Part III Annex H

Water Management Plan

Version 2.0

January 2015

Yara Dallol Potash Project, Danakil Depression, Ethiopia

Document Ref.	Prepared By	Reviewed By	Date Submitted to Yara Dallol BV for Review
0224244_V1.0_WAMP	Andreas Stoll	Dieter Rodewald and Mike Everett	October 2014
0224244_V2.0_WAMP			January 2015

CONTENTS

LIST OF ACRONYMS

Abbreviation	Full Definition
ANRS	Afar National Regional State
As	Arsenic
BMP	Biodiversity Management Plan
BOD	Biological Oxygen Demand
Cd	Cadmium
CHSSMP	Community Health, Safety and Security Plan
CN	Cyanide
COD	Chemical Oxygen Demand
Cr	Chromium
Cu	Copper
EHS	Environmental, Health and Safety
ES-MS	Environmental and Social Management System
ESIA	Environmental and Social Impact Assessment
Fe	Iron
Hg	Mercury
IFC	International Finance Corporation
IMCP	Integrated Mine Closure Plan
L	Litres
M	Metres
m3/h	Cubic Metres per Hour
Mg	Milligrams
Ni	Nickle
pH	Power of Hydrogen
VI	Roman Numeral for the number "6"
Pb	Lead
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedures
SPCCP	Spill Prevention Control and Containment Plan
TDR	Time Domain Reflectometry
TDS	Total Dissolved Solids
WAD	Weak Acid Dissociable
WMP	Waste Management Plan
WAMP	Water Management Plan
WHO	World Health Organisation
Zn	Zinc

DEFINITIONS

The following definitions are of relevance within this report:

- **Alluvial** - sediments deposited by flowing water.

- **Alluvial Fan Aquifer -** an aquifer formed of unconsolidated material deposited by water, typically occurring adjacent to river channels and in buried or paleochannels.

- **Aquifer** - geological formation(s) capable of supplying economic volumes of groundwater.

- **Borehole** – includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer [from National Water Act (Act No. 36 of 1998)].

- **Brackish** – water that contains between 1,000 and 10,000 mg/L of Total Dissolved Solids (TDS).

- **Brine** – Water that contains more than 35,000 mg/L of Total Dissolved Solids (TDS).

- **Catchment** – The area from which any rainfall will drain into the watercourse at a particular point, contributing to the runoff in a river system; synonymous with the term river basin.

- **Contamination** – The introduction of any substance into the environment by the action of man.

- **Contractors** – persons working for external companies (or employed by an employment agency) that are under contract to carryout for the unit, but not being part of the unit's workforce.

- **Dissolved Solids** – minerals and organic matter dissolved in water.

- **Drawdown** – the difference between the observed groundwater level during pumping and the non-pumping or rest groundwater level in a borehole.

- **Employees** – full time and part time employees of Yara Dallol BV (i.e. – salaries paid directly to individuals by Yara Dallol BV).

- **Formation** – a general term used to describe a sequence of rock layers.

- **Potable Water** – water that is safe and palatable for human use;

- **Recharge** – the addition of water to the zone of saturation, either by the downward percolation of precipitation or surface water and / or the lateral migration of groundwater from adjacent aquifers.

- **Runoff** – all surface and subsurface flow from a catchment, but in practice refers to the flow in a river i.e. excludes groundwater not discharged into a river.

- **Spring** – a point where groundwater emerges, usually as a result of topographical, lithological or structural controls.

- **Water Table** – the upper surface of the saturated zone of an unconfined aquifer at which pore pressure is at atmospheric pressure, the depth to which may fluctuate seasonally.

- **Well Field** – a group of boreholes in a particular area usually used for groundwater abstraction purposes.

1 INTRODUCTION

Yara International is a leading global fertilizer company with sales of fertilizer to about 150 countries globally. As part of Yara International's overall upstream strategy, the company is exploring for suitable raw sources that can be developed and used as a source to Yara International's global fertilizer production and directly as finished product in its product portfolio. To complement these upstream processes, Yara International has recently started a subsidiary company, Yara Dallol BV, which is involved in the exploration and mining development of potash concessions in Ethiopia. These concessions are located in the Danakil Depression, Afar National Regional State (ANRS), Ethiopia. Yara International, through its subsidiary, proposes to develop a potash mine – the Yara Dallol Potash Project (hereafter referred to as the Project) within these concession areas.

As part of the environmental approval process for the Project a suite of environmental and social management plans is needed to address the issues identified in the Environmental and Social Impact Assessment (ESIA). Several management plans have been developed to address impacts identified in the ESIA and are implemented as part of an environmental management system for the proposed Yara Dallol Potash Project.

Several activities associated with the Project will result in the abstraction and discharge of water, which could impact on the receiving environment (social and biophysical). This Water Management Plan (WAMP) has been compiled to address the specific impacts that are anticipated to occur as a result of the Project as identified in the ESIA and associated impact assessment. This plan sets out a formal system by which Yara Dallol BV will manage mitigation measures that will reduce the impacts on water.

1.1 POLICY STATEMENT AND OBJECTIVES

1.1.1 Policy Statement

The development of this WAMP has been guided by the Yara Dallol BV Health, Environment, Safety, Quality and Product Stewardship Policy, as set out in *Box 1.1*. This Policy is a high-level corporate statement of intent and establishes the principles to be followed in the management of environmental and health & safety issues.

Box 1.1 ***Health, Environment, Safety, Quality and Product Stewardship Policy Statement***

COMPANY COMMITMENT

Yara Dallol BV's aim is to establish sustainable growth and the creation of shareholder and societal value. Yara Dallol BV affirms to its stakeholders, including employees, customers and the public, its commitment to continuously improve and reach standards of excellence in Health Environment, Safety, Quality and Product Stewardship through its operations.

ENVIRONMENTAL POLICY

Yara Dallol BV will manage their business in a life cycle perspective. In Yara Dallol BV operations Yara Dallol BV will contribute to eco-efficiency by continuously improving energy consumption and reducing waste, emissions and discharges. Waste that is generated will be handled and disposed if safely and responsibly.

Yara Dallol BV will design its products and develop product applications to have the minimum adverse effect on the environment throughout their lifecycle.

1.1.2 Objectives

The objectives of this Water Management Plan (WAMP) are as follows:

1. To ensure that the plan complies with Ethiopian legislation;

2. To ensure alignment with the requirements set out in the International Finance Corporation (IFC) Performance Standards and IFC Environmental, Health and Safety Guidelines;

3. To ensure Project water management is in compliance with Ethiopian and World Health Organisation (WHO) drinking water standards;

4. To ensure the use of water resources in the broader Project Area is undertaken in a sustainable manner so as to reduce impacts to the receiving biophysical and social environments;

5. To preserve water resources in line with the objectives of integrated catchment management, thereby ensuring that this resource is utilised to the maximum benefit of Ethiopia and its inhabitants; and

6. To construct infrastructure and reticulation systems to standards designed to minimise water losses and leaks.

1.2 PURPOSE AND SCOPE

The purpose of the WAMP is to provide a clear set of actions and responsibilities for the control of impacts affecting the surface- and groundwater resources within the Project's Area of influence.

The scope of this WAMP covers construction, operational and decommissioning / closure phases of the Project. Mitigation measures are presented to ensure that adverse impacts to water resources are minimised.

This plan should be considered to be a "living" document that is amended in light of the learning experienced during its implementation.

1.3 *LINKAGE TO OTHER ENVIRONMENTAL AND SOCIAL PLANS*

This WAMP should be read in the context of the Environmental and Social Management System (ES-MS) (discussed in *Chapter 13* of *Part I* of the *ESIA*), which has been structured to provide a vehicle for the integrated management of the suite of management plans described in *Part III*. These plans have been designed to address a broad range of social and environmental risks.

It is recognised that the ES-MS and associated plans are living tools that will be constantly reviewed and updated to accommodate changing circumstances.

The WAMP links with the Community Health, Safety and Security Plan (CHSSMP), the Waste Management Plan (WMP), Biodiversity Management Plan (BMP), Integrated Mine Closure Plan (IMCP) and the Spill Prevention Control and Containment Plan (SPCCP). Details of this link are described in *Table 1.1* below.

Table 1.1 Details of Linkages between the WAMP and Other Management Plans associated with the Yara Dallol Potash Project

Management Plan	Overlap of this Plan with Content of Other Plans
SOCIAL PLANS	
Community Health, Safety and Security Plan (CHSSMP)	The contamination of surface- and groundwater must be avoided in the broader Yara Dallol BV Project Area, given the reliance of the local population on these resources. Numerical guidelines followed by Yara Dallol BV include Ethiopian, IFC and WHO guidelines for drinking water and effluent discharge.
ENVIRONMENTAL PLANS	
Waste Management Plan (WMP)	Procedures for the management of all waste streams produced by the Yara Dallol Potash Project must be in place to ensure surface- and groundwater is not contaminated.
Biodiversity Management Plan (BMP)	Yara Dallol BV's plans to abstract groundwater for mining and potential interruption of surface water run-off due to construction of infrastructure might impact the plants in the area, especially Doum palms used by communities in the Project Area and surrounds. There is a chance that the water supply for these palms will be compromised resulting in potential die off. Yara Dallol BV must ensure Project design follows good environmental and engineering practice, so as to ensure that water run-off from the highlands to Doum Palm fringes is not compromised.
Integrated Mine Closure Plan (IMCP)	Specific groundwater management and monitoring measures will need to be implemented during the decommissioning and closure phase of the Project

Management Plan	Overlap of this Plan with Content of Other Plans
OCCUPATIONAL HEALTH, SAFETY AND RISK PLANS	
Spill Prevention Control and Containment Plan (SPCCP)	Hydrocarbon and sewage spills have the potential to contaminate both surface and groundwater resources.

2 SUMMARY OF LEGAL AND OTHER REQUIREMENTS

A summary of the legal requirements and standards relevant to the WAMP are presented below.

2.1 NATIONAL LEGISLATION AND POLICY

2.1.1 Water Resources Management Proclamation (197/2000)

Water resources management in Ethiopia is governed by the Water Resources Management Proclamation (197/2000).

The purpose of the Proclamation is to ensure that the water resources (both surface- and groundwater) of Ethiopia are protected and utilized for the highest social and economic benefits of the country's people. All water resources are the common property of the Ethiopian people and the state. Water use for domestic purposes has priority over and above any other water uses. Planning, management, utilisation and protection of water resources is the responsibility of the "Supervising Body" (i.e. the Ethiopian Ministry of Water, Irrigation and Energy or any other organ of State delegated by the Ministry). Furthermore, the proclamation addresses the requirement for environmental conservation and water resource protection measures to be incorporated into water resource planning and project development.

An application for water use, release or discharge of waste, and waterworks construction permits shall be submitted to the Supervising Body. The Ministry of Energy, Water and Irrigation or an organ delegated by it shall issue the requested permit within sixty (60) days from the receipt of the application where the permit does not violate other person's legitimate interest or where the activity does not result in polluting or causing harmful effect on the water resource and the environment. A water use permit is issued for one year and renewable every year. The permit is also presumed to be cancelled if not renewed on time.

Furthermore, the proclamation defines *Waste* as any harmful matter introduced, released or discharged into any water body in any solid, liquid or gaseous form. Moreover, the proclamation defines *Polluted Water* as sewage and industrial effluents including toxic water.

Waste water discharge permits need to be obtained to (amongst others) release or discharge effluent into water resources unless otherwise provided for in the regulations.

Project Requirements

This Water Management Plan (WAMP) has been developed specifically to include mitigation/management measures pertaining to the hydrological environment in which the Project is located.

Moreover, the liquid discharges proposed by Yara Dallol BV are likely to considered effluent, and as a result may potentially require a waste water discharge permit (this is elaborated on in *Section 2.1.2*).

2.1.2 Water Resources Management Regulation (115/2005)

The Water Resources Management Regulation (115/2005) is mainly a further elaboration of the aforementioned Water Resources Management 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. Furthermore, the regulation provides provisions for fees associated with application or permits as well as the requirements of water charges to be paid for different uses of water. The amount of charges payable are left to be determined by the Council of Ministers and issued in a subsequent regulation (Article 31.4).

The proclamation also mentions that a waste water discharge permit is required for direct or indirect discharge of any treated trade effluent or sewerage effluent or any poisonous, noxious or polluting matter into surface or groundwater.

Project Requirements

Dallol BV are required by law to apply for and secure water use permits for land where water is intended to be used for the proposed Yara Dallol Potash Project. These applications will need to be lodged with the Federal Ministry of Water, Irrigation and Energy for consideration.

Furthermore, Yara Dallol BV is currently expecting to discharge the following liquid to the environment –

- Weak sodium chloride brine - this brine will be discharged to a ditch just outside of the evaporation ponds, where the water is expected to evaporate and form a salt crust.
- Magnesium chloride brine – this will be injected into depleted caverns to force out the final production grade brine, and used on unpaved road surfaces to reduce dust emissions.
- Potential run-off from salt tailings during rainfall events. The run-off of salt saturated rainwater will flow to the salt flats.

Based on the regulation, the liquid discharges proposed by Yara Dallol BV would be considered to be effluent, and as a result would theoretically require a waste water discharge permit, as they constitute release of ***potentially*** harmful or polluting matter directly and indirectly into surface and groundwater.

Only one specific Ethiopian regulation could be found relating to disposal of brine into brine caverns. The proclamation No. 52/1993 (A Proclamation to Promote the Development of Mineral Resources) states that – "*The license of brines may specify conditions of production and of extraction and disposal of minerals produced and of the use and disposal of minerals produced and of the use and disposal of the water remaining*".

Yara Dallol BV would need to engage with the Ministry of Water, Irrigation and Energy to confirm the need and applicability for waste water discharge permits and licenses associated with solution mining for the proposed Project.

2.2 NATIONAL GUIDELINES AND STANDARDS

2.2.1 *Environmental Standards for Industrial Pollution Control in Ethiopia*

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 (amongst others) water resources.

These standards are specified for a number of industrial sectors, including tanning and leather finishing; manufacture and finishing of textiles; production and processing of iron and steel; metal working, plating and finishing; base metal and iron ore mining; malting, brewing, distilling, production of wines and other alcoholic liquors; manufacture of dairy products; fruit and vegetable processing; manufacture of sugar; slaughtering, meat processing and rendering; timber preservation; manufacture of fertilisers (phosphate and nitrogenous); pulp and paper; cement manufacturing; petrochemical manufacturing; pesticide manufacturing; pesticide formulation; and pharmaceutical manufacturing; printing and surface coating. In addition, there are general standards for all other industrial effluents to be discharged to inland waters.

Project Requirements

The specified industries listed above are not fully relevant for the Yara Dallol Potash Project; however, the general standards for effluent discharge clearly assume discharge to relatively fresh waters, as TDS limits are specified at 3,000 mg/L, chloride at 1,000 mg/L and magnesium at 100 mg/L, and are therefore equally inappropriate, given that water quality within the salt flats of the Project Area and within the salt caverns is within the brine range (greater than 35,000mg/l TDS). However, this said, Yara Dallol BV will apply for a compliance exemption from these standards with the Ministry of Water, Irrigation and Energy.

2.2.2 Ethiopian Standard for Drinking Water (261/2001)

The Ethiopian drinking water standard specifies the physical, chemical and bacteriological requirements for water used for drinking and domestic purposes. These specifications are largely based on the WHO Guidelines for Drinking Water Quality 2nd edition, from 1993 (most recent edition is from 2011).

Project Requirements

Yara Dallol BV will ensure that water supplied for potable use meet these standards.

2.3 IFC PERFORMANCE STANDARDS

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. Those guidelines applicable to this WAMP are discussed below.

2.3.1 IFC EHS Guidelines – 1.3 (Wastewater and Ambient Water Quality)

IFC EHS Guideline 1.3 specifies that discharges should not result in contaminant concentrations in excess of local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality. Receiving water use and assimilative capacity, taking other sources of discharges to the receiving water into consideration, should also influence the acceptable pollution loadings and effluent discharge quality.

Project Requirements

The IFC approach is more suited to the receiving environment associated with the Yara Dallol Potash Project in that it would allow specification of site specific effluent discharge limits based on an understanding of baseline water quality, water use (e.g. domestic use, agricultural use), ecological reserve determinations, other potential sources of impact, and potential impacts related to effluent discharge. A robust set of baseline water quality data will assist greatly in negotiating reasonable receiving water quality objectives with regulators. However, unless provided with an exemption by the Ethiopian authorities, ERM are of the opinion that Yara will be obliged to comply with the Ethiopian National Standards

2.3.2 IFC EHS Guidelines – 1.4 Water Conservation

Other than the need for water permitting, there is no specific Ethiopian legislation related to water use; however, mechanisms included in the water conservation guidelines include –

- The setting of targets for water use, and monitoring of water flows against these targets;
- Water reuse where possible; and
- Reducing leaks and making more efficient use of water within the water reticulation system.

Project Requirements

Further mechanisms associated with water use and conservation are included in the Industry Specific EHS Guidelines for Mining detailed in *Section 2.3.3*.

2.3.3 Industry Specific EHS Guidelines

In addition to those EHS Guidelines presented above, further industry specific EHS guidelines applicable to this WAMP include the EHS Guideline for Mining. This Guidelines is 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. Furthermore, the Guideline recommends the following practices for water management:

- Establishing a water balance for the mine, including the potential impacts of dewatering related to groundwater abstraction.

- Developing a sustainable water supply management program. This is especially pertinent for Yara Dallol BV given the large volumes of relatively *fresh* water that are required.

- Considering reuse and recycling of process water where feasible.

- Consultation with key stakeholders to understand any conflicting water use demands, and communities' dependency on water resources and/or conservation requirements.

Effluent Guidelines are also provided under the EHS Guideline for Mining. These Guidelines specify discharge limits for pH, COD, BOD, oil and grease, As, Cd, Cr(VI), Cu, CN (total, free and WAD), total Fe, Pb, Hg, Ni, Zn, phenols and temperature. Despite the expected salinity of the effluent, the guidelines should be achievable as they do not specify TDS or major ion concentrations; however, if background concentrations are found to be in excess of the specified guideline values, the IFC does allow for establishment of site specific discharge levels based on the receiving water use classification.

In addition to the EHS Guideline for Mining, this WAMP has taken into account the EHS Guideline for Water and Sanitation. This Guideline includes 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.

With respect to this WAMP, Yara Dallol BV has the responsibility to provide water management and to structure and coordinate water management procedures for the Yara Dallol Potash Project.

Furthermore, Yara Dallol BV has the responsibility for ensuring that specific water management responsibilities allocated to them are organised and implemented. Yara Dallol BV has the responsibility to ensure that their employees and contracted third parties are trained and aware of all required water management procedures.

The roles and responsibilities within Yara Dallol BV for the implementation of the WAMP are presented in *Table 3.1*.

Table 3.1 Responsible Parties and Roles and Responsibilities

Responsible Parties	Roles and Responsibilities
Dallol General Manager	• Review monthly and quarterly water reporting. • Work with the Environmental and Social Manager to identify necessary improvements.
Environmental and Social Manager	• Responsible for implementation of Water Management requirements during all phases of the Project. • Develop training and management plans to ensure water concerns are addressed. • Responsible for implementing water monitoring programme.
Water Specialist	• Perform inspections after major events (i.e. heavy rains.) • Responsible for performing water monitoring programme.
Community Liaison Officer	• Provide water related information at local level and liaise with potentially affected communities • Keep detailed records of stakeholder communication and actions
Project Manager	• Together with the Environmental and Social Manager is responsible for staffing, planning and day-to-day execution of the management measures described under this WAMP during the construction phase of this Project. • As needed, this individual will develop and propose staff plans and contractual language to ensure that these measures are implemented by Yara Dallol BV staff and contractors throughout the construction phase of the Project.
Operations Manager	• Together with the Environmental and Social Manager is responsible for staffing, planning and day-to-day execution of the management measures described under this WAMP during the operational phase of this Project. • As needed, this individual will develop and propose staff plans and contractual language to ensure that these measures are implemented by Yara Dallol BV staff and contractors throughout the operational phase of the Project.
Contractors (Construction and Operations)	• Responsible for following the procedures and requirements indicated in construction, operational and decommissioning and closure sections of this WAMP.

4 IMPACT MANAGEMENT

4.1 SUMMARY OF WATER REQUIREMENTS FOR THE YARA DALLOL POTASH PROJECT

The Project will require large quantities of water with different quality requirements depending on the use. An estimated 650 m^3/hour of fresh water will be needed for conversion and 870 m^3/h of brackish water (up to a TDS of 30,000 mg/L) for solution mining. Further, an amount of 30m^3/hour of potable water will be required for drinking and sanitary needs. This will equate to an average Project water consumption of 1,550m^3/hour for the duration of solution mining and SOP production (20 years).

4.2 SUMMARY OF IMPACT MANAGEMENT

As with any project of this scale and nature, there are certain impacts that cannot be entirely eliminated, i.e. residual impacts after implementing mitigation measures. With respect to impact mitigation, the Project subscribes to the philosophy of impact avoidance (by changes to Project planning and/or design) and impact reduction (to reduce impacts that cannot be avoided to acceptable levels). What follows, is a description of the potential residual impacts and the mitigation measures proposed to reduce them to acceptable levels. These mitigation measures essentially comprise the "management plan" to address water related impacts.

The following sections will:

1. Identify potential impacts associated with each phase of the Project;

2. Identify the objectives and targets related to the impacts;

3. Describe the management measure(s) to minimise the impact; and

4. Assign responsibilities and accountability for the management measures.

Water monitoring requirements during pre-construction, construction, operation, decommissioning and closure/post-closure are included in *Section 5*.

4.3 MANAGEMENT DURING CONSTRUCTION

4.3.1 Potential Impacts

The key impacts during the construction phase of the Project are associated with:

- Surface- and groundwater quality impacts as a result of spillages and wastage during construction activities and / or potential runoff of spilled materials; and

- Surface water flow interruption due to construction of infrastructure (i.e. roads, pipelines).

4.3.2 Objectives and Targets for the Construction Phase

The following two objectives encompass the water mitigation requirements for the construction phase of the Project:

- To avoid/minimise adverse *surface- and groundwater* quality impacts; and

- To avoid/minimise adverse *surface water impacts due to flow interruption.*

4.3.3 Management Actions for the Construction Phase

The following management actions are required in order to meet the objectives and targets outlined above:

1. The SPCCP developed for the Project will be included in the Projects overall ES-MS so as to ensure that a process for rapid and efficient response to and management of hazardous material spills during the construction phase of the Project is developed. Furthermore, this process will also define the procedures for handling hazardous materials/chemicals in a manner that does not impact the environment.

2. The Project Manager and Environmental and Social Manager will ensure procedures are in place for spill prevention and clean-up, sewage handling and treatment, storage of fuels and chemicals and car washing and repairs following good industry practice.

3. Areas where spillage of soil contaminants occurs will be excavated (to the depth of contamination) and suitably rehabilitated. If any other minor spillage occurs the spillage will be cleaned immediately and the contaminated area will be rehabilitated. All contaminated material will be suitably disposed of.

4. Yara Dallol BV will prohibit the washing of Project vehicles in any surface water bodies in and around the Project Area. All Project vehicles will be washed at designated wash bays on site. Wash bays on site will include oil/grease and sediment traps for grey water, before this water is returned into mine processing.

5. Yara Dallol BV will prevent any *ad hoc* maintenance of vehicles in and around the Project Site. All vehicles will be maintained at a designated workshop at the Processing Plant. The workshop will include an oil/grease trap.

6. Chemicals and fuels will be stored in bunded areas together with emergency spill response equipment.

7. Yara Dallol BV will manage the sewage treatment system in a manner that results in zero discharge of raw sewage to the environment. If necessary, treated sewage will conform to recognised standards before discharge.

8. Stormwater control infrastructure will be designed to account for the high intensity and short duration flash flood events that are known to occur in the region.

9. Yara Dallol BV will implement all civil engineering requirements for roads (main/secondary/tertiary) so as to prevent any impedance of surface water flows (e.g. culverts: appropriate design, frequency and spacing), which are crucial to the survival of Doum Palms (refer to BMP – *Annex C* in *Part III* of this ESIA). The regular maintenance of culverts will be undertaken to ensure these remain clear of debris, especially after each runoff event.

10. Yara Dallol BV will ensure that any infrastructure constructed in and across surface water run-off channels will be undertaken in a manner that compliments good engineering/environmental practice. This will include-

    a. The installation of appropriately sized and spaced culverts to avoid flow interruption and increase of sediment loads in the rivers.
    b. If possible, construction of infrastructure in and across surface water run-off channels in the dry season, when no flash-floods are expected.

11. Clean water will be diverted around all major construction sites (*viz.* the site associated with the construction of the Staff Living Quarters and Processing Plant) and dirty water within the boundary of construction sites and other active areas containing potential pollutants will be managed on the site such that it does not flow from the site, and mix with floodwaters.

12. The Musley River run-off channel will be diverted around the Project Site into the nearest natural drainage path or Wadi so as to prevent flow onto the site. The diversion channels will be designed to accommodate the short duration /high flow events (flash floods).

13. Yara Dallol BV will train applicable employees and contractors regarding proper methods for transporting, transferring and handling hazardous substances that have the potential to impact surface- and groundwater resources.

14. All borrow pits will be located away from run-off channels.

4.4 MANAGEMENT DURING OPERATION

4.4.1 Potential Impacts

The potential key impacts during the operational phase of the Project are associated with:

- Groundwater drawdown in the alluvial fan aquifers as a result of groundwater abstraction and resulting impact on receptors;
- Groundwater quality impact as a result of groundwater abstraction in the alluvial fan aquifers;
- Groundwater quality impacts as a result of Project activities including the use of an oil blanket for solution mining;
- Surface water flow interruption due to infrastructure (i.e. roads); and
- Surface water quality impacts as a result of Project activities.

4.4.2 Objectives and Targets for the Operational Phase

The following objectives encompass the water mitigation requirements for the operational phase of the Project:

- To ensure protection of water resources;
- To avoid/minimise adverse groundwater level impacts;
- To avoid/minimise adverse surface- and groundwater quality impacts;
- To avoid/minimise adverse surface water impacts due to flow interruption;
- To avoid/minimise indirect impacts on flora, fauna and people; and
- To review the ES–MS compiled during the construction phase and amend if necessary to identify any water impacts due to mining activities.

4.4.3 Management Actions for the Operational Phase

The following management actions are required in order to meet the objectives and targets outlined above:

1. Spill prevention, control and containment measures included into the Projects overall ES-MS for during construction phase will be reviewed to amend operational procedures for rapid and efficient response to and management of hazardous material spills during the operational phase of the Project. Furthermore, this review and subsequent amendment process

will define the procedures for handling hazardous materials / chemicals during the operational phase.

2. The Operations Manager and Environment and Social Manager will ensure procedures are in place for spill prevention and clean-up, sewage handling and treatment, storage of fuels and chemicals, and car washing and repairs following good industry practice.

3. Yara Dallol BV will design the Project water supply well field in a way that minimises or avoids groundwater drawdown and subsequent impacts to sensitive social and biodiversity receptors. During well field design Yara Dallol BV will ensure that the spacing of abstraction wells in the well fields is such that water quantity is not compromised. In addition, the operation/management of the well field will continuously assess pump rates, pump cycles and monitor the levels of groundwater drawdown.

4. In the event that community wells/boreholes be impacted as a result of water abstraction, Yara Dallol BV will ensure the provision of water of adequate quality to these affected communities, either through:

    a. The digging of deeper wells/boreholes; or
    b. Alternative supplies from the well field.

5. All oil/water separators will be maintained in good working order.

6. The engineering of solution mining wells and associated caverns will be undertaken in a way that minimises the potential for sinkhole development. In this respect, a subsidence monitoring network should be established that covers the entire cavern field and its associated area of influence. This could be achieved through use of specific instrumentation (TDR, extensometers, etc.) to monitor overburden rock movement where caverns are shallower than 120m.

Mitigation Measures Applicable to the Operational Phase but Described for the Construction Phase

The following mitigation measures are applicable to the Operational Phase, but are described in *Section 4.3.3* (*Page 4-2*) for the Construction Phase:

- *Mitigation item 3* – clean-up of contaminated soil
- *Mitigation item 4* – the washing of vehicles
- *Mitigation item 5* – the maintenance of vehicles
- *Mitigation item 6* – the storage of chemicals and fuels
- *Mitigation item 7* – the management of sewage
- *Mitigation item 8* – stormwater control infrastructure
- *Mitigation item 13* – the training of employees and third party contractors

PLEASE NOTE

In order to manage and mitigate cumulative water impacts, ERM recommends a combined effort and coordinated groundwater abstraction with other water users (i.e. potash mining companies) to minimise impact on groundwater resource and sensitive receptors. A water committee should be established, including representatives from each of the companies operating in the Danakil, as well as affected communities and the Ethiopian government.

4.5 MANAGEMENT FOR DECOMMISSIONING AND CLOSURE

4.5.1 Potential Impacts

Impacts on water during decommissioning are similar to those experienced during construction and operation, which include the potential for surface, and groundwater contamination, a slow groundwater level recovery, post mining and indirect impacts to ecology and communities due to surface water flow interruption. Water monitoring needs to continue until a positive environmental trend is established.

4.5.2 Objectives and Targets for the Decommissioning and Closure Phase

The following objectives encompass the water mitigation requirements for the decommissioning and closure phase of the Project:

- To ensure decommissioning, demolition and decontamination of building structures, infrastructure and waste storage areas is undertaken in a way that conforms to internationally accepted best-practice standards;
- To ensure protection of water resources (surface- and groundwater);
- To have sufficient groundwater recovery;
- To avoid/minimise adverse surface- and groundwater quality impacts;
- To avoid/minimise adverse surface water impacts due to flow interruption;
- To avoid/minimise indirect impacts on flora, fauna and people; and
- To review the ES–MS compiled during operational phase and amend if necessary to identify any water impacts due to decommissioning and closure activities.

4.5.3 Management Actions

The following management actions are required in order to meet the objectives and targets outlined above:

1. Spill prevention, control and containment measures included into the Projects overall ES-MS for during operational phase will be reviewed to amend decommissioning and closure procedures for rapid and efficient response to and management of hazardous material spills during the decommissioning and closure phase of the Project. Furthermore, this review and subsequent amendment process will define the procedures for handling hazardous materials / chemicals during the decommissioning and closure phase.

2. Boreholes in the water supply well field will be sealed, decommissioned and the abstraction area will be suitably rehabilitated. Furthermore, all pipeline and pumping infrastructure associated with these boreholes will be removed.

3. If possible at the time, the use and maintenance of all community water supply boreholes will be handed over to the local or regional authorities.

4. Groundwater monitoring will continue until a positive environmental trend (i.e. until groundwater levels return to pre-mining elevations) is established. In order to understand what these pre-mining elevations are, ongoing groundwater level monitoring will be required pre-construction, through construction and into the operational phase.

5. In the event of groundwater contamination relating to mining activities is established, an analysis will be performed to determine the possible sources of pollution. Once the source has been established remediation measures will be developed and implemented.

6. When the water table reaches pre-mining elevations and no mining related groundwater contamination is detected, monitoring boreholes will be sealed and decommissioned, thus preventing consumption of water that is not suitable for human consumption.

5. On gentle slopes, water will be encouraged to flow off the rehabilitated surface, as surface flow, as quickly as possible without causing erosion. Periodic checks must be carried out during the wet season and associated flash flood events to identify areas where erosion is occurring. Appropriate remedial action, including the rehabilitation of the eroded areas, and where necessary, the relocation of the paths causing the erosion, are to be undertaken.

6. Monitoring of surface water features will continue until a positive environmental trend is established. In the event that water quality is considered contaminated (*viz.* hydrocarbon contamination), an analysis will be performed to determine the possible sources of pollution and recommend mitigation measures.

Mitigation Measures Applicable to the Decommissioning and Closure Phase but Described for the Construction Phase

The following mitigation measures are applicable to the Decommissioning and Closure Phase, but are described in *Section 4.3.3* (*Page 4-2*) for the Construction Phase:

- *Mitigation item 3* – clean-up of contaminated soil
- *Mitigation item 4* – the washing of vehicles
- *Mitigation item 5* – the maintenance of vehicles
- *Mitigation item 6* – the storage of chemicals and fuels
- *Mitigation item 7* – the management of sewage
- *Mitigation item 8* – stormwater control infrastructure
- *Mitigation item 13* – the training of employees and contractors

5 VERIFICATION AND MONITORING

In terms of water monitoring, the overarching aim at the pre-construction and construction phase of the Project is to establish a robust and defensible baseline data set against which possible future Project impacts can be measured and compared.

During operation, the aim of the monitoring programme is to monitor the water resources to identify adverse Project impacts at an early stage. This will enable Yara Dallol BV to take appropriate water management decisions during the mine operation in order to insure minimal impact to water resources and associated social and biophysical receptors.

This *Section* outlines the water monitoring requirements; however, does not go into specific detail, as to sampling methodologies and standard operating procedures (SOP) for surface- and groundwater monitoring. At the onset of the construction phase of the Project, Yara Dallol BV will develop a Sampling and Analysis Plan (SAP). This SAP will cover detailed monitoring requirements for surface- and groundwater resources in the Project Area and surrounds, including monitoring plans, monitoring locations, monitoring frequency and analytical suites for water samples, as well as SOPs for each monitoring task to ensure quality of data collection.

Water monitoring requirements and plans need to undergo periodic review (i.e. annual and after each Project phase) in order to insure adequate protection of the water resources.

5.1 GROUNDWATER MONITORING

Groundwater monitoring requirements for the Project include the following:

- Continuous groundwater level monitoring using water level loggers, as well as monthly manual groundwater level measurements;
- Quarterly groundwater quality monitoring (water sampling);
- Quarterly spring discharge monitoring (flow and quality); and
- Ongoing groundwater abstraction monitoring during the operational phase.

The installation of additional monitoring wells may be required e.g., if the drawdown cone extends further than the existing monitoring network and/or if the monitoring well located furthest down-gradient of any sources is contaminated. The monitoring requirements need to be reviewed periodically (i.e. every year) and amended as required.

5.2 SURFACE WATER MONITORING

Baseline monitoring of the surface water habitat (and associated Killifish populations) is required to develop a better understanding of their physical and biological characteristics prior to large-scale abstraction of groundwater resources during the operational phase. A quantifiable baseline state of the habitats and Killifish populations will be established in advance, covering physical attributes such as extent of surface water pools, depth, temperature and salinity fluctuations, water quality variables and fluctuations. Biological attributes of the Killifish populations are also required. It is important to understand the detailed baseline conditions, as it may be necessary to artificially replicate these systems at a later stage.

The monitoring requirements associated with these surface water habitats are detailed in *Annex C* of *Part III* of this ESIA.

5.3 VISUAL INSPECTION

During the construction, operation and decommissioning/closure phases, commitment is made to undertake visual inspections of activities resulting in impact to water resources and indirect impacts to communities and ecological receptors.

The visual inspections will be undertaken periodically and will reflect the ethos of 'see it, own it', in terms of identifying and addressing significant water impacts. Where significant impacts are observed, these will be recorded. On the basis of the reports, where there are activities that repeatedly result in significant impacts, further investigations will be undertaken to reduce these impacts.

This will be the role of the Yara Dallol BV Environmental and Social Manager and associated Support Staff.

5.4 GROUNDWATER MODELLING AND MODEL CALIBRATION

MWH (the hydrogeological consulting firm undertaking the water resources feasibility study for the proposed Yara Dallol Potash Project) are in the process of finalising the numerical groundwater flow model that will simulate different abstraction scenarios for the proposed Project and how each aquifer will react to such abstraction rates. The numerical model is predicted to be completed towards the end of 2014 and will provide a better understanding of the behaviour of targeted aquifers with varying abstraction rates. The objective of this model is to define the sustainable water potential of targeted aquifers, better define the potential impact of various abstraction rates and hence simulate various groundwater drawdown scenarios on the natural and social environments.

The conceptual and numerical groundwater model developed by MWH will be calibrated, validated and further refined when new monitoring results become available.

A regional water committee that is tasked with coordinating the water abstraction from the alluvial fans should be established. This committee should include each of the stakeholders potentially affected by large-scale groundwater abstraction from the alluvial fan aquifers; together with members of local, regional government (Bureau of Water Resources) and federal government (Ministry of Water, Irrigation and Energy) and representatives and representatives of each of the mining companies. The continually refined groundwater model should be used by this regional committee as a tool in the management of targeted aquifer systems in the future.

5.5 COMMUNITY COMPLAINTS

Complaints arising from impacts to water quality/quantity during the construction, operational and decommissioning phases of the Project will be treated sensitively and in a manner that recognises the potential for subsequent social and biophysical impacts. These complaints will also be managed through the grievance procedure detailed in the Social Engagement Procedure (refer to *Annex C* of *Part II* of this ESIA).

Records of any complaints associated with water will be kept and captured on a grievance register, identifying the nature of the complaint, and documenting the action taken. All complaints will be investigated and feedback provided to the complainant.

6 REPORTING AND DOCUMENTATION

6.1 GOVERNMENT/AUTHORITY REPORTING

There are no Ethiopian regulatory requirements dealing specifically with the need to submit water monitoring reports to the Ethiopian Government.

6.2 INTERNAL REPORTING

Quarterly reports will be compiled by the Environmental and Social Manager. These reports will include trend analysis, interpretation of results, recommendations on remedial measures and relevant figures and graphs.

The quarterly reports will be combined into an annual report which will include a trend analysis, identification of problem areas, recommendations and all historical results.

6.3 COMMUNITY REPORTING

On the basis of quarterly, a summary report suitable for understanding by a non-technical community audience will be developed and disclosed on a bi-annual basis. This report will focus where possible upon graphical representation of information, and in particular outcomes of any community complaints or grievances and those actions taken to remedy significant impacts.

Table 7.1 Construction Phase

Impact	Objective	Mitigation/Management Measures	Monitoring Plan	Responsibility
Surface- and groundwater quality impacts	To avoid/minimise adverse surface- and groundwater quality impacts	• Inclusion of the SPCCP in the overall ES-MS • No washing of Project vehicles in any surface water bodies in and around the Project Area. All Project vehicles will be washed at designated wash bays on site. Wash bays will include oil/grease and sediment traps. • Suitable clean-up of areas where spillage of soil contaminants occurs and appropriate disposal thereof. • No *ad hoc* maintenance of vehicles in and around the Project Site. All vehicles will be maintained at a designated workshop at the Processing Plant, which will include an oil/grease trap. • Chemicals and fuels will be stored in bunded areas with emergency spill response equipment. • The sewage treatment system will be managed in a manner that results in zero discharge of raw sewage to the environment. • Clean water runoff (through flash flood events) will be diverted around all major construction sites and dirty water (water collected within active parts of the mining process) (if any) within the boundary of construction sites. • All employees and contractors will be trained regarding proper methods for transporting, transferring and handling hazardous substances.	• Continuous groundwater level monitoring using water level loggers, as well as monthly manual groundwater level measurements • Quarterly groundwater quality monitoring (water sampling) • Quarterly spring discharge monitoring (flow and quality) • Visual Monitoring.	• Environmental and Social Manager • Project Manager
Surface water flow interruption	To avoid/minimise adverse surface water impacts due to flow interruption	• Stormwater control infrastructure will be designed to account for the high intensity flash flood events. • All civil engineering requirements for all roads so as to prevent any impedance of surface water flows will be implemented. The regular maintenance of culverts to ensure they remain clear will also be undertaken. • Construction of any infrastructure in and across surface water run-off channels will be undertaken in a manner that compliments good engineering/environmental practice. • The Musley River run-off channel will be diverted around the Project Site into the nearest natural drainage path or Wadi. The diversion channels will be designed to accommodate the short duration /high flow events (flash floods). • All borrow pits will be located away from run-off channels.	• Visual Monitoring.	• Environmental and Social Manager • Project Manager

Table 7.2 Operational Phase

Impact	Objective	Mitigation/Management Measures	Monitoring Plan	Responsibility
Groundwater drawdown and quality impact in the alluvial fan aquifers and resulting impact on receptors	• To ensure protection of water resources; • To avoid/minimise adverse groundwater level impacts; • To avoid/minimise adverse surface- and groundwater quality impacts; • To avoid/minimise indirect impacts on flora, fauna and communities	• The Project water supply well field will be designed in a way that minimises groundwater drawdown and subsequent impacts to sensitive social and biodiversity receptors. • In the event that community wells/boreholes are impacted as a result of Yara Dallol BV water abstraction, Yara Dallol BV will ensure the provision of water of adequate quality to these affected communities. • In order to manage and mitigate cumulative water impacts, ERM recommends a combined effort and coordinated groundwater abstraction with other water users in this area as well as affected communities and the Ethiopian government. • The engineering of solution mining wells and associated caverns will be undertaken in a way that minimises the potential for sinkhole development.	• Continuous groundwater level monitoring using water level loggers, as well as monthly manual groundwater level measurements; • Quarterly groundwater quality monitoring (water sampling); • Quarterly spring discharge monitoring (flow and quality); and • Groundwater abstraction monitoring (meters).	• Dallol General Manager • Environmental and Social Manager • Water Committee for the collaborative management of regional groundwater resources
Groundwater quality impacts as a result of Project activities	• To avoid/minimise adverse groundwater quality impacts; • To avoid/minimise indirect impacts on flora, fauna and communities	• Spill prevention, control and containment measures included into the Projects overall ES-MS for during construction will be reviewed to amend operational procedures. • All oil/water separators will be maintained in good working order.	• Quarterly groundwater quality monitoring (water sampling) • Visual Monitoring.	• Environmental and Social Manager • Operations Manager

Impact	Objective	Mitigation/Management Measures	Monitoring Plan	Responsibility
Surface water flow interruption due to infrastructure (i.e. roads)	• To avoid/minimise adverse surface water impacts due to flow interruption; • To avoid/minimise indirect impacts on flora, fauna and communities	• All borrow pits will be located away from run-off channels.	Visual Monitoring	• Operations Manager
Surface water quality impacts as a result of Project activities	• To avoid/minimise adverse surface water quality impacts; • To avoid/minimise indirect impacts on flora, fauna and communities	• No washing of Project vehicles in any surface water bodies in and around the Project Area. All Project vehicles will be washed at designated wash bays on site. Wash bays will include oil/grease and sediment traps. • Suitable clean-up of areas where spillage of soil contaminants occurs and appropriate disposal thereof. • No *ad hoc* maintenance of vehicles in and around the Project Site. All vehicles will be maintained at a designated workshop at the Processing Plant, which will include an oil/grease trap. • Chemicals and fuels will be stored in bunded areas with emergency spill response equipment. • The sewage treatment system will be managed in a manner that results in zero discharge of raw sewage to the environment. • All employees and contractors will be trained regarding proper methods for transporting, transferring and handling hazardous substances.	Visual Monitoring	• Environmental and Social Manager • Operations Manager

Table 7.3 Decommissioning and Closure Phase

Impact	Objective	Mitigation/Management Measures	Monitoring Plan	Responsibility
Groundwater level drawdown (slow recovery)	• To ensure protection of water resources; • To avoid/minimise indirect impacts on flora, fauna and communities	• When the water table reaches pre-mining elevations and no mining related groundwater contamination is detected, monitoring boreholes will be sealed and decommissioned. • Boreholes in the water supply well field will be sealed, decommissioned and the abstraction area will be suitably rehabilitated. • If appropriate, the use and maintenance of all community water supply boreholes will be handed over to the local or regional authorities.	Water level monitoring post closure will continue until a positive environmental trend is established	• Dallol General Manager • Environmental and Social Manager
Groundwater quality impacts	• To avoid/minimise adverse surface- and groundwater quality impacts; • To avoid/minimise indirect impacts on flora, fauna and communities	• Inclusion of the SPCCP in the overall ES-MS • In the event groundwater contamination relating to mining activities is established, an analysis will be performed to determine the possible sources of pollution. Once the source has been established remediation measures will be developed and implemented.	Water quality monitoring post closure will continue until a positive environmental trend is established	• Environmental and Social Manager
Surface water flow interruption due to infrastructure (i.e. roads)	• To avoid/minimise adverse surface water impacts due to flow interruption; • To avoid/minimise indirect impacts on flora, fauna and communities	• On gentle slopes, water will be encouraged to flow off the rehabilitated surface, as surface flow, as quickly as possible without causing erosion. Appropriate remedial action must be undertaken for eroded areas.	Visual Monitoring	• Environmental and Social Manager
Surface water quality impacts	• To avoid/minimise adverse surface water quality impacts; • To avoid/minimise indirect impacts on flora, fauna and communities	• No washing of Project vehicles in any surface water bodies in and around the Project Area. All Project vehicles will be washed at designated wash bays on site. Wash bays will include oil/grease and sediment traps. • Suitable clean-up of areas where spillage of soil contaminants occurs and appropriate disposal thereof. • No *ad hoc* maintenance of vehicles in and around the Project Site. All vehicles will be maintained at a designated workshop at the Processing Plant, which will include an oil/grease trap. • Chemicals and fuels will be stored in bunded areas with emergency spill response equipment. • The sewage treatment system will be managed in a manner that results in zero discharge of raw sewage to the environment. • All employees and contractors will be trained regarding proper methods for transporting, transferring and handling hazardous substances.	• Monitoring of surface water features will continue until a positive environmental trend is established. In the event that water quality is poor, an analysis will be performed to determine the possible sources of pollution and recommend mitigation measures. • Visual Monitoring	• Environmental and Social Manager