ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

for the development of a Soda Ash Facility at Lake Natron, Tanzania

DRAFT

May, 2007

Table of Contents

List of Figures

List of Tables

Appendices

List of Abbreviations and Acronyms

AIDS	Acquired Immune Deficiency Syndrome
AEWA	African-Eurasian Migratory Waterbird Agreement
BP	Before Present
CBOs	Community Based Organisations
CE	Consulting Engineer
CHARM	The Collaborative Historical African Rainfall Model
CMS	Convention on Migratory Species (Bonn Convention)
CITES	Convention on the International Trade in Endangered Species
CRT	Community Resource Team
CSOs	Civil Society Organisation
CUMEC	Cubic Metre per Second
DOE	Division of Environment
DED	District Executive Director
EMO	Environmental Management Officer
EMP	Environmental Management Plan
EIS	Environmental Impact Statement
ESIA	Environmental and Social Impact Assessment
ESO	Environmental Site Officer
FBD	Forestry and Beekeeping Department
GCA	Game Control Area
GoT	Government of Tanzania
IAPs	Interested and Affected Parties
IBA	Important Bird Area
IUCN	International Union for the Conservation of Nature
HIV	Human Immuno-deficiency Virus
KAKUTE	Kampuni ya Kusambaza Tekinolojia rahisi
NCAA	Ngorongoro Conservation Area Authority
NEMC	National Environment Management Council
NGO	Non governmental Organisation
OBC	Ortello Business Cooperation
PAP	Project Affected People
PWC	Pastoralist Women Council
ROW	Right of Way
SIA	Social Impact Assessment
SMP	Social Management Plan
TANAPA	Tanzanian National Parks
TANROADS	Tanzania National Roads Agency
TAWIRI	Tanzania Wildlife Research Institute
TRC	Technical Review Committee
USD	United States Dollars
VEO	Village Executive officer
WEO	Ward Executive Officer
WD	Wildlife Division
WCS	Wildlife Conservation Society
WCST	Wildlife Conservation Society of Tanzania
WR	Water Right
WWF	Wildlife Fund for Nature

1 INTRODUCTION

Lake Natron Resources Ltd (the proponent), a company jointly owned by the Government of Tanzania, represented by its agency the National Development Cooperation (NDC) and TATA Chemicals Ltd of Mumbai, India is considering developing a soda ash facility at Lake Natron in Arusha Region. The Lake falls into Ngorongoro (west) and Loliondo (east) districts with the present access road in Monduli District.

The proposed development covers the establishment of a soda ash extraction and processing plant and associated infrastructure at Lake Natron and upgrading of the access road from Mto Wa Mbu to the plant.

Since the 1950's Tanzania has considered the potential to abstract soda ash from Lake Natron; 1950 (Guest and Stevens); 1972-76 (Toyo Soda Manufacturing) and 1993 (Ingenierie). In 1996 an EIA was carried out on one proposed site near Engare Sero for the abstraction of 150,000 tons of soda ash per annum. Commercial abstraction of soda ash in Lake Magadi in Kenya has been ongoing for over a century.

After the 1996 EIA study and a proposal by Kenya to develop the Ewaso Ngiro (South) Multpurpose Project, that would effect the main source of fresh water into the Lake, the Ministry of Natural Resources, Wildlife Division, registered the Lake as a Ramsar site (July 2001).

By virtue of the environmental importance of the location in which the development is intended and the number of known environmental and social impacts that are associated with the process during the engineering works i.e. design, construction and operation, a comprehensive assessment to address these impacts is recommended.

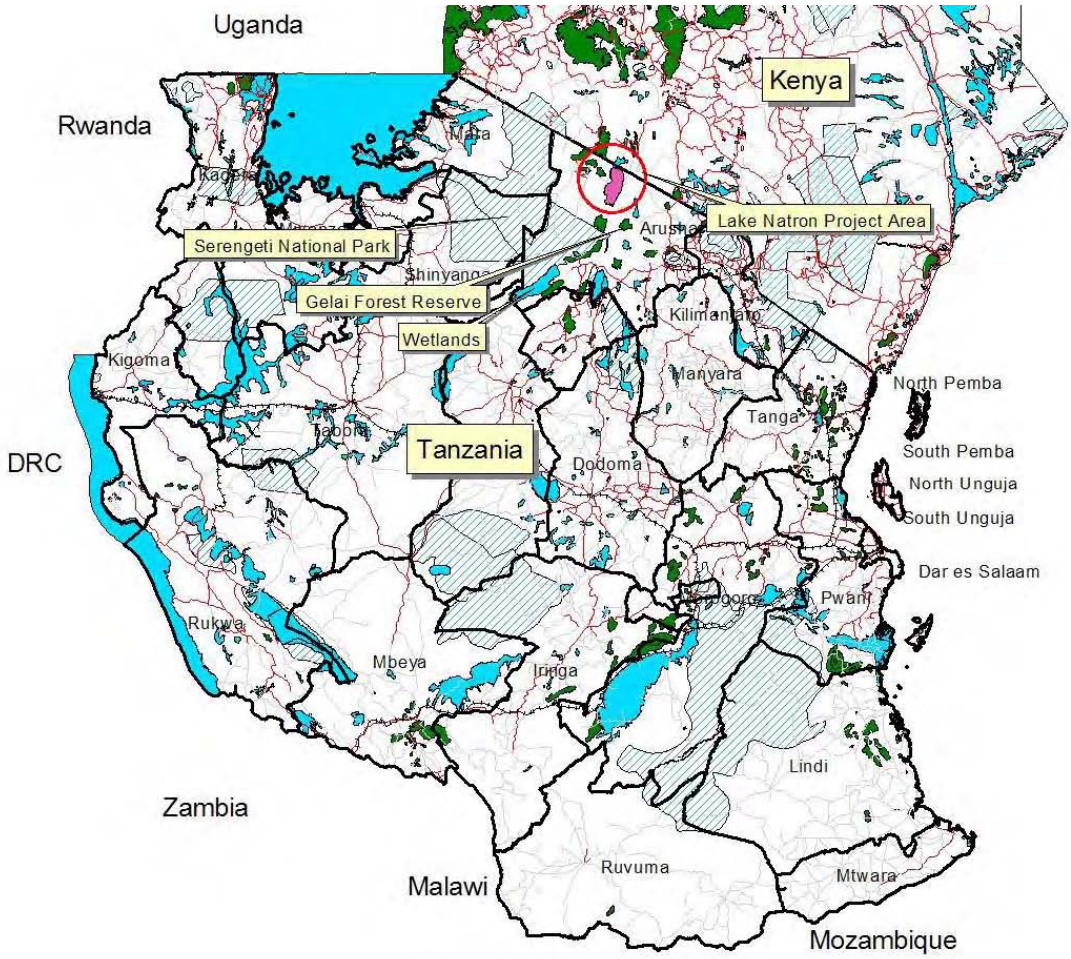
Tanzania has designed guidelines for developers (proponents) outlining appropriate procedures for the identification and address of impacts and ensuing mitigation measures with the aim to minimise all negative impacts and promote positive impacts. The outcome of this procedure is the ESIA, which enables the write-up of an environmental impact statement (EIS). The EIS provides the environmental authority with a basis to certify the project as being environmentally sound having adequately addressed all potential impacts. The guidelines ensure that the proponent is in line with the environmental legislation i.e. the Environmental Management Act (2004) and it's enforcing regulations (EIA and Audit Regulations, 2005 – G.N. No. 349 of 2005).

1.1 ESIA Scope of work

The project proponent has commissioned the current scope of works, which includes an ESIA of a selected site and route to the site from Mto wa Mbu to Norconsult A.S in association with Norconsult (T) Ltd. (hereinafter referred to as the Consultant).

The assignment has been carried out in three phases (registration, scoping and impact assessment) with review periods prior to the start of each subsequent phase. The ESIA, including the provision of the environmental and social mitigation plans, has been completed in accordance with the requirements of the terms of reference and national rules and regulations for EIAs as part of the services.

Figure 1: Location of Lake Natron in Tanzania



1.2 Project Rationale

Three segments drive the demand for Soda Ash. First is Glass segment, which is further driven by the Automobile segment and the Infrastructure (which includes both commercial and housing). Second is Detergent segment, which is driven by the GDP growth rate and increase in the per capita consumption. The third segment driving the demand is the Chemical industry itself.

Much of the growth in soda ash consumption in the past decade has been in the developing world, which mainly comprises developing and newly-industrializing countries that are characterized by a low level of per capita soda ash consumption. Soda ash consumption growth in the developing world has averaged ±5.5% over the 2000-2004 period compared to relatively flat demand in North America and in Western Europe.

2 DESCRIPTION OF THE PROPOSED PROJECT

In total approximately 1.5 km^2 of land will be required for plant and housing, together with upgrading of the access road from Mto wa Mbu. The summary (Table 1) below gives the requirements and potential outputs of the Soda Ash Plant.

Table 1: Infrastructure Summary

Staffing	
Number of permanent staff:	152
Number of construction staff	1,225
Land Take	
Land required for plant and works	0.5 km^2
Land required for housing	1 km^2
Road requirements	7 m wide tar road
Resource requirements	
Fresh brine from Lake Natron	561m3/hour
Fresh water for plant operation	106 m^3/hour
Fresh water for domestic use	23 m^3/hour
Power required at plant	11.5 Megawatts
Coke, coal and limestone (Boilers)	21 MTPH*
Sulphuric Acid	0.552 tonnes per day
Caustic Soda	0.1 metric tons per day
Lubricants	145 litres per month
Diesel (for water pumps)	9 kg/hour
Production	
Tons Soda Ash per hour/year produced on a 24 hour cycle	500,000 metric tons per annum
By products and pollutants	
Depleted brine returned to lake	476 MTPH
Mud slurry	93 MTPH
Fly ash from boilers	5 MTPH
SO2 emissions from power generation	unknown
Sewerage water	10 m^3 per hour

*MTPH = Metric tons per hour

2.1 Soda Ash extraction and processing

The plant facility will cover 0.5 km^2 and this includes the processing plant, administration, product storage, power and boiler plant, coal and fly ash storage, mud slurry pond and brine holding ponds.

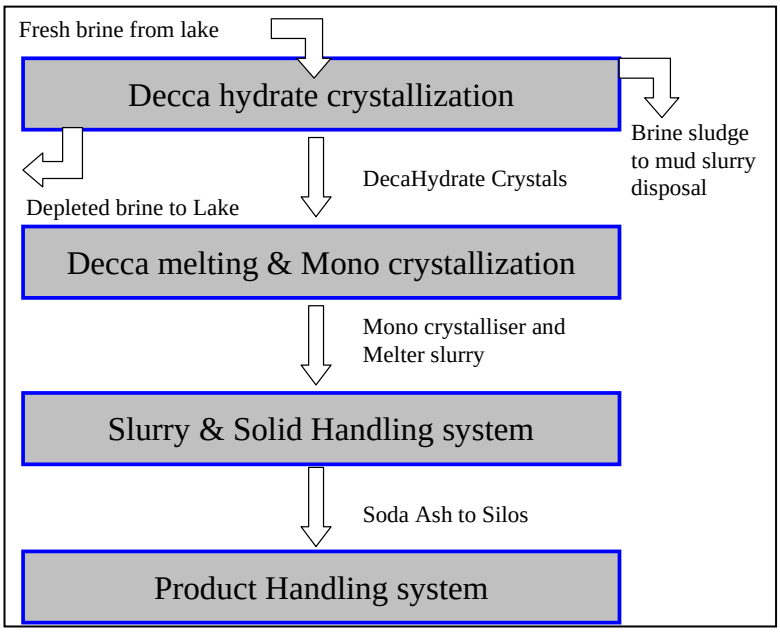
Brine from the lake is to be extracted at 561 tons per hour (TPH) by diesel or electrically operated pumps via a pipeline to a clarifier. A brine reservoir, with adequate storage capacity to supply the brine during monsoon season, will be filled from the clarified brine pumps during the dry season.

At the clarifier the Lake brine will be treated with flocculating agent for removal of impurities. Clarified brine will then be pumped to a decahydrate crystalliser while the clarified brine sludge will be pumped to a sludge handling area & a mud slurry disposal location. Dilution water and the purge from monohydrate mother liquor will then be mixed in a clarifier overflow tank before feeding the decahydrate to pre-coolers.

The pre cooled brine is then fed to a decahydrate crystalliser which is kept under vacuum. As a result of the cooling, Na_2CO_3 is precipitated in the form of Decahydrate ($Na_2CO_3.10H_2O$). The resultant Deca slurry will have 33 % Solids and will then be pumped to the hydrocyclones under-flow, centrifuged and solids washed. The total wet cake having 4 to 5% moisture will be fed to a melter to melt the decahydrate crystals into its own water of crystallization.

Melter circulation pumps will maintain the uniform super saturation in the melter. Heat is then to be supplied to melter through mono-crystalliser vapour condensation re-crystallizing the Decahydrate crystals to the monohydrate. The slurry withdrawn from the melter will have 10.13 % solids. This slurry will then be sent the magma tank of the mono crystalliser combined with magma re-pumped to the cyclone and centrifuged.

Figure 2: Summary of the extraction process



In a monohydrate crystalliser, monohydrate crystals from the melter mother liquor evaporation will be extracted using steam. Slurry fed to the Mono Slurry Hydrocyclone will be centrifuged and solids washed following which the wet cake will be fed to a fluidised-bed dryer.

The vapour from the last evaporator/crystalliser body will be condensed in a direct contact condenser to recover water and sent to the hot well, which will be then taken to the cooling tower through gravity. The condensates will be treated in a water treatment plant to provide water to the Boilers and other utilities like cake washing, flocculent preparation and for domestic consumption. All non-condensable gases are to be vented-off.

The monohydrate crystals leaving the centrifuge are to be fed to a dryer feed distributor. This rotating mechanism broadcasts the crystals across the surface of the dryer. The dried product containing less than 0.1% moisture will be discharged through an air-slide to the single-deck screen. Particulate emissions are anticipated to be less than 50 mg / Nm^3.

The final product will be dense soda ash having following composition:

- 99.8% sodium carbonate
- <0.04% sodium chloride
- <0.015% sodium sulphate
- <0.01% sodium fluoride
- 1,000 to 1,100 kg/m3 loose bulk density

The soda ash is to be received by a vibrating single-deck from the dryer product air slide. The screens remove 1,000-micron oversize material. The screens and all transfer points are vented through a fabric bag house. The exhaust gases will be vented to atmosphere at less than 50 mg/Nm^3 of dust.

The dense soda ash from the screen will be conveyed to the load-out area where a silo feed bucket elevator will ensure that the ash is properly transferred for storage.

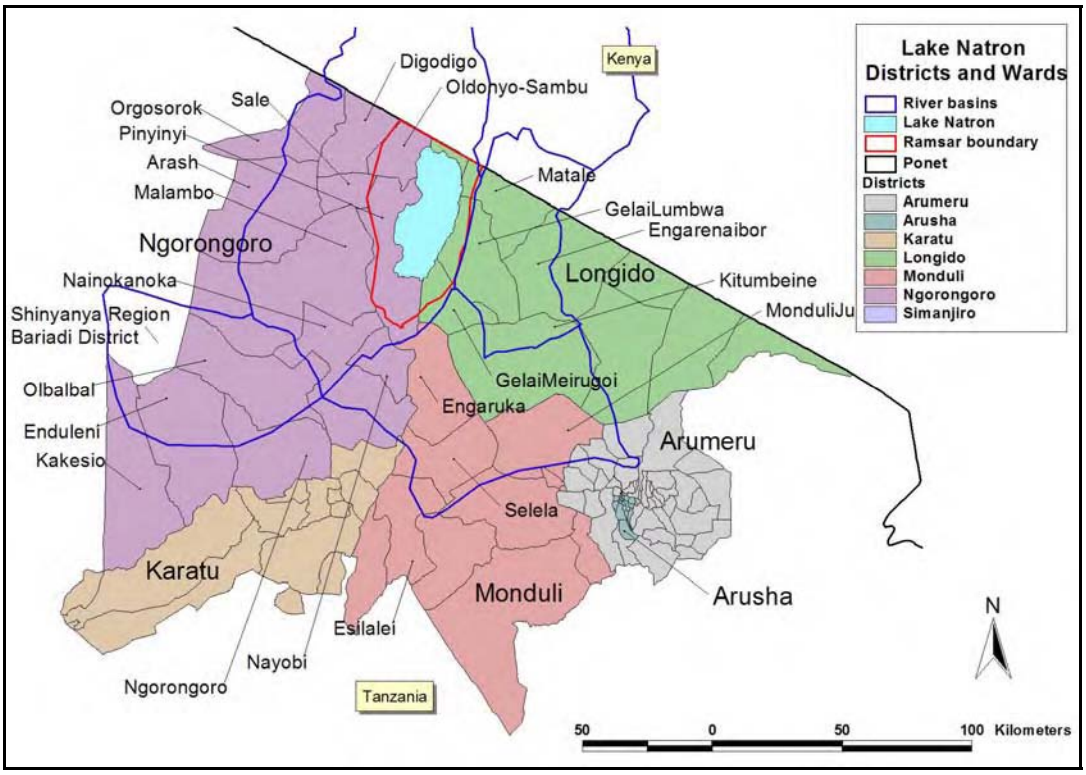
3 PROJECT SETTING

Lake Natron lies between the Districts of Longido on the east side of the Lake and Ngorongoro on the west. Access to the area from the south goes through a third district, Monduli.

In Ngorongoro District, Pinyinyi is the only ward within the Lake Natron area and for Longido District, Gelai Lumbwa and Gelai Bomba make up the wards concerned. In Monduli District, Esilalei, Selela and Engaruka are the wards that provide access to the Lake Natron GCAs.

In the North the Districts of Longido and Ngorongoro are bordered by Kenya and the larger catchment basin for the Lake lies in Kenya.

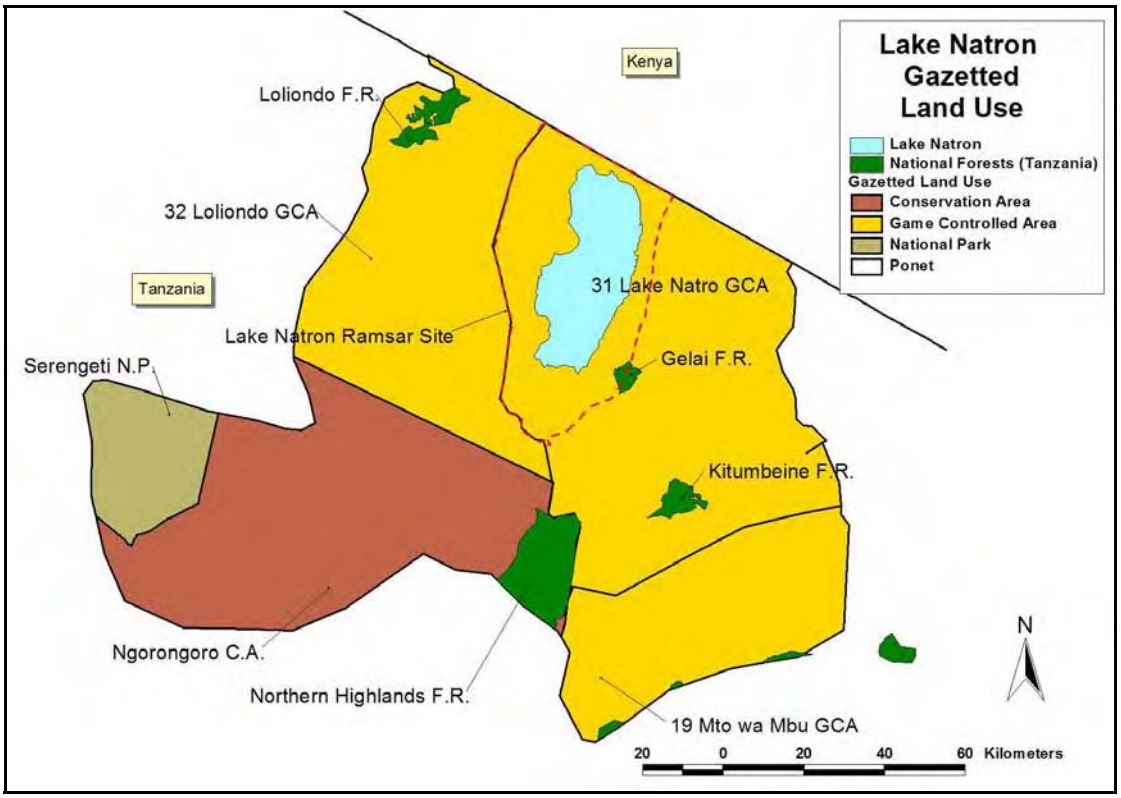
Figure 3: Administrative areas of the Lake Natron and surroundings



The area around Lake Natron is leased out in two main hunting blocks; Loliondo which covers western plateau and Lake Natron GCA. These are further sub-divided into North and South. Tanzania Game Trackers hold the lease for the Lake Natron North GCA and operate a commercial hunting operation. Lake Natron South is managed by TAWICO.

The Ramsar site boundary crosses two of the District (Ngorongoro and Longido), defining an area that is not linked directly to the existing administrative boundaries. The gazetted (Ramsar and GCAs) land use for the Lake and the land to the west is mainly for conservation and tourism.

Figure 4: Gazetted land use of the Lake Natron and adjacent catchments



In addition to the gazetted land use, there is widespread pastoralism and some rainfed, irrigated arable agriculture and a number of settlements. The Ramsar site falls within the GCA and uses the western boundary of Lake Natron GCA. To the east the Ramsar boundary follows the watershed from Oldonyo Lengai to Gelai and then northwards to Kenya separating the Kipingaine Swamp from the Lake.

3.1 Social Profile

The communities in the Lake Natron Basin are largely pastoralist Masai who are continually trying to preserve their own ways in an increasingly modern world. The society is among the most well-known African ethnic groups internationally. They maintain many of their cultural traditions while engaging contemporary regional and global economic, social, and political forces. Decisions are made by the elders for each Masai group being patriarchical in nature.

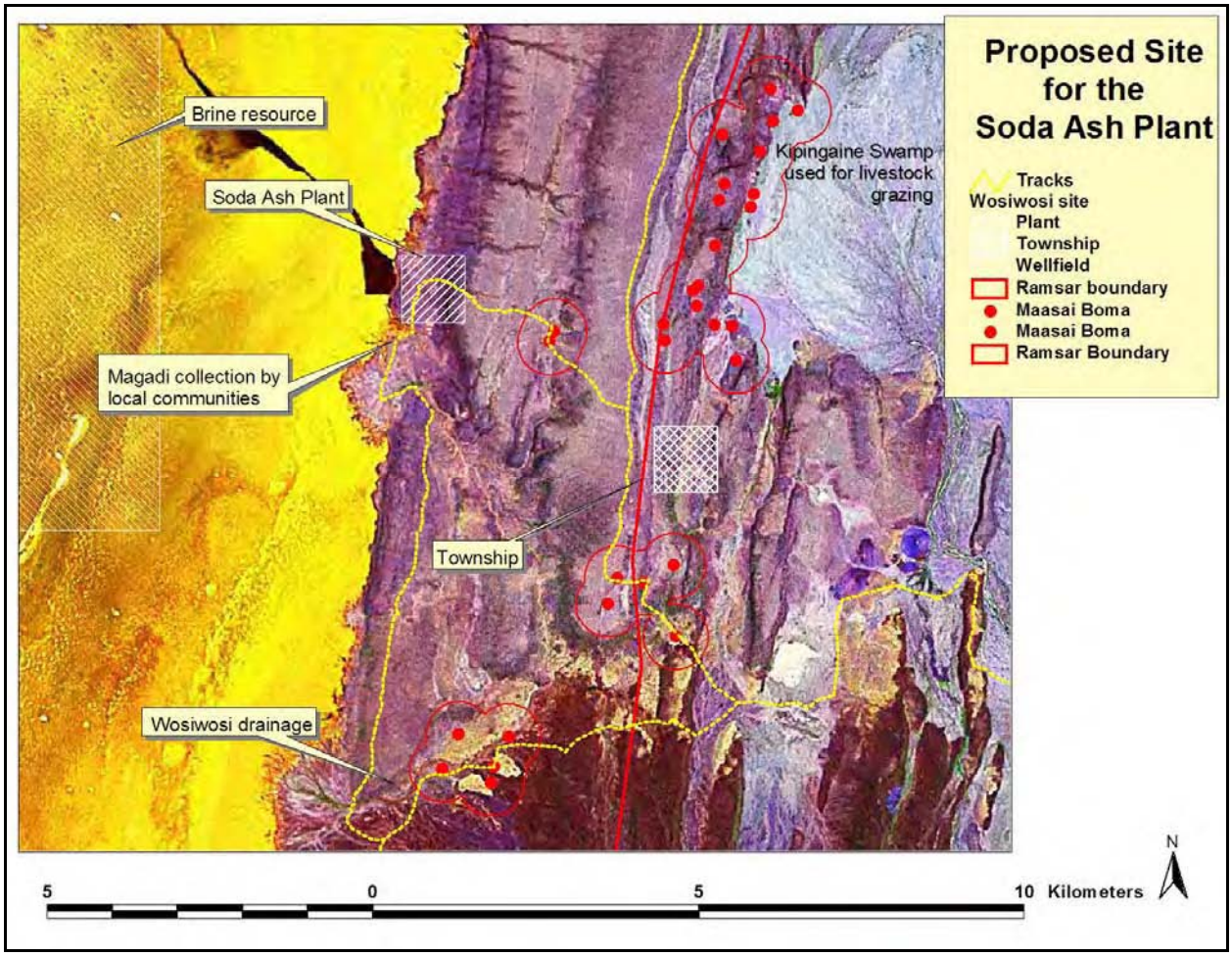
They live on border of Kenya and Tanzania, moving their homes from time to time to follow their cattle, which is the main source of their livelihood. For the Masai, cattle are a significant part of their life; they drink cow's milk and blood as a sacred drink; they use the cows' dung to cover and seal their homes; they don't slaughter their cattle for food; but if a cow is killed, then the horns are used for containers; the hides are used to make shoes, clothing, ropes, and bed coverings; and the

hooves and bones are made into ornaments. The Masai believe they are the rightful owners of all cattle, a source of many conflicts with other pastoral communities.

Second to the Masai are the Sonjo, they are farmers and cattle breeders and enemies of the Masai. They are the dominant tribe at Pinyinyi where they use an ingenious primitive irrigation system relying on the water from the escarpment (it is suggested that they are the first tribe in East Africa to water their fields by irrigation). Water is of significant value to them and they have controlled water rights where fourteen 'wanamiji' elders own the rights. Their origin is not easily established with a Bantu sounding language and nilotic features. There is a conscious reluctance by the tribe to adopt any new technologies.

The villages that are within the project area include Engare Sero, Pinyinyi, Alaililai and Londo Losirwa (also known as Magadini). The Sonjo are mainly found in villages on the western shore of the lake; Engasero, Pinyinyi with some at Engaruka Village. The Masai are the majority and predominate in almost all villages in the project area. Some minority groups such as the Rangi, Chagga, Pare, and Waarusha are found in strategic villages where agriculture, trade and tourism are common.

Figure 5: Settlement near the site of the proposed Soda Ash abstraction plant



3.2 Archaeology

Lake Natron is a Soda Ash lake situated in the bottom of the Rift Valley basin (Gregory Rift) and surrounded by Rift Valley escarpments and volcanic mountains. The lake flats are surrounded by steep sloping hills with Plio-Pleistocene sediments rich in important fossils and artefacts as discussed below.

At Pinyinyi (Peninj), is a site which is best known for the Australopithecine mandible which fits the famous Olduvai *Zinjanthropus* skull (OH 5, *A. boisei)* as if they belonged to the same individual and also for containing the earliest Acheulean sites contemporary to Kenos Gradual sites in Ethiopia (Isaac & Curtis, 1974). Palaeoanthropological work at Pinyinyi was first initiated by R.E.F. Leakey and G.Ll. Isaac between 1963 and 1964 Isaac 1967). Between 1981 and 1983 an international team under the direction of Isaac investigated the area, followed by a hiatus until 1995, when a Spanish team resumed work in the area.

To date a total of 27 palaeontological and 8 archaeological localities have been discovered along the Western shore of the Lake. Most of the sites are located in the Humbu Formation, the lower member of the "Pinyinyi Group" at the top of the Plio-Pleistocene stratigraphical sequence. Archaeological materials and fossil bones appear unevenly distributed in the three main areas around the modern Pinyinyi River. Type section (Maritanane, Kamare & Kipalagu), Southern Escarpment (Bayasi, Karonga North South and East Mugure and Northern Escarpment (Mgudulu) are among the better known localities.

3.3 Aquatic Biology

The size and shape of the rivers and Lake change constantly in the cycle of dry and rainy seasons and between dry and wet years. The lake is also influenced by thermal springs due to its recent history of volcanic activity. The constantly flowing spring water is the main contributor to the formation of brine and soda crust in the lake. These hydrological dynamics of the Lake's springs add an extra dimension to the riparian ecosystem as well as to the water resource management issues.

There are numerous permanent springs situated in the vicinity of the lake or in the lake itself, including hot water springs which feed salt rich water into the lake. The constantly flowing spring water is the main contributor to the formation of brine and soda crust in the lake. According to Guest and Steven (1951), there are about 28 hot alkaline springs flowing into Lake Natron. The temperature of the spring water is in the range of 30 - 50ºC.

There are several wetland patches associated with the lake: two relatively small *Typha domingensis* dominated wetland patches on the western shore and two medium sized to large partially fresh water wetlands on the eastern side. The wetlands are a source of water for wild and domestic animals.

During the fieldwork, fish and microalgae were studied from six sites located within Lake Natron. In total nine microalgae species were identified from water samples collected from the six sampling sites. Contrary to the popular belief, *Arthrospira fusiformis* was not found in the water samples collected from six sampling stations for which microalgae were examined.

The dominant microalgae were pinnate diatoms *Navicula* ssp. (especially *Navicula scolipleura* and *Navicula sphaerophora*). Other microalgae found in the water column in Lake Natron included cyanobacteria of the genera *Pseudoanabaena*, *Chroococcus*, and *Microcystis* as well as a diatom *Navicula oblonga* although these occurred at relatively low numbers. These results

suggests that in addition to *Arthrospira fusiformis*, there must be other important food sources for resident Lesser Flamingo and cichlid fish flocks in Lake Natron allowing for food diversity.

3.3.1 Lake Natron as a Key Site for Lesser Flamingo

Lake Natron is the only known successful breeding site for Lesser Flamingo in East Africa and is globally the most significant breeding site for this species. The majority of breeding occurs during October – November although breeding to a lesser degree of success can occur throughout the year. There are a number of clearly significant reasons why Lake Natron is preferred by this species. There are five main conditions that the flamingo require to successfully breed at Lake Natron:

1) Isolation of nesting sites from mammalian and avian predators. There is no other site within the range of the East African Lesser Flamingo which currently provides these parameters of isolation from mammalian predators. Documented evidence has suggested that a single episode of disturbance can cause the whole breeding colony to abandon the nest site.

2) Presence of freshwater springs throughout the year. The juvenile birds, once in a crèche move towards fresh water in large groups. If you look at the distribution of Lesser Flamingo's at Natron, large concentrations gather at the river deltas and springs to wash their feathers.
3) Presence of microscopic salt water algae for feeding throughout the year.

4) Presence of suitable substrate for nest construction. This is extremely important, the 'preferred' breeding sites are in areas were this mud is available, in dry years the colonies can be more spread out and follow the cracks in the trona where suitable mud can be accessed (these are known as string formation nests).

5) Suitable areas for the young when in a crèche to move, feed and obtain freshwater as outlined above.

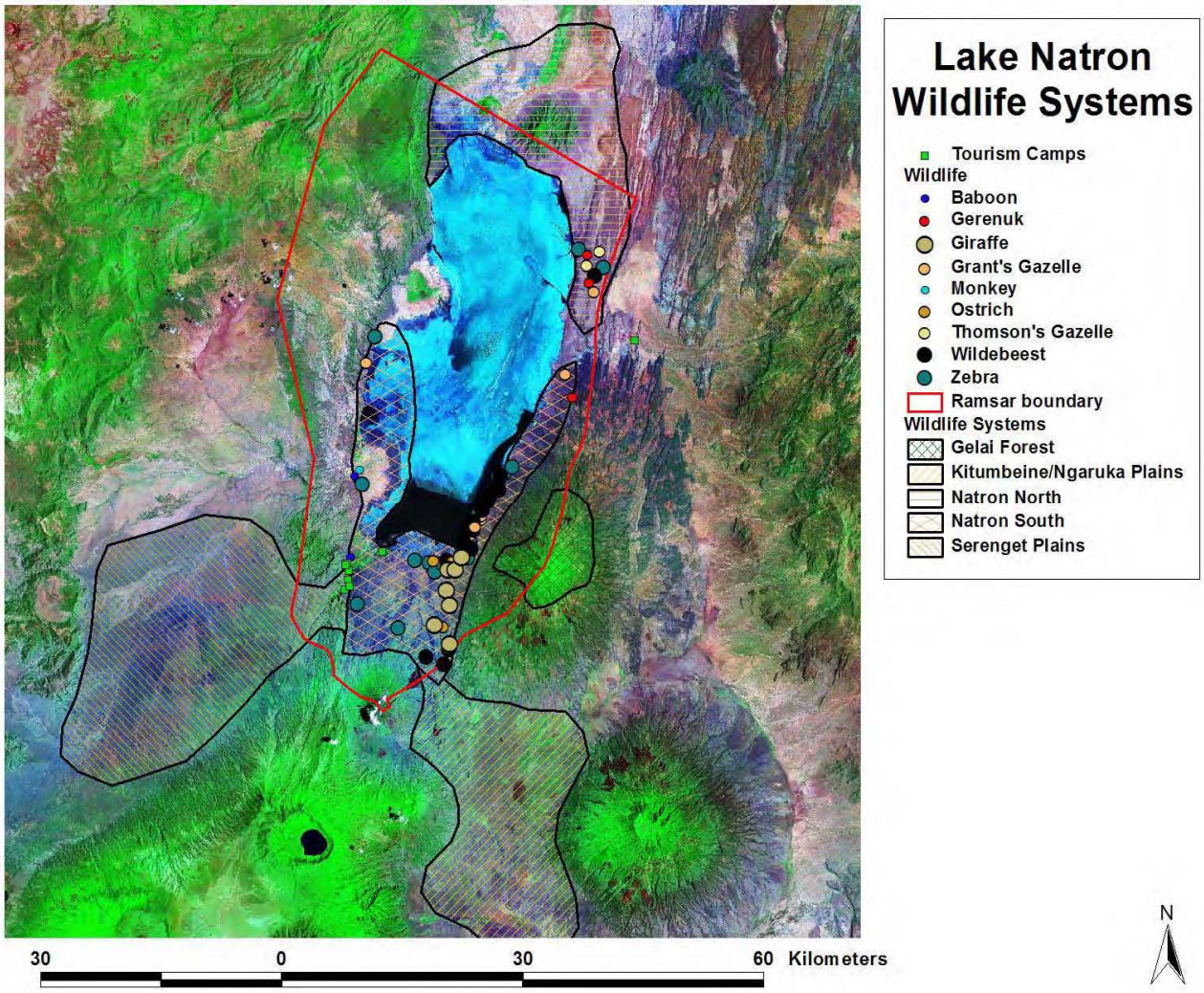
Other than breeding, Lake Natron is a key feeding site for this species throughout the Year with numbers often exceeding 200,000 individuals (c. 8% global population). As mentioned this species requires a network of sites in order to respond to changing environmental conditions.

3.4 Wildlife Systems

The Lake has permanent and migratory wildlife populations. The permanent species are either those adapted to arid systems reptiles, rodents rodentivoures (foxes and jackal), insectivoures and generalists (mongoose, Gerinuk,), or dependent on available fresh water. There are permanent populations of primates along the river systems and near settlement. There are also permanent larger ungulate populations in the well watered Galei forests.

Apart from the Wosi Wosi area, these permanent populations appear to be under threat from intensive land use practices (TAWIRI & FZS, 2002). In the west side of the lake there is displacement of wildlife due to expansion of arable agriculture, irrigation and settlement. To the south east (Magadi) there is competition for dry season grazing and systematic attempts to exclude wildlife from the dry season range. On Gelai there is considerable settlement, arable agriculture and pastoral activities.

Figure 6: Wildlife systems and observations August 2006



During the dry season there are relatively large populations of migratory and nomadic ungulates using the fresh water and semi sodic springs and associated wetlands for dry season grazing. During the wet season ungulates move onto the open grasslands to the south east and south west.

Literature suggests two migratory corridors between the Lake and other wildlife systems:

- A link between the Ngorongoro Conservation Area and Natron along the open grass plains
- A link between Lake Manyara National Park (Mto wa Mbu GCA) and the Lake Natron GCA along the approximate alignment of the existing Mto wa Mbu to Engare Sero road.

4 IDENTIFICATION OF IMPACTS

The ESIA baseline work has found that, there is indeed change occurring, both near the Lake and in the catchments of the rivers feeding Lake Natron. This change will accelerate exponentially as soon as the tar road from Mto wa Mbu to Loliondo is constructed (this is a TANROADS project which is in its final design phase and is not related to the proposed Soda Ash abstraction.). It has, therefore, been a difficult but essential task to separate out the impacts from the proposed project from those as a result of ongoing change and the new all-weather road etc.

There have been many concerns expressed due to the location of the proposed project in a wetland of international concern, the Lake Natron Ramsar Site. The importance of the Lake to certain bird populations and the transboundary importance of the lesser flamingo population which, although breeding at Lake Natron, move about and Feed in most of the Rift Valley Lakes has been identified as an important trans frontier concern and thus potentially effects countries in addition to Tanzania.

Birds, particularly internationally threatened species that are large and well known, will have large scale international support if the wider public feel there is any threat to them from the project. This makes decision making move from being based on environmental and economic criteria to that of the political arena.

4.1 Summary of impact Rankings

Note that impacts are negative unless otherwise ranked.

4.1.1 Summary of Administrative and Planning Impacts

No.	Component	Specific Activity and Aspect	Impact	Rank
Administrative and Planning				
A/P 1	Change in physical planning	Change in infrastructure and perceived opportunities from media hype will put extensive pressure on existing planning requirements and local authorities implementing management plans	The proposed soda ash development may threaten the Ramsar status of the Lake	mod-minimal
		As above	Development will undermine the Ramsar planning process	mod-minimal
		As above	Development may undermine changes occurring in GCA planning and development of WMAs	minimal
A/P 2	Change in administrative responsibility	Local administrative structures too weak (capacity, skills and legal mandate) to manage the development effectively	Environmental authority and district personnel unable to ensure mitigations are implemented resulting in predicted impacts occurring	mod
A/P 3	Other Developments	Possible cumulative impact of Ewaso Ngiro project and soda ash abstraction on ecology and Ramsar designation status	Loss of the Lake Natron Ramsar status	mod
A/P 4	Establishment of infrastructure	The proposed development falls into a GCA leased out to the hunting industry by Department of Wildlife	Clash with existing lease agreement and illegal occupation of the site	minimal

4.1.2 Summary of Changes to the Physical/Chemical Environment

No.	Component	Specific Activity and Aspect	Impact	Rank
P/C 1	Changes in ground water quality/quantity	Water abstraction for plant and housing	Depletion of fresh groundwater	minimal
		Seepage of effluent into groundwater	Groundwater pollution and loss of aquifer	minimal
		Solid waste management	Leachate from solid water reaching ground water or seeping into the Lake	mod-minimal
P/C 2	Changes in crop and grazing areas (productive land)	Establishment of plant, housing and access corridors	Loss of grazing land	mod-minimal
			Loss of critical dry season grazing along SE shores of Lake Natron	mod
P/C 3	Changes in pollution discharges	Operation of plant	Emissions and discharges that will negatively impact on the Lake	mod-minimal
P/C 4	Changes to Lake water quality	Use of fresh water in soda ash abstraction process. Use of surface water flows that enter the Lake	Lake water composition changed due to soda ash abstraction and increase of fresh water from process	minimal
		Removal of soda ash from the Lake	Lake chemical composition significantly changed due to Soda Ash abstraction	significant
		Operation of boilers and storage of flyash by-products	Emissions of carbon and SO2 from boiler flue stack and flyash deposited in lake thus negatively changing water quality for present life forms	minimal
P/C 5	Change in sound levels	Operation of the plant, steam and power plants will create noise	High noise levels will reduced wilderness value of the Lake environment and disturbance to biota	moderate
P/C 6	Change in air quality	Emissions from the use of coal in steam boiler furnaces	SO2 smell reduces natural quality of Lake	minimal
P/C 7	Change in light	High levels of light pollution from town, plant and security systems	Reduce night time wilderness value of the Lake	very significant
P/C 8	Changes to surface water flows	Abstraction of surface water from the Wosi Wosi River	Insufficient water for abstraction of wet and dry season water from the Wosi Wosi without effecting Lake inflow	minimal
		creation of roads and tracks onto the Lake bed and the laying of pipes and cables on the surface	Change to Lake structure and composition and change to surface water movement due to obstacles	mod-minimal

4.1.3 Summary of Changes to the Biological/Ecological Environment

No.	Component	Specific Activity and Aspect	Impact	Rank
B/E 1	Changes to fish populations	Change in water composition due to removal of soda ash or changes of fresh water inflows	Threat to the viability of endemic fish populations	minimal
B/E 2	Changes in biodiversity	Change in water composition due to removal of soda ash or changes of fresh water inflows	Potential threat to endemic species of fish. Threat to lesser flamingo populations	mod
B/E 3	Changes in disease vector populations	Domestic waste attracting pests. Abandoned borrow pits providing mosquito breeding sites. Increase in introduction of vectors through human and vehicle movement	Introduction of animal pests and pathogens	minimal
B/E 4	Changes in aquatic biota	Abstraction of surface water from the Wosi Wosi River	Loss of fresh water habitats in the Lake due to dry season abstraction	minimal

No.	Component	Specific Activity and Aspect	Impact	Rank
B/E 5	Changes in terrestrial plant populations	Access road along east side of the Lake	The *Cyperus laevigatus* sedgelands surrounding the semi sodic springs in the southern and eastern sides of the Lake form critical late dry season grazing for domestic stock and wildlife. Increased pressure or disturbance could deplete the remaining wildlife populations	mod
		Construction activities, the development of domestic gardens, the introduction of brine shrimp into the process	Introduction of alien invasive plant and animal species	minimal
B/E 6	Changes in terrestrial wildlife populations	Increased disturbance by staff and construction crews; increased poaching and pressure on grazing due to uncontrolled immigration and settlement into the area	Present decline in rare wildlife species such as gerenuk and Coir bustard and local extinction of rhino and Oryx due to increased pressure on grazing resources and increased poaching. This will increase with human immigration into the area.	minimal
		Access road along east side of the Lake	Disturbance or loss of critical dry season habitat used by the resident ungulate population	mod
		Construction of site and transportation of products and the associated high numbers of trucks travelling to and from the plant	Disruption of wildlife ungulate movements in the Manyara - Natron migratory corridor	mod
B/E 7	Change to bird populations	Disturbance from plant operation, abstraction, recreational activities of staff and the transportation of product. Change in Lake habitat from plant operation. Flamingos are highly specialised feeders and sensitive to changes in their food source. Due to habitat loss and habitat contamination at other locations important for this species (e.g. Lake Nakuru), the current population is believed to be in decline and the value of lake Natron has been increased as a refuge for this species	High disturbance levels or change to habitat reducing the value of the Lake to Lesser Flamingo and long term decline on flamingo populations in East Africa.	significant
		Pipelines and cables between the plant and brine abstraction points	Barrier to flamingo (young and adult) movements across the pan surface (pipes, overhead lines, smoke, open brine pools	moderate
		Traffic, aircraft, construction noise and change in ecosystem properties	Disturbance to lesser flamingo breeding sites	mod-minimal
		Water abstraction from Lake inflows may reduce the extent of the perennial lagoons that act as a deterrent to predators (or visitors) disturbing flamingo nesting sites,	Loss of nesting sites and abandonment of nest colonies due to predator or other disturbance	mod
		a reduction in available water due to offtake and increased disturbance by machinery and foreign objects near springs and river deltas regularly used by this species	Loss of habitats essential for the survival of juvenile flamingo	significant
B/E 8	Changes to wetlands	Abstraction of fresh water from west shore rivers entering the Lake	Loss of fresh water wetlands	mod-minimal

No.	Component	Specific Activity and Aspect	Impact	Rank
B/E 9	Changes to areas of natural habitat (including protected areas)	Abstraction of fresh water from rivers entering the Lake	Lake surface and the wetlands which provide feeding, shelter and nesting sites for a number of water birds, reptiles and amphibians that are important to the Lake ecosystem. Any changes that would dry out the wetlands would adversely impact this important ecosystem	mod-minimal
B/E 10	Changes to the Ramsar ecological character criteria	The conservation status of wildlife and habitats is weak. There have been suggestions, through the Ramsar process, to strengthen the legal basis for protecting the area by banning hunting in the Ramsar site and changing the status of the Game Controlled Area to that of a Wildlife Management Area.	Uncontrolled and potentially harmful settlement into and use of the Lake's natural resources leading to a collapse of the existing ecosystem processes and loss of suitable conditions for wildlife, particularly birds.	mod

4.1.4 Summary of Social and Cultural Impacts

No.	Component	Specific Activity and Aspect	Impact	Rank
S/C 1	Changes involving loss of housing	Establishment of a tar access road	No losses identified	none
S/C 2	Changes involving loss of commercial/public buildings	Establishment of plant, town and supporting infrastructure	No losses identified	none
S/C 3	Changes involving loss of cultural and archaeological heritage	A large number of hominin remains have been identified in the Humbo formation to the west of the Lake. It is thought that this formation also occurs to the east of the Lake. The Lake is one of the most important archaeological sites in East Africa.	Potential loss of archaeological remains at the plant site has been shown to be limited to "out of situ" chert artefacts. Housing site location not identified and impact unknown but may be higher.	mod-minimal
		Archaeological heritage close to the proposed access road is known from Selela where concentrations of MSA and LSA artefacts have been collected and reported. Extensive archaeological remains of the ancient irrigation system at Engaruka, and the scatter of Acheuelan/MSA and LSA artefacts in the Gelai Oldonyo Lengai stretch have been reported	Potential loss of archaeology relating to road construction and borrow pits	mod-minimal
S/C 4	Changes to livelihoods		Possible increase in wage labour opportunities	positive minimal
		Land take	Increased pressure on grazing land resources due to land take for housing and transport will increase social conflict.	mod-minimal
S/C 5	Changes to patterns of mobility and settlement	Development of the access road	Improved access (as shown with the Stamico development and associated road access) may result in an influx of people into the area and conflicts with existing communities	mod
S/C 6	Changes involving resettlement of people		No resettlement identified	
S/C 7	Changes to social stability/cohesion	There are existing conflicts over the use of the Lake's resources**.** These relate to traditional use of grazing, local soda ash extraction, watering of livestock, settlement and fuelwood.	The Lake's grazing resources are at their limit; dry season water is scarce and limits stock dry season distribution; fuelwood round settlements is scarce. The proposed project will exacerbate these conflicts	mod
		Uncontrolled immigration and settlement	Possible development of shanty towns with related lack of resource and waste management and high social impacts	mod-minimal
S/C 8	Changes involving loss of access to natural resources	Sale of soda ash is an income generating activity particularly for women and is a part of the household income.	Potential loss of right of access and use of soda ash by traditional users	minimal
S/C 9	Changes in health and disease status	Immigrant contract workers and the limited knowledge on HIV/AIDS status in the Ramsar area	Increase in HIV/AIDS in existing resident population	significant
		Good road links	Improved access to health care facilities	positive mod-minimal
S/C 10	Changes in access to social services	Good road links	Improved access to social services	positive mod-minimal

No.	Component	Specific Activity and Aspect	Impact	Rank
S/C 11	Changes to aesthetic landscapes	Plant, roads, rail, lights, noise will change the wilderness value of the lake	Loss of tourism value of the Lake	significant
S/C 12	Changes to the conservation status of Lake Natron	Industrial development, settlement and impact on ecosystem processes	Loss of wilderness value and reduced conservation value	significant
S/C 13	Changes to water users	Extraction of surface water from the Wosi Wosi river	Increased pressure on existing fresh water resources	minimal

4.1.5 Summary of Economic Impacts

No.	Component	Specific Activity and Aspect	Impact	Rank
E/1	Changes in crop/livestock generated incomes	Loss of grazing and disturbance/disruption of grazing systems in the dry season refuge	Reduced livestock production	mod-minimal
E/2	Changes in local wage labour incomes/opportunities		Potential short term employment opportunities.	positive mod-minimal
E/3	Changes in trade/commercial incomes/opportunities		Possible long-term increase in economic activities	positive significant
E/4	Cost of resettlement for land loss (to project)		None	none
E/5	Cost of compensation for physical structures (to project)		Minor	none
E/6	Cost of safeguarding quality of life (to project)	Risk of uncontrolled influx of immigrants and competition for arable agriculture and grazing resources	Reduced quality of life for arable agricultural farmers and pastoralists	mod
E/7	Changes in tourism economy (potential)	Improved road access for tourism and other economic activities due to project	Increase in tourism and change in type of tourism client due to project	positive minimal
		There are a number of tourist camp sites and eco-tourism activities that occur in the southern end of the Lake, These could be both negatively (through visual impacts) and positively (improved access) impacted upon	Negative visual impact on natural value, wilderness value and tourism and loss of existing tourism infrastructure investment (camps and marketing)	moderate
			Professional hunting occurs to the east of the Lake in the TGT concession. Industrial development and increased human settlement will negatively impact on this activity	mod
		The proposed development may not be sustainable nor as economically viable as existing land uses	Replacement of a potentially sustainable economy with a less sustainable one	minimal

5 ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING FRAMEWORK

The environmental and social management and monitoring plan (ESMMP) for the project will be operationalised at a number of levels, relating to project phase, anticipated impacts, mitigation requirements and degree of follow-up monitoring required.

The ESMP framework will encompass 3 main tiers and taken together be internalised into the overall environmental management system (EMS) controlling the development of the project. Regular independent environmental and social auditing will be a function of the EMS.

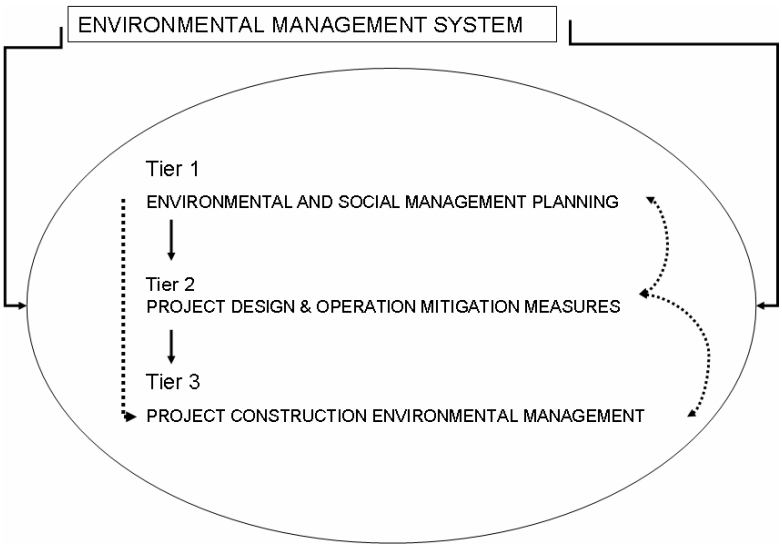
5.1.1 Tier 1 Planning

Tier 1 which will be the overarching planning, integrating the project into the Ramsar management process, District development planning and national and international conservation initiatives. It is recommended that Tier 1 planning is an ongoing process that will react to changes in District priorities, proponent requirements and the outputs of the environmental monitoring programme.

Key to the success of Tier 1 planning will be communication and commitment. It is, therefore, recommended that a ESMP committee be established comprising NEMC, senior District planning officers, senior management of the plant and the environmental management officer. This committee should meet on a regular basis (every 2 months during construction phase and every 6 months during operation) to discuss results from the monitoring programme, agree amendments to the mitigations in place and/or the monitoring programme if necessary.

Tier 1 oversight will apply to mitigation and monitoring on site and in the project area in the construction phase, operational and eventual decommissioning phase.

Figure 7: Project environmental and social management and monitoring framework



5.1.2 Tier 2 Planning

Tier 2 planning will focus on ensuring that mitigation measures suggested by the ESIA are efficiently implemented and that routine monitoring is carried out. This will apply to mitigation and monitoring in the project area in the construction phase and also the operational and decommissioning phase.

Regular meetings between project representatives, community leaders in the project area and local government should take place to review success and any potential failures in the mitigation and monitoring regime. Minor issues should be dealt with immediately at this level, serious issues should be referred up to regular or extraordinary meetings of the Tier 1 committee.

5.1.3 Tier 3 Planning

Tier 3 planning relates specifically to the construction phase and most importantly to the mode of work and behaviour of the construction contractor and the necessary mitigation and monitoring required for the project to fulfil its obligations under national guidelines and national and international best practice.

In practice the construction environmental management plan (EMP) will the provide the guidance for the Tier 3 planning and monitoring process. Appendix D provides more detail on the EMP and a summary appears below.

5.2 Construction Environmental Management Plan (EMP)

The EMP details the commitments necessary for the proponent and construction contractors (CC) to meet the relevant environmental guidelines inline with the recommendations in the ESIA. The full EMP is contained in Appendix D of the ESIA and summarised here.

This component specific EMP, therefore, operationalises the guidance contained in the ESIA. The EMP follows the principles of ISO 14001 (1996) related to Environmental Management Systems, and provides a structure for the development, implementation and review of the Plan and a process which ensures continuous improvement in the environmental management of construction activities. The EMP:

- Includes an Environmental Policy statement;
- Addresses contractual and regulatory requirements;
- Provides procedures developed to address the environmental aspects and risks related to the construction;
- Provides for the implementation and operation of the EMP to ensure that structure and responsibilities are assigned; staff are trained, aware and competent; and that there is proper communication, documentation, operational control and emergency preparedness and response.
- Provides clear and precise organisational and technical procedures for implementation of the EMP which ensure that construction activities associated with potential environmental impacts are carried out in a controlled and responsible way.
- Provides checking and corrective action through monitoring and measurement.
- Provides records collection and storage, and programme audit;
- Includes management review of the EMP and enables improvements to be incorporated in the Plan.

5.2.1 EMP Objectives and Concepts

It is the purpose of the EMP to describe measures that should be implemented by the proponent, and CC during the construction of the Project to eliminate or reduce key potential biophysical, social and health impacts related to construction activities to acceptable levels. Successful execution of this EMP requires that the specific measures presented in this EMP are committed to be undertaken by the responsible Project parties.

In keeping with this overall approach, the Project should avoid, where and when practical, those situations or incidents that could cause unacceptable, adverse biophysical, socio-economic, or health impacts. For those environmental situations or impacts that cannot be avoided, however, the Project should undertake appropriate mitigation measures.

The EMP has been developed on the basis of the following objectives:

- To reflect the environmental and social issues and impacts identified during project preparation and presented in the ESIA (2007);
- To comply with GoT regulations and laws and with the principles of ISO14001;
- To provide an operational reference and tool for environmental management during construction activities.

The EMP has been prepared as a flexible and adaptable document which provides for the possibility of changes in accordance with construction activities, areas and in environmental conditions. The information and statements contained in the EMP are considered to be accurate and applicable to the Project in its current form. However, as the Project progresses through construction, some changes in its specifications are bound to occur. Accordingly, it may be necessary to modify and adapt some of the environmental management measures and actions contained in this EMP to properly reflect Project changes.

Similarly, it may be necessary to add new mitigation measures to appropriately address new or unforeseen Project situations. In either case, all modifications or augmentations of the Project's environmental management objectives, measures, and programmes should be accomplished by adhering to a rigorous, systematic process to steward such changes. The management of change process to be implemented during the construction phase of the Project follows the recommendations of ISO 14001, including internal audit and management review process.

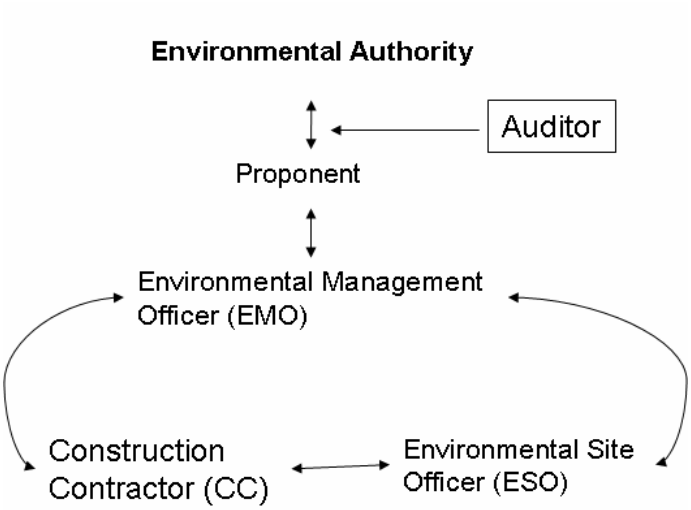
5.3 Environmental Organization

Three levels of organization, fully complementary, are set-up by the EMP:

- The Environmental Auditor
- The Environmental Management Officer (EMO),
- The CC's designated Environmental Site Officer (ESO)

General organization is presented in the following figure:

Figure 8: EMP Organisation



The Environmental Management organisation described above includes an Environmental Management Officer (EMO) and an Environmental Site Officer (ESO). The EMO function is for the duration of the construction period plus post-construction audit period.

The EMO role is executed by:

- The specialist environmental management officer attached to the Project (and assistants);
- Support from the Consulting Engineer (CE) through the site construction supervision staff.

The EMO coordinates (directly or through the CE) with the various CCs and with the ESO(s) appointed by the Construction Contractors. The overall role of the EMO is to oversee and monitor adherence to, and implementation of, the EMP by the CCs (which includes compliance with the relevant obligations contained in the EMP).

The EMO is assisted by the CE site supervision staff and the ESO on the CC's side, responsible for monitoring construction-related activities and implementing environmental measures on site as part of the EMP conditions.

The ESO is the CC’s focal point for all environmental matters, and coordinates directly with the EMO and CE. The ESO is routinely on-site for the duration of the construction works.

ESOs are appropriately briefed technical officers (often the CC site engineer). The ESO carries out regular inspections of the CC activities in relation to environmental issues, and provides day-to-day advice to Contractor personnel about environmental issues. Verification is provided by the EMO.

5.4 Mitigation Cost

Excluding design mitigations, the cost of environmental mitigation and monitoring (capital and recurrent annual) is estimated to be approximately USD 2.9 million for the construction phase.

6 INTER-AGENCY AND PUBLIC/NGO INVOLVEMENT

Public involvement (communities surrounding the proposed project, government authorities and other interested and affected parties) is essential and mandatory in Tanzania for the approval/ consideration of an Environmental and Social impact assessment. Input from public consultation provides the authorities interested and affected people and the developer an opportunity to ensure that decisions made in the course of the development due consideration is given to concerns and comments raised as part of the consultation. This ensures a sustainable working relationship between the developer and interested and affected parties (IAPs). It also provides an overview of the effectiveness and interagency cooperation and infrastructure that the project proponent can build upon or rely on for mitigation of project impact.

From the scoping phase the consultants identified key interested and affected parties through consultation and through this approach an expanded list of IAPs has been developed. The IAPs include national and international parties and individuals that have vested interest in the project area such as Non Governmental Organisations (NGOs), Civil Service Organisations (CSOs) and Community Based Organisations (CBOs), community representatives, government officials etc.

All the IAPs were provided with information on the project in the form of a project information document, this was used to stimulate discussion as it provided a larger picture for the project which was expected to enable the IAPs generate issues anticipated or existing with regards to the project.

Consultation with the IAPs was continued throughout the ESIA and all records of meetings documented and presented in Appendix C of the ESIA.

6.1 Interested and Affected Parties for Lake Natron Soda Ash Facility

The IAPs have been categorised into the following interest/ functional groups:

- Proponent; NDC and TCL who make up the shareholders of Lake Natron Resources Limited
- Central Government and environmental regulators
- Local Government,
- National and International NGOs, CBOs, CSOs
- Business/ Tourist stakeholders
- Transboundary stakeholders

All the listed stakeholders were requested to participate in consultative meetings.

7 SUMMARY AND CONCLUSIONS

7.1 Development Location

The assessment of alternatives indicated that the optimal site location was in the Wosi Wosi area which is located on the eastern shore of the Lake. A number of factors were then used to identify a suitable location for the project site, these were:

- The area of lowest impact on flamingo breeding;
- Avoidance of active river deltas
- Sufficient area for the plant footprint

- Minimal elevation difference between the lake surface and the plant
- Low settlement densities and limited land use
- As close to the brine resource as possible

Figure9: The general proposed site area (towards Lake) - November 2006

There are few alternatives to the site as further north results in conflict with Lesser Flamingo and Chestnut-banded Plover areas and south there are few areas with sufficient open space for the site footprint.

Negative features and concerns relating to the site were:

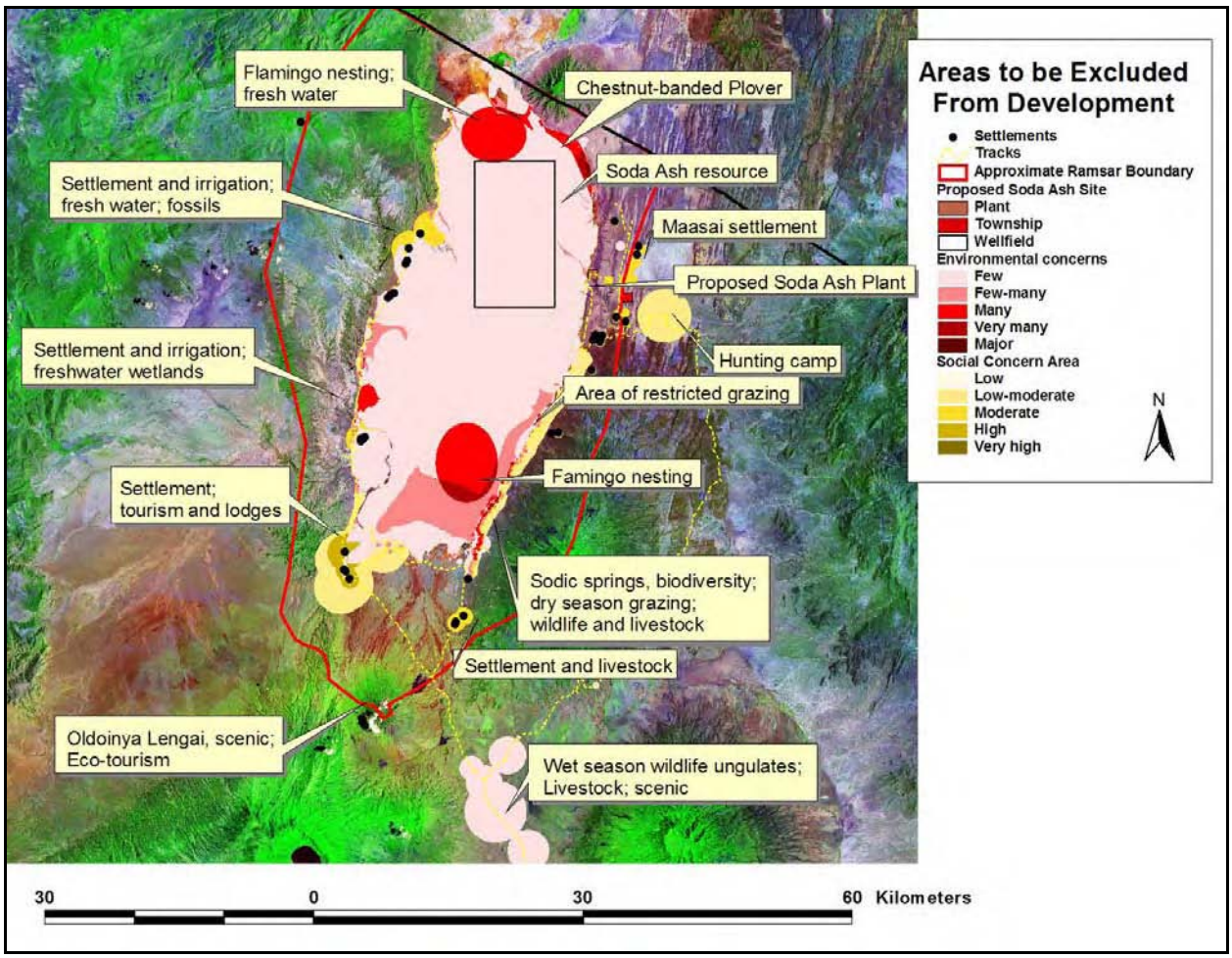
- The location of sodic springs adjacent to the site;
- Use of the southern soda springs for collection of magadi by local communities (small scale, but important);
- Within the Lake Natron Ramsar Site boundary;
- Limit to expansion by the escarpment which rises about 90 metres from the lake;
- Presence of pastoralist settlement in the surroundings (nearest boma is 1.5 km from the edge of the site).
- Presence of archaeological stone (mainly chert) artefacts scatted across the area

Positive features of the site are:

- Located within the zone of lowest bird impact;
- Adjacent to the Lake;
- Adjacent to the brine resource:

- Little altitude difference between plant and lake surface;
- Low population density in surrounding area;
- Ramsar area boundary less than 3.5 km from site which will allow for the township to be developed outside of the Ramsar area

Figure 10: Area of Lake Natron requiring protection during construction and operation



8 ENVIRONMENTAL IMPACT STATEMENT

The ESIA study concludes that:

From the present knowledge and understanding of the social and environmental conditions at Lake Natron, no single or likely cumulative impacts have been identified that would with certainty preclude project development. Given the context though, any development would have to adhere to strict environmental management safeguards and a stringent environmental monitoring regime.

However, it must be recognised that the limited knowledge available on the functioning of the Lake Natron ecosystem as it relates to the Lesser Flamingo suggests that the project may entail a significant degree of environmental risk for this species in the longer term that is probably not capable of direct mitigation. An enforceable link between environmental monitoring and continued project operation would need to be established as an essential means of offsetting this risk as far as possible.

1 INTRODUCTION

Lake Natron Resources Ltd (the proponent), a company jointly owned by the Government of Tanzania represented by its agency the National Development Cooperation (NDC) and TATA Chemicals Ltd of Mumbai, India is considering developing a soda ash facility at Lake Natron in Arusha Region.

The proposed development covers the establishment of a soda ash extraction and processing plant and associated infrastructure at Lake Natron and upgrading of the access road from Mto Wa Mbu to the plant.

Since the 1950's Tanzania has considered the potential to abstract soda ash from Lake Natron; 1950 (Guest and Stevens); 1972-76 (Toyo Soda Manufacturing) and 1993 (Ingenierie). In 1996 an EIA was carried out on one proposed site near Engare Sero for the abstraction of 150,000 tons of soda ash per annum. Commercial abstraction of soda ash in Lake Magadi in Kenya has been ongoing for over a century.

After the 1996 EIA study and a proposal by Kenya to develop the Ewaso Ngiro (South) Multpurpose Project, that would effect the main source of fresh water into the Lake, the Ministry of Natural Resources, Wildlife Division, registered the Lake as a Ramsar site (July 2001).

The Lake falls into Ngorongoro (west) and Loliondo (east) districts with the present access road in Monduli District.

By virtue of the environmental importance of the location in which the development is intended and the number of known environmental and social impacts that are associated with the process during the engineering works i.e. design, construction and operation, a comprehensive assessment to address these impacts is recommended.

Tanzania has designed guidelines for developers (proponents) outlining appropriate procedures for the identification and address of impacts and ensuing mitigation measures with the aim to minimise all negative impacts and promote positive impacts. The outcome of this procedure is the ESIA, which enables the write-up of an environmental impact statement (EIS). The EIS provides the environmental authority with a basis to certify the project as being environmentally sound having adequately addressed all potential impacts. The guidelines ensure that the proponent is in line with the environmental legislation i.e. the Environmental Management Act (2004) and it's enforcing regulations (EIA and Audit Regulations, 2005 – G.N. No. 349 of 2005).

1.1 ESIA Scope of work

The project proponent has commissioned the current scope of works, which includes an ESIA of a selected site and route to the site from Mto wa Mbu to Norconsult A.S in association with Norconsult (T) Ltd. (hereinafter referred to as the Consultant).

The assignment has been carried out in three phases (registration, scoping and impact assessment) with review periods prior to the start of each subsequent phase. The ESIA, including the provision of the environmental and social mitigation plans, has been completed in accordance with the requirements of the terms of reference and national rules and regulations for EIAs as part of the services.

1.2 EIA Methodology

Recommended standard methods for conducting ESIA were used in this study. Briefly, the specific and general Terms of reference (ToR) outlined in the scoping study are used to define the main issues for the ESIA.

Baseline information has been gathered using field observations along the route from Mto wa Mbu to the site, the plant area and associated facilities; consultation with interested and affected parties (IAPs) and reference to relevant secondary information. The baseline information is to substantiate the impacts and provide an overview of the projects biophysical and socio-economic environment. Specialist studies were undertaken in the key areas of avifauna, wildlife, aquatic ecology, archaeology, vegetation, socio-economy and land use.

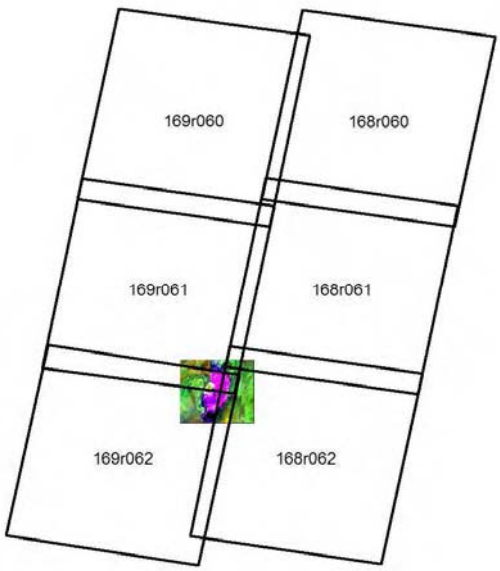
At District and community level, public meetings and key informant interviews were held. Contacts were established with authorities; district executive directors (DED), Ward executive officers (WEO) and village executive officers (VEO). These officials were involved in facilitating communication of the project activities to the community. The meetings provided an opportunity to learn and share the salient information with stakeholders in Kiswahili about the project. The officials were requested to circulate the information to the community members for comment.

In addition, the Consultant has actively sought out the view of IAPs in both Tanzania and Kenya through a series of formal and informal meetings together with press announcements.

1.2.1 Remote Sensing

Given the scale of the project extensive use was made of satellite imagery. The primary source came from the Zulu 7 world Landsat Series which were then merged to obtain a pixel resolution of 15m. The location of the scenes in relation to Lake Natron is shown in Figure 1-1. As the Lake spans a UTM zone, the Consultnat projected all images into UTM zone 26 South for ease of use.

Figure 1-1: Zulu 7 world Landsat series scenes utilised



A number of regional images in MrSid format were downloaded from Zulu7 as well.

1.2.2 Geographic Information System

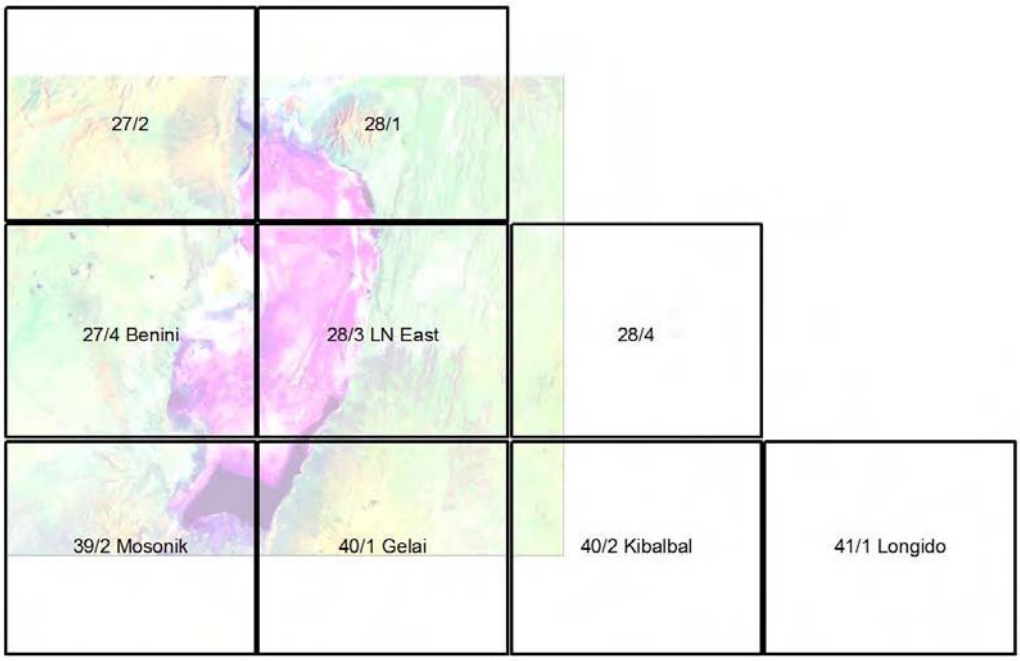
Most of the GIS data was obtained through either the African Data Sampler series or the internet. The national land cover shape files (Ministry of Natural Resources and Tourism 1996) were provided by the University Dar es Salaam at a 1:250,000 scale.

The location specific shape files were mapped off the Landsat images by this project. All shape files were stored as geographic.

1.2.3 Maps

A number of national maps were used for fieldwork and reference. The key 1:50,000 maps are shown in Figure 1-2.

Figure 1-2: 1:50,000 topographic maps used during the EIA



1.3 Reporting

In accordance with the national guidelines for ESIA reporting, the first three chapters present an overview of the project, location, proposed activities and the policy and legislative framework for the proposed development. The fourth and fifth chapters provide the socio-cultural and biophysical environmental setting and chapter six identifies and details the main impacts. Chapter seven presents an analysis of alternatives and chapter eight outlines mitigation measures for the identified impacts. Chapter nine is a managerial section presenting the monitoring and environmental and social management framework.

Chapter ten presents an overview of the consultation process and chapter eleven provides the recommended EIS for the project.

The consultant has opted to separate the route from Mto wa Mbu to the southern most township on the Lake of Engare Sero from the main ESIA report to allow a focused approach on critical issues pertaining to the development and the route from Engare Sero to the site on the eastern shore. The route from Mto wa Mbu has been treated separately in the presentation of this report because it is undergoing a separate feasibility study for upgrading to bitumen standard to Loliondo from Mto wa Mbu (TANROADS 2007). This separate study includes detailed design and an ESIA.

However ESIA issues from the existing alignment are included in this report and presented as an appendix a.

In addition to the assessment from the route from Mto wa Mbu a number of other appendices are included in this report. There is an appendix for each of the following; secondary information, list of consultants for the assignment, minutes of all the consultative meetings, an environmental management plan for the contractor, an environmental assessment of the route from Mto wa Mbu to the southern most point on the Lake (Engare Sero) and the specialist data.

2 PROJECT BACKGROUND AND DESCRIPTION

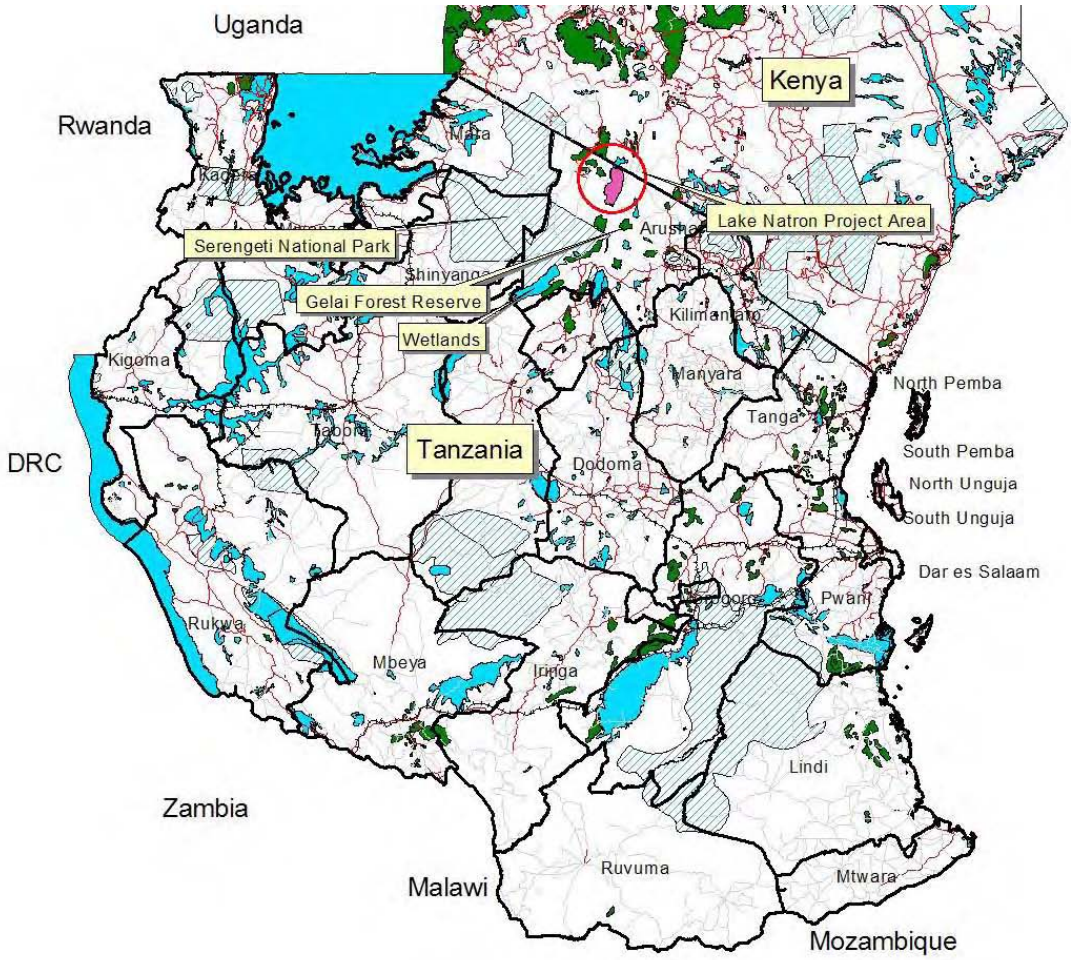
In September 2006, Lake Natron Resources Limited (the proponent) registered the proposed project with the National Environmental Management Council (Form EA1). The proposed development covers the establishment of a soda ash extraction and processing plant and associated infrastructure at Lake Natron and upgrading of the access road from Mto Wa Mbu.

Lake Natron is located in the Northern part of Tanzania, at latitude 2° 20' South, and longitude 36° 10' East. The Northern shore of the lake touches the territorial boundary with Kenya. The nearest town to Lake Natron is Arusha, which is at a distance of about 220 km. Lake Natron area is accessible from Arusha by road. The road up to Mto Wa Mbu (110 km) is a good tarmac road. From Mto Wa Mbu to Lake Natron is about 110 km, the first 50 km is a gravel road, while the rest is an earth road. The Lake falls into Ngorongoro (west) and Loliondo (east) districts with the present access road in Monduli District.

The nearest port to Lake Natron in Tanzania is Tanga, which is at a distance of about 600 km. (Regional location map Figure 2-1).

In the Country Biodiversity profile of 2002, Tanzania is recorded to have three sites befitting Ramsar categorization. Lake Natron is one of these sites and was designated as the Lake Natron Basin Ramsar site in 2001. The area adjoins the world famous Serengeti Wildlife area and is within the Lake Natron Game Controlled Area.

Figure 2-1: Location of Lake Natron in Tanzania



Plans to extract soda ash from Lake Natron are not new. The first publication on the deposits was undertaken in 1892. This has been followed up by studies in 1950 (Guest and Stevens, 1951) and a Japanese team in the 1972-76 period (Toyo Soda Manufacturing Co. 1974). More recently the French company MDPA Ingenierie (1993) carried out a feasibility and environmental impact assessment (EIA) for extraction of 150,000 tons of Soda Ash per year from the southern end of the Lake (Plant would be established near the Moinik River).

The MDPA study was accompanied by an environmental reconnaissance of Lake Natron by the Department of Zoology and Marine Biology, University of Dar Es Salaam (Kasule, Mlingwa and Mwasumbi, 1993).

Following on from the MDPA study, SWECO conducted an EIA for the National Chemical Industries (1996) which assessed impacts of the proposed 150,000 tons soda ash per annum plant. There have been other proposed developments and EIAs in the Lake Natron Basin. The most recent was the Ewaso Ngiro River (South) Multipurpose Project in Kenya which consisted of hydropower and agricultural developments (Prepared for the Kenyan Power Company by a consortium of companies in 1993).

For the current project, the ESIA is asked to assess the feasibility and environmental impacts of developing a plant with a capacity of producing 500,000 to 1,000.000 tons of soda ash per annum.

2.1 Project Rationale

2.1.1 Global Growth of Soda Ash

Three segments drive the demand for Soda Ash. First is Glass segment, which is further driven by the Automobile segment and the Infrastructure (which includes both commercial and housing). Second is Detergent segment, which is driven by the GDP growth rate and increase in the per capita consumption. The third segment driving the demand is the Chemical industry itself.

Much of the growth in soda ash consumption in the past decade has been in the developing world, which mainly comprises developing and newly-industrializing countries that are characterized by a low level of per capita soda ash consumption. Soda ash consumption growth in the developing world has averaged ±5.5% over the 2000-2004 period compared to relatively flat demand in North America and in Western Europe.

Figure 2-2: Global GDP and soda ash consumption

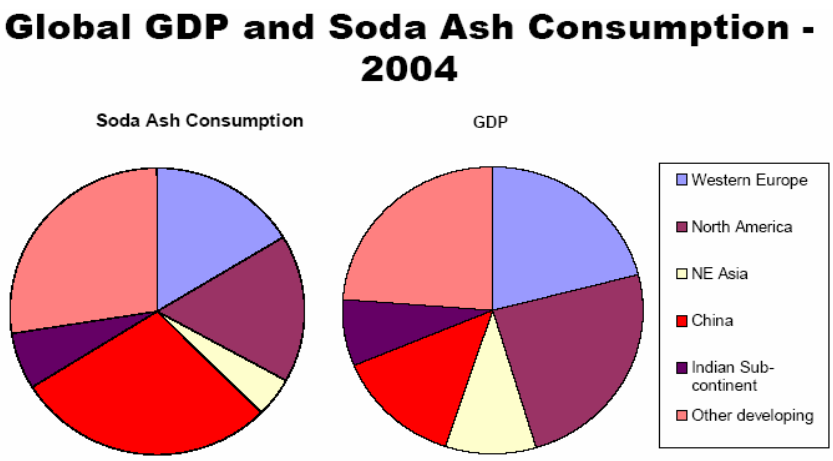
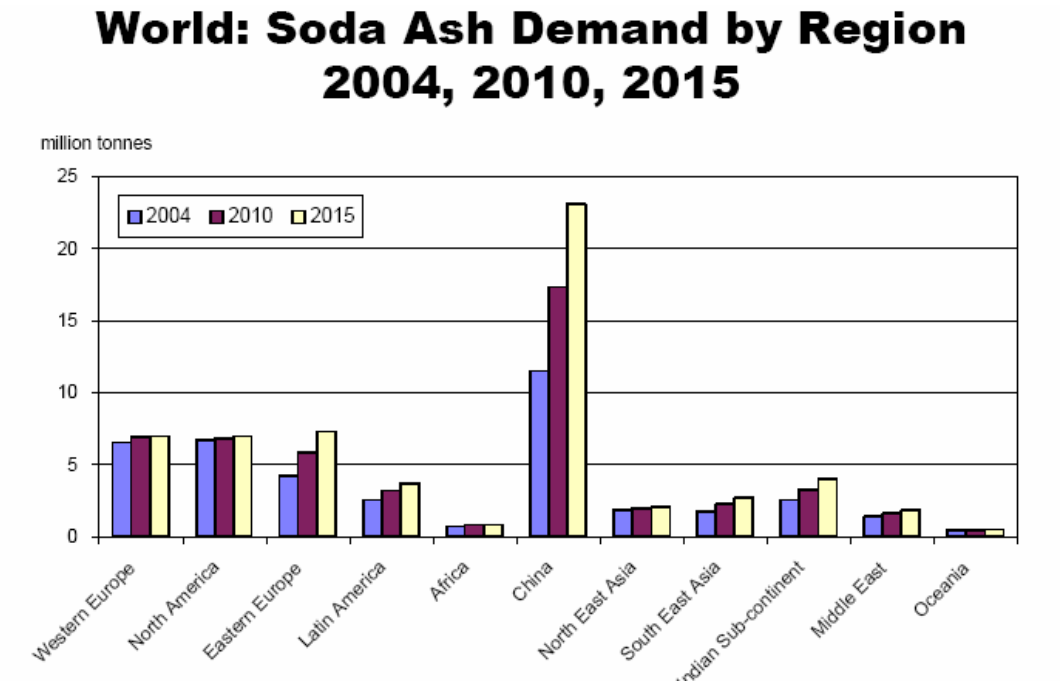


Figure 2-3: World Soda Ash Demand



Global soda ash demand growth is forecast to average 3.8% p.a. in the period to 2010, and thereafter slow down to 3.5% in the period to 2015. Consumption is forecast to increase from ±40.2 million tons in 2004 to ±50.3 million tonnes in 2010 and to ±59.8 million tonnes in 2015.

2.1.2 Regional Market Scenario

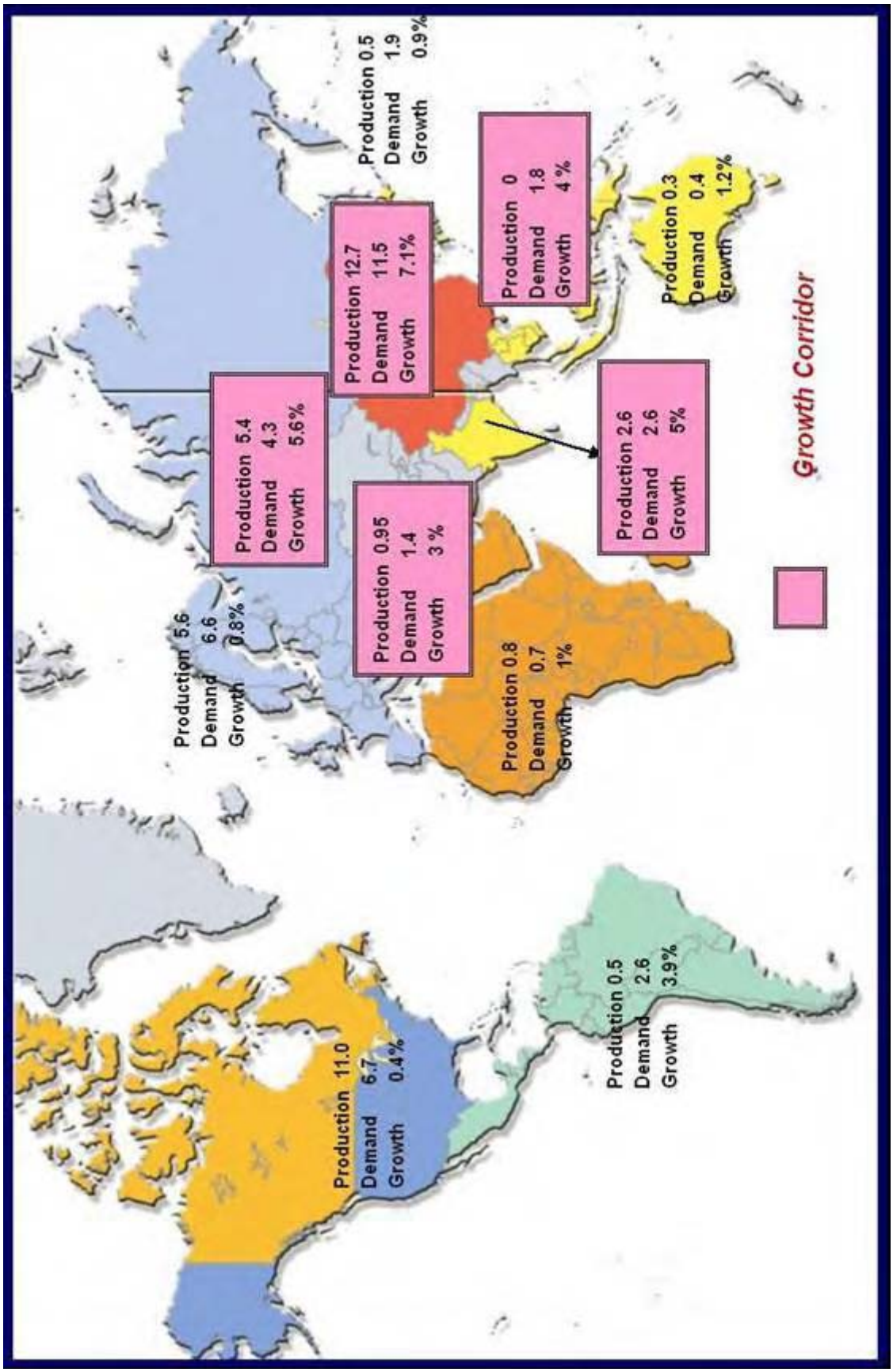
Though the global soda ash demand growth is forecast to average 3.8% p.a. in the period to 2010, the growth rate is estimated @ 7% p.a. in "Growth Corridor" (SEA, ISC and MEA). The demand supply scenario for potential growth corridor is shown in Figure 2-4.

The growth is mainly driven by new glass plants in growing economies for the requirements of infrastructure growth. The other driver of growth is high caustic prices due to which soda ash is preferred as a substitute of caustic soda in the chemical sector.

The most spectacular rate of soda ash demand growth has been in China, with growth rate averaging 11.2% p.a. over the 2000-2004 period. It is clear that China is having a significant and fundamental effect on the soda ash industry.

This growth has largely reflected the high levels of investment in infrastructural development, particularly in the construction industry, which has been the main driver for flat glass. China is expected to account for nearly 60% of the global demand growth during the period 2005-2015.

Figure 2-4: Growth Corridors; demand and supply



2.1.3 Economics of Natural Soda Ash Compared to Alternative of Synthetic Soda Ash

The cost of synthetic soda ash production in any location and in almost all circumstances of raw material and energy costs is higher than the production cost of natural ash. Synthetic soda ash producers are protected against competition by the cost of moving the low cost natural ash to the local markets in which synthetic soda ash is sold.

Generally speaking, synthetic soda ash producers depend upon the local markets where they have a freight advantage. Although the natural ash industry has low production costs, it has relatively high freight and handling costs.

The major elements contributing to the production cost of natural soda ash are extraction cost, royalties & taxes and refinery cost. A significant proportion of trona cash extraction costs, around 50%, is attributable to labour. The balance is made up by electrical power, maintenance and consumables. Labour costs account for ±25% of the cash refinery costs, on average. The balance of the cash refinery costs is made up of electricity, boiler fuel (coal/gas), maintenance materials and consumables.

Synthetic soda ash cost constituents are raw material costs, energy cost and conversion cost. For the Solvay process, the split by cost item is typically: raw material 24%, energy 30% and conversion cost 46%. Conversion cost consists primarily of labour, energy, maintenance materials and overheads. The main factors that have a bearing on conversion costs are labour costs and maintenance costs. On average, maintenance costs account for around a third of a site's conversion costs.

Whilst high costs put synthetic soda ash manufacturers at a disadvantage relative to natural soda ash producers, they can exist profitably, if they serve markets, which can only be reached by natural as producers at a high freight cost. There are several synthetic soda ash plants that are close to an export port and have low freight and handling costs. They are quite competitive with natural ash industry on an export basis.

2.1.4 Emerging Situation

As with any commodity, the more soda ash producers and/or fewer the number of buyers the more competitive the price becomes. The extensive consolidation in the glass industry in recent years has increased the bargaining power of the glass companies vis-à-vis soda ash suppliers. The soda ash industry is aiming to emulate the consolidation and globalization in the container glass industry.

Traditionally, the Asian markets have been the preserve of ANSAC, although in recent years Chinese suppliers have been very aggressive in SE Asia and have gained market share. In terms of soda ash export supply, the most significant changes are forecast as follows: Strong growth in domestic demand in Eastern Europe will restrict its export tonnage, particularly in the latter part of the forecast period (2005-2015).

A substantial increase is anticipated in Chinese net export tonnage during the forecast period, with the total net export tonnage reaching ±2.23 million ton by 2010 and ±2.67 million by 2015.

The USA should remain the biggest exporter in tonnage terms, but growth in tonnage over the outlook period will not be as strong as that experienced in the past. Forecast for US export tonnage is to increase to and then stabilize at a level of around 5.5-5.8 million TPA.; this would equate to an increase of ±0.8-1 million tons over the ten-year horizon.

2.2 Description of the Proposed Project

In total approximately 1.5 km^2 of land will be required for plant and housing, together with upgrading of the access road from Mto wa Mbu. The summary (Table 2-1) below gives a summary of the requirements and potential outputs of the Soda Ash Plant.

Table 2-1: Infrastructure Summary

Staffing	
Number of permanent staff:	152
Number of construction staff	1,225
Land Take	
Land required for plant and works	0.5 km^2
Land required for housing	1 km^2
Road requirements	7 m wide tar road
Resource requirements	
Fresh brine from Lake Natron	561m3/hour
Fresh water for plant operation	106 m^3/hour
Fresh water for domestic use	23 m^3/hour
Power required at plant	11.5 Megawatts
Coke, coal and limestone (Boilers)	21 MTPH*
Sulphuric Acid	0.552 tonnes per day
Caustic Soda	0.1 metric tons per day
Lubricants	145 litres per month
Diesel (for water pumps)	9 kg/hour
Production	
Tons Soda Ash per hour/year produced on a 24 hour cycle	500,000 metric tons per annum
By products and pollutants	
Depleted brine returned to lake	476 MTPH
Mud slurry	93 MTPH
Fly ash from boilers	5 MTPH
SO2 emissions from power generation	unknown
Sewerage water	10 m^3 per hour

*MTPH = Metric tons per hour

2.3 Soda Ash extraction and processing

The plant facility will cover 0.5 km^2 and this includes the processing plant, administration, product storage, power and boiler plant, coal and fly ash storage, mud slurry pond and brine holding ponds.

Brine from the lake is to be extracted at 561 tons per hour (TPH) by diesel or electrically operated pumps via a pipeline to a clarifier. A brine reservoir, with adequate storage capacity to supply the brine during monsoon season, will be filled from the clarified brine pumps during the dry season. The Figure 2-2 below presents a schematic representation of the process.

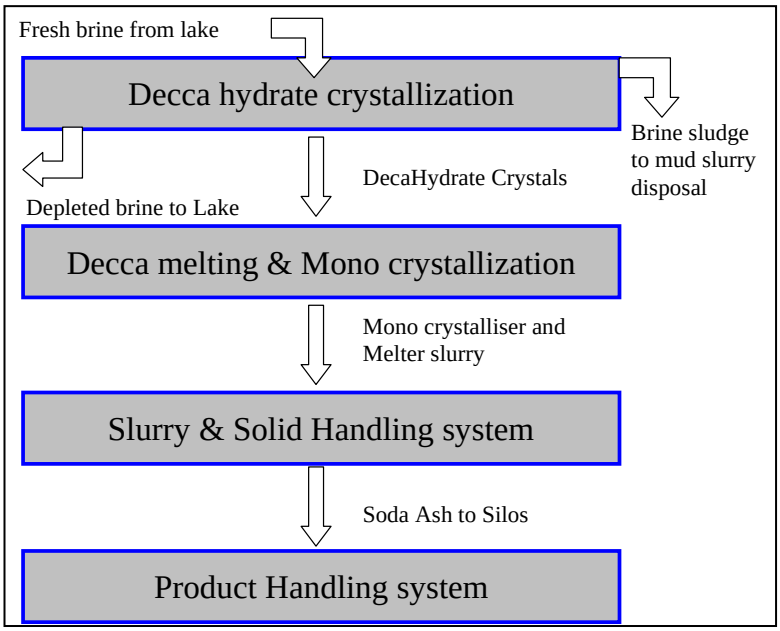
At the clarifier the Lake brine will be treated with flocculating agent for removal of impurities. Clarified brine will then be pumped to a decahydrate crystalliser while the clarified brine sludge will be pumped to a sludge handling area & a mud slurry disposal location. Dilution water and the

purge from monohydrate mother liquor will then be mixed in a clarifier overflow tank before feeding the decahydrate to pre-coolers.

The pre cooled brine is then fed to a decahydrate crystalliser which is kept under vacuum. As a result of the cooling, Na_2CO_3 is precipitated in the form of Decahydrate ($Na_2CO_3.10H_2O$). The resultant Deca slurry will have 33 % Solids and will then be pumped to the hydrocyclones under-flow, centrifuged and solids washed. The total wet cake having 4 to 5% moisture will be fed to a melter to melt the decahydrate crystals into its own water of crystallization.

Melter circulation pumps will maintain the uniform super saturation in the melter. Heat is then to be supplied to melter through mono-crystalliser vapour condensation re-crystallizing the Decahydrate crystals to the monohydrate. The slurry withdrawn from the melter will have 10.13 % solids. This slurry will then be sent the magma tank of the mono crystalliser combined with magma re-pumped to the cyclone and centrifuged.

Figure 2-5: Summary of the extraction process



In a monohydrate crystalliser, monohydrate crystals from the melter mother liquor evaporation will be extracted using steam. Slurry fed to the Mono Slurry Hydrocyclone will be centrifuged and solids washed following which the wet cake will be fed to a fluidised-bed dryer.

The vapour from the last evaporator/crystalliser body will be condensed in a direct contact condenser to recover water and sent to the hot well, which will be then taken to the cooling tower through gravity. The condensates will be treated in a water treatment plant to provide water to the Boilers and other utilities like cake washing, flocculent preparation and for domestic consumption. All non-condensable gases are to be vented-off.

The monohydrate crystals leaving the centrifuge are to be fed to a dryer feed distributor. This rotating mechanism broadcasts the crystals across the surface of the dryer. The dried product containing less than 0.1% moisture will be discharged through an air-slide to the single-deck screen. Particulate emissions are anticipated to be less than 50 mg / Nm^3.

The final product will be dense soda ash having following composition:

- 99.8% sodium carbonate
- <0.04% sodium chloride
- <0.015% sodium sulphate
- <0.01% sodium fluoride
- 1,000 to 1,100 kg/m3 loose bulk density

The soda ash is to be received by a vibrating single-deck from the dryer product air slide. The screens remove 1,000-micron oversize material. The screens and all transfer points are vented through a fabric bag house. The exhaust gases will be vented to atmosphere at less than 50 mg/Nm^3 of dust.

The dense soda ash from the screen will be conveyed to the load-out area where a silo feed bucket elevator will ensure that the ash is properly transferred for storage. Annex 2-1 shows a flow diagram of the process.

2.4 Pollution Abatement

The criteria for compliance used in the design of the plant area those provided in the World Bank Pollution Prevention and Abatement guideline, Tanzania Government (NEMC) guidelines and other specific code/standard wherever applicable.

In addition, the principles adopted by the Commission of the European Union of Four “R” will be employed: Prevent and Reduce Waste at Source, Increase Reuse, Increase Recycling and Recover Energy.

- Reduce – It’s clearly the first “R” because it's much better to stop waste at its source than it is to deal with it later. "Reduce" means to cut down on the amount of resources we use, and on the amount and toxicity of the garbage we produce
- Reuse – Repeated or continued use of a product in its original form. It means repairing what's broken, finding new uses for old things and sharing with others what we no longer need for ourselves.
- Recycling – Recycle" comes third, because recycling requires new resources for transportation and manufacturing process. Recycling converts used items back into raw materials, which are then used in making new products.
- Recover – Recycle" comes third, because recycling requires new resources for transportation and manufacturing. Recover - Burning of waste in a furnace, and the hot gases transfer their heat to water which is converted to steam that can be used for thermal energy or to generate electricity.

2.4.1 Air Emission

The proposed project is designed to use modern material handling, process control, solids separation and combustion techniques to minimize the impact on the existing air quality. The World Bank Pollution Prevention and Abatement guideline has been used to develop the emission prevention and control measures

Combustion Sources

The combustion sources include: Coal fired CFBC boiler and the emergency diesel generators. The boiler will be fired with 80% of pet coke and 20% of south African coal or 100% south African coal, the emergency diesel generators uses an internal combustion engine which will required diesel oil. The boiler has a maximum design capacity of 200MTPH/400 deg cent/70 bar. The emergency generator is not considered in emission inventory because it is used intermittently.

The boiler will be equipped with lime stone dosing system and ESP to control SO2 and particulate emissions to the atmosphere, the SO2 removal efficiency will be over 90% which will ensure the SO2 emission level below the World Bank recommendation.

Other Sources

The proposed plant will use an indirectly heated fluid-bed dryer (FBD). A bag house is used to clean the dryer exhaust and precipitator is used to reduce the fine dust level before directing to stack. The fabric filter will control the particulate matters to levels equal or less than the World Bank guideline of 50 mg/Nm3.

The Coal and lime stone is handled in coal handling area of plant by sub processes of Receipt & stacking of material, Loading of material from stacks & unloading at the respective plant hopper, crushing, screening of material and storage bins.

Dry Soda ash is handled in Product handling area of the plant by sub-processes of screening, belt conveyors, bucket elevators, screw conveyors, silos and product packaging machines.

The material handling equipment is equipped with positive ventilation in accordance with procedures and guidelines established by the American Conference of Governmental Industrial Hygienists. These procedures are use of covered conveyor discharge points with positive ventilation, bucket elevators operating under negative pressure, hooded screens with a positive ventilation system and silos, bins and ducts operating under negative pressure. The design practices minimize fugitive dust emissions to enable the owner to maintain proper workplace air quality. The ventilation air from these various points will be cleaned with bag houses before the air is emitted to atmosphere. The bag house design will meet the World Bank recommendation of SPM level of less than or equal to 50 mg/Nm3. Any collected sod ash dust will return to the process.

The plant is designed to minimize fugitive emissions by installing paved roads. The plant will use good housekeeping practices to minimize any particulate fugitive emissions.

Monitoring Of Air Emission

The plant will be monitored in accordance with the World Bank recommendations. The process equipment emissions shall be exhausted with stacks wherever applicable as per standards. Opacity –monitoring equipment will be supplied with the stack of fluid-bed dryer (FBD) to demonstrate the compliance of SPM levels. SO2 from the boiler stack will be monitored by manual sampling methods in accordance with the World Bank. Process flows such as feed or product rate or coal firing rate will be used a surrogate for monitoring the process rate in accordance with World Bank guidelines. Dedicated stack monitoring equipment will not be

installed on the ventilation dust collectors in the material handling areas because it is not cost effective. They can be sampled manually as and when required.

2.4.2 Water and Liquids

Water usage and water quality are important issues that affect the local environment. The design process is considered the influences of water use and liquid discharges would have on local water quality, the results of the engineering efforts are that most of the water requirement for plant operation will be recovered from the plant condensate. Total water requirement for the complex will be 128.57 MTPH (80.89 MTPH – Process water, 25 MTPH- Fire water etc, 22.68 – Domestic uses).

Cooling Tower Blow Down

In the cooling towers mineral salts viz. calcium carbonate, calcium sulphate etc. when exceeds saturation conditions, starts forming the scale on the inner side of the Heat Exchanger thus resulting in inefficient transfer of heat. By limiting concentration of the minerals in the circulating water, over saturation can be prevented or held. Natural windage loss of unintentional water loss may not be sufficient to hold the mineral concentrations below saturation limit. Hence this must be supplemented with intentional blowdown which is normally called cooling tower blowdown.
This is considered in design of plant to recycle the cooling water blowdown at DM plant inlet or at process water inlet.

Acidic Regeneration Waste From DM Plant

For the regeneration of strong acid cation exchanger resin in D M Plant, diluted HCL or H2So4 shall be used. This effluent being acidic in nature, planned to store in the DM plant pit for mixing with Alkaline Regeneration waste water and then after dilution with back wash water waste shall be pumped for use as appropriate.

Alkaline Regeneration Waste From DM Plant

Alkaline Regeneration Waste From DM Plant: For the regeneration of weak/strong Anion exchanger resin in the D M Plant , diluted NaOH shall be used.

This effluent being alkaline in nature, planned to store in the DM plant pit for mixing with Acidic Regeneration waste water and then after dilution with back wash water waste shall be pumped for use as appropriate.

Boiler Steam Blow down

Steam blow down from boiler steam drum shall be recycled at DM plant inlet water or at process water inlet.

Sewage Water

Sewage water of plant and township has been planned to pass through Sewage Water Treatment plant (STP).

Depleted Brine

Depleted brine (474.14 MTPH) after processing in Decca hydrate crystallizer will return back to lake . Since it is the part of lake brine so it is expected to have no adverse impact in the lake.

Slurry

Underflow of clarifier with 40% solid having flow of 92.67 MTPH will return back to lake paddock.

2.4.3 Solid Waste

Ash Waste From Boiler

It has been planned for boiler to operate in ratio of 80% pet coke with 20% of South African Coal by mixing the Lime Stone in boiler furnace. The solid generated will be a mix of coal ash and lime stone , which is planned to be disposed in the identified land filled area in initial stage and further scope to use it for making brick, road construction or to produce cement can be explored.

Bio-Degradable and Non Bio-Degradable Waste Handling

Bio-Degradable waste has been planned to store in the land filled area. Non Bio-Degradable waste may be disposed in land filled area and covered with soil or shall be sold to approved vendor for recycling, using of Non Bio–Degradable product in township and plant shall be discouraged.

Chemical Storage and Handling

All chemical preparation tanks and metering pumps of coagulant dosing system are located in the chemical handling sub section of each section. However, acid storage, transfer and measuring system are located DM plant at acid section.

The dike height (bund) of acid/chemical storage tank may be designed in such a way that they can confine the acid/chemical in inside of dike in case of any leakage from tank. The floor wash water drained to DM plant effluent pit.

2.4.4 Noise

The plant machinery is designed in such a way that the noise level will be as World Bank guidelines.

2.5 Ancillaries

2.5.1 Access

To enable transport of products and goods to and from the site a quality tar road link is required to the nearest railhead.

2.5.2 Power

There is no existing connection to the National Grid at Lake Natron thus alternative power sources are envisioned to be:

- Diesel pumps/generators for pumping the Brine
- Oil or coal powered generators for both plant processes and domestic use
- Steam – coke/coal fired boilers

The total power requirements for the plant is estimated to be 11.5 Megawatts

2.5.3 Water

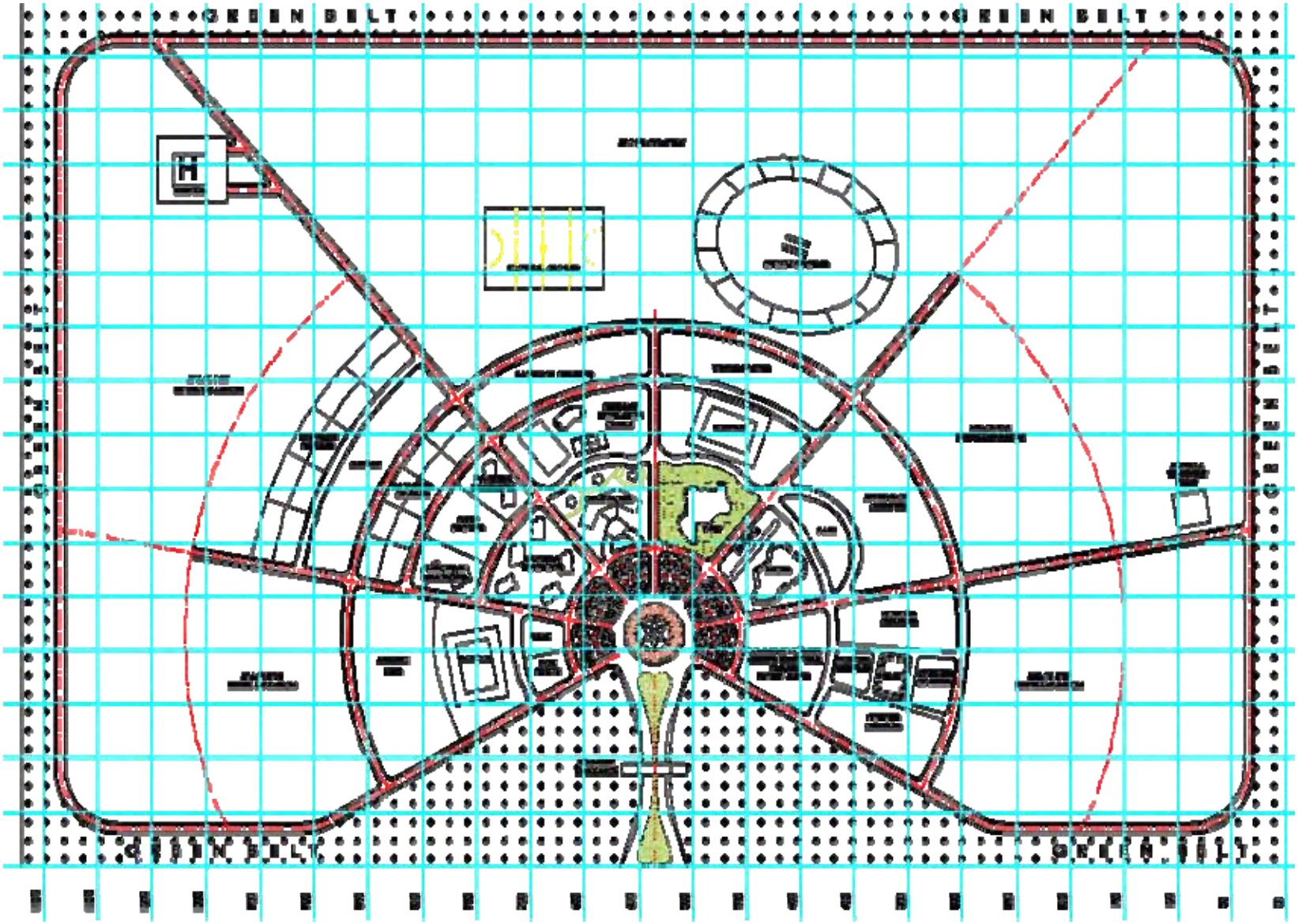
129 m^3 per hour of fresh water is expected to fulfil the plant and domestic use requirements. Water will be tapped from the eastern side of the Lake utilising local seasonal surface water flows, groundwater and piped water from neighbouring catchments if necessary. Process water can be of less than potable quality.

2.5.4 Accommodation

A support town with suitable accommodation for site staff will have to be constructed. It is also anticipated that an airstrip may form part of the associated structures for the plant.

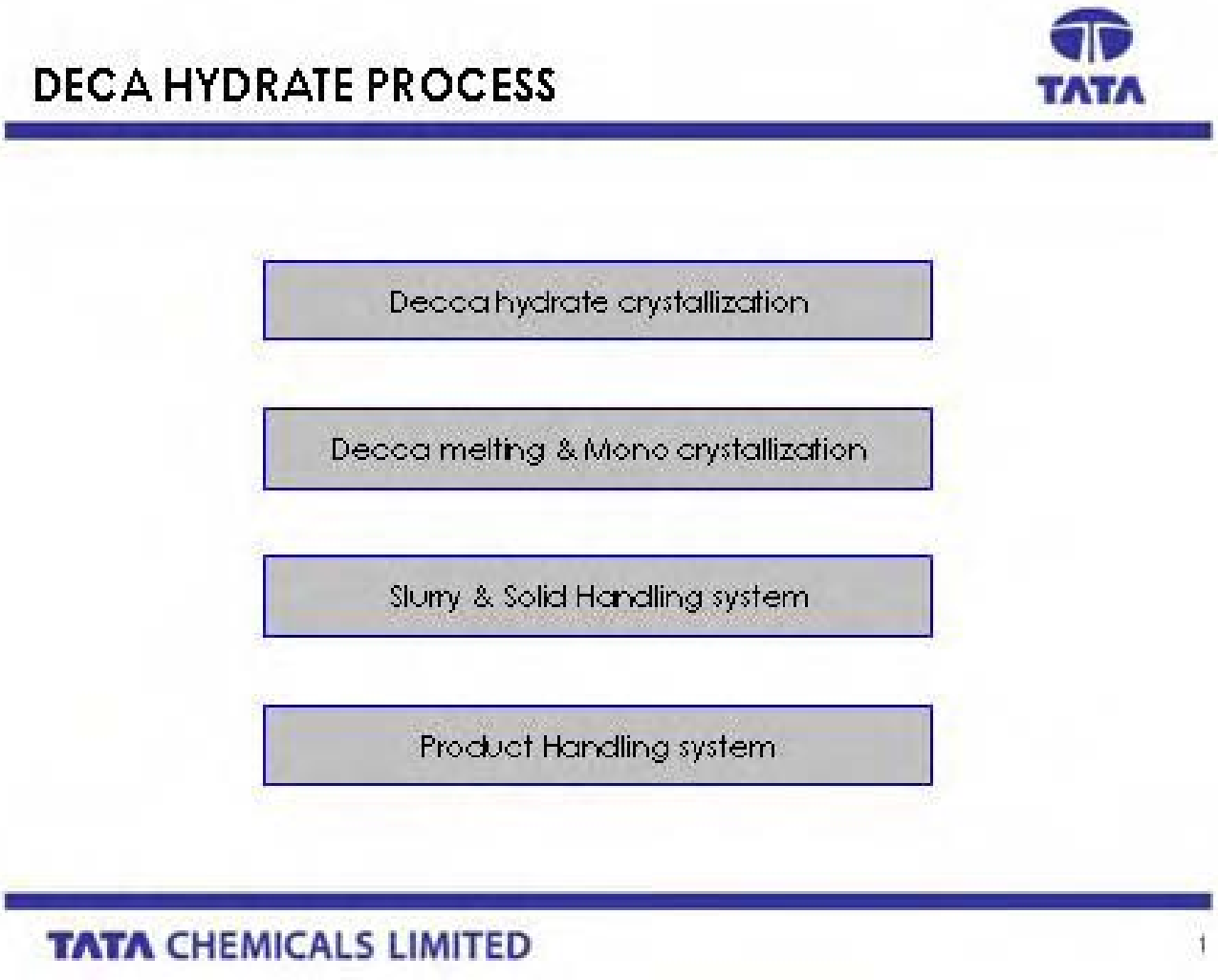
Important to note is that this ESIA relates to the project as described above - any significant material change to extraction method, processing capacity or infrastructure may entail an additional ESIA if any such changes are proposed in the future.

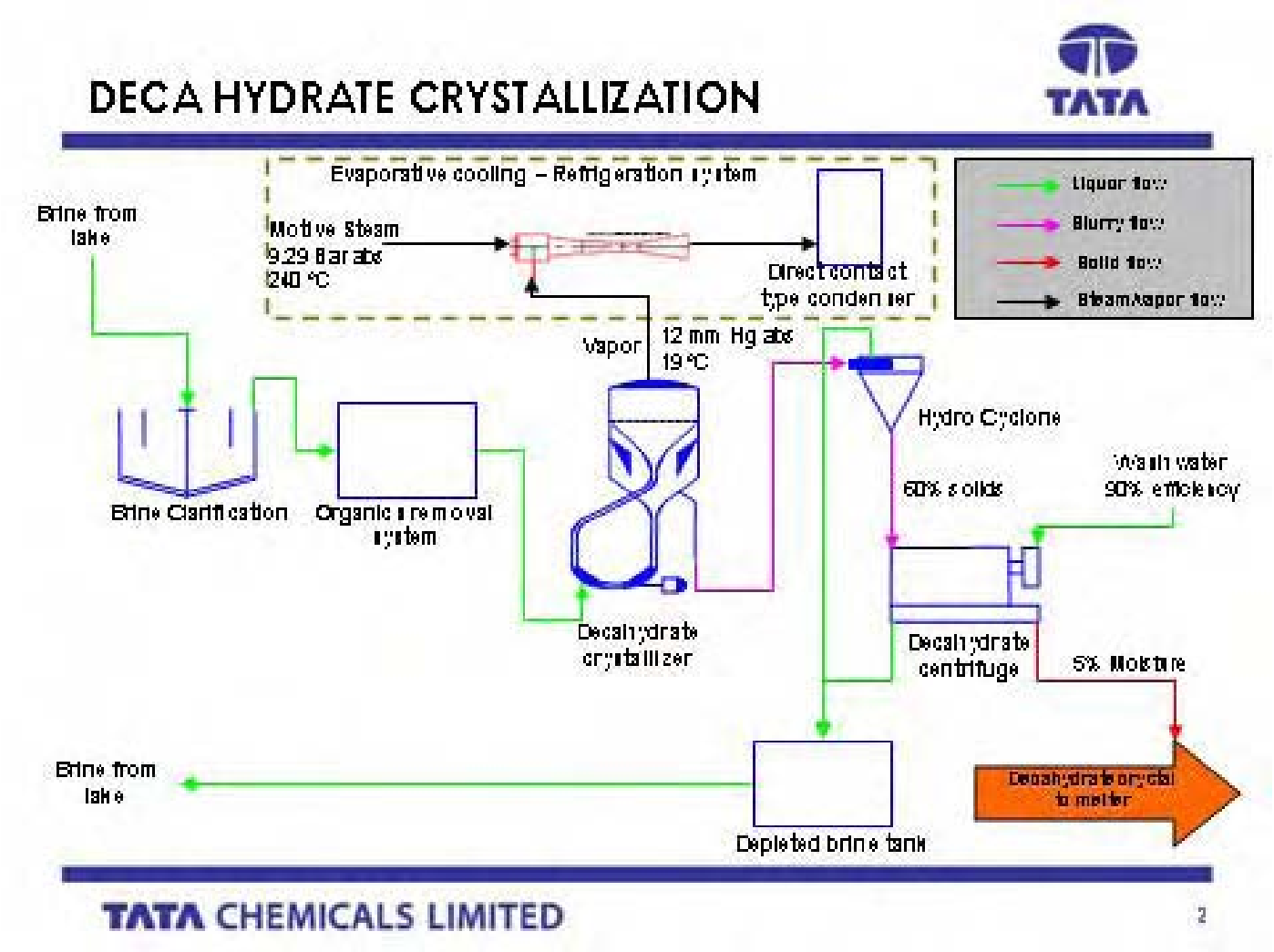
Figure 2-6: Indicative township layout

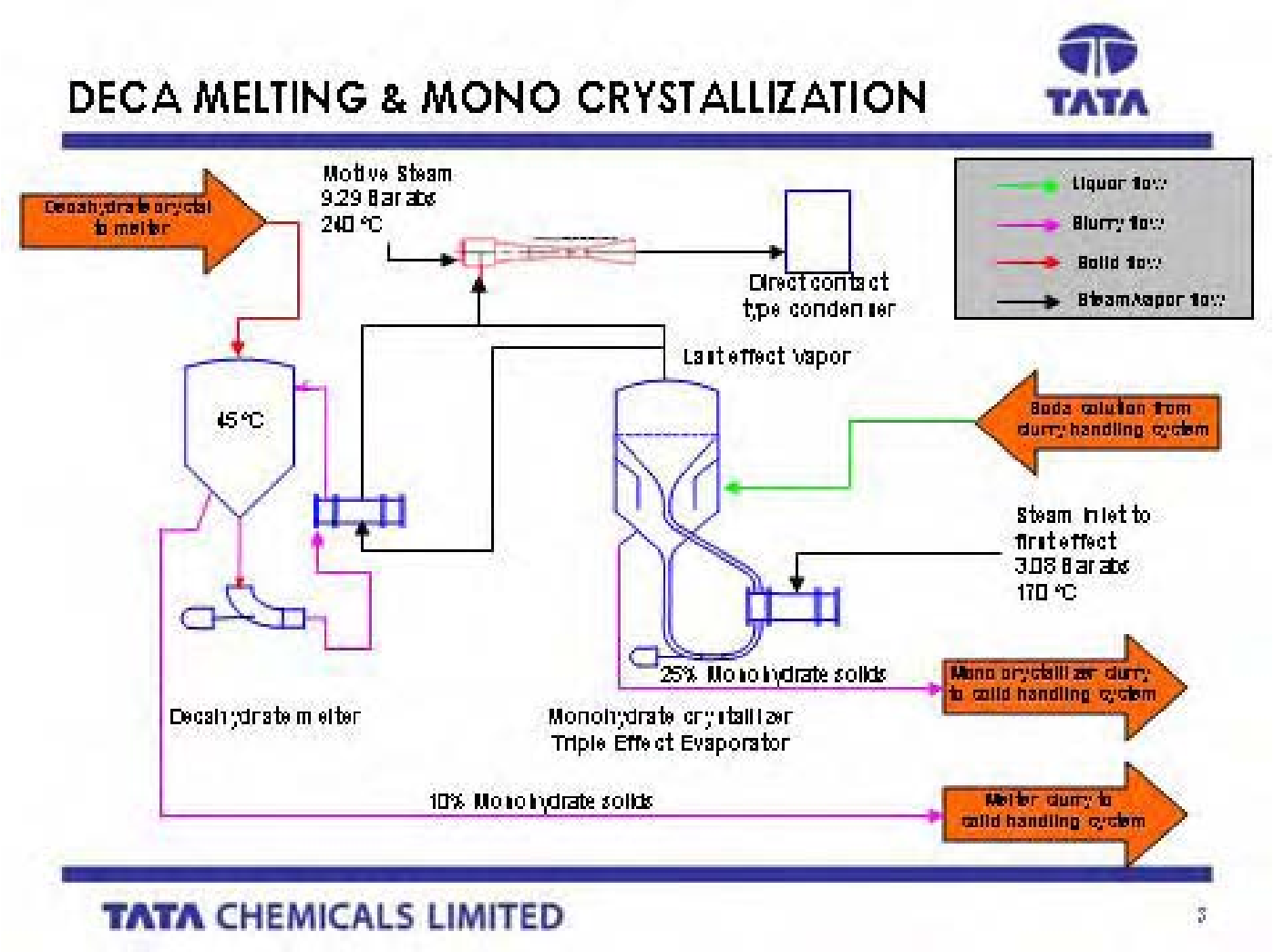


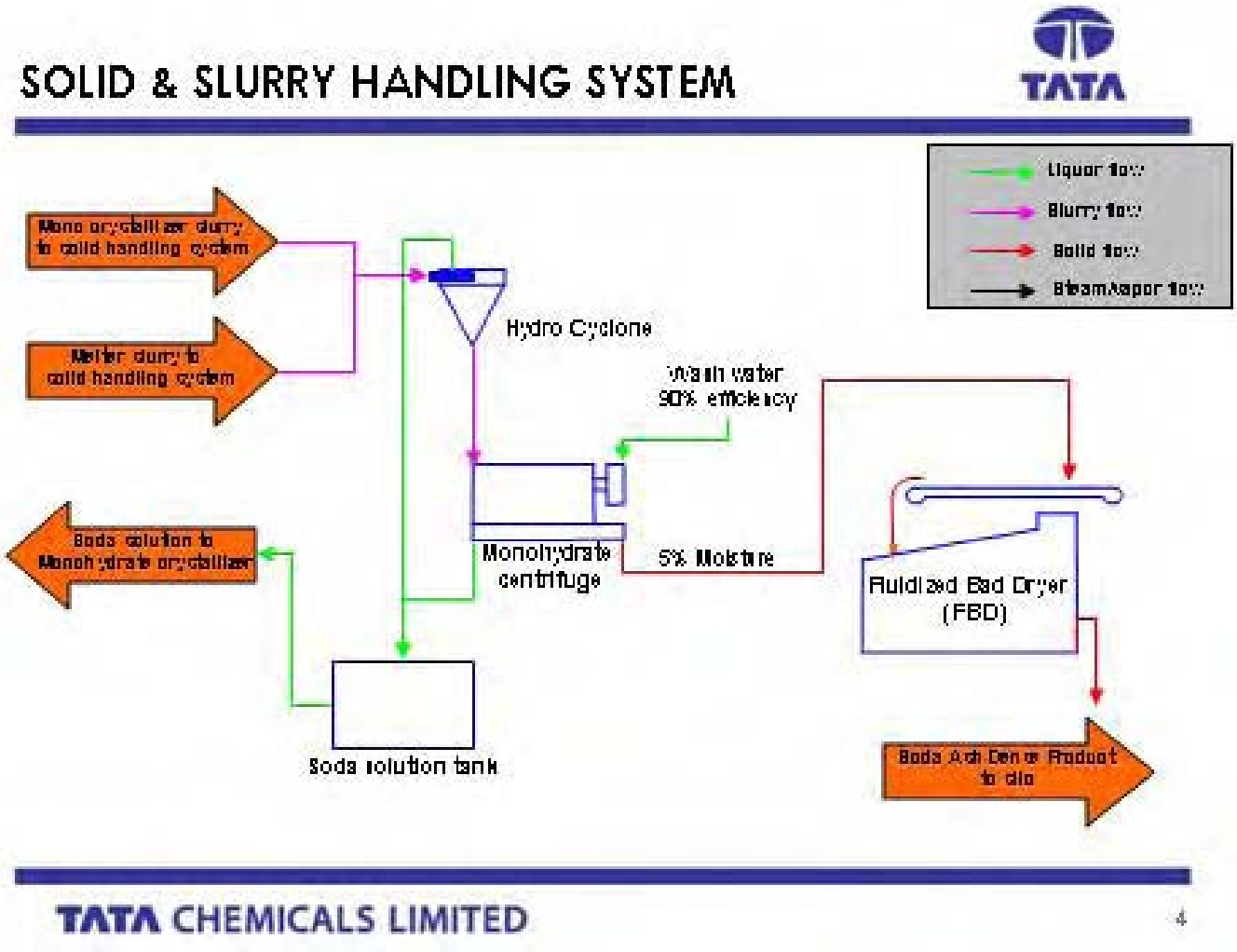
ANNEX 2-1

Process Flow Diagram



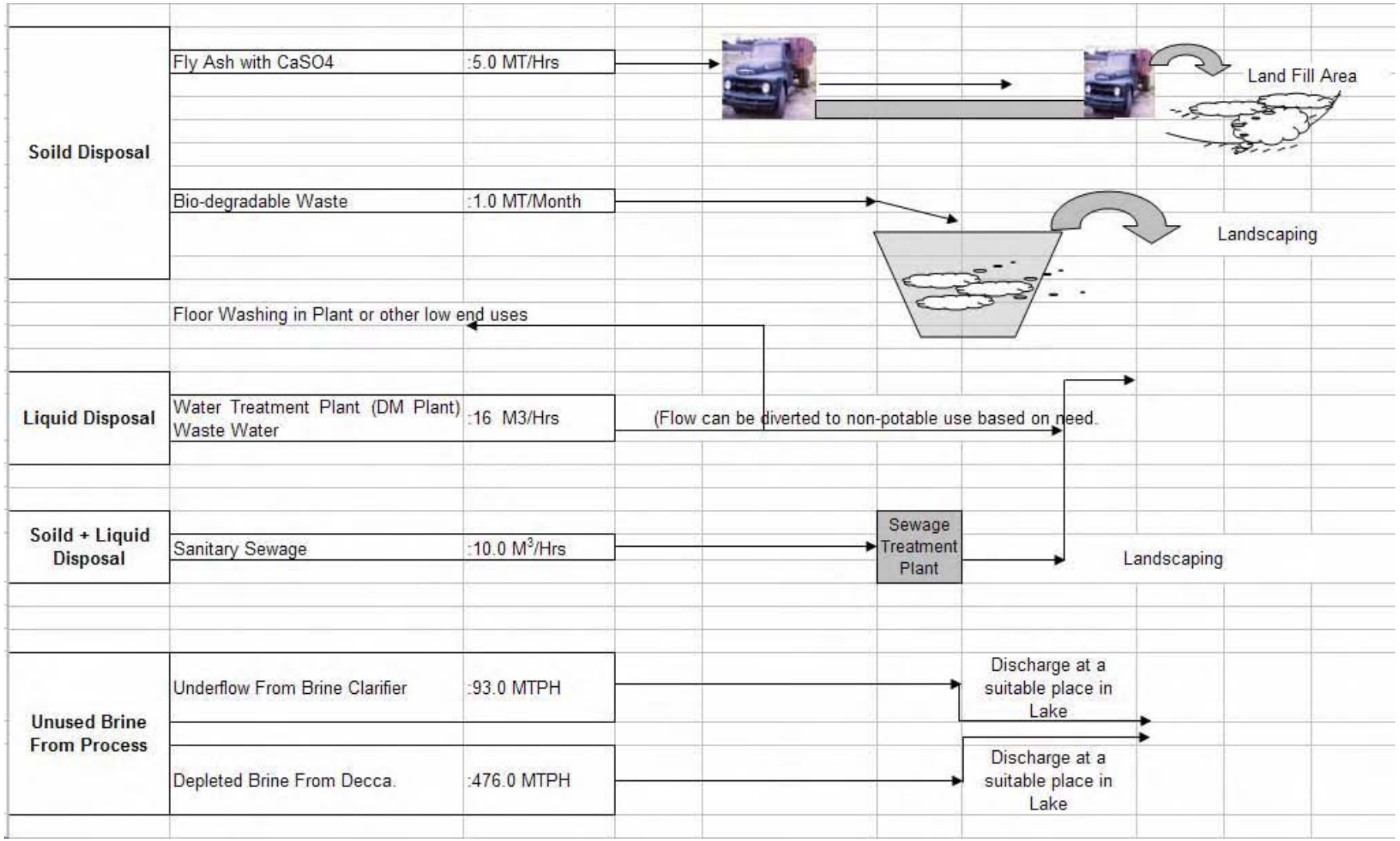

DECA HYDRATE CRYSTALLIZATION
TATA
Evaporative cooling – Refrigeration system
Brine from lake
Motive Steam
9.29 Bar abs
240 °C
Direct contact type condenser
Liquor flow
Slurry flow
Solid flow
Steam/vapor flow
Vapor
12 mm Hg abs
19 °C
Hydro Cyclone
Brine Clarification
Organic removal system
60% solids
Wash water
90% efficiency
Decahydrate crystallizer
Decahydrate centrifuge
5% Moisture
Brine from lake
Decahydrate crystal to melter
Depleted brine tank
TATA CHEMICALS LIMITED
2


DECA MELTING & MONO CRYSTALLIZATION
TATA
Decahydrate crystal to melter
Motive Steam
9.29 Bar abs
240 °C
Direct contact type condenser
Liquor flow
Slurry flow
Solid flow
Steam/vapor flow
Last effect vapor
45 °C
Soda solution from slurry handling system
Steam inlet to first effect
3.08 Bar abs
170 °C
25% Monohydrate solids
Mono crystallizer slurry to solid handling system
Decahydrate melter
Monohydrate crystallizer
Triple Effect Evaporator
10% Monohydrate solids
Melter slurry to solid handling system
TATA CHEMICALS LIMITED
3


SOLID & SLURRY HANDLING SYSTEM
TATA
Liquor flow
Slurry flow
Solid flow
Steam/vapor flow
Mono crystallizer slurry to solid handling system
Melter slurry to solid handling system
Hydro Cyclone
Wash water 90% efficiency
Soda solution to Monohydrate crystallizer
Monohydrate centrifuge
5% Moisture
Fluidized Bed Dryer (FBD)
Soda solution tank
Soda Ash Dense Product to silo
TATA CHEMICALS LIMITED
4

ANNEX 2-2

Major Waste Streams – Treatment & Disposal



ANNEX 2-3

List Of Raw Materials & Chemicals

Raw Material Requirement

Raw Material	Where To Be Used	Units	Quantity	Source
Brine	Soda Ash Plant as Feed	M^3/Hr	561.0	Lake Natron

Chemical Requirement

Chemical	Where To Be Used	Units	Quantity	Source
Hydrochloric acid (HCL) OR Sulphuric Acid H2SO4	DM Plant (SAC & MB) regeneration.	MT/Day	0.4	Local Purchase/Imported Based on suitability
Caustic soda (NaOH)	DM Plant (Anion & MB) regeneration.	MT/Day	0.1	Local Purchase/Imported Based on suitability

Fuel ,Lime stone & Lubricant Requirement

Fuel & Lubrication	Where To Be Used	Units	Quantity	Source
Pet Coke	Boiler	MTPH	14.0	Import From Middle East, India
South African Coal	Boiler	MTPH	3.5	Local Purchase/Imported Based on suitability
Lime Stone Requirement	Boiler	MTPH	3.5	Local Purchase
Lube Oil	Plant Machines	Ltr/Month	145.0	Local Purchase/Imported Based on suitability
Diesel Requirement	DG set For Brine Pumping	Kg/Hrs	9.00	Local Purchase/Imported Based on suitability

3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 National Policies

3.1.1 National Environmental Policy, 1997

The National Environmental Policy aims to ensure sustainability, security and equitable use of resources to meet the basic needs of the present and future generations without degrading the environment or risking health and safety.

To achieve this general aim the Policy emphasises the importance of sectoral legislation as an essential means for effective and comprehensive environmental management. Meaningful and effective environmental laws must be clearly understood and respected by the communities and the individuals for whom they are intended.

3.1.2 National Forest Policy (1988)

The Policy goal is to enhance the contribution of the forest sector to the sustainable development of the nation and the conservation and management of natural resources for the benefit of present and future generations. To attain this goal the policy focuses on four main areas; land management, forest based industries and products, ecosystem conservation and management and institutions and human resources.

The national forest policy has three key statements pertaining to the proposed project:

- *Policy statement (1):* To ensure sustainable supply of the forest products and services and environmental conservation, all, all types of forest reserves will be managed for production and/or protection based on sustainable management objectives defined for each forest reserve. The management of all types of forest reserves will be based on forest management plans.

Under the guidance of this statement the Gelai Forest Reserve was officially gazetted in 1955 with an area of 6050 acres (2448 ha)

- *Policy statement (5):* To enable sustainable management of forests on public lands, clear ownership for all forests and trees on those lands will be defined.

The allocation of forests and their management responsibility to villages, private individuals or to government will be promoted. Central, local and village governments may demarcate and establish new forest reserves.

The Gelai Forest is owned and managed by the Central Government through the District Natural Resources office.

- *Policy statement (15):* New forest reserves for biodiversity conservation will be established in areas of high biodiversity value. Forest reserves with protection objectives of a national strategic importance may be declared as nature reserves.

This statement allows for local governments to enforce protection on locally determined areas of importance for conservation or production.

3.1.3 National Land Policy, 1995

The Policy advocates equitable distribution and access to land by all citizens. It aims to ensure that existing rights in land especially customary rights of small holders (i.e. peasants and pastoralists who form the majority of the country's population) are recognized, clarified, and secured in law. Under the policy framework land is to be put to its most productive use to promote rapid social and economic development of the country among other objectives.

3.1.4 Agricultural and Livestock Policy (1997)

The number and nature of guidelines that constitute Tanzanian Agricultural and Livestock policy is complex. However, the overall aim is to promote and ensure a secure land tenure system to encourage the optimal use of land resources, and facilitate broad-based social and economic development without upsetting or endangering the ecological balance of the environment.

The major theme is the conversion of land into an economic asset to which all citizens should have equal access, especially in response to the vulnerability of smallholders and livestock keepers who do not produce a surplus. The focus is, therefore, on the commercialization of agriculture so as to increase income levels and alleviate poverty.

3.1.5 National Water Policy, 2002

Three components from the National Water Policy have a bearing on the proposed project. These address proper use, conservation and protection for human consumption and the environment.

(i) *Socio-Economic and Water Allocation:* Water is a basic need and its use is to be determined by and have consistence in the legislation, the allocation system should distinguish and separate water use permit from land titles and a sufficient supply of water and an adequate means of sanitation are prioritised.

(ii) *Protection and Conservation of Water Resources*: The "polluter pays principle" shall apply and water conservation for all aspects of water use are to be enforced. "Demand management" is to be used in conjunction with water supply provision.

(iii) *Water and the Environment*: Water related activities should aim to enhance or to cause least detrimental effect on the natural environment. Furthermore the allocation and consumption of water for environmental purposes shall be recognised and given appropriate considerations,

Water for the environment shall be determined based on scientific information available considering both the temporal and spatial water requirements to maintain the health and viability of riverine and estuary ecosystems.

3.1.6 National Fisheries Sector Policy and Strategy Statement (1997)

The Policy addresses the degradation of fishery waters and promotion of their wise use. The policy also emphasizes the need to gain an acknowledgement of the economic significance of aquatic systems and associated wetlands.

3.2 International Conventions

3.2.1 Ramsar Convention

Lake Natron has been designated a Ramsar site. Designation date was 04th August 2001 (Coordinates: 02°21'S 036°00'E Elevation: 600 m - 3000 m Area: 224,781 ha) and location: indicated as the Natron basin is situated in Ngorongoro and Monduli districts within the Arusha region, in northern Tanzania contiguous with the Kenyan border.

Classification criteria were 1, 2 ,3 ,4 ,5 ,6 ,7 as a globally important site for endangered species. The Lesser Flamingo *Phoenicopterus minor* is classified "Near Threatened", indicating that it is considered likely to qualify for a threatened category in the near future.

Reasons for listing are:

(1) representative example of a Rift Valley soda lake in East Africa
(2) the only regular breeding area for the 2-4 million *Phoeniconaias minor* in East Africa. The highly specialised flamingo community is considered a threatened ecological community. In addition,
(3) over 100,000 individuals of other waterbird species, including large numbers of migrant species
(4) fish species *Oreochromis alcalicus* appears to be endemic to Lake Natron and Kenya's Lake Magadi

Responsible authorities for site management are the Ngorongoro and Monduli District councils in collaboration with the Wildlife Division, District Executive Director Ngorongoro.[1]

Obligations under this Convention are:

- (*Article 3*) Formulate and implement planning so as to promote the conservation of the wetlands included in the List (Lake Natron);

- (*Article 3*) Inform the Convention bureau at the earliest possible time if the ecological character of any wetland in its territory and included in the List has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference (note: "Ecological character is the combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time." and "For the purposes of implementation of Article 3.2, change in ecological character is the human-induced adverse alteration of any ecosystem component, process, and/or ecosystem benefit/service." Finally, "Wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development." (Ramsar resolution IX appendix A).

- (*Article 4*) Promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands.

- (*Article 4*) The Contracting Parties shall encourage research and the exchange of data and publications regarding wetlands and their flora and fauna. The Contracting Parties shall endeavour through management to increase waterfowl populations on appropriate wetlands. The Contracting Parties shall promote the training of personnel competent in the fields of wetland research, management and wardening.

[1] (Source: Ramsar web site).

- (*Article 5*) Contracting Parties shall consult with each other about implementing obligations arising from the Convention especially in the case of a wetland extending over the territories of more than one Contracting Party or where a water system is shared by Contracting Parties. They shall at the same time endeavour to coordinate and support present and future policies and regulations concerning the conservation of wetlands and their flora and fauna.

The designation of the Lake as a Ramsar site has the following implications:

- Maintain ecological character; this is the combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time.

- Prevent change in ecological character created by the human-induced adverse alteration of any ecosystem component, process, and/or ecosystem benefit/service.

- Ensuring wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development.

- Prepare management plans and manage the wetlands to conserve ecological character criteria i.e. Ramsar site size; biological diversity; naturalness; rarity (species or habitats); fragility and typical-ness.

- Under the Ramsar Convention Article 3.2 the Tanzanian Government will be required to inform Ramsar if the ecological character of its Ramsar wetlands are likely to change as a result of technical developments, pollution or human interference.

3.2.2 African-Eurasian Migratory Waterbird Agreement

(AEWA) action plan, Column A: Requires strict protection of the Lesser Flamingo and other water birds.

3.2.3 Bonn Convention (CMS) Appendix II:

This aims to protect migratory species throughout their known range.

3.2.4 CITES convention Appendix II.

Monitoring the trade in Lesser Flamingo.

Important Bird Areas (IBA) Criteria

- Category 1. Globally Threatened Species
- Category 3. Biome-restricted assemblages
- Category 4i. More than one 1% of biogeographical population.
- Category 4iii. More than 20,000 waterbirds recorded.

3.2.5 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The basic principals of the CITES is to control and monitor international trade in endangered and threatened species. The Convention establishes the international legal framework for co-operation

between the producer and consumer and is essential for the conservation of wild species. The convention operates by means of a licensing system.

At the core of the Convention are three appendices-in effect three species lists.

Appendix I
Appendix 1 includes species of animals and plants in which, with a few exceptions trade in wild specimens is prohibited. None of the plant species listed under Appendix I was sighted/recorded in the vicinity of the proposed project area.

Appendix II
This list includes species whose survival is not yet threatened but projected to be so in a given time frame in the absence of conservation effort and/ or regulation. Trade for such species is in principal allowed for both wild and artificially propagated or captive breed specimens subject to licensing.

In the project area, a number of *Euphorbia* species were sighted that fall under this list particularly in the *Acacia-Commiphora* scrubland and rocky woodland dominated by *Euphorbia candelabrum* along the road from Mto wa Mbu to Selela and Engaruka (See Table 3-1)

Table 3-1: Euphorbia Species under CITES Appendix II

Species	Common name	Habit
Euphorbia cuneata Vahl	Mchongoma (Swahili)	Shrub up to 4m tall. Branches with spined tips
Euphorbia matabelensis Pax	Mchongoma (Swahili)	Woody shrub 5m tall. Branches with spined tips
Euphorbia quandrangularis Pax	Zasha (Sambaa, Zigua)	Succulent perennial 4m tall. Stem covered with spines
Euphorbia candelabrum Kotschy var. *candelabrum*	Zasha, Ganganyika (Sambaa, Zigua)	Tree up to 20m tall. Branches angular spined with yellow cream flowerss

Appendix III
The third list acts as a support mechanism for domestic legislation, where countries ask other parties to monitor trade taxa not listed on Appendix I or II.

Only *Dalbergia melanoxylon* (used for wood carvings) is registered under this list and occurs between Mto wa Mbu and Engare Sero in *Acacia tortilis* woodland.

3.3 Legislation, Regulations and Guidelines

3.3.1 Environmental Management Act, 2004

The Environmental Management Act (2004) encompasses all matters pertaining to the environment. The Act sets out standards and procedures, duties and limits, with obligations for all stakeholders, to benefit human needs and govern sustainable resources. It includes the composition and responsibilities of the environmental authorities i.e., The Minister, the Division of Environment and NEMC.