

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 Yara 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 Yara Dallol Potash Project and other actual or proposed future developments in the broader Project Area.

12.1

DEVELOPMENT CONTEXT

In addition to the proposed Yara Dallol Potash project the broader project Area may experience cumulative impacts as a result to the following developments:

- The Ethiopian Government are in the process of constructing a double lane paved road from the town of Agula (situated 35km northeast of Mekele City) through Mekele to the town of Berahale and up north to Bada Village.
- The Ethiopian Roads Authority is in the final stages of planning a government road through the Danakil Depression between the Hamad Ela Village and Afdera Town.
- The Ethiopian Electric Power (EEP) is planning on supplying a 230kV electrical line ⁽¹⁾ to a common substation proposed in the greater Project Area. From this substation each of the mining companies is responsible to source their own power, likely through a 132kV line.

(1) It must be noted that EEP is fully responsible for the design and construction of the Overhead Transmission Line

- In addition to Yara Dallol BV, other exploration and mining companies present in the Danakil include:
 - **Allana Potash Corp.** - Allana has completed feasibility study and has obtained a mining license from the Ethiopian Ministry of Mines (MoM). They are continuing with the development of potash mining project.
 - **G&B Central Africa Resources Plc** - G&B is conducting exploration work in their license areas. Exploration commenced with diamond core drilling in May 2011.

These developments may worsen or enhance the impacts identified in *Chapters 10 and 11*. Where the impacts may be intensified by cumulative factors, these are discussed in the following sections.

Given the limited information available regarding such future developments, the assessment that follows is necessarily of a generic (qualitative) nature and focuses on key issues and sensitivities, and how these might be influenced by cumulative impacts with other planned developments.

PLEASE NOTE:

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 Yara Dallol Potash Project, or at least not in isolation

12.2

HOLISTIC MANAGEMENT OF CUMULATIVE IMPACTS

Although specific management measures are described for later in this *Chapter*, the following measures will help to holistically mitigate and manage all cumulative impacts:

- **Undertaking a Strategic Regional Environmental and Social Impact Assessment:** A strategic regional impact assessment would allow a comprehensive assessment of potential impacts that may result from the development of the mining and some related industry in the Danakil. This type of assessment would consider the cumulative impacts associated with the presence of several solution mining projects and would prevent isolated and iterative decision-making. The assessment would require greater integration and planning by private developers and should be led by the Government of Ethiopia. Such an assessment would ideally feed into combined and issue-specific mitigation and enhancement measures.
- **Revenue Management:** The proposed Yara Dallol Potash Project and other mining developments in the Danakil will generate revenue for the local regional and national government through taxes and royalties. The

extent that this revenue is invested and used productively (by Federal / Regional government) back into the Danakil would determine the extent to which the Dallol and Berahale Woredas can provide the local infrastructure and resources to manage a range of social and environmental impacts effectively. Project developers in the area should combine to lobby the Ethiopian Government for a systematic system of revenue recording and management that would enable directing benefits back to the Danakil region.

- **Shared Infrastructure**: Proposed project developers should agree between them where possible, to share infrastructure (*viz.* access roads and transportation routes inside their project areas) to reduce the potential disturbance caused by installing several similar infrastructure in close proximity to each other.
- **Danakil Mining Forum**: The establishment of a Danakil Mining Forum, where companies in the area can share lessons learnt, align strategies and agree coordinated approaches to responding to social and environmental issues, will help to improve cooperation in managing stakeholder (including community) expectations, avoid setting bad precedents and improve ways in the pursuit of joint goals for sustainable development.

12.3 IDENTIFIED CUMULATIVE IMPACTS

The cumulative impacts that would result from a combination of the proposed Yara Dallol Potash Project and other actual or proposed future developments in the broader Project Area include:

- Impacts to Surface (Hydrology)- and Groundwater (Hydrogeology);
- Air Quality Impacts;
- Impacts to the Noise Environment;
- Impacts to the Ecological Environment; and
- Impacts to the Social Environment (including Cultural Heritage and Visual and Landscape Impacts).

Each of these potential cumulative impacts is described below.

12.3.1 Surface Water

Cumulative Impacts

A number of ephemeral surface water courses are present in the broader Project Area, and are associated with the Northern, Gehertu, Musley and Bacarti Alluvial Fans. These rivers flow only during in-frequent flash flood events caused by high rainfalls in the western highlands. Mining companies active in the Danakil will establish infrastructure for their mining operations including buildings, pipelines, access roads, borrow pits, evaporation ponds

and processing plants. The establishment of infrastructure has the potential to interrupt run-off channels and result in cumulative negative impacts to the sensitive ecology (*viz.* Doum Palms and Killifish) that depend on small drainage lines that transport surface water during flash flood events.

Moreover, with further mining developments in the Danakil, increased accessibility made possible by the construction of the government road from Berahale to Bada, and possible influx of further people attracted to the broader Project Area by job opportunities, these ephemeral river systems may possibly come (i.e. - if not mitigated) under increasing pressure, not only in terms of water abstraction, but also in terms of the potential contamination of these river systems by diffusing sources of pollution, such as:

- The *ad hoc* maintenance of vehicles and machinery;
- The washing of equipment and vehicles;
- Dirty run-off water from different mining company components, including processing plants, tailings areas and staff camps, etc.;
- Improper management of sewage; and
- Potential spillages of fuels and chemicals.

Management Considerations

Mining companies operating in the Danakil should collaborate and participate in a forum together with the necessary key authorities to discuss solutions to adverse cumulative hydrology impacts (such as surface water flow and quality impacts) through applying good engineering and industry practice related to infrastructure siting and establishment across run-off channels, vehicle washing and maintenance, and procedures around the storage and handling of fuels and chemicals.

12.3.2 *Hydrogeology*

Groundwater Impacts Related to Drawdown as a Result of Large-Scale Abstraction

Cumulative Impacts

The Allana Potash Corp. and G&B concessions are located adjacent to the Yara Dallol BV mining concessions. These three companies are currently in exploration/feasibility phases. This phase is unlikely to result in significant cumulative impacts to groundwater drawdown, as current water demand is relatively low; however, the combined operational phase water requirements for these companies do need to be considered.

The combined safe yield of fresh and brackish water available from the four alluvial fans (Bacarti, Musley, Gehertu and Northern Fans) is 17,733m³/hr (MWH, 2014). However, the combined defined fresh water safe yield of all four alluvial fans is much lower and is 1,150m³/hr, which is available from the Bacarti, Musley and Gehertu fans only (MWH, 2014). There is also an undefined quantity of fresh water flowing through the bedrock. It is

anticipated that this could be as much as 1,779m³/hr; however, this value could be substantially lower or higher (MWH, 2014).

It is also important to note that the Water Balance provides an estimate of the total rechargeable groundwater resources.

The total projected cumulative demand of fresh and brackish water from Yara Dallol BV, G&B and Allana is estimated ⁽¹⁾ at 122.6 ML/d (5,108m³/hr) and the combined fresh water demand is 61.3 ML/d (2,554m³/hr) (MWH, 2014). The combined fresh and brackish water safe yield is therefore substantially greater than the combined mine demand.

On the other hand, the fresh water safe yield (1,150m³/hr) is likely not sufficient for the combined projected demand for all three companies (MWH, 2014). However, the bedrock fresh water is undefined and is not included in this figure. It could increase the total fresh water resources to 2,929 m³/hr, which would just about be adequate for the combined mine fresh water demand; however, the confidence in this figure is currently low.

However, the overall potash mining process is sensitive to water quality and therefore fluctuating or deteriorating fresh water quality can become problematic for the processing of potash. As such, it does not make good water supply engineering sense to extract at the safe yield which will typically result in a deteriorating water quality. A lower value of 80% of the available fresh water is an appropriate guideline (MWH, 2014), but is actually dependent on the sensitivity of a particular aquifer to saline intrusion. Consequently the actual percentage figure will depend on the outcome of the final well field designs. In addition to mining related impacts, saline intrusion and associated impacts to groundwater quality would also result in adverse impacts on both community and ecological receptors.

Based on the data presented above, sufficient water for use by all three mining companies is probable; however, this resource will need to be carefully and diligently managed.

Management Considerations

All mining companies operating in the Danakil will require water of low salinity for the processing of potash. Over abstraction of groundwater will jeopardise the availability of good quality water required for the processing of potash product. Although the Ministry of Water, Irrigation and Energy is mandated to administer water use and is accountable in terms of ensuring that water utilisation is sustainable, all mining companies have a vested interest in managing the aquifer systems in the broader Project Area in a sustainable manner, not only in terms of quantity, but also in terms of quality.

(1) These are estimate values. To date Yara Dallol BV does not have an exact understanding of Allana Potash Corp. and G&B water requirements.

In this respect, it is recommended, that a regional water committee is established, tasked with coordinating the water abstraction from the alluvial fans. This committee should include each of the stakeholders potentially affected by large-scale groundwater abstraction from the alluvial fan aquifers. This committee should include members of federal government (Ministry of Water, Irrigation and Energy), regional government (Bureau of Water Resources), local government, local community representatives and representatives of each of the mining companies.

12.3.3

Air Quality

Construction Activities

Cumulative Impacts

Construction activities associated with the proposed Yara Dallol Potash Project together with construction activities from other potash mining developments have the potential to create significant negative cumulative impacts associated with the generation of total dust, PM₁₀ and PM_{2.5}. The magnitude of these potential impacts may be minor, moderate or major, depending upon how the impacts from other mining projects will combine with impacts arising from the proposed Yara Dallol Potash Mining Project and the respective timing of each project. These impacts may be worsened by elevated wind speeds, increasing the potential for cumulative impacts during periods of adverse weather.

Management Considerations

As the construction activities are temporary and because suitable mitigation will be in place, the potential for significant impacts is reduced as dust raising activities would need to be coincidental on other development locations.

The implementation of the mitigation measures included in the Air Quality Management Plan (AQMP) (*Annex A of Part II of this ESIA*) is considered likely to render the impacts associated with construction activities as having a negligible significance 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 the establishment of the Yara Dallol Potash Project or defer particularly dusty activities until such time as other activities are ceased, or weather conditions improve.

Traffic Generated during Both the Construction and Operational Phases

Cumulative Impacts

Significant cumulative impacts can arise due to emissions from vehicle exhausts and from dust dispersion lifted from unpaved road surfaces. Impacts at roadside sensitive receptors caused by the vehicles associated with the

proposed Yara Dallol Potash Project are however predicted to be of **negligible negative** significance (post-mitigation). On this basis, where air quality standards are to be approached or exceeded, these impacts would likely arise from vehicles other than Yara Dallol BV vehicles.

Where unpaved access roads are used however, major adverse impacts associated with dispersion of dust and PM₁₀/PM_{2.5} can potentially occur. These effects can be especially significant if the same unpaved road is used by Yara Dallol BV and other mining company traffic.

Management Considerations

Mining companies operating in the Danakil should collaborate and participate in a forum together with local authority, regional government and other key authorities so as to establish agreements regarding the use and maintenance of unpaved haul roads, the use of dust-binding agents and in keeping the speed of all traffic using unpaved roads to below 32kph ⁽¹⁾.

12.3.4 **Noise Environment**

Cumulative Impacts

Construction Activities

In the event that construction activities of other mining developments be in parallel with the construction phase 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 Military and Migrant Camps .

Operational Phase

The Yara Dallol Potash Project proposes to operate 24 hours, 7 days per week, 365 days per year. As a result, night time noise impacts to NSRs in close proximity to proposed Project infrastructure (specifically the processing plant) 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

(1) **Please Note** - the UK Highway Agency (2007) states that a speed limit of 10 to 15 mph (16 to 24 kph) should be maintained on unpaved roads that have not been chemically treated; however, it is noted that such speed limits are impractical. As such, the

developments in the broader Project Area. However, because the Project Area is sparsely populated, and based on the assumption that other similar mining developments will unlikely to have noise emitting infrastructure (*viz.* processing plant etc.) within 5km from one another it is expected that the cumulative impacts of mining activities will be of negligible significance.

Traffic during Operations

It is likely that other mining companies (such as Allana Potash Corp. /G&B) will use the same main haul road to transport product out of the Danakil Depression and through to the Port of Tadjoura. Although this will result in an increase in the number of trucks utilising the road, the actual predicted noise level will not increase; rather, the predicted road noise levels will become less intermittent.

Management Considerations

As such, there is the potential for cumulative noise impacts to arise as a result of potential noise contour overlap during the construction and operational phases of the Yara Dallol Potash Project and other mining projects in the Danakil. Although unlikely, this would be particularly significant if mining infrastructure (such as processing plants) between mining companies were sited in relatively close proximity (< 5km) to one another. In this respect, mining companies operating in the Danakil should collaborate with one another and participate in a forum so as to ensure that impacts (*viz.* overlapping noise impacts) are discussed and agreed and that (if necessary) appropriate mitigation implemented. In this respect, mining companies should attempt (if possible given other critical design factors) that a distance between their own and other mining companies infrastructure is such that the impacts associated overlapping noise emissions is avoided or kept to a minimum. Furthermore, mining companies should align their operations in a way that the mitigation/management recommendations outlined in *Chapter 10 (Noise)* are implemented during the life of the all mining projects in the Danakil.

12.3.5 Ecological Environment

Cumulative Impacts

Increased Habitat Loss and Disturbance of Wildlife

The three mining companies are located along the western edge of the salt pan associated with Lake Assale. While mining activities are largely restricted to the salt pan, which has little ecological value, the location of processing plants, workshops, offices and accommodation are focussed on dry ground adjacent to the salt pan. The narrow fringe of ecologically important habitat is thus impacted through habitat loss and fragmentation in various places along its

limited extent. Most of the faunal species present in the area are partially or wholly dependent on this habitat, and will be subjected to regular disturbances as a result of the cumulative effect of adjacent mining operations.

Widespread Human Influx

Each mining operation is expected to result in a large in-migration of people brought in to work there or attracted by potential opportunities there. An influx of people will lead to pressures on the environment in the form of fuel wood (for example from *Acacia sp.* and Tamarisk) harvesting, increased demands for water, increased pressure on ecosystem services such as the harvesting of palm leaves, and greater disturbance effects on wildlife. There may also be an increase in numbers of livestock. The arid environment has a very limited grazing capacity and has a slow recovery following degradation through overuse.

Management Considerations

Mining companies should collaborate with one another and participate in a forum together with local government, regional government and EWCA authorities to discuss solutions to adverse regional impacts that occur or are expected as a result of increased pressures on the environment.

12.3.6 Social Environment

This *Section* describes the potential cumulative impacts to the social environment that may result from the combined effects of the proposed Yara Dallol Potash Project and other potential developments including other proposed mining projects in the Danakil.

Project Induced In-Migration

Cumulative Impact

The proposed Project is expected to cause some in-migration into the Project Area and surrounds related to the arrival of opportunistic economic migrants and migrant labour. Other potential mining operations in the vicinity of the proposed Project may increase the scale and likelihood of this in-migration due to a perception that more benefits are available in the area. The presence of several mining Projects in the region is likely to increase the perceived desirability of the area for visitors, increasing the scale of in-migration. This increased in-migration is likely to contribute to in-migration related impacts detailed in *Chapter 11*.

Management Considerations

The following management consideration should be implemented to help mitigate negative impacts and enhance positive cumulative impacts related to in-migration respectively.

- **Capacity Building of Woreda and Kebele Administration:** Mining companies should agree on a holistic approach to provide Woreda and Kebele government with support and build the capacity of its staff 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). The potential benefits may include improved local governance and greater efficiency in capacity development initiatives.
- **Increasing Human Capital among the Local Population:** The residents of Dallol and Berahale Woreda are not in a position to access many of the potential benefits from economic activity related to the Yara Dallol BV and other proposed mining developments. Increasing the capacity of the local population will allow for increased local benefits and increase the local resilience to potential in-migration related impacts. Early efforts to increase human resource capital through training and capacity building would assist in putting local inhabitants in a position to be employed or start business enterprises to service future developments.
- **Recruitment Alignment:** mining companies should agree a holistic approach to aligning recruitment strategies. This 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. Combined efforts to align the approach to recruitment will help to reduce or avoid potential in-migration.

It should be noted that alignment between mining companies in the region implementing many of the mitigation measures described in *Chapter 11(Impacts Related to Project Induced In-Migration)* will ultimately help to boost their effectiveness. The ‘pull’ factors related to in-migration will be enhanced by the presence of three mining projects in the area therefore collaboration in implementing measures to avoid and manage in-migration will boost the potential for successful implementation. This may include:

- Collaboration with the regional and local Government and other operators in the developing and implementation of a shared PIIM Management Plan; and
- Developing a shared approach to monitoring changes in specific baseline conditions related to in-migration. This would require the establishment of a shared monitoring capability to consider price inflation, demographics, changes in land cover and land use etc.

Increased Risk of Road Traffic Accidents

Cumulative Impact

Existing vehicle traffic is not significant in the Danakil; local Afar people tend to walk to their destinations or use camels and donkeys to transport their

goods. Settlements tend to be located close to existing roads and children and livestock roam freely and are unsupervised.

The proposed Project will increase light and heavy vehicles using the local roads throughout the duration of the construction period and during the life of mine. During operations, there will be 96 heavy vehicle movements per day related to Yara Dallol BV leaving the processing site and travelling along the transport corridor to the Tadjoura port in Djibouti, as well as returning.

It is assumed that the two other proposed solution mining operations in the area will be transporting their product out of the SSA and to Djibouti using the same transport corridor. The anticipated number of light and heavy vehicles movements related to these other proposed mines is unknown; however, it can be assumed to be a significant number. The combined volumes of road traffic will place both human and livestock in danger of being injured or killed throughout the life of mine.

Measures for Consideration

In addition to the specific measures highlighted in *Chapter 8 (Increased Risk of Road Traffic Accidents)* that will manage the contribution of Yara Dallol BV to this risk, the following management considerations should be implemented to help mitigate potential cumulative impacts from other mining developers related to traffic accidents.

A specialist and integrated Road Traffic Risk Assessment should be considered by the Ethiopian Government (Ethiopian Roads Authority) to understand the cumulative risks related to three operators using the transport corridor to the Port of Tadjoura, Djibouti. This assessment should be informed by all three Projects and will assist in planning and coordination of road traffic reducing risks related to traffic accidents. Where possible all operators should consider the use of shared access roads that join a shared transport corridor.

Decreased Availability of Water and Livelihood Impacts

Cumulative Impact

Fresh water is a scarce resource in the Danakil and simultaneous large-scale groundwater abstraction of water from the alluvial fans by three different mining operations has the potential to decrease available groundwater resources. This could have adverse impacts on both local communities and ecological receptors (specifically the Doum Palms).

Without systematic management the unplanned and uncoordinated abstraction of groundwater resources could contribute to water shortages and livelihood impacts related to Doum Palm mortality. The unmanaged cumulative effect of three operators could exacerbate the impacts on natural resources assessed for the proposed Yara Dallol Potash Project (refer to *Chapter 11*).

Measures for Consideration

The measures described in the assessment of cumulative groundwater impacts will help to avoid or mitigate these impacts (refer to Section 12.3.2). Specifically establishing a regional water committee will help to manage the abstraction of groundwater.

In addition the following measures will help to manage potential cumulative impacts:

- Collaborate with the other mining companies (together with any other necessary/appropriate stakeholders) in the area in the establishment of a palm nursery / plantation supervised by a qualified horticulturalist. A coordinated approach to ensuring access to palm resources will help to divide the potential costs while seeking to proactively manage potential impacts associated with all projects.
- Collaborate with the other mining companies (together with any other necessary/appropriate stakeholders) in the area to conduct groundwater, ecological and livelihood analysis so as to understand the spatial extent and magnitude of the impact to palms. This should include specific monitoring of palm mortality and dieback.

Cultural Heritage

Cumulative Impacts

In terms of cumulative impacts, the main concern for cultural heritage is the potential for a substantial increase in population within the larger region as people from neighbouring regions move into the Danakil in search of work. Increased population is usually accompanied by the expansion of existing settlements or the establishment of new settlements. As settlements expand or are established, new areas are impacted by building activity and it is likely that archaeological resources will be impacted by this increased activity. Population growth may also prompt the development of roads and other civil infrastructure (i.e. the Ethiopian roads project currently underway in the region) with ground disturbing components, which will also likely impact archaeological sites. Increased traffic resulting from higher population density or other mining projects in the area could also generate additional vibration impacts.

Management Considerations

Public outreach is the main tool that can be used to educate newly arriving populations about the region's important local heritage and why archaeological sites should be avoided when choosing new places to build or expand communities. Engagement with the Ethiopian government would also be important since they would likely be in charge of civil infrastructure development and would need to better understand the cultural sensitivities of the region.

Cumulative Impact

The presence of the Yara Dallol Potash Project in combination with other potash mining projects in the Danakil will increase impacts on the surrounding landscape and visual receptors/amenity during the construction and operational phases, including:

- **Landscape Impacts** – the presence of additional development will increase the impact on the open desolate character of the surrounding landscape, in particular within the Open Arid Salt Plains and Mount Dallol. In addition characteristic views over the salt plains from Mount Dallol will be further impacted.
- **Visual Impacts** – the presence of additional infrastructure along with other developments in the area will increase the visual impact from receptors in relative proximity, such as from the tarmac road near the military camp and Mount Dallol. Viewpoints further afield, such as Ashe Ale and Asabuya village, will also experience a greater visual impact although this is unlikely to result in significant cumulative effects.

Management Considerations

Mining companies should collaborate with one another and participate in a forum where the potential to share infrastructure is discussed (*viz.* access roads and transportation routes). Moreover, mining companies should align their operations in a way that the mitigation/management recommendations outlined in *Chapter 11 (Visual and Landscape Impacts)* are implemented during the life of the all mining projects in the Danakil. Furthermore, mining companies in the Danakil should (as much as possible) confine their infrastructure to set corridors.

12.4

IMPLICATIONS OF UNCERTAINTY

The cumulative environmental and social impacts described in this *Chapter* 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), and other mining developers in the Danakil Depression. 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;

- How many potash companies will materialise and proceed to the construction/operations phase;
- 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.