survey households involved in tourism were located across the villages of Hamad Ela (57.1%), Asabolo (28.6%) and Ambule (14.3%). The majority (66.7%) of those surveyed identified that they worked as guides or guards with the remaining (16.7%) providing accommodation and transport / cleaning services. (Participants of the FGDs identified that it was most common for younger men to be involved in providing tourism services, and therefore are the group most likely to benefit from tourism in the area. In addition tourists have been known to rely on village elders as a means of security when travelling to key attractions such as Mount Dallol.

The average income earned by a household from providing tourism services in a good month was ETB 1,408.3 (USD 78.2) and ETB 900 (USD 50) in a bad month. In comparison to the other livelihood activities in the area tourism has the ability to provide the highest income to a household both across bad and good months. However the low number of households involved in tourism services (all of whom partake in it as a secondary occupation) may be a reflection of the low number of tourists that visit the area and the lack of services procured in the area, proving that the activity does not provide a consistent or significant source of income for households. Furthermore 60% of households involved in tourism stated their income had remained unchanged in the past two years, and 40% indicated a decrease in their income working in tourism.

According to national tourism operators some Afar have been known to charge 'taxes' for anyone who crosses their land, largely due to the absence of government control in the area, with local people taking the opportunity to benefit from any tourism that comes into the area. Tourists and operators have

been charged with significant levies by local Afar in the past (at prices higher than official entrance fees).

The importance of the area in terms of its natural attractions and ability to develop into a key tourist destination were heavily stressed by stakeholders both at the national and regional level. The regional Bureau of Culture and Tourism stated that the salt column formations and sulphur pools on Mount Dallol are truly unique attractions for tourists and therefore should be protected. In addition according to government offices at the national and regional level the natural attractions in the Danakil Depression are a source of pride not only for the Afar state and people, but as a tourist attraction for Ethiopia and therefore need to be protected against degradation.

The Ethiopian Wildlife Conservation Authority working together with the German Agency for Technical Corporation (GIZ) ⁽¹⁾ indicated that any impacts on tourism need to be considered. Their view is that the Danakil Depression is part of a larger tourist route and any impact in the Danakil Depression is likely to have an impact on the feasibility of the entire route including national and regional operators, and those involved in providing tourism services in Mekele, Erte Ale and as far south as Semera.

Petty Trading

The results of the FGDs and observations in the field indicated that Berahale has the largest scale trading in the area. This ranges from a weekly market on Saturday where a mixture of locally made products (*selen* and salt cutting tools) and imported goods are sold, to permanent shops selling vegetables and other miscellaneous products (soap, candles, batteries etc.). These shops mainly obtain their goods from Mekele which are brought in by local buses or trucks that service the area. There are also a number of hotels and restaurants in Berahale, of which residents have noted a particular increase in the past two years.

However the household survey results show that of the 13.2% of households involved in trade, 7.9% lived in Hamad Ela. Of those involved in trade 60% are involved in the sale of food and drinks, and 40% are involved in the sale of a range of products including medicine and carpentry products.

Hamad Ela is the only other village where a series of small shops operate (*Figure 9.83*). From observations Hamad Ela has approximately four to five prominent shops that sell a range of products including wheat, coffee, tea and some vegetables, the latter commonly perish due to the lack of fridges in Hamad Ela. For the villages in close proximity, Hamad Ela's shops and restaurants are their key source of food. A considerable portion of clothes, shoes and perfumes are also imported from towns along the Ethiopian border, Djibouti and Tigray region. In addition to the local shops women from the

(1) In German Gesellschaft für Internationale Zusammenarbeit (GIZ).

highlands operate tea / coffee shops with salt trade workers and the military as common customers.

Figure 9.83 *Shops in Hamad Ela*



The households involved in trade were able to estimate their monthly income from trade both across good and bad months, indicating that on average a household would earn ETB 725 (USD 40.3) in a good month, and ETB 400 (USD 22.2) in a bad month. The majority of respondents stated that their income from trading activities has decreased (67%) in the past two years, compared to 13.3% of households that indicated income from trade had either increased or stayed the same (20%).

The renting of houses in Hamad Ela was reported to be another source of income. The Afar have also been known to rent out houses to the salt trade workers; however, some participants of the FGDs in Hamad Ela indicated that members of the *Arho* are beginning to reserve land and build houses to stay in during the salt trade season. The results of the household survey show that only 0.2% of households are involved in renting accommodation. Land is owned by the government and the local village leader was identified as responsible for land allocation in the village.

There are no shops or markets in the other villages visited, and residents have to walk (or get a lift when available) to Berahale or Hamad Ela to access shops. Across the SSA Berahale is the only location with a market. Participants identified the key reason for the lack of a market in Hamad Ela is due to poor road conditions in the SSA, and in particular between Berahale and Hamad Ela.

Formal Employment

Households were asked if anyone within their household was formally employed by one of the following:

- A mining company;
- Construction company;
- The military; or
- The government.

Of the households surveyed 40.4% had a member of the household working for one of the above. Of those working in formal employment, working for a mining company provides the highest monthly income, providing an average monthly wage of ETB 1,236.2 (USD 68.7) which is three times higher than the average wage working for the government (ranked as the second highest wage).

9.10.3 Household Income and Expenditure

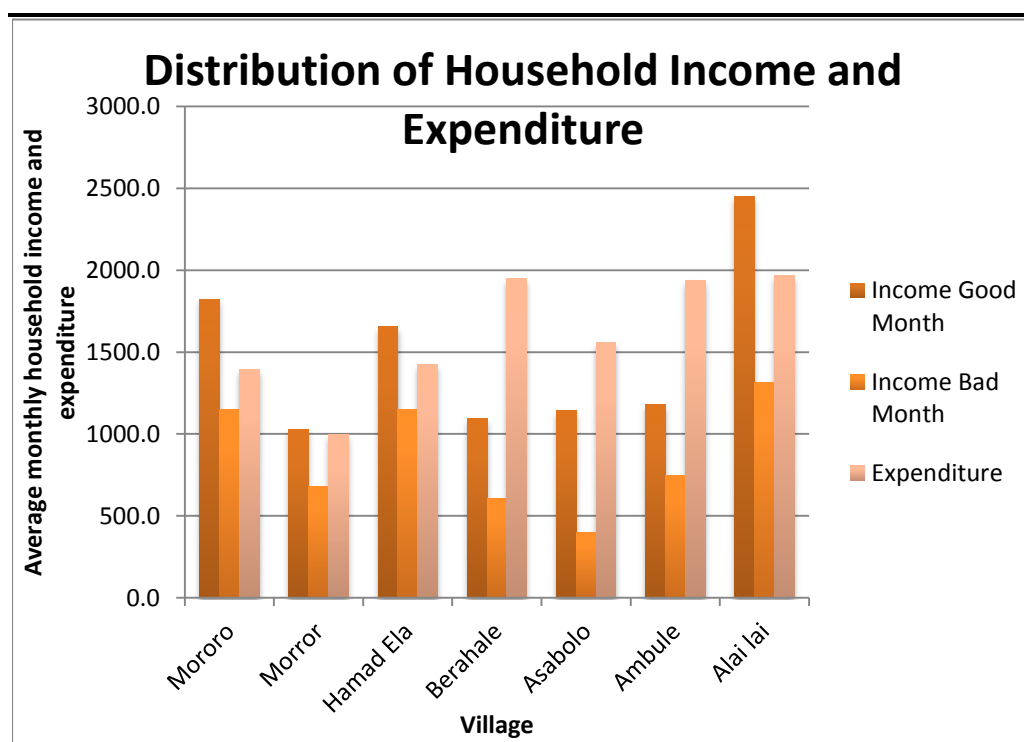
Basic data on household income and expenditure was collected during the household survey. The data collected and presented is based on estimates provided by respondents. The average annual household income throughout the total Study Area was reported both in a good month and a bad month.

In a good month the average household income was ETB 1,347 (USD 74.8), this however varied across the villages surveyed. *Figure 9.84* shows that in a good month Alai lai and Mororo had the highest household income and Morrora had the lowest. The household income in Alai lai and Mororo is skewed considerably by the higher income of one household in each village where the head of the household works as a salt cutter or for a mining company.

The average household income in a bad month was recorded at ETB 845.6 (USD 47.0). Households in Alai lai still had the highest monthly income across the villages in the SSA, and average household income in Asabolo featured as the lowest. When questioned as to whether households had observed a change in their level of income in the past two years the majority (60.4%) stated that it had decreased. The observed decline in income may be attributed to a genuine decrease in work, for instance a decreased demand for salt from a salt cutter, or rising inflation in the SSA which may render the perception that a household's income has decreased.

The average household expenditure across the SSA was equal to ETB (1,572 (USD 87.3). Household expenditure varied across villages and as shown in *Figure 9.84* in three villages (Ambule, Asabolo and Berahale) the average household expenditure exceeded monthly income in a good month. The results for Berahale are particularly stark where the majority of households surveyed had monthly expenditures higher than their household income in a good month. The higher expenditure rates highlight a household's lack of savings and an inability to cover the costs of basic needs.

Figure 9.84 *Distribution of Household Income and Expenditure*



Source: ERM Household Survey, (2012)

Based on the results of the household survey the greatest household expenditures are on food, clothing and healthcare including medicine (refer to *Figure 9.85*). On average a household reported spending ETB 806.6 (USD 44.8) and ETB 496.2 (USD 27.6) on food and on clothes per month. Healthcare was the third highest expenditure for a household in the SSA which supports evidence of the prevalence of disease in the area, and the lack of necessary health infrastructure for many villages.

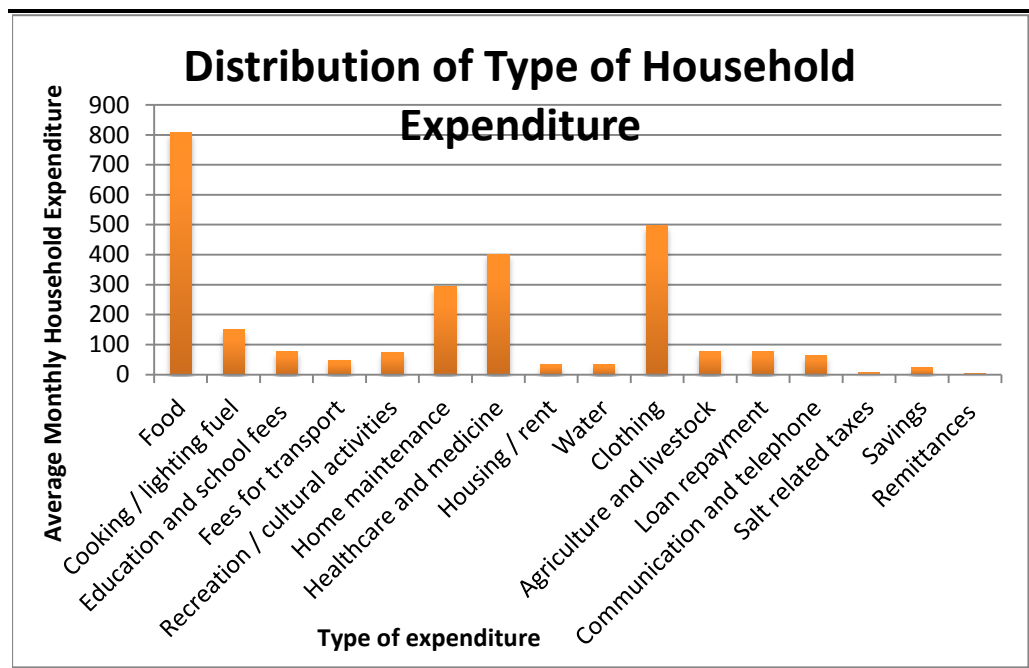
Figure 9.85 shows the amounts spent each month on various items. Both the household survey and FGDs identified that clothes were the second highest expenditure for a household, with respondents stating that a considerable portion of this expenditure is spent on women as Afar women are required to dress conservatively, and the way in which a women dresses is likely to influence her chances of attracting a husband.

During FGDs women in particular identified that the majority of a household’s income is used to buy food items including sugar, tea, spices, oil and ground wheat. The listed food items are bought from shops either in Hamad Ela or Berahale depending on the proximity of the village. The majority of the shops import the food items from Mekele and from other towns in the Tigray region. Wheat is both purchased from shops and received through the PSNP and forms the staple food source in a typical household in the SSA. Approximately 50% of the wheat consumed in a household is received from the government’s PSNP; the other 50% is bought using income from livelihood activities.

Other household expenditure includes clothes and healthcare. Some residents indicated that they would borrow money from family or friends particularly for health related expenses. This practice is an indication of the lack of savings for a household, in addition to their restricted ability to withstand any type of shock or pressure to the household, including illness.

The majority of households also indicated that their household expenditure had increased over the past two years.

Figure 9.85 *Distribution of Types of Household Expenditure for Villages in the Study Area*



Source: ERM Household Survey, (2012)

Very little of a household's expenditure is allocated towards savings, remittances or recreational activities, with the majority of households using income to purchase basic households requirements (i.e. food and clothing).

As previously mentioned some residents identified that the formation of the Salt Selling Association in Berahale has begun to change the saving and expenditure patterns for members of the Association, particularly in Berahale. Members (including women) commented that since joining the Association they have been able to open bank accounts, and access savings.

Productive Safety Net Programme

In response to the persistent food crisis observed in the Afar state, including the *Woreda* of Berahale, the federal government through the local government, has implemented the PSNP in order to assist chronically food insecure households. The PSNP is formed of two components:

- A labour based public works component; and
- A component focused on the direct transfer of food to households that are unable to participate in the labour based public works component.

Currently all the *Kebeles* in Berahale *Woreda* have been targeted by PSNP. In all of the seven villages surveyed men and women were involved in weekly activities associated with the PSNP. Key activities involve village cleaning, and building gabions. It was evident that that the villages closest to the salt plains rely heavily on the PSNP (to a lesser degree in Berahale), with up to 60% of a household's food source derived from the PSNP.

Men are responsible for receiving the food aid and therefore control the allocation of food to the household. In addition it has been noted that men sometimes sell the wheat in order to purchase chat or cigarettes.

9.11

HUMAN RIGHTS AND VULNERABILITY

Ethiopia is a signatory to a number of international treaties on human rights including the Universal Declaration of Human Rights (UDHR), the International Covenant on Civil and Political Rights (ICCPR), the African Charter on People's and Citizen's Rights, the International Covenant on Economic, Social and Cultural Rights and the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW).

Ethiopia's federal constitution integrates all international human rights agreements ratified by Ethiopia into Ethiopian law. The constitution stipulates the government's commitment to both a democratic order, and the advancement of economic and social development based on the 'respect for the fundamental rights of individuals and of the nations and nationalities as well as the even development of the various cultures and religions'.

This section discusses key human rights issues pertinent to Ethiopia and also highlights those of particular relevance within the Study Area.

9.11.1 *Allegations of Suppression by Government*

Allegations of censorship and repression have been made against the Ethiopian Government. Both the 2005 and 2010 general elections resulted in widespread demonstrations and international observers remarked that the processes failed to meet international standards. Intimidation, coercion and threats of violence were purported to have been used in both elections to secure the EPDRF's win. In 2010, the use of incentives such as access to seeds, fertilisers or loans (Human Rights Watch, 2011), was also reportedly used to gain party votes and, as a result of unrest during the 2005 election, at least 193 people were killed and more than 4,000 people arrested, including leading opposition figures. Several prominent detainees were reported to have received severe sentences, and although all were pardoned and released in 2007, some were later rearrested (Freedom House, 2012).

A number of proclamations passed by the Ethiopian government have been reported to have served to restrict freedom of press and hinder the promotion of human rights. The Charities and Societies Proclamation, passed in 2009, prevents Ethiopian NGOs from engaging in human rights advocacy if more than 10% of their funding is from foreign sources. It also prohibits NGOs from providing legal aid and other assistance or rehabilitation to victims of torture and abuse. Such stipulations have limited the resource capacity of NGOs in the country (Minority Rights Group International, 2011).

The Anti-Terrorism Proclamation, introduced in 2009, has been the focus of concern for several international NGOs, including Amnesty International. Amnesty International asserts that it is used by the Government to suppress freedom of expression. It is reported that in 2011, at least 108 journalists and opposition members accused of criticising the government, were arrested in accordance with the proclamation (Committee to Protect Journalists, 2006).

The majority of news media in Ethiopia are state-owned; one of the few independent papers in the capital, *Addis Neger*, closed in 2009, claiming harassment by Government authorities (Freedom House, 2012).

9.11.2 *Standard of Living, Poverty and Equality in Ethiopia*

Ethiopia has high levels of inequality and a low standard of living. Life expectancy at birth is 59.3 years, above the Sub-Saharan Africa average but considerably lower than the global average of 69.8 years (UNDP, 2011). Ethiopia has one of the highest performing economies in Sub-Saharan Africa;

however, it is one of the poorest countries in the world. It has a UNDP HDI ⁽¹⁾ rating of 174 out of 187 countries, comparable to other nations such as Afghanistan (172), Guinea (178) and Sierra Leone (180), with an index value indicating low human development (UNDP, 2011).

In 2005, 38.9% of Ethiopia's population lived below the international poverty line of less than USD 1.25 per day (The World Bank, 2012), and 77.6% lived on less than USD 2 per day (Alkire et al., 2011). Poverty is significantly more widespread and severe in rural areas than in urban ones; 93% of the urban population are in the highest wealth quintile in contrast to 10% of the rural population. Furthermore, a significant proportion of the rural population, including 72% in Somalie region and 67% in Afar, are in the lowest wealth quintile (Central Statistics Agency, 2005).

According to the 2011 Ethiopia Demographic and Health Survey, the unemployment ⁽²⁾ rate in urban areas of Ethiopia is higher than in rural areas. In 2011, 27.2% of the urban population were unemployed versus 22.8% of the rural population. Women are more likely to be unemployed than men; 42.2% in comparison to 5% however, their rates of unemployment are significantly higher in rural areas; 42.2% in comparison to 3.3%.

The Ethiopian economy and the poor in Ethiopia are extremely vulnerable to external shocks that may include climate change and the global price of exports and imports. Poverty studies in the country show that even if the poor are able to escape poverty for a substantial period of time, they are extremely vulnerable to slip back into poverty (UNDP, 2008).

9.11.3 *Gender Equality*

Ethiopia has demonstrated commitment to addressing gender disparities, and a number of legislative measures have been adopted to ensure equality under the law. Gender considerations have been included within policy such as the land certification program and the PSNP.

However, global comparisons show that Ethiopia still has further progress to make in achieving gender equality. According to the Gender Empowerment Measure (GEM), an aggregated index developed by the United Nations Development Programme (UNDP) to measure women's and men's capacities to actively participate in economic and political life, Ethiopia ranked 85th out of 109 countries in 2009, with a similar ranking to the Montenegro and Ukraine (ranking of 84 and 86 respectively). Ethiopia ranked comparatively low against other East Africa countries, with Uganda ranked 49th, and Tanzania in 69th position. The measure showed that at the time of publication women only held 21.4% of the seats in parliament, accounted for under a third

(1) HDI is a summary measure of human development that measures the average achievements in a country in three basic dimensions of human development: a long and healthy life (health), access to knowledge (education) and a decent standard of living (income).

(2) Currently not employed and not employed in the 12 months preceding the survey

of professional and technical workers and had a ratio of 0.6 to male earned income (UNDP, 2008).

The presence of systematic gender inequality is supported by qualitative and quantitative evidence that men dominate intra-household allocation of resources. The work of Fafchamps and Quisumbing (2002), which found gendered patterns of control over income streams, and Dercon and Krishnan (2000), which found incomplete risk sharing, with women bearing the brunt of adverse shocks (Laderchi et al., 2010), supports this analysis.

The Status of Women in the Afar Area

Within the Study Area access to land and physical possessions are maintained and controlled by the men; in the event of a marital separation the man therefore acquires both land and possessions. In FGDs women claimed that men control the allocation of resources, with the patriarchal system of inheritance perpetuating this phenomenon, even in the event of death. Whilst land is owned by the village as opposed to by the individual, plots of land are titled to men as opposed to women and it is men (often elders) who decide how it is used, e.g. for construction or farming purposes. A widowed woman is potentially able to inherit the family property for the wellbeing of her children only if she agrees to remain unmarried. However the closest male relative to the deceased (son or brother) is still able to make decisions concerning her resources and physical possessions. Men are recognised as the chief income generators, and a woman's dependence on a man is widely recognised in the proposed Project area.

The income disparity between men and women in a household restricts a woman's access to resources, and purchasing power. The intra-household allocation of food also demonstrates gender inequalities. Priority is given to the husband followed by other men in the household in terms of allowing them to eat first, and to eat the best food available. Furthermore women are prohibited from eating certain cuts of meat and certain foods. It was reported during FGDs that such restrictions are uncommon in urban areas and were less evident in Berahale. The unequal allocation of food in a household is further accentuated by the fact that polygamy is commonly practiced in the area. Several women acknowledged that a wife will keep the best food for her husband as a means of attracting him, thereby potentially depriving herself and others in the household.

The subordinate status of women is also reflected in marriage arrangements. Men in Afar society determine who a woman marries, with the elders or clan leaders acting as the key negotiators. Bride prices can be a source of significant income for the bride's family with prices ranging between ETB 8,000 and 15,000, (450 to 850 USD). Participants in the FGDs identified that the majority of women will marry between the ages of 16 to 18, however girls can get married as early as the age of 13. In addition cross-cousin marriage (*absuma*) is common in Afar culture with or without a girl's consent.

It is interesting to note that the number of Afar women engaged in work related to Allana's activities is increasing, indicating a potential attitudinal change among women and their engagement in non-household activities. In addition it provides an alternative source of income for women in the area. However during several *ad hoc* conversations with local Afar men it was indicated that working for Allana is usually perceived as a man's job.

A Woman's Role in the Household

Women are responsible for food preparation activities in the household. Men do not prepare food but typically will buy larger food items, such as bags of wheat, from Berahale market (and in some cases Hamad Ela). The woman is responsible for the vast majority of primary care duties; purchasing the remaining household items, looking after children, elderly and the sick, in addition to fetching water occasionally. Ultimately women are also accountable for the livestock as they oversee the children who herd the livestock on a daily basis.

As discussed in *Section 9.10.2* woman's key source of income is the collection and sale of palm products. This income revenue is typically used to purchase food items, clothes and water (in times of water shortage) for the household.

Female Headed Households

The results of the household survey show that 27% of households in the SSA are headed by a woman. During FGDs women indicated that the main cause for separation and divorce is lack of economic support from the husband and his failure to contribute to the household income.

Secondary research has indicated that female headed households (FHH) in Ethiopia experience discrimination. In urban areas 39% of households are FHH, compared to 23% in rural areas (The World Bank, 2010). This research has also indicated that FHH adopt different livelihood strategies due to the gendered division of labour and customary practices.

Within the SSA women produce *selen* and attend the weekly market regardless of their marital status. However women's reliance on this source of income greatly increases in a FHH where there is often only one income stream coming into the house. For example in non-FHH salt mining was identified to be a key source of income to purchase necessities such as food however women generally do not practice salt mining therefore this income stream is not available to FHH. According to the local Women's Affairs office approximately 94% of FHH are food insecure and this may be a representation of the limited income generating opportunities they are offered and limited subsistence food sources.

Domestic Violence and Female Genital Cutting

During FGDs women indicated that FGC is practiced in the area, but some participants had observed a decline in the occurrence due to rigorous government programmes prohibiting the practice.

FGC is considered a violation of human rights in Ethiopia under Proclamation 414/2004. In addition Ethiopia has ratified the Convention on the Rights of the Child (CRC) and the CEDAW. According to the World Bank (2010) the prevalence of and support for FGC is declining, both in urban and rural areas (the rate of decline in urban areas is reported to be twice that of rural areas).

However several research studies indicate that enforcement within Ethiopia is low. In addition, in a study conducted in Afar by SOS Sahel, out of the total men surveyed 82.1% said that they would not marry girls who had not undergone FGC, and 70% of married men and women participating in the survey would not allow their sons to marry a girl who was not circumcised (International Institute for Environment and Development, 2009). Other studies identify that Afar women define empowerment by being *hilaly* and *dieto* meaning powerful and capable. Achieving these qualities implies that an Afar woman has reached the height of social status, but this position can be obtained only after marriage, a milestone that, by definition, requires circumcision (Flintan, 2008).

In Afar, girls are typically subjected to FGC between the ages of seven to nine, or just before marriage between the ages of 15 to 17. FGC is considered a part of societal norms and values, and although women acknowledged the health implications associated with the practice it was largely accepted as a cultural practice. Key reasons for the practice are rite of passage into adulthood, and to ensure the fidelity of a woman in a marriage. Several studies conducted in the Afar region reference infibulation as a common and severe form of FGC.

All the women interviewed stated that domestic violence is common, and is considered acceptable in Afar society. When probed some of the women indicated that the beating of a wife is normal and she expects to be beaten if she has upset her husband. This is further supported by research conducted by the World Bank. This research identified women's acceptance of violence as a form of conflict resolution, as an indicator of women's low level of awareness of their rights. Statistics show women's acceptance of wife beating at more than 80% in urban areas (The World Bank, 2010). It was reported during FGDs that within the proposed Project area local area women are exposed to domestic violence from an early age, often correlating with the age at which girls get married.

9.11.4 *Marginalisation of the Afar and other Pastoralists*

The Afar and other pastoralists have traditionally been alienated from mainstream development efforts within Ethiopia, and it has only been since the establishment of the EPRDF Government, that the Afar people in Ethiopia have been granted Regional State status as one of the nine autonomous

regions. Research reports contend that until this point the Afar had fallen outside Ethiopian state administrative control, and to some extent still do. Prior to their political incorporation into the Ethiopian state the Afar are said to have lived in self-contained and self-supporting villages (Tesfay and Tafere, 2004).

Prior to the establishment of the ANRS the region was divided into the five provinces of Harar, Shoa, Wollo, Tigray and Eritrea. As a minority within the provinces, the Afar had limited opportunity to exert any political influence. Taxes were levied from the people and little investment in public infrastructure and services was made. In the 1960s the Tcheffa Valley became the location of commercial sorghum farms, and large cotton plantations were developed along the Awash. It is reported that 20,000 Afar pastoralists were displaced by irrigated land, and were unable to move to their traditional grazing lands when drought occurred.

The construction of roads which led into the area resulted in an influx of migrants from drought-stricken highland regions in search of work on the farms; increasing pressure on the land and other resources. As a result, the vulnerability of the Afar to drought and famine is high. Drought frequently affects the Afar and occurs every few years (Helland, 1980 and Ayele, 1991). In the famine of 1973, it is reported that the Afar lost a fourth of their livestock, and a third of their population is believed to have perished (Tesfya and Tafere, 2004).

Pastoralism continues to face increasing pressure from natural and human induced factors. The changes in natural resource use in Afar territory has had negative implications for the pastoral mode of production and culminated in resource use conflict (Ali, 1994). These changes have contributed considerably to the vulnerability of the Afar to drought and famine and the resultant human and livestock losses. Thus in recent years demographic, ecological and environmental factors have pressurised the pastoral production system resulting in significant loss of income. Coping mechanisms include the rearing of drought resistant livestock species, a change in the land use system, sedentary life, trade and wage labour migration (Tesfya and Tafere, 2004).

In addition the mobility of the Afar has been restricted by the flow of weaponry to their nomadic competitors the Issas (ethnic Somalis) and clashes over wells (Tesfya and Tafere, 2004).

9.11.5 *Vulnerable, Sensitive or Marginalised Groups*

Vulnerable groups includes people who, by virtue of gender, sexuality, ethnicity, age, physical or mental disability, economic disadvantage or social status may be more adversely affected by a project than others, and who may be limited in their ability to take advantage of a project's development benefits.

Vulnerability of receptors to social impacts is understood as a reflection of:

- The absence of an ability to adapt to socio-economic/cultural or biophysical change resulting in a potential increased susceptibility to negative impacts or a limited ability to take advantage of positive impacts; or
- A pre-existing sensitive, vulnerable or marginalised status that is independent of the project under consideration.

Compared against the national and regional context, the villages across the Study Area can be considered vulnerable due to their isolated nature resulting in low levels of education, restricted access to basic infrastructure and services, and low availability and access to resources.

However certain groups illustrate heightened vulnerability when considered against the local baseline conditions. This vulnerability is caused by an existing low level of access to key socio-economic/cultural or environmental resources or a low status in certain socio-economic/cultural indicators. Taking this into consideration the following groups have been identified as vulnerable in the proposed Project area:

- **Women / female headed-households:** Due to the nature of domestic relations and traditional practices, women's access to resources (physical and financial) is considerably restricted in the proposed Project area. Women have limited participation and representation in village level decision making, are reported to be commonly subjected to abuse from male members of a household and commonly are undergo harmful practices such as FGC. FHH can be identified as particularly vulnerable as they face reduced access to income generating opportunities and typically suffer from higher levels of food insecurity. FHH also witness further reduction of access to resources as they are not able to rely on a male member for provision of resources including access to health facilities. The results of the household survey show that 27% of households surveyed were headed by women.
- **Sex workers:** sex workers will not have access to forms of protection (authorities, health services, education for children) and may be subjected to discrimination.
- **Elderly:** The elderly within the village are less likely to receive an income and are reliant upon other members of a household. Thus their ability to adapt to potential changes in their environment is reduced. Within this group it is important to differentiate between men and women as women are identified to be more vulnerable. Elder men within the village play a prominent role in traditional institutions and village level decision making.
- **Children:** Children are mainly reliant upon older members of the household to access resources and for the maintenance of their general

wellbeing. During the FGDs children (particularly under the age of 5 years) were identified as particularly susceptible to illness due to decreased immunity.

- **People with physical / mental health illnesses and disabilities:** People that lack physical mobility or who have mental health issues are less likely to adapt to changes within their environment. Given the socio-economic context of the area, there are no institutional systems or services to encourage their economic and social participation in the community. In addition people with disabilities are less able to generate income for themselves relying upon others to provide for them. In the SSA 15% of households had a member of the household with a physical / mental disability.
- **Households reliant on artisanal salt mining:** A large majority of Afar men in the proposed Project area reliant on artisanal mining of salt as their primary livelihood. The majority are not engaged in diversified livelihood activities decreasing their resilience to potential changes in the environment. They are solely reliant on the land and resource base for their income generation and sustainable subsistence activities are uncommon. In addition a cultural identity is derived from their livelihood, desiring to maintain their cultural identity and artisanal skills as well as a desire to avoid socio-cultural change to their livelihood.
- **Households reliant on livestock:** Households in the proposed Project area have been subject to food shortages as a result of cyclic drought, animal epidemics, and consequent decline in the carrying capacity of the rangeland. Thus households who rely on livestock, either for cash income or subsistence, and have lost livestock due to drought and disease are identified as a potential vulnerable group.
- **Internally displaced persons -** As a result of the Ethiopia – Eritrea war the UN have reported a significant proportion of the Afar population as displaced. The definition of an IDP demonstrates that a person has been forced to leave their home which has the potential to impact several aspects of their wellbeing including access to resources and infrastructure, community cohesion and livelihoods. All of these indicators therefore identify any IDP living within the SSA as a potential vulnerable group.

An assessment of the identified vulnerable groups against key indicators used to specifically evaluate the issues they face in the study area are included in the matrix in *Table 9.20*.

Table 9.20 Vulnerability Matrix

Vulnerable Groups	Indicator	Aspects to be Considered	Description of Constraint Associated with Indicator for Vulnerable Groups
Human Receptors' (Individuals, Groups, Households, Villages etc.) Access to:			
<ul style="list-style-type: none"> Artisanal salt miners Households reliant on livestock 	Livelihoods	<ul style="list-style-type: none"> Diversity of livelihoods Legality of livelihood Productivity of livelihood 	<ul style="list-style-type: none"> Reliance on one principle livelihood Principle livelihoods are fragile Principle livelihoods are reliant on natural processes
<ul style="list-style-type: none"> All groups 	Resources	<ul style="list-style-type: none"> Water Wild Products Salt Land 	<ul style="list-style-type: none"> Poor access to available resources Resource shortages are frequent and serious
<ul style="list-style-type: none"> All groups <p>In particular:</p> <ul style="list-style-type: none"> Women Elderly Children <p>Lack of health and educational facilities has heightened impacts on these groups</p>	Services and Infrastructure	<ul style="list-style-type: none"> Health Education Transport Recreation Savings and support networks Fair policing and security 	<ul style="list-style-type: none"> Minimal access to key services and infrastructure Provision of key services and infrastructure is poor
<ul style="list-style-type: none"> Women 	Participation in Political and Civil Institutions and Decision Making	<ul style="list-style-type: none"> Active decision making Freedom of association Freedom from corruption 	<ul style="list-style-type: none"> Minimal ability to participate in orthodox governance and decision making systems Restrictions on rights of association, ability to participate freely in governance

Vulnerable Groups	Indicator	Aspects to be Considered	Description of Constraint Associated with Indicator for Vulnerable Groups
<ul style="list-style-type: none"> • Women • People with physical /mental health illnesses and disabilities • Internally displaced persons 	Community and Social Inclusion and Cohesion	<ul style="list-style-type: none"> • Security • Freedom from inter and intra community cohesion 	<ul style="list-style-type: none"> • Subject to marginalisation and discrimination • Subject to violence and conflict
Human Receptors' (individuals, groups, households, villages etc.) status:			
<ul style="list-style-type: none"> • Women • Elderly • Children 	Health	<ul style="list-style-type: none"> • Acute illness • Chronic illness • Maternal mortality • Child mortality • Malnutrition • Physical and mental disabilities 	<ul style="list-style-type: none"> • Poor health status and low immunity to diseases, illness and incidents including malaria, malnutrition and birth complications • Limited access to contraceptives and family planning
<ul style="list-style-type: none"> • Women • Children 	Knowledge, Skills and Education	<ul style="list-style-type: none"> • Levels of knowledge skills and education • Ability to participate in orthodox economic and social systems 	<ul style="list-style-type: none"> • Low levels of literacy and skills • Low school attendance and completion of education
<ul style="list-style-type: none"> • All groups, in particular FHH 	Financial resources	<ul style="list-style-type: none"> • Income generation • Remittances • Savings 	<ul style="list-style-type: none"> • Low income levels relative to expenditure • Inability to pay for food, key services, resources and infrastructure • Limited access to micro-credit and savings
<ul style="list-style-type: none"> • Artisanal salt miners 	Independent Cultural Identity	<ul style="list-style-type: none"> • Culture • Languages • Religious practices 	<ul style="list-style-type: none"> • Desire to maintain strong independent cultural identity and cultural practices • Desire to avoid socio-cultural change

Vulnerable Groups	Indicator	Aspects to be Considered	Description of Constraint Associated with Indicator for Vulnerable Groups
<ul style="list-style-type: none"> Children 	Labour Rights	<ul style="list-style-type: none"> Cultural practices regarding labour Forced labour Child labour Right to association H&S standards Minimum wage 	<ul style="list-style-type: none"> Weak H&S standards nationally subjecting groups to inadequate H&S standards Informal work practices Children prohibited from entering or completing education

Please Note – where ‘All groups’ are referred to in the table this refers to villages in the Social Study Area, and includes the six villages of Morrora, Ambule, Asabolo, Mororo, Alai lai and Hamad Ela

The perceptions and attitudes of stakeholders⁽¹⁾ to the proposed Project continue to be documented through the ESHIA process. The baseline data collection activities were an opportunity to receive feedback on stakeholder's opinions and concerns and to build upon the information collected during previous periods of engagement.

The key stakeholder concerns mentioned during the baseline data engagement activities have focused on both proposed Project and ESHIA related issues in the following areas:

- The proposed Project's potential impacts, particularly to water, artisanal salt mining, tourism, health and employment;
- Allana's existing labour practices; and
- Process related issues including the on-going stakeholder engagement process, and the need for comprehensive specialist studies.

Further information on stakeholder perceptions and attitudes are included in the Stakeholder Engagement chapter of the ESHIA report.

During the household survey residents in the SSA were also asked what their greatest concerns were for their village at present and in the future. The key concerns at present were identified to be health services, access and availability of drinking water and changes in lifestyle. Currently 44.7% of households identified health services as their most pressing concern followed by drinking water (27.2%) and electricity (8.8%). A household's future concerns were identified to be the same as their current concerns; however, a higher percentage of households were concerned about changes in their lifestyle in the future.

HIGH LEVEL NEEDS ANALYSIS

A high level analysis of village needs and priorities was conducted using the data collected from the baseline survey. The information collected for the needs analysis was primarily derived from the household survey, and FGDs.

The household survey focused on identifying the most pressing concerns of villages both now and in the future. In addition the household survey asked villages what they valued most about their respective community. The FGDs

(1) Engagement to date has identified the following as key stakeholder groups: NGOs, businesses, academic and research institutions, government, customary authorities and villages in the SSA. Stakeholder groups have been identified across the national, regional and local level.

sought to identify the greatest concerns of a community, in addition to stakeholder expectations of the proposed Project.

9.13.1 *Results of the Baseline Survey*

The results of the household survey indicate that at *present* the most pressing concerns for villages were identified to be:

- Availability, quality and access to health services;
- Access and availability of drinking water; and
- Lack of availability of electricity in households.

Villages were also asked to identify what their greatest concerns about the *future* of their village were. The majority of respondents identified the following as their greatest concerns:

- Availability, quality and access to health services;
- Access and availability of drinking water; and
- Changes in lifestyle.

The identification of potential changes in lifestyle as a future concern indicates that villages are aware of the changes that are likely to occur in the area, mainly attributed to the presence of mining companies and the construction of the government road.

The seven villages surveyed across the SSA identified that their existing relationships, solidarity and social networks are what they value most about their community. Strong Afar identity and social cohesion were features that were clearly evident during engagement and the baseline survey.

During engagement stakeholders in the local area repeatedly raised the need for further employment opportunities and frustration with what is perceived to be the allocation of Allana's formal employment opportunities to foreigners or highlanders. Given the low literacy and skills levels in the local area, this suggests the need for mechanisms to enable local employment opportunities in skilled jobs.

9.13.2 *Priority Needs*

The ESHIA baseline survey and consultations have identified the following as priority areas of village need and development:

- Educational infrastructure and resources;
- Health infrastructure and resources;
- Literacy and vocational skills development;
- Infrastructure development; and
- Enterprise development.

Table 9.21 presents supporting information drawn from the baseline survey and stakeholder consultation that align to the areas of greatest village needs identified above.

Table 9.21 Village Needs

Priority Area	Supporting Information
Educational infrastructure and resources	<ul style="list-style-type: none"> • Low formal education - the majority of household survey respondents (62.5%) have not received any form of formal education; • Only 6.1% have completed the second cycle of school; • Only one high school in the <i>Woreda</i> (across nine <i>Kebeles</i>) making it almost impossible for some villages to attend given the lack of transport available.
Health infrastructure and resources	<ul style="list-style-type: none"> • Local residents deem healthcare services inadequate and rely on Mekele hospital in times of emergency / serious illness; and • All households are eligible for training on the government Health Extension Programme including Water, Sanitation and Hygiene training but only 4% have received it in the <i>Woreda</i>; • There is no hospital in the Berahale <i>Woreda</i> • There are no medical doctors across the entire Zone 2, and there are no midwives across the Zone.
Literacy and vocational skills development	<ul style="list-style-type: none"> • Almost no certified skills in the area; • only 10.1% of survey respondents above the age of ten years know how to read and write in Afarigna; and • Literacy in other languages varies; 12.0% of respondents can read and write in Amharic, 5.8% in Tigrigna and 6.42% in English.
Infrastructure development	<ul style="list-style-type: none"> • Only 6% of households in the <i>Woreda</i> have access to a basic latrine; • 92.1% Of households surveyed use informal waste disposal techniques including dumping in open spaces; • 79% Of households surveyed do not have electricity; • 67% Have no access to transport including public transportation services.

Priority Area	Supporting Information
Enterprise development	<ul style="list-style-type: none"> • Lack of livelihood diversification and livelihood alternatives in the study area; • Large reliance on primary livelihoods that have low resilience to potential socio-economic or environmental changes; and • Lack of local procurement networks available in the area due to restrictions on transportation services, skills and financial capital.

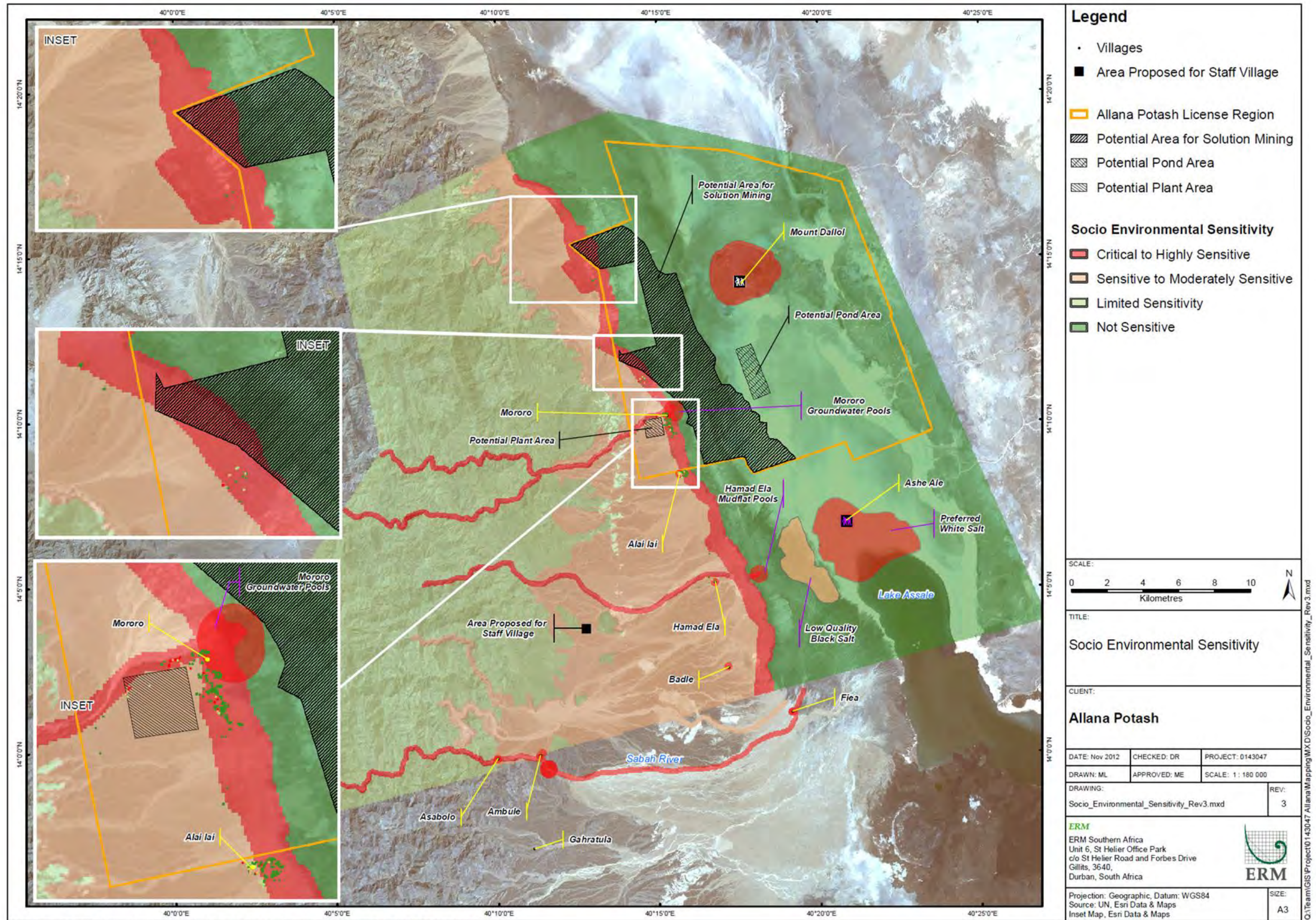
9.14

SOCIO-ENVIRONMENTAL SENSITIVITIES

Chapter 8 presents the sensitivity of the Study Area of influence from a ecological perspective. *Figure 9.86* presents the aforementioned biological sensitivities together with the following social sensitivities discussed in this Chapter:

- The presence of villages;
- Cultural heritage sites and associated significance rankings;
- Areas used by artisanal salt miners; and
- Key tourist features (Mount Dallol and Ashe Ale).

Figure 9.86 Socio-environmental Sensitivity Map for the Study Area



9.14.1

Socio-environmental Sensitivity Description

The Presence of Villages

All villages in the Study Area are considered to be **Critical to Highly Sensitive**, as members of the village are classified as being sensitive to activities associated with the proposed Project. A buffer of 200m has been placed around all villages. This buffer area is also characterised as having a critical to high sensitivity.

Cultural Heritage Sites

All structures that could be considered cultural heritage sites in the Study Area have been classified as either one of the following:

- Cultural Heritage Sites - **Critical to Highly Sensitive**
- Cultural Heritage Sites - **Sensitive to Moderately Sensitive**
- Cultural Heritage Sites - **Limited Sensitivity**
- Cultural Heritage Sites - **Not Sensitive**

A buffer of 10m has been placed around these cultural heritage sites.

Artisanal Salt Mining Area

Two areas for artisanal salt mining have been illustrated, namely - an area with lower quality black salt (**Sensitive to Moderate Sensitivity**) and an area with preferred higher quality white salt (**Critical to Highly Sensitive**). These areas were digitised based on differentiations of colour gradients. No buffer has been placed around these areas, as precise areas could not be classified.

Key Tourist Features

The two key tourist features in the Study Area include Mount Dallol and Ashe Ale. These two features were delineated through digitisation of the visual perimeter of the features. Furthermore, a 200m buffer has been placed around the digitised perimeter. Ashe Ale is located within the range of high quality white salt mined by artisanal salt miners. Both key tourist features and their associated buffers have been considered to be **Critical to Highly Sensitive**.

9.14.2

Application of the Socio-environmental Sensitivity Assessment

The socio-environmental map is created as a tool to guide the spatial development of activities/infrastructure in a manner that minimises impacts to both the social and biophysical environments. The following simple approaches should be followed for the planning of activities/infrastructure:

- Activities/infrastructure should be directed wherever possible towards the Limited Sensitivity and Not Sensitive areas.

- Activities/infrastructure that infringes areas classified as being Sensitive to Moderately Sensitive should strive to reduce the impacts on these areas that resulted in the sensitivity rating.
- Activities/infrastructure are to be planned and implemented in a manner that sustains the key values of Critical to Highly Sensitive areas.
- Activities/infrastructure should not infringe areas classified as being Sensitive or Highly Sensitive. Only where no feasible alternatives exist should any impacts be allowed on these habitats, and in such cases additional precautionary measures should be taken that reduce the impacts specifically on the biodiversity and ecosystem values for which these habitats have been classified as Sensitive or Highly Sensitive.

The predicted impacts to the physical and biological environment as a result of the proposed Dallol Potash Project are described in this chapter. Potential impacts to the socio-economic environment and community and occupational health as a result of the proposed Project are described in *Chapter 11*.

10.1***PROJECT AREA AND STUDY AREA DEFINITIONS***

For all the impact assessment chapters (this Chapter and *Chapter 11*), the definitions applicable to the Project Area and the Study Area are as follows:

- ***Project Area*** - defined as the footprint in which the actual mining development (solution wells, evaporation ponds, construction village, processing plant and ancillary linear infrastructure) will be developed.
- ***Study Area*** - defined as the footprint of the actual mining development including surrounding villages/towns from Berahale through to Bada.

10.2***ASSESSMENT OF IMPACTS AND MITIGATION***

This Chapter and *Chapter 11* provide an analysis of the direct and indirect impacts, both positive and negative, to the physical, biological, socio-economic and health environments that are expected to result from the construction, operation and decommissioning of the proposed Dallol Potash Project.

The methodology to identify and assess impacts is explained in *Chapter 6*; however, a summary is given here for ease of reference.

10.2.1***Methodology and Impact Assessment Layout***

From *Section 10.5* in this Chapter and *Chapter 11* the impact assessment is laid out as follows:

- Each section begins with the type of impact being assessed (e.g. *Section 10.5- Impacts on Air Quality* and *Section 10.5.1 - Impacts Related to Construction Activities during the Construction Phase*).
- Background information relating to the impact is then provided. This includes a description of the baseline environment that will be affected, the Project aspect or activities that will cause the impact and a description of the effected receptors.

- The significance of the impact pre-mitigation is then assessed and rated through use of a rating table; following which, the residual impact (post-mitigation) is rated.
- Following the pre- and post-mitigation rating tables a section describing the recommendations and mitigation measures proposed are provided.

Descriptions of impact assessment terminology are given in *Chapter 6* but are repeated below.

Table 10.1 *Impact Assessment Terminology*

Designation	Definition
Impact Nature	
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Impact Type	
Direct	Impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).
Cumulative	Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors of the Project.

Following the above mentioned, each impact is described. This assessment process is summarised in boxes setting out the impact magnitude (which is a function of extent, duration, scale, frequency and likelihood). The descriptions of each of these criteria are provided in *Chapter 6*, but are repeated in *Table 10.2* and *Table 10.3* below for ease of reference purposes.

Table 10.2 *Impact Characteristic Terminology*

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	Direct Indirect Induced
Extent	The “reach” of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.).	Local Regional International
Duration	The time period over which a resource / receptor is affected.	Temporary Short-term Long-term Permanent

Characteristic	Definition	Designations
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.)	[no fixed designations; intended to be a numerical value]
Frequency	A measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value]

Table 10.3 *Definitions for Likelihood Designations*

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (i.e., it is essentially inevitable).

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity/vulnerability/importance of the impacted resource/receptor. As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity/vulnerability/importance designations are:

- Low;
- Medium; and
- High.

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterised, the significance can be assigned for each impact (*Table 10.4*).

Table 10.4 *Impact Significances*

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrices presented in the methodology act as a guide only and there may be situations where their rigid application is inappropriate and where stakeholder perceptions and feedback have a significant role to play. For specific impacts in which this is the case, the derivation of significance is clearly explained in the evaluation of the impact.

10.2.2 *Air Quality Impact Assessment*

As is mentioned in *Chapter 6*, there is a need to make specific consideration of the guidance set out by the IFC when defining the significance of air quality impacts.

As per the IFC guidance, a degraded airshed is defined as a location where the baseline air quality is already in excess of the IFC air quality standards.

The significance of impacts is therefore defined in terms of the magnitude of impacts (i.e. the Process Contribution or PC), and whether the baseline pollution concentrations are above or below the air quality standards. Using this approach, the significance criteria for air quality have been defined. These are set out in *Table 10.5*.

Table 10.5 *Magnitude Criteria for Assessment of Air Pollutants*

Magnitude of Impact	Undegraded Airshed (i.e. baseline < AQS)	Degraded Airshed (i.e. baseline > AQS)
Negligible	PC <25% of AQS	PC <10% of AQS
Small	PC between 25% and 50% of AQS and PEC <100% of AQS	PC between 10% and 30% of AQS
Medium	PC between 50% and 100% of AQS, and PEC <100% AQS; or	PC between 30% and 50% of AQS
	PC between 25% and 50% of AQS, and PEC >100% of AQS	
Large	PC > 100% of AQS; or	PC > 50% of AQS
	PC > 50% of AQS, and PEC >100% of AQS	
PC: Process Contribution PEC: Predicted Environmental Concentration AQS: Air Quality Standard		

10.2.3 *Noise Impact Assessment*

Noise standards and guidelines generally give threshold levels (criteria), or minimum noise changes, above which noise impacts are expected. In using such guidance it is necessary to scale the degree of exceedence of the appropriate criteria into the impact magnitude ranges, which are required for an impact assessment. There are various guidelines on responses to changes in

noise levels and the probable response to excess change in noise level is presented in *Table 10.6*.

Table 10.6 *Noise Impact Magnitude Semantics*

Scale of Noise Exceedence OR Change in Noise Level	Impact Magnitude Classification EXCEEDENCE	Impact Magnitude Classification CHANGE	Comment
0 to 1 dB	Negligible	Negligible	Change in noise level would not be detected by most people
1 to 3 dB	Small	Small	Changes in environmental noise of less than 3dB are often not noticeable to a community
3 to 5 dB	Small	Medium	Noticeable change by some people
5 to 10 dB	Medium	Medium	Noticeable change by most people
>10 dB	Large	Large	A change of 10dB is often judged as subjectively twice as loud so may have additional significance, e.g. Very Large

The step from Impact Magnitude to Impact Significance may involve considering factors that influence significance. In cases where these factors are not deemed significant, the following pairings between Impact Magnitude and Impact Significance can be used (*Table 10.7*).

Table 10.7 *Noise Significance Semantic*

Impact Magnitude Classification		Impact Significance Rating
Negligible	Consider other influencing factors if necessary	Negligible
Small		Minor
Medium		Moderate
Large		Major

Factors that have the ability to increase or decrease noise emissions, propagation and the perception of noise that may influence significance, beyond impact magnitude include:

- **Duration;**
- **Operating Hours;**
- **Character of the Noise** - low frequency, tonality, impulsive, intermittent;
- **Receptor Detail or Building Design** - insulation, double glazing;
- **Existing Acoustic Environment;** and
- **Meteorological Conditions** - prevailing winds, temperature inversion.

For construction noise, the following impact assessment matrix (adopting the most stringent (>6 months duration) long term criteria) will be used (refer to *Table 10.8*).

Table 10.8 Construction Noise Impact Magnitude

Operating Period	Daytime Noise Level LAeq,1hr dB(A)				Night time Noise Level LAeq,1hr dB(A)			
	Negligible	Small	Medium	Large	Negligible	Small	Medium	Large
Long term exposure >6 months	<55	55 - 60	>60 - 65	>65	<45	45 - 50	>50 - 55	>55

For operational noise, the following impact assessment matrix will be used (refer to *Table 10.9*).

Table 10.9 Operational Noise Impact Magnitude

Operating Period	Daytime, LAeq, 1hr dBA				Night time, LAeq, 1hr dB			
	Negligible	Small	Medium	Large	Negligible	Small	Medium	Large
Impact Rating								
Noise Exceedence Impact Magnitude	<55	55-60	>60-65	>65	<45	45-50	>50-55	>55
Δ Baseline Impact Magnitude (LAeq, 1hr - LA90)	<10	10-15	15-20	>20	<10	10-15	15-20	>20

For traffic noise, the IFC guideline will be adopted to assess the road traffic noise impacts as the road’s existence is fundamentally linked to the Project.

10.2.4 Social Impact Determination

Furthermore, the overall approach to the rating and evaluation of social (including visual and cultural heritage) impacts is similar to what is detailed in *Section 10.2.1* above; however, the impact criteria used to define social sensitivities is disparate, and is detailed in *Annex D* of *Volume Two*.

10.2.5 Mitigation Measures and Residual Impacts

This chapter and *Chapter 11* detail potential mitigation measures in order to avoid, minimise, reduce, remedy or compensate for potentially negative

impacts, and enhance potential benefits of the Project. Furthermore the chapters provide a prediction of the residual impact that will remain, assuming that the appropriate mitigation measures are implemented. The development of mitigation measures and the management of residual impacts are fully described in each of the Management Plans provided in *Volume Three* of the ESHIA. Furthermore, a framework for the development of an Environmental, Social and Health Management System is provided in *Chapter 13*.

This Chapter and *Chapter 11* are divided into the following impact areas:

- *Chapter 10* – considers impacts to the *physical and biological environment* (including impacts on hydrology, air quality; noise environment and biological environment).
- *Chapter 11* – considers impacts to the socio-economic environment (including socio-economics and livelihoods; social and cultural cohesion; community health, safety and security; tangible cultural and heritage; physical and social infrastructure resources and services; landscape and visual environment; and labour and working conditions).

10.3 *IMPACTS ON HYDROLOGY*

The predicted impacts to the surface water environment as a result of the proposed Project are described in this Section. The baseline assessment of the surface water environment is presented in *Chapter 8*.

10.3.1 *Impacts Related to Interruption of Flows in the Bosi River due to Installation of Plant Infrastructure*

Background

Description of Baseline Environment

The Bosi River (refer to *Figure 8.14* in *Chapter 8*) collects water from the catchment to the west of the Project Site and is a west to east flowing river with a flow path flowing directly into the Project Site. The Bosi River is non-perennial and flows are only reported to occur during high rainfall flash flood events in the western highlands. As such, the river is not used extensively by local communities and does not support any significant ecological resources.

Proposed Project Activities

As part of the proposed Project, buildings, pipelines, roads, processing plant and temporary tailings storage will be constructed on the western portion of the concession area. As the Bosi River drainage line enters the western perimeter of the concession area, this drainage line has the potential to interfere with the operations of the proposed Project and if in flood, may cause production losses.

Sensitive Receptors

The Project site itself is considered a highly sensitive receptor, as should flash floods enter the active Project Area this would result in major damage to equipment and cessation of operations, resulting in production losses.

Significance of Impact (Pre-mitigation)

The magnitude of the impact is considered large and the sensitivity of the receptor high. Therefore, the significance of the impact is considered a “**Major Negative Impact**” (Table 10.10).

Table 10.10 Rating of Impacts Interruption of Flows in the Bosi River and Project Site (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Rating	Summary of Reasoning
Extent	Local	The interruption of the Bosi River flow will be local at the bottom reach of the drainage line and within the proposed Project site.
Duration	Long term	There is potential of the impact to occur during all phases of the Project.
Scale	Large	In the event of a flash flood entering the Project Site there is potential for major damage to equipment and cessation of operations and hence production losses.
Frequency	In-frequent	The high intensity short term rainfall events in highlands required to generate a flash flood are infrequent. Therefore the river flows very infrequently
Magnitude of Impact		
		Large
Large Magnitude		
There is potential for major damage to equipment and cessation of operations. The impact could occur at any time during the life cycle of the Project. Therefore the magnitude of the impact is considered large.		
Sensitivity of the Receptor		
Designation	Summary of reasoning	
High	The proposed Project Area is also considered a high sensitivity receptor as flash flood events have potential to cause major damage to equipment and production losses.	

Significance Rating Before Mitigation	
Negative Impact	Major Negative Impact
Major	

Recommendations and Mitigation/Management Measures

The following mitigation measures will be used to reduce the significance of the impact:

- Diversion of the Bosi River flow path around the Project Site into the nearest natural drainage path or Wadi to prevent flow onto the site. The diversion channels will be designed to accommodate these short duration /high flow events.
- Clean water will be diverted around the site and dirty water within the site boundary (if any) will be managed on the site such that it does not flow from the site, and mix with floodwaters.
- Stormwater control infrastructure will be designed to account for the high intensity flash flood events that are known to occur in the region and should accommodate a 1/100 year 24 hour event.

Residual Impact (Post Mitigation)

The mitigation measures above will reduce the scale of the impact to low reducing the significance of the impact to a '**Moderate Negative Impact**' (Table 10.11).

Table 10.11 Rating of Impacts Interruption of Flows in the Bosi River (Post-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Rating	Summary of Reasoning
Extent	Local	Interruption of the Bosi River flow will be local towards the bottom reach of the drainage line and into the Project Area.
Duration	Long term	There is potential of the impact to occur during all phases of the Project.
Scale	Low	With the mitigation measures implemented the scale of the impact will be reduced to low.
Frequency	In-frequent	The high intensity short term rainfall events in highlands required to generate a flash flood are infrequent. Therefore the river flows very infrequently
Magnitude of Impact		
	Small	
Small Magnitude		

The Bosi River flows only in flash flood events the clean water from the river will be diverted around the Project Site. With this mitigation the magnitude of impact on the Project Site is considered small.

Sensitivity of the Receptors	
Designation	Summary of reasoning
High	The proposed Project Area is considered a high sensitivity receptor as flash flood events have potential to cause major damage to equipment and stop operations.
Significance Rating After Mitigation	
Negative Impact	
Moderate	Moderate Negative Impact

10.3.2 Impacts Related to the Discharge of Pollutants from Non-Mining Activities into Water Courses in the Region

Background

Description of Environment

The majority of the rivers in the Study Area are ephemeral with the exception of the Sabah River (over 10km south of the Project Area) which maintains flows all year round. Other perennial water bodies include the Regali River which runs along the Eritrean-Ethiopian border and the Wadi Ainallah ca. 25km south of the Sabah River.

Proposed Project Activities

The proposed Project will require vehicle movements to and from the site to carry supplies and transport staff. It has been observed that some Government and road construction vehicles are washed in the Sabah River and this has the potential to contaminate the river system, leading to impacts to biodiversity (impacts to the aquatic ecology as a result of the vehicle crossing point over the Sabah River downstream of this point, have already been observed).

Sensitive Receptors

The Sabah River is one of three perennial water bodies in the Region. The river is used by all communities located along the banks of the river and is one of three perennial water bodies (the other being the Regali River to the north and the Wadi Ainallah ca. 25km south of the Sabah River) in the region that supports aquatic life.

Impact Significance (Pre-Mitigation)

Given the high sensitivity of the receptor and the potentially long term and large scale of the impact, the impact is considered **'Major Negative Impact'** (Table 10.12).

Table 10.12 Impacts Related to the Discharge of Pollutants from Non-Mining Activities into Perennial Water Resources in the Region (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Rating	Summary of Reasoning
Extent	Regional	The Sabah River runs from the western highlands through to lake Assale and the impact has potential to have a regional extent.
Duration	Long term	There is potential of the impact to occur during construction, operations and closure.
Scale	Large	The scale of the impact is dependent on the type of contaminants that enter the river and their concentrations in the water, chemicals such as fuels would result in a large scale impact.
Frequency	Frequent	There is potential for the impact to occur at any time during construction, operations and closure.
Magnitude of Impact		
		Large
Large Magnitude		
The impact has potential to impact regionally and potentially at a large scale. As the impact can occur at any time during construction, operations and closure the magnitude of the impact is considered Large.		
Sensitivity of the Receptor		
Designation	Summary of reasoning	
	The Sabah River is one of only three perennial water bodies in the Study Area and is considered a highly sensitive receptor, as the river is used by all communities located along the banks of the river and this river supports aquatic life.	
High		
Significance Rating Before Mitigation		
Negative Impact	Major Negative Impact	
	Major	

Recommendations and Mitigation /Management Measures

The following mitigation measures will be used to reduce the significance of the impact:

- Allana will continue to prohibit the washing of vehicles in the Sabah River. All vehicles associated with Allana (including those of contractors) are to be washed at the wash bays on the site. Wash bays on site are to include oil/grease and sediment traps for grey water, before this water is released off-site.
- An ESH-MS will be developed to define procedures for handling of fuels, chemicals and wash-down of vehicles in a manner that does not impact on the environment.

- Staff and contractors will be inducted appropriately using the ESH-MS and this induction will cover operating procedures for cleaning of vehicles and storage of fuels and chemicals.
- Chemicals will be stored in bunded areas and emergency spill response equipment will be stored near to all chemical and fuel storage sites.
- The sewage treatment system will be run in a manner that results in zero discharge of raw sewage to the environment. Treated sewage will conform to recognised standards before discharge.
- A low level bridge along the path of the access road into the Study Area should be constructed over the Sabah River. This bridge should be constructed to withstand 1:100 year flood events. It is believed that the government will construct such a bridge as part of the road development between Berahale and Bada.

Impact Significance (Post-Mitigation)

Given the high sensitivity of the receptor and the potentially long term and small scale of the impact the impact is considered '**Major Negative Impact**' (Table 10.12).

Table 10.13 *Impacts Related to the Discharge of Pollutants from Non-Mining Activities into Perennial Water resources in the Region (Post-Mitigation)*

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Rating	Summary of Reasoning
Extent	Regional	The Sabah River runs from the western highlands through to lake Assale and the impact has potential to have a regional extent.
Duration	Long term	There is potential of the impact to occur during construction, operations and closure.
Scale	Small	Implementation of the above mitigation measures would reduce the scale of the impact to small.
Frequency	In-frequent	With proper site management the impact will be in-frequent.
Magnitude of Impact		
		Small
Small Magnitude		
The impact has potential to impact regionally and potentially at a large scale. Implementation of the above mitigation measures will reduce the scale and frequency of the impact resulting in an impact of small magnitude.		
Sensitivity of the Receptor		
Designation	Summary of reasoning	
High	The Sabah River is the only perennial water body in the Study Area and is considered a highly sensitive receptor as it is the only fresh surface water source in the region. The river is used by all communities located along the banks of the river and is one of only three perennial water bodies in the region that supports aquatic life.	

Significance Rating After Mitigation	
Negative Impact	Moderate Negative Impact
Moderate	

10.4 IMPACTS ON GEOHYDROLOGY

The predicted impacts to the groundwater water environment as a result of the proposed Project are described in this Section. The baseline assessment of the surface water environment is presented in *Chapter 8*.

10.4.1 Impacts Related to Groundwater Drawdown in the Alluvial Fan Aquifers

Background

Description of Baseline Environment

The groundwater located in the alluvial fans to the west of the Study Area is the target water source for the solution mining production water.

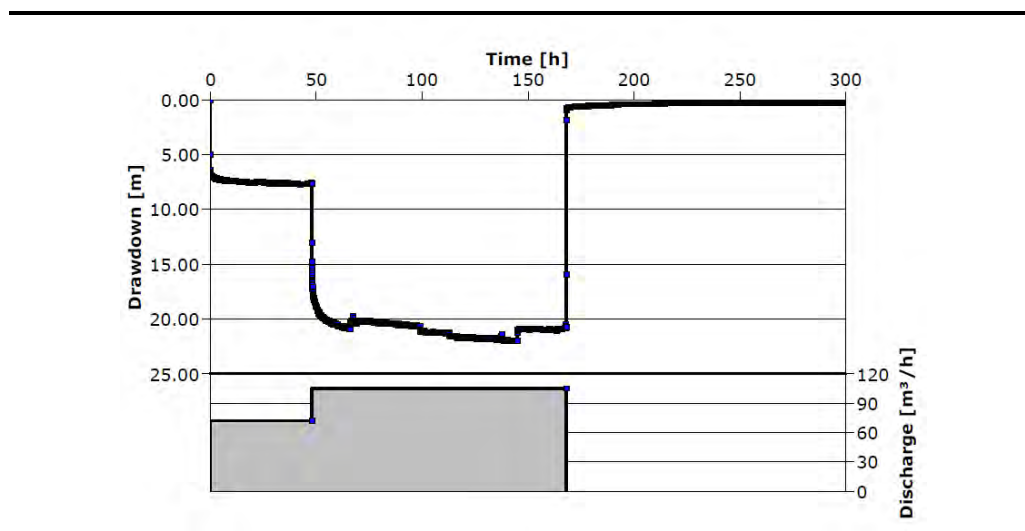
Based on the results of geophysics studies undertaken by Fugro (2012), the medial thickness of water bearing sediments in these alluvial fans can be estimated at between 30 to 40m between the basement rock of the westerly mountain range and the salt plain in the Danakil Depression. Based on this data, Fugro (2012) conceptualize a potential groundwater reservoir with a volume of approximately **180,000,000 m³**; the usable volume of which would be dependent on the water quality, especially chloride, which may render some water too brackish for use in solution mining. Taking into account a water demand of approximately **16,000,000m³/a** for solution mining in the Study Area, the reservoir would be depleted, *without recharge*, after approx. 11 years.

Recharge is therefore the critical factor in determining the long term sustainability of utilizing this potential water resource.

Recharge into the alluvial fan area was estimated by Fugro (2012) based on the results of geophysics, drilling, pump tests and water level measurements. To date, a total of 18 observation wells at 9 locations, 3 pumping wells and 2 solution wells have been drilled on the Project Site.

The pumping test, pumping at a rate of 110 m³/h for 168 hours (*Figure 10.1*) shows that the groundwater table recovers completely and immediately at the end of testing. This data suggests the cone of depression surrounding this well as a result of drawdown was steep and recovered shortly after pump testing. Such long term pump tests at the pumping wells and depth to groundwater monitoring (October 2011 to December 2012) measured at all boreholes in the Study Area indicates a permanent subsurface influx to the groundwater bearing fan structures.

Figure 10.1 Pump Test Data (100m³/h for 168h): HyDal-20-PW



This data was presented in the hydrogeological baseline (*Chapter 8*).

In order to quantify recharge, Fugro (2012) developed a conceptual geohydraulic model, with the following structure and parameters:

- One layer (2D);
- One hydraulic conductivity of $7 \cdot 10^{-4}$ m/s (the average rate from all the pumping tests conducted);
- A geological base of -145 m masl;
- Varying evaporation rates up to 3600mm to a depth of water table of 0,5 m; and
- No direct recharge caused by precipitation in the fan area.

Due to the uncertainty with regards the evaporation rate and depth of evaporation influence; this input into the model was tested using various evaporation rates.

The conceptual model results indicated that in order to maintain the detected hydraulic gradient, a subsurface influx (recharge) from the west of between **35.7 Mm³/a and 55.2 Mm³/a** is required. This result is an important indication of a considerable influx (recharge) into the alluvial fans through large fault structures, and serves to confirm recharge indicated by initial long term pump test and longer term groundwater depth measurements.

Proposed Project Activities

The proposed Project will require large volumes of water during the operational phase, with current estimates for full production being 16 Mm³/a. Given the results of geophysics studies, pump testing, groundwater depth monitoring, and the output of the geohydraulic model, Fugro (2012) conclude that the water demands of this Project, in terms of quantity, will be able to be met with a high degree of probability.

Sensitive Receptors

The water in the Alluvial Fans (the target water source) flows into the Salt Pan Fringe and supports both community users and ecological resources.

Current users of groundwater from the *targeted alluvial fan systems* include the villages of Mororo (situated within the Allana concession) and Alai lai (situated a few meters outside of the Allana concession). These villages source their water from an open saline pool on the edge of the salt flats; this water has high concentrations of, in particular, sulphate, sodium, chloride and potassium, which are above the maximum allowable SANS Class II guideline, rendering it unsuitable as a source of potable water. Currently therefore, these communities receive water that is delivered to them by the Ethiopian Military; however, this supply has been reported to be unreliable.

The Salt Pan Fringe Habitat type maintains an interaction between ecology and people and is of high importance with respect to ecosystem services. Therefore the Salt Pan Fringe is considered of high sensitivity.

Impact Significance (Pre-Mitigation)

Given the sensitivity of the receptor, and the volumes of water to be abstracted, and applying the precautionary principle in the rating of such impacts, the impact is considered a **'Moderate Negative Impact'** (Table 10.14).

Table 10.14 *Rating of Impacts Related to Drawdown of the Alluvial Fan Aquifer (Pre-Mitigation)*

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Rating	Summary of Reasoning
Extent	Local	The extent of any groundwater drawdown will be confined to each of the targeted alluvial fans, from the point where it exits the mountains to the west, to the edge of the salt plains.
Duration	Long term	There is potential of the impact to occur during operations and potentially into post closure. The duration of the impact will be dependent on the level of drawdown and the rate of recharge.
Scale	Small	Given the pump test data presented, drawdown of the aquifer was very localised, and the aquifer recovered immediately upon the cessation of pumping activities. On this basis, drawdown is classified as being localised, and will also be confined to the target alluvial fan.
Frequency	Frequent	There is potential for the impact to occur at any time during operational phase of the mine and potentially into post closure depending on the magnitude of aquifer drawdown and recharge rates.

Magnitude of Impact	
	Small
Small Magnitude	
Based on the results of pump testing, and the longer term monitoring of groundwater levels, a permanent subsurface influx to the groundwater bearing fan structures is evident. Fugro (2012) estimate recharge into the alluvial fan bearing aquifers of between 35.7 Mm ³ and 55.3 Mm ³ . This is an order of magnitude in excess of Allana's water needs, which are approximately 16Mm ³ .	
Sensitivity of the Receptor	
Designation	Summary of reasoning
High	Although the community relying on this water source are not vulnerable (small community capable of being supplied with water of a better quality), the palm fringe habitat, which relies on the seepage of groundwater on the salt plain fringe, is regarded as a sensitive habitat.
Significance Rating Before Mitigation	
Negative Impact	
Moderate	Moderate Negative Impact

Recommendations and Mitigation/Management Measures

Although current monitoring results indicate high recharge, to establish this fact with greater certainty, and to ensure this valuable resource is managed in a safe and sustainable way, the following is required:

- Further isotope investigation for recharge evidence using C-14 as a supplemental survey.
- Installation of a series of monitoring wells between the production boreholes and the Salt Pan Fringe. Where possible, two lines of wells are to be installed as detection wells close to the production well and a second set of wells further downstream of the detection wells. The wells will be monitored regularly and ideally with online systems (data loggers).
- Continued long term monitoring of groundwater levels in boreholes and wells on a regional scale.
- During the well field development phase. Fugro (2012) recommend 4 weeks' demonstration pumping in every established well field for recharge verification, and observation of water quality development by way of sampling and analysis in each of the observation and production wells.
- This data, together with long term monitoring of groundwater levels in boreholes and wells on a regional scale, will allow for further refinement of the geohydraulic water management model, which will confirm recharge characteristics and allow for the optimisation of well positions.

Other proposed mitigation measures include:

- The resettlement of the Mororo and Ali lai Villages. The provision of an alternative water source to these villages should be of a higher quality than what is currently used (preferably to conform to the SANS Class I standard, which is available in all of the surface water bodies in the Region – refer to the table on Regional Water Quality provided in *Chapter 8*).
- Monitoring wells (installed with automatic loggers) should be installed upstream of wells used by communities in the Study Area, and downstream of production wells to provide an early indication of aquifer drawdown.
- The water levels in the community wells are to be monitored and *should* water levels in the wells drop by a significant level, then Allana has committed to providing alternative sources of water. As for the Mororo and Ali lai Villages, these villages will be relocated and will be provided with a new supply of potable water. This water should conform to the SANS Class I standard (which is available in all of the surface water bodies in the Region).
- Transects within the vegetation in the Salt Pan Fringe will be monitored by an appropriately qualified botanist. As the Doum Palms will act as a *secondary* indicator to groundwater draw down, a cutback in water abstraction will be required should a **combination** of the following be realised:
 1. A significant dieback of Doum Palms in the Salt Pan Fringe; and
 2. A significant drawdown in groundwater levels established from groundwater depth monitoring in observation wells.
- The water reservoir appears to have sufficient capacity for water supply, even in dry years. It is however recommended, in order to prevent salt water intrusion and from the viewpoint of sustainability, *to abstract only an amount of ground water equal to the average recharge*.

Residual Impact (Post-Mitigation)

Provided the mitigation measures provided above are implemented, and given that the aquifer parameters and behaviour will be better understood with further data collection and groundwater model refinement, management of this aquifer in a sustainable manner can be achieved, especially if the volumes of groundwater abstracted never exceed the recharge volumes into this aquifer. On this basis, the impact post-mitigation can be considered a '**Moderate Negative Impact**' (*Table 10.15*).

Table 10.15 Rating of Impacts Related to Drawdown of the Alluvial Fan Aquifer (Post-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Rating	Summary of Reasoning
Extent	Local	With continuous groundwater level monitoring, demonstration pumping in every well field for recharge verification, and further refinement of groundwater models used as a groundwater management tool, it is likely that the drawdown of water in the targeted alluvial aquifers will remain localised.
Duration	Long term	There is the potential for the impact to occur during operations and potentially into post closure. The duration of the impact will be dependent on the level of drawdown and the rate of recharge.
Scale	Small	Given the pump test data presented, drawdown of the aquifer was very localised, and the aquifer recovered immediately upon the cessation of pumping activities. On this basis, drawdown is classified as being localised, and will also be confined within the target alluvial fan. If abstraction is limited to the amount equal to the average recharge, drawdown of the aquifer will likely be minimal.
Frequency	Infrequent	If drawdown is limited to the average recharge, and if drawdown is continually monitored and managed, the frequency of large scale drawdown will be minimised.
Magnitude of Impact		
	Small	
Small Magnitude		
Given data presented by Fugro (2012) and assuming the adequate management of the alluvial fan aquifers and the implementation of the mitigation measures suggested, the magnitude of the impact will be small.		
Sensitivity of the Receptor		
Designation	Summary of reasoning	
High	Although the community relying on this water source are not vulnerable (small community capable of being supplied with water of a better quality), the salt pan fringe habitat, which relies on the seepage of groundwater on the salt plain fringe, is regarded as a sensitive habitat.	
Significance Rating After Mitigation		
Negative Impact	Moderate Negative Impact	
Moderate		

Impacts Related to Groundwater Quality as a Result of Groundwater Abstraction in the Alluvial Fan Aquifers

Background

Description of Baseline Environment

The groundwater located in the alluvial fans to the west of the Study Area is the target water source for the solution mining production water.

Based on the results of geophysics studies undertaken by Fugro (2012), the medial thickness of water bearing sediments in these alluvial fans can be estimated at between 30 to 40m between the basement rock of the westerly mountain range and the salt plain in the Danakil depression. Based on this data, Fugro (2012) conceptualize a potential groundwater reservoir with a volume of approx. **180,000,000 m³**; the usable volume is, however dependent on the water quality, especially chloride, which may render some water too brackish for use in solution mining (*Table 10.16*).

The laboratory tests of groundwater samples showed a wide variation in salinity values in the aquifer. The specific conductivity varies between 2 and 187 mS/cm. The main parameters for salinity are Sodium, Chloride and local Calcium.

The water quality measured in the newly drilled wells in the alluvial fans, which are located away from the salt plains (“Alluvial Fan Water”), when compared to the water quality results from seepages in the alluvial fans or seepages near the edge of the salt plains (“Seepage Water”) have two distinct water qualities.

Seepage Water generally has highly elevated major ion concentrations; the concentrations of sodium and chloride in these samples were above the concentrations found in sea water, and these sites are considered highly saline.

Major ion concentrations at sites within the Alluvial Fan boreholes and Observation Wells were considerably lower than the highly saline Seepage Waters; these sites all have concentrations of sodium and chloride that are one or two orders of magnitude lower than the Seepage Water and sea water.

The concentrations of major ions in the Alluvial Fan Water and the Seepage water are however considerably higher than those found in the regional groundwater and surface water samples taken over the wider Study area.

The results of these water quality analyses are also confirmed by Fugro’s geophysics study results, which showed that the water quality of Observation wells with their filters mostly in aquifer 2 (the saline aquifer at depths of lower than -100masl, or at the bottom of the aquifer 1 (the primary aquifer), show higher concentrations of the major ions (refer to *Chapter 8; Figure 8.13: Depth Profiles of the Fugro Geophysical Study*).

In summary, water in the deeper parts of the aquifer and closer to the salt plain, show significantly higher salinities.

Proposed Project Activities

The proposed Project will require large volumes of water during the operational phase, with current estimates for full production being 16 Mm³/a.

The water quality requirements for solution mining and processing water are different. A range of acceptable water quality composition, based on the analytical results of water sampled from wells drilled during the water exploration campaign, is given in *Table 10.16* below.

Processing water for the plant should have a low mineralisation. For solution mining the requirements are less stringent and mixing of different mineralized waters is possible, but overall mineralization should not exceed about 140 ms/cm, with the summed Ca and Mg content below 10 g/l (ErcosPlan, 2012).

Table 10.16 *Allana Water Quality Requirements for Processing Water and for Solution Mining*

	Process Water	Process Water	Solution Mining	Solution Mining
	Good	Acceptable	Acceptable	Barely Acceptable
Na	0.012 g/l	0.083 g/l	14.5 g/l	34.2 g/l
K	0.014 g/l	0.094 g/l	0.70 g/l	1.85 g/l
Mg	0.039 g/l	0.110 g/l	1.10 g/l	2.76 g/l
Ca	0.280 g/l	0.370 g/l	3.38 g/l	7.32 g/l
Cl	0.220 g/l	0.980 g/l	28.0 g/l	64.3 g/l
SO ₄	0.598 g/l	1.21 g/l	2.08 g/l	1.57 g/l
Conductivity	2.05 ms/cm	5.54 ms/cm	70 ms/cm	141 ms/cm

Source: ErcosPlan (2012)

The water quality observed in the Production Wells (HyDal-2-PW, HyDal-20-PW and HyDal-11-PW), and in the Alluvial Fan Water in general, indicates that the water quality in these wells is suitable for Solution Mining.

Sensitive Receptors

The water in the Alluvial Fans (the target water source) flows into the Salt Pan Fringe and supports both community users and ecological resources.

Current users of groundwater from the *targeted alluvial fan systems* include the villages of Mororo (situated within the Allana concession) and Alai lai (situated a few meters outside of the Allana concession). These villages source their water from an open saline pool on the edge of the salt flats (i.e. Seepage Water); this water has high concentrations of, in particular, sulphate, sodium, chloride and potassium, which are above the maximum allowable SANS Class

II guideline, rendering it unsuitable as a source of potable water. Currently therefore, these communities receive water that is delivered to them by the Ethiopian Military; however, this supply has been reported to be unreliable.

The Salt Pan Fringe maintains an interaction between ecology and people and is of high importance with respect to ecosystem services. Therefore the Salt Pan Fringe is considered of high sensitivity.

Other communities in the Project area utilise water from surface water bodies and other aquifers, primarily alluvial aquifers (eg. The Defence Well close to the Sabah River), which are of better quality than the Alluvial Fan and Seepage Water found in the Study area (refer to *Table 8.2 and 8.5 of Chapter 8*).

Impact Significance (Pre-Mitigation)

Given the sensitivity of the receptor (Salt Pan Fringe habitat), the volumes of water to be abstracted, and the presence of both saline and better quality water in the aquifer, the potential impact of a deterioration in groundwater quality as a result of mixing of different quality waters in this aquifer as a result of over-abstraction, is considered a **'Moderate Negative Impact'** (*Table 10.17*).

Table 10.17 Rating of Impacts Related to a Deterioration in the Groundwater Quality of the Alluvial Fan Aquifer (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Rating	Summary of Reasoning
Extent	Local	The extent of any groundwater drawdown and/or deterioration in the groundwater quality will be confined to each of the targeted alluvial fans, from the point where it exits the mountains to the west, to the edge of the salt plains.
Duration	Long term	There is potential of the impact to occur during operations and potentially into post closure. The duration of the impact will be dependent on the level of drawdown and the rate of recharge, but a deterioration in groundwater quality may persist until adequate flushing of the aquifer occurs over the medium to long term.
Scale	Medium	A deterioration in groundwater quality as a result of over-abstraction will be restricted to the target alluvial fan and will be felt primarily at the point of abstraction in the direction of the groundwater flow, which mirrors the natural topography and flows towards the salt plains.
Frequency	Frequent	There is potential for the impact to occur at any time during operational phase of the mine and potentially into post closure depending on the magnitude of aquifer drawdown and recharge rates, and the scale of abstraction.
Magnitude of Impact		
		Medium
Medium Magnitude		

The impact has potential to result in a deterioration in groundwater quality as a result of the over-abstraction of less saline water used in the solution mining process. The intrusion of poorer quality water at lesser elevations and extending from the salt plain edge westwards, could negatively affect vegetation reliant on this groundwater – and although salt tolerant – poorer quality water may exceed the tolerance levels of this vegetation.

Sensitivity of the Receptor

Designation	Summary of reasoning
High	Although the community relying on this water source are not vulnerable (small community capable of being supplied with water of a better quality), the Salt Pan Fringe habitat, which relies on the seepage of groundwater, is regarded as a sensitive habitat. This habitat is salt tolerant (eg. presence of tamarisk sp.), but a deterioration in groundwater quality may affect this habitat.

Significance Rating Before Mitigation

Negative Impact	Major Negative Impact
Major	

Recommendations and Mitigation/Management Measures

Many of the proposed mitigation measures relating to a better understanding of the recharge characteristics of the targeted aquifers are also relevant to managing and controlling the salinity levels of these aquifers. The primary mitigation measures include:

- Installation of a series of monitoring wells between the production boreholes and the Salt Pan Fringe. Where possible, two lines of wells are to be installed as detection wells close to the production well and a second set of wells further downstream of the detection wells. The wells will be monitored regularly and ideally with online systems (data loggers) for the continuous measurement of groundwater depths.
- Continued long term monitoring of groundwater water quality in boreholes and wells on a regional scale.
- During the well field development phase Fugro (2012) recommend 4 weeks’ demonstration pumping in every established well field for recharge verification, and observation of water quality development by way of sampling and analysis in each of the observation and production wells.
- This data, together with long term monitoring of groundwater levels in boreholes and wells on a regional scale, will allow for further refinement of the geohydraulic water management model, which will confirm recharge characteristics, and will allow for the maintenance of and allow for the optimisation of well positions.

Other proposed mitigation measures include:

- The resettlement of the Mororo and Ali lai Villages. The provision of an alternative water source to these villages should be of a higher quality

than what is currently used (preferably to conform to the SANS Class I standard, which is available in all of the surface water bodies in the Region – refer to the table on Regional Water Quality provided in *Chapter 8*).

- The water levels in the community wells are to be monitored and *should* water levels in the wells drop by a significant level, then Allana has committed to providing alternative sources of water. As for the Mororo and Ali lai Villages, these villages will be relocated and will be provided with a new supply of potable water. This water should conform to the SANS Class I standard (which is available in all of the surface water bodies in the Region).
- Transects within the vegetation in the Palm Salt Fringe will be monitored by an appropriately qualified botanist. As the Doum Palms will act as a *secondary* indicator to groundwater draw down, a cutback in water abstraction will be required should a **combination** of the following be realised:
 1. A significant dieback of Doum Palms in the Salt Pan Fringe; and
 2. A significant drawdown in groundwater levels established from groundwater depth monitoring in observation wells.
- The water reservoir appears to have sufficient capacity for water supply, even in dry years. It is however recommended, in order to prevent salt water intrusion and from the viewpoint of sustainability, *to abstract only an amount of ground water equal to the average recharge*.
- Regarding salinity, it may become necessary to blend the different waters for the different wells to establish a uniform water quality for solution mining purposes.

Residual Impact (Post-Mitigation)

Provided the mitigation measures provided above are implemented, and given that the aquifer parameters and behaviour will be better understood with further data collection and groundwater model refinement, management of this aquifer in a sustainable manner can be achieved, especially if the volumes of groundwater abstracted never exceed the recharge volumes into this aquifer. On this basis, the impact post-mitigation can be considered a **'Moderate Negative Impact'** (Table 10.18).

Table 10.18 *Rating of Impacts Related to a Deterioration in the Groundwater Quality of the Alluvial Fan Aquifer (Post-Mitigation)*

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Rating	Summary of Reasoning
Extent	Local	The extent of any groundwater drawdown and/or deterioration in the groundwater quality will be confined to each of the targeted alluvial fans, from the point where it exits the mountains to the west, to the edge of the salt plains.

Duration	Long term	There is potential of the impact to occur during operations and potentially into post closure. The duration of the impact will be dependent on the level of drawdown and the rate of recharge, but a deterioration in groundwater quality may persist until adequate flushing of the aquifer occurs over the medium to long term.
Scale	Medium	A deterioration in groundwater quality as a result of over-abstraction will be restricted to the target alluvial fan and will be felt primarily at the point of abstraction in the direction of the groundwater flow, which mirrors the natural topography and flows towards the salt plains.
Frequency	Infrequent	Although there is the potential for the impact to occur at any time during operational phase of the mine, with adequate management of the aquifer (groundwater levels monitoring, water quality monitoring, refinement of groundwater models) and limiting abstraction to a maximum amount not exceeding annual average recharge, the potential for salt water intrusion as a result of over abstraction will be limited.

Magnitude of Impact	
Small	Medium

Although there is the potential for the impact to occur at any time during operational phase of the mine, with adequate management of the aquifer (groundwater levels monitoring, water quality monitoring, refinement of groundwater models) and limiting abstraction to a maximum amount not exceeding annual average recharge, the potential for salt water intrusion as a result of over abstraction will be limited.

Note: Allana’s processing plant requires water of a low mineralisation. By over-abstraction of the aquifer, Allana will jeopardise the availability of good quality water for this process. Allana therefore also have a vested interest in managing the aquifer sustainably, not only in terms of quality, but also in terms of water quality.

Sensitivity of the Receptor

Designation	Summary of reasoning
	As the hydro-geologic conditions of the alluvial fan aquifer and other aquifers in the region is not fully understood a conservative approach has been undertaken and sensitivity of the receptor is considered high.

High

Significance Rating Before Mitigation	
Negative Impact	Moderate Negative Impact
Moderate	

10.5

IMPACTS ON AIR QUALITY

The predicted impacts to air quality as a result of the proposed Project are described in this Section. The key sources of emissions are:

- Construction activities;
- Movement of vehicles over paved and unpaved surfaces;
- Vehicle emissions;
- Extraction of potash from evaporation ponds and the processing and handling of potash product and residual materials;

- Tailings stockpiling and processing;
- Power generation utilising fossil fuels; and
- Decommissioning.

There are two key impacts that are considered in the assessment: emissions of dust and PM₁₀ from mechanical generation (i.e. the passage of vehicles over unpaved roads, and earthworks), and emissions arising from combustion processes (i.e. vehicle exhausts and power plant emissions).

In the case of fugitive emissions arising from mechanically generated dust, this is a particularly important consideration for the proposed Project. Due to a combination of factors the potential for dust to be generated is high. The underlying material onsite is wadi outwash deposit, composed of a mixture of rocks, stone, gravel, sand and silt. The silt component of this material has the potential to become friable when disturbed. This material underlies the area proposed for the processing plant and will likely be used to construct internal access roads. The climatic conditions mean that any moisture in the upper layer of the wadi outwash deposit is rapidly evaporated. When the surface is disturbed there is therefore little or no moisture to bind fines and attenuate the generation of dust. The high potential for dust generation is further exacerbated by the elevated wind speeds to which the Study Area is subjected. There is also a lack of natural barriers when the winds are from the northeast east and southeast, as is frequently the case, which further exacerbates the issues associated with high winds.

Any dust generated will remain airborne and travel considerable distances. Research undertaken by the Desert Research Institute (2010) states:

“Based on gravitational settling velocities that apply to particles with aerodynamic diameters >~2 µm (Slinn, 1982), ... half of the 10 µm particles mixed within the first meter are removed after ~3.5 minutes, and that half of the 2.5 µm particles in this layer are gone after an hour. Less than 10% of the 10 µm particles remain after 12 minutes, with 90% of the 2.5 µm particles depleted after 3.5 hours. A 1 m/s wind speed results in a transport distance of 3.6 km/hr. In an average 5 m/s wind, only 10% of the 10 µm particles uniformly mixed through a 10 m depth would travel more than 36 km from the source within two hours after suspension, while 10% of the 2.5 µm particles could achieve distances of nearly 600 km”.

On the basis of this evidence it is apparent that emissions of PM₁₀ and PM_{2.5} from fugitive sources have the potential to travel considerable distances from source.

All mitigation/management measures recommended in this Section have been detailed in the Air Quality Management Plan (AQMP) (refer to Annex A of Volume Three).

*Background**Description of the Baseline Environment*

Based on the monitoring results presented in *Chapter 8*, in terms of dust deposition, PM₁₀ and PM_{2.5}, the existing airshed is described as **degraded**. This is attributed to the high level of naturally occurring dust associated with the extremely arid climate, high wind speeds and lack of vegetation. In terms of NO₂ and SO₂, the existing airshed is described as **un-degraded**, primarily due to low vehicle numbers and a lack of any industry.

Proposed Project Activities

The construction of the proposed Dallol Potash Project will involve the construction of access roads; transport of materials to the site by truck; earthworks to prepare the site for construction; construction of the processing plant, ancillary facilities and staff village; and construction of the mine workings and evaporation ponds.

The construction activities have the potential to result in significant emissions of dust, PM₁₀ and PM_{2.5} to atmosphere, and significant emissions of combustion gases. In addition, the movement of trucks around the Study Area will result in impacts to air quality as a result of emissions from exhausts and also from the lifting of dust from the road surface and open surfaces.

Furthermore, earthworks are a potential significant source of emissions of dust and PM₁₀. The underlying material is wadi outwash deposit, composed of a mixture of rocks, stone, gravel, sand and silt. This material is deposited when the wadi's flood. Upon drying, the fine material will be lifted off or cemented with larger particles leaving a crust. When this layer is disturbed and the underlying materials are exposed, the fine materials within the silt component have the potential to become friable and therefore airborne. This effect is greatly exacerbated by the high wind speeds, high temperatures and the extremely arid conditions, as described in *Chapter 8*, which will rapidly dry this material and lift dust from exposed surfaces and stockpiles.

Sensitive Receptors

Construction activities are potentially a particularly significant source of emissions of dust, PM₁₀ and PM_{2.5}. In addition, due to the local meteorological conditions, there is the potential for impacts associated with dust emissions to be significant at a distance of several kilometres downwind based upon evidence from the Desert Research Institute (2010) (presented in *Section 10.5* above). As a result, construction activities have the potential to negatively impact on sensitive receptors some distance from the site, including Mororo, Alai lai and Hamad Ela.

The emissions associated with the construction activities have not been quantified as these will depend very much upon the exact activities taking place at any one time or location. However, due to the local conditions, if unmitigated and uncontrolled, impacts are potentially of Major Significance. On this basis, a number of mitigation measures are identified to control emissions of dust and PM₁₀. These mitigation measures take into consideration the local conditions, and the fact that certain techniques, for example vegetating and watering will be of less effect or ineffectual due to the local conditions.

In terms of vehicle emissions, the number of vehicles during the construction phase are unknown; however, it is understood that the numbers of vehicles will be less than generated during the operations phase, where 155 heavy goods vehicle movements per day are estimated (a movement is a one way trip). The potential impacts associated with operational vehicles have been assessed, and the findings are set out in *Section 10.5.2*.

The assessment of the potential impacts of operational phase traffic set out in *Section 10.5.2* identified that impacts associated with emissions of NO₂ from all roads and dust, PM₁₀/PM_{2.5} from paved roads will be negligible; however, impacts from dust, PM₁₀/PM_{2.5} from unpaved roads are predicted to be of major significance. The assumption is made that the roads will be unpaved during the initial construction activities. On the basis that the construction phase vehicle movements will be less than the operational phase, it is reasonable to conclude that in terms of impacts associated with NO₂, dust and PM₁₀/PM_{2.5} associated with paved roads will also be negligible. However, in terms of emissions of dust and PM₁₀/PM_{2.5} associated with unpaved roads it is reasonable to conclude that there is the potential for major negative impacts.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above and in *Section 10.5.2*, it is the opinion of this ESHIA that air quality impacts from construction activities pre-mitigation will be a '**Major Negative Impact**'.

This is as a result of the notion that:

- Impacts associated with emissions arising from vehicle exhausts will be a negligible negative impact for all roads (paved or unpaved);
- Impacts associated with PM₁₀ and PM_{2.5} emissions for paved roads will be a negligible negative impact; and
- Impacts associated with emissions (PM₁₀ and PM_{2.5}) arising from vehicular movement along unpaved roads and/or construction works taking place on friable wadi material will be a major negative impact.

Refer to *Table 10.19* below.

Table 10.19 Rating of Impacts Related to Construction Emissions (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Within 5km of construction activities	Construction activities and the movement of vehicles along unpaved roads at the site have the potential to result in significant emissions of dust. Due to the extremely arid conditions, dust emissions may travel for up to 5km from the construction activities in significant concentrations.
Duration	Short Term	Impacts would arise throughout the construction period.
Scale	5km from source	Due to extremely arid conditions in the Study Area, dust emitting construction activities and the movement of vehicles over unpaved roads during the construction phase will result in dust emissions may travel for up to 5km from source.
Frequency	Continuous	Impacts would arise, in effect, continuously from construction activities.
Likelihood	Likely	Impacts will arise throughout the construction period.
Magnitude		
		Large
Large Magnitude		
Impacts associated with emissions of NO ₂ from all roads, and PM ₁₀ , PM _{2.5} and dust from paved roads are negligible. Impacts associated with emissions of PM ₁₀ , PM _{2.5} and dust from open areas and unpaved roads is large .		
Sensitivity of the Receptor		
Designation	Summary of Reasoning	
	All receptors are considered to be of high sensitivity as humans are considered to be equally sensitive to the health effects of airborne pollution.	
High		
Significant Rating Before Mitigation		
Negative Impact		Major Negative Impact
	Major	

Recommendations and Mitigation/Management Measures

With regard to impacts associated with road traffic, the paving of Construction Access Roads used by trucks is considered sufficient mitigation to render all residual impacts as negligible. The recommendation is made that the primary Construction Access Roads are paved as early as possible in the construction phase. If appropriate, priority should be given to those sections of haul roads that are within 5km of sensitive receptors. In addition to permanent paving, consideration should be made to the use of chemical binding or salt encrusting of roads, as means of attenuating dust emissions on roads that are lesser used within the Study Area.

During the early phases of construction works, where unpaved roads will be in use, the use of chemical surface binders should be implemented to minimise emissions from the road surface. Surface watering may be

appropriate for short term mitigation of dust emissions; however, due to the extreme climate, it is anticipated that evaporation rates will be very high and therefore, this technique largely ineffective on larger areas.

In addition, the use of vehicles that are compliant with recent emission standards and maintained in reasonable working order is considered to be good practice. When vehicles are not in use, these should be switched off, unless impractical for health and safety reasons (for example maintenance of air conditioning).

In terms of construction activities, a number of mitigation measures are recommended:

- Vehicles should be kept clean and free of residual dirt and mud, and wash down should continue as is currently the case;
- A speed limit of 28 mph (45kph) should be implemented on unpaved surfaces to minimise the potential for dust to be raised;
- Wind breaks should be erected around the key construction activities (i.e. around the construction sites of the processing plant, staff village, power plant), and, if possible, in the vicinity of potentially dusty works;
- All vehicles leaving and accessing the site carrying friable materials should be covered;
- Where ground and earthworks are exposed, these areas should be covered as far as possible, for example with sheeting or boarding, or the use of chemical binders investigated;
- Where ground and earthworks are covered or surface binders are used, the smallest possible area for working should be exposed;
- Where practicable, surface binding agents should be used on exposed open earthworks and on open (unpaved) surfaces used by vehicles;
- Use of localised dampening (good quality water should not be used) and activity specific dampening should be used to reduce localised emissions of dust;
- Stockpiling of material, for example, wadi outwash, rocks, sand and soils should be minimised;
- Drop heights of material when stockpiling should be minimised;
- Where stockpiles are in use, the design should be optimised to retain a low profile with no sharp changes in shape;

- Stockpiles should be located as far away as possible from receptors; and
- Stockpiles should be enclosed or sheeted as far as practicable.

In addition to the implementation of mitigation measures, monitoring of meteorological conditions and ambient dust and PM₁₀ should be undertaken. The monitoring of PM₁₀ should be undertaken at the site boundary, and should include provision of 'action levels'. The 'action levels' are trigger points at which investigation of on-site dust raising activities and baseline conditions are investigated. In the event that activities are being undertaken which are resulting in unacceptable emissions of dust, further localised mitigation and control should be implemented (i.e. localised water spraying), or activities ceased until weather conditions improve or more effective dust suppression is identified.

Residual Impact (Post-mitigation)

With suitable mitigation/management this impact is likely to decrease, resulting in a residual assessment of the impact as a '**Moderate Significance Impact**' (refer to Table 10.20 below).

Table 10.20 Rating of Residual Impacts Related to Construction Emissions (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Within 5km of construction activities and construction access roads	The impacts associated with construction activities will be difficult to control from all sources and at all times, due to the extremely challenging local climatic conditions. Therefore, whilst mitigation measures will render residual impacts as <i>Negligible</i> for the majority of the time, no guarantee can be made that significant impacts will not, occasionally, arise. Mitigation is designed to control emissions as far as practicable. Monitoring is proposed to allow significant impact events to be identified, recorded and remedied as far as possible. In terms of impacts associated with vehicle emissions, impacts from paved roads are expected to be limited to within 200m of the roadside as pollutant concentrations reduce rapidly. The mitigation measure of paving roads is considered sufficient to render residual impacts, negligible with regards to emissions of PM ₁₀ , PM _{2.5} and dust.
Duration	Short Term	The mitigation measures are designed to control emissions as far as practicable, and render residual impacts not significant. However, due to the extreme local climatic conditions, it is foreseeable that occasional significant impacts may arise. These impacts may arise at any time during the construction activities.
Scale	5km from road	Due to the extremely arid conditions, dust emissions may travel for up to 5km from source.
Frequency	Occasional	Although majority of air quality related impacts will be managed/mitigated for majority of the time, occasional significant impacts may arise due to emissions of dust.
Likelihood	Likely	Occasional air quality related impacts for during the construction phase of the proposed Project is likely.

Magnitude	
	Small
Small Magnitude	
Due to the extreme local climatic conditions, no guarantee can be made that the mitigation will render all residual impacts negligible at all times, and therefore residual impacts can be considered at worst to be to be small.	
Significant Rating After Mitigation	
Negative Moderate Impact	
	Moderate

10.5.2 *Impacts Related to Traffic during the Operational Phase*

Background

Description of the Baseline Environment

Based on the monitoring results presented in *Chapter 8*, in terms of dust deposition, PM₁₀ and PM_{2.5}, the existing airshed is described as **degraded**. This is attributed to the high level of naturally occurring dust associated with the extremely arid climate, high wind speeds and lack of vegetation. In terms of NO₂ and SO₂, the existing airshed is described as **un-degraded**, primarily due to low traffic volumes, as the primary means of transport remain camel or donkey.

Proposed Project Activities

The potash product will be transported from site using trucks. These trucks will result in impacts to air quality as a result of emissions from exhausts and also from the lifting of dust from the road surface. These emissions have the potential to impact on sensitive human receptors living in close proximity to the haul road, including people working on the salt flats and living in Mororo, Alai lai, Hamad Ela, Ambule and potentially Asabolo.

An assessment of the potential impacts to sensitive receptors has been undertaken, primarily based upon the approach and calculations set out in the UK Highways Agency Design Manual for Roads and Bridges (DMRB), and using emission factors set out by the United States Environmental Protection Agency (USEPA, 1995). Whilst the DMRBs guidance is based principally on UK experience, it has been adapted to the Ethiopian situation. Similarly, the USEPA guidance has been interpreted to reflect the characteristics of the Study Area.

Approximately 155 truck movements are anticipated to be generated per day, during the operational phase of the proposed Project. A movement is defined as a one way journey along a road. The assumption has been made that the trucks are 30 tonne load rigid vehicles, and that through locations where there

are sensitive receptors close to the roadside (i.e. less than 200m), speeds will be limited to 48kph (30mph) ⁽¹⁾ for reasons of public safety.

At present, there is no paved road from the site to the national road network. However, a paved road is proposed to be constructed from the site approximately 120km south to link to the existing national road network.

In terms of paved roads, impacts will be expected to be limited to within 200m of the roadside, based upon evidence set out in DMRB. In terms of unpaved roads, where emissions of dust are likely to be significant, impacts may arise at distances of up to 5km from the roadside, as based upon evidence from the Desert Research Institute (2010) (presented in *Section 10.5* above).

Sensitive Receptors

In terms of vehicle exhausts, the pollutants of interest are NO₂, PM₁₀ and PM_{2.5}. *Table 10.21* below sets out the impacts arising at receptors 5m from the roadside as a result of the combined emissions from vehicle exhausts and paved and unpaved roads respectively.

Table 10.21 Impacts Associated with Vehicle Emissions

Road type	Pollutant	Air Quality Standard (µg/m ³)	PC ⁽¹⁾ at receptor (µg/m ³)	PC as % of AQS	Magnitude	Significance
All Roads	NO ₂	40	1.15	2.9%	Negligible	Negligible
Paved Road	PM ₁₀	20	0.897	4.5%	Negligible	Negligible
	PM _{2.5}	10	0.295	2.9%	Negligible	Negligible
	TSP	n/a	4.24	n/a		
Unpaved Road	PM ₁₀	20	166	830%	Large	Major
	PM _{2.5}	10	16.7	167%	Large	Major
	TSP	n/a	542	n/a		

¹ - PC: Process Contribution, the amount of airborne pollution that arises as a result of the process emissions

The results of the assessment illustrate that the 155 truck movements per day are predicted to result in negligible impacts post mitigation (i.e. paving of the road). However, pre-mitigation, where unpaved roads are used, there are predicted to be major negative impacts at roadside receptors. This is supported by anecdotal evidence from observations made on site that trucks travelling over unpaved roads raise considerable dust (refer to *Figure 10.2*).

(1) this speed limit is based on an assumption of what is likely to be appropriate for highway safety.

Figure 10.2 Example of Truck Moving along Unpaved Road in the Study Area



Within the results there are uncertainties, primarily relating to the composition of the material used to construct unpaved roads, and the amount of material deposited onto paved road surfaces that is subsequently re-suspended. In the first case, the quantity of silt within the construction material is the critical factor; this has been assumed to be 10%. However, consideration of the results illustrate that even substantial reduction in this factor (which is unlikely) would still result in significant impacts. In terms of material on the paved road surface, the default factor recommended by the USEPA of $0.6\text{g}/\text{m}^2$ has been used. There is no data available for the site location to directly validate this number; however, the baseline dust deposition monitored through use of dust buckets in the vicinity of the site proposed for the processing plant ranges from 0.079 to $2.23\text{g}/\text{m}^2/\text{day}$. On this basis, the use of the default factor appears to be reasonable to account for deposition arising from baseline sources. Analysis of the results suggests that the uncertainty in this factor is worthy of consideration, but that even a considerable increase in this factor is unlikely to result in a significant impact on the results; the factor will need to be inaccurate by an order of two in order to change the impacts from Negligible to Moderate.

With regard to NO_2 , the assumption has been made that the trucks servicing the site will be Euro I compliant ⁽¹⁾. However, this may not be the case if older,

¹ Within the European Union there are a series of emission standards for road vehicles. These standards are phased to deliver progressively lower emissions to air. The assumption of a Euro I fleet reflects emissions compliant with the 1993 emission standards, whereas the current Euro emission standards are Euro IV. This approach is taken to reflect the fact that the Ethiopian fleet is likely to be somewhat different from the European Fleet with a likelihood for higher emissions.

or poorly serviced vehicles are used. Consideration of the impacts associated with emissions of NO₂ suggest that emissions could be up to nine times higher before the impacts would change from negligible to minor significant.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is the opinion of this ESHIA that the impact from traffic will be negligible for NO₂ for all roads, and PM₁₀ and PM_{2.5} for paved roads; and '**Major Negative**' for unpaved roads pre-mitigation (refer to Table 10.53 below).

Table 10.22 Rating of Impacts Related to Traffic Emissions (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Within 5km of roadside	Impacts from paved roads are negligible at all receptor locations as pollutant concentrations reduce rapidly. However, for unpaved roads due to the extremely arid conditions of the Study Area, dust emissions may travel for up to 5km from the road.
Duration	Long Term	Impacts would arise throughout the life time of the proposed Project.
Scale	5km from road	Due to the extremely arid conditions in the Study Area, dust emissions may travel for up to 5km from the road.
Frequency	Continuous	Due to the numbers of truck movements, impacts would arise, in effect, continuously.
Likelihood	Likely	As trucks will be used to transport product, impacts are likely and will arise continuously throughout the lifetime of the plant.
Magnitude		
		Large
Large Magnitude		
Impacts associated with emissions of NO ₂ from all roads are negligible. Impacts associated with emissions of PM ₁₀ , PM _{2.5} and dust from unpaved roads is large.		
Sensitivity of the Receptor		
Designation	Summary of Reasoning	
High	All receptors are considered to be of high sensitivity as humans are considered to be equally sensitive to the health effects of airborne pollution.	
Significant Rating Before Mitigation		
Negative Impact		Major Negative Impact
		Major

Recommendations and Mitigation/Management Measures

With regard to impacts associated with road traffic during the operational phase of the proposed Dallol Potash Project, the following mitigation will be required:

- Haul roads used by trucks should be paved;
- Internal roads should be salt encrusted or should have a chemical binding application applied;
- Trucks carrying product should be covered; and
- Vehicles should be washed down prior to leaving the site.

These measures are considered sufficient mitigation to render all residual impacts as negligible.

In addition, the use of vehicles that are compliant with recent emission standards (such as the Euro I standards used in this assessment), and maintained in reasonable working order is considered to be best practice. These measures should be sufficient to ensure that residual impacts remain negligible.

Residual Impact (Post-mitigation)

With suitable mitigation/management this impact is likely to decrease, resulting in a residual assessment of the impact as a '**Negligible Significance Impact**' (refer to Table 10.23 below).

Table 10.23 Rating of Residual Impacts Related to Traffic Emissions (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Within 5km from roadside	Impacts from paved roads are expected to be negligible for receptors at all locations as pollutant concentrations reduce rapidly. The mitigation measure of paving roads is considered sufficient to render residual impacts, negligible.
Duration	N/A	Impacts will be negligible
Scale	N/A	Impacts will be negligible
Frequency	N/A	Impacts will be negligible
Likelihood	N/A	Impacts will be negligible

Magnitude	
	Negligible
Negligible Magnitude	
The paving of roads is expected to render the residual impacts negligible, due to the reduction in dust emissions.	
Significant Rating After Mitigation	
Negligible Negative Impact	
	Negligible

Impacts Related to Potash Processing and Management of Tailings during the Operational Phase

Background

Description of the Baseline Environment

Based on the monitoring results presented in *Chapter 8*, in terms of dust deposition, PM₁₀ and PM_{2.5}, the existing airshed is described as **degraded**. This is attributed to the high level of naturally occurring dust associated with the extremely arid climate, high wind speeds and lack of vegetation. In terms of NO₂ and SO₂, the existing airshed is described as **un-degraded**, primarily because of there being a small number of vehicles, as the primary means of transport remain camel or donkey.

Proposed Project Activities

During operation of the proposed project brine is withdrawn from the wells and fed directly to the evaporation pond via a network of pipelines. In order to reduce the costs and increase the efficiency of the operation, brine undergoes an initial stage of solar evaporation, where it is reduced in quantity by extracting NaCl. Following this pre-extraction of NaCl, the resulting brine is processed further to form a KCl by solar evaporation, complete crystallisation and flotation. The NaCl crystals are sedimented inside the ponds. The solid NaCl sediment is a superfluous material and may possibly remain in the pond, if sufficient capacities are available. Alternatively, residual salt tailings will be permanently stockpiled (smaller quantities will be used as backfill of the mine workings).

The KCl material will be left in the pond until the moisture content is around 8-10%. This approach ensures that the material remains moist and therefore non-friable as this would result in loss of product. As the material is moist, there is minimal potential for dust to be generated during the harvesting process using cold planer surface miners and during loading onto conveyors. The harvested material will then be transported to the processing plant by conveyor. Any materials spilled from the loading process or from conveyors will form a hard, non-friable form when dried, and is therefore not a source of dust emissions.

At the processing plant, the potash product will be separated from other residual salts. The potash product remains at 8-10% moisture throughout the process, until the final stage of processing where the product is dried to <1% moisture. The potash product is then loaded into trucks for export. At this point there is the potential for the product to become friable and therefore generate dust emissions.

In addition to the activities set out above, maintenance will be undertaken at the site and the mine areas using vehicles, rigs and excavators. Personnel will also be transported around the site and to and from the site and the staff village.

Sensitive Receptors

There is minimal potential for significant dust emissions during the handling of the brine; evaporation of the brine; loading of the harvested product to conveyors; and the handling of the potash product when at 8-10% moisture. This is due to the physical characteristics of the material throughout this process, insomuch that the moist materials are clumpy and non-friable. Furthermore, stockpiled salt tailings rapidly dry and form a solid crust, and are therefore not anticipated to result in significant dust emissions.

The loading of trucks with the final potash product will be undertaken in an enclosed area, and therefore any dust raised by this process will be contained.

In terms of exhaust emissions from cold planer surface miners, this will not be sufficient enough to result in significant impacts to sensitive receptors.

There is the potential for significant quantities of dust, PM₁₀ and PM_{2.5} to be raised as a result of a small number of vehicle movements associated with infrastructure maintenance and staff movements around site, where this is over unpaved surfaces. As discussed in *Section 10.5.1*, there is the potential for dust raised to travel considerable distances downwind, and therefore negatively affect sensitive receptors.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is the opinion of this ESHIA that the impact from the mining and handling of product and tailings materials will be a '**Negligible Negative Impact**' for all air borne pollutants. There is the potential for dust emissions to occur when loading the final product into trucks for transportation; any emissions that do occur have the potential to travel up to 5km from source.

Table 10.24 Rating of Impacts Related to Potash Processing and Management of Tailings Emissions (Pre-Mitigation)

Type of Impact		
Negative		Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Within 5km of the processing plant	With regard to handling and processing of the potash and the tailings, air borne emissions are only anticipated from the handling of the final product at the processing plant where emissions of dust may occur. Due to the local conditions, any such emissions may travel up to 5km from source.
Duration	Long Term	Impacts would arise throughout the life time of the proposed Project and associated processing plant.
Scale	5km from the processing plant	Emissions arising from the handling of final product may travel for up to 5km from the processing plant.

Frequency	Continuous	As the process operates continually, impacts would arise continuously.
Likelihood	Likely	Impacts will arise continuously throughout the lifetime of the proposed Project and associated processing plant.

Magnitude	
	Negligible

Negligible Magnitude

Impacts associated with dust emissions from the handling of potash product are negligible, as this will take place in an enclosed area so as to prevent product loss. Furthermore, air borne emissions from the handling of tailings is expected to be negligible as tailings rapidly dry and from a solid crust.

Sensitivity of the Receptor	
-----------------------------	--

Designation	Summary of Reasoning
	All receptors are considered to be of high sensitivity as humans are considered to be equally sensitive to the health effects of airborne pollution.
High	

Significant Rating Before Mitigation	
--------------------------------------	--

Negative Impact	Negligible Negative Impact

Recommendations and Mitigation/Management Measures

The following mitigation measures are recommended with regard to the handling of the final product at the processing plant:

- The handling of the final product, once moisture content has been reduced to <1%, should be undertaken in an enclosed environment;
- Trucks used to transport product should be sheeted or lidded; and
- Truck wash down should be undertaken prior to departure from the site to minimise track out.

As is discussed in *Section 10.5.2*, there is the potential for significant dust, PM₁₀ and PM_{2.5} to be generated by the general movements of vehicles around the greater site, where these movements occur over unpaved surfaces. Therefore, the following mitigation measures are recommended:

- Where practicable, surfaces should be permanently paved;
- Where impractical to pave surfaces, consideration should be given to the use of chemical binders or salt encrusting to seal the surface and attenuate dust;

- Where short term or intermittent movements over unpaved surfaces are taking place, consideration should be made of the use of water sprays for short term dust suppression; and
- On site speeds should be limited, to as low as practicable to minimise dust, PM₁₀ and PM_{2.5} emissions. An indicative maximum speed, for example, would be 45kph ⁽¹⁾.

Residual Impact (Post-mitigation)

With suitable mitigation/management this impact is likely to remain a Negligible Significance Impact (refer to *Table 10.25*).

Table 10.25 Rating of Residual Impacts Related to Potash Processing and Management of Tailings Emissions (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Within 5km of the plant	With regard to handling and processing of the potash and the tailings, emissions are anticipated only from the handling of the final product where emissions of dust may occur. The enclosure of this process and wash down of trucks prior to leaving the site is anticipated to render these impacts negligible.
Duration	Long Term	Impacts would arise throughout the life time of the proposed Project and associated processing plant.
Scale	5km from the plant	Emissions arising from the handling of final product may travel for up to 5km from the processing plant.
Frequency	Continuous	As the process operates continually, impacts would arise continuously.
Likelihood	Likely	Impacts will arise continuously throughout the lifetime of the proposed Project and associated processing plant.

Magnitude		
	Negligible	Small
Negligible to Small Magnitude		
Impacts associated with dust emissions from the handling of potash product are negligible, as this will take place in an enclosed area so as to prevent product loss. Furthermore, air borne emissions from the handling of tailings is expected to be negligible as tailings rapidly dry and from a solid crust.		
Significant Rating After Mitigation		
Negligible Negative Impact		
	Negligible	

(1) this speed is a balance between a reasonable site speed and the lowest speed for control of dust emissions.

10.5.4 *Impacts Related to Power Generation Through the Use of Fossil Fuel Generators*

Background

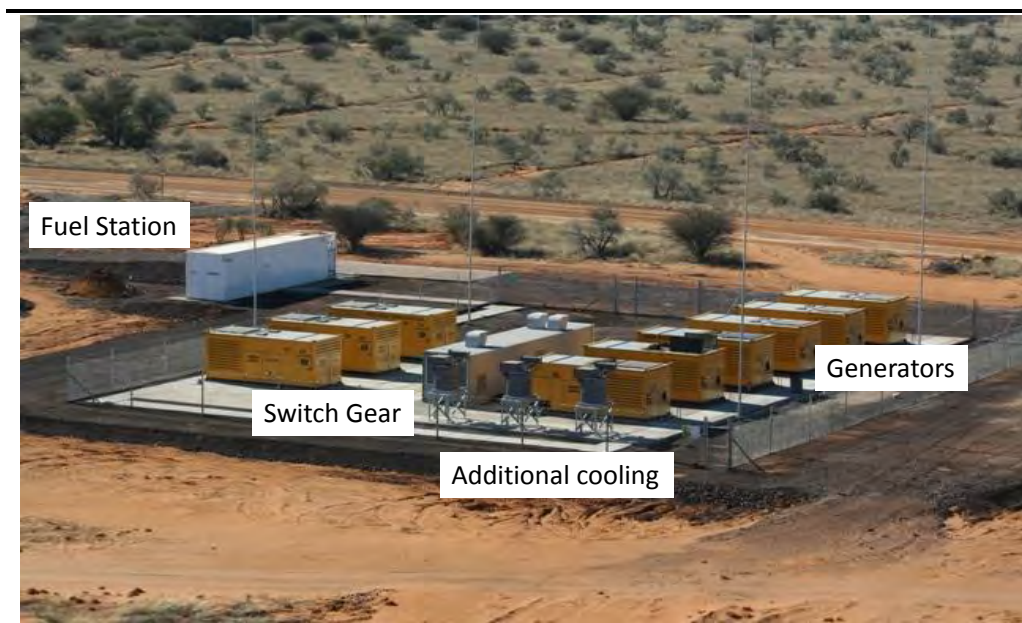
Description of the Baseline Environment

Based on the monitoring results presented in *Chapter 8*, in terms of dust deposition, PM₁₀ and PM_{2.5}, the existing airshed is described as **degraded**. This is attributed to the high level of naturally occurring dust associated with the extremely arid climate, high wind speeds and lack of vegetation. In terms of NO₂ and SO₂, the existing airshed is described as **un-degraded**, primarily because of there being a small number of vehicles, as the primary means of transport remain camel or donkey.

Proposed Project Activities

The processing plant and associated ancillary facilities (staff village, workshops, conveyors etc.) will require power generation capacity of approximately 20MW (thermal input). This capacity will be provided by the use of diesel powered reciprocating engine generators; an example of a similar plant design is illustrated in *Figure 10.3* below. This power plant will result in the emissions to air of NO_x/NO₂, PM₁₀, PM_{2.5} and SO₂. These emissions have the potential to negatively impact on air quality at nearby sensitive human receptors. There may be other isolated power generators, for example for the well heads. However, these are anticipated to be of sufficiently small size (i.e. <3MW) to not lead to significant emissions.

Figure 10.3 *Example of Power Generation Plant*



Source: Ercosplan, (2012)

The power plant will operate continuously to provide power for the processing plant and ancillary facilities. In terms of emissions from power

generation, the pollutants of interest are NO₂, PM₁₀, PM_{2.5} and SO₂. The potential impacts associated with emissions from the power plant have been assessed using dispersion modelling, in this case the UK developed ADMS model. The model inputs are summarised in *Table 10.26*.

Table 10.26 Summary of Power Plant Emissions

Parameter	Value	Unit	Notes	Source
Power Plant Specifications				
Generator Units	Atlas Copco QAC 1250		The use of this unit is assumed on the basis of the use of Atlas Copco plant	Client data
Number of Units	7		Based upon a total plant requirement of 20MW _{thermal} input	
Unit rating (MW rated)	1.1			Client data
Unit rating (MW thermal)	3.1		Assumed 35% efficiency	Client data
Engine in Unit	Cummins KTA 50			1
Emission Parameters				
	Value	Units		
Height	2.59	m	Based upon unit dimensions	2
Diameter	0.068606	m	Calculated	2,4
Volume Flow rate	0.00831	Nm ³ /s	Calculated	3,5
Volume Flow rate	0.05545	Am ³ /s		3
Exhaust Temperature	594	Celsius		3
NO _x	30	mg/Nm ³	5% O ₂ , dry	2
PM	56	mg/Nm ³	5% O ₂ , dry, fuel 0.035% fuel sulphur by weight	2
SO ₂	4800	mg/Nm ³	5% O ₂ , dry	2
NO _x	0.039889	g/s	Calculated	2
PM	0.000249	g/s	Calculated	2
SO ₂	0.000465	g/s	Calculated, based upon 0.035% fuel sulphur content	2
Building Dimensions¹				
Number of buildings	7			
Height	2.59	m		1
Width	2.44	m		1
Length	6.06	m		1

1: Atlas Copco website, details of QAC 1250 generator

<http://www.atlascopco.co.uk/ukus/products/navigationbyproduct/Product.aspx?id=1740620&productgroupid=1484153>

2: Details of emissions from Cummins KTA 50 engine [as installed in the QAC 1250]

<http://www.gopower.com/documents/docs/1181858023.pdf>

3: Emissions data for KTA 50 engine from Cummins website

<https://marine.cummins.com/attachments/public/marine/Products/Auxiliary%20Engines/k50/fr6385.pdf>

4: UK Government Her Majesty's Inspectorate for Pollution (1993) Technical Guidance Note (Dispersion) D1

5: Emissions data for diesel powered generation plant, Lome, Togo.

¹ – The buildings included in the model represent the shipping containers in which the engines are housed

² – In relation to human health, the interest is for NO₂ rather than total NO_x. Atmospheric reactions limit the conversion of NO_x to NO₂. Therefore, for short term impacts a conversion factor of 50% is used.

Sensitive Receptors

Due to the use of a diesel driven power plant, emissions of NO_x are a key consideration. Initial modelling suggested that the emissions of NO_x may result in significant impacts. Therefore the model was amended to reflect a separation distance between the power plant and receptors of at least 200m. In addition, the model was run with the basic configuration of the power plant, and fitted with 3m stacks on the units. The results of these two model scenarios are set out in *Table 10.27*.

Table 10.27 *Impacts Associated with Power Plant Emissions*

Pollutant	Averaging Period	Air Quality Standard (µg/m ³)	Background (µg/m ³)	PC ⁽¹⁾ (no stack) (µg/m ³)	PC / AQS	PEC ⁽²⁾ (µg/m ³)	PEC/ AQS	PC (with 3m Stack) (µg/m ³)
NO ₂	Annual mean	40	0	10.8	27%	10.8	27%	6.27
	1 hour maximum	200	0	110	54.9%	110	55%	84.7
PM ₁₀	Annual mean	20	47.4	0.0677	0.34%	47.5	237%	0.0391
	24 hour mean, 3 rd highest	50	55.9	0.276	0.55%	56.2	112%	0.232
PM _{2.5}	Annual mean	10	15.5	0.0677	0.68%	15.6	156%	0.0391
	24 hour mean	25	18.3	0.308	1.2%	18.6	74%	0.0731
SO ₂	24 hour mean	20	0	0.575	2.9%	0.575	2.9%	0.460
	10 minute mean	500	0	4.25	0.85%	4.25	0.85%	1.42

¹ – PC: Process Contribution, the amount of airborne pollution that arises as a result of the process emissions.

² – PEC: Predicted Environmental Concentration, the PC added to the existing baseline

The results of the assessment illustrate that emissions of PM₁₀, PM_{2.5} and SO₂ are not predicted to result in significant impacts. Emissions of NO_x are predicted to result in Small Magnitude impact, which is of Moderate Significance.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is the opinion of this ESHIA that the impact from power generation will be negligible for PM₁₀, PM_{2.5} and SO₂; and will be a '**Moderate Negative Impact**' for emissions of NO₂ (should no stack

be used) where there are sensitive receptors within 600m to the power plant (refer to *Table 10.28* below).

Table 10.28 Rating of Impacts Related to Power Plant Emissions (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	600m from power plant	Significant impacts associated with inhalation of NO ₂ emissions from the power plant may arise up to 600m from the power plant boundary.
Duration	Long Term	Impacts would arise throughout the life time of the proposed Project and associated power plant.
Scale	600m from power plant	Significant impacts associated with inhalation of NO ₂ emissions from the power plant may arise up to 600m from the power plant boundary.
Frequency	Continuous	Due to the continuous operation of the power plant, impacts would arise continuously.
Likelihood	Likely	Likely, as the power plant is necessary for the proposed Project to operate.
Magnitude		
		Medium
Medium Magnitude		
Impacts associated with the release of NO ₂ from the proposed power plant are medium.		
Sensitivity of the Receptor		
Designation	Summary of Reasoning	
High	All receptors are considered to be of high sensitivity as humans are considered to be equally sensitive to the health effects of airborne pollution.	
Significant Rating Before Mitigation		
Negative Impact		Moderate Negative Impact
Moderate		

Recommendation and Mitigation/Management Measures

With regards to the operation of the power plant, the following mitigation measures are recommended:

- The power plant units should be equipped with stacks, if practicable, with a minimum height of 3m.
- The power plant compound should be sited away from sensitive receptors as far as is practicable, with a minimum separation distance of 600m where no stacks are in use, and 350m where stacks are used.
- The power plant engines should be subject to routine maintenance to keep the engines in optimum working order.

- The diesel fuel should contain no more than 350 ppm sulphur where there are sensitive receptors <350m from the plant; and 3,800ppm where there are sensitive receptors >600m, and where 3m stacks are in use, for the control of emissions of sulphur dioxide.
- Emissions of greenhouse gases will be calculated using the methodology set out in the UK Government guidance ⁽¹⁾.

Residual Impact (Post-mitigation)

With suitable mitigation/management (use of at least a 3m stack and keep a distance between receptor and power plant of at least 350m) this impact will reduce to a '**Negligible Significance Impact**' (refer to *Table 10.29* below).

Table 10.29 Rating of Residual Impacts Related to Power Plant Emissions (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	350m from power plant	Negligible impacts from the power plant will arise outside of a 350m buffer from the power plant.
Duration	N/A	Impacts will be negligible
Scale	N/A	Impacts will be negligible
Frequency	N/A	Impacts will be negligible
Likelihood	N/A	Impacts will be negligible
Magnitude		
	Negligible	
Negligible Magnitude		
Impacts associated with the release of NO ₂ from the proposed power plant outside of a 350m buffer of the power plant are negligible.		
Significant Rating After Mitigation		
	Negative Negligible Impact	Negligible

10.5.5 Impacts Related to Decommissioning Activities during the Decommissioning Phase

Background

Description of the Baseline Environment

Based on the monitoring results presented in *Chapter 8*, in terms of dust deposition, PM₁₀ and PM_{2.5}, the existing airshed is described as **degraded**. This is attributed to the high level of naturally occurring dust associated with the extremely arid climate, high wind speeds and lack of vegetation. In terms of NO₂ and SO₂, the existing airshed is described as **un-degraded**, primarily

¹ UK Government Department for Environment, Food and Rural Affairs (2012) 2012 Guidelines to Defra/DECCs GHG Conversion Factors for Company Reporting: Methodology Paper for Emission Factors

because of there being a small number of vehicles, as the primary means of transport remain camel or donkey.

Proposed Project Activities

The decommissioning of the proposed Dallol Potash Project will involve the deconstruction of all mining related and ancillary infrastructure; transport of materials from the site by truck; earthworks to restore the site; and decommissioning and restoration of the mine workings and evaporation ponds.

Decommissioning activities have the potential to result in significant emissions of dust, PM₁₀ and PM_{2.5} to atmosphere, significant emissions of combustion gases and significant impacts on sensitive receptors in the vicinity of the decommissioning activities. In addition, the movement of trucks around the Study Area will result in impacts to air quality as a result of emissions from exhausts and also from the lifting of dust from the road surface and open surfaces.

Furthermore, earthworks are a potential significant source of emissions of dust and PM₁₀. As is mentioned in *Section 10.5.1*, the underlying material is wadi outwash deposit, which has the potential to become friable and therefore airborne; an effect exacerbated by the local climatic conditions.

Sensitive Receptors

Decommissioning activities are potentially a particularly significant source of emissions of dust, PM₁₀ and PM_{2.5}. In addition, due to the local meteorological conditions as described in *Chapter 8*, there is the potential for impacts associated with dust emissions to be significant at a distance of several kilometres downwind based upon evidence from the Desert Research Institute (2010) (presented in *Section 10.5* above). As a result, decommissioning activities have the potential to negatively impact on sensitive receptors some distance from the site, including Mororo, Alai lai and Hamad Ela.

The emissions associated with the decommissioning activities have not been quantified, as these will depend very much upon the exact activities taking place at any one time or location. However, due to the local conditions, if unmitigated and uncontrolled, impacts are potentially of Major Significance. On this basis, a number of mitigation measures are identified to control emissions of dust and PM₁₀. These mitigation measures take into consideration the local conditions, and the fact that certain techniques, for example vegetating and watering will be of less effect or ineffectual due to the local conditions.

In terms of vehicle emissions, the number of vehicles generated during the decommissioning phase are unknown; however, it is understood that the numbers of vehicles will be less than generated during the operations phase, where 155 heavy goods vehicle movements per day will be generated (a

movement is a one way trip). The potential impacts associated with operational vehicles have been assessed, and the findings are set out in *Section 10.5.2*. The outcomes of this assessment identified that impacts associated with emissions of NO₂ from all roads and dust, PM₁₀/PM_{2.5} from paved roads will be negligible; however, impacts from dust, PM₁₀/PM_{2.5} from unpaved roads are predicted to be of major significance. On the basis that the decommissioning phase vehicle movements will be less than the operational phase, it is reasonable to conclude that in terms of impacts associated with NO₂, dust and PM₁₀/PM_{2.5} associated with paved roads will also be negligible. However, in terms of emissions of dust and PM₁₀/PM_{2.5} associated with unpaved roads it is reasonable to conclude that there is the potential for major negative impacts.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above and in *Section 10.5.2*, it is the opinion of this ESHIA that the impact from decommissioning activities pre-mitigation will be a '**Major Negative Impact**'.

This is as a result of the notion that:

- Impacts associated with emissions arising from vehicle exhausts will be a negligible negative impact for all roads (paved or unpaved);
- Impacts associated with PM₁₀ and PM_{2.5} emissions for paved roads will be a negligible negative impact; and
- Impacts associated with emissions arising from vehicular movement along unpaved roads and/or decommissioning activities taking place on friable wadi material will be a major negative impact.

Refer to *Table 10.30* below.

Table 10.30 Rating of Impacts Related to Decommissioning Emissions (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Within 5km of construction activities	Decommissioning activities and the movement of vehicles along unpaved roads at the site have the potential to result in significant emissions of dust. Due to the extremely arid conditions, dust emissions may travel for up to 5km from where decommissioning activities are taking place in significant concentrations.
Duration	Short Term	Impacts would arise throughout the decommissioning period.
Scale	5km from source	Due to extremely arid conditions in the Study Area, dust emitting decommissioning activities and the movement of vehicles over unpaved roads during the decommissioning phase will result in dust emissions may travel for up to 5km from source.
Frequency	Continuous	Impacts would arise, in effect, continuously from decommissioning activities.

Likelihood	Likely	Impacts will arise throughout the decommissioning period.
Magnitude		
		Large
Large Magnitude		
Impacts associated with emissions of NO ₂ from all roads, and PM ₁₀ , PM _{2.5} and dust from paved roads are negligible. Impacts associated with emissions of PM ₁₀ , PM _{2.5} and dust from open areas and unpaved roads is large .		
Sensitivity of the Receptor		
Designation	Summary of Reasoning	
High	All receptors are considered to be of high sensitivity as humans are considered to be equally sensitive to the health effects of airborne pollution.	
Significant Rating Before Mitigation		
Negative Impact		Major Negative Impact
Major		

Recommendations and Mitigation/Management Measures

Where unpaved roads will be in use, the use of chemical surface binders should be implemented to minimise emissions from the road surface. Surface watering may be appropriate for short term mitigation of dust emissions; however, due to the extreme climatic conditions in the Study Area, it is anticipated that evaporation rates will be very high and therefore, this technique largely ineffective on larger areas.

In addition, the use of vehicles that are compliant with recent emission standards and maintained in reasonable working order is considered to be good practice. When vehicles are not in use, these should be switched off, unless impractical for health and safety reasons (for example maintenance of air conditioning).

In terms of decommissioning activities, a number of mitigation measures are recommended:

- Vehicles should be kept clean and free of residual dirt and mud, and wash down should continue as is currently the case;
- A speed limit of 45kph should be implemented on unpaved surfaces to minimise the potential for dust to be raised;
- Wind breaks should be erected around the key decommissioning activities (i.e. processing plant, staff village, power plant), and, if possible, in the vicinity of potentially dusty works;
- All vehicles leaving and accessing the site carrying friable materials should be covered;

- Where ground and earthworks are exposed, these areas should be covered as far as possible, for example with sheeting or boarding, or the use of chemical binders investigated;
- Where ground and earthworks are covered or surface binders are used, the smallest possible area for working should be exposed;
- Where practicable, surface binding agents should be used on exposed open earthworks and on open (unpaved) surfaces used by vehicles;
- Use of localised dampening and activity specific dampening should be used to reduce localised emissions of dust;
- Stockpiling of material, for example, wadi outwash, rocks, sand and soils should be minimised;
- Drop heights of material when stockpiling should be minimised;
- Where stockpiles are in use, the design should be optimised to retain a low profile with no sharp changes in shape;
- Stockpiles should be located as far away as possible from receptors; and
- Stockpiles should be enclosed or sheeted as far as practicable.

In addition to the implementation of mitigation measures, monitoring of meteorological conditions and ambient dust and PM₁₀ should be undertaken. The monitoring of PM₁₀ should be undertaken at the site boundary, and should include provision of 'action levels'. The 'action levels' are trigger points at which investigation of on-site dust raising activities and baseline conditions are investigated. In the event that activities are being undertaken which are resulting in unacceptable emissions of dust, further localised mitigation and control should be implemented (i.e. localised water spraying), or activities ceased until weather conditions improve or more effective dust suppression is identified.

Residual Impacts (Post-mitigation)

With suitable mitigation/management this impact is likely to decrease, resulting in a residual assessment of the impact as a 'Moderate Significance Impact' (refer to *Table 10.31* below).

Table 10.31 Rating of Residual Impacts Related to Decommissioning Emissions (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Within 5km of construction activities and construction access roads	<p>The impacts associated with decommissioning activities will be difficult to control from all sources and at all times, due to the extremely challenging local climatic conditions. Therefore, whilst mitigation measures will render residual impacts as <i>Negligible</i> for the majority of the time, no guarantee can be made that significant impacts will not, occasionally, arise. Mitigation is designed to control emissions as far as practicable. Monitoring is proposed to allow significant impact events to be identified, recorded and remedied as far as possible.</p> <p>In terms of impacts associated with vehicle emissions, impacts from paved roads are expected to be limited to within 200m of the roadside as pollutant concentrations reduce rapidly. The mitigation measure of paving roads is considered sufficient to render residual impacts, negligible with regards to emissions of PM₁₀, PM_{2.5} and dust.</p>
Duration	Short Term	<p>The mitigation measures are designed to control emissions as far as practicable, and render residual impacts not significant. However, due to the extreme local climatic conditions, it is foreseeable that occasional significant impacts may arise. These impacts may arise at any time during decommissioning activities.</p>
Scale	5km from road	<p>Due to the extremely arid conditions, dust emissions may travel for up to 5km from source.</p>
Frequency	Occasional	<p>Although majority of air quality related impacts will be managed/mitigated for majority of the time, occasional significant impacts may arise due to emissions of dust.</p>
Likelihood	Likely	<p>Occasional air quality related impacts for during the decommissioning phase of the proposed Project are likely.</p>

Magnitude	
Small	
Small Magnitude	
<p>Due to the extreme local climatic conditions, no guarantee can be made that the mitigation will render all residual impacts negligible at all times, and therefore residual impacts can be considered at worst to be to be small.</p>	
Significant Rating After Mitigation	
Moderate Negative Impact	
Moderate	

10.6 IMPACTS ON THE NOISE ENVIRONMENT

This section assesses the likely noise levels and potential impacts to off-site noise sensitive receptors (NSR's) as a result of activities during the construction, operational and decommissioning phase of the proposed Project.

10.6.1 *Impacts during the Construction Phase*

Background

Description of the Baseline Environment

Based on monitoring results presented in *Chapter 8, noise levels in the Study Area are low*. In isolated areas of the Study Area where the noise environment typically consisted of natural sounds (such as wind and livestock) the LA_{eq} ranged between 25 to 33dB, whereas areas dominated by human activity and village infrastructure (such as water pumps, children and passing trucks) the LA_{eq} ranged between 48 to 53dB during the daytime and 44 to 49dB during the night time.

Proposed Project Activities

The construction phase of the proposed Project will involve the construction of access roads; transport of materials to the site by truck; earthworks to prepare the site for construction; construction of the processing plant, ancillary facilities and staff village; and construction of the mine workings and evaporation ponds. These activities will result in the generation of noise.

During the construction phase, noise impacts are related to machinery noise emissions. Construction noise sources are generally intermittent and impacts depend on the number and types of machinery used for each activity.

It is assumed that construction will occur only during the daytime period and will likely include the following construction activities:

- Earth works:
 - Construction of access roads; and
 - Establishment of solution ponds.

- Construction:
 - Establishment of the permanent office and staff village;
 - Establishment of a processing plant; and
 - Establishment of support facilities (i.e. power plant, waste water treatment plant etc.).

For construction modelling purposes the equipment teams (see *Table 10.32*) were placed in seven locations inside the Study Area to represent potentially worst case scenarios where construction activities are likely to be closest to receptors.

Table 10.32 Proposed Construction Phase Equipment List

Equipment Description	Location	Quantity	Sound Power Level, Lw dB(A)
Construction (per site)			
90 t Hydraulic Excavator	Overall Study Area	1	120
Tracked Dozer (CAT D8 or similar)		1	114
Front end Loader (CAT 920 or similar)		1	105
50 t Haul Trucks (CAT 7,73B or similar)		3	116

To assess the noise emission from activities associated with the construction of access roads, it has been assumed that typical earthmoving equipment of suitable scale would be used. Therefore the road construction plant team has been assumed to consist of the following equipment:

- Grader;
- Roller;
- Backhoe; and
- Dump trucks.

Sensitive Receptors

The villages of Mororo and Alai lai will be the most affected in terms of activities associated with the construction. Villages located along the access road (refer to *Figure 10.4* on *Page 10-56*) will be susceptible to noise emissions from trucks transporting materials to the site; this includes Hamad Ela, Ambule, Asabolo, Tahasuli, Asgubi, Oilayle, Ondamodgalu, Armdeli, Kahniyeb and Berahale Town.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is the opinion of this ESHIA that the noise related impacts from construction activities pre-mitigation will be a '**Negligible Negative Impact**' (refer to *Table 10.33* below).

Table 10.33 Predicted Construction Noise Levels - Daytime

Receptor	Predicted Noise Level, from Construction Area dB(A)	Noise Criteria dB(A)	Impact Magnitude ¹
NSR 1 (Mororo Village)	48	55	Negligible
NSR 2 (Alai lai Village)	33		Negligible
NSR 3 (Hamad Ela Village)	<25		Negligible
NSR 4 (Ambule and Asabolo Village)	<25		Negligible
NSR 5 (Tahasuli, Asgubi, Oilayle, Ondamodgalu, Armdeli and Kahniyeb Villages)	<25		Negligible
NSR 6 (Berahale Town)	<25		Negligible

As is mentioned above, construction noise levels at receptors refer to the maximum noise level predicted at each receptor where construction equipment is located at the nearest point to a receptor location. This assumption represents a worst case scenario, considering the worst combination in terms of source level and distance.

The predicted construction noise levels do not exceed the noise construction criteria (55dB) presented in *Chapter 6* at all NSRs, and would be considered of *negligible* magnitude, assuming that the construction will take place only during the daytime.

Furthermore, as the alignment of internal access roads is yet to be determined, a calculation of expected noise emissions from the construction team has been calculated to determine the distance from the construction activity to avoid potential noise impacts. Based on a short term duration of exposure to road construction noise, as the road progresses, an offset distance of 100m would be required for noise levels not to exceed 70 dB LAeq,1hr and result in *negligible* impacts.

Recommendations and Mitigation/Management Measures

The assessment concluded that there will be no significant impacts on people from noise during construction and additional mitigation measures other than good construction work methods and practice are not required.

Residual Impact (Post-mitigation)

As additional mitigation measures (other than good construction work methods) are not required, the impact will remain as a '**Negligible Negative Impact**'.

10.6.2 *Impacts during the Operational Phase*

Background

Description of the Baseline Environment

Based on monitoring results presented in *Chapter 8, noise levels in the Study Area are low*. In isolated areas of the Study Area where the noise environment typically consisted of natural sounds (such as wind and livestock) the LA_{eq} ranged between 25 to 33dB, whereas areas dominated by human activity and village infrastructure (such as water pumps, children and passing trucks) the LA_{eq} ranged between 48 to 53dB during the daytime and 44 to 49dB during the night time.

Proposed Project Activities

The operational phase comprises a considerable number of processes, activities and equipment that generate noise. The proposed Project will operate 24 hours a day, 7 days a week.

The significant noise generating activities during the operational Phase of the Project include:

- Activities at solution wells:
 - Drills;
 - Air compressors; and
 - Pumps.

- Surface miners removing potash bearing crystal from the evaporation ponds, where it will be crushed and loaded onto haul trucks, which will transport the product to the Run of Mine (ROM) pad. A plough or similar reclamation method will transfer the material onto a conveyor to transport the intermediate product to the processing plant.

- Processing plant, where noise will be produced by crushing, screening and drying of product which is then loaded via overhead bins onto highway trucks and transported off site.

- Ancillary plant and equipment such as the power plant, waste water treatment plant and staff village.

The predicted noise levels in all models are based on the assumption that equipment is operating simultaneously and at full load. The equipment simulated and their acoustic performances for each scenario are shown in *Table 10.34*.

Table 10.34 Proposed Operational Phase Equipment List

Equipment Description	Location	Quantity	Sound Power Level, Lw dB(A)
Operation			
Drill	Well Brine field	4	110
Pump		4	100
Compressor		2	100
Conveyor			127
50 t Haul Trucks (CAT 7,73B or similar)			116
Surface Miner (1,200tph)	Evaporation Pond	2	125
Pre-process Crush & screen plant	Plant site	1	111
Floating debrine/ deslime plant		1	115
Power Station (10MW Diesel Generator)		2	124
Truck Load out		1	127

In the context of this ESHIA, when determining significance, no other influencing factors have been considered as the operation will operate 24 hours, 7 days per week, 365 days per year, and will be designed such that noise emissions will not have tonal or low frequency characteristics. Therefore the impact assessment is based on exceedances of the criteria (worst case).

Sensitive Receptors

The villages of Mororo and Alai lai will be the most affected in terms of activities during the operational phase. Other villages that may potentially be susceptible to noise emissions operational activities associated with the proposed Project include Hamad Ela, Ambule, Asabolo, Tahasuli, Asgubi, Oilayle, Ondamodgalu, Armdeli, Kahniyeb and Berahale Town.

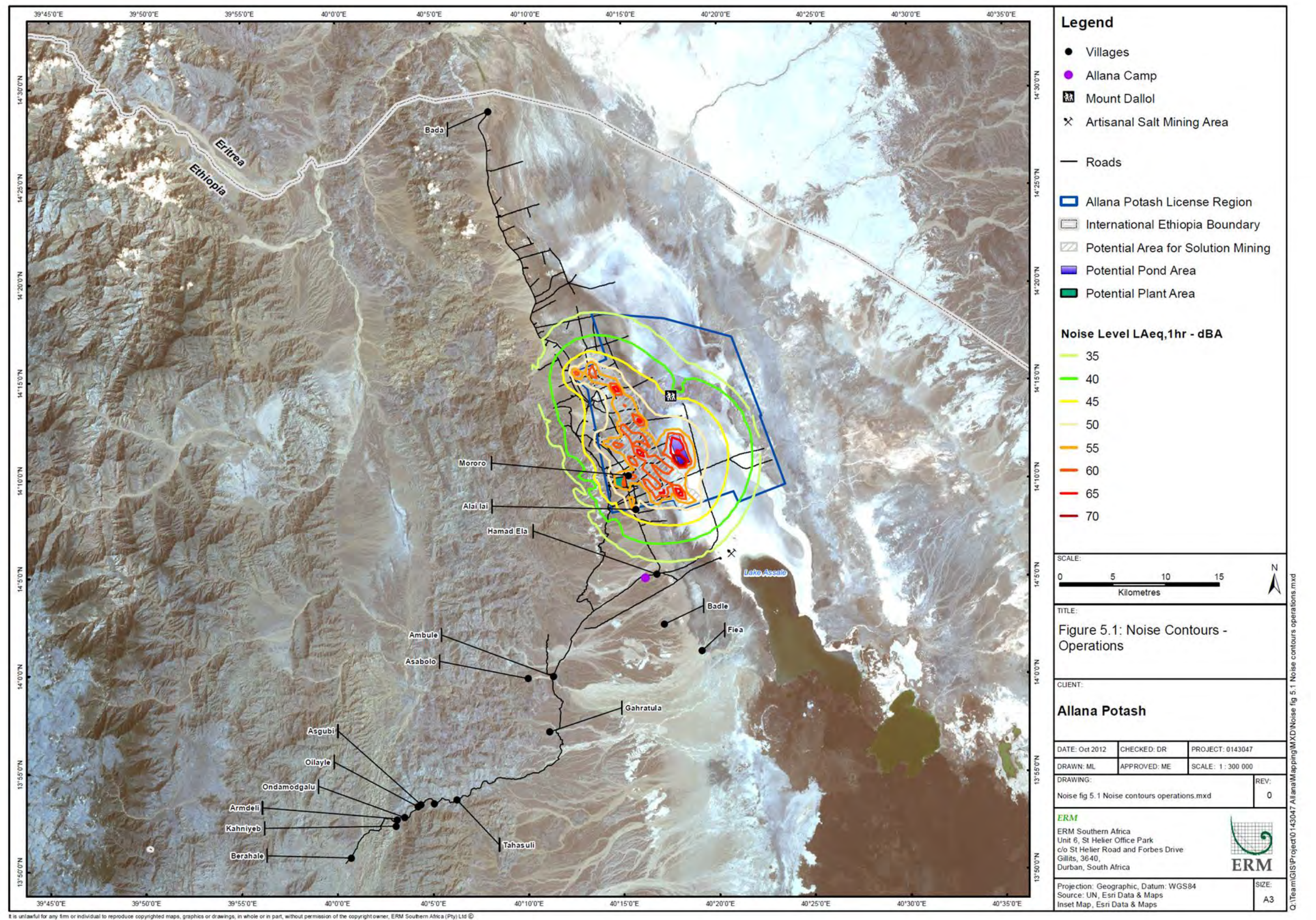
Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is the opinion of this ESHIA that the noise related impacts from operational phase activities pre-mitigation will be a '**Major Negative Impact**' for Mororo Village and a '**Minor Negative Impact**' for Alai lai Village (refer to Table 10.35 below). These are presented in Figure 10.4 as noise contours.

Table 10.35 Predicted Operational Phase Noise Levels

Receptor	Predicted Noise Level dB LAeq,1hr	Noise Criteria			
		Daytime 55 dB LAeq,1hr		Night time 45 dB LAeq,1hr	
		Impact Magnitude Daytime	Noise Impact	Impact Magnitude Night time	Noise Impact
NSR 1 (Mororo Village)	56	Small	Minor	Large	Major
NSR 2 (Alai lai Village)	48	Negligible	Negligible	Small	Minor
NSR 3 (Hamad Ela Village)	30	Negligible	Negligible	Negligible	Negligible
NSR 4 (Ambule and Asabolo Village)	<25	Negligible	Negligible	Negligible	Negligible
NSR 5 (Tahasuli, Asgubi, Oilayle, Ondamodgalu, Armdeli and Kahniyeb Villages)	<25	Negligible	Negligible	Negligible	Negligible
NSR 6 (Berahale)	<25	Negligible	Negligible	Negligible	Negligible

Figure 10.4 Noise Contours for Activities during the Operational Phase



The predicted operational noise levels comply with the Project noise criteria during the daytime for all scenarios, except at NSR1 (Mororo Village) where noise levels are expected to exceed the criteria by up to 1 dB; whereas during the night time, noise levels comply with the criteria at all locations except at NSR1 (Mororo Village) and NSR 2 (Alai lai) where noise levels are expected to exceed the criteria by up to 11dB and 3dB respectively.

In the absence of mitigation, noise levels from operations are expected to exceed the IFC and Ethiopian 55dB(A) LAeq, 1hr daytime and 45dB(A) LAeq, 1hr night-time criteria.

The noise sources that contribute to the exceedence of the criteria in ranked order are presented in *Table 10.36*, which clearly shows that the significant contributing sources differ for each receptor. Noise from the wells and brine extraction are much more dominant at NSR2 (Alai lai Village) and the processing plant and evaporation ponds are relatively equal contributors at NSR1 (Mororo Village).

Table 10.36 *Ranked Order of Noise Contributing Activities for the Operational Phase*

Noise Source	Predicted Noise Level, dBA	
	NSR 1 - Mororo Village	NSR 2 - Alai lai Village
Processing Plant	52	38
Evaporation Pond	51	40
Solutions Wells and Brine extraction	49	45
Load out & Transport	41	42
Overall Noise Level dB, LAeq, 1hr	56	48

Recommendations and Mitigation/Management Measures

It is the understanding of this ESHIA that the villages of Mororo and Alai lai are intended to be resettled, as the proximity of these two villages in relation to Allana’s proposed operations poses a significant community health and safety risk to Allana. Resettlement of these two villages is also recommended from a noise impact perspective.

As the proposed Project has the potential to generate significant noise emissions, it is recommended that an Occupational Noise Management Plan (ONMP) be developed and implemented. A typical ONMP may consist of the following framework and aspects:

- Pre-screening employee audiometry;

- Regular employee audiometry and threshold shift detection;
- Regular noise surveys/ audits of the site;
- Identifying specific noise sources and work areas of excessive noise;
- Engineering noise reduction programmes;
- Hearing protection program; and
- Employee education and training.

Residual Impact (Post-mitigation)

Should Mororo and Alai lai Villages be resettled, the identified noise impacts would be eliminated and hence the residual impacts for the remaining villages would be a “**Negligible Negative Impact**” (based on the Ethiopian noise standard and IFC EHS Guidelines) (see *Table 10.37* below).

Table 10.37 Residual Operational Noise Levels

Receptor	Predicted Noise Level dB LAeq,1hr	Baseline Noise Level LA90,night	Noise Criteria Night time 45 dB LAeq,1hr	
			Impact Magnitude Night time	Noise Impact significance
NSR 3 (Hamad Ela Village)	30	37	Negligible	Negligible
NSR 4 (Ambule and Asabolo Village)	<25	35	Negligible	Negligible
NSR 5 (Tahasuli, Asgubi, Oilayle, Ondamodgalu, Armdeli and Kahniyeb Villages)	<25	30 ¹	Negligible	Negligible
NSR 6 (Berahale Town)	<25	30 ¹	Negligible	Negligible

1 - minimum baseline level of 30 dBA applied

10.6.3 *Impacts Arising from Road Traffic Noise*

Background

Description of the Baseline Environment

Based on monitoring results presented in *Chapter 8*, noise levels in the Study Area are low. In isolated areas of the Study Area where the noise environment typically consisted of natural sounds (such as wind and livestock) the LA_{eq} ranged between 25 to 33dB, whereas areas dominated by human activity and village infrastructure (such as water pumps, children and passing trucks) the LA_{eq} ranged between 48 to 53dB during the daytime and 44 to 49dB during the night time.

Proposed Project Activities

Road traffic noise will be highway trucks transporting the potash through the Study Area via a purpose built haul road. The proposed Project is expected to produce approximately 155 truckloads (310 vehicle movements) per day.

The equipment simulated and their acoustic performances for road traffic are illustrated in *Table 10.38*.

Table 10.38 *Proposed Equipment List for the Transportation of Product*

Equipment Description	Location	Quantity	Sound Power Level, Lw dB(A)
Road Traffic (off site)			
Road Trucks	Road Alignment	155/day	103 each

Sensitive Receptors

The villages of Mororo, Alai lai and Hamad Ela will be the most affected in terms of noise emissions from the transport of product off-site (*Figure 10.4*).

Significance of Impact (Pre-mitigation)

As the exact road alignment is yet to be determined, noise emissions from heavy vehicle traffic generated by the proposed Project have been calculated to determine the required distance the road would need to be from NSR's to meet the 55dB LA_{eq,1hr} daytime and 45dB LA_{eq,1hr} night time noise criterion.

The offset distances presented in *Table 10.39* and *Table 10.40* will allow the road to be designed such that the potential impacts can be determined. This will assist in designing the road to minimise the impacts from road traffic noise generated by the proposed Project. The predicted levels are the same for daytime and night time, since the proposed Project will operate 24 hours per day.

Table 10.39 Predicted Road Noise Levels for during the Daytime

Noise Level dB LAeq,1hr	Distance from Road	Daytime Criteria - 55 dB LAeq,1hr	
		Impact Magnitude	Impact Significance
60	10m	Small	Minor
55	17m	Negligible	Negligible
50	25m	Negligible	Negligible
45	45m	Negligible	Negligible

Table 10.40 Predicted Road Noise Levels for during the Night Time

Noise Level dB LAeq,1hr	Distance from Road	Daytime Criteria - 45 dB LAeq,1hr	
		Impact Magnitude	Impact Significance
60	10m	Large	Major
55	17m	Moderate	Moderate
50	25m	Small	Minor
45	45m	Negligible	Negligible

Based on the analysis provided above, it is the opinion of this ESHIA that the noise related impacts from road noise will be a '**Negligible Negative Impact**' should the main haul road be built at a distance greater than 45m from a NSRs.

Recommendations and Mitigation/Management Measures

The assessment concluded that there will be no significant impact on people as a result of noise arising from road traffic during the operational phase of the proposed Project, should the main haul road be paved and built at a distance greater than 45 metres from NSRs.

Residual Impact (Post-mitigation)

Should the main haul be constructed a distance of 45m (or greater) away from NSRs, the impact will remain as a '**Negligible Negative Impact**'.

10.6.4 Impacts during the Decommissioning Phase

Background

Description of the Baseline Environment

Based on monitoring results presented in *Chapter 8, noise levels in the Study Area are low*. In isolated areas of the Study Area where the noise environment typically consisted of natural sounds (such as wind and livestock) the LA_{eq} ranged between 25 to 33dB, whereas areas dominated by human activity and

village infrastructure (such as water pumps, children and passing trucks) the LA_{eq} ranged between 48 to 53dB during the daytime and 44 to 49dB during the night time.

Proposed Project Activities

During the decommissioning phase of the proposed Project, noise impacts will be related to the dismantling and removal of infrastructure. With regard to noise emissions, decommissioning works are less intensive than construction, although involving similar equipment, but usually not requiring heavy earthworks.

The equipment simulated and their acoustic performances for decommissioning activities are illustrated in *Table 10.41*.

Table 10.41 Proposed Equipment List for use During the Decommissioning Phase

Equipment Description	Location	Quantity	Sound Power Level, Lw dB(A)
Decommissioning			
25t Mobile Crane	Overall Study Area	1	114
Front end Loader / backhoe		1	105
Road Trucks		4	106 each

Sensitive Receptors

The villages of Mororo and Alai lai will be the most affected in terms of activities associated with the decommissioning of actual mining related infrastructure; however, these villages are proposed to be re-settled. Villages located along the access road will be susceptible to noise emissions from trucks transporting materials off site; this includes Hamad Ela, Ambule, Asabolo, Tahasuli, Asgubi, Oilayle, Ondamodgalu, Armdeli, Kahniyeb and Berahale Town.

Significance of Impact (Pre-mitigation)

As is mentioned above, decommissioning works are less intensive than that of construction, as such, activities associated with decommissioning would have similar or lesser impacts to those predicted for construction (refer to *Section 10.6.1*) and therefore will be a '**Negligible Negative Impact**' pre-mitigation.

Recommendations and Mitigation/Management Measures

The assessment concluded that there will be no significant impacts on people from noise during the decommissioning phase and additional mitigation measures other than good construction work methods and practice are not required.

Residual Impact (Post-mitigation)

As additional mitigation measures (other than good decommissioning work methods) are not required, the impact will remain as a '**Negligible Negative Impact**'.

10.7 IMPACTS ON THE BIOLOGICAL ENVIRONMENT

10.7.1 Introduction

The predicted impacts on the biological environment as a result of the proposed Project are described in this Section. The baseline assessment of the biological environment (*Figure 8.13 in Chapter 8*) separated the area of influence into various habitats (*Table 10.42*). These habitats have been described as Modified, Natural or Critical Habitats based on guidance notes to the IFC Performance Standards and a sensitivity assessment conducted for the baseline assessment. The ecological state and sensitivity of each habitat type is set out in *Table 10.42*.

Table 10.42 Habitats and associated Sensitivities within the Allana Project's Area of Direct Influence

Habitat Unit	Ecological State	Sensitivity as per the Baseline Assessment
Terrestrial Habitats		
Bare Lands		
• Upper (Mountainous) Bare Lands	Natural	Limited Ecological Sensitivity
• Lower Bare Lands	Natural	Moderate Ecological Sensitivity
Alluvial Habitats		
• <i>Senna</i> Alluvial Pasture	Natural	Ecologically Sensitive
• <i>Aerva</i> -dominated Alluvial Fans	Natural	Ecologically Sensitive
<i>Hyphaene-Cyperus</i> Salt Pan Fringe	Natural	High Ecological Sensitivity
Aquatic Habitats		
Salt Pan, Lake Assale (and Dallol)	Not applicable	Ecologically Not Sensitive
Sabah River (freshwater)	Modified	High Ecological Sensitivity
Groundwater fed ponds and streams		
• Mororo Groundwater ponds	Fully Natural	Critical Habitat
• Hamad Ela Mudflats	Natural Habitat	Critical Habitat

Potential impacts on the ecology of the Project's area of influence include:

- Loss of habitat through pumping of large quantities of groundwater during the operational phase.
- Development of infrastructure and induced third party access and associated potential loss of Critical and Natural Habitat.
- Loss of Red Data species may occur through inappropriate development of infrastructure and cultural alterations resulting from improved infrastructure and access to external markets.

All mitigation/management measures recommended in this Section have been detailed in the Biodiversity Management Plan (BMP) (refer to *Annex B* in *Volume Three*).

10.7.2 ***Impacts Related to Habitat Loss and Fragmentation of the Salt Pan Fringe during All Project Phases***

Background

Description of the Baseline Environment

The Salt Pan Fringe is a natural habitat and has been classified as having a high ecological sensitivity (*Table 10.42* and *Figure 8.37* in *Chapter 8*) in the baseline assessment due to its natural state, restricted extent and importance for supporting biodiversity. This habitat is created by a natural upwelling of groundwater from alluvial fans caused by the geology that surrounds the salt pan. The vegetation community within this habitat is dominated by Doum Palms (*Hyphaene thebaica*), *Acacia* trees and sedges and is unique to the area. This habitat is the focus for biodiversity activity for the region and provides a buffer around areas of Critical Habitat. Furthermore, this habitat is key from a social perspective, as the fronds from Doum Palms are collected and processed by communities living in the Study Area (refer to *Chapter 9*).

Proposed Project Activities

The project will involve extracting large quantities of groundwater from alluvial fans in the Study Area during the operational phase. This groundwater will be used to dissolve Potash in a brine solution and transport it to evaporation ponds.

The extraction of groundwater may cause the water table in the area of direct influence to drop resulting in dependent plant species within the Salt Pan Fringe habitat located in the Project Area to potentially die, and render the habitat unsuitable for the faunal species present there. The extent of the habitat loss is expected to be restricted to local catchments, which are thought to be approximately delineated by the Alluvial Fan structures. A groundwater model has been developed and estimates that a significant subterranean reservoir with a volume of 180,000,000 m³ exists with significant recharge capacity. Allana's groundwater requirement is estimated at 16,000,000 m³/annum.

An Impact Assessment of the Groundwater resource estimates that a drawdown impact will have a Moderate significance, but that groundwater extraction can be restricted to the natural recharge capacity. Based on mitigation measures, these impacts can be reduced to a Minor negative significance.

Additional impacts resulting in the loss of this habitat will be caused by the development of infrastructure including roads, pipelines, power lines and

potential extraction of borrow material for the construction of roads. Furthermore, the construction of roads could potentially open the Project Area to an influx of immigrants; however, security restrictions imposed by Allana may avoid uncontrolled access to the immediate Project Area.

Sensitive Receptors

The Salt Pan Fringe Habitat and associated ecosystem (including communities dependent on ecosystem services within this habitat) can be classified as the sensitive receptor. The Doum Palms (*Hyphaene thebaica*) are prominent features of the habitat and are considered a suitable indicator species for monitoring the habitat response to groundwater alterations for the following reasons:

- Doum Palms are restricted to the Salt Pan Fringe and riparian habitats;
- These species provide refuge for a diversity of faunal species;
- These species provide important ecosystem services to the local Afar communities;
- The palms are shallow-rooted and are expected to show a clear response to alterations in groundwater levels; and
- Few dead palms currently exist in this habitat.

Significance of Impact (Pre-mitigation)

Given the sensitivity of the habitat, and the impact of habitat loss within the Salt Pan Fringe is considered a **'Major Negative Impact'** (Table 10.43).

Table 10.43 Rating of Impacts Related to Habitat Loss and Fragmentation in the Salt Pan Fringe (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Rating	Summary of Reasoning
Extent	Local	The groundwater drawdown cones are predicted to be restricted to the area of a local catchment.
Duration	Long term	Impacts are expected to occur throughout the operational phase and possibly extend into the post closure period. The duration of the impact will be dependent on the level of drawdown and the rate of recharge.
Scale	Medium	Based on data presented by the pump test in the Hydrology Baseline, the drawdown of the aquifer is expected to be localised and confined to the target alluvial fan. Locations for extraction of groundwater will be located some distance away from the Salt Pan Fringe and a reduced drawdown impact is expected in the vicinity of this habitat.
Frequency	Frequent	There is potential for the impact to occur at any time during operational phase of the mine and potentially into post closure depending on the magnitude of aquifer drawdown and recharge rates.
Likelihood	Likely	The extraction of groundwater is a planned event that will occur throughout the operational phase of the proposed project.

Magnitude of Impact	
	Medium
Fugro (2012) estimate recharge into the alluvial fan bearing aquifers is in excess of Allana's water needs and drawdown impacts pre-mitigation are estimated to be Moderate. Fugro (2012) did detect different water qualities within the groundwater aquifer, and the potential pre-mitigated impacts on groundwater quality could have a Moderate significance.	
Sensitivity of the Receptor	
Designation	Summary of reasoning
High	The Salt Pan Fringe habitat was assessed in the baseline assessment as being highly sensitive due to its natural state, restricted extent and importance for supporting biodiversity. This habitat is the primary source of palm products for the local Afar communities and is an important foraging ground of the Near Threatened Striped Hyena.
Significance Rating Before Mitigation	
Negative Impact	Major Negative Impact
Major	

Recommendations and Mitigation/Management Measures

The IFC Performance Standard 6 requires that impacts on natural habitats be managed in a manner that leads to no net loss of biodiversity values where feasible ⁽¹⁾. Appropriate actions provided by the Performance Standard 6 include:

- Avoiding impacts through the identification and protection of set asides ⁽²⁾;
- Implementing measures to minimize habitat fragmentation, such as biological corridors;
- Restoring habitats during operations and/or after operations; and
- Implementing biodiversity offsets.

The following mitigation measures are recommended to reduce impacts on the Salt Pan Fringe habitat:

Establish a Baseline State

A baseline count and assessment of the health of Doum Palms present in the Salt Pan Fringe habitat within the Project Area will be required prior to the operational phase of the proposed Project and subsequent groundwater extraction. This will allow a benchmark to be established, against which the future state of the habitat can be compared. These large palm clusters will be easily identified on a detailed satellite image which can be used to map and count plants in different zones of the Salt Pan Fringe Habitat. This desktop-

(1) Paragraph 15 of Performance Standard 6 states "In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible."

(2) Set-asides are defined within the Performance Standard 6 as: "Land areas within the project site, or areas over which the client has management control, that are excluded from development and are targeted for the implementation of conservation enhancement measures. Set-asides will likely contain significant biodiversity values and/or provide ecosystem services of significance at the local, national and/or regional level. Set-asides should be defined using internationally recognized approaches or methodologies (e.g., High Conservation Value, systematic conservation planning)."

based exercise must be followed by a ground-truthing exercise to allocate plants into size categories and state of health. Limited expertise will be required and the necessary skills could be provided by local researchers with some initial training.

Avoidance Measures

This habitat type must be avoided as far as possible. The following avoidance measures are to be instated:

- A significant tract of this habitat must be recognised as a Set-aside area and protected from transformation or fragmentation by linear developments or human settlement. The northern portion of this habitat currently offers the best prospects for establishment of a Set-aside area. Similar and cumulative impacts caused by neighbouring mining operations must also be considered.
- Any activities that can be conducted elsewhere will be shifted away from this habitat. Infrastructure such as the processing plant, staff village, evaporation ponds etc. will not be constructed in this habitat or within a 150 meter buffer thereof. Furthermore, vehicle parking, temporary construction camps, containers, equipment and materials drop-off and storage sites will be located outside of this habitat.
- Developments within this habitat are to be restricted to essential linear infrastructure that needs to cross over this habitat. *Refer also to Minimisation Measures below.*
- No borrow pits may to be excavated within this habitat or within a 150 meter buffer of this habitat as determined in the Biological Environment Baseline Assessment (Chapter 8).

Minimisation Measures

- The water reservoir appears to have sufficient capacity for water supply, even in dry years. It is however recommended, in order to prevent salt water intrusion and from the viewpoint of sustainability, ***to abstract only an amount of ground water equal to the average recharge.***
- A key mitigation measure within the Hydrology Impact Assessment (*Section 10.4*) requires that groundwater abstraction will be cutback should a combination of the following be realised:
 - A significant dieback of Doum Palms in the Salt Pan Fringe as determined by a qualified botanist; and
 - A significant drawdown in groundwater levels established from groundwater depth monitoring in observation wells.

- Proper planning is recommended in advance of any linear developments passing through this habitat or a 150 meter buffer thereof to determine the minimum required footprint.
- Linear infrastructure that passes through this habitat should be grouped, for example pipelines, powerlines and roads can follow the same route and occupy the minimum possible width (linear infrastructure corridors).
- Linear infrastructure that does transect this habitat must include culverts (not necessarily associated with drainage requirements) to allow movement of terrestrial fauna.
- The minimum footprint that will be disturbed must be clearly demarcated so that staff and contractors understand the extent to restrain their activities within the demarcations.

Rehabilitation Measures

The following rehabilitation measures are recommended as part of the proposed Project:

- A nursery will be established in which Doum Palms (*Hyphaene thebaica*) are propagated. Expertise of an experienced horticulturalist will be sought to propagate these palms from seed or tissue culture from locally acquired stock to maintain the local genetic purity. Young palms will then be supplied to the local communities at minimal cost or donated to community organisations for planting wherever suitable habitat exists, such as along the Sabah River and areas where these palms may previously have been over-harvested. Evidence of palm-planting by local communities was observed along the Sabah River (*Figure 10.5*) and their acceptance of this concept should be possible.
- If groundwater abstraction is cutback in response to an observed die-off of Doum Palms (*Hyphaene thebaica*) as determined by a qualified botanist, then young palms will be provided by the nursery for planting in these areas at a ratio of 10:1 (planted palms per die-off specimen). Every effort shall be made to ensure their survival.
- Doum Palms that need to be removed to make way for development activities such as roads or pipelines will be transplanted to areas where future access by local communities is possible. Small specimens will be easier to transplant. Initial efforts should focus on smaller plants to assess the capacity required and build experience for moving larger specimens.

Figure 10.5 Doum Palm Seedlings Planted by Local Communities along the Sabah River



Residual Impact (Post-mitigation)

An improved understanding of the aquifer dynamics should be possible based on further data collection required from mitigation measures presented in the Hydrology impact assessment. Proper implementation of the above mitigation measures to restrict groundwater abstraction to the average recharge capacity will reduce the impacts on the Salt Pan Fringe habitat. On this basis, the impact post-mitigation can be considered a **Minor Negative Impact** (Table 10.44).

Table 10.44 Rating of Impacts Related to Habitat Loss and Fragmentation in the Salt Pan Fringe (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The groundwater drawdown cones shall be restricted to the local catchment.
Duration	Long term	There is the potential for the impact to occur during operations and potentially into post closure. The duration of the impact will be dependent on the level of drawdown and the rate of recharge.
Scale	Small	Fugro (2012) pump test data indicate that the drawdown effect will be localised. If abstraction levels do not exceed the recharge capacity, then this effect will have a limited impact at the edge of the Salt Pan Fringe habitat.
Frequency	Continuous	If abstraction levels are restricted to the average recharge capacity, and if drawdown is monitored and managed as per the hydrology requirements, then the frequency of large scale drawdown will be minimised.

Magnitude	
	Small
Negligible to Small Magnitude	
Monitoring of palms by a qualified botanist will be used as one of the indirect indicators to adjust the levels of groundwater extraction, and losses of palms will be compensated with replanting. The magnitude on this species shall be low, and will limit the impacts on the habitat as a whole.	
Significant Rating After Mitigation	
Minor Negative Impact	
Minor	

10.7.3 Impacts Related to Loss of Critical Aquatic Habitats due to Groundwater Extraction during the Operational Phase

Background

Description of the Baseline Environment

Small pools of highly-saline water exist in the vicinity of the Mororo and Hamad Ela villages, which are fed by groundwater flows referred to in the Hydrology baseline (*Chapter 8*) as seepage water. The water in these pools is hot due to the limited volume and the salinity is considerably higher than sea water. These pools support viable populations of Killifish (*Aphanius dispar*) and a limited diversity of aquatic invertebrates that survive under extreme environmental conditions. *Aphanius dispar* has not been classified with a Red Data status but land-locked populations occurring in Saudi Arabia are considered to be Endangered (IUCN Red Data website, 2012). The extent of genetic differences within the species between these areas is not known but a taxonomic revision of the species is expected with many range-restricted species recognised. The same endangered status is currently applied to the local population. These seepage pools have been classified in the baseline assessment as **Critical Habitat** in accordance with the IFC Performance Standard 6 ⁽¹⁾ due to their support of an Endangered species. Rationale for the classification of Critical Habitat is presented in the Baseline Report.

Proposed Project Activities

As described for the previous impact (Section 10.7.2), plans exist to extract large quantities of groundwater to be used for solution mining of Potash. Excessive abstraction of groundwater could cause the seepage pools at Mororo and Hamad Ela Villages to dry out.

Sensitive Receptors

The primary sensitive receptor of this impact is the Killifish (*Aphanius dispar*). Few other faunal species were observed to survive in this habitat.

⁽¹⁾ Paragraph 16 of IFC Performance Standard 6 provides the criteria to justify the recognition of Critical Habitats.

Significance of Impact (Pre-mitigation)

Based on the available information and analysis provided above, it is the opinion of this ESHIA that the pre-mitigation impact on critical aquatic habitats from extraction of large quantities of groundwater will be a '**Major Negative Impact**'. The rationale for this assessment is set out in *Table 10.45* below.

Table 10.45 Rating of Impacts Related to Loss of Critical Aquatic Habitats due to Groundwater Extraction (Pre-mitigation)

Type of Impact		
	Negative	Indirect
Indirect Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local / Regional	Plans exist to extract large quantities of groundwater from the local groundwater catchments resulting in a drawdown of the groundwater table within the catchments associated with these pools and subsequent loss of groundwater fed aquatic habitats and species dependent on these habitats.
Duration	Permanent	Loss of this habitat would result in the permanent loss of the Killifish populations in the Study Area
Scale	Full extent	This habitat consists of small seepage pools that could dry out, and thus their full extent would be lost.
Frequency	Occasional	A significant groundwater aquifer exists, but continuous high levels of abstraction could interrupt the seepage flows causing surface pools to dry out intermittently and cause a die-off of entire fish populations.
Likelihood	Likely	Plans exist to extract significant volumes of groundwater. Impacts, if not mitigated, will thus likely occur.
Magnitude		
		Large
Large Magnitude		
Removing the source of replenishment through pumping large quantities of groundwater would result in these pools drying out and represent a complete loss of the essential habitat required by these Killifish populations. The highest level of magnitude is thus applied.		
Sensitivity of the Receptor		
Designation	Summary of Reasoning	
High	The Sensitivity Assessment within the baseline report classified this habitat as Critical for the survival of the Killifish (<i>Aphanius dispar</i>), which represents the highest level of ecological sensitivity.	
Significant Rating Before Mitigation		
Negative Impact		Major Negative Impact
	Major	

Recommendations and Mitigation/Management Measures

The IFC Performance Standard 6 requires projects that impact upon Critical Habitats to demonstrate a net gain ⁽¹⁾ in the biodiversity values that trigger the Critical Habitat classification, in this case the Killifish *Aphanius dispar*.

The IFC Performance Standard 6 requires project activities not to be implemented in areas of critical habitat unless all of the following criteria are demonstrated ⁽²⁾:

- No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;
- The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values assessed on an ecologically relevant scale;
- The project does not lead to a net reduction ⁽³⁾ in the global and/or national/ regional population of any Critically Endangered or Endangered species over a reasonable period of time; and
- A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program.

Further Studies Required to Develop Appropriate Mitigation

The presence of high-salinity pools and the presence of Killifish (*Aphanius dispar*) in the greater area of the Danakil Depression, and particularly within Lake Assale are to be investigated. There is a possibility of this species occurring in the nearby Lake Assale in which case a significant population may be present. The species has not been formerly classified as an Endangered species and demonstrating the presence of a viable population there may reduce the Critical Habitat classification applied to the groundwater-fed pools within the concession area and reduce the significance applied to the assessment of this impact.

Availability of alternative water sources for the operational phase of the proposed mining project must be investigated (if not already done so). Allana will need to demonstrate and justify the availability / non-availability of alternative water sources for mining. The Sabah River provides a reliable supply of freshwater upon which communities and a broad range of

⁽¹⁾ Net gains are additional conservation outcomes that can be achieved for the biodiversity values for which the critical habitat was designated. Net gains may be achieved through the development of a biodiversity offset and/or, in instances where the client could meet the requirements of paragraph 17 of Performance Standard 6 without a biodiversity offset, the client should achieve net gains through the implementation of programs that could be implemented *in situ* (on-the-ground) to enhance habitat, and protect and conserve biodiversity.

⁽²⁾ Paragraph 17 of Performance Standard 6 presents four criteria to be met for Critical Habitats.

⁽³⁾ Net reduction is a singular or cumulative loss of individuals that impacts on the species' ability to persist at the global and/or regional/national scales for many generations or over a long period of time. The scale (i.e., global and/or regional/national) of the potential net reduction is determined based on the species' listing on either the (global) IUCN Red List and/or on regional/national lists.

biodiversity depend, and must therefore **not** be considered an alternative source.

The current taxonomy of the Killifish species is very broad, with populations located in both hyper saline and fresh water environments. These populations exhibit different physical characteristics and are expected to exhibit considerable genetic variation that may qualify populations to be recognised as separate species. Allana should support an academic researcher to investigate the genetic variation between the fish populations in the Sabah River, the Hamad Ela Mudflats, the Mororo Groundwater Pools and any other populations that may be found in the greater area. Considerable genetic variation will raise the uniqueness of the species and raise their sensitivity. Such studies may take up to two years to complete. Requirements of such studies are presented in a management plan.

Emergency Mitigation Measures

The following range of mitigation measures (in order of importance) is presented to facilitate the survival of this Killifish in its natural habitat, plus ways to increase populations and provide opportunities to further understand the ecology of this species.

1. Baseline Monitoring of Existing Habitats

Baseline monitoring of the habitat is required so as to develop a better understanding of the physical and biological characteristics of the groundwater fed habitats prior to large-scale extraction of groundwater resources. The following monitoring is recommended:

- Monitoring of baseline water levels and water quality, including temperature, salinity and duration of water levels throughout the year for as long as possible prior to the onset of significant groundwater extraction. It is important to understand the baseline conditions, as it may be necessary to artificially replicate these systems at a later stage.
- An approximate estimate of the fish population in the respective pools is recommended, which could be achieved through sample photographing of shoals of fish in the water. The pools are small and the water is clear and the fish can be easily counted.
- Map and measure the full extent of pools in the Study Area from a focussed aerial image.
- The '*Development of Seed populations*' described below presents an opportunity to test the ability of these fish to adapt to alternative water sources. Should those attempts be unsuccessful, the support must be provided for an academic researcher to establish the tolerance of the fish,

under controlled environments, to survive various water quality changes, such as salinity and temperature changes.

2. Likelihood of Impact

- The groundwater model must be calibrated as early as possible to extraction volumes, groundwater levels and supply of water to the high-salinity pools. This will allow for a more quantitative understanding of the likelihood of these pools drying out due to groundwater extraction during the operational phase of the proposed Project. The pools may dry out naturally during the dry season, but drying in the wet season would be catastrophic to the killifish populations there.

3. Development of Seed Populations

- Limited numbers of fish should be translocated as seed populations to artificial water bodies (quality of the water provided must be within the range of salinity and temperature fluctuations assessed in the baseline determination of their habitat as described above.).
- The pilot evaporation ponds in the vicinity of Mororo Village will become redundant once Allana have demonstrated their capacity to conduct solution mining. These artificial ponds can be filled with water to match the salinity profile of the nearby natural seepage pools and small numbers of fish released there to test whether they are able to survive. Steps to be taken with regard to this translocation are presented in the Biodiversity Management Plan.
- Killifish must **NOT** be translocated from any of the seepage pools to other water bodies that support natural populations of killifish. Different populations of killifish species frequently are genetically distinct from one another, and their genetic purity must be maintained.

4. Artificial Maintenance of Existing Habitats

- As a last resort if it appears that the pools will imminently be lost, and based on an understanding of the fish's tolerance to change, water must be artificially supplied to the existing pools. Quality of the water provided must be within the range of salinity and temperature fluctuations assessed in the baseline determination of their habitat as described above.

Biodiversity Offset

Development of a Biodiversity Offset is not proposed for this situation as there is currently no information available on the extent of the distribution of this fish species and if reasonable opportunities exist for its protection elsewhere. This option may be considered at a later stage if suitable opportunities arise from an improved understanding of this fish species. Alternatively the need for an offset may not be necessary if the population of

Killifish (*Aphanius dispar*) can be shown to be significant and widespread in the area, in which case the baseline assessment presented in Chapter 8, this Impact Assessment and the BMP (*Annex B in Volume Three*) will need to be amended. The species has not been formerly classified as Endangered and demonstrating a wider distribution could overcome the Critical Habitat designation applied to its habitat.

Residual Impact (Post-mitigation)

Based on implementation of measures to restrict groundwater extraction to the aquifer recharge capacity described for the previous impact, securing local killifish populations through successful translocation of seed populations to artificial water bodies and maintaining the habitat, the residual impact of the loss of Critical Habitats is assessed as a '**Minor Negative Impact**' (Table 10.46).

Table 10.46 Rating of Impacts Related to Loss of Critical Aquatic Habitats due to Groundwater Extraction (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	Fugro (2012) demonstrate that the drawdown cones will be restricted to local groundwater catchments.
Duration	Short term	Limited fluctuations in the water levels of the pools may occur as a result of intermittent supply of seepage flows.
Scale	Small	Limited fluctuations in the water levels of the pools may occur as a result of intermittent supply of seepage flows.
Frequency	Occasional	A significant groundwater aquifer exists, which will be able to buffer the impacts of groundwater extraction provided levels do not exceed the recharge capacity.
Magnitude		
		Small
Small Magnitude		
Groundwater extraction will be limited to the recharge capacity of the aquifer and indirect impacts on the surrounding habitat shall be monitored. Loss of the killifish species will be avoided by securing safe populations within artificial water bodies that have already been constructed.		
Significant Rating After Mitigation		
Minor Negative Impact		
Minor		

10.7.4 Impacts Related to Habitat Loss and Fragmentation of the Alluvial Fan Habitat during All Project Phases

Background

Description of the Baseline Environment

The Alluvial Fans provide a trap for large sediment loads that are transported from the Mountainous Upper Bare Lands before reaching the Highly Sensitive Salt Pan Fringe habitat. The Alluvial Fans habitat has been classified in the

baseline assessment as Natural Habitat according to IFC criteria and assessed as Ecologically Sensitive due to the limited extent and the ecosystem services provided for grazing community livestock and Dorcas Gazelle. Key grazing lands based on alluvial sands in the vicinity of the current airstrip have similarly been classified as Ecologically Sensitive for the same reasons.

Proposed Project Activities

Linear infrastructure such as roads and pipelines will be required within this habitat to link various Project activities. Access to the Project Site will also be required in the form of large access roads. Other forms of development within the Alluvial Fans habitat are considered unlikely due to the occasional flooding of this habitat and the unstable alluvial substrates. Furthermore, potential extraction of borrow material for the construction of roads could potentially occur in the habitat type.

Extraction of groundwater is not expected to significantly affect these habitats.

Sensitive Receptors

Both of these alluvial habitats are important for supporting wildlife, particularly Dorcas Gazelle (*Gazella dorcas*) and hence their predators. These species provide ecological services for communities in the Study Area and the habitat is also an important grazing ground for livestock of the local Afar communities.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it considered that the impact from development of infrastructure that could result in the loss of habitat and fragmentation of the various alluvial habitats will be a '**Moderate Negative Impact**'. The rationale for this is set out in Table 10.47).

Table 10.47 Rating of Impacts Related to Habitat loss and Fragmentation of the Alluvial Fans (Pre-Mitigation)

Type of Impact		
Negative		Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	Linear developments will be required to cross the immediate habitat in the Project Area
Duration	Long term	Impacts will last for the duration of the operational phase of the proposed Project, and possibly longer
Scale	Partial extent	The Alluvial Fan Habitat is fairly extensive with only a small portion potentially impacted
Frequency	Continuous	The presence of infrastructural developments would have a continuous impact
Likelihood	Likely	Linear developments will be required to cross this habitat and the event will thus be likely
Magnitude		

	Small	Medium	
Small to Medium Magnitude			
This habitat covers a large extent with occasional linear infrastructure crossings planned to occur. These developments are considered to have a Small to Medium magnitude impact.			
Sensitivity of the Receptor			
Designation	Summary of Reasoning		
Medium	The alluvial fans and alluvial pastures are classified in the baseline assessment as being Ecologically Sensitive based on the natural state of these habitats and the ecological services provided to local communities in the form of livestock grazing and wildlife support. Based on the extent of these habitats, the Sensitivity is rated as Medium.		
Significant Rating Before Mitigation			
Negative Impact		Moderate Negative Impact	
Moderate			

Recommendations and Mitigation/Management Measures

The IFC Performance Standard 6 requires that there is no net loss of biodiversity values in a natural habitat ⁽¹⁾. The impacts resulting from developments such as linear infrastructure crossing through these habitats, if adequately mitigated, will not result in a net loss of the biodiversity value.

Avoidance Measures

The Alluvial Fan Habitat shows a range in vegetation density, with some areas sparsely vegetated while other areas support dense stands of *Aerva* shrubs (such as the alluvial pastures in the vicinity of the airstrip). The densely vegetated parts are more sensitive, and developments within these areas are to be avoided. Development activities must rather be shifted to the Lower Bare Lands Habitat, which will likely be wise engineering practice as the Alluvial Fan Habitat is occasionally flooded following heavy rains in the catchment areas. It is however expected that essential linear infrastructure will need to intersect these habitats and that they cannot be avoided entirely.

Minimisation Measures

The footprint of developments within this habitat will be minimised through adequate advance planning, and a clear demarcation of the areas to be disturbed must be provided so that staff and contractors know the extent to restrain their activities within the demarcations.

Linear developments through the Alluvial Fans must consider installation of adequate drainage infrastructure to allow unimpeded movement of flood waters.

Consideration must be given to the movement of terrestrial fauna across linear infrastructure developments. Culverts and under passes will be incorporated

⁽¹⁾ Paragraph 15 of IFC Performance Standard 6 states that for areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible.

into the infrastructure design where such developments could pose a barrier to movement.

Restoration Measures

Redundant infrastructure should be removed as early as possible and areas appropriately rehabilitated. This concept is important during the decommissioning phase, but also be applied during construction and operational phases of the proposed Project.

Residual Impact (Post-mitigation)

With suitable mitigation/management this impact is likely to decrease, resulting in a residual assessment of the impact as a '**Minor Significance Impact**'. The rationale for this is set out in *Table 10.48* below.

Table 10.48 Rating of Residual Impacts Related to Habitat Loss and Fragmentation of the Alluvial Fans (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	Linear developments will be required to cross the immediate habitat in the Project Area
Duration	Long term	Impacts will last for the duration of the operational phase of the proposed Project, and possibly longer
Scale	Small extent	The Alluvial Fan Habitat is fairly extensive with only a small portion potentially impacted; however, minimisation of the footprint of development activities can reduce the scale of this impact
Frequency	Continuous	The presence of infrastructural developments would have a continuous impact
Likelihood	Possible	Linear developments will be required to cross this habitat and the event will thus be likely; however, mitigations applied to linear developments can reduce the likelihood of impacts
Magnitude		
	Negligible	Small
Negligible to Small Magnitude		
Installation of adequate drainage facilities would reduce the fragmentation effect of linear infrastructure as such structures could facilitate the movement of terrestrial fauna. Minimised footprint of developments achieved through careful planning and disciplined construction can significantly reduce the magnitude of the impact in dry conditions to a negligible/small level		
Significant Rating After Mitigation		
Minor Negative Impact		
Minor		

10.7.5 *Impact Related to the Loss of Terrestrial Red Data Species during All Project Phases*

Background

Description of the Baseline Environment

Terrestrial Red Data species currently occurring in the study area, namely Egyptian Vultures (*Neophron percnopterus*) and Striped Hyena (*Hyaena hyaena*) are scavengers that rely on the availability of carcasses for their survival. The salt trade in its current form brings thousands of camels to the area and is considered an important source of food for these animals.

Proposed Project Activities

Road networks are being improved to provide access to the mining operations; however, these developments bring the risk that trucks could be used to transport salt to distant markets and cause the current camel trains to become a historical feature of the area. The Egyptian Vulture and Hyena populations are thought to depend on camel carcasses originating from old and weak animals brought to the area by the annual salt trade. The current camel-based culture of the salt trade should thus be encouraged to continue.

A wide range of effects caused both directly and indirectly by the proposed Project could have a suppressing effect on the populations of Red Data species in the Study Area. These include the following:

- The potential construction of power lines places large raptors, particularly the Egyptian Vultures at risk of collisions with the electrical wires and electrocution when landing on pylon structures.
- Communities generally have a negative perception of scavengers and tend to discourage their presence. The vulture and hyena populations survive the current human densities but an increase in people into the Study Area attracted to economic opportunities created by the proposed Project could result in increased persecution of these animals.

At this stage, surface water sources such as the Sabah River will not be used for the solution mining operations, and impacts related to groundwater extraction are not expected to significantly impact on the Red Data species described here.

Sensitive Receptors

Sensitive receptors associated with this impact include the Egyptian Vulture (*Neophron percnopterus*) classified as Endangered and the Striped Hyena (*Hyaena hyaena*) classified as Near Threatened based on global Red Data classifications provided by the IUCN. The Study Area also provides suitable habitat for the Critically Endangered African Wild Ass (*Equus africanus*). Within Ethiopia, this species is now restricted to limited locations to the south

of the Allana Concession. Collaboration with the Ethiopian Conservation Authorities is proposed to investigate ways in which support can be provided to prevent the extinction of this species.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is considered that the impact from loss of terrestrial Red Data species will be a '**Moderate Significance Impact**'. The rationale for this is set out in *Table 10.49*.

Table 10.49 Rating of Impacts Related to Loss of Terrestrial Red Data Species (Pre-Mitigation)

Type of Impact		
	Negative	Indirect
Indirect (and cumulative) Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Regional	Red Data species occurring in the area consist of small numbers of wide ranging individuals. Loss of animals could thus impact upon the population at a regional scale
Duration	Long term / Permanent	The local loss of species could be permanent, or at least for the duration of disturbance posed by the proposed Project
Scale	Difficult to assess	The size of local populations is not known and could only be determined through detailed study which has not been feasible for this level of assessment
Frequency	Difficult to assess	The frequency of species loss cannot be accurately predicted
Likelihood	Possible	Population declines are documented for Ethiopia, and further declines are thus possible
Magnitude		
		Medium
Medium Magnitude		
Both Striped Hyena and Egyptian Vulture populations are widespread in Northern and Eastern Africa and beyond, which reduces the magnitude of the impact of loss of individuals to Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	Egyptian Vultures occurring in the Study Area are internationally classified as Endangered due to their small population size and widespread declines in recent years. Striped Hyena is classified as Near Threatened.	
High		
Significant Rating Before Mitigation		
Negative Impact		Moderate Negative Impact
Moderate		

Recommendations and Mitigation/Management Measures

The following mitigation measures are recommended:

- The introduction and use of poisons for veterinary and other purposes must be discouraged.
- Any overhead powerlines should be installed with perching devices that prevent large birds from coming into contact with wires carrying live currents.
- Powerlines should have numerous flappers and other visibility devices installed to increase the possibility that they are seen by flying birds.
- The current camel-based culture of the salt trade should be encouraged to continue. The following approaches are proposed although additional measures may also be required:
 - The salt market for small-scale salt miners must not be undermined through use of vast quantities of salt that will become available through the solution mining for potash.
 - Continued access to the salt pan must be allowed for camel caravans despite their passing in close proximity to mining developments.
 - Trucks should not be allowed access to the salt pan for the purpose for transporting traditionally harvested salt to distant markets.
 - Natural flooding patterns of the salt pan must not be impeded. Raised roads built within the salt pan require regular culverts to be installed. Numerous small culverts will be more appropriate than fewer larger culverts to allow a natural spread of slowly rising water levels emanating from Lake Assale.
 - Closure and removal of the BHP Billiton road that directly accesses the salt mining area is recommended.⁽¹⁾
- Acceptance of hyenas and vultures must be promoted within surrounding communities and staff through awareness campaigns.
- Prey populations, particularly Dorcas Gazelle and Ostrich must be protected.
- A strict policy will be enforced that prohibits harvesting of wildlife or taking of wildlife products by any Allana staff or third party contractors. This applies to hunting of antelope, killing of predators, hunting birds or collecting their eggs (including ostrich eggs), killing of snakes or other reptiles and equally to the purchase of wildlife products such as meat or eggs from local markets or communities.

(1) Closure and removal of the BHP Billeton road should be the responsibility of the Ethiopian government as they are the ones that let BHP leave without rehabilitating the area. However Allana should intervene here to avoid inheriting negative impacts caused by this road.

- Additional conservation measures are to be developed between Allana and the Ethiopian Conservation Authorities to assess the importance of the areas in the vicinity of the Allana Concession for conservation of African Wild Ass (*Equus africanus*) populations, and to explore avenues to improve the protection of this Critically Endangered species, for example to provide additional logistical or financial support to on-going initiatives.
- Further additional conservation measures between Allana and the Ethiopian Conservation Authorities could include the introduction and protection of a population of Beisa Oryx. This species historically occurred in the Study Area.
- Some form of land tenure needs to be locally recognised for the established Afar pastoralists to protect their grazing lands and cultural heritage. Formal land tenure for pastoralist communities may be difficult to achieve; however, the Allana Corporation could internally recognise and support their rights.

The Ethiopian Conservation Authorities at the regional government level have indicated a willingness to recognise the sparsely populated Danakil Depression as a protected area. Such actions are likely to conflict with the opinions of local pastoral communities. Ethiopia has designated vast protected areas, but on-the-ground management of these areas is weak and many of the protected areas lack formal proclamation. Support towards the management of existing protected areas, such as the Mille-Serdo Wild Ass Reserve to the south of the Allana Concession is considered to be more beneficial than diluting the currently weak management over an even greater area.

Residual Impact (Post-mitigation)

With suitable mitigation/management this impact is likely to remain at the same level of significance, resulting in a residual assessment of the impact as a '**Moderate Significance Impact**'. The rationale for this is set out in *Table 10.50* below.

Table 10.50 *Rating of Residual Impacts Related to Loss of Terrestrial Red Data Species (Post-Mitigation)*

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Regional	Red Data species occurring in the area consist of small numbers of wide ranging individuals. Loss of animals could thus impact upon the population at a Regional scale.
Duration	Long term / Permanent	The local loss of species could be permanent, or at least for the duration of disturbance posed by the proposed Project
Scale	Difficult to assess	Incidents will be isolated and unlikely to be reported. Monitoring the scale and frequency of loss of individuals is not practical for this Project
Frequency	Difficult to assess	
Likelihood	Possible	Persecution of scavengers is unlikely to be eliminated

Magnitude		
	Medium	
Medium Magnitude		
Both Striped Hyena and Egyptian Vulture populations are widespread in Northern and Eastern Africa and beyond; however, management of the loss of Red Data species is difficult. As such, the magnitude of the impact of loss of individuals remains Medium		
Significant Rating After Mitigation		
Moderate Negative Impact		
	Moderate	

10.7.6 *Impact Related to Reduced Water Quality of Aquatic Systems, Particularly the Sabah River during All Project Phases*

Background

Description of the Baseline Environment

The Project Area is based in a dry desert environment with an extremely hot climate, and sources of surface water, and particularly freshwater are scarce. The Sabah River provides a reliable flow of freshwater that originates from distant western mountainous areas. This water sustains life in a variety of forms and local communities depend on it for drinking and their livestock. The Sabah River is an important source of water for Lake Assale and contributes to the seasonal flooding of the vast salt pan. Seasonal flooding of the pan is important for replenishment of salt resources, which is harvested and traded by the Afar. Furthermore, the salt trade brings with it a substantial number of camels to the area on an annual basis.

Proposed Project Activities

The presence of the proposed Project could result in an influx of people into the Study Area, attracted by a perception that increased economic opportunities are available there. This effect will be cumulative with other developments in the region.

The washing of vehicles in the river has been identified as the major cause of water quality deterioration at present. This impact could be worsened by development of mining activities. Soil erosion resulting from road construction, road use and other disturbances could similarly increase and result in sediment accumulations within the Sabah River and other aquatic systems in the vicinity of the Study Area. Increased human presence resulting from staff and third party access will result in an increase in vehicles, clothing and other items being washed in the Sabah River, possible increases in sewage effluent and contamination from agricultural sources resulting in increased levels of contamination there.

At this stage, surface water sources such as the Sabah River will not be used for the solution mining operations, and impacts related to groundwater

extraction are not expected to significantly impact on the flow of water in the Sabah River.

Sensitive Receptors

The sensitive habitat of the Sabah River is at risk of contamination through a diversity of sources associated with an increased human presence in the Study Area. A diversity of fauna depends on this freshwater source and would be adversely affected by contamination impacts. The small Killifish (*Aphanius dispar*) was found in the lower reaches of the Sabah River and will be sensitive to water quality changes occurring within its habitat.

Significance of Impact (Pre-mitigation)

Based on the analysis provided above, it is the opinion of this ESHIA that the impact of the proposed Project on the quality of water of important aquatic systems pre-mitigation will be a '**Moderate Negative Impact**'. The rationale for this is set out in Table 10.51.

Table 10.51 Rating of Impacts Related to Reduced Water Quality of Aquatic Systems, Particularly the Sabah River (Pre-Mitigation)

Type of Impact		
	Negative	Indirect
Indirect (and cumulative) Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	Drainage of aquatic systems ends locally and thus limits the extent of this impact
Duration	Long term	Contamination of aquatic systems can have long term effects
Scale	Partial extent	The scale of the impact is limited by access to the river which is controlled by the rugged topography and harsh climate
Frequency	On-going	A human presence along the banks of the river will have an on-going impact
Likelihood	Highly likely	Fresh water aquatic resources in the area are sparse, and pressure on these resources is high.
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
High	The Sabah River is the sole source of freshwater within the Study Area. This water source sustains a range of biodiversity and is vitally important to local communities established there. The river provides a biodiversity corridor for species unable to penetrate the adjacent inhospitable bare lands. The Sabah River habitat is therefore considered to have a High Ecological Sensitivity.	
Significant Rating Before Mitigation		
Negative Impact		Moderate Negative Impact
Moderate		

Recommendations and Mitigation/Management Measures

Mitigation measures are presented below as a means to reduce the perceived impacts to the water quality in the Sabah River; however, this site is outside of the area of direct influence of the proposed Project and limited control on human settlement there will be possible.

- Erosion control measures are recommended that will reduce erosion at source and trap sediments prior to entering river systems. These include (but not limited to) the following measures:
 - Construction of wire and stone gabions where strong flows of water are potentially generated from construction activities.
 - Appropriate concrete aprons are required on the downstream end of culverts to spread the flow of flood waters and discourage gulley formation; and
 - The free flow of flood waters through naturally-existing drainage systems must be encouraged.
- Any further settlement and cultivation along the banks of the Sabah River as a result of population influx should be discouraged.
- Vehicle washing facilities must be provided with appropriate soak-away facilities or other forms of dirty water management. The washing of any Allana-owned and contractor vehicles in the Sabah River will be prohibited.
- Other forms of dirty water, including sewage, are to be appropriately handled and any discharges into aquatic systems must meet appropriate international water quality standards.
- Housing requirements must be well planned and implemented accordingly, and should include a policy towards family support / accommodation. For the optimal protection of biodiversity, the total number of people brought to the site should be minimised, and can be partially achieved by not allowing entire families to relocate themselves there.
- Socially-related developments should be focussed around the existing towns such as Berahale Town, and water must be made available only at officially approved locations to prevent an unplanned spread of settlements. An In-migration Management Plan has being developed (*Annex K in Volume Three*) as part of a suite Social Management Plans, and provides guidance on these matters.

Residual Impact (Post-mitigation)

With suitable mitigation/management this impact is likely to remain at the same level of significance, resulting in a residual assessment of the impact as a '**Moderate Significance Impact**'. The rationale for this is set out in Table 10.52 below.

Table 10.52 Rating of Residual Impacts Related to Reduced Water Quality of Aquatic Systems, Particularly the Sabah River (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	Drainage of aquatic systems ends locally and thus limits the extent of this impact
Duration	Long term	Contamination of aquatic systems can have long term effects
Scale	Partial extent	Application of mitigation measures could reduce the scale of impacts, although the extent to which these impacts can be reduced is difficult to assess in advance
Frequency	On-going	A human presence along the river will have an on-going impact
Likelihood	Likely	Fresh water aquatic resources in the area are sparse, and pressure on these resources will not disappear
Magnitude		
		Medium
Medium Magnitude		
Significant Rating After Mitigation		
Moderate Negative Impact		
		Moderate

10.8 SUMMARY OF IMPACTS AND RESIDUAL IMPACTS

A summary of residual physical and biological impacts is provided per phase below. Management Plans detailing mitigation measures aimed at reducing impact are explained in Annex A to G of Volume Three. The management and monitoring of residual impacts, the significance of which are provided for each impact for each phase in the tables below, is also detailed in each of the respective Management Plans in Annex A to G of Volume Three.

Table 10.53 Summary of Impacts for Construction Phase

Impact	Significance (pre-mitigation)	Residual Impact Significance
Hydrology Impacts		
Impacts related to interruption of flows in the Bosi River due to Installation of plant infrastructure	MAJOR NEGATIVE	MODERATE NEGATIVE
Impacts related to the discharge of pollutants from non-mining activities into perennial water resources in the region	MAJOR NEGATIVE	MODERATE NEGATIVE

Impact	Significance (pre-mitigation)	Residual Impact Significance
Hydrology Impacts		
Impacts related to interruption of flows in the Bosi River due to Installation of plant infrastructure	MAJOR NEGATIVE	MODERATE NEGATIVE
Impacts related to the discharge of pollutants from non-mining activities into perennial water resources in the region	MAJOR NEGATIVE	MODERATE NEGATIVE
Air Quality Impacts		
Impacts to air quality as a result of construction activities during the construction phase	MAJOR NEGATIVE	MODERATE NEGATIVE
Noise Impacts		
Impacts to the noise environment as a result of activities during the construction phase	NEGLIGIBLE NEGATIVE	NEGLIGIBLE NEGATIVE
Biological Impacts		
Impacts as a result to habitat loss and fragmentation of the Salt Pan Fringe Habitat type	MAJOR NEGATIVE	MINOR NEGATIVE
Impacts related to habitat loss and fragmentation of the Alluvial Fan Habitat	MODERATE NEGATIVE	MINOR NEGATIVE
Impacts related to loss of terrestrial Red Data species	MODERATE NEGATIVE	MODERATE NEGATIVE
Impacts related to reduced water quality of aquatic systems, particularly the Sabah River	MODERATE NEGATIVE	MODERATE NEGATIVE

Table 10.54 *Summary of Impacts for Operational Phase*

Impact	Significance (pre-mitigation)	Residual Impact Significance
Hydrology Impacts		
Impacts related to interruption of flows in the Bosi River due to Installation of plant infrastructure	MAJOR NEGATIVE	MODERATE NEGATIVE
Impacts related to the discharge of pollutants from non-mining activities into perennial water resources in the region	MAJOR NEGATIVE	MODERATE NEGATIVE
Geohydrology Impacts		
Impacts related to drawdown of the alluvial fan aquifer	MODERATE NEGATIVE	MODERATE NEGATIVE
Impacts related to a deterioration in the groundwater quality of the alluvial fan aquifer	MAJOR NEGATIVE	MODERATE NEGATIVE
Air Quality Impacts		
Impacts to air quality as a result of traffic during the operational phase	MAJOR NEGATIVE	NEGLIGIBLE NEGATIVE

Impact	Significance (pre-mitigation)	Residual Impact Significance
Hydrology Impacts		
Impacts related to interruption of flows in the Bosi River due to Installation of plant infrastructure	MAJOR NEGATIVE	MODERATE NEGATIVE
Impacts related to the discharge of pollutants from non-mining activities into perennial water resources in the region	MAJOR NEGATIVE	MODERATE NEGATIVE
Geohydrology Impacts		
Impacts related to drawdown of the alluvial fan aquifer	MODERATE NEGATIVE	MODERATE NEGATIVE
Impacts related to a deterioration in the groundwater quality of the alluvial fan aquifer	MAJOR NEGATIVE	MODERATE NEGATIVE
Impacts to air quality as a result of potash processing and management of tailings during the operational phase	NEGLIGIBLE NEGATIVE	NEGLIGIBLE NEGATIVE
Impacts to air quality as a result of power generation through the use of fossil fuels during the operational phase	MODERATE NEGATIVE	MODERATE NEGATIVE
Noise Impacts		
Impacts to the noise environment as a result of activities associated with the operational phase	MAJOR NEGATIVE	NEGLIGIBLE NEGATIVE
Impacts to the noise environment arising from road traffic during the operational phase	MAJOR NEGATIVE	NEGLIGIBLE NEGATIVE
Biological Impacts		
Impacts as a result to habitat loss and fragmentation of the Salt Pan Fringe Habitat type	MAJOR NEGATIVE	MINOR NEGATIVE
Impacts related to loss of critical aquatic habitats due to groundwater extraction	MAJOR NEGATIVE	MINOR NEGATIVE
Impacts related to habitat loss and fragmentation of the Alluvial Fan Habitat	MODERATE NEGATIVE	MINOR NEGATIVE
Impacts related to loss of terrestrial Red Data species	MODERATE NEGATIVE	MODERATE NEGATIVE
Impacts related to reduced water quality of aquatic systems, particularly the Sabah River	MODERATE NEGATIVE	MODERATE NEGATIVE

Table 10.55 *Summary of Impacts for Decommissioning Phase*

Impact	Significance (pre-mitigation)	Residual Impact Significance
Hydrology Impacts		

Impacts related to interruption of flows in the Bosi River due to Installation of plant infrastructure	MAJOR NEGATIVE	MODERATE NEGATIVE
Impacts related to the discharge of pollutants from non-mining activities into perennial water resources in the region	MAJOR NEGATIVE	MODERATE NEGATIVE
Geohydrology Impacts		
Impacts related to drawdown of the alluvial fan aquifer	MODERATE NEGATIVE	MODERATE NEGATIVE
Impacts related to a deterioration in the groundwater quality of the alluvial fan aquifer	MAJOR NEGATIVE	MODERATE NEGATIVE
Air Quality Impacts		
Impacts to air quality as a result of decommissioning activities during the decommissioning phase	MAJOR NEGATIVE	MODERATE NEGATIVE
Noise Impacts		
Impacts to the noise environment as a result of activities during the decommissioning phase	NEGLIGIBLE NEGATIVE	NEGLIGIBLE NEGATIVE
Biological Impacts		
Impacts as a result to habitat loss and fragmentation of the Salt Pan Fringe Habitat type	MAJOR NEGATIVE	MINOR NEGATIVE
Impacts related to habitat loss and fragmentation of the Alluvial Fan Habitat	MODERATE NEGATIVE	MINOR NEGATIVE
Impacts related to loss of terrestrial Red Data species	MODERATE NEGATIVE	MODERATE NEGATIVE
Impacts related to reduced water quality of aquatic systems, particularly the Sabah River	MODERATE NEGATIVE	MODERATE NEGATIVE

10.9 GENERAL IMPACTS

In addition to the key impacts detailed above, this section will detail the more general impacts that the proposed Project will have on the physical and biological environments.

10.9.1 Soil and Water Contamination

Impact Description

The contamination of soils and surface water by in particular fuel and spills may occur through all phases of the proposed Project, during activities whereby the use of heavy machinery is necessary. Hydrocarbons will be delivered and used in bulk throughout proposed Project phases and need to be managed to avoid impacts arising from any such spills. Hydrocarbon spills

have the potential to contaminate soil, surface and groundwater resources. Furthermore, possible contamination may result in deterioration in the ecological functioning of soils and water. In addition, owing to the high permeability of these soils, oils and fuels could be washed deep into the soil and could ultimately cause pollution to the groundwater regime.

Recommendations and Mitigation/Management Measures

As is discussed above, there is the potential for spills to occur during the life of the mine. As such, the following mitigation measures are recommended:

- A Spill Prevention, Control and Containment Plan (refer to *Annex E* of *Volume Three*) should be implemented.
- Measures prescribed in the Waste Management Plan (*Annex F* of *Volume Three*) for soil clean-up and decontamination should be implemented, in the event that a hydrocarbon spill occurs.
- There should be frequent audits of fuel storage, handling and transfer facilities conducted to ensure compliance with the Spill Prevention and Containment and Waste Management Plans.
- An Emergency Response Plan (refer to *Annex C* of *Volume Three*) should be implemented. This plan should provide a framework for rapid response and clean-up to socio-environmental emergencies such as spills.

10.9.2 Waste Disposal

Impact Description

The construction, operation and decommissioning phases of the proposed Project will result in several waste streams that have the potential to impact on the biophysical and social environment. Such impacts could be directly attributed to the haphazard disposal or management of wastes (especially hazardous wastes). Furthermore, waste related impacts to both the biophysical and social environments can be exasperated should the quantities of waste and end disposal thereof not be minimised.

Recommendations and Mitigation/Management Measures

A Waste Management Plan (WMP) (*Annex F* of *Volume Three*) should be implemented. The WMP should –

- Ensure compliance to both national and international waste related legislation;
- Take into account the internationally accepted waste management hierarchy model;

- Identify, categorise and quantify the sources of waste associated with all phases of the proposed Project;
- Provide mitigation measures that will minimise waste related impacts;
- Assign responsibilities for implementation of the WMP; and
- Provide verification and monitoring procedures.

10.10

IMPLICATIONS OF UNCERTAINTY

The physical and biological environmental impacts described in this section were assessed on the basis of the information available at the time, using information from:

- Baseline data collection (both primary and secondary) and analysis of collected data;
- Project description information made available from Allana and Ercosplan; and
- Information collected from consultations with stakeholders.

The impact assessment above was based on information gathered through primary and secondary means and there is, inevitably, some uncertainty associated with a study of this type. Uncertainties will arise as a result of:

- On-going changes in Allana Potash Mining activities and design as the implementation of the Project is optimised;
- Inconsistencies or inexplicable results arising from primary and secondary baseline data sources;
- The nature and extent of impacts based on human responses to events and changes that are not definite or predictable; and
- Residual ecological impacts can only be rated and finalised after the extent and scale of the impact is predicted from modelling the response of groundwater resources to the expected extraction requirements of the mining operation. Field data are currently being collected by Fugro (a specialist geohydrological company) and a model will be developed for predicting groundwater responses to extraction.

These uncertainties are discussed below.

10.10.1 *Allana Potash Activities and Design*

Planning and design for the proposed Dallol Potash Project is an on-going process in which the proponent seeks to optimise the potash resource. On-going planning and design is also as a result of Project engineers having to manipulate certain design criteria to accommodate harsh climatic conditions in which the Project is proposed. The impact assessment has therefore been based on the most up-to-date technical information available for the proposed Project. Should there be any major changes to the current Project description, which in turn may change the nature of the impacts; these will be addressed through formally submitted amendments to the ESHIA.

10.10.2 *Nature of Impacts*

The impact assessment itself highlights areas of certainty/uncertainty in the assessment tables. As the Project moves forward and on-the-ground implementation confirms or puts in question the nature or extent of impacts discussed above, these will need to be addressed as part of the on-going updating and refining of the Management Plans.

The predicted impacts to the social environment as a result of the proposed Dallol Potash Project are described and analysed in this *Chapter*. This includes impacts across the construction, operations and decommissioning phases.

This section will include a discussion of the key socio-economic and bio-physical changes that will result in impacts to social receptors. The major changes and effects that may occur as a direct, indirect or induced consequence of the proposed Project will be discussed holistically in *Section 11.1* before the individual social effects (or impacts) are discussed in detail and assessed in later sections.

Impacts will be assessed across several themes, specifically:

- Socio-Economics and Livelihoods;
- Social and Cultural Cohesion;
- Community Health, Safety and Security;
- Tangible Cultural Heritage;
- Physical and Social Infrastructure Resources and Services;
- Landscape and Visual Environment; and
- Labour and Working Conditions.

Although this section used the impact assessment methodology established within *Chapter 6* the specific criteria for vulnerability, magnitude and significance of impact for social and health receptors are discussed in Volume II *Annex D*.

11.1

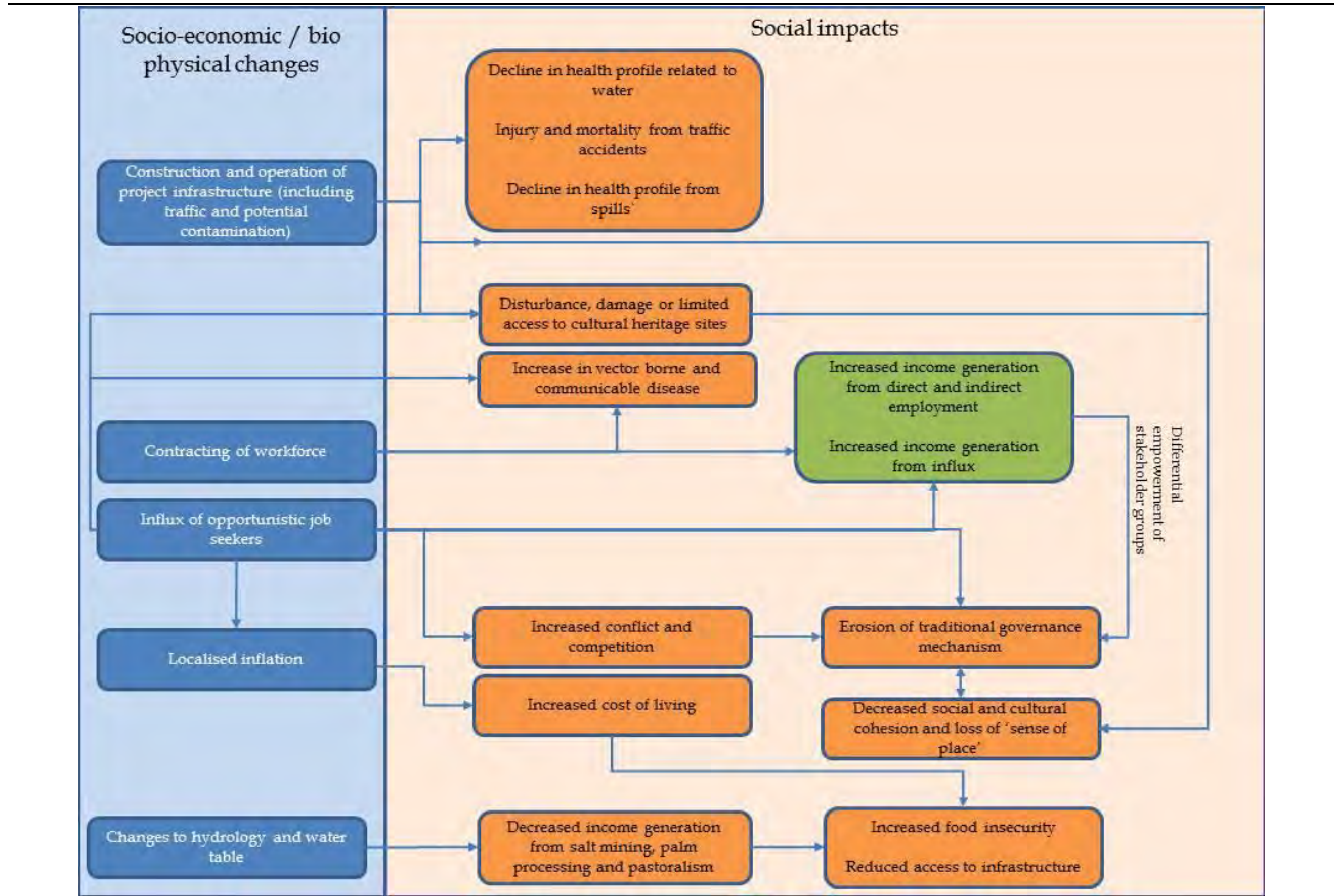
SUMMARY OF SOCIAL CHANGES AND IMPACTS

This section provides a holistic picture of the key social changes and impacts that may occur due to the proposed Project seeking to illustrate the overall relationship between:

- Changes that may occur;
- Common causes of different impacts; and
- Interactions between different impacts.

Figure 11.1 provides a summary of the most significant socio-economic, cultural and bio-physical changes that may cause direct, indirect or induced impacts, and the interrelations between these impacts for the proposed Project.

Figure 11.1 Summary Flowchart of Social Impacts Associated with the Proposed Dallol Potash Project



As many of the identified impacts are caused by the same set of changes, or are related to each other, a shared hierarchy of avoid / minimise, mitigate, compensate management has been identified. As a result mitigation measures will often be used to mitigate several impacts.

For example, in-migration will potentially act as a cause of several impacts and all measures to avoid or manage the likelihood for in-migration will be relevant to impacts that have in-migration as a cause.

11.2 *IMPACTS RELATED TO RESETTLEMENT*

This section discusses impacts related to the resettlement of Mororo and Alai Lai, recommended as part of the noise mitigation measures in *Chapter 10*.

The assessment of impacts related to the resettlement of these villages will be discussed in a Resettlement Action Plan (RAP) that sets out the process, anticipated impacts, compensation framework, engagement and schedule for the resettlement.

11.2.1 *Resettlement of Mororo and Alai Lai*

Background

Description of the Baseline Environment

According to the results of the household survey (where 100% of households present were included) Mororo contains three households with a total population of 15 people, while Alai Lai contains four households with a total population of 22 people.

The household survey also recorded that the population of these settlements were Afar, permanently resident in their village. In Mororo two of 15 people were reported to have been born outside of Ethiopia (presumed to be in Eritrea) compared to six in Alai Lai. The rest of the population reported that they were born in the community in which they live. None of the residents of these settlements reported that they had received any education above primary level and 84.4% of those aged six years or older had no formal education.

Mororo and Alai Lai respectively were reported to contain eight and five people below the age of 16. Only three people in Mororo reported having principle economic activities including herding, collecting and weaving palm products (the most common livelihood for the three people mentioned above) and working for mining companies. In Alai Lai the most common principle economic activity was reported to be salt cutting and collecting and weaving palm products, which was reported by six and five people respectively.

Proposed Project Activity

In the Noise Impact Assessment (*Chapter 10*) it is recommended that Mororo and Alai Lai Villages be resettled due to the potential to experience substantial noise impacts and due to potential health and safety risks.

Sensitive Receptors

The resettlement of Mororo and Alai Lai will require the physical movement of the village and all infrastructures. If not properly managed this can cause economic displacement and social and health impacts related to the physical process of resettlement itself. In addition the resettlement of people from Mororo and Alai Lai may cause potential impacts in the new ‘host communities’ if not properly managed.

These impacts may particularly affect groups identified to be vulnerable, potentially including women, the elderly and those households reliant on one natural resource-based economic activity such as salt cutting or palm collections and processing.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a ‘**Major Negative Impact**’ prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.1*.

Table 11.1 Rating of Impact Related to Resettlement of Mororo and Alai Lai (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by the villages of Mororo and Alai Lai.
Duration	Long Term	Without mitigation and management measures the impact may continue for the duration of the proposed Project.
Scale	Up to 40 people	This impact may be experienced by the villages of Mororo and Alai Lai.
Frequency	Constant	This impact would be constant.
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
High	Vulnerability of receptors is dictated by the high levels of dependence on land-based livelihoods and poor educational, health and socio-economic status of households.	

Significant Rating Before Mitigation	
Negative Impact	Major Negative Impact
Major	

This impact is anticipated to begin during the construction phase when the resettlement process is anticipated to commence. It will continue throughout the duration of the proposed Project.

Recommendations and Mitigation/Management Measures

To avoid and reduce the significance of this impact Allana will develop a Resettlement Action Plan (RAP) that considers livelihood restoration as guided by international good practice and the laws of Ethiopia. A RAP will plan the resettlement and compensation process so as to avoid or reduce impacts related to resettlement with the objective of replicating or improving standards of living post-resettlement.

This is an on-going process and is anticipated to begin during January 2013.

Residual Impact (Post-mitigation)

The resettlement planning of Mororo and Alai Lai will include specific monitoring and management measures to scrutinise the post-resettlement effects. These measures will help to assess the residual impact of the resettlement; however, as the resettlement planning has only begun in January 2013 a residual impact rating cannot be awarded at the time of writing.

11.3 IMPACTS TO SOCIO-ECONOMICS AND LIVELIHOODS

This section will discuss impacts to livelihoods practiced in the Social Area of Influence brought about by potential changes to the current socio-economic baseline.

11.3.1 Increased Income Generation Opportunities from Direct and Indirect Job Creation at a Local, Regional and National Level

Background

Description of the Baseline Environment

The socio-economic environment of the Study Area is characterised by a low degree of livelihood productivity with some degree of diversity. Local government workers, the salt trade and livestock rearing were all recorded as livelihoods by 22.8%, 21.0% and 17.5% respectively of respondents to the Household Survey. In settlements within and around the Social Study Area (SSA), rates of formal employment are higher than may be expected in such a remote area, with 40.4% of households surveyed declaring that they had at least one member of their household who was formally employed. The high

level of formal employment is largely attributed to the presence of government offices in Berahale Town. Of the 40.4% surveyed, respondents were employed in one or more of the following:

- A mining company;
- A construction company;
- The military; and / or
- The government.

Levels of educational achievement and capacity are reported to be low within the Social Study Area with 82.3% of household heads and 62.5% of household members within the household survey indicating they had not received any form of formal education.

Proposed Project Activities

Allana will require up to a peak of approximately 1,000 skilled, semi-skilled and unskilled workers during construction. Construction workers will be hired variously as both daily/weekly workers, and for longer periods until construction is complete. During operation Allana will require a maximum of approximately 442 permanent staff for the operation and maintenance of the mine. This is estimated to be made up of approximately 98 skilled staff, 244 semi-skilled and 100 unskilled workers. In addition, approximately 400 to 600 truck drivers will be hired for the transportation of potash from the Project site to the Port of Tadjoura.

It is assumed that to maximise efficiencies, wherever possible these workers will be sourced from villages in proximity to the proposed Project; at a local, regional or national level. Given that levels of educational achievement and formal employment experience in relevant sectors are low within the Study Area, it is assumed that the majority of local labour sourced may be unskilled or at most semi-skilled.

It is recognised that given the relative immaturity of the mining industry within Ethiopia, and the level of specialism required in solution mining, some expatriate staff will also be required, as well as skilled or semi-skilled staff drawn from other areas in Ethiopia. It is assumed that non-local staff would therefore represent a significant proportion of the Allana workforce.

In addition to direct benefits from the employment of local residents, the proposed Project may also offer potential economic benefits through the local procurement of goods and services. It is assumed that the majority of this procurement will be at a regional or national level due to shortages in suitable industry and service providers in the Study Area. The scale of service providers for basic consumables, such as food and water, within the Study Area is such that it is unlikely in the short term that this can be provided within the local area. In addition, due to shortages in access to credit the opportunity for local entrepreneurs to expand businesses to provide goods and services to Allana is unlikely in the short term.

The combined effect of direct employment and contracting, and the procurement of goods and services may have a 'multiplier effect' on economic growth, where beneficiaries spend the additional income they have generated in their local communities, driving increased economic growth. This multiplier effect will be particularly relevant for any local benefits as it will be concentrated in a smaller area.

Sensitive Receptors

Increased income generating opportunities will be experienced at a national, regional and local level to varying scales, causing different degrees of economic growth. It is assumed that the majority of beneficiaries will be educated Ethiopians with some experience of formal employment who can provide a swift response to labour requirements with minimum training. Based on the baseline conditions it is assumed that very few of these types of candidates will be available from within the local area. As a result this benefit is expected to be experienced mainly by beneficiaries in urban centres across Ethiopia, across a widespread area, potentially diluting the multiplier effect it may have.

It should be noted that although hiring local Afar people may be preferable to boost the local effect of this impact; it may prove difficult without significant and long-term investment in their capacity building. Capacity, experience in formal employment, formal education and certified skills in the Study Area are limited and this may limit the potential for local Afar people to receive employment without significant support.

Receptors in the Social Area of Influence (AoI) that may be able to make the most of these opportunities are those who have received some experience of formal employment, gained basic education or learned English language skills. Typically this may be youthful males who have received some education, have experience working for the government or other mining companies, or who have learnt some English. It should be noted that at the local level the overall lack of education, skills and capacity means that vulnerability is high, meaning a large majority will be ill equipped to maximise benefits.

Those who will be particularly less able to take advantage of such opportunities include the elderly who are less able to carry out the tasks required and women (and residents within female-headed households) for whom it may not be culturally acceptable or feasible (given requirements to attend to primary care duties) to pursue formal employment.

One of the side effects of this impact may be the raised expectation of local people that Allana will deliver widespread benefits to the area, beyond what is feasible. Managing these raised expectations will be a critical part of the

¹ The multiplier effect refers to the 'trickle down' of economic growth as those who receive additional income spend that income in shops and businesses, driving further economic growth.

impact management process and is considered in the Stakeholder Engagement Strategy (SES – refer to Volume III *Annex M*).

Significance of Impact (Pre-mitigation)

This impact has been assessed as a positive impact with benefits to be received at a local, national and regional level. While it is recognised that the likelihood for this impact is certain, given that employment will be required, a lack of capacity, experience and skills at the local level means that it is assumed that this impact will be reduced in this area.

In addition without management and enhancement measures due to the limited capacity in the local area, the economic multiplier effects of this impact may also be limited.

Table 11.2 Rating of Impact Related to Income Generation Opportunities

Type of Impact	
Positive	Direct
Direct Positive Impact	
<p>The direct and indirect contracting of employees, procurement of goods and services and combined multiplier effect of this economic growth will result in increased income for successful candidates and their local communities; promoting some degree of increases in standards of living.</p>	

Although some limited hiring has already occurred to support advanced exploration, this impact is anticipated to begin during the construction and production phases as large scale hiring occurs. This impact will continue throughout the Life of Mine (LoM) however will be less widespread during operations and decommissioning as the number of workers is reduced.

Once the proposed Project has been decommissioned and enter post-closure this impact will cease to occur.

Recommendations and Mitigation/Management Measures

In order to enhance this positive impact the following management measures will be required.

- **Education and Skills Attainment in the Local Area**

Due to skills shortages in the Study Area skills training will be provided to residents of the local communities to increase local employment capacity. This training will be designed into short and medium term programs targeted to provide local candidates eligible at the construction and production phases.

Preliminary training programmes will be designed to ‘up-skill’ local candidates to allow them to attain positions within construction teams, and

potentially attain experience helping to gain employment during operations. This may include training in:

- Carpentry;
- Basic plumbing and pipefitting;
- Basic electrical engineering;
- Safe driving skills;
- Equipment operation; and
- Camp services (cooking, cleaning etc.) and administration.

This training will be provided as part of Allana's recruitment policy in a pre-emptive manner in order to ensure that local capacity has been developed in advance of large scale hiring. This skills training will be offered to a greater number of local inhabitants than will be required as employees in order to boost local skills and enhance capacity to benefit from overall development in the Study Area. It will be clearly communicated to training participants that not all people trained will be guaranteed to receive employment with Allana, although where possible those who have received training will be preferred candidates. Further tailored training programmes will be developed and implemented to provide the skills required for the production phase.

Efforts will be made to provide suitable training in a culturally appropriate manner to women, youth and other marginal groups to ensure that they receive all possible potential access to training and employment.

Allana will look for opportunities to work with partner organisations to implement this education and skills training. The Community Development Plan (CDP - refer to Volume III *Annex 1*) has identified investment in education and associated infrastructure as a key community development theme. Recommendations include providing language and literacy and Information Technology (IT) classes to high school students, current employees and other relevant local residents. Any investment in education should be aligned to the government's strategy for the education sector, and where possible involve engagement with relevant stakeholders and partnering with relevant organisations involved in educational programmes.

Training will also be provided to all new employees in order to ensure they are appropriately skilled to carry out their job. This may include 'on-the job' training, training during induction processes or formal training programmes.

- **Certification of Training and Employment**

Allana, as part of their Human Resources function, will develop a system of certification for training in basic skills that also recognises periods of employment. As part of this the successful completion of training and attainment of competency in new skills while employed with Allana, or as part of an education and skills training programme, will be formally recognised through a company certification system. This system will also help trainees gain recognition for the skills they have gained and assist in finding

alternative work during any potential retrenchment. Certification may be provided for skills gained outside of formal training programmes and could include 'on-the-job' training and skill development such as changing car tyres, pipefitting, camp administration etc. On-the-job training in simple tasks will also be certified by Allana. All Allana employees, upon leaving the company, will be provided with a letter referencing the work they have completed and the skills they have acquired during their period of employment.

- **Coordination Between Allana, Other Local Mining Companies and Government**

Skills and recruitment needs will be identified in consultation with other local mining companies and the Government of Ethiopia (GoE), including regional and local government, in relation to other existing and potential future industrial developments in the area. To achieve this Allana should continue to engage relevant departments of the GoE to proactively plan for the existing development process. Where possible training and education programmes will then be developed in partnership to maximise their benefit and reduce costs. Collaboration with government and other mining companies will allow for collective funding and collaboration of potential skills development and training programmes, developing a pool of skilled local employees potentially benefitting all parties involved.

- **Sourcing, Procurement and Recruitment Management Plan**

Allana will develop a Sourcing, Procurement and Recruitment Policy to complement the Sourcing, Procurement and Recruitment Management Plan (SPRMP - refer to Volume III *Annex L*) which sets out the objectives and actionable tasks required to suitably manage hiring and procurement of goods and services. This policy will include requirements to engage marginalised groups surrounding employment and procurement to allow the opportunity for benefits to reach a wide range of potential beneficiaries. This policy will be publicly available in relevant languages including English, Amharic, Tigrigna and Afarigna, and will be included within stakeholder engagement activities. Allana will develop and implement a statement within the policy favouring the recruitment of local Afar to the extent practicable given the skill and experience required for different positions.

It is recognised that the local sourcing and procurement of goods and services from near to the proposed Project will be difficult. The types of equipment required for the proposed Project are specialised in nature and may not be available within Ethiopia. It is also understood that at the time of writing locally available goods are of mixed quality and availability, often not available in suitable volumes, and can be more expensive due to the logistical challenges associated with bringing them to site. In addition due to environmental limitation (extreme heat and small volumes of precipitation) minimal products are locally grown for sale. Due to these challenges it is understood that the local sourcing and procurement of goods may be limited or at a small scale during the construction and / or early operations phases.

Nonetheless Allana will seek to encourage and facilitate the sourcing and procurement of goods and services locally as capacity and supply increases throughout the Life of Mine (LoM).

The Sourcing, Procurement and Recruitment Policy will confirm the process for identifying those who self-identify as 'local Afar'; that will require the corroboration of the local traditional governance. Targets will be developed for Allana and third party contractors to seek employment of recognised Afar employees and these will be used as a Key Performance Indicator (KPI) for Human Resources reviews.

Allana will specifically define and favour local applicants, businesses and service providers ahead of providers from outside the area and stipulate the processes that must be adhered to prior to appointing external staff or service providers. The requirements of this plan will apply to contractors. Allana will develop and implement a policy requirement to pay local suppliers and contractors in a timely fashion (within seven days) to improve cash flows.

- **Transparent Hiring Techniques**

Allana will develop, publicise and adhere to transparent hiring protocols that ensure no staff are hired in an *ad hoc* manner from Hamad Ela and other population centres close to the proposed Project. In addition efforts will be made to identify and train local Afar people prior to hiring from other parts of Ethiopia, and that the Allana Human Resources Department and recruitment partners are the only groups that can hire staff. Applicants will be required to submit application forms to the Allana site or designated offices. All Allana commitments to hiring processes will also be contractually required of contractors. Short term employment of unskilled employees will involve a Human Resources Database and local traditional governance to identify available labour. The recruitment protocols will ensure that nepotism, extortion of 'recruitment fees' and the use of third party local labour brokers are explicitly avoided.

- **Human Resources Database**

Allana will develop a database of locally available human resources detailing skills, proficiency and education levels of potential interested applicants. This database will be a 'live document' controlled by Human Resources and used to record potentially interested candidates (where applications are made without advertised positions). It will be developed in coordination with the formal and traditional governance structures and with other local mining projects (where possible). The database will continue to be consulted to identify the maximum number of locally available candidates. In addition, this resource can be used to help structure the application or expression of interest process for potential employees.

- **Financial Management Training**

Due to limited experience of long-term wage labour in the local area Allana will provide, in collaboration with relevant partner organisations, training in fiscal management to employees, their families and affected communities. This training will be designed to maximise the benefits employees receive from increased household cash income, seeking to improve the sustainability of any local economic growth. This training will be designed to help promote savings, banking and responsible financial management for households that may have minimal experience managing a monthly cash budget, thus helping to increase the sustainability of any benefits received from employment. This will be provided with the aid of a relevant local partner or NGO in local languages, and will be made available to all members of employees' families.

- **Social Closure Planning**

The retrenchment of employees during periods of downscaling of the workforce (e.g. the completion of the construction phase, decommissioning and post-closure) will require careful management involving social closure planning (refer to the Integrated Mine Closure Management Plan in Volume III *Annex D*). This will be developed prior to the completion of the construction phase and will be regularly updated; detailing how retrenched employees will be supported.

- **Promote Mining Skills**

Further detail of recommended investment in local education and educational infrastructure is included in the CDP. As part of their community investment programme Allana will work with the training programmes in place at higher education organisations in Semera, Addis Ababa, Mekele and /or other potential locations to promote the development of mining skills nationally. This may include the provision of funding / sponsorship for mining-related courses, grants for Afar applicants, or skills exchange and knowledge sharing through presentations, or internship programmes.

- **Recording Project Related Benefits**

The proposed Project may result in various benefits including direct employment, taxes and royalties, community development initiatives and increased income generation opportunities. Allana will identify, track and record key benefits generated including the recipients of the benefits and the timeframe over which these will occur. This will be important in managing benefits over the life of mine (LoM) in an equitable and strategic manner.

- **Stakeholder Engagement Programme**

Allana will implement and continue to develop an on-going and continuous Stakeholder Engagement Programme (in line with the Stakeholder Engagement Strategy, SES, refer to Volume III *Annex M*) built on openness,

mutual trust and inclusiveness that will seek to actively inform stakeholders of Allana's activities. Engagement will include raising awareness on training, recruitment and capacity development programmes.

11.3.2 Increased Income Generating Opportunities Related to In-Migration

Background

Description of the Baseline Environment

Within the Social Study Area certain settlements currently receive some level of income from seasonal in-migration of workforce related to the salt mining and associated transporting industry. This is particularly prominent in the settlements of Hamad Ela, Berahale and potentially along the settlements visited during the *Arho* migration route.

It should be noted that this income is not anticipated to be significant and although salt workers and transporters rent accommodation and purchase food while in Hamad Ela, not a single respondent to the household survey reported earning rent as their primary source of income. Only 3.2% of respondents reported earning rent as secondary source of income. In addition there appears to be minimal capacity and experience in entrepreneurial business, and although some shops are present in Berahale, there are only a few shops and coffee / tea houses in Hamad Ela. To illustrate this point within the household survey, earning from petty trading was cited to be the primary occupation of only 3.5% of respondents, accounting for between USD22.20 and 40.30 per month on average. Rates of savings are believed to be very low within the Study Area and respondents to the household indicated that only 5.2% of households had access to savings.

Although the current seasonal in-migration into the Hamad Ela is believed to be related to the feasibility of the production and sale of palm products as a livelihood the sale of goods and services is not currently a significant driver of income generation.

Proposed Project Activities

The proposed Project may attract in-migration of opportunistic job seekers and service providers, potentially increasing demand for accommodation, goods and services and increasing income for local providers. This may be exacerbated by the construction of a new road from Mekele to Bada.

The In-Migration Risk Assessment (IMRA - refer to Volume III *Annex F*) has highlighted the settlement of Hamad Ela and Berahale, and to a lesser extent Ambule and Asabolo, as potential 'hotspots' for in-migration and as a result any increase in demand from local businesses will most likely be experienced there.

Sensitive Receptors

In-migration and the associated increased demand for accommodation, goods and services will benefit service-providers, business owners or entrepreneurs who can provide the requirements needed by in-migrants.

Those who will be most suited to capitalise on this positive impact include those who have the financial capacity and experience allowing them to offer goods and services to potential migrants. This may include existing business owners in Hamad Ela and Berahale or local people with savings or entrepreneurial knowledge; allowing them to respond quickly to an increase in demand related to potential in-migration. Due to Afar socio-cultural conditions men are most likely to capitalise on this impact, in particular those who are wealthy or powerful, or with experience in business.

Receptors in the Study Area that may be vulnerable to this impact and therefore facing a reduced ability to maximise the benefits may include a large proportion of the local Afar inhabitants who do not have access to savings, markets or credit facilities. In addition a large proportion of the population are believed to not have suitable experience to establish or expand a business.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a positive impact with benefits to be received by people who can capitalise on the requirements of migrants.

While it is recognised that the likelihood for in-migration and therefore increased demand is high, it should be recognised that the benefits received by local inhabitants may be limited due to a shortage of business experience, access to markets, and entrepreneurial experience within the Study Area. Without management and enhancement measures the impact may be limited and capitalised on by non-local inhabitants, themselves in-migrants.

Table 11.3 *Rating of Impact Related to Income from In-Migration*

Type of Impact	
Positive	Induced

Induced Positive Impact

The in-migration of opportunistic migrants into the Social Study Area may provide some income generating opportunities for the existing population as demand increases for accommodation, goods and services; potentially promoting some degree of increases in standards of living.

Although some limited migration is understood to have occurred during the exploration phase of the proposed Project, this impact is anticipated to become most obvious during the construction and operations phase, as in-migration is likely to increase. The benefits of this impact may last through to the decommissioning phase, however it is anticipated that in-migration will slow

considerably or cease during the transition from operations to decommissioning.

Recommendations and Mitigation/Management Measures

To enhance the beneficial effect of this positive impact the following management measures are required.

- **Micro-Finance Provision and Enterprise Development Support**

As part of their planned Community Development (CD) efforts Allana will work with appropriate partner organisations to develop a micro-finance organisation targeted at local Afar people allowing them access to credit to help develop small businesses, increase banking habits and improve access to markets (refer to the Community Development Plan, CDP, refer to Volume III *Annex I*).

In addition Allana will work with a relevant partner organisation to provide a programme to support and encourage enterprise and entrepreneurial development by local Afar people. This may include engagement and training with local people to help understand the current limiting factors to business development.

- **Support Increased Capacity of Local Authorities**

Allana will work with local authorities to create a more positive local business environment, to maximize the potential local benefit of increased in-migration. This may include identifying sites and developing infrastructure for markets, providing greater forms of policing and protection around markets and establishing fair and appropriate mechanisms for the generation of revenue by local authorities.

- **Promote Access to New Opportunities to Vulnerable Groups**

Beyond providing micro-finance opportunities to local Afar communities, Allana will explore ways of promoting access to new economic opportunities to vulnerable or marginalised groups, such as female, headed households, people with disabilities, and other marginalised groups. This enterprise development is discussed in greater detail in the Community CDP, refer to Volume III *Annex I*.

11.3.3 ***Reduced Productivity of Livestock Related to a Decline in Productivity of Pasture***

Background

Description of the Baseline Environment

Although the Afar are typically considered to be mobile or semi-mobile pastoralists with significant socio-cultural and socio-economic significance

afforded to herds of cattle and mixed sheep and goats (commonly jointly referred to as 'shoats'), due to localised environmental limitations, pastoralism is not the principle livelihood, although it is a significant typically subsistence livelihood. The household survey recorded that 45.6% of respondent households indicated that they own some livestock; most commonly goats and donkeys. 77.2% of respondents to the household survey indicated that they use livestock for subsistence purposes, with only 10.3% being used to supplement income. On average income received from the sale of livestock products was reported to range from USD1.10 to 3.90 per month.

The most productive pasture in the area was reported to be on the escarpment away from the proposed Project site although communities in proximity to the salt pan (Mororo, Alai Lai, Hamad Ela, Fiea and Badle) are believed to occasionally use the habitat within the alluvial fans and salt pan fringe as secondary pasture.

Food insecurity is reported to be high in the area as discussed in *Section 11.3.4*.

Proposed Project Activities

Allana will require a substantial amount of groundwater for solution mining activities which will be abstracted from a series of boreholes. The groundwater required for the proposed Project is estimated to be 16 million cubic metres (m³) per year. Tentative plans indicate that Allana intend to construct approximately 20 boreholes in total, replaced at a scale of approximately two per annum.

In addition the Project will require some land acquisition to carry out solution mining for access roads, piping, well heads etc. and this may limit access to certain areas for local pastoralists. Specifically approximately 0.5 square kilometres (km²), over a moving area, will be used for solution mining.

Sensitive Receptors

The abstraction of ground water could lower water resources available to plants, reducing the availability of pasture and reducing the productivity of pastoralism and use of livestock as a livelihood. The reduction of the availability of groundwater and the potential impacts to flora are described in greater detail in *Section 11.3.5* and in *Chapter 10*. Prior to mitigation the biological impact assessment (refer to *Chapter 10*) assessed that this will be a major impact in the salt pan fringe, dropping to a minor impact with appropriate mitigation. For alluvial fans the biological impact assessment (refer to *Chapter 10*) assessed that this will be a moderate impact, dropping to a minor impact with appropriate mitigation.

The extent and scale of the impact will continue to be informed by on-going monitoring of groundwater and ecological resources, however it is assumed that the impacted area will be within or slightly to the south of to the proposed Allana site and will not extend all the way to Hamad Ela.

In addition to the consequences of groundwater abstraction the development of solution mining infrastructure will mean that access to the Salt Pan Fringe within Allana's concession area will be unsafe for local communities and will be prevented by Allana through patrols and gating of roads.

In addition the use of these liminal areas of the salt flats for solution mining will cause some reduced access and potentially some mortality of pasture materials.

The reduced productivity of pasture in these areas will force some people to take livestock further distances and potentially over-stress these areas due to increased competition.

This impact may be exacerbated by the cumulative effect of other potential solution mining Projects in the area who may have similar water demands and land acquisition requirements. This may further reduce the availability of pasture.

The planned resettlement of Mororo and Alai Lai will mean that they are moved away from the Allana concession area, however it is anticipated that they will choose to live in a similar area nearby and may therefore still experience a reduced productivity of pastoralism due to groundwater abstraction.

Receptors that may be particularly sensitive or vulnerable to this impact include those households that are reliant on livestock for a large proportion of subsistence or income generation, or those unable to travel to the escarpment to access more productive pasture. It should be noted that livestock is often used as a 'safety net' by rural settlements with animals slaughtered or killed during times of economic struggle or environmental shock. Significant impacts to the feasibility of livestock upkeep may affect this safety net, contributing to worsening of economic difficulty or environmental shock.

Significance of Impact (Pre-mitigation)

Based on the potential impacts to plants within the Biological Impact Assessment (refer to *Chapter 10*) this impact has been assessed as a '**Moderate Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.4*.

Table 11.4 Rating of Impact Related to Decline in Pastoralism (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in villages that use pasture within the planned area for solution mining. This may include Hamad Ela, Mororo, Badle and Fiea and Alai Lai.
Duration	Long Term	Without mitigation and management measures the impact may continue for the duration of the proposed Project.
Scale	Up to 2,000 people	This impact may be experienced by community members in villages of Mororo and Alai La (post-resettlement, dependent upon the resettlement location). This will be informed by on-going monitoring and modelling to inform if, for example, Hamad Ela, Badle and Fiea may also be impacted.
Frequency	Constant	This impact would be constant as ground water in the area is reduced.
Likelihood (for unplanned events only)	N/A	
Magnitude		
	Medium	Large
Medium to Large Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	Vulnerability of receptors is dictated by the absence of alternative livelihoods and the distances required to travel in search of alternative pasture. However the designation of vulnerability also recognises that the salt fringe is not the 'prime' pasture.	
Significant Rating Before Mitigation		
	Negative Impact	Moderate Negative Impact
	Moderate	

This impact is anticipated to begin during the operations phase as groundwater abstraction begins. It will continue until the decommissioning phase when mining operations are complete and groundwater flow returns to normal.

Recommendations and Mitigation/Management Measures

To avoid and reduce the significance of this impact the mitigation and management measures developed in response to impacts to water resources and biological receptors (refer to *Chapter 10*) will be relevant. Within the biological impact assessment these measures focus on avoiding, minimising, restoring and offsetting the impact to palms (and other flora). *Section 11.3.5* and *11.5.1* provide summaries of these mitigation measures.

In addition the following measures have been developed for adoption by Allana.

- **Reduced Disturbance**

Wherever possible, Allana will plan road and infrastructure construction outside of the area planned for solution mining, to reduce disturbance to the vegetated area on the edge of the salt flat using existing tracks and roads. This will reduce the loss of pasture available (including reduced access).

- **Driving Policy**

Allana will develop a Driving Policy which explicitly limits and reducing the need for 'off road' driving wherever possible limiting disturbance to areas used for pasture.

- **Direct Provision of Fodder**

Allana will monitor the productivity of pastoralist livelihoods through a process of hydrogeological modelling and monitoring, ecological monitoring and stakeholder engagement and will prepare the system to, where required, provide a supply of livestock fodder annually to affected Afar households.

- **Resettlement of Alai Lai and Mororo**

The resettlement of Alai Lai and Mororo away from the proposed area for solution mining will involve specific consideration of livelihood restoration and improvement as part of a Resettlement Action Plan (RAP). This will include the selection of resettlement areas that have suitable pasture resources.

Residual Impact (Post-mitigation)

On-going groundwater, ecological and livelihood analysis means that the spatial extent and magnitude of the impact to pasture is a continuing process and will be affected by on-going monitoring. Based on current understandings of the potential area of impact and with suitable avoidance and mitigation, this impact is likely to decrease resulting in the assessment of the impact as a '**Minor Negative Impact**'.

Table 11.5 *Rating of Residual Impact Related to Decline in Pastoralism (Post-Mitigation)*

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in villages that use pasture within the planned area for solution mining. This may include Hamad Ela, Mororo, Badle and Fiea and Alai Lai.
Duration	Short Term	With suitable mitigation and management the impact will occur sporadically only in the short term where suitable replacement pasture or fodder is not available.

Scale	Up to 2,000 people	This impact may be experienced by community members in the villages of Mororo and Alai La (post-resettlement, dependent upon the resettlement location). This will be informed by on-going monitoring and modelling to inform if, for example, Hamad Ela, Badle and Fiea may also be impacted.
Frequency	Sporadically	This impact would occur sporadically as pasture resources are restricted.
Likelihood (for unplanned events only)	N/A	

Magnitude	
	Small
Small Magnitude	
Sensitivity/Vulnerability/Importance of the Resource/Receptor	
Designation	Summary of Reasoning
Medium	Vulnerability of receptors is dictated by the absence of alternative livelihoods and the distances required to travel in search of alternative pasture. However the designation of vulnerability also recognises that the salt fringe is not the 'prime' pasture.
Significant Rating Before Mitigation	
Negative Impact	Minor Negative Impact
Minor	

11.3.4 Reduced Income Generating Opportunities Related to Artisanal Salt Mining

Background

Description of the Baseline Environment

The artisanal mining and transport of salt is a significant livelihood activity within the Social AoI for income generation and socio-cultural identification. Primary data collected by ERM indicates that salt mining was reported to be the most significant livelihood in the area and is a principal source of income.

According to the results of the household survey the average monthly income for salt digger, cutters, and transporters was reported to range between USD5.60 and 63.00. However, the income generating significance of the salt mining industry is believed to extend beyond those primarily involved in it. Requirements for the provision of food, accommodation, services, equipment etc. means that the salt mining industry is the driver of the majority of income generation in Social Study Area and may contribute to socio-economic wellbeing of people all the way from the area surrounding the proposed Project to Mekele.

The Afar people consulted during baseline data collection reported a strong cultural link to the livelihood and were very protective of it and concerned about its possible disruption through Allana's activities. The perceived consequences of any impact may therefore be more significant.

It is also important to note that the GoE, in collaboration with international development organisations, have established the Central Iodization Facility (CIF) in 2009 in Afdera aimed at addressing Ethiopia's high rate of iodine deficiency disorders. The objective of CIF is for small salt producers and traders to transport salt to the CIF where it will be iodised and packaged for national distribution ⁽¹⁾. Currently salt produced at the salt flats at Lake Assale is not iodised. Attempts by the GoE to promote the use of iodized salt may challenge the existing artisanal salt mining process at Lake Assale, and traditional transportation of salt. In addition local salt trade workers currently lack the means and capacity to iodise the salt they produce.

Subsistence food provision in the Social Study Area is limited and all of the key livelihoods in the Study Area were typically related to income generation rather than the generation of subsistence items; with the majority of an income used to purchase food for the household. Both men and women identified artisanal salt mining as the most important livelihood to generate income and purchase subsistence items including food, clothes and medication. The existing baseline demonstrates clear signs of a food insecure area. Drought is common across the Afar region and coupled with the low socio-economic status of the villages in the Social Study Area this culminates in a poor nutritional status. Anecdotal evidence provided during health baseline data collection indicates that the prevalence of vitamin deficiencies and worm infection may be high.

Food shortages are common across the Study Area and the government implemented the Productive Safety Net Programme (PSNP) that provides food aid to households that suffer from chronic food shortages. All of the households interviewed in the FGDs indicated that they had or continue to rely on the PSNP as their main source of food.

It was reported that levels of food insecurity and household food supply are sensitive to change, such as the food shortages experienced following the return of the *Arho* (in September).

Proposed Project Activities

An increase in vehicle movements associated with the Allana Project may result in an increased number of trucks and cars travelling across the preferred white salt areas, reducing the amount of salt available to mine. These vehicle movements could also result in an increase in traffic accidents involving camel trains, reducing the productivity of the salt production as a livelihood.

Allana will generate a large amount of waste salt including approximately 700,000 tonnes per annum of sodium chloride (salt) and 1.2 million tonnes per annum of sodium chloride and in addition an unspecified amount of salt

⁽¹⁾ http://www.micronutrient.org/CMFiles/News%20Room/Announcements/Ethiopia_Salt_iodization_FINAL.pdf

unsuitable for human or animal consumption. The proposed Project have not yet finalised how to dispose of salt that will be generated as a waste material from potash solution mining. If it is sold into the Ethiopian market, this may undermine demand for artisanally mined salt.

A decline in the productivity of key livelihoods, such as artisanal salt mining will impact the level of income generation and the ability of households to purchase food and access infrastructure and services. In addition, increased in-migration may aggravate and intensify the existing fragility of food security in the Study Area as increasing food demand may not be met by an increase in local food supply. Furthermore, localised inflation resulting from increased demand for food products as a result of the presence of the Allana workforce and new residents may exacerbate food insecurity.

This impact may be naturally mitigated by some other changes brought about by the proposed Project. Employment of local residents by Allana may change the nutritional status and perception of a balanced diet, not only for those who are employed by Allana but it may also influence employee household members. In addition it is likely that employees will be exposed to improved eating habits and handling of food (from a hygiene and sanitation perspective) on site which may influence eating habits at home. In addition these Allana employees will receive increased income from wages, allowing them to purchase more subsistence items. Finally, Project related in-migration may create income generating opportunities for some people who may use this income to increase subsistence items in the household. However, for those who are not able to exploit these opportunities, increased food insecurity is likely to result.

Sensitive Receptors

The artisanal mining (digging, cutting and transportation) of salt is the most significant livelihood in the Social Study Area. Although some income is generated from other activities, economically and culturally salt mining was reported to be the most significant livelihood. The level of economic dependency on salt mining and its significance for socio-cultural self-identification for Afar communities means that a large majority of people are believed to be highly vulnerable to any changes in its productivity or availability. The absence of obvious and established alternative livelihoods in the area, exacerbated by the harsh environmental condition, means dependency on salt mining is increased, leaving many people vulnerable to any change in the livelihood or resource availability.

A considerable proportion of Afar households in the Study Area rely on the PSNP and are reliant on the key livelihoods in the area for subsistence, therefore they will also be sensitive to the impact.

Women and female headed households are identified as one of the most susceptible groups to food insecurity related to a decrease in productivity of livelihoods and may face malnutrition and therefore be susceptible to disease.

The local Woreda Health Clinic reported that children are also currently most likely to suffer from malnutrition making them vulnerable to a decrease in productivity of livelihoods.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Major Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in Table 11.6.

Table 11.6 Rating of Impact Related to Artisanal Salt Mining (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Regional	This impact may be experienced by stakeholders involved in the salt mining industry including migrants travelling into the area from the highlands to transport and dig salt, local people cutting salt or with a stake in the salt buying and selling cooperative, or those marketing salt in Mekele.
Duration	Long Term	Without mitigation and management measures the impact may continue for the duration of the proposed Project.
Scale	Up to 15,000 people	The impact may be experienced by community members throughout the Social AoI.
Frequency	Constant	This impact would be constant as waste salt is regular by-product of the salt mining process and truck movements would be constant throughout construction and operation, with associated disruption to camel trains.
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Large
Large Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
High	Vulnerability of receptors is dictated by the low levels of dependence on salt mining in the communities surrounding the proposed Project.	
Significant Rating Before Mitigation		
Negative Impact		Major Negative Impact
		Major

This impact is anticipated to begin during the construction when the number of vehicles passing through the area increases, and to become more acute during the operations phase as groundwater abstraction and the development of salt as a by-product begins. It will continue until the decommissioning phase when mining operations are complete.

To avoid and reduce the significance of this impact the mitigation and management measures developed in response to impacts to water resources (refer to *Chapter 10*) will be relevant. In addition the following measures have been developed for adoption by Allana.

- **Livelihood Diversification**

Allana will look to develop and support an appropriate programme that focuses on enterprise development and livelihood diversification to improve levels of income in the Study Area. This will be part of Allana's community development initiative and is discussed in greater detail in the CDP (refer to Volume III *Annex I*).

- **Driving Policy**

As discussed in *Section 11.3.3* Allana will develop a Driving Policy that explicitly limits, wherever possible, driving on areas exploited for artisanal salt mining.

- **Sale of Waste Salt**

Allana will consider the effect to the artisanal salt economy when disposing or selling the salt generated as a waste product of solution mining. This may include:

- Stockpiling waste salt for the duration of the LoM;
- Not selling all waste salt produced to regional salt buyers;
- Seeking to sell a portion of waste salt to buyers only outside of Ethiopia; and
- Limiting the sale of salt to industry within Ethiopia and only selling products that will not provide competition to artisanal salt miners.

Allana will seek to ensure that the sale or dispose of salt is carried out in such a manner so as not to 'flood' the market and depreciate the value of locally produced artisanal salt.

- **Supporting Local Salt Traders in Salt Iodisation**

The government policy regarding salt iodisation may be challenging for local salt workers at Lake Assale due to the absence of iodisation facilities in vicinity of Lake Assale, and the low levels of capacity and knowledge to engage in the iodisation process. Allana will engage with government to understand government strategy on the salt iodisation programme, in particular the artisanal salt mining at Lake Assale. As part of investment in enterprise development, identified in the CDP, Allana will assess the potential

to work with local salt trade workers and other relevant stakeholders (e.g. the Berahale Salt Selling Association) to build their capacity in creating a local salt iodisation process, which can then be sold to the regional and national market.

- **Camel Transport Route Overpass**

Due to the camel train route passing over many roads, Allana will develop one or more camel train 'overpasses', as necessary in consultation with local and formal leaders and the salt mining cooperative in order to establish a means by which camel trains can safely cross roads in an agreed location.

- **Compensation Mechanism**

During the construction phase Allana will develop in consultation with local and formal leaders and the salt mining cooperative an agreed process, mechanism and entitlement matrix for compensation for any traffic accidents that result in damage to camel trains.

- **Stakeholder Engagement - Waste Salt**

Allana will include information surrounding the management of waste salt within on-going stakeholder engagement activities. This will seek to explain the on-going plans for the material and manage expectations and concerns.

- **Collaboration with Local Healthcare Services**

In order to lessen any consequences for food security related to decreasing productivity of livelihoods Allana will work with the local healthcare services, particularly in Hamad Ela, a sizeable village in proximity to the proposed Project, to support programmes focused on the hygienic handling of food, and the importance of a balanced diet.

Allana could also support to the Health Clinic in providing deworming and vitamin A supplementation programmes for local schools, in particular the school in Hamad Ela. In addition support could be provided to current programmes targeting malnutrition and anaemia. This will help to boost the nutritional value of food ingested including access to vitamin A.

Residual Impact (Post-mitigation)

With suitable avoidance and mitigation, this impact is likely to decrease resulting in the assessment of the impact as a '**Moderate Negative Impact**'.

Table 11.7 Rating of Residual Impact to Artisanal Salt Mining (Post-mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Regional	This impact may be experienced by stakeholders involved in the salt mining industry including migrants travelling into the area from the highlands to transport and dig salt, local people cutting salt or with a stake in the salt buying and selling cooperative, or those marketing salt in Mekele.
Duration	Short Term	Without mitigation and management measures the impact may occur as the salt mining area moves to the south.
Scale	Up to 15,000 people	The impact may be experienced by community members throughout the Social AoI.
Frequency	Sporadically	This impact would occur sporadically as traffic accidents occur.
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Medium
Medium Magnitude		
Significant Rating After Mitigation		
Moderate Negative Impact		
		Moderate

11.3.5 Reduced Income Generating Opportunities Related to Palm Collecting and Processing

Background

Description of the Baseline Environment

The collection and processing of palm leaves to produce ropes, mats, brooms etc. is the significant livelihood activity for women living in settlements close to the salt flats. 59.8% of households surveyed responded that they have at least one person involved in the activity. Within the household survey it was indicated that the palm collecting and processing earned between USD 0.80 and 27.80 per month.

Food insecurity is reported to be high in the area as discussed in *Section 11.3.4*.

Proposed Project Activities

Allana will require a substantial amount of groundwater for solution mining activities which will be abstracted from a series of boreholes. The volumes of water required are described in greater detail in *Section 11.3.3*.

This abstraction of water may affect the ability of palms on the liminal fringe of the salt flats to survive. The extraction of groundwater may cause the water table in the area to drop resulting in dependent plant species within the salt pan fringe habitat to potentially die. However the groundwater resource

estimates that drawdown impact will have a Moderate significance, but that groundwater extraction can be restricted to the natural recharge capacity. The extent of the loss of palms is therefore expected to be restricted to local catchments, which are thought to be approximately delineated by the Alluvial Fan structures. The extent and scale of the impact needs to be informed by on-going monitoring and modelling the response of groundwater resources to the expected extraction requirements of the mining operation, and on-going monitoring of the mortality of palms.

As referenced in the biological impact assessment (refer to *Chapter 10*) there is currently some uncertainty regarding the extent and scale of impacts on the Salt Pan Fringe. As such, this impact assessment will consider specific monitoring measures. However it is assumed that the impacted area will be within or slightly to the south of to the proposed Allana site and will not extend all the way to Hamad Ela.

In addition to the effect of groundwater abstraction, the proposed Project will require approximately 1km² for the construction of the processing plant, approximately 2.5km² for pond areas and approximately 0.5km² at any one time as part of the brine field. Allana plan to fence throughout the brine field area, fencing an area as it is completed. The main pipework between the processing plant and the brine field and the conveyor belt between the solution pond and the processing plant will not be fenced. The development of this infrastructure will mean that access to the Salt Pan Fringe within Allana's concession area will be unsafe for local communities and will be prevented by Allana through patrols and gating of roads.

This series of causal factors may be exacerbated by other potential potash solution mining Projects planned in the area with similar demands for water abstraction and land take.

The reduced availability of palms will concentrate people in a smaller area and potentially over-stress these areas due to increased competition.

Sensitive Receptors

The abstraction of ground water could lower water resources available to plants along the Salt Pan Fringe potentially causing plant mortality, reducing the availability of palms as a natural resource. The spatial extent and magnitude of the impacts to palms will be defined according to on-going water and ecological monitoring as discussed in *Chapter 10*; however, for the purposes of this assessment it is assumed that palms available for collection within the alluvial fans and salt fringe directly surrounding the Allana concession will be significantly decreased.

In addition the use of these liminal palm areas as the area for potential solution mining will mean that due to health and safety concerns the Allana concession will be inaccessible.

The collection and processing of palms into products is one of the only livelihoods available to women. Although some women work in shops and gain small amounts income from petty trading, palm collecting and processing represents the only significant income generating activity that is available to women, leaving them vulnerable to any changes in its productivity or availability. Any change to the camel transport route for salt mining will also affect palm industry as camels are used to transport palms and palm products out of the Social Study Area.

A decline in the productivity of the palm industry could affect the ability of women and female-headed households to access infrastructure and services, purchase food and worsen food insecurity.

Significance of Impact (Pre-mitigation)

Based on the anticipated mortality of palms identified within the Biological Impact Assessment (refer to *Chapter 10*) this impact has been assessed as a '**Major Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.8*.

Table 11.8 Rating of Impact Related to Palm Collection and Processing (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in villages that use the palms that grow within the planned area for solution mining for income generation. This may include Hamad Ela, Mororo and Alai Lai.
Duration	Long Term	Without mitigation and management measures the impact may continue for the duration of the proposed Project.
Scale	Up to 2,000 people	This impact may be experienced by community members in villages of Mororo and Alai La (post-resettlement, dependent upon the resettlement location). This will be informed by on-going monitoring and modelling to inform if, for example, Hamad Ela, Badle and Fiea may also be impacted.
Frequency	Constant	This impact would be constant as ground water in the area is reduced.
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Medium
		Large
Medium to Large Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
	Vulnerability of receptors is dictated by the high levels of dependence on palm products for income by women and female-headed households.	
High		
Significant Rating Before Mitigation		

Negative Impact	Major Negative Impact
Major	

This impact is anticipated to begin during the construction phase where access to the palm area is limited but will become most pronounced during the operations phase as groundwater abstraction begins. It will continue until the decommissioning phase when mining operations are complete.

Recommendations and Mitigation/Management Measures

To avoid and reduce the significance of this impact the mitigation and management measures developed in response to impacts to water resources and biological receptors (refer to *Chapter 10*) will be relevant as well as the mitigation measures developed in response to impacts to pastoralism (refer to *Section 11.3.3*). Within the biological impact assessment these measures focus on avoiding, minimising, restoring and offsetting the impact to palms, these will be based on further research to determine the likely scenario of groundwater abstraction and the appropriate response. These measures include:

- On-going assessment of the palm population baseline to benchmark the health of the population;
- Reduction in groundwater abstraction on the basis of potential significant dieback of palms and drawdown in groundwater;
- Grouping of infrastructure;
- Developing a set-aside area protected from transformation or fragmentation by infrastructure ⁽¹⁾ ;
- Relocation of infrastructure, borrow pits and linear developments away from Salt Pan Fringe;
- Preparation of a palm nursery supervised by a qualified horticulturalist with palms replanted as agreed with local communities; and
- Transplantation of palms removed during construction.

A summary of the measures designed to avoid and mitigate for potential impacts to groundwater are summarised in *Section 11.5.1*.

In addition the following measures have been developed for adoption by Allana.

- **Livelihood Diversification – Female Targeted**

(1) Recognising that a set-aside area may be in the north of the concession (as recommended in the biological impact assessment), which may prove impractical for access by Hamad Ela or should Mororo and Alai Lai resettle south of the concession.

The development and support for an appropriate programme of enterprise development and livelihood diversification (as discussed in *Section 11.3.4*) will include specific consideration of enabling women and female-headed households to diversify their livelihoods away from palm related industries. This will be part of Allana's community development initiative and are discussed in greater detail in the CDP (refer to Volume III *Annex I*).

- **Livelihood Restoration Framework and / or Plan**

Allana will continue to conduct groundwater, ecological and livelihood analysis so as to understand the spatial extent and magnitude of the impact to palms. Based on the results of these studies Allana will develop a Livelihood Restoration Framework (LRF) and / or Plan (LRP) to define the scale of required mitigation and / or compensation for affected households, as well as a programme to monitor impacts to palms over time and its associated impact on palm-related livelihood activities. The LRF / LRP will include specific measures, based on the updated modelling and monitoring data related to palms and groundwater, to respond to the nature and significance of the impact. This may include only further mitigation measures such as the provisions of palm products from other areas, or the provision of transport to people dependent upon palms to gather the product from other areas.

- **Facilitated Access to Concession / Set-Aside Area**

Allana will provide households from Mororo, Alai Lai and Hamad Ela supervised access on an agreed basis into the concession or set-aside area ⁽¹⁾ (depending on level of impact) to collect suitable numbers of palms. This will be agreed with palm and women's associations and will be subject to discussion and engagement. Allana will provide transportation and guidance during the collection of palms and will set up a means to receive requests to enter the concession area to collect palm resources.

- **Biodiversity Offset Area**

As discussed in *Section 11.3.3* and the biology impact assessment section (refer to *Chapter 10*) this ESHIA does not favour the establishment of an offset area however, should the hydrogeological modelling reveal that more than 75% of palms are expected to perish, and /or that cumulative impacts of other companies groundwater extraction leave no options for establishment of a set-aside or minimisation of impacts to palms, then a biodiversity (palm) offset does need to be considered. In this context Allana will seek to establish a sustainably managed and irrigated palm nursery and palm offset area that will seek to maintain a palm population in proximity to Hamad Ela. This area will be irrigated with water provided by Allana and training will be given to local users concerning the sustainable management of the resource.

(1) Although hunting and the collection of 'woody' products will not be allowed.

- **Community Monitoring of Groundwater**

Allana will train a number of community members from potentially affected communities to understand the results from the groundwater monitoring process its staff will undertake periodically. These community members will then communicate this information to local communities so that they remain aware of changes to groundwater and associated ecology over time. This approach will help to ‘demystify’ the use of and impacts to groundwater for local communities, and to may reduce the risk of unfounded community claims of groundwater impact.

Residual Impact (Post-mitigation)

On-going groundwater, ecological and livelihood analysis means that the spatial extent and magnitude of the impact to palms is a continuing process that will be defined by on-going monitoring. Based on the current understanding of the potential area of impact and with suitable avoidance and mitigation, this impact is likely to decrease resulting in the assessment of the impact as a ‘**Moderate Negative Impact**’.

Table 11.9 Rating of Residual Impact to Palm Collection and Processing (Post-mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in villages that use the palms that grow within the planned area for solution mining for income generation. This may include Hamad Ela, Mororo, Badle and Fiea and Alai Lai.
Duration	Short Term	With suitable mitigation and management the impact will occur over the short term as replacement palms are being established.
Scale	Up to 1,000 people	The impact may be experienced by community members in the settlements of Mororo and Alai Lai.
Frequency	Sporadically	This impact would occur sporadically as replacement palms are grown or supplied.
Likelihood	N/A	

Magnitude	
	Small
Small Magnitude	
Significant Rating After Mitigation	
Moderate Negative Impact	
	Moderate

11.3.6 Reduced Income Generating Opportunities from Tourism

Background

Description of the Baseline Environment

Although the Danakil Depression does receive a certain number of ‘adventure tourists’ the level of income generated by people within the Social Study Area

from these tourists is believed to be comparatively insignificant. Local inhabitants are believed to on occasion rent out houses or rooms, sell small items, tea and coffee, and young men serve as guides and interpreters. However, it was reported that the tourist groups are typically fairly self-sufficient, bringing supplies and camping equipment into the area by vehicle and do not rely on services in the Social AoI. Anecdotal evidence indicates that members of the local militia and traditional governance mechanism may also generate income from tourists charging to act as guards; however, data related to this was difficult to corroborate.

Based on the results of the household survey, only 6.1% of households surveyed stated that they or someone within their household was involved in tourism services. All households involved in providing tourism services identified it to be a secondary occupation. The majority (66.7%) of those surveyed and involved in tourism identified that they worked as guides or guards with the remaining providing accommodation and transport / cleaning services.

According to the household survey the average monthly income earned by a household from providing tourism services ranged from USD78.20 and USD 50. This is the highest potential income source cited in the household survey; however the low number of households involved demonstrates that tourism may not to provide a consistent source of income for households.

Benefits from tourism in the Afar area is believed to also be felt across the region as tour groups typically visit Mekele, Erte Ale and other areas. In addition the majority of tourists coming into the Danakil Depression organise trips via tourism operators at a national or international level. Therefore any changes to tourism in the Study Area are likely to impact tourism operators outside of the local area.

Proposed Project Activities

The proposed Project will cause a series of visual changes related to the construction and operation of solution mining. These changes are illustrated in *Section 11.8*.

The presence of a large scale mining company may have a detrimental effect on the perceived 'wilderness' and aesthetic beauty of the Danakil Depression, reducing the appeal to tourists.

It should be noted that improved infrastructure into the Social AoI, partially due to the construction of a non-Project Government road from Mekele to Bada will improve access, potentially increasing the ability for tourists to come into the area.

Sensitive Receptors

The development of the proposed Project may reduce the appeal of the area to tourists reducing opportunities for people to maximise income generating opportunities.

This impact may be naturally counteracted by transportation improvements related to infrastructure that Allana will develop and that the Government are in the process of planning and developing. In addition, loss of income for the youth may be mitigated by income generating opportunities related to direct employment or in-migration.

Receptors that may be sensitive to this impact include the youth who tend to be the ones who capitalise on income generating opportunities from tourists.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Minor Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.10*.

Table 11.10 Rating of Impact Related to Tourism (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Mainly local and to some extent regional and national	This impact may be experienced by stakeholders living in villages that benefit from tourism. This may include Hamad Ela and Berahale and to a lesser extent communities along the road network from Berahale to the area proposed for the Project such as Ambule, where tourists stop to camp. Tourists visit other tourist destinations in the Afar region as part of the Danakil Depression route so impacts may be felt at the regional level. In addition tourism operators are typically located in Addis Ababa and therefore the impact may extend to the national level.
Duration	Long Term	Without mitigation and management measures the impact may continue for the duration of the proposed Project.
Scale	Up to 4,000 people	The impact may be experienced by community members in the settlements of Hamad Ela and Berahale, and to a lesser degree by stakeholders at the regional and national level.
Frequency	Intermittent	This impact may occur intermittently during the key seasons for tourism.
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Low	Vulnerability of receptors is dictated by the low levels of dependence on	

tourism. The youth may demonstrate a higher level of vulnerability due to an absence of viable alternative livelihood options.

Significant Rating Before Mitigation	
Negative Impact	Minor Negative Impact
Minor	

This impact is anticipated to begin during the construction phase and continue into the operations and decommissioning phases.

Recommendations and Mitigation/Management Measures

To avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by Allana.

- **Stakeholder Engagement - Engage Tourists**

In order for Allana to ensure that travel media and journalists do not portray a skewed description of Allana’s effect on the area. This may include:

- Installing a description of the Project, Community Development activities and the environmental and social management on ‘tourist notice boards’ in Hamad Ela, Berahale and near Mount Dallol in various languages.
- Copies of the ESHIA and / or Executive Summary will be made available these tourist notice boards.
- Develop an accurate and up to date Allana Potash Dallol Project website that contains downloadable versions of ESHIA documentation as well as basic Project information and a description of community development and environmental and social management activities in non-technical language. This website should be referenced on all tourist notice boards.
- In liaison with relevant tourism operators offer short organised site tours hosted by local Afar employees to provide tourists with an accurate overview of the proposed Project.

- **Tourist Information Office**

In consultation and partnership with traditional and local leaders Allana will establish and sponsor a tourist information office in Hamad Ela. This office will include discussion of key geological and geochemical activities in the area, displays of archaeological finds made in the area and descriptions of the different types of cairns in the area. In addition Allana will display and map the archaeological site ‘discovered’ during the ESHIA fieldwork to the south (refer to *Chapter 9*) and discuss the significance of the finding. In addition at

the tourist information office Allana will install a series of ‘western’ toilets and bathroom facilities available to visiting groups.

- **Enterprise Development**

As part of Community Development activities and as discussed in the CDP (refer to Volume III *Annex I*) Allana will provide capacity development and support for local enterprise in the development of a local shop, café or hotel that can provide comfortable safe accommodation and chilled drinks.

Residual Impact (Post-mitigation)

With suitable avoidance and mitigation the negative consequences of this impact are likely to decrease. With suitable intervention the impact to tourism may ultimately present as a positive, increasing tourism in the area and the associated income generating opportunities. As a result the residual rating of this impact would be a positive impact.

Table 11.11 Rating of Residual Impact Related to Tourism (Post-Mitigation)

Type of Impact	
Positive	Indirect
Indirect Positive Impact	
<p>The on-going engagement and construction of infrastructure in the area, in addition to the provision of basic tourist facilities and enterprise development will boost the local benefits extracted from tourism in the area, which may increase.</p>	

11.3.7 Increased Cost of Living Due to Localised Inflation

Background

Description of the Baseline Environment

According to the results of the household survey the largest expenditure within surveyed households was on food, clothing and healthcare and medicine. On average a household reported spending ETB 806.6 (USD 44.8) and ETB 496.2 (USD 27.6) on food and on clothes per month respectively. Very little of a household’s expenditure was reported to be allocated towards savings, remittances or recreational activities with the majority of households using income to purchase basic households requirements. It was reported that a large proportion of food is provide by food aid networks and donors.

63.5% of households who responded to the household survey indicated that they perceived their expenditure had stayed the same or increased within the last two years.

The only market within the Study Area is in Berahale however small shops and cafés are present in Hamad Ela

Proposed Project Activities

The presence of the proposed Project, augmented by other development in the Social AoI such as the new road and other mining companies, may result in in-migration into the area of opportunistic job seekers and associated service providers, particularly into the potential 'in-migration hotspots' of Berahale and Hamad Ela, and to a lesser extent Ambule and Asabolo. This in-migration and resultant increase in population could result in additional demand for goods and services causing an increase in the cost of basic goods. This will be most pronounced where in-migration is highest, namely Hamad Ela and Berahale.

In addition the presence of mining company employees, including Allana's employees is likely to increase the demand for goods and services and establish a cash economy in the area which may also result in an increase in the cost of basic goods.

As a natural mitigating factor improvements to road infrastructure may increase the feasibility and reduce the cost of moving goods and services into the areas and enable an increased supply, which would have the effect of reducing the cost of basic goods.

Sensitive Receptors

Increased cost of living due to localised inflation may result in a worsening of the health profile of residents where food, goods and services become prohibitively expensive or in short supply. The key determining factor will be the extent to which the increased demand created by recent in-migrants can be met by an increase in supply of basic goods. If in-migration is rapid and the consumer base expands quickly, it is likely that local prices will rise sharply over the short term, affecting the ability of communities with reduce access to cash and income to buy basic commodities. This impact may be pronounced in the settlements of Hamad Ela and Berahale, and to a lesser extent Ambule and Asabolo, which may act as 'hotspots' for in-migration.

The average household income and expenditure reported within the household survey are almost comparable (USD74.80 compared to 87.30 per month). Although income and expenditure data within household surveys is not always reliable, the similarity between expenditure and income indicates some potential financial vulnerability across the surveyed households as savings may not be widespread.

Sensitive receptors may include members of female-headed households who are less able to generate sufficient funds to purchase basic goods due to cultural conditions or primary care responsibilities. They may also include those households whose sources of income are not linked positively to potentially changing dynamics of local supply and demand that are brought about by in-migration. This may include those households who rely on income from salt mining to purchase food as it is assumed that the income

from salt mining will not rise in line with food prices, driven by increased demand.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Moderate Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.12*.

The magnitude of the impact has been evaluated to be medium based on the potential for it to be intermittently experienced at a local extent by communities that may face a large amount of in-migration.

The vulnerability of receptors has been evaluated to be high because of reduced access to subsistence and income generating activities and minimal savings networks.

Table 11.12 Rating of Impact Related to Localised Inflation (Pre-Mitigation)

Type of Impact		
	Negative	Induced
Induced Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in communities that experience substantial amounts of in-migration. This may include Hamad Ela and Berahale and to a lesser extent communities along the road network from Berahale to the area proposed for the Project such as Ambule.
Duration	Long Term	Without mitigation and management measures the impact may continue for the duration of the Project.
Scale	Up to 7,000 people	The impact may be experienced by community members in all of the settlements within the Study Area.
Frequency	Intermittent	This impact may occur where in-migration is significant and demand increases for goods and services.
Likelihood (for unplanned events only)	N/A	
Magnitude		
	Medium	
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	Vulnerability of receptors is dictated by the widespread reliance on the salt mining industry (and insecurity), which may not experience an increase in income generating potential if substantial inflation occurs.	
Significant Rating Before Mitigation		
Negative Impact		Moderate Negative Impact
Moderate		

This impact is anticipated to begin during the construction phase and continue into the operations and decommissioning phases.

Recommendations and Mitigation/Management Measures

All mitigation measures related to helping reduce, avoid and manage potential in-migration will be relevant to this impact. This will include promoting transparent hiring techniques and a sourcing and procurement policy that plans hiring in a way that may limit in-migration (refer to Section 11.3.1).

In addition livelihood improvement and diversification measures will help to promote increased household income and increase the ability to manage inflation and price raises (refer to Sections 11.3.4).

To avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by Allana.

- **Monitor Food Prices**

Allana will establish a food price monitoring system that establishes a precedent for monitoring the prices of a standardised 'basket of goods'¹, allowing Allana to track the potential increases in goods and services. A rapid increase in the price of a basket of goods should trigger further investigations into the changing abilities of affected consumers to meet these increased costs. If necessary, Allana should take measure to ensure supply of basic goods in localised 'hotspots' in emergency situations, where they are affected by rapid in-migration.

- **Emergency Food Aid**

Allana will liaise with relevant food aid providers to establish a precedent to inform relevant NGOs / Government providers where environmental shocks, food shortages or sharp increases in prices cause pronounced short term food insecurity. This should be informed by the monitoring of food prices and on-going engagement activities.

- **'Closed Camp' Worker Accommodation**

Allana will manage worker accommodation through a 'closed camp' (for both Allana employees and any contractors used) preventing unauthorised off-duty movement of workers throughout local communities. This will prevent the emergence of a casual labour economy to service the workforce, reducing inflation.

¹ A basket of goods is a fixed set of consumer products and services valued and used to track inflation and account for changes in consumer habits. This may include everyday products such as food, clothing, medicine etc. As the prices of products in the basket increase or decrease the overall value of the basket will change determining levels of inflation.

Residual Impact (Post-mitigation)

With suitable avoidance and mitigation the frequency, scale and duration of this impact is likely to decrease resulting in the assessment of the impact as a '**Minor Negative Impact**'.

Table 11.13 Rating of Residual Impact Related to Localised Inflation (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in communities that experience substantial amounts of in-migration. This may include Hamad Ela and Berahale and to a lesser extent communities along the road network from the area proposed for the Project such as Ambule and Asabolo.
Duration	Short Term	With mitigation and management measures impact may be reduced to only occur in short term after in-migration occurs.
Scale	Up to 7,000 people	The impact may be experienced by community members in all of the settlements within the Study Area.
Frequency	Rare	This impact may occur where in-migration is significant and demand increases for goods and services.
Likelihood (for unplanned events only)	N/A	
Magnitude		
Small		
Small Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		
Minor		

11.4 IMPACTS TO SOCIAL AND CULTURAL COHESION

The following section identifies and discusses impacts to social and cultural cohesion but not including impacts related to tangible cultural heritage and archaeology (discussed in Section 11.6).

11.4.1 Erosion of Traditional Governance Mechanisms

Background

Description of the Baseline Environment

The traditional Afar social and political organisation is effective at the local level and continues to govern Afar social, economic and political life. FGD participants reported that clans provide the strongest and most effective leadership structures at the community level. The traditional system often overlaps with the formal administration system where clan leaders and village elders are commonly representatives in the Kebele government. The Sabana Demale Kebele Administration, in which the proposed Project is located, is formed by both government representatives and representatives of the traditional authorities.

The traditional governance system remains a strong and respected parallel administrative structure in the Social Study Area, and traditional leaders are reported to retain significant influence. Within all of the villages surveyed, although to a lesser extent in Berahale, traditional leadership is still viewed as essential for resolving disputes, making key decisions and in general representing the community.

Proposed Project Activities

Due to potential in-migration associated with the proposed Project the traditional leadership will be challenged to redefine and/or assert itself on the population of the Social AoI, many of who will now be outsiders, some neither accustomed to, nor bound by, allegiance to traditional leadership structures. Other newcomers will be familiar with traditional leadership structures and roles but may not feel particular allegiance to local leaders.

Differences in income between Allana employees from the local area and those who don't work for Allana are already evident and this may fuel disparity in the levels of development and empowerment of local residents. Those who receive better employment opportunities and income may desire a more substantive role in governance and may, directly or indirectly, challenge the traditional systems. Furthermore local people who work for Allana are likely to be exposed to different (non-Afar) cultures and ways of life. These differences may challenge the traditional subordination to the existing cultural management and leadership systems.

The results of the household survey show that the majority of Berahale Woreda's population is comparatively young, with 50% of the population under the age of 15. As this age group are increasingly exposed to changes in the Study Area including greater access to information, and potentially more employment opportunities they are likely to feel more empowered. This may affect levels of support for traditional decision making and leadership hierarchies. As employment increases an increase in young men with independent access to income could undermine established age-based relations and the ability of older generation to exercise controls on younger men. However it should be noted that for the youth this impact may be perceived as positive allowing them develop their own identity that is not informed by traditional systems.

The challenge for the traditional leadership of managing perceived and actual socio-economic changes may place further pressures on the traditional authority. Opinions about the correct approach to manage changes may differ, potentially leading to internal conflict, undermining their role in providing a consolidated 'voice'.

Sensitive Receptors

The erosion of the traditional governance mechanism due to an in-migration of different cultural systems, differential empowerment of specific groups or due to internal conflict may elicit a series of responses. The traditional

governance mechanism may stress their role by forcing a backlash against change, they may seek to position themselves as gatekeepers to control on-going change or most likely may be gradually eroded, reducing the significance of the role they play currently. For those that currently rely on the traditional governance mechanism for support or cultural stability this erosion will have negative consequences. For example the elderly and those suffering from illness may lose the support systems that they rely on and are upheld through traditional governance mechanisms.

It should be recognised that some people may perceive this impact to have positive consequences. The youth may look to benefit from changes to existing governance mechanism to increase the role they currently play in decision making and women reported during engagement that they anticipate that change may reduce socio-cultural limitations on them.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Moderate Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.14*.

Table 11.14 Rating of Impacts Related to Traditional Governance Mechanism (Pre-Mitigation)

Type of Impact		
Negative		Indirect
Indirect Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in communities that experience substantial amounts of in-migration and have interactions with non-local Allana workforce. This may include Hamad Ela and to a lesser extent communities along the road network from Berahale to the area proposed for the Project such as Ambule.
Duration	Long -Term to Permanent	Without mitigation and management the impact will either cause a long-term or permanent change to traditional governance mechanisms.
Scale	Up to 1,000 people	The impact may be experienced by community members in the settlements of Hamad Ela and to a lesser extent communities along the road network from Berahale to the Project such as Ambule and Asabolo.
Frequency	Intermittent	This impact may present as a slow degeneration of the governance mechanism.
Likelihood (for unplanned events only)	NA	
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	Receptors to this impact include the majority of households in the Study Area as traditional governance mechanisms were identified to	

be the most important means of decision-making at a local level. Particularly sensitive receptors will include the elderly and leaders (clan, religious and elders) within the community.

Significant Rating Before Mitigation	
Negative Impact	Moderate Negative Impact
Moderate	

The causes of this impact are anticipated to begin during the construction phase; however it is anticipated to present during the operations and decommissioning phase.

Recommendations and Mitigation/Management Measures

Mitigation and management measures have been developed for adoption by Allana and third party contractors. The impact will also be mitigated using the measures described to preserve the local sense of place, detailed in *Section 11.4.2* including cultural programmes etc. The development of ‘closed camp’ for worker accommodation, as discussed in *Section 11.3.2* will also help to mitigate this impact.

- **Stakeholder Engagement Programme**

It is important that the Stakeholder Engagement Programme is designed putting local Afar culture and norms at its forefront so as to avoid potential conflict between local residents and Allana’s employees, many of whom will have different cultural practices and expectations. To specifically mitigate the erosion of traditional governance mechanisms Allana should seek to acknowledge and actively involve traditional leaders, women and the youth in the consultation processes in a culturally appropriate manner. In addition Allana will involve these groups in the design and organisation of engagement. The feedback and grievance mechanism included within the Stakeholder Engagement Programme should also be aligned to traditional governance mechanisms and resolution processes.

- **Personnel Code of Conduct**

Allana will develop and implement a Personnel Code of Conduct for all current employees, contractors and visitors directly related to the Project. This will be a contractual and enforced requirement for all staff and subcontractors.

This code of conduct would increase worker sensitivity to local norms and customs and would ensure that contractors and employees are aware of appropriate and acceptable behaviour. The code of conduct should ensure that personnel do not encroach on or disturb areas where local residents live / use. It is key that employees understand the socio-cultural context of the area, and the effects of increased in-migration and interaction of outsiders with the local Afar. The code of conduct should be developed with input from local

communities and traditional authorities, to ensure that it responds to their concerns and reflects their preferences to the extent possible.

Camp management procedures will also be developed and applied, including a controlled alcohol policy, banning of unauthorised visitors to camps, and provision of recreational facilities for workers in camps. Allana should also manage the location of contractor accommodation to limit the impact of the high numbers of outsiders converging on local towns. A cultural awareness induction will be provided to all non-local staff and contractors (including Ethiopians) regarding local customs, traditions, and religious beliefs not only of the Afar but of other groups in the Area. This will include information and training on the traditional governance mechanisms that exist in the area ensuring that these are acknowledged and respected by all personnel.

In addition the induction should inform employees of the current status of community relations. The content of the induction should be guided by input from local community representatives including traditional authorities, to reflect the cultural norms they feel are important for non-locals to understand.

- **Utilising Traditional Governance Mechanisms to Address Key Social Issues**

The role that elders and traditional leaders play in Afar society has been identified during data collection as a key mechanism through which common socio-economic issues in the Study Area are addressed. Traditional leaders should therefore be involved in the Community Development / Stakeholder Engagement process, playing a role in raising awareness about the importance of education, and potentially become involved in any Community Development Plans that focus on health, education or other relevant topics. This will work to potentially reduce the low health status and low educational achievement in the Study Area, whilst working to enhance the existing traditional governance systems.

The utilisation of the traditional governance mechanism for those involved in the Community Development / Stakeholder Engagement process should be paired with efforts to mobilise other parts of communities less able to become involved in decision making. Specific forums for women, youth and the elderly should also be established to ensure that their opinions and views are considered.

- **Manage In-Migrants to Settle in 'Contained Areas'**

Recognising that the proposed Project will inevitably lead to some degree of in-migration, the potential impact of this phenomenon on the erosion of traditional governance mechanisms may be limited by confining the impacts of in-migration to specific geographical areas. In consultation with local traditional leaders (and other relevant stakeholders such as the Woreda and Kebele administration), Allana should identify areas where in-migrant settlement would have the least impact on traditional governance institutions

and develop measures to encourage in-migrants to settle in these areas that are deemed suitable by local stakeholders. This may include the development of residential plots that are accessible to outsiders, or the centralisation of basic services that in-migrants are likely exhibit some demand for. It should be recognised that this may incentivize movement of local Afar people and should be carefully managed, in particular to avoid any conflict. Furthermore incentives should not be designed that can be interpreted to favour or enhance the status of in-migrants. The planning and implementation will also require consent from traditional authorities and local Woreda and Kebele administration. These measures should also be included in subsequent stakeholder engagement activities as it is key local residents (in particular Afar) understand the reasoning behind such measures.

Residual Impacts (Post-mitigation)

With mitigation the magnitude of the impact is likely to decrease. However the extent and duration will not change as the impact will remain local, and any changes that do occur will either cause permanent / long-term impacts. Therefore with sufficient mitigation the impact is likely to be of '**Minor to Moderate**' significance.

This significance rating has also considered the positive perceptions of changes to traditional governance mechanisms among the youth and women.

Table 11.15 Rating of Residual Impacts Related to Traditional Governance Mechanism (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The impact will be experienced by local Afar households.
Duration	Long -Term to Permanent	Without mitigation and management the impact will either cause a long-term or permanent change to traditional governance mechanisms.
Scale	Up to 1,000 people	The impact may be experienced by community members in the settlements of Hamad Ela and to a lesser extent communities along the road network from Berahale to the area proposed for the Project such as Ambule.
Frequency	Rare to intermittent	This impact may present as a slow degeneration of the governance mechanism. The perceived benefit of this impact means the frequency may be reduced.
Likelihood (for unplanned events only)	NA	
Magnitude		
		Medium L
Medium Magnitude		
Significant Rating After Mitigation		
Minor to Moderate Negative Impact		
Minor		Moderate

*Background*Description of the Baseline Environment

The Afar typically demonstrate close ties to the land and natural resource and local residents reported that they are accustomed to accessing and using land when and where they chose. This phenomenon was observed in the Social Study Area where residents spoke about the close unity of the Afar people, ties to the land and natural resource-based livelihoods and the strong sense of identity that is derived from being Afar. The landscape, livelihoods and traditions in the Study Area were reported to be intrinsically related to the Afar social identity and cultural landscape of the region.

As part of this the local Afar community within the Social Study Area demonstrated a strong and shared social cultural identity. Social and cultural cohesion is key to the wellbeing of households in the Study Area and it offers support systems and networks that are of critical importance due to the current lack of physical and social infrastructure, livelihoods and low financial capacity of households.

Kinship and the significance derived from clan membership determine the extent to which someone will receive assistance in times of difficulty, the ability to secure and access resources, and the way in which conflicts are resolved. The social ties and connections within and between villages, and their importance for the sustainability of local communities, was evident during data collection. During engagement activities it was common for members of a household to claim a familial relationship to members of a household in another village, occasionally going as far back as five generations.

A characteristic common to the Afar is the sharing of resources and informal welfare structures that exist not only within, but across villages. Traditional Afar society and social interaction is structured according to the sharing of resources and possessions. It is uncommon and often perceived as rude for someone to claim sole ownership over resources or possessions, with households commonly sharing items such as food, medication and water.

Afar society is based on a patriarchal system where men are recognised as the leaders in society and are the chief income generators and decision makers. A woman's role is identified to be in the household and she is responsible for the maintenance of wellbeing of the household and its member. There are clear expectations of men and women in Afar culture and engagement in sex work and substance abuse is strictly prohibited of anyone in the local Afar community.

Proposed Project Activities

The proposed Project will cause a variety of visual changes in the Social AoI related to increased traffic, increased population and the construction of industrial facilities. In addition the proposed Project will require a certain degree of land acquisition and associated security arrangements that may reduce access and freedom of movements of local inhabitants into areas previously used for natural resource collection.

The proposed Project will directly and indirectly improve infrastructure into the area, potentially driving further induced development and related increases in ambient noise and light pollution and traffic above levels directly related to construction and operations.

In addition the proposed Project will cause a substantial increase in the presence of non-local people in the area including expatriate and highland project staff, in addition to the in-migration of opportunistic job-seekers from the highland areas. This increase will occur in an environment that is predominantly rural and traditional and may bring about significant social and cultural changes. The in-migration of people, each with their associated cultural and social norms, will introduce a range of new norms with the potential to challenge social and cultural systems.

Challenges to traditional mechanisms and potential conflict between traditional and formal governance mechanisms may also contribute to the loss of social and cultural cohesion. Discussion on the erosion of traditional governance mechanisms is included in *Section 11.4.1*. In addition the loss of local 'sense of place' will also contribute to a decrease in social and cultural cohesion and a loss in social identity, this is discussed in *Section 11.4.2*.

Sensitive Receptors

The visual changes may affect the local people's interaction with and perception of their cultural environment, and their association with landmarks. This may undermine existing cultural ties to the landscape, feelings of belonging and what it means to be Afar; ultimately affecting the 'sense of place'¹ of local people. This may be exacerbated where perceived and actual restrictions are in place to reduce access to sites of cultural and livelihood significance due to the presence of the Project. This may further engender feelings that Afar cultural identity is being threatened.

A decrease in social and cultural cohesion may undermine the existing cultural system of kinship support and resource sharing, impacting people's abilities to suitably cope with environmental shocks and food and infrastructure shortages. Where informal social support systems and welfare structures create stability and security, the disruption is likely to create some anxiety and insecurity. This is perhaps most relevant for groups such as the

¹ Sense of place is a concept that summarises the association that people may feel to a geographic area including the cultural value placed on that area. It refers to the cultural ties that a population may have to a landscape, relying upon it to develop their cultural identity.

elderly, the ill, female headed households and those with physical or mental disabilities who will be particularly vulnerable to this impacts as they may depend on these social structures and organisations for support and security. Socio-economic and cultural change may affect and threaten the social identity of local Afar people affecting their perception of self and identification within a cultural system.

Groups who may be particularly vulnerable to this impact may include the elderly who, with a lifetime of relatively remote rural living, will experience a dramatic and potentially difficult change. In addition for residents less likely to benefit from the proposed Project and development of the area (e.g. the elderly, the sick, those unable to secure employment etc.), this dramatic visual and landscape change could be accompanied by a sense of loss for the 'way things were', with possible psycho-social issues arising (e.g. depression).

It should be noted that for some groups a change to the 'sense of place' may be interpreted as a positive sign of development. For example for women and the youth for whom their involvement in decision-making and ability to benefit from socio-economic are currently limited this change may be perceived to be positive. Engagement during data collection suggested openness to some cultural change and even an excitement at the opportunity to be exposed to different people, a broader range of life experiences and a different type of economic activity. Some local stakeholders expressed anticipation for the area to be redefined as a hub of activity and economic opportunity, injecting a new level of energy and opportunities for local communities. In this way the impact can be perceived as a *positive* impact.

For people equipped to maximise the benefits of the proposed Project (e.g. through employment), and who see an opportunity to alter their current identity, these changes in cultural and social norms are likely to be embraced as a positive impact. A considerable proportion of the women in the FGDs stated that they looked forward to the introduction of new cultures, values and people into the area which may be a reflection of their desire to change their current marginalised status and for greater access to opportunities and influence over decisions. In addition the youth may perceive cultural change to be synonymous with development and new opportunities.

However the overall response from residents has been mixed in their desire to move away from current subsistence and rurally defined lifestyles. This openness to cultural change was expressed less often by elders within the villages who spoke more of the possible risks of breakdown in the sense of community cohesion and the undermining of traditional social values and norms.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Moderate Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.16*.

Table 11.16 Rating of Impacts Related to 'Sense of Place' and Cultural Cohesion (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The key causes of the impact will occur at the local level with the local Afar communities experiencing the impact.
Duration	Permanent	Without mitigation and management the impact may cause a permanent change within the Study Area.
Scale	Approximately 7,000 people (currently)	The impact may affect a portion of Afar people in the Study Area across the Berahale and Sabana Demale Kebeles. The population of the villages in the Social Study Area was identified to be approximately 7,000.
Frequency	Constant	The impact will be constant throughout the LoM.
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
	With minimal experience of industrial development vulnerability to this impact may be raised. The ability for people to potentially normalise this impact may reduce the vulnerability to medium.	
Medium	The elderly may have a higher vulnerability as they are typically more deeply connected to the area and will not perceive change to be as positive.	
Significant Rating Before Mitigation		
Negative Impact		Moderate Negative Impact.
	Moderate	

This impact may already be in existence due to the construction that Allana have completed as part of their advanced exploration. It will continue during the construction phase; however, it is anticipated to be more significant during the operations and decommissioning phase.

Recommendations and Mitigation/Management Measures

The mitigation measures to reduce the visual impact of the Project will help to mitigate this impact (refer to Section 11.8 for further details); this may include blending equipment colours to the background.

The mitigation measures should aim to maintain cultural cohesion wherever possible. Development in the Study Area is more likely to be sustainable if the importance of social and cultural cohesion to the sustainability of affected groups is recognised and incorporated into the mitigation measures.

The Cultural Awareness induction (refer to *Section 11.4.1*) will also be important in managing any negative impacts to social and cultural cohesion, and will work to avoid any challenges to social and cultural norms

In addition the following mitigation measures have been recommended to manage this impact.

- **Stakeholder Engagement Programme**

As identified in *Section 11.4.1* Allana will implement and continue to develop an on-going and continuous Stakeholder Engagement Programme which will be designed with input from those affected and which will be based on the principles of openness, mutual trust and inclusiveness in terms of its operational activities and community-based development initiatives. This process will help people to understand what changes are upcoming and to cope with them. The absence of information around the Project and construction can exacerbate the impact.

The programme should actively aim to inform stakeholders of Allana's activities, provide responses to stakeholder input to show that their views are being considered in Project planning, and empower communities to identify and address issues of concern to them. Stakeholder engagement should be designed according to transition between different phases of the Project, in addition to changes to Project activities and key issues that are likely to arise.

Where possible and appropriate, key decisions which directly affect communities will incorporate their views. Specifically this will include the development of a Worker Code of Conduct (refer to *Section 11.4.1* for details), siting of roads constructed by Allana, Community Development planning, anticipated cultural changes etc. This process will seek to ensure that communities are involved in relevant Project decisions and allows them some form of control over cultural change.

The programme will be designed together with community representatives and reflect their preferences and needs. The forms of engagement should be agreed mutually between Allana and community representatives and should seek to involve regular engagement with the traditional authority and regular 'roundtable' discussions with stakeholders, allowing them to feedback their opinions prior to and throughout the construction, operation and decommissioning period. Vulnerable groups should be represented in stakeholder activities. Allana should seek to use engagement in a culturally appropriate manner allowing individual stakeholder groups (e.g. women, the youth and the elderly etc.) to discuss issues together. Furthermore engagement should be designed taking into account the non-Afar groups in the area, and how their interests / concerns can also be represented.

Included within the stakeholder engagement process will be on-going plans to involve key local stakeholders in guided tours of the Allana constructions and

operations sites to demonstrate what the site looks like and the on-going processes.

- **Personnel and Stakeholder Feedback Mechanism**

Allana should implement a feedback mechanism for both Project stakeholders and their own workforce. The feedback mechanism for Project stakeholders should be aligned to and consistent with the stakeholder engagement programme Allana develops. The stakeholder feedback mechanism will allow stakeholders to feel that their concerns are being incorporated into the Project and taken on board, hopefully relieving concerns and reducing the perceived changes that a Project is causing.

Both feedback mechanisms will ensure that concerns raised are acknowledged and addressed in a timely, structured and culturally appropriate manner. All feedback received from stakeholders should be formally recorded. Key issues will be identified and responses generated and communicated back to stakeholders / employees. For Project stakeholders it will be important to ensure that the feedback mechanism is easily accessible to all local residents given the geographical distribution of communities and current lack of communication networks. Finally a monitoring system should be incorporated into both feedback mechanisms to track the concerns raised to date, and identify progress on addressing key issues raised.

- **Cultural Programmes**

Allana will assist in developing programmes that encourage and celebrate the Afar culture in the Study Area. This can include supporting / organising a series of cultural activities to help strengthen Afar culture and encourage the current social ties and networks that exist between households and villages. This may include the provision of presents, food, drink, and petrol during significant holidays, or the Allana Community Relations Team attending the majority of key festivities and celebrations to which they are invited. Other initiatives could include supporting projects / educational programmes at the local high school on Afar culture and identity aimed particularly at the youth, and collaboration with Berahale Woreda Sports and Cultural office in such programmes. In addition Allana could support the annual cultural festival and competition held at the regional level by sponsoring or collaborating with the regional Bureau of Culture and Tourism. Such support and the form in which it is provided should be discussed and agreed with communities involved, to ensure that it reflects their preferences and will be considered as part of their community development planning.

- **Partnership with Local Healthcare Services**

Allana should work closely with local healthcare services in monitoring changes in levels of community health and wellbeing related to the change in social identity. This could include supporting additional social welfare/ social worker positions in the area to assist people struggling with the transition.

Residual Impacts (Post-mitigation)

Changes and challenges to social and cultural cohesion often accompany a sudden in-migration of outsiders and the development of commercial industry in a previously isolated area. Responses to this change can vary dramatically from person to person and can change over time, meaning it is very difficult to develop 'blanket' mitigation measures.

However, with the Project's commitment to management of its workforce and contractors, combined with strategies to enhance people's ability to adapt to and accommodate change, and with suitable mitigation the extent, scale and frequency of this impact should result in a decrease in the magnitude.

Therefore the overall impact is of 'Minor Negative Significance' post mitigation.

Table 11.17 Rating of Residual Impacts Related to 'Sense of Place' and Cultural Cohesion (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The impact may be experienced by the majority of households in the Area of Influence, in particular community members who live in more isolated areas and do not interact with non-Afar groups.
Duration	Medium to Long-term	The duration of the impact is likely to occur over the medium to long term
Scale	Approximately 1,000 people	It is likely that there will be a reduction in the number of community members that are likely to be impacted due to the implementation of effective mitigation measures.
Frequency	Intermittent	The impact will be intermittent throughout the LoM.
Likelihood (for unplanned events only)	NA	
Magnitude		
Small		
Significant Rating After Mitigation		
Minor Negative Impact		
Minor		

11.5 COMMUNITY HEALTH, SAFETY AND SECURITY IMPACTS

This section will discuss impacts related to health, safety and security of potentially impacted communities.

11.5.1 *Decline in Health Profile due to Decreased Availability and /or Quality of Groundwater*

Background

Description of the Baseline Environment

Community access to both surface and groundwater resources are limited in the Study Area. Most of the communities reported frequent water shortages as a serious concern, and that existing water sources do not provide a consistent source of water.

Three of the seven villages visited had access to water via a communal water tap pumped from a borehole; however, the remaining villages access water through hand-dug wells or seasonal river channels usually located on the periphery of the village. It is believed that even those villages that have access to a borehole have only shallow access to groundwater resources.

For the majority of residents water is untreated and considerably saline and samples of groundwater taken by ERM indicate that it is below international drinking water standards.

Proposed Project Activities

Allana will require a substantial amount of groundwater for solution mining activities which will be abstracted from a series of boreholes. This is described in greater detail in *Section 11.3.3*. This abstraction of water may impact the availability of water for community users. This impact may be exacerbated by the cumulative effect of other potential solution mining Projects in the area which are anticipated to have similar water demands and land acquisition requirements.

This impact may also be exacerbated by in-migration into the area where demand and extraction of surface / groundwater resources and the increased chance for contamination of water sources may result from a greater number of users accessing an essentially unmanaged resource.

The Groundwater Impact Assessment (refer to *Chapter 10*) discusses the potential for water abstraction to result in the lowering of the local water table or the complete drying up of aquifers. It also mentions the potential for mixing of different quality waters within the aquifer as a consequence of abstraction; this would affect the quality of groundwater, potentially causing a decrease as the concentrations of major ions increase.

This impact is only anticipated to be experienced by the communities of Mororo and Alai Lai who currently depend on the same aquifer as that targeted for groundwater abstraction. The nature of the impact is not only directly related to the overall changes in the groundwater flow, but also how changes in flow may impact the availability of the groundwater resources to local communities and base-flow to the local rivers.

This impact does not consider potential contamination of surface water sources used for human consumption; this is considered in *Section 11.5.3*.

Sensitive Receptors

Lowering of the local water table, mixing of water qualities and the prevention of through flow may result in boreholes and wells drying up or decreasing in quality, directly impacting human health and potentially increasing malnutrition associated with failing pastoral / agricultural (palm) productivity. As referenced in the biological and groundwater impact assessment (refer to *Chapters 10*) there is currently some uncertainty regarding the potential groundwater impacts. Allana are developing a three dimensional groundwater flow model to help predict the extent and scale of the impact. If groundwater modelling and monitoring shows the lowering of the water table, mixing of water qualities, and the prevention of through-flow towards the salt plains, this will affect water supply to Mororo and Alai Lai and reduce access to water.

As a result household's access to water and sanitation facilities may be compromised, in addition to the ability of local healthcare services, already overstretched and inadequate, to effectively provide Water, Sanitation and Hygiene (WaSH) programmes. Therefore the prevalence of water and sanitation related diseases including diarrhoeal, parasitic and water washed diseases may increase ⁽¹⁾.

During baseline data collection it was clearly identified that mothers, women and children are more likely to suffer from malnutrition and water related diseases. This may leave them more vulnerable to this impact.

Children will have increased vulnerability due to their susceptibility to disease and the lack of a fully developed immune system. Due to cultural practices in Afar society women are accustomed to reserving more nutritious foods for men in the household, and usually eat last, after men and children have been served, leaving them vulnerable to this impact. The restricted diet and lack of necessary nutrients in a woman's diet results in frequent cases of malnutrition and other health complications.

The elderly will also be sensitive receptors due to their decreased immune-responsiveness to disease.

(1) WaterAid, 2012 - Water washed diseases are caused by water scarcity where people cannot wash themselves, their clothes or home regularly.

The planned resettlement of Mororo and Alai Lai will mean that they are moved away from the Allana concession area and will be provided with replacement infrastructure including replacement access to water. It is however anticipated that they will choose to live in a similar area nearby and may therefore still experience a reduction in water available from wells and boreholes (if provided by Allana) due to groundwater abstraction.

Significance of Impact (Pre-mitigation)

Based on the reasonable worst case scenario (drying up of community water sources in Mororo and Alai Lai) this impact has been assessed as a '**Major Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.18*.

Table 11.18 Rating of Impacts Related to Health Impact from Water (Pre-Mitigation)

Type of Impact		
	Negative	Indirect
Indirect Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by community members in the villages of Mororo and Alai Lai.
Duration	Permanent	Without mitigation and management measures the impact may cause a permanent change in the health profile.
Scale	Up to 1,000 people	This impact may be experienced by community members in villages of Mororo and Alai La (post-resettlement, dependent upon the provision of replacement infrastructure). This will be informed by on-going monitoring and modelling to inform if, for example, Hamad Ela, Badle and Fiea may be impacted.
Frequency	Continuous	The impact may occur continuously throughout the life of the Project and beyond (dependent upon the results of hydrogeological modelling and monitoring).
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
High	Vulnerability of receptors is dictated by the current prevalence of disease, particularly water related disease which is high. In addition the current health profile is extremely poor with inadequate access to health, water and sanitation facilities.	
Significant Rating Before Mitigation		
Negative Impact		Major Negative Impact
	Major	

This impact is anticipated to begin during the operations phase and continue into the decommissioning phase.

Recommendations and Mitigation/Management Measures

To avoid and reduce the significance of this impact all mitigation measures related to water resources (refer to *Chapter 10*) will help to manage this impact. These measures focus on avoiding, minimising and restoring the impact to groundwater; these will be based on further research to determine the likely scenario of groundwater abstraction and the appropriate response. These measures include:

- development of a comprehensive local and regional monitoring system to ensure that an early warning system provides a timely indication of the impact of abstraction;
- development and modelling of different abstraction strategies to minimise the impacts of water abstraction;
- the drilling of monitoring boreholes to monitor the effects of groundwater abstraction on community water supplies; and
- the assessment of the cumulative impact of groundwater abstraction by various mining companies.

In addition the following mitigation and management measures have been developed for adoption by the Project.

- **Resettlement of Alai Lai and Mororo – Provision of Replacement Water**

Due to potential impacts and health and safety concerns Allana will resettle Alai Lai and Mororo in line with relevant national and international standards (please refer to *Section 11.2.1* for details). This resettlement will include the provision of access to an improved quality of water than previously used. This will include, at a minimum of provision of water that meets the SANS Class II standard and efforts will be made to supply water that meets the SANS Class I standard.

- **Provision of Replacement Water Sources**

Based on the results of groundwater monitoring and the effect on community water sources (excluding those anticipated in Mororo and Alai Lai) Allana will develop suitable infrastructure to ensure supply of potable water to all potentially impacted communities should monitoring indicate that access / quality of water may be impacted. These water sources will provide water of a higher standard than previously occurring, based on the results of a hydro-census.

Based on the hydro-census and existing knowledge of the availability of ‘good quality’ potable water it is assumed that much of the potential groundwater is too saline to be used in replacement community wells and boreholes. Should this impact occur Allana will therefore commit to providing and maintaining

methods and infrastructure to treat replacement water sources so as to provide water of a higher standard than previously experienced. This will include, at a minimum of provision of water that meets the SANS Class II standard and efforts will be made to supply water that meets the SANS Class I standard.

The provision of infrastructure may include the construction of new replacement village wells / boreholes, solar powered pumps, and / or pipework¹. This will include the provision of an improvement in quality of water source for the communities of Alai Lai and Mororo at their resettlement site as part of the resettlement process.

- **Collaboration with Local Government / NGOs**

Hygiene and sanitation programmes are currently implemented through local government and NGOs operating in the area. As part of their Community development programme Allana will identify and collaborate with NGOs who are working on hygiene and sanitation projects in the Study Area. For instance the Red Cross have been involved in the building of community latrines and the construction of communal water taps.

Given the potential for increased transmission of water related diseases, Allana will collaborate with local health services to strengthen the delivery of the WaSH programme and expand its application across area potentially affected by its operations. Allana will work with the local healthcare services to conduct health education programmes on prevention of faecal / oral transmission of disease, in addition to treatment of drinking water. This would be part of their community development programme and should be implemented in collaboration with relevant and qualified partners.

- **Waste and Effluent Management**

Mitigation measures tailored to manage the creation of waste and effluent are included within the Waste Management Plan (refer to Volume III *Annex F*). This will include details surrounding how Allana will ensure the adequate provision for the collection, treatment and disposal of sewage from all site facilities. All waste will be separated on site and temporarily stored in separate waste storage facilities for hazardous and non-hazardous waste. These facilities will be designed in such a way so as to prevent contamination of waste products to the environment.

Allana will also develop and implement a monthly monitoring programme for sampling and analysis of effluent released from the facility site in accordance with national and international requirements. Where monitoring results indicate that community water sources may be impacted, Allana will promptly engage the community to explain the impact, isolate the

¹ Specific consideration should be given in the siting of wells / boreholes away from potential biological contamination from effluent or animals. Any replacement borehole must therefore be constructed upstream with a large exclusion area.

contaminated water sources, and provide a replacement water source of at least the same standard prior to the impact occurring.

- **Community Monitoring of Groundwater**

Allana will train a number of community members from potentially affected communities to understand the results from the groundwater monitoring process its staff will undertake periodically. These community members will then communicate this information to local communities so that they remain aware of any changes to groundwater over time. This approach will help to ‘demystify’ the use of and impacts to groundwater by Allana for local communities, and to may reduce the risk of unfounded community claims of groundwater impact.

Residual Impact (Post-mitigation)

On-going groundwater analysis means that the spatial extent and magnitude of potential impacts to groundwater resources is a continuing process that will be defined based on on-going hydrogeological modelling and monitoring. Should this process show that community water sources may be impacted and Allana provide a suitable potable water replacement of an acceptable and improved standard, this may cause a residual positive impact, improving access to clean water with an improvement in health profile.

Therefore with suitable implementation of avoidance, mitigation and compensation / offset measures the residual rating of this impact would be positive.

Table 11.19 *Rating of Residual Impact Related to Health Impact from Water (Post-Mitigation)*

Type of Impact	
Positive	Direct
Direct Positive Impact	
The construction of replacement water sources of a higher quality than existing water sources would mean that receptors would experience a positive impact.	

11.5.2 *Increase in Vector Borne and Communicable Disease*

Background

Description of the Baseline Environment

The current health profile of Social Study Area is extremely poor and is a reflection of the current status of healthcare infrastructure and services as well as widespread poverty. Of the major causes of morbidity and mortality in the Woreda 70 to 80% are preventable diseases ⁽¹⁾ that are predominantly caused

(1) Afar Regional Bureau of Health, 2011

by the lack of infrastructure and services, including unsafe water supply, poor hygiene and sanitation and lack of vaccines for preventable diseases.

The current leading communicable diseases in Berahale Woreda are HIV/AIDS, STIs, TB, malaria, respiratory diseases and diarrhoeal diseases ⁽¹⁾.

Healthcare professionals from Berahale, interviewed in June 2012, indicated that they have seen an increasing number of STI cases reported at local Health Centres over the past two years, although quantified information to back up these claims at a local level was not available. Healthcare professionals reported anecdotally that they believed this increase was related to the increased in-migration of people into the area driven by the presence of mining companies and construction workers associated with the government road.

Proposed Project Activities

The introduction and expansion of the Allana workforce is likely to result in regular interaction with local people, particularly in Berahale (as a popular stop-off point on the journey from camp to Mekele) and Hamad Ela, Ambule and Asabolo (due to its close proximity to the Allana Camp). Community-workforce interactions in the mining sector have a history of frequently including the use of sex workers by a predominantly male remote and isolated workforce. Due to the prevalence of STIs in Ethiopia, and by proxy in the Social AoI, this may cause and increase to STI related vector borne and communicable diseases. This may be worsened by the number of vehicle movements and drivers required for the proposed Project.

In the event of an outbreak of an airborne (e.g. tuberculosis) or food-borne illness among the workers, the home villages of the local workers, and any settlement visited by Project workforce may also become susceptible to these infectious diseases.

In addition to increases related to direct interactions with the workforce, increasing population densities and crowded conditions related to in-migration, particularly in the absence of adequate sanitation, will be likely to increase the incidence of infectious disease.

The in-migration of opportunistic job seekers, combined with the increase in Project workforce may also result in an increase of sex workers. Sex workers in the Study Area have to date typically come from 'highland' areas, a trend which is expected to continue due to Afar cultural restrictions, and are expected to become more prevalent, potentially increasing the prevalence of risky health behaviour and STDs in the Study Area.

Although the Study Area largely lacks permanent non-saline water bodies, and does not experience rainfall, malaria has been reported as a common

(1) Afar Regional Bureau of Health, 2011

disease in the Woreda, with prevalence evidently higher closer to water bodies such as the Sabah and Hamad Ela River and during the wet season. The incidence of malaria may increase, particularly during construction activities due to the creation of temporary water pools that may provide breeding grounds for the *Plasmodium* parasite.

Sensitive Receptors

As identified in Section 11.5.1 mothers, women, children and the elderly are most susceptible to diseases due to a range of factors including restricted access to food, inadequate vaccination coverage and immunodeficiency.

Based on the information gathered during the baseline it is also evident that the populations in Hamad Ela and Berahale (and to a lesser extent Ambule and Asabolo) are more likely to be susceptible to the impact due to the higher potential for in-migration, potentially leading to higher population densities. It should however be noted that larger populations in these settlements may mean that they are more likely to be targeted for Government health improvements, allowing them to increase their adaptability and leaving them more equipped to respond to and manage any challenges. The relative isolation of villages along the main Mekele to Hamad Ela road could exacerbate the impacts of increased rates of infectious diseases.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Major Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in Table 11.20.

The magnitude has been assessed as medium based on the impact being recurrent in nature and having a long-term impact i.e. over the lifecycle of the proposed Project. Although in some cases dependent on the disease the impact may be permanent. The scale of the impact is currently limited by low population densities in the majority of villages.

The sensitivity of receptors has been identified to be high due to the poor quality and limited availability of healthcare services in the area. Local residents have restricted ability to address any health issues they currently face due to the low availability of healthcare services, low levels of income and general health awareness.

Table 11.20 *Rating of Impacts Related to Vector Borne and Communicable Disease (Pre-Mitigation)*

Type of Impact		
	Negative	Induced
Induced Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning

Extent	Local	This impact may be experienced by community members across the Study Area, and in particular the villages of Hamad Ela and Berahale and potentially those villages close to the planned staff village such as Ambule and Asabolo.
Duration	Long-term	Without mitigation and management measures the impact may occur throughout the LoM.
Scale	Up to 7,000 (currently)	This impact is more likely to be experienced by residents in the larger settlements including Hamad Ela and Berahale. However the scale of people affected is also dependent on the transmission characteristics of the communicable disease, and the rate at which people migrate in and out of the Study Area.
Frequency	Recurrent	The incidence of communicable disease is likely to recur in the absence of mitigation and monitoring measures.
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
High	Vulnerability of receptors is dictated by the current prevalence of disease, and the health status of receptors. The prevalence of communicable diseases such as malaria and TB are common in the Study Area, however the incidence rate is limited by low population densities in the majority of villages. The health status of residents is currently very low.	
Significant Rating Before Mitigation		
Negative Impact		Major Negative Impact
		Major

The causes of this impact are anticipated to begin during the construction phase as the Project workforce increases and in-migration begins to occur. It is anticipated to continue, if unmitigated, into the operations and decommissioning phase.

Recommendations and Mitigation/Management Measures

Mitigation and management measures have been developed for adoption by Allana and third party contractors. These will be supplemented by mitigation measures for other impacts such as a worker code of conduct which will reduce worker-community interactions (refer to Section 11.4.1), and workforce accommodation standards ('closed camp') which will reduce the likelihood of infectious diseases spreading amongst the workforce (refer to Section 11.9.2). In addition all mitigation measures intended to reduce in-migration will also help to avoid this impact.

- **Collaboration with Local Healthcare Services**

To reduce the risk of an increase in communicable diseases Allana will work with the local healthcare services. This could include providing support in the following areas:

- Strengthening local educational programmes that are ‘women and youth friendly’, focusing on the control of STIs and particularly HIV / AIDs;
- Providing support to Health Extension Workers and community volunteers for educational programmes focusing on the mitigation and control of malaria;
- Providing support to the local Health Office investing into Health Centres and procuring and distributing Long-Lasting Insecticide-Treated Nets (LLITNs); and
- Providing educational programmes to communities on basic control measures against communicable diseases.

This support will be delivered as part of Allana’s community development program and should be planned in collaboration with suitable and trained partner organisations.

- **HIV Workplace Policy and Programme**

Allana will develop and implement a sustainable and consistent workplace policy and programme for the Project on HIV prevention among all workers and their families, and mitigation of HIV impacts via voluntary testing, care, counselling and support of workers living with the disease.

The HIV Workplace Policy should focus on the following principles:

- Ensure company ownership and sustainability of the HIV/AIDS workplace programme;
- Support HIV/AIDS prevention, non-discrimination, care and support, primarily focused on workers, but also on their families and their communities;
- Monitoring and evaluation of policy;
- Provide a clear statement about non-discrimination, in particular non-discrimination based on HIV and on gender; and
- Establish procedures for addressing HIV/AIDS issues in the workplace, in particular:
 - Implementation of a voluntary testing programme to enable and encourage staff to be confidentially tested for HIV. This should not involve HIV screening of job applicants;

- Ensure strict confidentiality related to HIV testing and HIV status of workers;
- No dismissal of workers due to HIV;
- Prevention and protection of workers living with HIV against harassment;
- Provide education and awareness raising services to workers including the provision of condoms; and
- Provide support and counselling for workers and their families living with HIV.

- **Worker Health Screenings and Monitoring**

Allana will conduct 'fitness for work' screenings of workers and contractors pre-employment to assess the health of all personnel to be hired including specific consideration of communicable diseases that could be passed onto other workers. No worker will be denied employment on the basis of the disease testing (as long as they are fit to work), but will need to commence treatment and be non-infectious before taking up their post. Pre-placement and periodic medical examinations will be conducted at Allana nominated medical clinic, where medical examinations can be performed to the standards as specified by Allana medical staff's requirements. Allana will assume all costs associated with the pre-contract medical check-ups; and ensure that examining physicians will obtain employee permission as appropriate before conducting tests which require such permission (e.g., HIV, STD).

Once employed Allana will provide a regular voluntary Worker Medical Screening Program onsite, while ensuring the protection of employee rights and confidentiality. Alongside this Allana should develop a Monitoring and Evaluation (M&E) system to monitor any cases that arise.

Allana will adhere to food hygiene standards and encourage the early reporting of illness amongst food handlers. In addition those hired to work as food handlers will be subject to medical screening on a routine basis (e.g., semi-annual medical exams); however, the results of this will not affect their ability to work, and will be used to identify workers in need of medical treatment.

- **Employee Health Training**

Allana will develop a specific worker health and safety induction and (continuous) training programme. This will include specifics on basic hygiene, sexual health, etc. Allana will make free condoms available within worker accommodation and in suitable locations such as washing or recreational facilities.

- **Employee Recreational Facilities**

In order to reduce the number of employees seeking recreational activities in local villages Allana will set up suitable and culturally appropriate recreational activities at the staff village. This may potentially include an employee café-bar, a gym, a volleyball facility, a games room and a television or film room.

- **Risk Communication Planning**

As part of an Emergency Response Plan (ERP, refer to Volume III *Annex C*), Allana will establish appropriate communication systems with local and regional health facilities (e.g., local Health Clinic and Mekele Hospital) and leaders of potentially affected communities as part of an update to emergency response plans, in the rare event of an outbreak of infectious disease (e.g., malaria, TB, food-borne illness) either at the mine site or in the surrounding villages. The Emergency Response Plan should set out clear actions to be taken in such an event by each party involved, and these actions should be discussed and developed with the explicit input of all health facilities and relevant community leaders. The ERP will establish the required engagement criteria to inform local communities of recognised risks and management measures.

Residual Impact (Post-mitigation)

Assuming the effective application of these mitigation measures the significance of the negative impact is assessed as '**Minor Negative Impact**'. This reduction in significance results from the reduction of the magnitude from medium to small largely based on the frequency at which the impact occurs.

Table 11.21 Rating of Residual Impact Related to Vector Borne and Communicable Disease (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by community members across the Study Area, and in particular the villages of Hamad Ela and Berahale.
Duration	Mid-term	With mitigation measures implemented receptors are more likely to be affected by the impact for a shorter period of time; however, this is dependent on the nature of the communicable disease.
Scale	Up to 7,000 (currently)	This impact is more likely to be experienced by residents in the larger settlements including Hamad Ela and Berahale. However the scale of people affected is also dependent on the transmission characteristics of the communicable disease, and the rate at which people migrate in and out of the area.
Frequency	Rare	The incidence of communicable disease is likely to decrease and occur only rarely.
Likelihood (for unplanned events only)	N/A	
Magnitude		
Small		
Small Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		
Minor		

*Background*Description of the Baseline Environment

As stated in Section 11.5.2 the health profile in the Social Study Area is poor and is a reflection of the current status of healthcare infrastructure and services as well as widespread poverty.

Background levels of dust (PM₁₀ and PM_{2.5} etc.) are high and the associated respiratory illnesses are also high.

Proposed Project Activities

Starting from construction and throughout the LoM Project activities that may be potential sources of environmental health hazards to communities may include:

- Potential for accidental spillage of hazardous materials such as fuel (heavy fuel oil or diesel), lubricants, sewerage etc. along transport routes or at proposed infrastructure;
- Improper management and disposal of hazardous materials during construction, operation and closure of the mine that could result in water resource contamination;
- Vehicles crossing the Sabah / Hamad Ela River and introducing contamination / pollution;
- Land-disturbing activities that may result in increased dust emissions; and
- Project related traffic along the Transport Corridor that may be sources of fugitive dust emissions and combustion emissions leading to higher levels of air pollution.

The pathways of exposure for communities to potential environmental health hazards related to the proposed Project may include:

- Direct contact with hazardous materials in the event of an accident / spill occurring;
- Direct contact with hazardous materials in the event that an accident occurs on one of Allana's proposed transport routes;
- Contact with water that may be polluted, particularly for residents that are located downstream of the Hamad Ela / Sabah River and use the water resource as bathing / drinking water; and
- Potential inhalation of fugitive dusts and combustion emissions among communities nearest to the transport or mining infrastructure associated with the proposed mine.

Sensitive Receptors

Sensitive receptors to this impact may include communities located in close proximity to transport or mining infrastructure associated with the proposed mine. This currently includes Hamad Ela, Mororo and Alai Lai. These villages will be more susceptible to any contamination of air and water resources that may occur. Sensitive receptors may also include those living downstream to crossing points over the Hamad Ela or Sabah Rivers (Ambule, Hamad Ela and Fiea).

Communities living and travelling along the current road will also be particularly sensitive to any accidents. In addition these community members will be more susceptible to fugitive emissions.

Any existing community members who suffer from ill health or respiratory illness will be at greater risk to negative health effects from exposure to fugitive dust emissions.

Significance of Impact (Pre-mitigation)

The impact is assessed as an unplanned event and therefore the likelihood of the impact occurring is factored into the determination of the magnitude of the impact.

The assessment of the likelihood-factored magnitude identifies that in the absence of mitigation measures the impact is likely because:

- It is possible for accidents involving the transportation of hazardous materials to occur. This is based on the frequency at which Allana will need to transport such materials. In addition villages are situated along the main road, with several respondents indicating that the number of villages relocating to be closer to the road will increase.
- Impacts to air quality (i.e., increase in fugitive dusts and combustion emissions) are certain.
- Potential contamination of ground / surface water is possible.

The sensitivity of receptors has been identified to be high due to the poor health status of the majority of residents in the area. In addition access to healthcare is limited in the event that the impact does occur.

The impact has been assessed as a '**Major Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.22*.

Table 11.22 Rating of Impacts Related to Spills Emissions and Contamination (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by community members in close proximity to the proposed Project
Duration	Permanent	Without mitigation and management measures the impact may cause a permanent change in the health profile.
Scale	Up to 3,000 people	This impact may be experienced by community members in villages of Ambule, Fiea Hamad Ela, Mororo and Alai Lai.
Frequency	Intermittent	This impact would only intermittently occur
Likelihood (for unplanned events only)	Likely	Air emissions are certain, contamination and spillage are possible
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
High	Vulnerability of receptors is dictated by their current health status which is poor. In addition receptors' ability to access healthcare services in the event of the impact occurring is largely restricted.	
Significant Rating Before Mitigation		
	Negative Impact	Major Negative Impact
	Major	

This impact is anticipated to begin during the construction phase when materials are transported however will be at its most significant during the operations phases

Recommendation and Mitigation/Management Measures

To avoid and reduce the significance of this impact all mitigation measures related to water resources, waste management and air quality will help to manage this impact (refer to Spill Prevention Control and Contamination Plan and Emergency Response Plan in Volume III Annexes E and C). Specifically in relation to discharge of pollutants into the surface water this includes:

- Prohibition of washing vehicles in streams and rivers;
- Zero discharge of raw untreated sewage to the environment; and
- Operation of a vehicle washing facility and the delivery of appropriate training to Allana workforce.

In addition the following mitigation and management measures have been developed for adoption by the Project.

- **Safe Transport of Hazardous Materials**

Allana will develop and implement procedures that ensure compliance with national laws and international requirements applicable to the transport of hazardous materials. The procedures for transportation of hazardous materials, at a minimum, will include:

- Ensuring that the volume, nature, integrity and protection of packaging and containers used for transportation are appropriate for the type and quantity of hazardous material and modes of transportation involved;
- Ensuring adequate transportation vehicle specifications;
- Training employees involved in the transportation of hazardous materials regarding proper shipping procedures and emergency procedures; and
- Providing the necessary means for emergency response as part of the Emergency Response Plan (refer to Volume III *Annex C*).

- **Risk Communication Planning**

As part of the risk communication planning, collaborate with the identified local Health Clinics, Health Offices, and local community leaders in developing and adopting emergency procedures that may require their participation in responding to emergency situations that can impact community health and safety, such as an accidental spill of hazardous materials along the transportation corridor.

In the event of such an emergency, immediately notify nearby communities directly and through the community partners on the appropriate protective precautions to take to reduce exposure to these hazards.

- **Closure Planning**

During the operations phase the Project will develop and adhere to an Integrated Mine Closure Plan (refer to Volume III *Annex D*) taking into account community health and safety. The closure plan will include requirements that:

- All disturbed areas will be rehabilitated to natural conditions as much as possible;
- All buildings and facilities will be completely removed (including the foundations), unless specified otherwise by the government; and /or in agreement with the local communities; and

- Post-closure monitoring of groundwater, surface water and rehabilitation will be required.
- **Protection of Water Resources**

The following measures will be undertaken to ensure protection of water (ground and surface) resources:

- Ensure proper placement of soil stockpiles to reduce exposure of sediment-generating materials to wind or water;
- Reduce or prevent off-site sediment transport using appropriate methods such as effective site drainage, and sediment/silt trapping mechanisms;
- Any hydrocarbons, fuels, lubricants and chemicals to be used will be stored in bunded and lockable oil storage tanks, with hoses and gauges kept within the bund; and
- Regular checking and maintenance of all plant and machinery to minimise the risk of fuel or lubricant leakages.
- **Training of Allana Personnel**

All of Allana’s personnel will receive training on basic hygiene and sanitation so as to prevent further occurrence and transmission of disease. Allana will provide training to relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques.

Residual Impact (Post-mitigation)

Assuming the effective application of these mitigation and management measures the significance of the potential negative impacts is assessed as **‘Moderate Negative Impact’**.

Table 11.23 Rating of Residual Impact Related to Spills Emissions and Contamination (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by community members in close proximity to the proposed Project.
Duration	Short Term	Without mitigation and management measures the impact may cause a short term change in the health profile.
Scale	Up to 3,000 people	This impact may be experienced by community members in villages of Ambule, Fiea, Hamad Ela, Mororo and Alai Lai (in their post-resettlement locations).
Frequency	Rare	This impact would only rarely occur.
Likelihood (for unplanned events only)	Unlikely	Air emissions are certain, contamination and spillage are possible
Magnitude		
		Small
Small Magnitude		

11.5.4 *Increased Injuries and Mortality from Traffic Accidents*

Background

Description of the Baseline Environment

The Study Area is relatively rural and isolated in nature with only one major road passing through the Study Area. The number of vehicles, including heavy trucks, along the current road is reported to be increasing in part due to the construction of the new Government built road from Mekele to Bada and to the increased mining-related activity in the area. Historically traffic along this route is reported to have been extremely low. Commercial busses provide weekly transportation for goods and people between Berahale and Mekele and between Berahale and Hamad Ela.

Local communities tend to travel on foot and only 31.3% of respondents to the household survey indicated that they rely on motorised transport, although it should be noted that qualitative data indicated this is probably related to hitch-hiking and bus services, with vehicle ownership believed to be very low. 67% of respondents to the household survey indicated that walking is their principle mode of transport.

Between the salt flats and Berahale, goods, particularly salt are transported by camel seasonally, typically between August and May. The camel route does not align completely with the road although camel trains are occasionally seen using the road network. This is believed to be against an unofficial set of agreed rules developed by local communities, the salt buying and selling organisation and the Woreda Government to prevent the road network from being congested. Road traffic safety measures including road markings, signage and speed limits do not currently exist and there is no policing of driver behaviour.

Communities have reported that there has been a rise in the number of traffic accidents occurring in the area, although there is no data available in this regard. Settlements along the road felt that drivers were driving very fast on the main road which made people feel unsafe. Given the previously rural nature of the road, communities are not accustomed to high levels of traffic in the area, and have not been exposed to common road safety measures, thus increasing their vulnerability to road traffic accidents.

Proposed Project Activities

During the construction phase Allana will require the movement of vehicles from a Port in Djibouti as well as from within Ethiopia to site in order to

provide materials and supplies for the construction of the Project. Based on preliminary assumptions this is believed to include delivery of:

- Approximately 70 forty tonne trucks to be used for potash transport to arrive from Djibouti;
- Approximately eight trucks to carrying supplies and materials for the fuel plant to arrive from Djibouti;
- Approximately five trucks carrying 25 to 30 tonne loads to deliver drill pipes, casing and pipework to the area for solution mining;
- Approximately three new drill rigs;
- Approximately four 50 tonne cranes; and
- Approximately four fork-lift vehicles.

Vehicles for the construction phase will travel to the proposed Project site on existing (or in-construction) roads, including the new Government road from Mekele to Bada.

During operations the traffic involved to operate the proposed Project is believed to include:

- Approximately four buses daily (on a return journey) between the camp and the processing plant; and
- Approximately eight light pick-up trucks to provide transport around the area for solution mining daily.
- Approximately 200-300 trucks transporting potash product from the proposed Project to the Port of Tadjoura in Djibouti.

In addition, the proposed Project will require the delivery of goods to upkeep camp and provide supplies. It is unclear the number of vehicle movements required to provide these goods. It is likely that traffic will travel to site through Mekele, Berhale and to the camp along the Government road that is in construction.

Peak traffic around the Proposed Project will be during shift changes which are planned to be at midnight, eight o'clock in the morning and four o'clock in the afternoon. Drivers are currently planned to work on twelve hour shifts.

Based on comparable mining and infrastructure developments in rural areas, it is considered to be likely that as the condition of roads improves (the road between the Project area and Berahale is currently unpaved) road users may exploit this resulting in an increase in unsafe driving practices, including speeding.

Allana plan to construct a Haul Road that could also be used to receive equipment and deliveries as well as export potash. This route is planned to travel south from site through the Depression to Serdo, Afdera and into Djibouti and onto the Tadjoura Port (on existing roads). This impact assessment does not consider vehicle movements associated with the transport of potash away from the site or the construction of any new Haul Road as the planned infrastructure and receiving environments are not clear, but does include the delivery of all construction material and all other vehicle movements associated with the operation of the proposed Project.

Sensitive Receptors

Increased vehicle traffic, including truck traffic operated by Allana and third party contractors and traffic related to increasing population due to immigration, increases the risk of accidents and injuries; this will particularly be the case if informal traders increase their presence around key junctions and along the road side.

Accidents involving livestock may also increase and as livestock are a form of savings for many households in the area, any loss of livestock will impact on household income and status.

Receptor sensitivity to this impact is related to the absence of emergency and medical services and the lack of familiarity in the area with industrial vehicle transportation (particularly of children). In addition those households reliant on livestock for income and subsistence may be vulnerable to this impact if accidents occur involving livestock.

Significance of Impact (Pre-mitigation)

The impact has been assessed as a '**Major Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.24*.

Table 11.24 Rating of Impacts Related to Traffic Accidents (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Regional	This impact may be experienced by stakeholders using the road network between Mekele and the camp and between the camp and the Tadjoura Port in Djibouti.
Duration	Long Term	Without mitigation and management measures the impact may continue for the duration of the proposed Project.
Scale	Up to 30,000 people	The impact may be experienced by community members throughout the Social AoI.
Frequency	Constant	This impact would be constant as vehicle movements would be over twenty four hours daily.

Likelihood (for unplanned events only)	N/A	
Magnitude		
		Large
Large Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
High	Sensitive receptors to this impact include the residents of all settlements along the road, in particular those who walk along the road including herders, women and children fetching water and in some area salt trade transporters. Sensitivity is high due to the lack of emergency medical services in the area, and the lack of formal paths / routes in the area for pedestrians.	
Significant Rating Before Mitigation		
Positive / Negative Impact		Major Negative Impact
		Major

This impact is likely to occur during construction phase and material is transported to the Project and traffic related to the Project increases and will continue in the operations and decommissioning phase.

Recommendations and Mitigation/Management Measures

To avoid and reduce the significance of this impact all mitigation measures related to traffic management will be relevant. A Community Feedback Mechanism (discussed in *Chapter 7*) will allow members of the community to provide comments to Allana on driving practices and to make grievances and compensation claims related to accidents involving livestock, should these occur). In addition the following mitigation and management measures have been developed for adoption by the Project.

- **Transport Route Environmental and Social Screening**

Allana will conduct a screening exercise to identify potential environmental social, health and cultural heritage risks and impacts from the planned haul road from the Dallol Project site to the Tadjoura Port in Djibouti. The objective of the assessment is to inform the ‘optioneering,’ design and route alignment so as to avoid or reduce these risks and impacts. This screening will be the preliminary stages of an impact assessment process for the Haul Road construction and operation.

- **Traffic Management Plan**

Allana will develop, implement and monitor a Traffic Management Plan based on an assessment of the potential export routes from the proposed Project site to Djibouti. This plan will identify the key traffic-related accident hotspots or high risk areas (e.g. key road crossings with the transportation road) and proposed locally-relevant and effective protective measures.

- **Vehicle Monitoring**

Allana will implement a monitoring system to record vehicle speeds through GIS equipment installed in vehicles and will limit the top speed of trucks according to safe maximums.

- **Community Awareness and Coordination on Public Safety**

Prior to the start of commencement of construction and use of any access / haul roads Allana will conduct community consultations to identify potential high risk areas (areas commonly frequented by locals) in order to integrate these into construction hazard analysis. Before conducting any activities that will increase Project traffic, Allana will inform communities regarding which areas will be partially inaccessible due to construction activities and present relevant safety signage and advice. In addition communities identified as high risk from traffic accidents will be involved in Allana traffic management capacity development, potentially in partnership with relevant partners.

Allana will engage with communities along the transport routes to raise awareness on road safety and accident prevention. In addition, Allana will identify regional/national emergency services and discuss potential coordination needs to ensure first aid and emergency medical response is provided in the event of accidents.

- **Contractor's Health and Safety Management**

Allana will ensure hauling operations and road construction contractors adopt and implement measures for all workers to consider public safety and worker safety such as:

- Ensure Project work sites and areas are clearly marked with appropriate signage and barricades (particularly if work activities extend through the evenings);
- Agree traffic safety standards and operating procedures; and
- Promote safety culture at work, particularly among workers with limited prior health and safety awareness to reduce risk of accidents and injuries associated with construction activities.

- **Driver Policy and Training**

Allana will develop a safe driving test for all Allana employees who will need to operate a vehicle. Employ the following policy for all drivers and contractors:

- Adopt a policy on driving safety practices (speed limits, decreasing speed in communities, safe driving hours etc.);

- Adopt a policy where drivers and contractors will not stop for unplanned/unauthorised breaks on the journey; and
- Develop worker fatigue and stress management program for long haul truck drivers.

Residual Impact (Post-mitigation)

Assuming the effective application of these mitigation and management measures the significance of the potential negative impacts is assessed as a '**Moderate Negative Impact**' due to a reduction in magnitude and vulnerability.

Table 11.25 Rating of Residual Impact Related to Traffic Accidents (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Regional	This impact may be experienced by stakeholders using the road network between Mekele and the camp and between the camp and the Tadjoura Port in Djibouti.
Duration	Long Term	Without mitigation and management measures the impact may continue for the duration of the proposed Project.
Scale	Up to 30,000 people	The impact may be experienced by community members throughout the Social AoI.
Frequency	Rare	Traffic control measures will reduce the frequency of accidents
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Medium
Medium Magnitude		
Significant Rating After Mitigation		
Moderate Impact		
		Moderate

11.5.5 Increased Intra and Inter Community Competition and Conflict

Background

Description of the Baseline Environment

The villages within the Social Study Area are mainly Afar with Berahale and Hamad Ela showing smaller populations of Tigreans and Amhara. Historically there have been ethnic tensions between the Afar and other Ethiopian groups from the highlands. Many non-Afar Ethiopians that have moved in from the highlands work as government authorities and service-providers. Others migrate seasonally and work as salt diggers and transporters. Anecdotal evidence gathered during the baseline data collection has indicated that the Afar in the Study Area accept the in-migration of 'highlanders' to fill Government positions or the seasonal in-migration to act as diggers / transporters within the salt trade. However, it became clear

during engagement that the Afar possess a strong socio-cultural perception of what is acceptable social behaviour and attribute much of the 'socially unacceptable behaviours' (substance abuse, sex work etc.) to the presence of outsiders. These socially unacceptable behaviours may be related to the widespread prevalence of the Islamic religion which accounted for 97.6% of the respondents of the household survey.

Although there is clearly some tension between Afar groups and highlanders to date, it does not appear that this has manifested in significant competition and conflict. Currently conflict between the Afar communities within the Social Study Area was not mentioned as an on-going issue; however, it was recorded that the settlements of Alai Lai and Mororo moved from Hamad Ela due to a desire to maintain a degree of separation in their settlements.

Proposed Project Activities

The proposed Project has the potential to attract an in-migration of opportunistic job seekers into the area in addition to migrants hired to provide services and act as Allana workforce. This in-migration has the potential to create social tensions over resources and social conduct, potentially causing increased intra and inter community conflict.

Currently it is anticipated that approximately 442 personnel will be required at peak construction and approximately 1,000 personnel will be required for management and maintenance during operations (not including vehicle drivers). The workforce will comprise a mixture of unskilled, semi-skilled and skilled employees, although due to a lack of skills and experience in the area it is anticipated that local employees will largely make up unskilled positions. Tensions and conflict surrounding the hiring of non-local Ethiopians is already in existence and this may increase as hiring increase in the construction and operation phases if it is perceived that non-locals are receiving a disproportionate percentage of employment or benefits from Allana. This may result in a degree of backlash by Afar locals to non-Afar migrants and Allana.

Other potential impacts such as the decreased social and cultural cohesion, the erosion of the traditional governance system and the loss of 'sense of place' (refer to *Sections 11.4.1* and *11.4.2*) may further weaken the social bonds promoting greater likelihood for conflict and tension.

Sensitive Receptors

In-migration and inadequate planning of hiring and recruitment processes may result in increased competition and conflict generally and over of natural resources.

The settlement of Hamad Ela and Berahale are highlighted within the In-migration Risk Assessment (IMRA) as a high probability and medium-to-high social risk area for potential in-migration, primarily due to the potential for the majority of in-migration and conflict over claims to land and property.

In addition sensitive receptors may include members of communities who are considered to be vulnerable, have a limited 'voice' (such as women or the youth) who may be less able to cope with increased conflict and competition.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Major Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.26*.

The magnitude of the impact has been evaluated to be medium based on the potential for it to be intermittently experienced at a local extent by communities in proximity to proposed Project infrastructure.

The vulnerability of receptors has been evaluated to be high because of a potentially weakened governance structure, the association of Afar cultural identity with social practices (that may change) and the absence of effective policing capacity in many of the affected areas.

Table 11.26 *Rating of Impact Related to Increased Competition and Conflict (Pre-Mitigation)*

Type of Impact		
	Negative	Indirect
Indirect Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in communities that experience substantial amounts of in-migration, without the governance, service and resources to cope. This may include Hamad Ela, Berahale and to a lesser extent communities along the road network from Berahale to the area proposed for the siting of the Project such as Ambule.
Duration	Long Term	Without mitigation and management measures impact may continue for at least the duration of the proposed Project.
Scale	Up to 1,000 people	The impact may be experienced by community members in the settlements of Hamad Ela and to a lesser extent communities along the road network from Berahale to the Project such as Ambule.
Frequency	Intermittent	This impact may occur where resources are in competition or when local residents clash with in-migrants causing flare-ups in competition and conflict.
Likelihood (for unplanned events only)	N/A	
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
	Vulnerability of receptors is dictated by the weakened governance structure, the association of Afar cultural identity with social practices	

High	and the absence of effective policing capacity in many of the affected area.
Significant Rating Before Mitigation	
Negative Impact	Major Negative Impact
Major	

The causes of this impact are anticipated to begin during the construction phase continuing during the operations and decommissioning phase.

Recommendations and Mitigation/Management Measures

All mitigation measures related to helping reduce, avoid or manage potential in-migration, and helping to protect Afar identity in impacted communities will be relevant to this impact, reducing the potential causes of conflict. This will include promoting transparent hiring techniques and a sourcing and procurement policy that plans hiring in a way that may limit in-migration and promoting Afar culture (refer to Sections 11.3.1). In addition to avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by the Project.

- **Monitoring of In-Migration**

Allana will establish an in-migration monitoring programme that establishes a precedent for quantitative and qualitative monitoring of the level and consequences of in-migration. This may include population and socio-economic surveys.

- **Stakeholder Consultation - In-Migration Concerns**

Allana will establish a programme of engagement with local Afar communities to allow them an opportunity to raise their concerns and identify potential solutions to in-migration and labour recruitment related issues. The feedback mechanism, discussed in Section 11.4.2, and stakeholder engagement forums will be particularly relevant allowing communities and opportunity to raise issue before they increase.

- **Support Integrated Youth Programmes**

Allana will work with local leaders and community groups to support integrated youth programmes related to sport, arts and culture seeking to build bonds and coordination between different ethnic groups as part of their Community Development Plan. This may involve partnership with relevant organisations.

- **Promote Conflict Resolution Programmes**

Allana will work with the traditional governance network and the relevant Kebele or Woreda government to promote conflict resolution programmes through a consultation process, including sponsoring discussion between different communities where necessary.

Residual Impact (Post-mitigation)

With suitable avoidance and mitigation the frequency, scale and duration of this impact is likely to decrease resulting in the assessment of the impact as a '**Moderate Negative Impact**'.

Table 11.27 Rating of Residual Impact Related to Increased Competition and Conflict (Post-mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in communities that experience substantial amounts of in-migration, without the governance, service and resources to cope.
Duration	Long Term	Without mitigation and management measures impact may continue for the duration of the Project.
Scale	Up to 1,000 people	The impact may be experienced by community members in the settlements of Hamad Ela and to a lesser extent communities along the road network from Berahale to the Project such as Ambule.
Frequency	Rare	This impact may occur where resources are in competition or when local residents clash with in-migrants causing flare-ups in competition and conflict.
Likelihood (for unplanned events only)	N/A	

Magnitude	
	Small

Small Magnitude	

Significant Rating After Mitigation	
	Moderate

11.5.6 Increased Marginalisation of Vulnerable and Sensitive Groups

Background

Description of the Baseline Environment

The Social Baseline (Chapter 9) discusses potentially vulnerable groups including:

- Women / female headed-households;
- Sex workers;
- The elderly;
- Children;
- People with physical / mental health illnesses and disabilities;

- Households dependent on artisanal salt miners;
- Households reliant on livestock; and
- Internally displaced persons.

Vulnerability of receptors to social impacts is understood as a reflection of the absence of an ability to adapt to socio-economic/cultural or biophysical change or a pre-existing sensitive, vulnerable or marginalised status that is independent of the proposed Project.

Proposed Project Activities

Continued engagement by Allana and the Government of Ethiopia with the traditional governance, without regard for existing marginalised groups who are isolated from decision making processes, may also exacerbate the vulnerability and marginalisation experienced by certain groups as decisions are made without their input.

Sensitive Receptors

The exclusion of marginalised groups from significant engagement activities within the Study Area and the planned development processes may result in the increase in vulnerability of these receptors, exacerbating their marginalised status.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Moderate Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.28*.

The magnitude of the impact has been evaluated to be small based on the potential for it to be intermittently experienced at a local extent.

The vulnerability of receptors has been evaluated to be high because the impact will be experienced specifically by groups that are already marginalised from decision making and input.

Table 11.28 Rating of Impact Related to Increased Marginalisation (Pre-Mitigation)

Type of Impact		
	Negative	Indirect
Indirect Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by marginalised or vulnerable groups living in communities within the Study Area.
Duration	Long Term	Without mitigation and management measures impact may continue for the duration of the proposed Project.
Scale	Small numbers	The impact may be experienced by existing marginalised groups.
Frequency	Intermittent	This impact may occur where resources are in competition or where local residents clash with in-migrants.

Likelihood (for unplanned events only)	N/A	
---	-----	--

Magnitude	
	Small

Small Magnitude	
Sensitivity/Vulnerability/Importance of the Resource/Receptor	

Designation	Summary of Reasoning
High	Vulnerable groups are groups who have been identified to already be marginalised for a variety of reasons and therefore will have a heightened sensitivity.

Significant Rating Before Mitigation	
Negative Impact	Moderate Negative Impact
Moderate	

In the absence of effective mitigation and management measures this impact has the potential to occur in the construction phase and throughout the LoM.

Recommendation and Mitigation/Management Measures

All mitigation measures related to helping reduce or avoid potential damage to the Afar identity will be relevant to this impact, reducing the potential causes for further marginalisation. This will include developing an Allana workforce code of conduct; supporting cultural programmes and working with the traditional governance network for engagement purposes (refer to Section 11.4.1 and 11.4.2). In addition, all of Allana's hiring and procurement policies (including pre-emptive training of local people) will be targeted to provide fair and unbiased access to employment opportunities for all potential applicants, potentially helping to empower marginalised groups (refer to Section 11.3.1).

In addition, to avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by Allana.

- **Stakeholder Engagement Planning**

Allana will implement the Stakeholder Engagement Strategy (SES, refer to Volume III *Annex M*) and a more detailed operational (forward looking) Stakeholder Engagement Plan (guided by the engagement documents developed for the ESHIA) for the construction, operation and closure phases that specifically highlights how marginalised or vulnerable groups will be included within the engagement process. This may include an on-going process of stakeholder and vulnerability analysis and the establishment of engagement 'working groups' that represent the interests of vulnerable parties who may not be able to speak out during other engagement activities. Allana

will develop a mechanism whereby their views can be fully considered in relevant Project decision-making, to ensure that they are not only heard, but able to influence the proposed Project's development where appropriate and practicable.

The SES and Operational (forward looking) Stakeholder Engagement Plan will include requirements surrounding consideration of engagement with vulnerable groups during all engagement activities.

Residual Impact (Post-mitigation)

With suitable avoidance and mitigation the frequency, scale and duration of this impact is likely to decrease resulting in the assessment of the impact as a '**Minor Negative Impact**'.

Table 11.29 Rating of Residual Impact Related to Increased Marginalisation (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by marginalised or vulnerable groups.
Duration	Long Term	Without mitigation and management measures impact may continue for the duration of the Project.
Scale	Small numbers	The impact may be experienced by existing marginalised groups.
Frequency	Rare	This impact may occur where resources are in competition or where local residents clash with in-migrants.
Likelihood (for unplanned events only)	N/A	

Magnitude		
Negligible		
Negligible Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		
Minor		

11.5.7 Increased Anti-Social Behaviours

Background

Description of the Baseline Environment

Anti-social behaviour in this context refers to behaviour that is perceived to lack consideration to others and cause damage to wider society, whether intentionally or through negligence. Anti-social behaviour therefore can be understood as actions that are contrary to the prevailing norms and influences the way that a community functions. This may incorporate a large spectrum of

actions however in this context refers to alcohol and substance abuse, the use of sex workers, crime and violence etc.

Within the SSA a limited amount of anti-social behaviour was cited during data collection. Although some alcohol consumption and abuse is believed to be present, particularly by 'highlanders' in the more ethnically diverse settlements of Berahale and Hamad Ela, it is not a widespread activity; indeed Muslim and traditional values mean that alcohol consumption is currently quite rare and alcohol consumption was reported to be disapproved of by local communities.

Other substances consumed include low levels of khat and tobacco. Khat is not widespread in the Study Area and was reported to be predominantly used by goods transporters (including truck drivers and the *Arho*) with some low level consumption by Afar local men.

Sex workers are reported to be present within Hamad Ela and Berahale; however, were not observed elsewhere within the SSA. It was reported that sex workers, who tend to operate out of coffee houses, worked in the area to serve the military camp, tourists and migrant salt workers or transporters, and were not used by local Afar inhabitants.

Proposed Project Activities

The proposed Project may attract in-migration of opportunistic job seekers into the Study Area in addition to migrants hired to provide services and act as Allana workforce. This in-migration has the potential to change the way that the local community function and increase the practice of activities that are currently taboo in the Afar area, but more widespread across the rest of Ethiopia.

The potential for employment opportunities for local Afar men may increase available pools of cash income which may be associated with higher rates of alcohol and substance abuse, and solicitation of sex workers (among local people). It should be noted that during data collection some stakeholders reported that increased employment of Afar locals, particularly members of the youth, may directly reduce stress, anxiety, depression and related social dysfunctions. The receipt of employment was believed to have benefited the mental health of some employees resulting in their cessation of khat and tobacco consumption.

The presence of mine workers, including nationals from outside the local Afar area, may disrupt the community cohesion and traditional way of life (refer to Section 11.4.1 and 11.4.2), potentially creating stress and anxiety for some residents and increasing the tendency to seek out anti-social behaviours as coping mechanisms or may further weaken the social bonds, promoting a greater likelihood for increases in anti-social behaviours.

Sensitive Receptors

Increased prevalence of anti-social behaviours may cause a worsening of the health profile related to substance abuse, STIs etc.

The youth may be particularly susceptible to developing anti-social behaviours as they currently face a limited ability to participate in the governance network and may be keen to pursue new activities perceived to be exotic or glamorous.

Women may be particularly susceptible to the negative consequences of an increase in anti-social behaviour including violence and STIs.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Moderate Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.30*.

The magnitude of the impact has been evaluated to be medium based on the potential for it to be intermittently experienced at a local extent by communities in proximity to proposed Project infrastructure.

The vulnerability of receptors has been evaluated to be medium because of a potentially weakened traditional governance structure, and the association of Afar cultural identity with social practices (that may change).

Table 11.30 Rating of Impact Related to Anti-Social Behaviour (Pre-Mitigation)

Type of Impact		
	Negative	Induced
Induced Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in communities that experience substantial amounts of in-migration. This may include Hamad Ela and communities along the road network from Berahale to the proposed Project, such as Ambule.
Duration	Long Term	Without mitigation and management measures impact may continue for the duration of the Project.
Scale	Up to 3,000 people	The impact may be experienced by community members in the settlements of Berahale, Hamad Ela and potentially communities along the road network from Berahale to the proposed Project, such as Ambule.
Frequency	Intermittent	This impact may occur where residents substantially change the way they act.
Likelihood (for unplanned events only)	N/A	
Magnitude		
	Medium	
Medium Magnitude		

Sensitivity/Vulnerability/Importance of the Resource/Receptor	
Designation	Summary of Reasoning
Medium	Vulnerability of receptors is dictated by the absence of existing cosmopolitan areas with substantial variation in social requirements.
Significant Rating Before Mitigation	
Negative Impact	Moderate Negative Impact
Moderate	

This impact will occur during the construction phase and continue during the operations and decommissioning phase.

Recommendation and Mitigation/Management Measures

All mitigation measures related to helping reduce, avoid or manage potential in-migration, and helping to preserve Afar identity in impacted communities will be relevant to this impact. This will include promoting transparent hiring techniques that plan hiring in a way that may limit in-migration and protect Afar culture, and developing a worker code of conduct will help to limit unplanned worker-community interactions (refer to Section 11.4.1 and 11.4.2).

To avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by the Project.

- **Education and Awareness Programme - STIs and Substance Abuse**

Allana will work with relevant partners, local leaders and the relevant Kebele or Woreda officials to promote an education and awareness programme targeted at managing anti-social behaviour. This programme, as part of Allana’s community development may include a series of training and awareness raising events around the dangers and consequences of substance abuse, violence etc.

Residual Impact (Post-mitigation)

With suitable avoidance and mitigation the frequency, scale and duration of this impact is likely to decrease resulting in the assessment of the impact as a **‘Minor Negative Impact’**.

Table 11.31 Rating of Residual Impact Related to Anti-Social Behaviour (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in communities that experience substantial amounts of in-migration. This may include Hamad Ela and communities along the road network from Berahale to the Project such as Ambule.
Duration	Long Term	Without mitigation and management measures impact may continue for the duration of the Project.
Scale	Up to 3,000 people	The impact may be experienced by community members in the settlements of Berahale, Hamad Ela and potentially communities along the road from Berahale to the Project area.
Frequency	Rare	Reduction in frequency
Likelihood (for unplanned events only)	N/A	

Magnitude		
Small		
Small Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		
Minor		

11.5.8 Increased Violence and Conflict between Community and Security Providers

Background

Description of the Baseline Environment

Currently within the Project area there is a police station in Berahale, and two police officers are stationed in Hamad Ela. There is also a military camp in Hamad Ela village.

There have been allegations regarding segments of the Ethiopian security forces including the Ethiopian National Defence Force (ENDF) committing breaches to human rights elsewhere in Ethiopia, as protected by the Ethiopian criminal code (Human Rights Watch, 2011). The prevalence of this type of allegation in the past means that the potential for future occurrence should be considered.

Allana currently do not have any company policy regarding third party security providers.

Proposed Project Activities

The Project currently uses contractors to provide camp-gate supervision including sign-in and out of vehicles, entry supervision and patrols of Allana

exploration sites. Security at drill rigs and for transportation of staff is provided by the ENDF. During the operations of the proposed Project it is anticipated that this approach will continue with camp and Project security being contracted to a third party.

Sensitive Receptors

The use of third party security providers (including the military) may result in instances of violence towards community members or conflict between communities and security providers. This may include instances of community unrest or protest resulting in violence and conflict and disproportionate acts of force, or abuses of power for personal benefit of security providers.

Sensitive receptors may include members of communities who have a limited ‘voice’ in communities (such as women or the youth) who may not be empowered to speak out against acts of violence.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a ‘**Major Negative Impact**’ prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.32*.

The magnitude of the impact has been evaluated to be medium based on the potential for it to be intermittently experienced at a local extent by communities in proximity to project infrastructure.

The vulnerability of receptors has been evaluated to be high because a large proportion of receptors have minimal access to the functional legal system and may have limited ability to express and affect potential violence from security forces.

Table 11.32 Rating of Impacts Related to Conflict with Security (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders surrounding the Project who come into direct contact with the Project security providers.
Duration	Long Term	Without mitigation and management measures impact may continue for the duration of the Project.
Scale	Up to 2,000 people	The impact may be experienced by community members in those communities in proximity to proposed Project infrastructure who may come into contact with Project security staff.
Frequency	Intermittent	This impact may occur where security staff are violent toward community members

Likelihood (for unplanned events only)	N/A	
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Magnitude	
	Medium

Medium Magnitude

Sensitivity/Vulnerability/Importance of the Resource/Receptor

Designation	Summary of Reasoning
	Vulnerability of receptors is dictated by the separation of large proportions of the local inhabitants from the formal legal system and the lack of access to legal control measures. Women and the youth may be particularly vulnerable because of their inability to have a 'voice' within their community to speak out against instances of violence.
High	

Significant Rating Before Mitigation

Negative Impact	Major Negative Impact
	Major

This impact may occur during the construction, operations and decommissioning phases.

Recommendation and Mitigation/Management Measures

To avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by Allana.

Manage Security Providers with Guidance from Voluntary Principles on Security and Human Rights

The Voluntary Principles on Security and Human Rights (VPs) are a set of principles established by the Governments of the USA, the United Kingdom of Great Britain and Northern Ireland (UK) aimed at companies in the extractive and energy sectors and NGOs. The VPs guide companies in maintaining the safety and security of their operations within an operating framework that ensures respect for human rights and fundamental freedoms.

These principles include requirements for:

- **Risk assessment** related to the security and operating environment including identification of security risks, the potential for violence, the human rights record of public and private security forces, the local authority and judiciary's ability to hold accountable human rights abusers, the root causes and nature of local conflicts and the risk of any equipment transfer.
- **Interactions between companies and public security forces** to consider the implications for the protection and promotion of human rights including the principled deployment and conduct of security staff, the provision of

consultation and advice between the company and the security forces and the provision for suitable responses to human rights abuses.

- ***Interactions between companies and private security forces*** to consider the implications for the protection and promotion of human rights.

Allana will establish a system of management of security providers (public and private) that complies with the principles of the VPs. This will include reporting of progress and incidents to the public. Allana should also, through the Stakeholder Engagement Programme, aim to understand the opinions of local stakeholders to security providers, and monitor any changes in perception or relationship between security providers and local communities.

- **Training of security staff**

Allana will provide training to both private and to the extent possible, government security forces used to guard its facilities (government security forces trained would include only those regularly used for guarding of infrastructure). This training will provide guidance on Allana's Human Rights policy and its practical application in security arrangements. It will include topics such as appropriate use of force, interaction with local communities and protection of human rights of local residents. If necessary a specialist firm should be hired to provide this training.

- **Community Feedback Mechanism**

Allana will establish a Community Feedback Mechanism that is scaled appropriately to risks and adverse impacts. The feedback mechanism should be an understandable and transparent process, should be culturally appropriate and therefore include traditional authorities and religious leaders in the Project area. The feedback mechanism should also be readily accessible to all segments of the population and have no cost implications and be without retribution. In addition the feedback mechanism should be available as a confidential system where necessary and have no impediment to judicial or administrative remedies.

In addition Allana shall undertake a process of culturally appropriate engagement surrounding the objectives, methods and process surrounding the community feedback mechanism. The feedback mechanism should also establish the practicalities for management and monitoring of feedback including roles and responsibilities within Allana and the resolution and arbitration of grievances.

Further details of the feedback mechanism are available in *Section 11.4.1*.

- **Stakeholder Engagement Programme Relevant to Security Provision**

Allana will implement a programme of culturally appropriate engagement with potentially impacted communities surrounding the planned security

forces and their conduct. This programme should specify Allana requirements regarding security provision, the feedback mechanism and the desire to protect and respect human rights.

- **Monitoring, Auditing and 'Due Diligence' of Security Providers**

Allana will establish a system where an independent third party monitors and audits the conduct of security providers on a bi-annual basis, particularly focusing on the rights of potentially vulnerable groups through culturally appropriate means.

- **Respect Human Rights**

In alignment with the United Nations 'Protect, Respect and Remedy Framework' Allana will develop a corporate commitment to respect human rights. As a means to implement this commitment Allana will implement a policy that stipulates the company's human rights expectations, which is publically available and is reflected in operational policies and procedures. In order to identify, prevent, mitigate and account for how they address human rights Allana will carry out a Human Rights Due Diligence of the proposed Dallol Project, which is intended to:

- document Allana's vision and objectives related to managing Human Rights, documented through a formal policy;
- track and record accountability for human rights performance in the proposed Project;
- assess and plan potential issues and impacts related to human rights;
- develop a management plan which includes communication with internal and external stakeholders;
- review against a set of pre-agreed indicators; and
- Analyse findings to seek opportunities for improvements in performance.

The process should include assessing actual and potential human rights impacts, integrating and acting upon the findings, tracking responses, and communicating how impacts are addressed.

Residual Impact (Post-mitigation)

With suitable avoidance and mitigation the frequency, scale and duration of this impact is likely to decrease resulting in the assessment of the impact as a '**Moderate Negative Impact**'.

Table 11.33 Rating of Residual Impacts Related to Conflict with Security (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders surrounding the Project who come into direct contact with the Project security providers.
Duration	Medium Term	With mitigation and management this impact may occur during the establishment of the management systems
Scale	Up to 2,000 people	The impact may be experienced by community members in those communities in proximity to Project infrastructure who may come into contact with Project security staff.
Frequency	Very Rare	This impact would be reduced to almost non-existent.
Likelihood (for unplanned events only)	N/A	

Magnitude		
	Small	
Small Magnitude		
Significant Rating After Mitigation		
	Moderate Negative Impact	
	Moderate	

11.6 TANGIBLE CULTURAL HERITAGE AND ARCHAEOLOGY IMPACTS

This section will discuss impacts related to tangible cultural heritage and archaeological sites. The general impact assessment methodology is established in *Chapter 6* and the specific criteria for sensitivity, magnitude and significance of impact to cultural heritage and archaeology are discussed in *Volume II Annex D*.

11.6.1 Limited Access to Cultural Heritage or Archaeological Sites

Background

Description of the Baseline Environment

As part of the Social Impact Assessment (SIA) of the proposed Project, a desktop and field based baseline survey was conducted to gather data for the assessment of Project impacts on cultural heritage sites within the Project license area.

The baseline data gathering efforts revealed that the proposed Project area contains a number of above ground physical and cultural heritage sites. There are 145 cultural sites of high, medium or low significance presently known within the proposed Project area. All 145 physical cultural resources fall within the categories of either Archaeological Cultural Heritage (ACH) or Living Cultural Heritage (LCH).

Because no previous archaeological studies had been conducted in the region, ERM's baseline field survey developed a system of classification for the five site categories. The majority of sites identified during the field survey were clustered around the villages of Mororo, Hamad Ela, and Alai Lai, and a small number of features were found further north and west of Mororo and Alai Lai villages. These included:

- Prehistoric Circular Cairns;
- Prehistoric Stacked Circular Cairns;
- Prehistoric Conical (pyramid-shaped) Cairns;
- Modern Burials; and
- Modern Military Shooting Blinds.

The modern burials and shooting blinds are relatively easy to interpret as their functions are known to the modern populations. As for the *cairn* structures, their functions are unknown. Modern populations provided a variety of interpretations as to the functions of the *cairn* structures. From a scientific perspective, it is likely that the *cairn* structures are of significant age as they are similar to larger, probable late Stone Age monuments found on the north-western slopes on Mount Erte Ale located 18 kilometres south of the proposed Project.

The modern graves are believed to be of either of medium or high importance. Local stakeholder involvement would be required in order to more accurately assign significance, in the event that any of the modern graves require removal by the proposed Project. All modern military shooting blinds are considered to be of low importance. Prehistoric cairn structures (circular, stacked circular and conical), in the opinion of ERM archaeologists, have significance values ranging from low, to medium, to high.

In addition to the stone features, both inside and outside the proposed Project concession area, Mount Assale (outside of the Project concession area), was identified as one of the key living cultural heritage sites in the Study Area. The local community uses salt from Mount Assale for medicinal purposes. Ashe Ale is believed to be the 'mother of all salt' and is a protected site by the locals and only village elders or leaders are able to take salt from it.

The Cultural Heritage baseline is described in greater detail in *Chapter 9* and the 145 known cultural heritage sites in the concession areas are listed in Volume II *Annex E*.

Proposed Project Activities

The location of the proposed Project infrastructure may restrict access to cultural heritage assets of importance to local communities, including modern graves and Mount Assale. These impacts may occur both during the project construction phase and during the project operation phase. Graves may be inaccessible during the project construction and operation phases due to

restricted access due to health and safety concerns or due to physical barriers created by the mining operation.

Sensitive Receptors

Based on current proposed Project plans the majority of the cultural heritage assets would not be subject to concerns of limited access.

It should be noted that it is difficult to quantify the sensitivity of these cultural heritage resources given the limited scientific study undertaken into their content. However it should be recognised that during data collection community members stated that it was not common practice to visit gravesites.

Significance of Impact (Pre-mitigation)

The impact related to limited access to cultural heritage sites for local people will be '**Negligible to Moderate Negative Impact**', depending on the normal frequency of visits by the local populations. Access restriction is only likely in the case of recent graves or Mount Assale.

Table 11.34 Rating of Impacts Related to Limited Access (Pre-Mitigation)

Type of Impact		
	Negative	Direct Indirect
Direct or Indirect Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The cultural heritage sites are of varying degrees of local importance, as currently understood.
Duration	Temporary to Long-term	Dependent on whether the access limitation derives from short-term construction requirements or long-term operational requirements.
Scale	>75%	If access is restricted, it is likely to apply to the entire site.
Frequency	-	Unknown at this time.
Likelihood (for unplanned events only)	NA	
Magnitude		
		Small Medium
Small to Medium		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	The cultural heritage sites will be of Medium to High sensitivity dependent on their scientific and historical importance and their value to local stake holders. Recent and contemporary graves are of higher sensitivity, as are well preserved sites related to the earliest phases of ancient occupation.	
High		
Significant Rating Before Mitigation		
Negative		Negligible-Moderate Negative Impact
Negligible		
Minor	Moderate	

This impact would begin during the construction phase and continue throughout the LoM until decommissioning.

Recommendations and Mitigation/Management Measures

To avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by Allana.

- **Additional Archaeological Field Assessments**

Additional archaeological field surveys have taken place to assess the previously identified cultural heritage sites and to assess numerous potential cultural heritage sites that were recognized during the satellite imagery analysis of the Project area. This additional fieldwork will assist project planners by confirming those cultural heritage sites that should be avoided, where feasible.

- **Engagement with Local Community - Cultural Heritage**

Allana will undergo a process of engagement with local communities to identify potential solutions to limitations on access to gravesites. This may involve negotiations of moving graves, altering details of Project design or facilitating access into certain non-hazardous areas by community members.

Residual Impacts (Post-mitigation)

Assuming the effective application of management and mitigation measures impacts related to limited access for local people will be assessed as a '**Negative Negligible to Moderate Impact**'.

Table 11.35 Rating of Residual Impact Related to Limited Access (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The impacts remain local.
Duration	Temporary to short-term	The limitations to access should be reduced through engagement with local stakeholders. Allowing access to certain area
Scale	>50%	The impacts to those sites that cannot be avoided remains extensive, but key archaeological and historical data will be recovered.
Frequency	>75%	In cases where access is restricted, that access still is likely to relate to most of the cultural heritage sites.
Likelihood (for unplanned events only)	N/A	

Magnitude		
	Small	Medium
Small to Medium Magnitude		
Significant Rating After Mitigation		
Negligible to Moderate Negative Impact		
	Negligible	
Minor	Moderate	

11.6.2

Disturbance, Damage to Cultural Heritage and Archaeological Sites

Background

Description of the Baseline Environment

The Cultural Heritage baseline is discussed in *Section 11.6.1*.

Proposed Project Activities

Cultural heritage resources located within proposed Project component footprints will be subject to impacts and require mitigation. Furthermore, cultural heritage resources located outside proposed Project component footprints still might be impacted by Project activities that have not yet been planned or designed. The latter may include access roads; borrow pits, utilities, and other Project infrastructure between the processing plant, the Brine Field, and the Pond Area. These impacts would be direct and could create irreparable damage to physical cultural heritage. These impacts may occur both during the Project construction phase and during the Project operation phase.

The development and operation of the mine will increase the presence of national and foreign workers in this remote area, exposing cultural heritage assets to greater accessibility and thus risk of damage. These impacts may occur both during the project construction phase and during the project operation phase. The presence of Project workers will increase the likelihood for disturbance to cultural heritage sites from increased commercial activity and development, from unauthorized removal of artefacts from sites by non-locals, and also from looting of the artefacts by locals seeking items to sell to the non-local workers.

Sensitive Receptors

There are seven known cultural heritage sites that currently fall within the proposed footprint of the Plant. The remainder of the known sites (138) lie outside of any Project component footprints. Cultural resources that currently fall outside proposed project footprints might still be impacted, especially if the Project adjusts the construction plan layout. These cultural sites, both within and outside Project footprints, are built of stone and are often visible from a distance. Some are less visible, especially the modern graves.

The existence of subsurface cultural remains is unknown as no excavations have taken place in the general area. If subsurface cultural remains do exist, they could be found during site construction. Subsurface cultural remains fall under the protection and management of the Chance Finds Protocol outlined in the Archaeological and Cultural Heritage Management Plan (ACHMP - refer to Volume III *Annex H*).

Significance of Impact (Pre-mitigation)

The impacts from groundwork's will be '**Moderate to Major Negative**', dependent on the social value, age and function of the cultural heritage sites in question. Rescue excavations would recover archaeological data of local or regional significance and human remains could be relocated to a site selected by the local communities to mitigate the impacts of disturbance and damage. Avoidance, however, is the preferred method of mitigation and should be considered as the first option before undertaking more intensive mitigation measures.

Table 11.36 Rating of Impacts related to Groundwork's (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The cultural heritage sites are of local importance, as currently understood.
Duration	Permanent	Unless avoided, the sites will be destroyed by groundwork's.
Scale	>50%	Unless avoided, the sites will be significantly damaged by groundwork's.
Frequency	>1	Potential impacts from different forms of groundwork's: cutting and filling, trenching during construction phase and operations phase.
Likelihood (for unplanned events only)	NA	
Magnitude		
	Medium	Large
Medium to Large Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	The cultural heritage sites will be of Medium to High sensitivity dependent on their importance to local stakeholders and the scientific community.	
High		
Significant Rating Before Mitigation		
Negative		Moderate - Major Negative Impact
	Moderate	
		Major

The impact related to increased potential looting related to increased access to cultural heritage by non-locals will be '**Negligible to Moderate Negative**', dependent on whether the prehistoric cairn features are determined to be graves with potentially rich burial artefacts within.

Table 11.37 Rating of Impacts Related to Increased Access for Non-Locals (Pre-Mitigation)

Type of Impact		
	Negative	Induced
Direct or Indirect Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The cultural heritage sites are of local importance, as currently understood.
Duration	Temporary to Long-term	Dependent on whether interests in local sites are antiquities create commercial interests.
Scale	>75%	If interests in sites or antiquities become common, sites may be extensively looted.
Frequency	-	Unknown at this time.
Likelihood (for unplanned events only)	N/A	
Magnitude		
	Small	Medium
Small to Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	The cultural heritage sites will be of Medium to High sensitivity dependent on their importance to local stakeholders and the scientific community.	
High		
Significant Rating Before Mitigation		
Negative		Negligible-Moderate Negative Impact
Negligible		
Minor	Moderate	

Recommendations and Mitigation/Management Measures

To avoid and reduce the significance of this impact the following mitigation and management measures will be implemented by Allana.

- **Additional Archaeological Field Assessments**

Additional archaeological field surveys have taken place to assess the previously identified cultural heritage sites and to assess numerous potential cultural heritage sites that were recognized during the satellite imagery analysis of the Project area. This additional fieldwork has provided a basis for assisting project planners by confirming those cultural heritage sites that should be avoided, if feasible.

- **Post-Assessment Archaeological Field Excavations**

Allana will sponsor a programme of archaeological excavations to collect data from identified graves and archaeological features that cannot be avoided through project design. The scope of this programme of excavations will be developed in consultation with national and local stakeholders and staffed by a team of Ethiopian archaeologists, with guidance provided by internal cultural heritage specialists as required. Allana will develop a Land Clearance

Procedure identifying cultural heritage sites that can be avoided through Project design, and the procedures by which this will be achieved. In addition the procedure will identify any cultural heritage sites that cannot be avoided by Project design and how these will be addressed.

- **Execution of a Chance Finds Programme**

Allana will establish a Chance Find Programme staffed with on-site Ethiopian archaeologists and overseen by ex-patriot cultural heritage specialists to manage the discovery of Chance Finds during the project construction phase. This is detailed within the ACHMP in Volume III *Annex H*.

- **Marking of Vulnerable Cultural Heritage Sites**

Allana will mark vulnerable cultural heritage for avoidance using warning signage and high visibility temporary flagging. This will reduce the incidence of unintended impact to cultural heritage sites. Staff and contractor briefings on cultural heritage will include information on the presence and significance of the protective signage at cultural heritage sites.

- **Provision of Cultural Heritage Training**

Allana will establish a Cultural Heritage Training Programme for project management and workers. This training should address Chance Finds procedures, consultation with local and national stakeholders, local sensitivity to loss of access to cultural heritage sites, and the sensitivity of cultural heritage sites to looting.

Residual Impacts (Post-mitigation)

With suitable avoidance and mitigation the significance of this impact will be reduced. The significance of impacts caused by physical disturbance from groundwork's, and increased potential looting has been considered separately to demonstrate the changes in rating.

Table 11.38 Rating of Residual Impact Related to Groundwork's (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The impacts remain local.
Duration	Permanent	The impact to those sites that cannot be avoided remains permanent.
Scale	>50%	The impacts to those sites that cannot be avoided remains extensive, but key archaeological and historical data will be recovered.
Frequency	>1	The implementation of the recommended schemes will reduce the potential for Chance Finds.
Likelihood (for unplanned events only)	N/A	

Magnitude		
	Medium	High
Medium to High		
Significant Rating After Mitigation		
Negligible to Major Negative Impact		
	Negligible	
Minor	Moderate	Major

Assuming the effective application of management and mitigation measures impacts related to limited access for local people will be assessed as a negligible to moderate impact.

Table 11.39 Rating of Residual Impact Related to Increased Access from Non-Locals (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The impacts remain local.
Duration	Temporary to short-term	The training of management and staff should reduce intensity of looting and engagement with local looters.
Scale	>25%	The scale of impacts to individual sites will be reduced if there is less of a market for looters and workers understand the risks of looting.
Frequency	>10%	The frequency of impacts to individual sites will be reduced if there is less of a market for looters and workers understand the risks of looting.
Likelihood (for unplanned events only)	N/A	

Magnitude		
	Small	Medium
Small to Medium Magnitude		
Significant Rating After Mitigation		
Negligible to Moderate Negative Impact		
	Negligible	
Minor	Moderate	

11.7 IMPACTS TO PHYSICAL AND SOCIAL INFRASTRUCTURE

This section includes a discussion and analysis of impacts to physical and social infrastructure.

11.7.1 Reduced Access, Pressure and Overburdening of Physical and Social Infrastructure

Background

Description of the Environment

The current availability of basic infrastructure and services is very low, and does not meet the needs of the local population. The results of the household

survey identified that residents deemed medical and educational facilities in the Study Area to be unsatisfactory. Furthermore the most pressing concern for the majority of people surveyed was access and availability of drinking water and inadequate healthcare services.

In addition to low availability, access to infrastructure and services such as education and healthcare is limited for the majority of households in the Study Area due to poor transport infrastructure and the low levels of income received from current livelihoods.

The social baseline (refer to *Chapter 9*) highlights how the quality and availability of basic social and physical infrastructure within the potentially affected areas is minimal. There are only two health centres and 10 health posts in Berahale Woreda and a number of these are believed to be basic or non-functioning. The average student - teacher ratio is 1:35 in Berahale Woreda and Berahale town is the only settlement in the Social Study Area with a secondary school.

Although Hamad Ela and Berahale have more infrastructure than other settlements, with some access to electricity, shops, a school(s) and public sanitation, the reliability and quality of these is very low. Service and resource provision is currently at a level that can be assumed to be below that required by the existing population and there are gaps in the provision of clean water, adequate health and education facilities, sanitation etc.

Both the FGDs and household survey indicate that on average monthly household expenditure is higher than the monthly household income. The majority of household income is used to purchase food; what remains is used to purchase clothes or access to healthcare services or medication. Expenditure related to education did not feature high on the list of a household's expenditure items; this is probably due to a lack of surplus income remaining after purchasing for the household. The majority of respondents in FGDs indicated that often they do not have sufficient income to pay for healthcare and have to borrow from neighbours.

The IMRA indicated that villages within the SSA had very little 'absorptive' capacity in terms of existing social infrastructure and services, to support any in-migration of opportunistic job seekers.

Proposed Project Activities

As outlined in *Sections 11.3.3, 11.3.4 and 11.3.5* Project activities may cause a decrease in the productivity of certain livelihoods causing a decrease in income generated and thus an inability to pay for access to social infrastructure including transportation, health and education infrastructure.

It is important to note that a decline in income from key livelihoods in the area (as indicated from the baseline data collection) has already been reported to have occurred over the past two years. In addition the potential for localised

inflation, as discussed in *Section 11.3.7* may mean that the purchasing power of people within the Social Study Area is reduced.

In addition the presence of the proposed Project, augmented by other development in the area such as the new road and other mining companies, will result in in-migration into the area of opportunistic job seekers. This in-migration may be particularly likely due to low levels of formal employment available throughout Ethiopia and the Afar region. The IMRA has identified Hamad Ela and Berahale as potential hotspots for in-migration and recognised the overall low 'absorptive' capacity of the area to cope with increases in population and demand for services.

This impact may be exacerbated by the cumulative impact of the new planned road into the area and the existence of other mining projects, which may also attract in-migration associated with employment opportunities (refer to *Section 12*).

It should be noted that for some of those affected this impact may be mitigated by some other changes brought about by the Project and other developments in the area (such as the road from Mekele to Bada being developed by the Government, which will increase access to a wider range of healthcare facilities). Employment of local residents by Allana may provide additional income and Project related in-migration may create income generating opportunities for some people who may use this income to access physical and social infrastructure.

Sensitive Receptors

Current and potential declines in income will have direct consequences on access to schooling and health services for people in the Social Study Area as levels of income may not be sufficient to pay for items such as transportation, cost of medication, uniforms and books.

In addition, in-migration and the resultant increase in population would result in pressure or overburdening of local infrastructure and services (including health services), potentially reducing levels of availability and quality of service.

The overburdening or pressure on services, infrastructure and resources may result in a worsening of the health profile where an absence or breakdown sanitation facilities results in health problems, water shortages, inadequate health and educational service provision etc.

Hamad Ela has a history of seasonal migration to serve as a central 'hub' for various livelihood activities (tourism, artisanal salt mining and transport, palm products transportation etc.) and although this has established the precedent for in-migration of 'non-locals', there are very limited resources to serve a significant increase in population. Similar to Hamad Ela even with

more infrastructure and services available a significant level of in-migration into Berahale would overburden the existing systems.

It should be noted that access to infrastructure and services is already limited in the Study Area, with very poor access to health and educational facilities. Therefore in the event that this impact occurs the majority of Afar households would be vulnerable. The currently poor health and educational status of local people is likely to worsen.

Receptors that may be particularly vulnerable to this impact include those households that are reliant on natural-resource based livelihoods for income such as salt mining that may be affected and will not increase during periods of inflation. In addition female headed households, with less access to income generating livelihoods may be particularly vulnerable to this impact.

Sensitive receptors may also include members of communities who are offered less access to services and resources due to socio-cultural norms (such as women or the youth) who may be disproportionately impacted or less able to cope with increased conflict and competition for services and resources.

It should be recognised that although Hamad Ela and Berahale have been recognised as potential ‘hotspots’ for in-migration and therefore may experience this impact in a more pronounced way, should their populations increase suitably they may reach ‘critical mass’ and cause the Government to invest in additional infrastructure.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a ‘**Major Negative Impact**’ prior to mitigation based on a combined evaluation of magnitude and vulnerability as illustrated in *Table 11.40*.

The sensitivity is also evaluated to be high based on the majority of households have limited savings networks; low levels of income compared to expenditure (in several instances expenditure exceeded income) and reduced ability to pursue alternative income generating opportunities.

Table 11.40 *Rating of Impacts Related to Reduced Access to Infrastructure (Pre-Mitigation)*

Type of Impact		
	Negative	Induced
Induced Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Regional	This impact may be experienced by stakeholders involved in the salt mining industry, reliant on pastoralism or palm collecting. This may including migrants travelling into the area from the highlands to transport and dig salt, local people cutting salt or with a stake in the salt buying and selling cooperative, or those marketing salt in Mekele.

Duration	Long Term	Without mitigation and management measures the impact may continue for the duration of the proposed Project.
Scale	Up to 15,000 people	The impact may be experienced by community members throughout the Social AoI.
Frequency	Intermittent	This impact may occur where service, infrastructure and resources are in competition or where livelihoods are impacted.
Likelihood (for unplanned events only)	NA	
Magnitude		
		Large
Large Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
High	Identified to be high due to the limited savings networks; low levels of income compared to expenditure (in several instances expenditure exceeded income), the absence of service, infrastructure and resources and primary reliance on livelihoods for subsistence needs.	
Significant Rating Before Mitigation		
Negative / Positive Impact		Major Negative Impact
		Major

This impact is anticipated to begin during the construction phase as in-migration increases and continue into the operations phase as groundwater abstraction begins. It will continue until the decommissioning phase when mining operations are complete.

Recommendations and Mitigation/Management Measures

All mitigation measures related to helping reduce, avoid or manage potential in-migration, and impacts to livelihoods will be relevant to this impact (refer to Sections 11.3.3, 11.3.4 and 11.3.5). In addition management measure to promote local employment and procurement of goods and services, as detailed in Section 11.3.1 will help to mitigate this impact.

Community development targeted at improving services, infrastructure and access to resources (refer to Section 11.7.2) will help to mitigate the vulnerability to this impact.

To avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by the Project team.

- **Local Procurement of Goods and Services**

A frequent concern raised by both local and regional stakeholders to date has been the lack of local procurement that is currently taking place. Thus it is recommended that a strategic Local Procurement Plan (where possible in partnership with other mining companies) is developed that identifies

opportunities to promote local procurement of goods and services, and how this will be implemented. The key objective will be to promote and diversify alternative livelihoods in the Social Study Area, and increase the potential for income generation particularly in line with the in-migration that is likely to occur. It is recognised, as discussed in *Section 11.3.1*, that given the skills, capacity and goods available locally this may be a challenge to implement and the effect may not be widespread at a local level.

- **Improvements to Water and Waste Management Infrastructure**

Allana will work with potentially impacted communities and the relevant Woreda / Kebele local authorities to support them in securing safe and sustainable water supplies and waste management infrastructure. This may involve providing direct support for the construction of local infrastructure for safe water supply, sanitation, wastewater treatment and solid waste disposal through collaboration with partner organisation such as NGOs. As part of providing direct support Allana should also focus on raising awareness and building community capacity in maintaining any water or waste management infrastructure that is provided.

This may involve the provision of local authorities and recipient communities with training and awareness raising campaigns in the planning, provision and use of community sanitation services. In addition Allana may consider promoting or enabling a mechanism for providing potable water in impacted communities through the installation of wells etc.

- **Education and Awareness Programme - Healthy Practices**

Allana will work with relevant partners, local leaders and the relevant Kebele or Woreda officials to promote an education and awareness programme targeted at managing community sanitation and infrastructure use. This programme, as part of Allana's community development may include a series of training and awareness raising events around sanitation and healthy practices aimed at different groups within the community i.e. women, men, and the youth.

- **Settlement Planning**

Allana will assist the traditional and formal governance system with the identification and demarcation of transitional zones for settlement, business, and informal trading in anticipation of an in-migration of people and associated housing demands, with the aim of directing future settlement patterns and preventing illegal settlement.

Residual Impacts (Post-mitigation)

With suitable avoidance and mitigation the frequency, scale and duration of this impact is likely to decrease resulting in the assessment of the impact as a '**Minor Negative Impact**'.

Table 11.41 Rating of Residual Impacts Related to Reduced Access to Infrastructure (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact may be experienced by stakeholders living in communities that experience substantial amounts of in-migration, without the service, infrastructure and resources to cope. This may include Hamad Ela and Berahale and to a lesser extent communities along the road network from Berahale to the Project such as Ambule.
Duration	Short Term	Without mitigation and management measures impact may continue until suitable infrastructure is supplied.
Scale	Up to 3,000	The impact may be experienced by community members in the settlements of Hamad Ela and Berahale.
Frequency	Rare	This impact may occur where service, infrastructure and resources are in competition or where local residents clash with in-migrants.
Likelihood (for unplanned events only)	N/A	

Magnitude	
	Small
Small Magnitude	
Significant Rating After Mitigation	
Minor Negative Impact	
	Minor

11.7.2 Improvements Related to Community Development Initiatives

Background

Description of the Baseline Environment

A number of infrastructure, health and socio-economic development needs have been identified in the Social Baseline (*Chapter 9*). Allana will have the opportunity to address some of these needs through a planned targeted program of community development.

Proposed Project Activities

Allana has committed to implementing a program of community investment; however levels of investment and the duration of this investment have yet to be defined.

A proposed community development programme can be expected to begin in earnest during construction stage and continue throughout operations. Funding will be phased out during the closure phase but the benefits of previous investment, if carefully planned and managed, will likely be experienced post-closure.

Sensitive Receptors

Chapter 9 describes some of the potential development needs in the local area and considers the potential beneficiaries of any Community Development. Although Allana intend to complete some Community Development activities, there is not yet a definite financial commitment for levels of spending and very little planning has been undertaken regarding the application of any community development spending.

Receptors in the local area that may be vulnerable to this impact and therefore facing a reduced ability to maximise the benefits it presents may include women or members of the youth who may be less able to be involved within the development process and are marginalised in local society.

One of the indirect consequences of community development initiatives may be the raised expectation of local people that Allana will deliver widespread benefits to the area, beyond what is feasible. Managing these raised expectations is considered in the Stakeholder Engagement Strategy (SES – refer to Volume III Annex M).

Significance of Impact (Pre-mitigation)

Impacts associated from potential future community development have been assessed as a potential '**Positive Impact**'.

Table 11.42 Rating of Impact Related to Community Development

Type of Impact	
Positive	Direct
Direct Positive Impact	
Community development will provide support, capacity development and direct investment in infrastructure to improve conditions within the Social Study Area.	

This impact will begin during the construction phase, when community development spending is anticipated to begin, and continue throughout operations until funding is phased out during decommissioning.

Recommendation and Mitigation/Management Measures

To enhance the beneficial effect of this positive impact the following management measures are required.

- Allana will implement the CDP contained in Volume III Annex I which aims to provide sustainable long term benefits to recipients improving standards of living within the Social AoI.
- Allana will develop a detailed Community Development Implementation Plan based on the CDP included in Volume III Annex I. This implementation plan will detail specifics around Allana's plans for Community Development and will ensure investment activities are

considered in a systematic manner. Community Development will require a participatory and consultative needs assessment to understand the development requirements in the area in greater detail and the best way to integrate Community Development into the existing development environment. Although a preliminary needs assessment has been undertaken for the proposed Project, a detailed needs assessment should be conducted by a team experienced in this area such as a specialist consultancy, partner organisation or NGO.

- Community Development will be targeted at helping impacted communities in the areas of health, education, livelihood diversification; food security and socio-economic development as identified in the preliminary needs assessment (refer to *Chapter 9*). A Community Development Implementation Plan will include targets for delivery of benefits and will include measures to assist wider community groups as well as ensuring the inclusion of the marginalised and vulnerable.
- Community development activities will be aligned, where possible, with government, partner organisation and local NGO activities to ensure that the potential positive effects are maximised and project synergies are realised.
- As part of on-going stakeholder engagement Allana will consult with local communities to manage expectations of the proposed Project.
- Community development will be designed so that community benefits are not reliant on the project for continuation and will not require substantial upkeep, maintenance, input of human or technical resources unless this upkeep has been sourced from elsewhere. This will be crucial to enhance the sustainability of the benefits delivered by any investment.

An Investment Committee will be established with responsibility for leading strategy and decision-making about community development. Members of this committee will include representatives from the local recipient community, the Allana Team and local development experts including government, NGOs and other stakeholders. Community consultation via this Investment Committee will ensure that the development needs prioritised by the community and those identified by Allana are aligned.

The core principles for successful community development initiatives have been identified in the CDP (refer to Volume III *Annex I*) and include strategies to avoid creating community dependency, and replacing the role of local government and other institutions. Allana will consider and follow the principles outlined in the CDP so as to avoid community dependency, and the potential for government to leave service and infrastructure delivery to mining companies.

This section considers the landscape and visual impacts of the proposed Project including the predicted impacts upon the landscape character, views and visual amenity.

Although this section uses the general impact assessment methodology established within *Chapter 6* the specific criteria for sensitivity, magnitude and significance of impact for the landscape and the visual environment are discussed in Volume II *Annex D*.

It should be noted that all of the mitigation measures related to the landscape and visual environment are considered inherent in Project design and therefore no residual impact ratings will be calculated.

It is acknowledged that short-term landscape and visual impacts will occur throughout the construction phase of the proposed Project. However, these impacts would be phased, temporary and restricted to the construction period, and therefore the resulting landscape and visual impacts will also be temporary.

11.8.1 *Impact to Landscape and Visual Environment during Construction*

Background

Description of the Baseline Environment

The baseline landscape and visual environment is expected to be similar to that described in *Chapter 9*.

The receiving environment is a very open and expansive area characterised by a number of scattered villages. There is an existing Allana exploration camp in the Study Area as well as those of the other mining companies (Yara/Sainik and Nova) and an army base located in Hamad Ela and close to the old Nova camp.

Proposed Project Activities

Landscape and visual changes will result from the construction phase activities including:

- The construction and installation of a new site compound ('worker village' and guarding posts);
- The construction and installation of new offices and sign boards;
- Temporary works and installations and temporary storage of fuel, supplies, pipework, water etc.;
- The installation and movement of heavy and light construction machinery; and

- Construction lighting including high mast lighting for activities.

Sensitive Receptors

The construction activities, including lighting, will provide some degree of increased disruption to the landscape and intrusion into views, especially to visual receptors in the immediate area. It is important to note however, that with the increase in distance from the proposed site there is significant reduction in potential impact. This is particularly relevant to some of the villages which are considerable distances from the proposed project area (although which it will still be visible from) such as Hamad Ela.

In the vicinity of the site, the main receptors are from the group of houses in Mororo and Alai Lai and potentially Hamad Ela and any tourists visiting attractions in the area such as Mount Dallol. The receiving environment has medium-low sensitivity due to the limited number of landscape and visual designations of value.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Minor Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and sensitivity as illustrated in *Table 11.43*.

Table 11.43 Rating of Impacts Related to Landscape and Visual Environment during the Construction Phase (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact is likely to be experienced by the nearest communities, including Mororo and Alai Lai (prior to resettlement). Communities further afield are unlikely to be significantly disturbed due to their distance from the proposed site.
Duration	Short term and temporary	The construction phase is temporary.
Scale	Limited within the concession area	The work is limited within the concession area and mainly in the areas of built infrastructure being planned.
Frequency	Intermittent	Dependent on construction sequence and schedule. Work will increase in the initial stages and then stabilise.
Likelihood (for unplanned events only)	NA	
Magnitude		
		Medium
Medium Magnitude		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		

Designation	Summary of Reasoning
Low	Low sensitivity of the receiving landscape and absence of any landscape and visual designations
Significant Rating Before Mitigation	
Negative Impact	Minor Negative Impact
Minor	

This impact will be temporary and occur during the construction phase.

Recommendations and Mitigation/Management Measures

The mitigation measures described below are an inherent part of the construction management practice and should be included throughout the construction phase to minimise landscape and visual impacts;

- Machinery and materials will be stored neatly in designated areas;
- Temporary roads providing access to site compounds and works areas will consider dust suppression;
- Outdoor construction lighting, where required, shall be as unobtrusive as possible and shall not allow light to shine upwards or towards residential receptors; and
- Security and work lighting shall be shielded and directed downwards to prevent side spill and the use of tall mast lights shall be carefully assessed to avoid causing light impacts.

11.8.2 Impact to Landscape and Visual Environment during Operations

Background

Description of the Baseline Environment

The baseline landscape and visual environment is as described in *Chapter 9*.

The receiving environment is a very open and expansive area characterised by a number of scattered villages. There is an existing Allana exploration camp in the Study Area as well as those of the other mining companies (Yara/Sainik and Nova) and an army base located in Hamad Ela and close to the old Nova camp.

Proposed Project Activities

Proposed project activities which will cause this impact will include the operation of:

- The processing plant and pumping stations;
- Worker Village;

- Drill rigs;
- Solution wells, boreholes and pumping stations;
- Evaporation Ponds;
- Offices and sign boards;
- Heavy and light vehicle movements;
- Lighting including high mast lighting; and
- Special load movement and storage, including potash and tailing storage / stockpiling.

Sensitive Receptors

Permanent landscape and visual impacts will arise during operations due to the proximity to a number of villages and tourist receptors, and the development of infrastructure. In addition the operation of the proposed Project will require night time lighting. The lighting will be apparent in hours of darkness, particularly visible to and affecting the residents of nearby villages. Given the topography, night lighting is also likely to impact views within the wider area affecting some populations to the south from where the power plant will be visible.

The Zone of Theoretical Visibility (ZTV) modelled for the Project (see *Figure 11.2* and

Figure 11.3) show the approximate 'worse case' Project visibility. This is based on an assumption of 65m for taller elements, and 15m for average building components. The ZTV highlights the fact that the proposed development is likely to be visible within the areas of Mororo, Alai Lai (prior to their resettlement), Hamad Ela, Ashe Ale and southern areas of Mount Dallol. The project is also likely to be visible from key transportation routes used by the tourists. As seen in the ZTV, the visibility is limited to the saline plains to the east, north and south. Views from the west are limited due to topography.

It is important to reiterate that the ZTV do not take into account vegetation, buildings or environmental conditions like haze and reflection which effectively screen or reduce views or visibility to/from the site. Therefore, whilst considering the ZTV and arriving at the significance of landscape and visual impacts, other factors discussed below are taken into consideration.

There are currently no designated or protected landscapes located within the study area (visual envelope) or in the wider area which would make the landscape more sensitive.

Table 11.44 discusses the sensitivity of the range of landscape character areas within the ZTV.

Table 11.44 *Sensitivity on Landscape Character Areas*

Landscape Character Area	Sensitivity
Open Arid Land and Salt Plains	The sensitivity is considered to be <i>low</i> given that the area is open, desolate with no vegetation. The area is also not designated for protection or value. There are however a small number of scattered settlements in the surrounding area and one within the Project area.
Mount Dallol	The sensitivity is considered to be <i>high</i> given that the area is visited by tourists and has spectacular views of the salt deposits.
Lake Assale	The sensitivity is considered to be <i>low</i> given that the area is open, deserted with limited vegetation and uninhabited.
Built forms/villages	The sensitivity is considered to be <i>medium</i> given their nomadic nature with almost no facilities and infrastructure.

Table 11.45 discusses the sensitivity of relevant views and viewpoints that are commonly used by human receptors (tourists and local people) within the ZTV.

Figure 11.2 Zone of Theoretical Project Visibility - Processing Plant

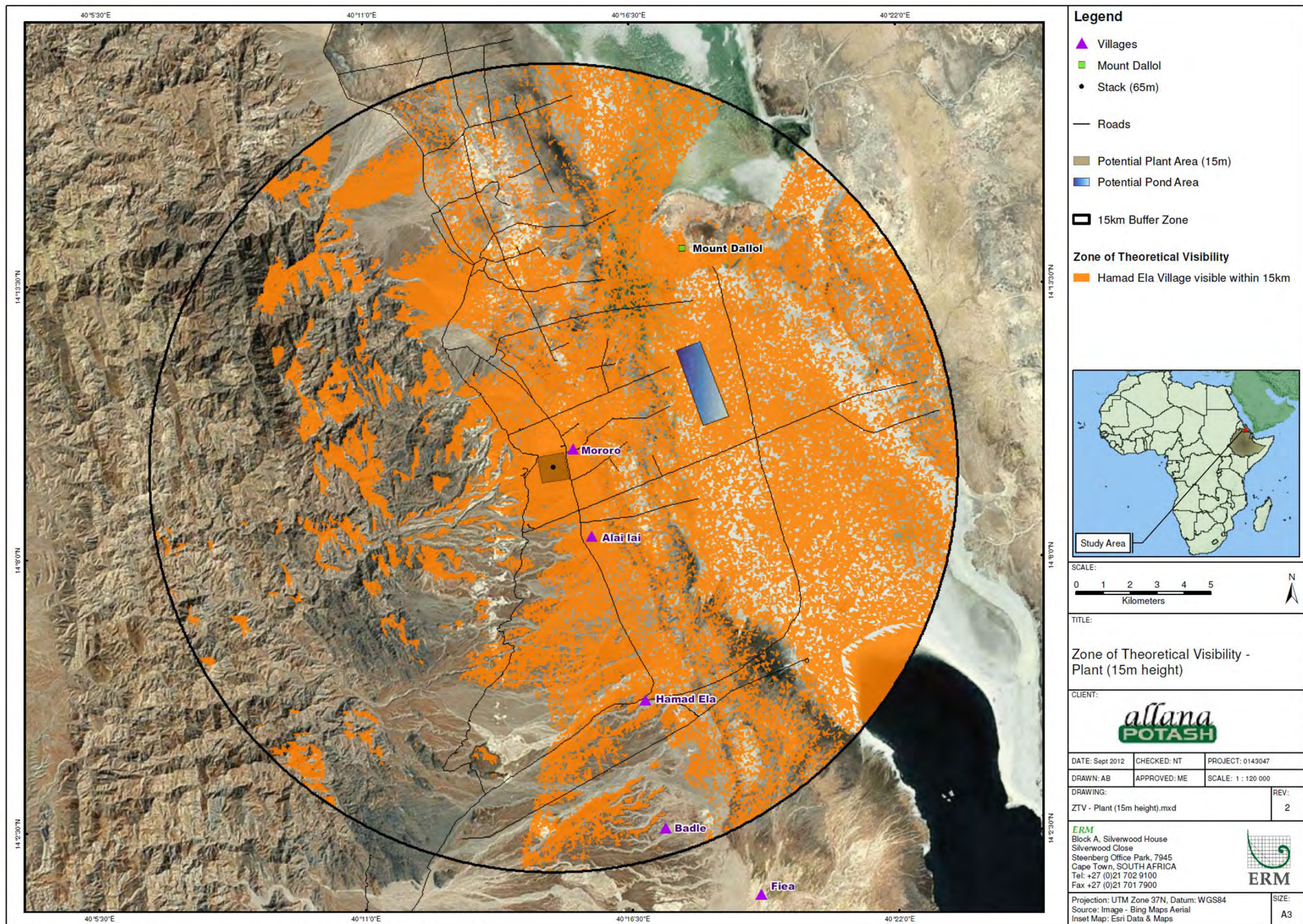


Figure 11.3 Zone of Theoretical Project Visibility - Stacks

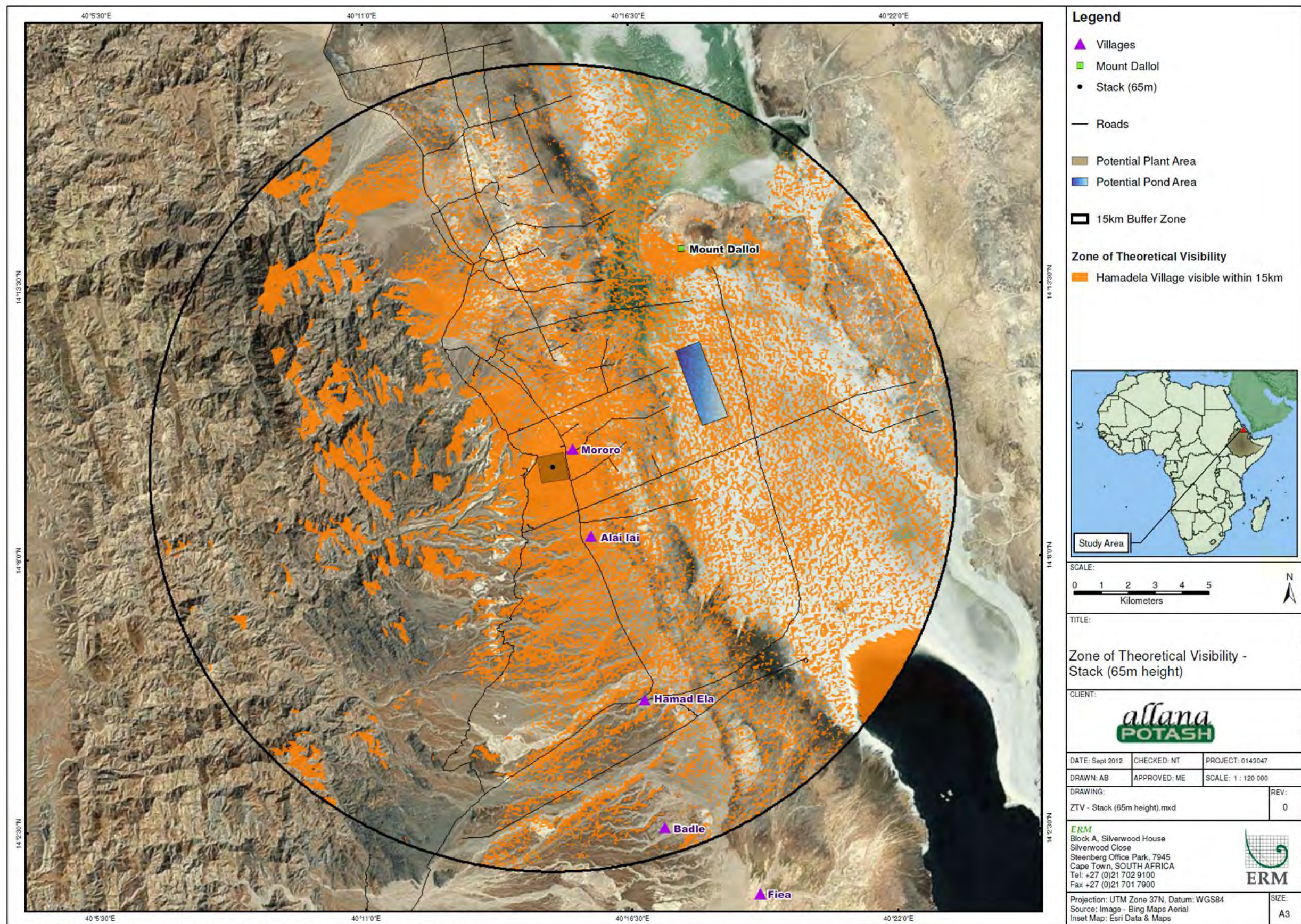


Table 11.45 Visual Impacts at fixed Viewpoint Locations

View Point (VP) Number	Description Of Viewpoint	Viewer Type and Number	Components in Existing View	Proposed View	Viewpoint Sensitivity
VP 4	View from base of Mount Dallol (approx. 3 km from site)	R(Few)	Dirt track, open clear land without any vegetation, hills in the background	Views of the proposed Project power plant along with associated infrastructure are barely visible. Some components can be recognised (e.g. processing plant) while others merge in the background.	Considering the distance and very small number of tourists the sensitivity is considered to be <i>medium</i> .
VP 6	View from western gravel foothills - (similar views will be available from Mororo village (approx. 500 m)	H(Few) T (Few)	Gravel and stones, open clear land without any vegetation, hills in the background	Direct views of the proposed power project, especially the processing plant and stockpiles.	Considering the distance and the very small number of residents and workers the sensitivity is considered to be <i>medium</i> .
VP 8	View from Hamad Ela village (approx. 6.2 km)	H(Few) R(Few)	Dirt track, open clear land without any vegetation, hills in the background(west)	Views of the proposed Project power plant along with associated infrastructure are barely visible. Some components can be recognised (e.g. processing plant) while others merge in the background.	Considering the distance and the small number of residents and tourists the sensitivity is considered to be <i>medium</i> .

Key: Viewer type: H = housing (residential); R = recreational; T = road users and commuters; W = workers.

Viewer numbers: Residential and Recreational: Many >50; Mod 15-50; Few 0-15, **Road users and Workers:** Many >1000, Mod >500, Few <500.

Significance of Impact (Pre-mitigation)

As discussed in Table 11.44 the sensitivity of the landscape character areas range from low (for open arid land and salt plains, and Lake Assale) to high (for Mount Dallol). The sensitivity of the villages is considered to be medium given their semi-mobile nature with almost no facilities and infrastructure.

Based on the individual visual environment and viewpoint sensitivities (see Table 11.45) the viewpoint sensitivity is considered to be medium given the small number of residents and workers and the small number of tourists.

Based on the magnitude of change in individual landscape character area (see Table 11.46) the magnitude of change for the landscape character areas range from being imperceptible (for Lake Assale) to being medium (for open arid land and salt plains, Mount Dallol and the villages of Mororo, Alai Lai and Hamad Ela).

Table 11.46 Magnitude of Change to Landscape Character Areas

Landscape Character Area	Magnitude of Change
Open Arid Land and Salt Plains	Magnitude of change is considered to be <i>medium</i> given the scale of project and large footprint of the concession area (15 X 18 km)
Mount Dallol	Magnitude of change is considered to be <i>medium</i> considering the distance.
Lake Assale	The magnitude of change is considered to be <i>imperceptible</i> given that the lake is approximately 8-10 km from the key components of the Project which have significant impacts.
Built forms/villages (Mororo, Alai Lai and Hamad Ela)	The magnitude of change is considered to be <i>medium</i> considering the distance and size of villages in comparison to the project.

Based on the magnitude of change in the visual environment and on viewpoints (see Table 11.47) the magnitude of change for the landscape character areas range from being small (views from Mount Dallol and Hamad Ela) to being medium (for views west of Mororo village).

Table 11.47 Magnitude of Change to Visual Environment and Viewpoints

Viewpoint (VP) Number	Description Of Viewpoint	Magnitude of Change
VP 4	View from base of Mount Dallol (approx. 3km from site)	The magnitude of change is considered to be <i>small</i> given the distance and that the project is barely visible. At this distance visibility will be affected by climatic factors.
VP 6	View from western gravel foothills - (similar views will be available from Mororo village (approx. 500 m)	The magnitude of change is considered to be <i>medium</i> given the distance and taking topography into consideration.
Vp8	View from Hamad Ela village (approx. 6.2 km)	The magnitude of change is considered to be <i>small</i> given the distance and as the project is barely visible. At this distance visibility will be affected by climatic factors.

Impacts to the landscape character during operation are considered to range from being not significant (for Lake Assale) to moderate (for Mororo and Alai Lai) to major (for Mount Dallol), as illustrated in *Table 11.48*.

Table 11.48 *Rating of Impacts Related to the Landscape Environment during the Operational Phase (Pre-Mitigation)*

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact is likely to be experienced by stakeholders living in nearby villages and also those who are further away to the south of concession area.
Duration	Long term	This will be a permanent change to the landscape
Scale	Medium	The salt plains are a large area with few inhabitants. The concession area is a substantial part of this landscape
Frequency	NA	
Likelihood (for unplanned events only)	NA	
Magnitude		
		Medium
The magnitude of change for the landscape character areas range from being imperceptible (for Lake Assale) to medium (for open arid land and salt plains, Mount Dallol and Villages)		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
High	The sensitivity of the landscape character areas range from being low (for open arid land and salt plains, Lake Assale) to high (for Mount Dallol). The sensitivity of the villages is considered to be medium given their nomadic nature with almost no facilities and infrastructure.	
Significant Rating Before Mitigation		
Negative Impact		The significance of impacts range from being <i>not significant</i> (for Lake Assale) to <i>moderate to major</i> (for Mount Dallol)
Not-significant		
	Moderate	Major

Impacts to the visual environment during operation are considered to range from being minor (view from Mount Dallol and Hamad Ela) to being moderate (view from Western Gravel Foothills near Mororo) as shown in *Table 11.49*.

Table 11.49 Rating of Impacts Related to the Visual Environment during the Operational Phase (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	This impact is likely to be experienced by receptors living in nearby villages and also those who are further away to the south of concession area e.g. residents of Hamad Ela and the tourists and travellers who visit Mount Dallol.
Duration	Long term	This will be a permanent change to available views in the area.
Scale	Ranges from small to medium	The desolate salt plains are a large area with few inhabitants.
Frequency	NA	
Likelihood (for unplanned events only)	NA	
Magnitude		
		Medium
The magnitude of change for the landscape character areas range from being small (views from Mount Dallol and Hamad Ela) to being medium (for views west of Mororo village)		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	The viewpoint sensitivity is considered to be medium given the small number of residents and tourists who visit the area.	
Significant Rating Before Mitigation		
Negative Impact		
Minor	Moderate	The significance of impacts range from being minor (view from Mount Dallol and Hamad Ela) to being moderate (view from Western Gravel Foothills near Mororo)

This impact will occur during the operations phase.

Three dimensional computer simulations (photomontages) have been prepared to illustrate the visibility of the proposed Project. Professional judgement has been used to assess the landscape and visual impacts assisted by field work photography from sensitive receptors. These computer simulations can be seen in *Figure 11.4, Figure 11.5, Figure 11.6, and Figure 11.7.* *Figure 11.8* shows the locations of these visual viewpoints.

Recommendations and Mitigation/Management Measures

The following mitigation measures are recommended throughout the operational phase of the proposed Project to further minimise landscape and visual impacts:

- The design, orientation and materials will be appropriately and reasonably developed to match existing site and landscape characteristics;

- Appropriate use of non-reflective surfaces and surface colour treatment;
- Minimisation of external signage clutter;
- Roads providing access to site facilities and works areas will be maintained free of dust where feasible;
- Outdoor lighting shall be as unobtrusive as possible and shall be shielded and directed downwards to prevent side spill. The use of tall mast lights shall be carefully assessed before being used due to proximity of settlements (especially Mororo and Alai Lai) and its inherent desolate location (specially for views from Mount Dallol and along tourist routes; and
- Monitoring to ensure that visual screening and dust control measures in the Management and Action Plans for the Project are implemented effectively.

Residual Impacts (Post-mitigation)

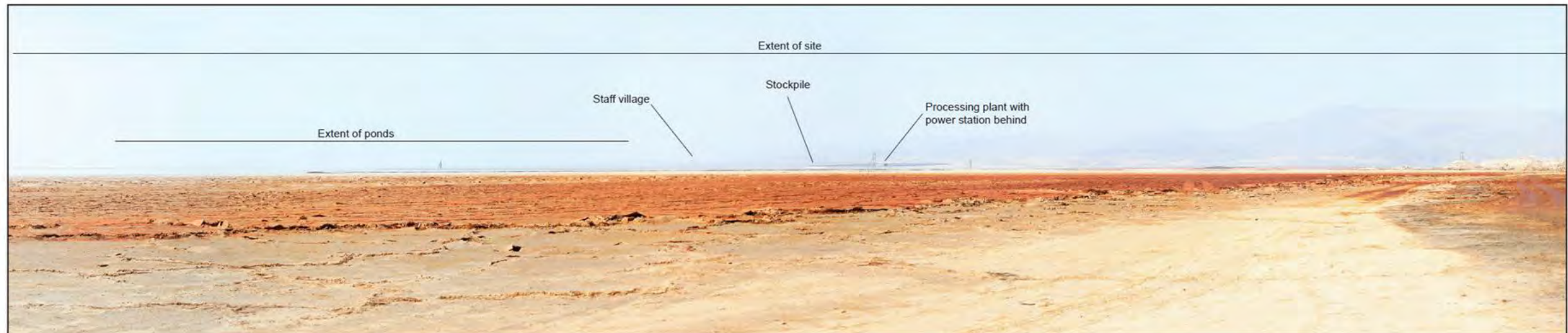
It is important to note that the height and bulk of the proposed Project is generally dictated by the relevant processes, and the use of recommended mitigation measures is limited in the current landscape. It is assumed that the recommended mitigation measures described are implemented and managed according to industry best practice. In addition the planned resettlement of Mororo and Alai Lai will remove potential receptors from the areas closest to the proposed Project.

Due to this the landscape and visual impacts of the development will be *slightly* reduced. Its residual landscape impacts during the operation stages will remain to be of '**Minor to Moderate-Major Significance**' for landscape and would range from '**Minor to Moderate**' for visual.

Figure 11.4 Photomontage View from Mount Dallol



Existing



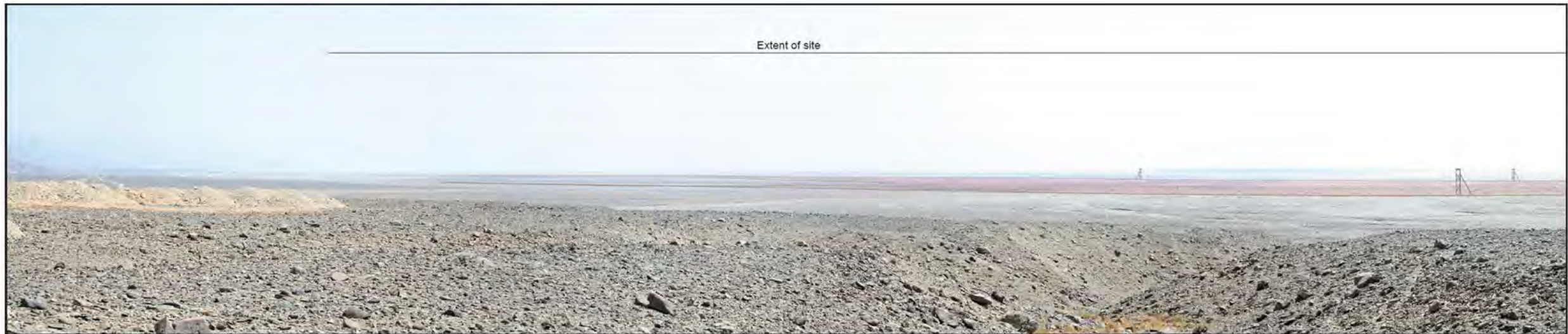
Proposed

Grid Reference:	640641 E 1573729 N	Notes: 1. Far away site features that would be hidden by mist are shown for clarity 2. Area for solution mining shown as a faded red wash with a 2m high boundary 3. Area for plant shown as a faded blue wash with a 2m high boundary 4. Power station shown as 17 (10m x 3 m x 3m high) blocks and 6 (4m high) stacks 5. Processing plant shown as a 50m x 100 m x 20m high block 6. Four mining head frames shown as 70m high towers with main frame 10m x 10m wide 7. Stockpile shown as 15m high with a flat area on top 100m x 50m 8. Two ponds shown 0.75km ² and 2.25km ² 9. Staff village shown as 10 buildings, 21m x 16m x 5m to eaves 10. Waste water treatment plant not shown	CLIENT:	Allana Potash	SIZE:	A3	Viewpoint 4 View from Mant Dallol in area where tourist vehicles park
Distance to site:	2.9Km			DATE: 21/9/12	CHECKED: NT	PROJECT:	
Direction from site:	NE			DRAWN: TMD	APPROVED: NT	0143047	
View point level:	-117m		Perspective	DRAWING:	REV: 0		

Figure 11.5 Photomontage View from West of Mororo (Left)



Existing



Proposed


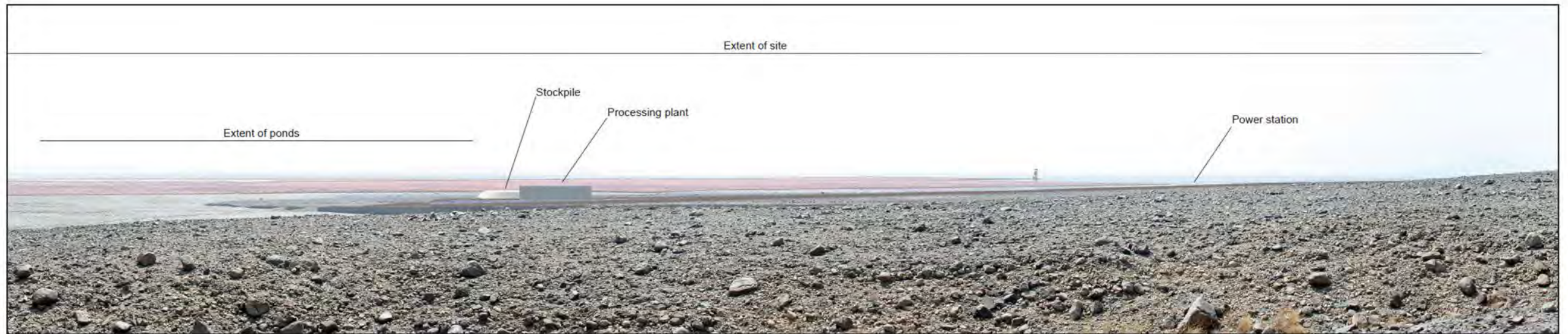
Grid Reference:	633596 E 1566426 N	Notes: 1. Far away site features that would be hidden by mist are shown for clarity 2. Area for solution mining shown as a faded red wash with a 2m high boundary 3. Area for plant shown as a faded blue wash with a 2m high boundary 4. Power station shown as 17 (10m x 3 m x 3m high) blocks and 6 (4m high) stacks 5. Processing plant shown as a 50m x 100 m x 20m high block 6. Four mining head frames shown as 70m high towers with main frame 10m x 10m wide 7. Stockpile shown as 15m high with a flat area on top 100m x 50m 8. Two ponds shown 0.75km ² and 2.25km ² 9. Staff village shown as 10 buildings, 21m x 16m x 5m to eaves (hidden by foreground) 10. Waste water treatment plant not shown	CLIENT:	Allana Potash	SIZE:	A3	Viewpoint 6 View from Western Gravel Foothills - Left Hand Side			
Distance to site:	0.55Km			DATE:	21/9/12	CHECKED:	NT	PROJECT:		
Direction from site:	SW			DRAWN:	TMD	APPROVED:	NT	0143047	REV:	0
View point level:	-51m			DRAWING:						
Photo taken:	17/5/12									
Horizontal field of view:	90°									
Viewing distance approx:	25.5cm for A3 print									
Perspective	Cylindrical									

Figure 11.6 Photomontage View from West of Mororo (Right)



Existing



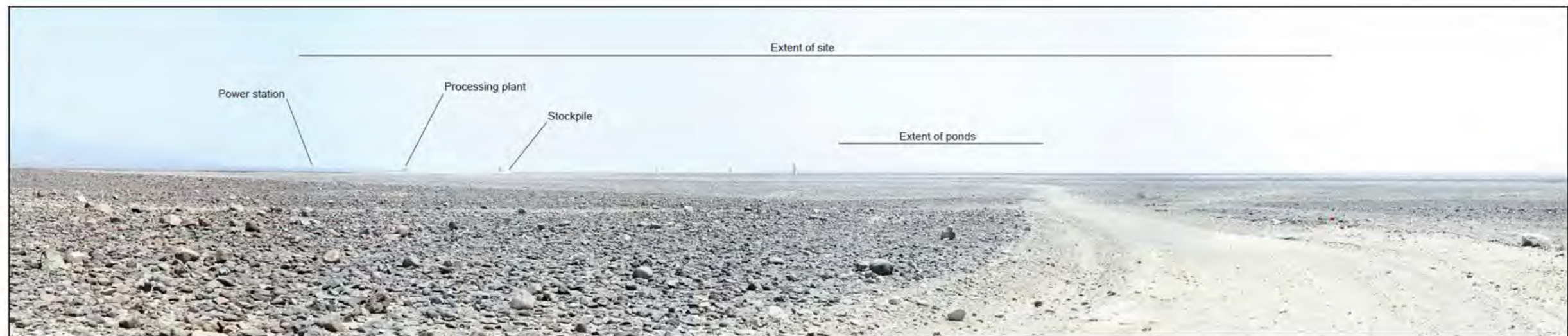
Proposed

Grid Reference:	633596 E 1566426 N	Notes:	<ol style="list-style-type: none"> 1. Far away site features that would be hidden by mist are shown for clarity 2. Area for solution mining shown as a faded red wash with a 2m high boundary 3. Area for plant shown as a faded blue wash with a 2m high boundary 4. Power station shown as 17 (10m x 3 m x 3m high) blocks and 6 (4m high) stacks 5. Processing plant shown as a 50m x 100 m x 20m high block 6. Four mining head frames shown as 70m high towers with main frame 10m x 10m wide 7. Stockpile shown as 15m high with a flat area on top 100m x 50m 8. Two ponds shown 0.75km² and 2.25km² 9. Staff village shown as 10 buildings, 21m x 16m x 5m to eaves (hidden by foreground) 10. Waste water treatment plant not shown 	CLIENT:	Allana Potash	SIZE:	A3	Viewpoint 6 View from Western Gravel Foothills - Right Hand Side		
Distance to site:	0.55Km				DATE:	21/9/12	CHECKED:		NT	PROJECT:
Direction from site:	SW				DRAWN:	TMD	APPROVED:	NT	0143047	REV:
View point level:	-51m									
Photo taken:	17/5/12									
Horizontal field of view:	90°									
Viewing distance approx:	25.5cm for A3 print									
Perspective	Cylindrical									

Figure 11.7 Photomontage View From Hamad Ela



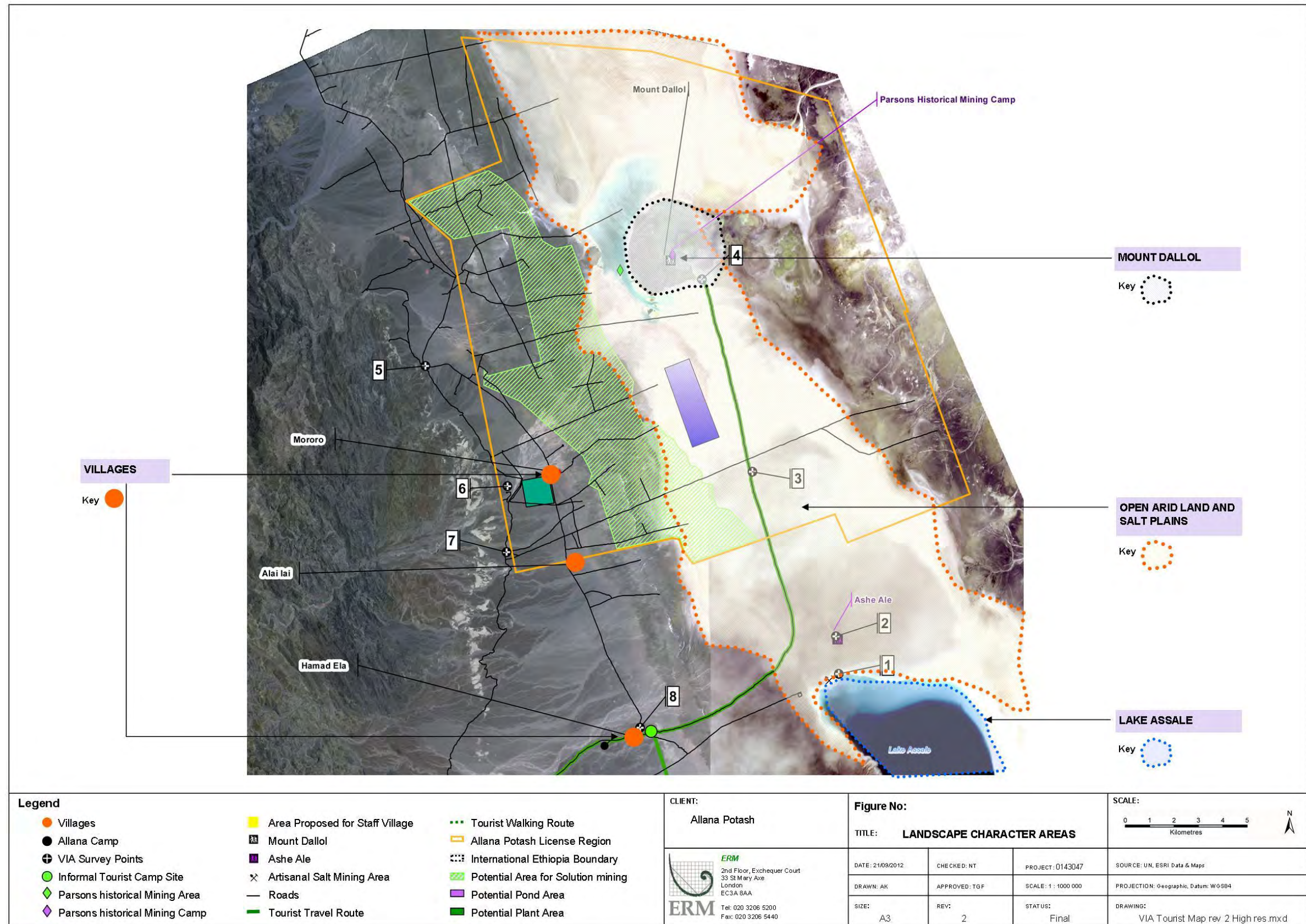
Existing



Proposed

<p>Grid Reference: 638390 E 1557854 N Distance to site: 6.2Km Direction from site: S View point level: -92m</p> <p>Photo taken: 17/5/12 Horizontal field of view: 90° Viewing distance approx: 25.5cm for A3 print Perspective: Cylindrical</p>	<p>Notes:</p> <ol style="list-style-type: none"> 1. Far away site features that would be hidden by mist are shown for clarity 2. Area for solution mining shown as a faded red wash with a 2m high boundary 3. Area for plant shown as a faded blue wash with a 2m high boundary 4. Power station shown as 17 (10m x 3 m x 3m high) blocks and 6 (4m high) stacks 5. Processing plant shown as a 50m x 100 m x 20m high block 6. Four mining head frames shown as 70m high towers with main frame 10m x 10m wide 7. Stockpile shown as 15m high with a flat area on top 100m x 50m 8. Two ponds shown 0.75km² and 2.25km² 9. Staff village shown as 10 buildings, 21m x 16m x 5m to eaves (hidden by foreground) 10. Waste water treatment plant not shown 	<p>CLIENT: Allana Potash</p> <p>SIZE: A3</p> 	<p>Viewpoint 8 View from Hamadela Village</p> <table border="1"> <tr> <td>DATE: 21/9/12</td> <td>CHECKED: NT</td> <td>PROJECT:</td> </tr> <tr> <td>DRAWN: TMD</td> <td>APPROVED: NT</td> <td>0143047</td> </tr> <tr> <td colspan="2">DRAWING:</td> <td>REV: 0</td> </tr> </table>	DATE: 21/9/12	CHECKED: NT	PROJECT:	DRAWN: TMD	APPROVED: NT	0143047	DRAWING:		REV: 0
DATE: 21/9/12	CHECKED: NT	PROJECT:										
DRAWN: TMD	APPROVED: NT	0143047										
DRAWING:		REV: 0										

Figure 11.8 Landscape Character Areas and Viewpoint Locations



11.9 *IMPACTS RELATED TO LABOUR AND WORKING CONDITIONS*

The impacts to labour and working conditions of Allana employees are discussed in the following section.

11.9.1 *Exposure of Workforce to Insufficient Health and Safety Standards*

Background

Description of the Baseline Environment

Allana have made commitments to comply with both Ethiopian legislation and international requirements including the relevant IFC Guidelines and Performance Standards and the Equator Principles. When Ethiopian regulations differ from the levels and measures presented in the EHS Guidelines, the proposed Project will be expected to achieve whichever is more stringent.

Ethiopia ratified the International Labour Organisation's (ILO) Occupational Safety and Health Convention (No. 155) in 1991, and several other ILO conventions relating to labour conditions including the Abolition of Forced Labour Convention (No. 105) and Worst Forms of Child Labour Convention (No. 182) in 1999 and 2003 respectively. Relevant Ethiopian legislation includes Part 7 of the Ethiopian Labour Amendment Proclamation (No. 494 of 2006) that outlines occupational health, safety and working environment requirements.

Allana have developed a Health and Policy Statement which outlines the provisions of Allana's Safety, Health and Environmental (SHE) Management System that includes:

- Safe and healthy working conditions;
- Arrangements for the operation, design and maintenance of safe systems for work;
- Proper maintenance of machinery;
- Information, instruction, training and supervision appropriate to the company's activities; and
- Arrangement for consultation with employees and their representation of health and safety matters.

Allana have committed to continue to develop their SHE Management System in alignment with international good practice. Allana have also developed an Emergency Response Plan (ERP) that identifies the appropriate response to incidents using a comprehensive response matrix. Allana have trained personnel and emergency equipment in place in the event of any emergency

occurring. In addition all site personnel, including contractors, are to be trained in the appropriate responses for fire and accident emergencies.

Allana have developed an Emergency Evacuation Plan (EEP) that applies to all contractors and authorised visitors who may be on site. The EEP provides a detailed procedure should an emergency evacuation of the camp be ordered.

Proposed Project Activities

The proposed Project will require Allana to employ a number of employees directly and through subcontractors during the construction, operation and decommissioning phases.

Currently it is anticipated that approximately 1,000 personnel will be required at peak construction and 442 permanent personnel will be required for management and maintenance during operations. This is estimated to be made up of approximately 98 skilled staff, 344 semi-skilled and 100 unskilled workers. A number of this workforce will be directly employed and some will be third party contractors not directly managed by Allana.

Sensitive Receptors

Mining and associated processing in the Danakil, albeit solution mining, involve inherent hazards. Without careful management the workforce employed to support the Project may be exposed to these as a result of insufficient health and safety standards, potentially resulting in injury or death. This may include, but not limited to:

- Exposure to dehydration and hyperthermia (heat stress) related to the extreme temperature;
- Injury associated with the use of machinery during construction and operation;
- Injury from vehicle (including aviation) accidents while travelling to and from and within the site;
- Vehicle and machine interfaces;
- Falls from height;
- Dropped objects;
- Exposure to noise;
- Exposure to dusts;
- Excavation (fall of ground from excavations);
- Exposure to poisonous insects, snakes etc.;

- Manual handling;
- Exposure to hazardous materials (including chemicals);
- Exposure to water hazards and drowning;
- Exposure to radiation sources; and
- Exposure to electricity both associated with portable and fixed equipment including medium and high voltage systems, sub-stations, transmission systems etc.

It should be noted that due to the extreme environmental conditions in the area surrounding the proposed Project baseline ambient air quality and temperature are expected to be very high.

As the number of employees increase it will become more difficult to manage the workforce and enforce the necessary health and safety standards, particularly amongst contractor staff and their sub-contractors. In addition the unskilled labour force is less likely to be accustomed to working to both national and international health and safety standards which may leave them more at risk of unsafe behaviours.

Furthermore, working in a remote area, in a country with less stringent and frequently poorly enforced labour laws and using primary and secondary subcontractors may result in Allana, contractors and suppliers being underprepared to meet national and international requirements, placing employees at risk.

This impact should be considered not only for Allana staff but also for third party contractors. Typically the lower down in the 'subcontractor hierarchy' a supplier is, the greater the risk for Allana health and safety standards to not be applied and therefore the higher the potential for exposure of workers to health and safety hazards.

Sensitive receptors may include employees who have a poor understanding of the requirements of OHS standards and their labour rights as enshrined by law. In addition the extreme nature of the Danakil Depression means that workers who are not used to the environmental conditions may be particularly sensitive.

Significance of Impact (Pre-mitigation)

This impact has been assessed as a '**Moderate Negative Impact**' prior to mitigation based on a combined evaluation of magnitude and sensitivity as illustrated in *Table 11.50*.

The magnitude has been evaluated as being medium as the impact may occur for as long as Project staff are working at the Allana Potash site from the construction phase through to decommissioning. The source of the impact will be removed once Allana have left the area.

The sensitivity of receptors is evaluated to be medium. Employees from other regions in Ethiopia and international employees are likely to have a better understanding of both national and international health and safety standards, and therefore understand the relevance of any training and mitigation measures and appropriate working conditions. However employees sourced from the Study Area may have a higher sensitivity to the impact due to a poorer understanding of OHS standards and working conditions, and lower literacy levels.

Table 11.50 Rating of Impacts Related to Health and Safety Standards (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The impact is only relevant for Allana’s workforce (including contractors) all of whom are at a local level (although they may come from elsewhere in Ethiopia or the world).
Duration	Long-term	Without mitigation and management measures the impact may continue for the duration of the Project. Severe consequences of the impact will potentially result in permanent impacts.
Scale	Approximately 442 employees exposed to the impact during operations	The construction workforce is estimated to be 1,000 at peak construction. Allana plan to hire at peak 442 personnel for the operation of the solution mine.
Frequency	Intermittent	Impact is likely to recur / occur intermittently and potentially for prolonged periods of time if management measures are not implemented and monitored.
Likelihood (for unplanned events only)	NA	
Magnitude		
		Medium
Medium Negative Impact		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	Receptors to this impact may include those contracted or subcontracted to work on the Project. Receptors with heightened sensitivity may include employees who have a poor understanding of the requirements of OHS standards.	
Significant Rating Before Mitigation		
	Negative Impact	
	Moderate	Moderate Negative Impact

This impact will begin during the construction phase and continue throughout operations and decommissioning while the Allana workforce is present.

Recommendations and Mitigation/Management Measures

Mitigation measures related to a fitness to work assessment and monitoring (refer to Section 11.5.2) will be relevant to this impact. In addition the measures detailed within the Worker Management Plan (WkMP) will help to mitigate this impact.

To avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by the Project.

- **Health and Safety Policies**

All Project staff including third party contractors will be subject to Allana's health and safety standards and policies. It is recommended that Allana develops and implements a detailed Occupational Health and Safety Management Plan and System. The Occupational Health and Safety (OHS) management plan should include but not be limited to:

- Hazard identification and risk assessment procedure;
- A 'fitness for work' programme to ensure that all employees are physically able to undertake their work without impact to their health;
- Occupational health and safety monitoring and surveillance programme;
- Mandatory OHS training programmes (including awareness-raising of disease vectors) provided to all employees, including contractors to ensure staff are aware of the health and safety guidelines;
- Specific OHS training programmes provided for workers assigned to tasks associated with particular H&S risks;
- Development of camp and workforce management protocols that reflect Allana's OHS standards and contractually require all contractors to comply as minimum standard;
- The provision and enforcement of use of appropriate Personal Protective Equipment (PPE);
- Visual warning signs in place, including those for the electrical and mechanical equipment safety warning, and chemical hazard warning; and
- Toolbox talks or health and safety meeting on a daily basis to ensure that procedures are being adhered to, and to discuss any incidents that have occurred.

In addition an OHS monitoring programs should be put in place to verify the effectiveness of prevention and control strategies.

- **Engagement with Workforce**

All workers (including those of primary and secondary third party contractors) will have contracts that clearly state the OHS terms and conditions of their employment and their legal rights, with copies provided in relevant local languages. Contracts will be verbally explained to all workers where this is necessary to ensure that workers understand their rights. This engagement will include OHS induction and training. Allana will implement their worker feedback mechanism and OHS event reporting system that allows workers (including contractors) to report health and safety events or issues.

- **Contractor Auditing**

All contractors will be audited on a quarterly basis for adherence to the relevant Ethiopian laws and Allana's OHS standards.

- **Actioning Health and Safety Gaps in Contractor Audits**

All contracts for primary and secondary contractors will specify OHS performance and monitoring in their contracts and will be required to action gaps in an agreed period.

- **Supply Chain Management**

All primary suppliers will be audited on a bi-annual basis for adherence to both national requirements and Allana's OHS standards. Regular auditing will serve to monitor Allana's primary supply chain and identify any significant changes or new risks arising.

Where significant health and safety risks are identified related to supply chain workers Allana will introduce procedures and mitigation measures to address these risks over a specified time period. If risks are not addressed Allana will look to change the primary supply chain by selecting suppliers that comply with Allana's OHS standards and national requirements.

A central part of supply chain management will consider identifying potential risks related to significant safety incidents, damage to the environment or use of child or forced labour.

- **Worker Feedback Mechanism**

As indicated in *Section 11.4.1* Allana should use the worker feedback mechanism to record and respond to any issues raised by employees in relation to OHS.

Residual Impacts (Post-mitigation)

Assuming the effective application of Allana’s OHS standards and the application of the aforementioned mitigation measures by the Project team the significance of the potential negative impact is assessed as a ‘**Minor Negative Impact**’. This reduction in significance results from the reduction of the magnitude from medium to small due to a decline in the frequency of the impact occurring.

Table 11.51 Rating of Residual Impacts Related to Health and Safety Standards (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The extent of the impact will remain local.
Duration	Short-term	The impact is less likely to have a long-term / permanent impact if mitigation measures are implemented.
Scale	442 employees during operations and approximately 1,000 construction workers (peak construction)	A potential reduction in the number of employees that are exposed / experience the impact throughout all phases. (Supply chain numbers not included).
Frequency	Rare	Decline in the frequency of the impact occurring from recurrent to rare.
Likelihood (for unplanned events only)	NA	
Magnitude		
		Small
Small Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		
Minor		

11.9.2 Exposure of Workforce to Insufficient Labour and Accommodation Standards

Background

Description of the Baseline Environment

As stated in Section 11.9.1 Allana Potash have made a commitment to comply with both Ethiopian legislation and international requirements including the IFC Guidelines and Performance Standards, and the Equator Principles.

During construction Allana plans to accommodate all staff in either their current Dallol Camp, a new temporary camp or within the Allana village to be constructed for the operational phase of the proposed Project.

During operations Allana plans to construct a camp to accommodate up to 442 staff at any one time. The following accommodation is planned for staff:

- Unskilled Staff: these staff will share an apartment with four persons. It is assumed that one person is always working in shift and another is on rotation and is absent;
- Semi-skilled Staff: these staff will share an apartment with two persons; and
- Skilled Staff: these staff will have their own apartment.

In total 200 apartments are planned to be constructed. Each apartment will have a base area of 30m² and will be furnished with sanitary facilities, a kitchen and air-conditioning and will be constructed to meet both national and international standards. The apartments will be constructed in 10 separate buildings, each with two floors.

Allana intend to house contractors in in either their current Dallol Camp, a new temporary camp or within the Allana village to be constructed for the operational phase of the proposed Project.

Allana intend to require staff to work a six week on, two week off rotation, including an eight hour working day, seven days a week.

The most relevant national legislation regarding worker accommodation is the Ethiopian Labour Amendment Proclamation, in particular Parts 2, 3, 4 and 6 that outline requirements on employment relations, wages, weekly rest and hours of work and working conditions for women and youth. In addition Ethiopia has also ratified several other ILO conventions relating to weekly rest, employment services, abolition of forced labour, the minimum age for employment and elimination of discrimination in the workplace.

Ethiopia however has been identified by the ILO to have significant labour issues particularly with regards to child labour; a national Child Labour Survey conducted in 2001 with ILO assistance indicated that 52% of children aged between five - 17 years were economically active ⁽¹⁾. In addition although Ethiopian law includes legislation on labour conditions regulation and monitoring is identified as the reason for shortfalls in current labour conditions.

During the ESHIA stakeholder engagement process, complaints were made regarding Allana's employment practises (including labour and accommodation conditions for local employees; employment, dismissal and retrenchment procedures and perceived gender disparities in employment).

(1) ILO, 2008

Allana are in the process of implementing a SHE Management System and a Human Resources Management System. These systems will take into account the relevant OHS requirements and labour standards.

Proposed Project Activities

The Project will require that Allana employ 442 employees directly and through subcontractors during operations. During construction this will include a workforce of approximately 1,000. There is risk that employees may be exposed to insufficient labour and accommodation standards which will affect their wellbeing, health and safety.

A minority of staff will be local Afar living in their own quarters in Hamad Ela or other nearby villages. Taking into account the comments raised during engagement with regards to labour and accommodation, the difference in accommodation may have the potential to create perceptions of inequality and generate tension among the workforce.

Sensitive Receptors

Should workforce experience insufficient labour and accommodation standards they will be negatively impacted including affecting their legal rights, their psychological well-being, as well as increasing the chances for health and safety impacts (refer to Section 11.9.1) such as increased disease and to conflict.

This impact should be considered not only for Allana staff but also for primary and secondary subcontractors. Typically the lower down in the 'subcontractor hierarchy' a supplier is, the greater the risk for Allana health and safety standards to not be applied and therefore the higher the potential for exposure of workers to health and safety hazards.

Receptors to this impact may include those contracted or subcontracted to work on the Project. Sensitive receptors may include employees who have a poor understanding of the level of national and international requirements for labour and accommodation standards or a lower literacy levels.

Significance of the Impact (Pre-mitigation)

Based on the analysis provided, the impact resulting from insufficient labour and accommodation standards is evaluated to be a '**Moderate Negative Impact**'.

The magnitude has been evaluated as medium based on the potential for the impact to occur once employment begins, from construction through to decommissioning. The duration of the impact will be long-term if management measures are not put in place, and potentially result in severe consequences.

The sensitivity of the receptor is evaluated to be *medium*. Employees from other regions in Ethiopia and international employees are likely to have an improved understanding of both national and international standards, and therefore understand the relevance of any training / mitigation measures provided. However employees sourced from the Study Area may have a higher sensitivity to the impact due to poorer understanding of national and international labour and accommodation standards, and on average lower literacy levels.

Table 11.52 Rating of Impacts Related to Labour and Accommodation Standards (Pre-Mitigation)

Type of Impact		
	Negative	Direct
Direct Negative Impact		
Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The impact is only relevant for Allana's workforce all of whom are situated at a local level.
Duration	Long-term	Without mitigation and management the impact may continue for a prolonged period, commencing from construction through to the decommissioning phase of the Project.
Scale	Greater than 442 personnel	Allana plan to hire approximately 442 personnel during operations. The number of people employed during construction is anticipated to be approximately 1,000.
Frequency	Recurrent	Impact is likely to recur / occur for prolonged periods of time if management measures are not implemented and monitored.
Likelihood (for unplanned events only)	NA	
Magnitude		
		Medium
Medium Negative Impact		
Sensitivity/Vulnerability/Importance of the Resource/Receptor		
Designation	Summary of Reasoning	
Medium	Receptors to this impact may include those contracted or subcontracted to work on the Project. Receptors with heightened sensitivity may include employees who have a poor understanding of the level of national and international requirements for labour and accommodation standards.	
Significant Rating Before Mitigation		
Negative Impact		Moderate Negative Impact
	Moderate	

This impact will begin during the construction phase and continue throughout operations and decommissioning while the Allana workforce is present.

To avoid and reduce the significance of this impact the following mitigation and management measures have been developed for adoption by the Project team and contractors. This impact will also be mitigated using the measures described in *Section 11.9.1*.

- **Accommodation Standards**

All accommodation will be built in adherence with international best practice, including the IFC (and European Bank of Reconstruction and Development - EBRD) standards and guidelines on worker accommodation. Allana should put in place and implement policies on the quality and management of accommodation and provision of basic services. In addition accommodation services provided should be consistent with the principles of non-discrimination and equal opportunity.

- **Contractor Accommodation**

Allana will provide or oversee contractor accommodation to ensure that it is of a standard that is in adherence with their requirements.

- **Labour Standards**

Allana will develop a comprehensive set of labour policies that enforce the principles of non-discrimination and equality and ensure compliance with national and international labour requirements. Labour policies will work to protect workers particularly vulnerable groups and ensure equality of opportunity and treatment.

The labour policies will include a range of aspects on labour conditions however it should cover fundamental requirements on working hours, wages, overtime, compensation and retrenchment. The labour policies will also outline clear prohibition of any forms of forced labour and child labour.

All Project staff including contractors and suppliers will be subject to the labour standards put in place. All staff will be given specific training surrounding labour standards.

- **Contractor Auditing**

All contractors will be audited on a quarterly basis for adherence to Ethiopian laws and Allana's standards for labour and accommodation.

- **Actioning Gaps relating to Labour and Working Conditions in Subcontractor Audits**

All contracts for primary and secondary contractors will specify labour and accommodation performance and monitoring, and contractors will be required to action gaps in an agreed period.

- **Engagement with Workforce**

All workers (including those of primary and secondary contractors) will have contracts which clearly state the labour and accommodation terms and conditions of their employment and their legal rights (in suitable languages). Contracts will be verbally explained to all workers where this is necessary to ensure that workers understand their rights. The engagement will include induction and training. In addition workers will make use of the grievance mechanism and event reporting system that Allana puts in place to allow workers (including contractors) to report events or issues.

Residual Impacts (Post-mitigation)

Assuming the effective application of the aforementioned mitigation measures by the Project team the significance of the impact is assessed as a '**Minor Negative Impact**'.

The reduction in significance results from the reduction of the magnitude from medium to small due to a decline in the frequency of the impact occurring, and a decline in the potential for long-term impacts occurring.

Table 11.53 Rating of Residual Impacts Related to Labour and Accommodation Standards (Post-Mitigation)

Rating of Impacts		
Characteristic	Designation	Summary of Reasoning
Extent	Local	The extent of the impact will remain at the local level.
Duration	Short-term	Insufficient labour and accommodation standards are less likely to occur over the long-term if mitigation measures are put in place from construction.
Scale	More than 442 personnel	The number of employees exposed to insufficient standards is likely to decrease with the implementation of mitigation measures.
Frequency	Intermittent	Decline in the frequency of the impact occurring from recurrent to intermittent.
Likelihood (for unplanned events only)	NA	
Magnitude		
Small		
Small Magnitude		
Significant Rating After Mitigation		
Minor Negative Impact		
Minor		

11.10

SUMMARY OF IMPACTS AND RESIDUAL IMPACTS

A summary of pre and post (residual) mitigation social impacts is provided in *Table 11.54*.

Management Plans detailing mitigation measures aimed at reducing impact, and the management and monitoring of residual impacts is also detailed in each of the respective Management Plans in Volume III *Annex A to N*.

Table 11.54 Summary of Impacts

Impact	Significance (pre-mitigation)	Residual Impact Significance
Impacts Related to Resettlement		
Resettlement of Mororo and Alai Lai.	Major	The resettlement planning of Mororo and Alai Lai will include specific monitoring and management measures to scrutinise the post-resettlement effects. These measures will help to assess the residual impact of the resettlement; however, as the resettlement planning has only begun in January 2013 a residual impact rating cannot be awarded.
Impacts to Socio-Economics and Livelihoods		
Increased income generating potential from direct and indirect contracting at a local, regional and national level.	Positive	N/A
Increased income generating opportunities related to in-migration.	Positive	N/A
Reduced productivity of livestock related to a decline in productivity of pasture.	Moderate	Minor
Reduced income generating opportunities related to artisanal salt mining.	Major	Moderate
Reduced income generating opportunities related to palm collecting and processing.	Major	Moderate
Reduced income generating opportunities from tourism.	Minor	Positive
Increased cost of living due to localised inflation.	Moderate	Minor
Impacts to Social and Cultural Cohesion		
Erosion of traditional governance mechanisms.	Moderate	Minor to Moderate
Loss of local 'sense of place' and decreased social and cultural cohesion.	Moderate	Minor
Impacts to Community Health, Safety and Security		

Impact	Significance (pre-mitigation)	Residual Impact Significance
Decline in health profile due to decreased availability and / or quality of ground water.	Major	Positive
Increase in vector borne and communicable diseases.	Major	Minor
Worsening of health profile related to spills, emissions and contamination.	Major	Moderate
Increased injuries and mortality of traffic accidents.	Major	Moderate
Increased inter and intra community conflict.	Major	Moderate
Increased marginalisation of vulnerable and sensitive groups.	Moderate	Minor
Increased anti-social behaviours.	Moderate	Minor
Increased violence and conflict between community and security providers.	Major	Moderate
Impacts to Tangible Cultural Heritage and Archaeology		
Limited access to cultural heritage or archaeological sites.	Negligible-Moderate	Negligible-Moderate
Disturbance, damage to cultural heritage and archaeological sites (groundworks).	Moderate - Major	Negligible - Major
Disturbance, damage to cultural heritage and archaeological sites (increased access for non-locals).	Negligible -Moderate	Negligible -Moderate
Impacts to Physical and Social Infrastructure		
Reduced access, pressure and overburdening of physical and social infrastructure.	Major	Minor
Improvements related to community development initiatives.	Positive	N/A
Impacts to Landscape and Visual Environment		
Impacts to landscape and visual environment during construction.	Minor	N/A

Impact	Significance (pre-mitigation)	Residual Impact Significance
Impacts to landscape environment during operations.	The significance of impacts range from being <i>not significant</i> (for Lake Assale) to <i>moderate to major</i> (for Mount Dallol)	The residual landscape impacts during the operation stages will remain to be of 'Minor to Moderate-Major Significance' for landscape environment
Impacts to visual environment during operations.	The significance of impacts range from being minor (view from Mount Dallol and Hamad Ela) to being moderate (view from Western Gravel Foothills near Mororo)	The residual landscape impacts during the operation stages will remain to be of 'Minor to Moderate' for visual environment
Impacts Related to Labour and Working Conditions		
Exposure of workforce to insufficient health and safety standards.	Moderate	Minor
Exposure of workforce to insufficient labour and accommodation standards.	Moderate	Minor

The IFC Performance Standard 1 (Paragraph 5) defines the broader Project area to include "... areas potentially impacted by cumulative impacts from further planned development of the Project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken."

In addition, the IFC Performance Standard 1 (Paragraph 6) states that the "... assessment will also consider potential trans-boundary effects, such as pollution of air, or use or pollution of international waterways, as well as global impacts, such as the emission of greenhouse gases."

Cumulative impacts are those impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the proposed Dallol Potash Project. Cumulative impacts are therefore generally impacts that act with others in such a way that the sum is greater than the parts. This is, however, not always the case – sometimes they will simply be the sum of the parts, but that sum becomes significant.

This chapter considers the cumulative impacts that would result from the combination of the proposed Project and other actual or proposed future developments in the broader Study Area.

12.1

DEVELOPMENT CONTEXT

In addition to the proposed Dallol Potash Project the Study Area may experience cumulative impacts due to:

- A planned government constructed road leading from Mekele, through Berahale Town to Bada Village. This road is currently being engineered and constructed by the Ethiopian Government and will include an improved paved road surface;
- A government transport route leading from the Tadjoura Port in Djibouti to Serdo, Afdere and the proposed Project Area through the Danakil Depression is currently being planned. The route will follow an existing road network between Tadjoura Port, Serdo and Afdere; however, a road will need to be constructed between Afdere and the Project Area. To date it is still uncertain as to whether Allana or the government will construct the portion of road between the Project Site and Afdera. Furthermore, it should be noted that it has not been decided whether this shall be a rail or road transport route; and

- A series of planned and existing advanced exploration mining projects including:
 - BHP completed their first phase of seismic surveys and had entered into the exploration drilling programme, when they decided to withdraw from their project in the Danakil. To date, BHP still hold the license to their concession (refer to *Figure 2.3* in *Chapter 2*).
 - Yara / Sainik Potash's project is in exploration phase and have embarked on a solution mining pilot programme and pilot evaporation ponds (refer to *Figure 2.3* in *Chapter 2*);
 - Stratex International's Blackrock gold exploration project approximately 30 km from Allana Potash Project; and

These cumulative factors may exacerbate the impacts identified in *Chapters 10* and *11*. Where these impacts may be intensified by these cumulative factors they are discussed in the following sections.

Given the limited detail available regarding such future developments, the assessment that follows is necessarily of a generic nature and focuses on key issues and sensitivities, and how these might be influenced by cumulative impacts with other planned development. Many of the recommendations emerging from this analysis are relevant to the Government of Ethiopia, the local administration and future private developers and may not be commitments or actions for the proposed Dallol Potash Project, or at least not in isolation.

12.2 IDENTIFIED CUMULATIVE IMPACTS

The cumulative impacts that would result from a combination of the proposed Dallol Potash Project and the abovementioned additional developments in the Study Area include:

- Impacts to both surface and groundwater;
- Impacts to air quality;
- Impacts to the noise environment;
- Impacts to the ecology; and
- Impacts to the social environment.

Each of these potential cumulative impacts is described below.

Cumulative Impacts

The majority of rivers in the Study Area are ephemeral with the exception of the Sabah River (over 10km south of the Project Area). This river is one of three perennial water bodies in the Region (the others being the Regali River to the north and the Wadi Ainallah ca. 25km south of the Sabah River). These ephemeral river systems are important oases in an otherwise hyper-arid environment, in terms of both a source of water supply to communities and in terms of supporting aquatic life.

It has been observed that some government and road construction vehicles are washed in the Sabah River and this has the potential to contaminate the river system, leading to impacts to biodiversity (impacts to the aquatic ecology as a result of the vehicle crossing point over the Sabah River downstream of this point, have already been observed).

With further mining developments in the Region, increased accessibility made possible by the construction of the government road from Berahale to Bada, and possible influx of further people attracted to the Study Area by job opportunities, these ephemeral river systems are likely to come under increasing pressure, not only in terms of water abstraction, but also in terms of the potential contamination of these river systems by diffuse sources of pollution (such as sewage), waste disposal, the washing of vehicles, and potential spillages of fuels and chemicals.

Management Considerations

- All sites to provide wash bays on site, which are to include oil/grease and sediment traps for grey water, before this water is released off-site.
- All sites to develop procedures for handling of fuels, chemicals and wash-down of vehicles in a manner that does not impact on the environment.
- All sites to store chemicals and fuels in bunded areas, and to ensure emergency spill response equipment is stored near to all chemical and fuel storage sites.
- All sites to adopt a zero discharge policy for raw sewage and other untreated waste water. Sewage and waste water (from wash bays, grey water from kitchens and shower blocks etc.) should be treated to conform to recognised standards before discharge.
- A low level bridge along the path of the access road into the Study Area should be constructed over the Sabah River. This bridge should be constructed to withstand 1:100 year flood events. It is believed that the government will construct such a bridge as part of the road development between Berahale and Bada. Culverts and bridges over ephemeral river systems bisecting mine concession areas, should be constructed over such systems to prevent blockages and flooding.

- Mine sites should maintain flood control systems which ensure the separation of dirty water (e.g. that water used in the processing plants) with clean storm water runoff.
- Mine sites should establish a recruitment and procurement system. Furthermore, impacts related to influx can be managed (to a certain degree) by reducing the appeal of the area to opportunistic migrants through the management of localising employment and procurement opportunities wherever possible.

12.2.2

Geohydrology

Cumulative Impacts

The Yara/ Sainik Potash project will be located in close proximity to the proposed Dallol Project; less than 5km from Allana's concession area. The project is currently in the exploration and pilot plant phase; this phase is unlikely to result in cumulative impacts, as current water demand is relatively low.

However, as a conservative approach the operational phase of the project needs to be considered. Current understanding of the project is that it will be of a similar scale as the proposed Dallol Project, will also utilise solution mining as a mining method, and will require similar volumes of water (~16 Mm³/a) as Allana's water needs for this purpose.

The groundwater located in the alluvial fans to the west of the Study Area will likely be the target water source for solution mining production water, for both Allana and the Yara/ Sainik Potash project. Fugro (2012) conceptualize a potential groundwater reservoir with a volume of approx. **180 000 000 m³**, dependent on the water quality, which may render some water too brackish for use in solution mining. Based on the outcomes of pump testing and groundwater level measurements, Fugro (2012) estimate a subsurface influx (recharge) from the west of between **35.7 Mm³/a and 55.2 Mm³/a**, which indicates a considerable influx (recharge) into the alluvial fans through large fault structures. Based on this data, sufficient water for use by both mining companies is probable, although this resource will need to carefully and diligently managed.

Management Considerations

All potash mining companies utilising solution mining, will require water of a low mineralisation in their processing plants. By over-abstraction of the aquifer, Allana and Yara/Sainik will jeopardise the availability of good quality water for this process. Both mining companies therefore have a vested interest in managing the aquifer sustainably, not only in terms of quantity, but also in terms of water quality.

To do this, it is essential that both (and any potential future) mining companies manage this shared water resource in a transparent and collaborative manner. It is essential therefore that from the viewpoint of sustainability and to prevent salt water intrusion, an agreement is reached between mining companies *to abstract only an amount of ground water equal to the average recharge*. To ensure this objective is met, the following management measures are required:

- Continued long term monitoring of groundwater levels in boreholes and wells on a regional scale.
- Monitoring of groundwater levels and water quality in the Study Area on a collaborative basis.
- Development of a groundwater model that takes into account cumulative impacts. The outcome of such a model should be used to manage the aquifer in a collaborative and transparent manner.

12.2.3

Air Quality

Cumulative Impacts

The IFC states that for un-degraded airsheds, impacts from any one project should not exceed 25% of any air quality standards, and ERM interpret the IFC guidance such that in degraded airsheds no one project should exceed more than 10% of any air quality standard. The potential cumulative impacts to air quality in the Study Area are discussed in this section.

Increased Airborne Emissions as a Result to Construction Activities

With regard to construction activities, there is the potential for significant negative cumulative impacts to arise. These impacts are associated with the generation of dust, PM₁₀ and PM_{2.5} during the construction phase of the proposed Project and the construction phase of other developments in the Study Area.

The magnitude of the potential cumulative impact may be minor, moderate or major, depending upon how the impacts from other developments combine with impacts arising from the proposed Dallol Potash Project and the respective timing of these impacts. Airborne emissions during the construction phases of individual projects (and as a result the cumulative impact) will be exacerbated by elevated wind speeds. However, as construction activities are temporary and subject to a high degree of mitigation, the potential for significant impacts are reduced as dust raising activities would need to be coincidental on other development locations.

Increased Traffic Volumes during the Construction and Operational Phases

The potential for significant cumulative impacts to arise from airborne emissions from traffic during the construction and operational phases of the

proposed Project and other developments in the Study Area are possible. These emissions will be attributed to vehicular emissions and dust lifted from road surfaces. However, if main haul roads are paved, impacts to roadside sensitive receptors predicted to arise from the vehicles associated with the proposed Project are deemed (post-mitigation) to be negligible. Nevertheless, where unpaved internal access roads are used there is the potential for major adverse impacts associated with emissions of dust, PM₁₀ and PM_{2.5}. These effects are particularly significant if the same unpaved road is used by Allana and traffic from other developments. However, should the villages of Alai lai and Mororo be resettled to outside of the Project Area, then the cumulative impact of these activities is expected to be of negligible significance.

Increased Potash Processing and Handling of Tailings

Chapter 10 established that the processing of potash product would not result significant airborne emissions, as potash processing will take place in an enclosed area so as to prevent product loss. Furthermore, air borne emissions from the handling of tailings is expected to be negligible as tailings rapidly dry and from a solid crust. As such, the cumulative impact of these activities is expected to be of negligible significance.

Increased Need for Power Generation

Impacts associated with power generation for the proposed Project are only significant in close proximity to the power generation compound (within a radius of 350m should a 3m stack be used). On this basis, it is highly unlikely that other developments will result in significant impacts within this zone and therefore there is considered to be no potential for significant cumulative impacts to arise from this aspect of this Project and other potash developments.

Management Considerations

On this basis, there are potentially significant cumulative air quality impacts associated with construction activities and the use of unpaved roads. This would be particularly significant if the construction phase of the proposed Project were to be co-incidental with the construction phase of other developments detailed in *Section 12.1* above, for example those at Yara/Sainik. In the case of construction activities, the implementation of the mitigation measures recommended in *Chapter 10* and the AQMP (*Annex A of Volume Three*) is considered likely to render the impacts associated with construction activities as negligible during most circumstances. However, during periods of particularly adverse weather conditions (i.e. on days when the wind speed is particularly elevated), or when activities elsewhere are resulting in major emissions of dust, there may be call to reduce dust causing activities associated with Allana or defer particularly dusty activities until such time as other activities are ceased, or weather conditions improve. In the case of

unpaved roads, the mitigation recommendations set out in *Chapter 10* are considered adequate to render residual impacts as negligible.

12.2.4 *Noise Environment*

Cumulative Impacts

This section details activities associated with the proposed Dallol Potash Project and other developments in the Study Area that have the potential to result in cumulative impacts to the noise environment.

Increased Noise Levels associated with Construction and Decommissioning Activities

It was noted in *Chapter 10* that noise levels associated with activities during the construction and decommissioning phases of the proposed Project would result in a negligible negative impact.

Should construction and decommissioning phases of other developments in the Study Area run in parallel with the said phases of the proposed Project, it is possible that the cumulative noise impact of activities carried out in these phases may increase from the direct impact predicted in *Chapter 10*; however, this is dependent on how the impacts from other developments combine with the impacts from the proposed Project, and the respective timing of these impacts. However, this said, construction sites between developments will vary in their locality and hence it is unlikely that there will be a cumulative increase in predicted noise levels for noise sensitive receptors (NSR's), and in particular the villages of Alai lai and Mororo (especially if these two villages are resettled).

Increased Noise Levels associated with Activities during the Operational Phase

As the Project proposes to operate 24 hours, 7 days per week, 365 days per year, night time noise impacts to villages in close proximity to the proposed Project (Alai lai and Mororo) would be significant. Furthermore, because predicted noise levels for operational activities can potentially be heard as far as 5km from source, it is possible that that the incremental increase in the predicted noise environment (as a result of potential noise contour overlap) may be increased as a result of other developments in the Study Area (in particular other mining operations). However, based on the assumption that Alai lai and Mororo Villages will be resettled, the cumulative impact of these activities is expected to be of negligible significance.

Increased Noise Levels from Haul Roads out of the Danakil Depression

It is likely that other mining companies (such as Yara/Sainik) will use the same main haul road to transport product out of the Danakil Depression during the operational phase. Although this will result in an increase in the

number of road (highway) trucks utilising the road, the actual predicted noise level will not increase; rather, the predicted road noise levels will become less intermittent. As such, should the main haul road be built at a *distance greater than 45m* from NSRs it is the opinion of this ESHIA that cumulative impacts from road noise will still be a negligible negative impact.

Management Considerations

As such, there are potentially significant cumulative noise impacts associated with potential noise contour overlap associated with operational phase mining activities between mining companies in the Study Area. This would be particularly significant if mining infrastructure (such as processing plants etc.) between mining companies were sited in relatively close proximity to one another. The implementation of the recommended resettlement of Alai lai and Mororo Villages is considered likely to render the impacts associated with the aforementioned activities as negligible during most circumstances.

12.2.5 *Ecological Environment*

Cumulative Impacts

The cumulative ecological impacts that would result from a combination of the proposed Dallol Potash Project and other developments in the Study Area are discussed in this section.

Increased Groundwater Extraction

There are a number of other potash mining concessions surrounding the Allana concession. Solution mining represents the simplest and most cost effective approach to mine potash in this Study Area, and the demand for groundwater is thus expected to rise dramatically in the short to medium term. Increased groundwater abstraction would pose a greater risk to the highly sensitive Salt Pan Fringe Habitat type, which, if not managed correctly, would indirectly impact on terrestrial fauna utilising this habitat for refuge and foraging. Furthermore, increased groundwater abstraction would potentially result in a greater drawdown of the groundwater fed pools in Mororo and Hamad Ela, which in turn will pose added risk to the rare Killifish (*Aphanius dispar*).

Increased Influx and Uncontrolled Settlement

Influx and uncontrolled settlement of immigrants into the Study Area will occur as the area becomes developed. The Afar Triangle has largely been cut off and isolated from the remainder of Ethiopia and neighbouring countries; however, the development of advanced infrastructure networks will remove this isolation. Subsequent economic opportunities presented are bound to result in an influx of employed staff and hopeful job seekers. This will

potentially result in added pressures to terrestrial Red Data species such as Egyptian Vultures (*Neophron percnopterus*) and Striped Hyena (*Hyena hyena*), as communities generally have a negative perception of scavengers and tend to discourage their presence. Furthermore, should influx not be managed correctly, the banks of the Sabah River will be the likely area that immigrants will settle. This is largely due to it being the only source of fresh water into the Study Area. Increased human presence in this area will result in the cumulative impacts to a range of biodiversity that rely on the Sabah River as a form of sustenance or a corridor to penetrate the adjacent inhospitable bare lands.

Increased Disturbance to the Artisanal Salt Trade from an Ecological Perspective

Developments involving improvements to the transport route (such as the government road and the route planned between the Project Area and Afdera) bring the risk that trucks could be used to transport salt to distant markets and cause the current camel trains to become a historical feature of the area. As is discussed in *Chapter 10*, the Egyptian Vulture and Hyena populations are thought to depend on camel carcasses originating from old and weak animals brought to the area by the annual salt trade.

Management Considerations

It is recommended that Allana and other developers in the Study Area regard and agree on the following considerations related to the management of ecology in the Study Area:

- Adequate management of the shared groundwater resource in a transparent and collaborative manner, as is described in *Management Considerations* in *Section 12.2.2* above.
- The development of set-aside areas. It is recommended that set-aside areas between developers be connected so as to avoid having piecemeal and disjointed areas for conservation.
- Avoidance of sensitive habitats such as the Salt Pan Fringe and key grazing areas in the Alluvial Fan Habitat.
- Further investigation / studies relating to the presence and tolerance of the Killifish species and baseline monitoring of their existing habitats.
- The potential development of seed pools and artificial maintenance of existing habitats if the need arises.
- The management of influx away from the Sabah River.
- Encouragement and continuation of the use of camels as a means of transporting salt that was minded through artisanal means.

- Regular meetings to discuss community relations, environmental performance and environmental data sharing is recommended between the various mining companies operating in the area.

12.2.6 *Social Environment*

Cumulative Impacts

This section details the potential cumulative impacts that may result from the cumulative effect of the proposed Project and the other potential developments *Section 12.1*.

Increased Income Generating Opportunities

Other actual or proposed developments may provide income generating opportunities for people within the Social AoI due to requirements for employment and spin-off economic opportunities related to the presence of a wage-earning workforce. If local people can develop experience and skills this may assist them in achieving employment with Allana. In addition these developments may facilitate or exacerbate in-migration which may provide some limited income generating opportunities.

Impacts to Livelihoods and Health from Water Resources Changes

Large scale additional demand for water resources from planned solution mining projects may result in impacts to livelihoods and human health. In particular, mining companies may also look at abstracting water from the Sabah River for use in solution mining. Should water resources be depleted or contaminated this will cause a reduction in income generating opportunities that are reliant of groundwater (palm collection and processing, pastoralism, salt trade etc.) or consequences for human health.

Impacts to Income from Tourism

The actual or proposed development of exploration or mining projects in the area may result in a change in the perceived desirability of the area for visitors, reducing the potential for tourism in the area and any associated income generation for local people.

Impacts to Traditional Governance, 'Sense of Place' and Cultural Cohesion

The actual or proposed development of exploration or mining projects in the area as well as a new road into the area may exacerbate cultural change undermining the traditional governance, 'sense of place' and affecting cultural cohesion.

Impacts to Cultural Heritage and Archaeology

The development of other exploration Projects and the new road may cause further ground works or in-migration which could result in damage or disturbance to cultural heritage or archaeology sites.

Impacts Related to In-Migration

The construction of a new road into the area and the actual or perceived opportunities associated with mining projects in the area may:

- Increase traffic volumes and speeds increasing the risk of traffic accidents, injury and mortality;
- Cause localised inflation and increased costs of living;
- Increase community conflict and competition;
- Increase vector borne and communicable diseases; and

Pressurise or overburden physical and social infrastructure

12.2.7 *Management Considerations*

The following management consideration should be implemented to help mitigate or enhance negative and positive cumulative impacts respectively:

- **Strategic Impact Assessment:** a strategic impact assessment would enable a comprehensive consideration of potential impacts that may result from the development of the mining industry in the Danakil area. Such an assessment would ideally feed into land use zoning, analysis of infrastructure, utility and social service needs. In addition this type of assessment would consider the cumulative impact to bio-physical and social receptors of the potential abstraction of ground water by several solution mining projects. Such an integrated and holistic approach would prevent isolated and iterative decision-making. The assessment would require greater information on the types of development than is presently available and would ideally be led by the Government.
- **Revenue Management:** the proposed Dallol Potash Project and other planned future developments would generate revenue for the Government of Ethiopia through taxes and royalties. The extent that this revenue is invested productively back into its point of origin would determine the extent to which the Dallol and Berahale Woredas can provide the infrastructure and resources to manage significant growth effectively. In order to share the benefits of the planned Projects some systematic system of revenue recording and management should be established.

- **Capacity Building of Woreda and Kebele Administration:** support provided to Woreda and Kebele government to build the capacity of its staff would determine the extent to which it is able to plan effectively for future development. Administrative capacity building could include training, provision of equipment and the provision of technical support (e.g. information technology support).
- **Monitoring of Change:** this would allow for the proactive management of negative trends that could arise over time. This would require the establishment of a monitoring capability within local government and a set of indicators that would allow the positive and negative impacts associated with change to be tracked.
- **Increasing Human Capital among the Local Population:** the residents of Dallol and Berahale Woreda are in many respects not in a position to benefit as much as they could from economic activity related to future developments. Early efforts to increase human capital through training and capacity building would assist in putting them in a position to be employed or start business enterprises to service future developments.
- **Community Development Alignment:** alignment between different mining companies' approach to community development planning will go some way to ensure that investment is made in a sustainable and strategic manner helping to maximise its benefits.
- **Recruitment Alignment:** alignment between different mining companies' approach to recruitment will help to ensure that there is a viable labour pool of local employees for companies and help to build the skills and experience of local people.
- **Danakil Mining Forum:** the establishment of a Danakil Mining Forum, where companies in the area can share lessons learnt and align strategies, will seek efficiencies across the delivery of local benefits and help to improve cooperation in the pursuit of sustainability goals.
- **Shared Infrastructure:** agreements between mining companies to share infrastructure (well heads, piping, transportation routes etc.) may reduce the disturbance and impacts that may be caused by installing several similar projects in close proximity.

12.3

IMPLICATIONS OF UNCERTAINTY

The cumulative environmental and social impacts described in this section were assessed on the basis of the information available at the time, using information collected through site visits, consultation with governments (national, regional and local), other mining developers in the Danakil Depression and Allana and Ercosplan. The cumulative impact assessment has

a certain level of uncertainty, which is inevitable with a study of this type. Uncertainties are associated with the following:

- Other mining developments are at different phases of development, and as such, are experiencing on-going changes in design as implementation of these projects is optimised;
- Inconsistencies or inexplicable results arising from the fact that there is no detailed information available for the other projects; and
- The nature and extent of impacts based on human responses to events and changes that are not definite or predictable.

In the course of the ESHIA, impacts (both positive and negative) to the physical, natural and socio-economic environments, as well as to community and occupational health, have been identified. In order to avoid, minimise and reduce negative impacts, and to ensure opportunities for the enhancement of positive impacts are realised, Environmental, Social and Health Management Plans (Management Plans) have been prepared. The full list of Management Plans is provided in *Volume Three* of the ESHIA and is outlined in *Box 13.1*.

Box 13.1 *List of Environmental, Social and Community and Occupational Health Management Plans*

VOLUME THREE: ENVIRONMENTAL, SOCIAL AND HEALTH PLANS/STRATEGIES

Annex A: Air Quality Management Plan
Annex B: Biodiversity Management Plan
Annex C: Emergency Response Plan
Annex D: Integrated Mine Closure Plan
Annex E: Spill Prevention, Control and Containment Plan
Annex F: Waste Management Plan
Annex G: Water Management Plan

Annex H: Archaeology and Cultural Heritage Management Plan
Annex I: Community Development Plan
Annex J: Community Health, Safety and Security Management Plan
Annex K: In-migration Management Plan
Annex L: Sourcing, Procurement and Recruitment Management Plan
Annex M: Stakeholder Engagement Strategy
Annex N: Worker Management Plan

Each management plan listed above provides the following:

- A legal context and the context for other requirements (Project standards);
- Appropriate aspects of Allana's Environmental, Health and Safety Policies and Strategies;
-
- Mitigation measures (actions);
- Implementation plans for specific environmental, socio-economic or health issues as required;
- Monitoring requirements, including targets, performance indicators and reporting requirements; and
- Resources required and responsibilities for implementation.

To provide a *vehicle* for the *integrated* management of all the Management Plans listed in *Box 13.1*, an Environmental, Social and Health Management System (ESH-MS) will be implemented. In this regard, the ESH-MS is a key component of this ESHIA. The main elements of an ESH-MS are provided in *Figure 13.1* and comprise the following four phases.

Planning:	Establishing the <i>objectives</i> and processes necessary to deliver results in accordance with the Allana Potash Environmental, Social and Health Policy.
Doing:	Implementing the processes through defining <i>mitigation</i> measures and assigning <i>responsibilities</i> for undertaking or implementing such mitigation measures.
Checking:	<i>Monitoring</i> and <i>measuring</i> these processes against the policy, objectives and targets, legal and other requirements (such as those of the IFC), and <i>reporting</i> of the results.
Acting:	Taking actions to continually improve performance of the ESH-MS through the <i>training</i> of personnel and <i>auditing</i> of results.

Figure 13.1 Elements of an Environmental, Social and Health Management System (after ISO14001:2004)



The ESHIA has essentially undertaken most of the initial *planning* aspects required by an ESH-MS by identifying environmental, social and health impacts and formulating management plans. Further elements of an ESH-MS related to *planning* and those related to *doing*, *checking* and *acting*, are described in this chapter under the following sections:

- **Planning:** *Section 13.1* provides the Allana Environmental, Social and Community Health Vision, Policy statement as well as specific strategies aimed at meeting these policy commitments.
- **Planning/doing:** *Section 13.2* provides an overview of the Environmental, Social and Health Management Plans.
- **Planning/doing:** *Section 13.3* and *13.4* provides the institutional framework, organisational frameworks and specific roles and responsibilities for implementing the ESH-MS.
- **Planning/doing:** *Section 13.5* outlines plans for on-going stakeholder engagement including the management of community grievances and concerns.
- **Checking/acting:** *Section 13.6* introduces key components for the implementation of the ESH-MS including training, monitoring, audits and inspections, and reporting.
- **Acting:** *Section 13.6.5* explains the system for the management of change during the implementation of the Project.

An ESH-MS is therefore implemented to:

- Assist management in establishing priorities for environmental, social and health impacts;
- Provide a mechanism for ensuring that measures identified in the ESHIA and listed in each management plan, are implemented;
- Ensure that changes in Ethiopian legislation are tracked and adhered to at all times;
- Provide a framework for compliance auditing and inspection programmes;
- Ensure environmental, social and health issues continue to be integrated into business decisions;
- Provide a framework for mitigating impacts that may be unforeseen or unidentified until construction or operation is underway;
- Encourage and achieve appropriate environmental, social and health performance and awareness from all employees and contractors;
- Provide assurance to regulators, stakeholders and lenders that their requirements with respect to environmental, social and health performance are being managed; and

- Provides the opportunity to certify the system to international standards, such as ISO 14001, if so desired.

13.1 *ALLANA POTASH VISION, POLICY AND STRATEGIES*

The development of the ESH-MS has been guided by the overall Environmental and Health and Safety and Policies setup by Allana. These Policies are high-level corporate statements of intent and establishes the principles to be followed in the management of environmental, social and health issues. The policies therefore constitute the documents against which all related activities should be judged.

13.1.1 *Allana Potash Vision*

The vision of Allana Potash is provided below:

Allana's primary focus is the exploration, acquisition and development of international potash assets. Their vision is to be a leading potash mining company with a mission of creating value for their shareholders, employees and their business and social partners through safely and responsibly exploring, mining and marketing potash.

13.1.2 *Allana Potash Environmental Policy*

Allana's Environmental Policy is provided below:

OBJECTIVE

Allana Potash recognizes that maintenance of environmental quality is vital to the Company's existence, progress, and continued development. The Company will maintain high environmental standards and will adhere to World Bank guidelines limited only by technical and economic feasibility. The Company will take positive action to protect the safety of its workers, conserve natural resources, and minimize the impact of its activities on the environment through diligent application of appropriate technology and responsible conduct at all stages of exploration, mine development, mining, mineral processing, decommissioning, and reclamation.

The purpose of Allana Potash's Environmental Policy is to provide a measurable framework for the performance of the Company's activities in an environmentally responsible manner, ensuring compliance by the Company and its employees with all applicable environmental regulations and commitments.

IMPLEMENTATION

Allana Potash will:

- Evaluate, plan, construct, and operate all projects and facilities to reduce adverse environmental impacts and to meet or exceed applicable environmental laws, regulations, and standards. In the absence of applicable regulations, the Company will apply cost effective best management practices to protect the environment.
- Require managers of all projects and operations to adhere to the Company Environmental Policy and to identify, evaluate, and minimize risks to the environment.
- Continuously review environmental achievements and technology to seek and implement methods for further improvement.
- Require all operations to have site-specific emergency response plans as well as adequate management plans to mitigate impacts which meet or exceed all applicable regulations.
- Conduct regular audits of environmental performance and emergency response plans to verify compliance with the Company's policy and applicable regulations. Identify revisions or improvements to current practices in order to minimize environmental impacts. Report findings quarterly to the Board of Directors.
- Educate employees in environmental matters and responsibilities relating to performance of their assigned tasks. Entrust all employees to maintain necessary environmental performance for their activities.
- Foster communication with shareholders, the public, employees, and government to enhance understanding of environmental issues affecting the Company's activities.
- Work pro-actively with government and the public to define environmental priorities. Participate in the development of responsible laws for the protection of the environment.
- Allocate sufficient resources to meet the Company's environmental goals. Annually assess the projected costs of decommissioning and reclamation while funding off balance sheet an appropriate amount to ensure that there is sufficient cash reserves to pay for these costs upon closure.

13.1.3 *Allana Potash Health and Safety Policy*

Allana's Health and Safety Policy is provided below:

The Company acknowledges that it is its duty to ensure, so far as is reasonably practicable, the health, safety and welfare of all who are affected by the way its undertaking is conducted. This refers to all permanent and temporary employees, sub-contractors, and members of the public who are, or may be, affected by its activities.

It is the policy of the Company to provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to health. To this end it will allocate sufficient resources and sound management systems to the fulfilment of this policy.

Allana Potash and its subsidiary companies will comply with all relevant statutory provisions and appropriate Approved Codes of Practice, and follow the best current practice in all aspects of its undertaking.

The company considers health and safety to rank equally with all other objectives in the performance of its business. To this end the health and safety responsibilities of all personnel have been defined and allocated. The Safety Management System is intended to affirm that the company achieves its purposes in this area and is based on the philosophy that accidents can be prevented by the identification and management of risk. In particular, the Company acknowledges that the management of health and safety is an integral part of good management at all levels. This includes the provision of:

- Safe and healthy working conditions.
- Arrangements for the operation, design and maintenance of safe systems of work.
- Properly maintained and guarded machinery.
- Information, instruction, training, and supervision appropriate to the company's activities.
- Arrangements for consultation with employees and their representation health and safety matters.

All employees shall receive a copy of this policy statement translated into their native language. Copies shall also be posted on appropriate notice boards where feasible given the nature of mineral exploration.

In return, the company requires all employees, sub-contractors and visitors to recognise their own individual responsibility and to comply with all health and safety requirements relevant to their activities.

This policy statement, associated procedures and practices will be reviewed regularly to ensure that the company's health & safety performance is continuously improved

Section 13.1.2 and 13.1.3 give effect to the Environmental and Social and Health Policies. These provide the framework for the compilation of appropriate management plans and outline the objectives and targets to be met under each of these plans.

13.1.4 *Allana Potash Strategies*

The Environmental and Social and Health Policies provide a set of strategies. These include:

Legal Compliance

- Evaluate, plan, construct, and operate all projects and facilities to reduce adverse environmental impacts and to meet or exceed applicable environmental laws, regulations, and standards. In the absence of applicable regulations, the Company will apply cost effective best management practices to protect the environment.

Employee Awareness

- Require managers of all projects and operations to adhere to the Company Environmental Policy and to identify, evaluate, and minimize risks to the environment.
- Educate employees in environmental matters and responsibilities relating to performance of their assigned tasks. Entrust all employees to maintain necessary environmental performance for their activities.

Emergency Responses

- Require all operations to have site-specific emergency response plans as well as adequate management plans to mitigate impacts which meet or exceed all applicable regulations.

Interaction with Stakeholders

- Foster communication with shareholders, the public, employees, and government to enhance understanding of environmental issues affecting the Company's activities.
- Work pro-actively with government and the public to define environmental priorities. Participate in the development of responsible laws for the protection of the environment.

Occupational Health and Safety

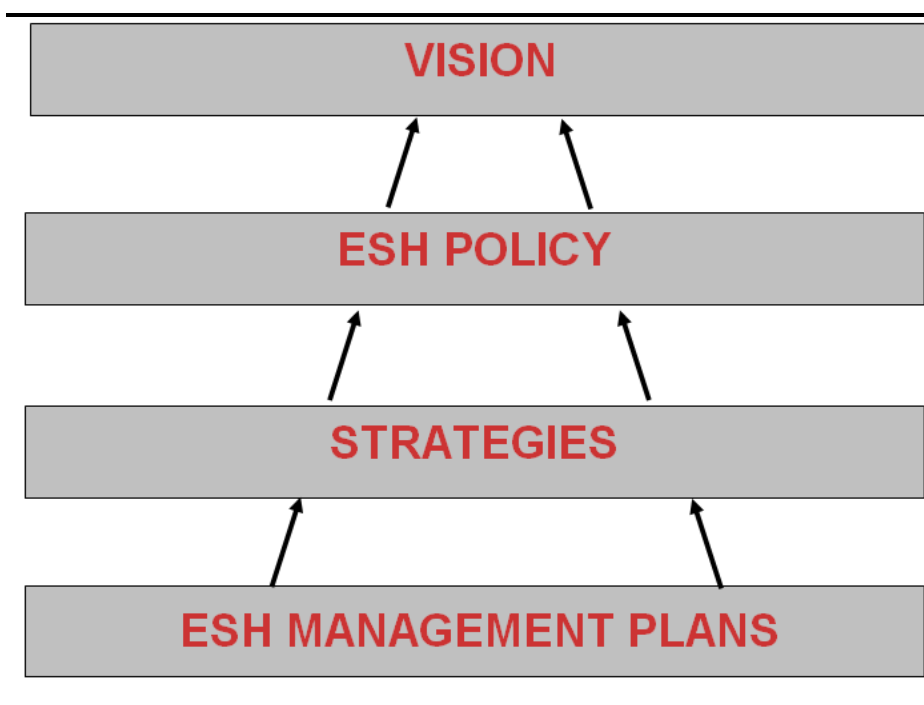
- Safe and healthy working conditions.
- Arrangements for the operation, design and maintenance of safe systems of work.
- Properly maintained and guarded machinery.
- Information, instruction, training, and supervision appropriate to the company's activities.
- Arrangements for consultation with employees and their representation health and safety matters.

Continuous Assessment

- Continuously review environmental achievements and technology to seek and implement methods for further improvement.
- Conduct regular audits of environmental performance and emergency response plans to verify compliance with the Company's policy and applicable regulations. Identify revisions or improvements to current practices in order to minimize environmental impacts. Report findings quarterly to the Board of Directors.
- Allocate sufficient resources to meet the Company's environmental goals. Annually assess the projected costs of decommissioning and reclamation while funding off balance sheet an appropriate amount to ensure that there is sufficient cash reserves to pay for these costs upon closure.

The management plans should support the commitments made in the Allana's Vision, Environmental and Social and Health Policy statements and associated strategies. This hierarchy of commitments is indicated in *Figure 13.2*.

Figure 13.2 ESH-MS Hierarchy of Commitments



13.2 OVERVIEW OF THE ENVIRONMENTAL, SOCIAL AND HEALTH MANAGEMENT PLANS

13.2.1 Purpose of the Environmental, Social and Health (ESH) Management Plans

During the course of the ESHIA process, Project design decisions have been made taking into account the need to avoid, minimise and reduce negative

environmental, socio-economic and health impacts, and the opportunity to enhance positive impacts.

To ensure that identified and unforeseen or unidentified impacts are detected and resolved a set of management plans have been developed. The management plans will be supplemented with additional requirements as detailed design proceeds and as contractors are selected. Contractors will be required to develop their working methods and procedures in accordance with the management plans.

The management plans are an integral part of the ESH-MS and act as the main vehicle for converting the Vision, Policy and Strategies into action.

13.2.2 *Contents of the ESH Management Plans*

Each of the management plans included in *Volume Three* provides:

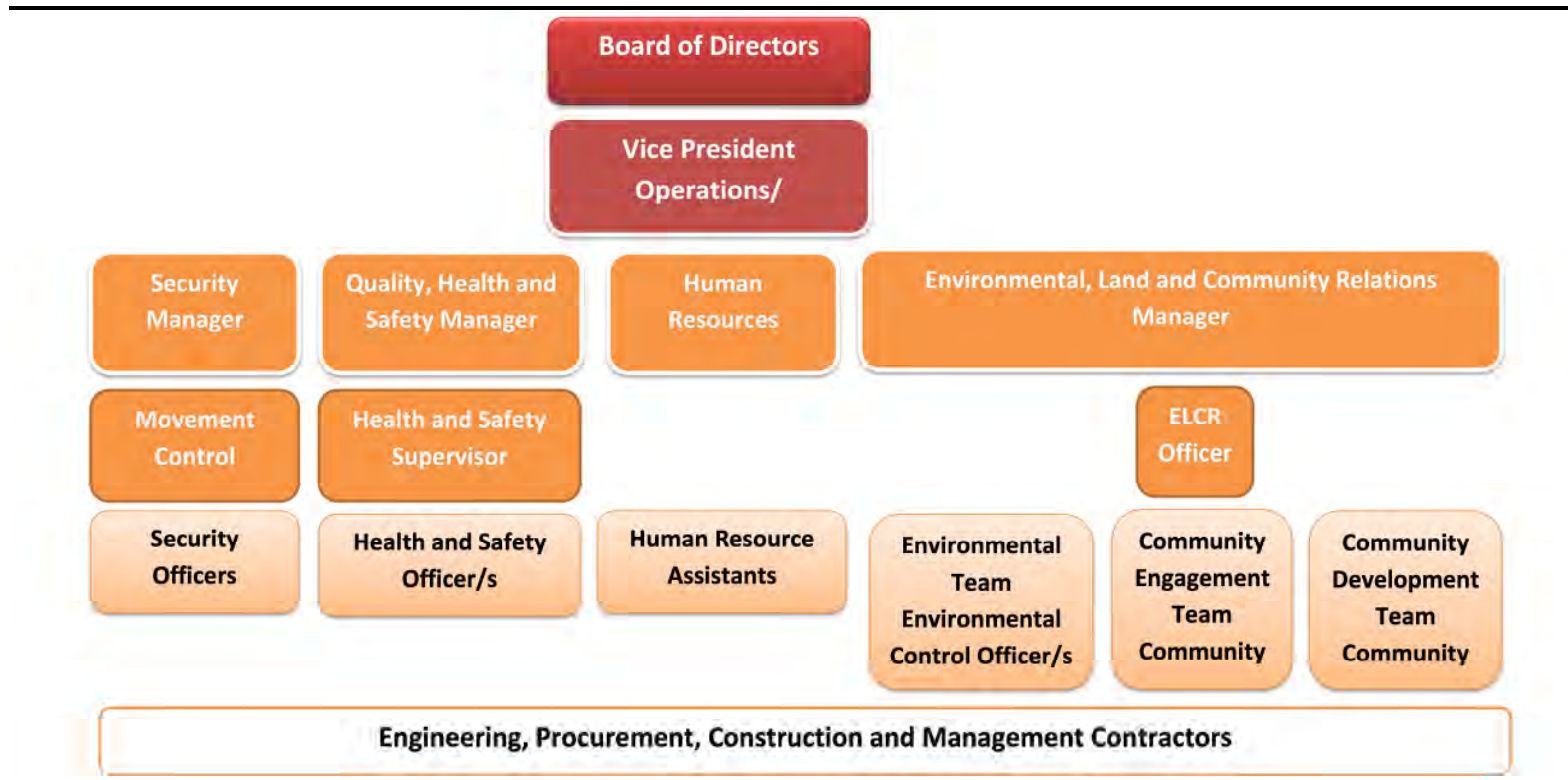
- Strategies that will be utilised to ensure the commitments made support the Policy;
- Objectives and targets to be met;
- Links to the other Management Plans;
- An overview of legal and other requirements;
- Appropriate aspects of Allana's Environmental, Health and Safety Policies and Strategies;
- A description of the impacts, actions and direct responsibility for managing the impact;
- Monitoring requirements, including targets and performance indicators; and
- Reporting requirements.

The formulation of each plan covers the *planning* process of the ESH-MS as depicted in *Figure 13.1* while the implementation of each plan will cover the *implementation* and *operations* processes.

13.3 *INSTITUTIONAL FRAMEWORK*

To *implement* the Management Plans, roles and responsibilities for implementation need to be defined. These roles and responsibilities are presented in *Figure 13.3*, and roles and responsibilities are discussed at a high level in *Section 13.4*.

Figure 13.3 Anticipated Corporate Structure



The successful implementation of the ESH-MS requires a commitment from Allana as well as their employees and contractors. Within these structures roles and responsibilities for the implementation of the Management Plans need to be defined within the following functions:

- Environmental function;
- Community communication and engagement function;
- Local development and social investment function;
- Security and emergency response function;
- Facilities and recreation function; and
- Community health, wellness and safety function.

Similarly specific roles and responsibilities need to be defined for contractors and subcontractors. During construction, and to a lesser extent operations, contractors will be the key implementers of mitigation measures as defined in management plans and will also be responsible for ensuring compliance with the Project policies and commitments.

Under their contracts, contractors will be responsible for managing the potential environmental, socio-economic, safety and health impacts of all their contract activities including those of their subcontractors.

Contractors must as part of their obligations:

- Demonstrate compliance with the Environmental and Social and Health Policies through the development and approval of detailed environmental, social and health plans, procedures and standards;
- Demonstrate commitment to the ESHIA and its management plans in their management structure;
- Identify individuals responsible for overall environment, social, safety and health management; and
- Undertake regular environmental, social, health and safety inspections and provide reports to allow for the monitoring and evaluation of performance.

Although the contractors will have the primary roles in delivering on the measures set out in the ESHIA and management plans, Allana will have the ultimate accountability for ensuring the measures are delivered. This accountability may be delegated to the other where applicable.

Allana will continue to engage with stakeholders throughout the life of the Project. During construction, communication with local communities and other local stakeholders will be undertaken by the community liaison function who will work closely with the relevant contractors.

The objectives of the Stakeholder Engagement Strategy outlined in *Annex M* of *Volume Three*, are as follows:

- **To ensure understanding** by facilitating an open, culturally appropriate and inclusive approach to engagement that provides timely and accurate information in an accessible and transparent way to all stakeholders, regardless of their status.
- **To manage expectations and concerns** by providing a mechanism which not only provides stakeholders an opportunity to freely provide comment and feedback but also allows Allana to respond to this feedback, thereby addressing concerns.
- **To manage risks through building sustainable relationships.** Stakeholder risks are widely recognised to be one of the key challenges facing the mining industry worldwide. Communities expect more open and transparent dialogue and longer term social commitments from companies. Engagement will allow Allana to understand stakeholder interests and issues and work with stakeholders to find mutually acceptable ways to achieve or address these.
- **To create value** where engagement allows for partnerships to be developed for the mutual benefit of both Allana and the stakeholders. This includes but is not restricted to corporate social investment activities. This relates also to seeking mutual benefit through design and operations by considering stakeholders and seeking their benefit in all Mine activities.

13.5.1

Grievance Procedure

It is intended that the stakeholder engagement measures outlined above, and the mitigation and management measures outlined in all other management plans, will work proactively towards identifying and addressing issues before they become grievances. However, when grievances are reported they need to be addressed in a consistent and verifiable manner. This will be done through the implementation of a grievance procedure.

This procedure focuses on the recording and processing of complaints and grievances and *not of incidents*, which should be dealt with through the ESH-MS (refer to *Section 13.6.2*). The definitions of both a grievance and an incident are presented in *Box 13.2* below. Although their definitions may differ, there are clear links that need to be established between this grievance procedure and the incident reporting system.

Box 13.2 *Grievance versus Incident*

A **grievance** is when a complaint linked to the operation is raised with the expectation that the complaint will be addressed.

An **incident** is any occurrence that has caused, or has the potential to cause, a negative impact on people, the environment or property (or a combination thereof). It also includes any significant departure from standard operating procedures.

In some cases, grievances may be linked to actual incidents, in which case the incident also needs to be reported.

The grievance procedure for the Allana should be followed for all grievances relating to the Project as a whole, including issues related to resettlement and rehabilitation. The grievance procedure is divided into six key steps:

- Step 1: Receive and log grievance.
- Step 2: Acknowledge grievance.
- Step 3: Assess and prioritise grievance and forward to relevant function.
- Step 4: Investigate and resolve grievance.
- Step 5: Sign off on grievance.
- Step 6: Monitor.

Each of these steps is described in the Stakeholder Engagement Strategy (*Annex M of Volume Three*).

13.6 **KEY COMPONENTS FOR THE IMPLEMENTATION OF THE ENVIRONMENTAL, HEALTH AND SOCIAL MANAGEMENT SYSTEM**

Mitigation, monitoring and management measures are contained throughout this ESHIA and in all management plans. These measures all represent the *doing* and *checking* processes of the ESH-MS framework depicted in *Figure 13.1*.

In addition to these commitments, other key components of the ESH-MS include training, audits and inspections and reporting. These measures all represent the *doing* (training), *checking* (audits and inspections) and *acting* (reporting) processes of the ESH-MS framework.

13.6.1 **Training**

The key components of training requirements are to ensure that all site personnel, including contractors understand the:

- Environmental, social and health requirements of the proposed Project and how these will be implemented and monitored on site;
- Contents and relevant requirements of Project actions contained within the applicable management plans;

- Environmental and social sensitivities of the Study Area;
- Procedures to be followed in the event of non-compliance with the environmental, social and health requirements; and
- Procedures for responding to the media, unauthorised visitors to the site, and enquiries from the public.

They must also:

- Know how to deal with unforeseen environmental, social and health incidents; and
- Be aware of their roles with respect to environmental, social and health issues.

Project Sponsors Training Programme

One of the most important mechanisms for the enhancement of the Project's environmental, social and health performance will be the continued implementation of a training programme for all Project personnel including the personnel of contractors and subcontractors.

Training will include:

- Induction training for all staff including modules on: health and safety, environmental awareness, accommodation rules, worker code of conduct, stakeholder engagement, grievance mechanisms and cultural heritage awareness;
- Toolbox training for specific tasks; and
- Training for individuals involved in tasks with specific responsibilities.

Refresher training programmes will also be implemented to ensure continual improvement in environmental awareness for all Project personnel.

Training will be provided at each stage of the Project, from initial establishment of logistical facilities through to construction and operation. The training function will assist managers in developing and co-ordinating training programmes as required.

Training records will be maintained by the training function and an assessment of the effectiveness of the training programmes will be included as part of the internal audit procedures.

Contractor Training Programme

Contractors will be responsible for ensuring that all their personnel are aware of their environmental, social and health responsibilities. They will develop and implement training programmes to the satisfaction and approval of the Project Sponsors.

Training will include:

- Induction training for all staff prior to carrying out any work on site. This will include modules on: health and safety, environmental awareness, accommodation rules, worker code of conduct, stakeholder engagement, grievance mechanisms and cultural awareness;
- Toolbox training for specific tasks;
- Training for individuals involved in tasks with specific responsibilities; and
- Training programmes organised by the Project Sponsor as required.

The contractor will keep auditable records of training given. Assessment of the effectiveness of the training programme will be included as part of the ESH-MS audit procedures.

13.6.2 Responses to Incidents

A definition of an incident is provided in *Box 13.2*. The reporting and investigation of all potential and actual incidents that could have a detrimental impact on human health, the natural environment or property is required so that remedial and preventive steps can be taken to reduce the potential or actual impacts as a result of all such incidents.

For Allana, environmental incidents can be classified in three categories, with each category having specific reporting and follow-up requirements (*Table 13.1*).

Table 13.1 Environmental Incident Categories

Classification	Category 1	Category 2	Category 3
Identification	An incident resulting in a breach of lender or licence conditions, environmental regulations and/or Allana standards; an incident that is reportable to the government by law or other statute, or has caused significant environmental harm or	An incident with potential to breach lender and/or licence conditions or environmental regulations or standards, but which is not reportable to the government (though voluntary disclosure may be undertaken at the discretion of site	An incident with little potential to breach lender or licence conditions or environmental regulations or standards and which is not reportable to the government and/or the management committee.

	injury to people, animals, or property. This category incident also includes incidents whose impacts have extended onto publicly accessible land and which have the potential to adversely impact on surrounding communities, livestock or wildlife.	management). Has the potential to cause significant environmental harm or injury to people or animals and/or has impacted on publicly accessible land in some measure. This includes incidents that have interfered with the public domain outside the Allana concession, but which are not reportable by law to Government.	
Reporting	Immediately reportable to the Allana Potash board of directors.	Reportable to all management associated with site operations of the project .	Reportable only to the environmental manager.
Follow up	Formal investigation will be required.	Formal investigation required.	Informal investigation actions required.

The actions resulting from any formal or informal investigations will be used to update the applicable management plans. The Audit programme (presented in *Section 13.6.3* below) should be revised to audit areas or aspects where incidents occur more regularly to ensure that the potential for such incidents recurring are minimised.

13.6.3 ***Audit and Inspection***

An audit programme detailing the aspects to be audited, the area (relevant department or section), and the frequency of audits will be established. The audits will be based on appropriate protocols prepared by the environmental, social and health functions.

Regular environmental, social and health audits and random spot checks will be undertaken by selected audit team members throughout all phases of the Project. The audit and inspection frequencies will be defined, and may be increased or decreased according to the findings and degree of confidence in the audit programme. Audits will also assess compliance with agreed objectives and targets as well as the effectiveness of the management plans and their implementation.

Audit findings will be reviewed by the applicable management functions and where corrective actions are deemed necessary; the relevant management plans will be updated.

13.6.4 *Reporting*

The proposed Project will develop a system of internal reporting that allows for appropriate reporting on the effectiveness of the ESH-MS. Public reports will also be prepared on a range of issues of interest or concern to local communities.

During the construction phase, contractors are required to take all appropriate measures in its ESH-MS and related plans and procedures to identify and document incidents of environmental, social and health non-conformance. These records should be produced at no less than weekly frequency, identifying the category of non-conformance, its potential severity and its frequency to be demonstrated. The resultant records will be addressed in the appropriate management meetings to initiate corrective actions required.

These records are intended to facilitate the purposeful reduction of incidents of non-conformance, leading to a consequential reduction of the root causes of such incidents.

All management plans include a monitoring plan detailing parameters that will be monitored. The results from this data will be reviewed and published annually. The report will review performance over the previous year and will set targets for subsequent years.

13.6.5 *Management of Change*

As is discussed in *Chapter 6*, as Project design is finalised, and as additional baseline data is gathered, a greater level of certainty regarding the impacts of the Dallol Potash Project will emerge. Accordingly, Project design changes may occur that need to be accommodated by Allana and their contractors. Similarly, the institutional framework and roles and responsibilities provided *Sections 13.3* and *13.4* respectively may also change as the Project progresses.

The ESHIA management plans require a mechanism to manage change. At times these changes may be material, potentially influencing the original findings of the ESHIA, and hence, the basis for its approval. Such a mechanism to manage change, or a change management system, must ensure that changes to the scope of the proposed Project are subjected to a robust assessment process. Any changes to Project scope will be evaluated for their degree of significance, and will be incorporated into the appropriate Allana documentation as follows:

- Minor changes will be reflected in updates to the applicable Management Plans; and
- Substantive changes that might potentially alter the ESHIA findings (i.e. those that result in changes to the predicted significance of environmental, socio-economic and health impacts) will be subject to re-assessment, further stakeholder consultation, supplementary reporting and revision of

the Project's Environmental, Social and Health Management Plans. Typically, such substantive changes will be submitted as an addendum to this ESHIA.

An increasing global population, coupled with increasing rates of urbanisation and demand for agricultural crops, has resulted in an increased demand for fertilisers (of which potash is an essential component) in crop production. Furthermore, potash has become an essential product in managing food security in developing countries. Global demand for potash is expected to increase by 320% during the period 2010 to 2020, and is expected to grow further in the longer term. Increasing global demands for potash have necessitated an increased level of supply.

With increasing support by the Ethiopian Government of investment into the private sector, commitments to foreign investment and the recent enactment of laws to regulate mining and mining taxation, Ethiopia can be characterised as having a stable investment environment for new mining ventures. Additionally, the proximity of the Danakil potash reserves to potential deep water port infrastructure in Djibouti allows for the relative ease of export to the second largest importer of potash globally, namely India. Lastly, poverty levels in Ethiopia have decreased since the instatement of the Ethiopian government's programme of economic reform (poverty levels decreased by 6.5% during the period 1995 to 2005). Future development in the mining sector will enhance this, and will contribute to employment creation and poverty reduction.

Allana propose to develop the proposed Dallol Potash Project within their concession area in the Danakil Depression, in north eastern Ethiopia. The resource potential of this area is significant and constitutes a potential target of nearly two billion tonnes of potash. Under the Ethiopian EIA Proclamation (No. 299/2002) before Allana proceed with the proposed Project, it is required that an EIA be undertaken and authorisation granted by the EPA. As such, Allana have appointed ERM as independent environmental practitioners to undertake an ESHIA for the proposed Project.

The ESHIA has taken into account the laws of Ethiopia and furthermore, has identified all the necessary licensing and permitting requirements based on the current project concepts and designs. In addition to the laws of Ethiopia, the ESHIA has been developed to conform to the World Bank Group Operations Policies, the IFC Performance Standards and the AfDB Policies and Strategies.

The ESHIA (this report) is the second and final phase of the overall EIA process being undertaken in support of the proposed Project. The purpose of the ESHIA report is:

- Present a detailed baseline review of the physical, biological , socio-economic and health characteristics of the Study Area;

- Assess the impacts (including cumulative impacts) of the physical, biological, socio-economical and health environments related with the different phases of the proposed Project; and
- Provide mitigation measures and associated management plans that aim to avoid /minimise/manage the severity of identified impacts.

14.1 **NEGATIVE IMPACTS AND RECOMMENDATION**

Based on the Impact Assessment process, the **Major Negative Impacts** to the physical, biological, socio-economic and health environment are presented in *Table 14.1* below.

Table 14.1 Major Environmental, Social and Health Impacts (Pre-mitigation)

Impact	Significance (pre-mitigation)	Residual Impact Significance
Hydrology Impacts		
Impacts related to interruption of flows in the Bosi River due to installation of plant infrastructure	MAJOR NEGATIVE	MODERATE NEGATIVE
Impacts related to the discharge of pollutants from non-mining activities into perennial water resources in the region	MAJOR NEGATIVE	MODERATE NEGATIVE
Geohydrology Impact		
Impacts related to groundwater drawdown in the alluvial fan aquifers	MODERATE NEGATIVE	MODERATE NEGATIVE
Impacts related to groundwater quality as a result of groundwater abstraction in the alluvial fan aquifers	MAJOR NEGATIVE	MODERATE NEGATIVE
Air Quality Impacts		
Impacts to air quality as a result of activities carried out during the construction and decommissioning phases	MAJOR NEGATIVE	MODERATE NEGATIVE
Impacts to air quality as a result of traffic during the operational phase	MAJOR NEGATIVE	NEGLIGIBLE NEGATIVE
Noise Impacts		
Impacts to the noise environment as a result of activities associated with the operational phase	MAJOR NEGATIVE	NEGLIGIBLE NEGATIVE
Impacts to the noise environment arising from road traffic during the operational phase	MAJOR NEGATIVE	NEGLIGIBLE NEGATIVE
Biological Impacts		

Impact	Significance (pre-mitigation)	Residual Impact Significance
Impacts as a result to habitat loss and fragmentation of the Salt Pan Fringe Habitat type during the life of the proposed Project	MAJOR NEGATIVE	MINOR NEGATIVE
Impacts related to loss of critical aquatic habitats due to groundwater extraction	MAJOR NEGATIVE	MINOR NEGATIVE
Social Impacts		
Resettlement of Mororo and Alai lai	MAJOR NEGATIVE	UNKNOWN
Reduced income generating opportunities related to artisanal salt mining	MAJOR NEGATIVE	MODERATE NEGATIVE
Reduced income generating opportunities related to palm collecting and processing	MAJOR NEGATIVE	MODERATE NEGATIVE
Decreased availability and/or quality of water	MAJOR NEGATIVE	POSITIVE IMPACT
Increase in vector borne and communicable diseases	MAJOR NEGATIVE	MINOR NEGATIVE
Worsening health profile related to spills, emissions and contamination	MAJOR NEGATIVE	MODERATE NEGATIVE
Increased injuries and mortality from traffic accidents	MAJOR NEGATIVE	MODERATE NEGATIVE
Increased intra and inter community competition and conflict	MAJOR NEGATIVE	MODERATE NEGATIVE
Increased conflict between community and security providers	MAJOR NEGATIVE	MODERATE NEGATIVE
Reduced access, pressure and overburdening of physical and social infrastructure	MAJOR NEGATIVE	MINOR NEGATIVE

The impacts described in *Table 14.1*, together with a summary of the proposed mitigation measures, are described briefly below:

- **Impacts Related to Interruption of Flows in the Bosi River due to Installation of Mining Infrastructure:** The Bosi River collects water from the catchment to the west of the Project Site and is a west to east flowing river with a flow path flowing directly into the Project Site. As the Bosi River drainage line enters the western perimeter of the concession area, this drainage line has the potential to interfere with the operations of the proposed Project and if in flood, may cause production losses, thus resulting in a major negative impact (pre-mitigation).

Diversion of the Bosi River floodwaters around the site into the nearest natural drainage path or Wadi to prevent flow onto the site, together with clean and dirty stormwater segregation, and the establishment of stormwater infrastructure designed to account for the high intensity flash flood events, will reduce this impact to a moderate level of significance.

- **Impacts Related to the Discharge of Pollutants from Non-mining Activities into Water Courses in the Region:** The majority of the rivers in the Study Area are ephemeral with the exception of the Sabah River (over 10km south of the Project Area) which maintains flows all year round. The proposed Project will require vehicle movements to and from the site to carry supplies and transport staff. It has been observed that some Government and road construction vehicles are washed in the Sabah River and this has the potential to contaminate the river system, leading to impacts to biodiversity. This is considered a major negative impact (pre-mitigation).

The continuance of not allowing Allana personnel to wash vehicles in the Sabah River, adequate handling and storage of fuels and chemicals, zero discharge of raw sewage to the environment and the construction of a low level bridge across the Sabah River will reduce this impact to a moderate level of significance.

- **Impacts Related to Groundwater Drawdown in the Alluvial Fan Aquifers:** The groundwater located in the alluvial fans to the west of the Study Area is the target water source for the solution mining production water. The proposed Project will require large volumes of water during the operational phase, with current estimates for full production being 16 Mm³/a. Given the results of geophysics studies, pump testing, groundwater depth monitoring, and the output of the geohydraulic model, Fugro (2012) conclude that the water demands of this Project, in terms of quantity, will be able to be met with a high degree of probability.

The water in the Alluvial Fans (the target water source) flows into the Salt Pan Fringe and supports both community users and ecological resources. The Salt Pan Fringe Habitat type maintains an interaction between ecology and people and is of high importance with respect to ecosystem services. Given the sensitivity of the receptor, and the volumes of water to be abstracted, and applying the precautionary principle in the rating of such impacts, the pre-mitigation impact is considered to be of major significance.

Further groundwater recharge investigations, long-term monitoring of groundwater levels in the Study Area, the resettlement of Mororo and Alai lai Villages, the provision of a new potable water supply for these villages and the monitoring of Doum Palms (as an indicator species) will reduce this impact to a moderate level of significance.

- **Impacts Related to Groundwater Quality as a result of Groundwater Abstraction in the Alluvial Fan Aquifers:** The groundwater located in the alluvial fans to the west of the Study Area is the target water source for the solution mining production water. Water in the deeper parts of the aquifer and closer to the salt plain, show significantly higher salinities.

The water quality requirements for solution mining and processing water are different. Processing water for the plant should have a low mineralisation. For solution mining the requirements are less stringent and mixing of different mineralized waters is possible.

The water in the Alluvial Fans (the target water source) flows into the Salt Pan Fringe and supports both community users and ecological resources. The Salt Pan Fringe maintains an interaction between ecology and people and is of high importance with respect to ecosystem services. Therefore the Salt Pan Fringe is considered of high sensitivity. Given the sensitivity of this habitat, the volumes of water to be abstracted, and the presence of both saline and better quality water in the aquifer, the potential impact of a deterioration in groundwater quality as a result of mixing of different quality waters in this aquifer as a result of over-abstraction, is considered to be of moderate significance (pre-mitigation).

Long-term monitoring of groundwater depths and quality in the Study Area, further 4 week pump tests during the well field development phase, the resettlement of Mororo and Alai lai Villages, the provision of a new potable water supply for these villages and the monitoring of Doum Palms (as an indicator species) will reduce this impact to a moderate level of significance.

- **Impacts to Air Quality as a Result of Activities Carried Out during the Construction and Decommissioning Phases:** Impacts associated with construction and decommissioning activities of the proposed Project have the potential to result in significant emissions of dust, PM₁₀ and PM_{2.5} to atmosphere. This impact was rated as a major negative impact; as emissions (PM₁₀ and PM_{2.5}) arising from vehicular movement along unpaved roads and/or construction/decommissioning works taking place on friable wadi material have the potential to impact on nearby communities.

Paving, the addition of chemical surface binders or salt encrusting of roads that are within 5km of sensitive receptors should be implemented. This together with the implementation of good practice construction/decommissioning practices will reduced the impact to a level of moderate significance (post-mitigation).

- **Impacts to Air Quality as a Result of Traffic during the Operational Phase:** Impacts associated with the transportation of potash product off-site has the potential to be major negative impacts at roadside receptors should transport take place over unpaved roads. This is due to the fact that impacts may arise at distances of up to 5km from the roadside, as based upon evidence from the Desert Research Institute (2010).

The paving of haul roads and implementation of good transportation practice (e.g. – the covering of trucks carrying potash) are considered sufficient mitigation to render all residual impacts as negligible.

- **Impacts to the Noise Environment as a Result of Activities associated with the Operational Phase:** The operational phase comprises a considerable number of processes, activities and equipment that generate noise. Furthermore, the proposed Project will operate 24 hours a day, 7 days a week. The villages of Mororo and Alai lai will be the most affected in terms of activities during the operational phase. Impacts from operational phase activities pre-mitigation will be a major negative for Mororo Village and a minor Negative for Alai lai Village.

It is the understanding of this ESHIA that the villages of Mororo and Alai lai will be resettled, as the proximity of these two villages in relation to Allana's proposed operations poses a significant community health and safety risk. Resettlement of these two villages is also recommended from a noise impact perspective. Should Mororo and Alai lai Villages be resettled, the identified noise impacts would be eliminated and hence the residual noise impacts for the remaining villages would be a negligible negative impact.

- **Impacts to the Noise Environment Arising from Road traffic during the Operational Phase:** Road traffic noise will be generated through the use of highway trucks transporting potash through the Study Area via a purpose built haul road. Based on analysis, it is the opinion of this ESHIA that noise related impacts to road side receptors will be of a major significance should the main haul road be built at a distance less than or equal to 10m from receptors.

However, the assessment concluded that there will be no significant impact on people as a result of noise arising from road traffic during the operational phase of the proposed Project, should the main haul road be paved and built at a distance greater than 45 metres from road side receptors.

- **Ecological Impacts on the Salt Pan Fringe as a Result of Groundwater Drawdown:** The proposed Project will involve abstraction of large quantities of groundwater from alluvial fans in the Study Area during the operational phase. The extraction of groundwater may cause the water table in the area of direct influence to drop resulting in dependent plant species within the Salt Pan Fringe habitat located in the Project Area to potentially die, and render the habitat unsuitable for the faunal species present there. Additional impacts resulting in the loss of this habitat will be caused by the development of infrastructure including roads, pipelines, power lines and potential extraction of borrow material for the construction of roads. This impact is considered to be of major significance (pre-mitigation).

A baseline count and assessment of the health of Doum Palms present in the Salt Pan Fringe habitat within the Project Area will be required prior to the operational phase of the proposed Project and subsequent groundwater extraction. Furthermore, this habitat type should be avoided

as far as possible, and a significant tract of this habitat must be recognised as a Set-aside area and protected from transformation or fragmentation. The water reservoir appears to have sufficient capacity for water supply, even in dry years. It is however recommended, in order to prevent salt water intrusion and from the viewpoint of sustainability, to abstract only an amount of ground water equal to the average recharge. A nursery will be established in which Doum Palms (*Hyphaene thebaica*) are propagated. If groundwater abstraction is cutback in response to an observed die-off of Doum Palms (*Hyphaene thebaica*) as determined by a qualified botanist, then young palms will be provided by the nursery for planting in these areas at a ratio of 10:1.

An improved understanding of the aquifer dynamics should be possible based on further data collection required from mitigation measures presented in the geohydrology impact assessment. Proper implementation of the above mitigation measures to restrict groundwater abstraction to the average recharge capacity will reduce the impacts on the Salt Pan Fringe habitat. On this basis, the impact post-mitigation can be considered to be of minor significance.

- **Impacts Related to Loss of Critical Aquatic Habitats due to Groundwater Extraction:** Impacts associated with a potential loss of aquatic habitats as a result of excessive groundwater abstraction is considered to be a major impact (pre-mitigation), as the primary sensitive receptor, Killifish (*Aphanius dispar*) it is considered to be an endangered species.

There is insufficient clarity on the presence of this Killifish species within Ethiopia and a biodiversity offset programme cannot be proposed unless evidence showing the presence of this species can be demonstrated. Further studies are thus required before measures can be formulated to confidently ensure the local survival of this species. Emergency measures, although not ideal, are presented to artificially maintain the existing habitat should authorisation be granted for Allana to proceed with local mining operations.

Based on implementation of measures to restrict groundwater extraction to the aquifer recharge capacity described previously, securing local killifish populations through successful translocation of seed populations to artificial water bodies and maintaining the habitat, the residual impact of the loss of Critical Habitats is assessed as being of minor significance.

- **Impacts Resettlement Related to the Resettlement of Mororo and Alai lai:** As a result of noise related impacts, and due to potential health and safety risks to the villages of Mororo and Alai lai, it is recommended that these villages be resettled. The impacts of resettlement were considered to be of major significance (pre-mitigation), as if not properly managed this can cause economic displacement and social and health impacts related to the physical process of resettlement itself. In addition the resettlement of

people from Mororo and Alai lai may cause potential impacts in the new 'host communities' if not properly managed.

To avoid and reduce the significance of this impact Allana will develop a Resettlement Action Plan (RAP) that considers livelihood restoration as guided by international good practice and the laws of Ethiopia. A RAP will plan the resettlement and compensation process so as to avoid or reduce impacts related to resettlement with the objective of replicating or improving standards of living post-resettlement. As the resettlement planning has only begun in January 2013 a residual impact rating cannot be awarded.

- **Reduced Income Generating Opportunities Related to Artisanal Salt Mining:** Allana will require a substantial amount of groundwater for solution mining activities which will be abstracted from a series of boreholes. This abstraction of water, although not anticipated to impact the replenishment of salt, may shift the area of salt deposition slightly further south, increasing the distances required to travel by diggers, cutters and transporters. This may be exacerbated by other potential potash solution mining projects planned in the area with similar demands for water abstraction. This impact is considered to be of major significance (pre-mitigation).

To avoid and reduce the significance of this impact Allana will look to develop and support an appropriate programme that focuses on enterprise development and livelihood diversification to improve levels of income in the Study Area and will consider the effect to the artisanal salt economy when disposing or selling the salt generated as a waste product of solution mining. Allana will seek to ensure that the sale or disposal of salt is carried out in such a manner so as not to 'flood' the market and depreciate the value of locally produced artisanal salt. In addition, Allana will engage with government to understand the government strategy on the salt iodisation programme, develop camel train overpasses for roads and develop a compensation mechanism for salt miners. With suitable avoidance and mitigation, this impact is likely to decrease to a moderate level of significance.

- **Reduced Income Generating Opportunities related to Palm Collecting and Processing:** The abstraction of groundwater could lower water resources available to plants along the Salt Pan Fringe Habitat type potentially causing plant mortality, reducing the availability of palms as a natural resource. The spatial extent and magnitude of the impacts to palms will be defined according to on-going water and ecological monitoring as discussed in *Chapter 10*; however, for the purposes of this assessment it is assumed that palms available for collection within the alluvial fans and salt fringe directly surrounding the Allana concession will be significantly decreased. The pre-mitigation livelihood impacts for this are considered to be of major significance.

To avoid and reduce the significance of this impact the mitigation and management measures developed in response to impacts to water resources and biological receptors (refer to *Chapter 10*) will be relevant as well as the mitigation measures developed in response to impacts to pastoralism. In addition to these, livelihood diversification and restoration and facilitated access to the concession area will reduce the pre-mitigation impact to a level of moderate significance.

- **Increase in Vector Borne and Communicable Diseases:** The current health profile of Social Study Area is extremely poor and is a reflection of the current status of healthcare infrastructure and services as well as widespread poverty. The introduction and expansion of the Allana workforce is likely to result in regular interaction with local people, particularly in Berahale (as a popular stop-off point on the journey from camp to Mekele) and Hamad Ela, Ambule and Asabolo (due to its close proximity to the Allana Camp). This has the potential to result in an increase in the prevalence rate of communicable diseases and is considered to be a major negative impact (pre-mitigation).

Implementation of a worker code of conduct will reduce worker-community interactions, and workforce accommodation standards ('closed camp') will reduce the likelihood of infectious diseases spreading amongst the workforce. In addition all mitigation measures intended to reduce in-migration will also help to avoid this impact. To reduce the risk of an increase in communicable diseases Allana will work with the local healthcare services will develop and implement a sustainable and consistent workplace policy and programme for the Project on HIV prevention among all workers and their families. In addition, Allana will conduct 'fitness for work' screenings of workers and contractors pre-employment to assess the health of all personnel and will develop a specific worker health and safety induction and (continuous) training programme. In order to reduce the number of employees seeking recreational activities in local villages Allana will set up suitable and culturally appropriate recreational activities at the staff village. Assuming the effective application of these mitigation measures the significance of the negative impact is assessed as minor.

- **Worsening Health Profile Related to Spills, Emissions and Contamination:** The villages of Hamad Ela, Mororo and Alai lai are susceptible to any contamination of air and water resources that may occur. The pre-mitigation health impacts for this are considered to be of major significance.

The development of a Spill Prevention Control and Contamination Plan and Emergency Response Plan, safe transportation of hazardous materials, risk communication with local health facilities and leaders and on-going training of Allana employees will reduce (if adequately implemented) pre-mitigation impacts to a moderate significance.

- **Increased Injuries and Mortality from Traffic Accidents:** During the construction and operational phases of the proposed project Allana will require the movement of vehicles from the Port of Djibouti to site and from Mekele to site. This impact is considered to be of major significance (pre-mitigation), because the Study Area is relatively rural and isolated in nature with only one major road passing through the Study Area.

To avoid and reduce the significance of this impact all mitigation measures related to traffic management will be relevant. A Community Feedback Mechanism will allow members of the community to provide comments to Allana on driving practices and to make grievances and compensation claims related to accidents involving livestock (should these occur). In addition a Traffic Management Plan will be developed by Allana. Allana will also monitor vehicular movement and will conduct community consultations to identify potential high risk areas prior to commencement of construction. Lastly, Allana will ensure hauling operations and road construction contractors adopt and implement measures for all workers to consider public safety and worker safety and will develop a safe driving test for all Allana employees who will need to operate a vehicle. Should these measures be adequately implemented, the significance rating of this impact (post-mitigation) is considered to be of moderate significance.

- **Increased Intra and Inter Community Competition and Conflict:** The proposed Project has the potential to attract an in-migration of opportunistic job seekers into the area in addition to migrants hired to provide services and act as Allana workforce. This in-migration has the potential to create social tensions over resources and social conduct, potentially causing increased intra and inter community conflict. This impact is considered to be of major significance (pre-mitigation).

All mitigation measures related to helping reduce, avoid or manage potential in-migration, and helping to protect Afar identity in impacted communities will be relevant to this impact, reducing the potential causes of conflict. This will include promoting transparent hiring techniques and a sourcing and procurement policy that plans hiring in a way that may limit in-migration and promoting Afar culture. In addition to avoid and reduce the significance of this impact Allana will establish an in-migration monitoring programme and a programme of engagement with local Afar communities to allow them an opportunity to raise their concerns and identify potential solutions to in-migration and labour recruitment related issues. With suitable avoidance and mitigation the frequency, scale and duration of this impact is likely to decrease resulting in the assessment of the impact to a level of moderate significance.

- **Increased Conflict between Community and Security Provider:** The use of third party security providers (including the military) may result in instances of violence towards community members or conflict between communities and security providers. This impact is considered to be of major significance (pre-mitigation).

To avoid and reduce the significance of this impact Allana should manage security providers with guidance from Voluntary Principles on Security and Human Rights. Furthermore, Allana will establish a Community Feedback Mechanism that is scaled appropriately to risks and adverse impacts. Allana will also implement a programme of culturally appropriate engagement with potentially impacted communities and establish a system where an independent third party monitors and audits the conduct of security providers on a bi-annual basis. With suitable avoidance and mitigation the frequency, scale and duration of this impact is likely to decrease moderate significance.

- **Reduced Access, Pressure and Overburdening of Physical and Social Infrastructure:** Current and potential declines in income will have direct consequences on access to schooling and health services for people in the Social Study Area as levels of income may not be sufficient to pay for items such as transportation, cost of medication, uniforms and books. In addition, in-migration and the resultant increase in population would result in pressure or overburdening of local infrastructure and services (including health services), potentially reducing levels of availability and quality of service. This impact is considered to be of major significance (pre-mitigation).

All mitigation measures related to helping reduce, avoid or manage potential in-migration, and impacts to livelihoods will be relevant to this impact. In addition management measure to promote local employment and procurement of goods and services will help to mitigate this impact. Furthermore, community development targeted at improving services infrastructure and access to resources, improvements to water and waste management infrastructure, the establishment of an education and awareness programme and settlement planning will decrease (if adequately implemented) the impact to a minor level of significance.

14.2

POSITIVE IMPACTS

In addition to those positive impacts identified above, the proposed Dallol Potash Project is expected to have the following positive impacts:

- **Increased Income Generation Opportunities from Direct and Indirect Employment at a Local, Regional and National Level:** Allana will require up to a peak of approximately 1,000 skilled, semi-skilled and unskilled workers during construction. Construction workers will be hired variously as both daily/weekly workers, and for longer periods until construction is complete. During operation Allana will require a maximum of approximately 442 permanent staff for the operation and maintenance of the mine. This is estimated to be made up of approximately 98 skilled staff, 244 semi-skilled and 100 unskilled workers. In addition, approximately

400 to 600 truck drivers will be hired for the transportation of potash from the Project site down to the Port of Tadjoura.

- **Increased Income Generated Opportunities Related to In-migration:** The proposed Project may attract in-migration of opportunistic job seekers and service providers, potentially increasing demand for accommodation, goods and services and increasing income for local providers. This may be exacerbated by the construction of a new road from Mekele to Bada.
- **Improvement of Transport Routes in the Study:** The local population and their access to markets are restricted by their lack of physical infrastructure and transport routes. In particular the limited availability of healthcare services and infrastructure may be a direct result of the lack of roads into the Study Area. Levels of education are also low as a result of long commuting times, and bad road conditions which restrict access to schools. The lack of markets and public transport services is also evidence of the condition and quality of current transport routes in the Study Area.
- **Improvements Related to Community Development:** Allana has committed to implementing a program of community investment; however levels of investment and the duration of this investment have yet to be defined.

14.3

CUMULATIVE IMPACTS

The study identified that the presence of other planned and potential developments in the Study Area (a planned government road from Mekele to Bada, a government transport route from Tadjoura Port to the Project Area and the presence of other mining companies) has the potential to exasperate impacts relating to:

- Impacts to both surface and groundwater;
- Impacts to air quality;
- Impacts to the noise environment;
- Impacts to the ecology; and
- Impacts to the social environment.

Management of cumulative impacts involves alignment between developers with respect to resourcing and infrastructure needs, the potential sharing of infrastructure (such as roads), establishment of a forum between mining companies and transparency and buy-in from of developers to mitigation and management measures adopted by Allana.

14.4

CONCLUSION

Provided that all the social and environmental mitigation/management measures provided in this ESHIA are implemented, it is the opinion of ERM that there are no environmental or social fatal flaws which inhibit authorisation of the proposed Dallol Potash Project. Although Fugro (2012)

indicate that it is highly probable that there are sufficient water reserves for solution mining, and that recharge into the aquifers targeted for groundwater abstraction is thought to be sufficient, long term monitoring of groundwater levels and water quality in production boreholes and observation wells, as well as community wells and boreholes, is required, both to confirm recharge parameters and to better refine a groundwater model, that must be used as a tool in the management of these aquifers. Given the potential cumulative impacts as a result of both Allana and other mining companies abstracting water from the same aquifers, it is essential that all users of this resource manage their water in a cooperative and transparent manner, and in order to ensure security of supply, commit to abstracting at equal or less than the calculated annual recharge to these aquifers. Furthermore, it is crucial that Allana ensure that the sale or disposal of by-product salt is carried out in such a manner so as not to 'flood' the market and depreciate the value of locally produced artisanal salt.

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