ENVIRONMENTAL IMPACT ASSESSMENT

Draft Environmental Impact Assessment Report for the Proposed Construction, Operation and Decommissioning of a Seawater Reverse Osmosis Plant and Associated Infrastructure in Tongaat, Kwazulu-Natal

DRAFT EIA REPORT

CHAPTER 9: NOISE IMPACTS

Abbreviations

Ambient noise	Totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far. Note: Ambient noise includes the noise from the noise source under investigation.
Annoyance	General negative reaction of the community or person to a condition creating displeasure or interference with specific activities
A-weighted sound pressure level (LpA and LAeq,T)	A-weighted sound level LpA which is the sound pressure level at specific frequencies and is given using the following equation: $LpA = 10Log \left(\frac{P_A}{P_O}\right)_2$ Where: PA = is the root-mean-square sound pressure, using the frequency weighting network A PO = is the reference sound pressure (PO = 20 µPa). A-weighted sound pressure level is expressed in decibels dBA Note: For clarity in this study LpA shall equal LAeq,T
dBA	The decibel is the unit used to measure sound pressure levels. The human ear does not perceive all sound pressures equally at all frequencies. The "A" weighted scale adjusts the measurement to approximate a human ear response.
DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment

Equivalent continuous day/night rating level (LR,dn)	Equivalent continuous A-weighted sound pressure level (LAeq,T) during a reference time interval of 24 h, plus specified adjustments for tonal character, impulsiveness of the sound and the time of day; and derived from the following equation: $L_{R,dn} = 10\text{Log}\left[\left(\frac{d}{24}\right)10^{L_{Req,d}/10} + \left(\frac{24-d}{24}\right)10^{L_{Req,n+k_n}/10}\right]\text{dB}$ Where: LR,dn is the equivalent continuous day/night rating level; d is the number of daytime hours; LReq,d is the rating level for daytime; LReq,n is the rating level for night-time; Kn is the adjustment of 10 dB added to the night-time rating level.
High-energy impulsive sound	Sound from one of the following categories of sound sources: quarry and mining explosions, sonic booms, demolition and industrial processes that use high explosives, explosive industrial circuit breakers, military ordnance (e.g. armour, artillery, mortar fire, bombs, explosive ignition of rockets and missiles), or any other explosive source where the equivalent mass of TNT exceeds 25 g, or a sound with comparable characteristics and degree of intrusiveness
Highly impulsive sound	sound from one of the following categories of sound sources: small arms fire, metal hammering, wood hammering, drop-hammer pile driver, drop forging, pneumatic hammering, pavement breaking, or metal impacts of rail yard shunting operations, or sound with comparable characteristics and degree of intrusiveness
Impulsive sound	Sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the residual noise
Low frequency noise	Sound which predominantly contains sound energy at frequencies below 100 Hz
Reference time interval	Representative duration of time periods that are regarded as typical for sound exposure of the community within a period of 24 h: – Daytime: 06:00 to 22:00 – Night-time: 22:00 to 06:00
Residual noise	Totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far, excluding the noise under investigation

Specific noise	Component of the ambient noise which can be specifically identified by acoustical means and which may be associated with a specific source Note: Complaints about noise usually arise as a result of one or more specific noises.
Sound Reduction Index (R_w)	The measured quantity which characterises the sound insulating properties of a material or building element.

EXECUTIVE SUMMARY

Safetech was appointed to conduct a noise specialist study as part of the Environmental Impact Assessment for the desalination project proposed by Umgeni Water at Tongaat in Kwa-Zulu Natal.

Baseline monitoring of the ambient noise levels at and adjacent to the proposed sites was conducted. The results show that current noise levels are in the order of 40 - 60 dB(A) during the day and during the night at the site. Noise levels at the proposed site are heavily influenced by passing trucks and cars, sea noise and human interaction.

The impact of noise generated by the proposed pump station and desalination plant will be affected by the direction of the wind and the state of the sea, which will increase or decrease the ambient noise levels. The traffic noise on the N2 is also a large contributor to the noise levels in the area.

Results of the study showed that residents are not anticipated to be impacted by noise generated at either the main plant or the pump station during the operational phase. Long term noise impact from the plant during the operation phase will be concentrated in the immediate area around the facility (i.e. 45 dBA would be reached within a maximum of approximately 50 metres from the site boundary).

However, there may be some noise impact in the immediate area surrounding the proposed desalination plant and the proposed potable water pipeline/powerline routes during the construction phase, as the ambient noise levels will be exceeded. It must be noted that noise impacts associated with the construction of the potable water pipeline/powerline will be of very short term and will decrease as the line progresses away from the receptor. Blasting and drilling impact during the construction of marine pipelines will be difficult to mitigate.

The conclusion is that the Tongaat Desalination Plant noise impact on receptors is predicted to be of **low to very low significance** during the construction and operational phases respectively, provided the recommendations for mitigating noise impacts are applied effectively.

Recommendations are provided to mitigate the potential noise impacts. These include construction and operational management techniques to minimise impact as well as physical design considerations.

The following noise reduction techniques should be considered as <u>inherent</u> to the project design:

- Ensuring building walls are at least 200mm thick with an Rw55-60
- Acoustic attenuation devices should be installed on all ventilation outlets;
- No noisy plant and equipment is to be contained in buildings that have been cladded in thin sheeting (such as corrugated metal or cement fibre sheets).

The following noise reduction techniques should be considered as <u>additional</u> key mitigation measures:

<u>Design Phase</u>

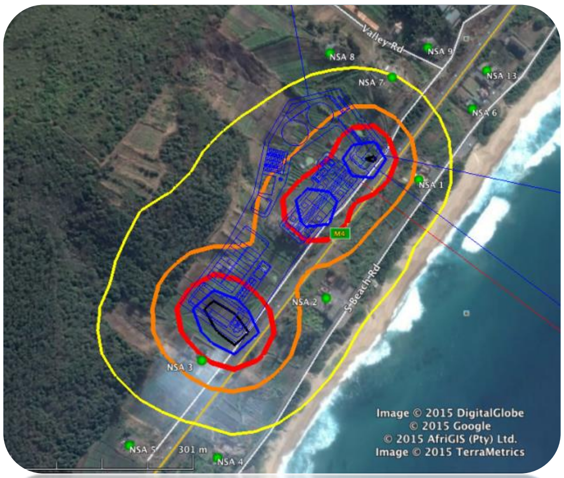
- Selecting equipment with lower sound power levels;
- Installing silencers on fans;
- Installing suitable mufflers on exhausts and compressor components.

- Installing acoustic enclosures for equipment to stop noise at source;
- Improving the acoustic performance of buildings by applying sound insulation where possible;
- Installing vibration isolation products for mechanical equipment.
- High pressure gas or liquid should not be ventilated directly to the atmosphere, but through an attenuation chamber or device.

<u>Construction Phase</u>

- All construction operations should only occur during daylight hours if possible;
- No construction blasting should occur at night. Blasting should only occur during the hottest part of the day to take advantage of unstable atmospheric conditions; and
- Blasting should only occur if there are no signs of birds feeding in the immediate vicinity (e.g. flocks of gulls out to the sea) or marine mammals present if blasting is conducted at sea.

It is not possible to eliminate all low frequency noise during the construction phase, but it should be noted that there are already existing sources of low frequency noise sources (e.g. traffic, sea noise etc.) in the area. The potential low frequency noise from the project is therefore not anticipated to be of significance.



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CHAPTER 9: NOISE IMPACT ASSESSMENT

This chapter presents the noise specialist study undertaken by Brett Williams of Safetech as part of the Environmental Impact Assessment for the proposed 150 Ml Seawater Reverse Osmosis Plant and associated infrastructure in Tongaat, KwaZulu Natal.

9.1 INTRODUCTION

9.1.1 SCOPE OF WORK AND TERMS OF REFERENCES

The overall objective of this assessment is to provide a comprehensive and detailed Noise Impact Assessment that presents and evaluates potential noise impact associated with the proposed project. The scope of work of the noise study includes the following:

- Conduct a desktop study of available information that can support and inform the specialist noise study;
- A description of the current environmental conditions from a noise perspective in sufficient detail so that there is a baseline description/status quo against which impacts can be identified and measured i.e. sensitive noise receptors.
- The measurement and description of the present ambient noise levels at the proposed development site, during both the day and night time. This will be quantified by collecting noise measurement samples, in line with relevant specifications and regulations, at representative points and times during a typical weekday and weekend. Noise measurements will be collected with the use of a noise meter. Measure the existing ambient noise at the proposed site;
- Identify the components of the project that could generate significant noise levels;
- Identify the sensitive noise receptors in the vicinity of the proposed project. These include the receptors within 1km of the site boundary (external to the site);
- Prediction of the future ambient noise levels due to the noise emissions during the construction and operation of the proposed project (and alternatives). This will be carried out by developing a detailed model, in line with relevant specifications and regulations, of the noise emissions during both the construction and operational phases. Where possible, measurements of noise for similar activities/operations will be undertaken and used as proxy inputs in the model.
- Identify issues and potential impacts, as well as possible cumulative impacts related to the noise aspects of the project; and
- Identify management and mitigation actions to enhance positive impacts and avoid/reduce negative impacts respectively.
- List and describe any applicable legislation, policies and guidelines, in preventing a disturbing noise/nuisance from occurring, e.g. SANS standards for industrial and residential/rural areas (as applicable), especially from key sources of noise.
- Provide guidelines to be incorporated into the design of the facility to attenuate the nosie impacts.

9.1.2 Study Approach

The methodology used in the study consisted of two approaches to determine the noise impact from the proposed plant and associated infrastructures:

- A desktop study to model the likely noise emissions from the plant; and
- Field measurements of the existing ambient noise at three locations in the vicinity of the proposed plant locations and at the shoreline.

Desktop study methodology

The desktop study was done using the available literature on noise impacts as well as numerical calculations using the method described in SANS 10357:2004 version 2.1 (The calculation of sound propagation by the Concawe method). The numerical results were then used to produce a noise map that visually indicates the extent of the noise emissions from the site. The sound emissions were modelled at the main plant and the pump station.

The worst case weather conditions were used in the study, namely, a temperature of 10°C and 100% humidity and zero wind speed with no wind masking effect. The weather data thus indicates very stable conditions which have little noise attenuation effects.

Field Study

A field study and specialist workshop were conducted in Durban on the 23rd and 24th February 2015 and further field trip on the 19th March 2015 during which noise levels were measured at a number of sensitive areas which were chosen based on their proximity to the desalination plant and pump station. These points are referred to as Noise Sensitive Areas (NSA).

A number of measurements were taken by placing the noise meter on a tripod and ensuring that it was at least 1.2 m from floor level and 3.5 m from any large flat reflecting surface.
All measurement periods were taken over a period of more than 10 minutes, except where indicated. The noise meter was calibrated before and after the survey. At no time was the difference more than one decibel (dB) (Note: If the difference between measurements at the same point under same conditions is more than 1 decibel, then the meter is not properly calibrated). The weighting used was on the A scale and the meter placed on impulse correction, which is the preferred method as per Section 5 of SANS 10103:2008. No tonal correction was added to the data. A measurement was taken during the day and night-time. The meter was fitted with a windscreen, which is supplied by the manufacturer. The screen is designed so as to reduce wind noise around the microphone and not bias the measurements.

The test environment contained the following noise sources:

- Vehicular traffic.
- Birds.
- Waves breaking on the sea shore.
- Wind.
- Community noise such as people talking, laughing, music, dogs barking etc.

SANS 10210:2004 standard (Calculating and predicting road traffic noise) was not used in this assessment as the noise source being investigated, if complaints occur, originates from the desalination plant and not from the traffic.

The instrumentation that was used to conduct the study is as follows:

- Rion Precision Sound Level Meter (NL32) with one third Octave Band Analyzer, Serial No. 00151075
- Microphone (UC-53A) Serial No. 307806
- Preamplifier (NH-21) Serial No. 13814
- Garmin GPS III – Pilot.

All equipment was calibrated in November 2014 according to the South African National Accreditation System (SANAS) requirements.

9.1.3 Information Sources

The Information used in the noise impact assessment includes:

- The satellite images used in the report from Google earth.
- Site layout maps sourced from Aurecon
- Process information sourced from Aurecon.
- Building design philosophy sourced from Aurecon
- Information on similar plant sourced from an internet search on Google and Google Scholar.

9.1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to the noise impact assessment:

- The infrastructure layout for the preferred site was supplied by the client.
- The infrastructure construction impacts include all pipelines and additional electrical supply lines that may be needed. The construction noise for all infrastructure, regardless of the type, is similar in noise impact.
- The noise impacts of the pipelines and power line infrastructure was not modelled as the construction sites are not stationary. The noise impact is however estimated.
- The sound power levels for the operational equipment were not available from Aurecon as the exact equipment has not been specified yet. Information on similar equipment from previous studies was used in the modelling.
- It is assumed that mitigation measures inherent to the project design, as described in the project description, will be implemented regardless of additional mitigation measures recommended by this study (i.e. ratings for impact 'without additional mitigation' is assumed to already include mitigation measures inherent to the design). Mitigation measures pertaining to this specific field of study that is assumed to be inherent to the project design that were incorporated into the modelling include:
  - All buildings will be constructed out of solid walls of at least 200mm thickness.
  - The Pump Station equipment will be below ground level and the ventilation exit points will be fitted with sound attenuation devices.
  - All high pressure pumps will be installed in an enclosed building where sound attenuation properties have been considered for the walls, roofs and access doors.
  - All access doors are kept closed when not in use.

The above mitigation measures were confirmed telephonically by Aurecon.

9.2 PROJECT DESCRIPTION: (NOISE IMPACTS)

Umgeni Water is proposing to construct a seawater reverse osmosis desalination plant in the Tongaat area, KwaZulu-Natal, The plant will have various processes that generate noise that could impact on the receiving environment. The site is surrounded by sensitive receptors that were identified during a field study. The project description provided in Chapter 2 was used as the basis for the noise study. Some additional project information specific to the noise study, was provided by Aurecon, for example, on the types of vehicles and equipment to be used on site during construction (Table 9-4) and operations (Table 9-5)

9.2.1 Potential Noise Sources for the Construction Phase

The construction phase could generate noise during different activities such as:

- Site remediation and earthworks;
- Building construction using mobile equipment, cranes, concrete mixing and pile driving equipment;
- Vehicle use and movement;
- Temporary jetty construction for the laying of the intake and discharge pipelines. Activities might include pile driving, drilling and blasting; and
- Construction of a power line and potable water pipelines.

The number and frequency of use of the various types of vehicles and equipment has been estimated and is presented in Table 9.1 below.

Table 9-1 - Types of vehicles and equipment to be used on site (Construction Phase)

TYPE	DESCRIPTION	NUMBER	FREQUENCY OF USE	TYPICAL SOUND POWER LEVEL (DB)
Bus	60 seater	5	Daily return trips to site	95
Passenger Vehicle	Passenger vehicle or light delivery vehicle such as bakkies	5	Daily return trips to site as well as delivery of materials	85
Trucks	10 tonne capacity	3	Daily return trips to site as well as delivery of materials	95
Cranes	Overhead and mobile	2	Operational on site 08:00 to 17:00	109
Mobile Construction Vehicles	Front end loaders	3	Operational on site 08:00 to 17:00	100
Mobile Construction Vehicles	Excavators	2	Operational on site 08:00 to 17:00	108
Mobile Construction Vehicles	Bulldozer	1	Operational on site 08:00 to 17:00	111
Mobile Construction Vehicles	Dump Truck	3	Operational on site 08:00 to 17:00	107

TYPE	DESCRIPTION	NUMBER	FREQUENCY OF USE	TYPICAL SOUND POWER LEVEL (DB)
Mobile Construction Vehicles	Grader	1	Operational on site 08:00 to 17:00	98
Mobile Construction Vehicles	Water Tanker	2	Operational on site 08:00 to 17:00	95
Stationary Construction Equipment	Concrete mixers	1	Operational on site 08:00 to 17:00	110
Compressor	Air compressor	1	Operational on site 08:00 to 17:00	100
Compactor	Vibratory compactor	1	Operational on site 08:00 to 17:00	110
Pile Driver	Piling machine (mobile)	1	Operational on site 08:00 to 17:00	115

Source: GCDA 2006

Blasting will be undertaken during the construction of the seawater feed and brine discharge pipelines (tunnels). This could change once the exact site conditions are determined. During blasting atmospheric instantaneous levels up to 125 dB can be expected.

Dredging and drilling may produce low frequency noise emissions under water that can travel over considerable distances underwater. Under water construction machinery emits sound waves mainly in the low frequency range. Dredging systems typically emit sound waves in the frequency range between 20 Hz and 1 kHz with sound levels of 150 to 180 dB. The reference pressure (i.e. corresponding to 0 dB) for under water sound is 1 micro Pascal (µPa) whereas in air it is 20 µPa (UNEP 2008).

9.2.2 Potential noise sources for the Operational Phase

The nature of the desalination process involves the need to provide high raw water pressures to produce potable water. The main noise sources will be the high pressure pumps and energy recovery turbines to achieve this. The operational phase could typically generate noise from the following sources:

- The reverse osmosis plant with the high pressure pumps and energy recovery systems.
- The dissolved air and flotation plant.
- The effluent treatment plant.
- The treated water pump station.

9.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT: (NOISE IMPACTS)

The proposed site is set in a suburban area with residential units all around the site. The site is situated on a flat portion of land that is approximately 170m from the coastline. There is a valley to the north and steep hills to the east. The M4 is situated in front of the site and the N2 to the west. The predominant noise at the site is the sea noise as well as vegetation noise when the wind is blowing.

9.3.1 Sensitive Receptors

The main noise-sensitive receptors potentially affected by noise pollution associated with the proposed project are human receptors, marine animals as well as terrestrial animals. Four community ambient noise monitoring points were chosen based on their proximity to the desalination plant and pump station. A number of other NSA's were identified to include in the modelling as being representative of the surrounding communities. The coordinates of the identified NSA's are presented in Table 9-2 below and the locations of the various receptors are indicated in Figures 9.1 – 9.2.

Table 9-2 - Location of Noise Sensitive Areas around Main Plant

NSA	Description	Longitude	Latitude	Field Test Measured	Distance to Desalination plant (m) (1)	Distance to Desalination plant (m) (2)	Distance to proposed powerline route (m)	Distance to proposed pipeline route (m)	Type of District as per SANS 10103:2008
NSA 1	Private House	31°08'52.96"	29°37'25.35"	Yes	80	106	280	280	Sub-Urban
NSA 2	Private House (Seabelle Restaurant)	31°08'46.50"	29°37'32.70"	Yes	90	175	360	390	Sub-Urban
NSA 3	Private House	31°08'38.07"	29°37'36.44"	Yes	60	86	460	550	Rural
NSA 4	Private House	31°08'39.23"	29°37'42.21"	No	210	260	630	730	Sub-Urban
NSA 5	Private House	31°08'33.44"	29°37'41.41"	No	260	282	710	650	Rural
NSA 6	Private House	31°08'56.79"	29°37'20.85"	No	180	233	390	330	Sub-Urban
NSA 7	Private House	31°08'51.03"	29°37'18.95"	Yes	90	163	250	160	Rural
NSA 8	Private House	31°08'46.56"	29°37'17.46"	No	70	208	160	50	Rural
NSA 9	Private House	31°08'53.59"	29°37'17.07"	No	180	247	330	250	Sub-Urban
NSA 10	Private House	31°08'31.66"	29°37'13.10"	No	390	569	220	250	Sub-Urban
NSA 11	Private House (King Shaka Estate)	31°08'48.15"	29°37'09.66"	No	310	443	390	170	Sub-Urban
NSA 12	Multilevel accommodation	31°08'35.63"	29°37'45.93"	No	350	386	750	830	Sub-Urban
NSA 13	Private House	31°08'57.84"	29°37'18.40"	No	240	290	430	340	Sub-Urban

Note: All field measurement location co-ordinates are referenced to WGS84.

(1) The distances are the closest distance measured from the sensitive receptors to the noise source (i.e. site boundary at the Main Plant)

(2) Distances from the sensitive receptors to the main noise source at the plant (i.e. RO building)

Table 9-3 - Location of Noise Sensitive Areas around the proposed Potable Water Pipeline and Powerline routes

NSA	Description	Longitude	Latitude	Distance to proposed powerline route (m)	Distance to proposed pipeline route (m)	Type of District as per SANS 10103:2008
NSA - CP1	Private House	31°08'36.33"	29°36'59.71"	600	40	Sub-Urban
NSA - CP2	Private House	31°08'52.00"	29°35'27.00"	3 420	410	Rural
NSA - CP3	Private House	31°08'03.92"	29°37'19.50"	90	410	Rural
NSA - CP4	Private House	31°07'19.87"	29°38'15.33"	320	340	Sub-Urban
NSA - CP5	Private House	31°07'06.73"	29°38'20.27"	220	220	Rural
NSA - CP6	Private House	31°06'21.81"	29°39'00.04"	290	70	Rural
NSA - CP7	Private House	31°05'38.87"	29°40'04.65"	2 220	60	Rural
NSA - CP8	Private House	31°04'39.94"	29°39'44.24"	2 420	150	Sub-Urban
NSA - CP9	Private House	31°04'13.85"	29°39'50.88"	3 090	130	Sub-Urban
NSA - CP10	Private House	31°05'52.69"	29°39'04.33"	360	780	Rural
NSA - CP11	Private House	31°05'25.22"	29°38'56.04"	500	1 560	Rural

Note: All field measurement location co-ordinates are referenced to WGS84. The distances are the closes distance measured from the sensitive receptors to the noise source (i.e. pipeline/powerline route).

Figure 9-1 - Map of the proposed facility (including all associated infrastructure)

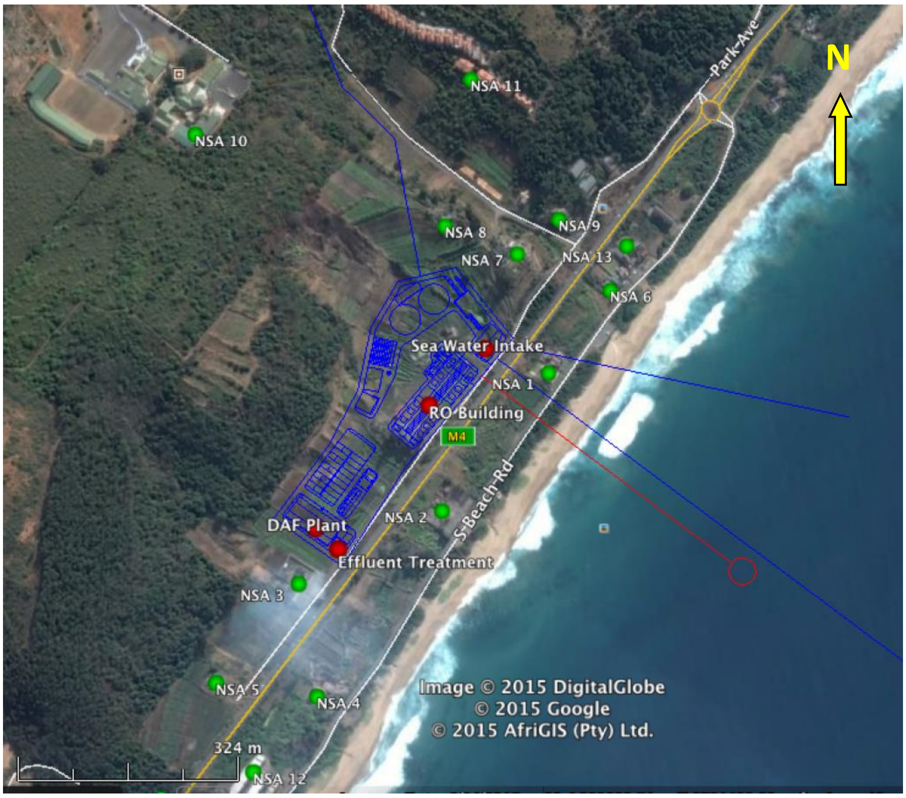

Figure 9-2 - Map of the proposed facility showing noise sensitive receptors

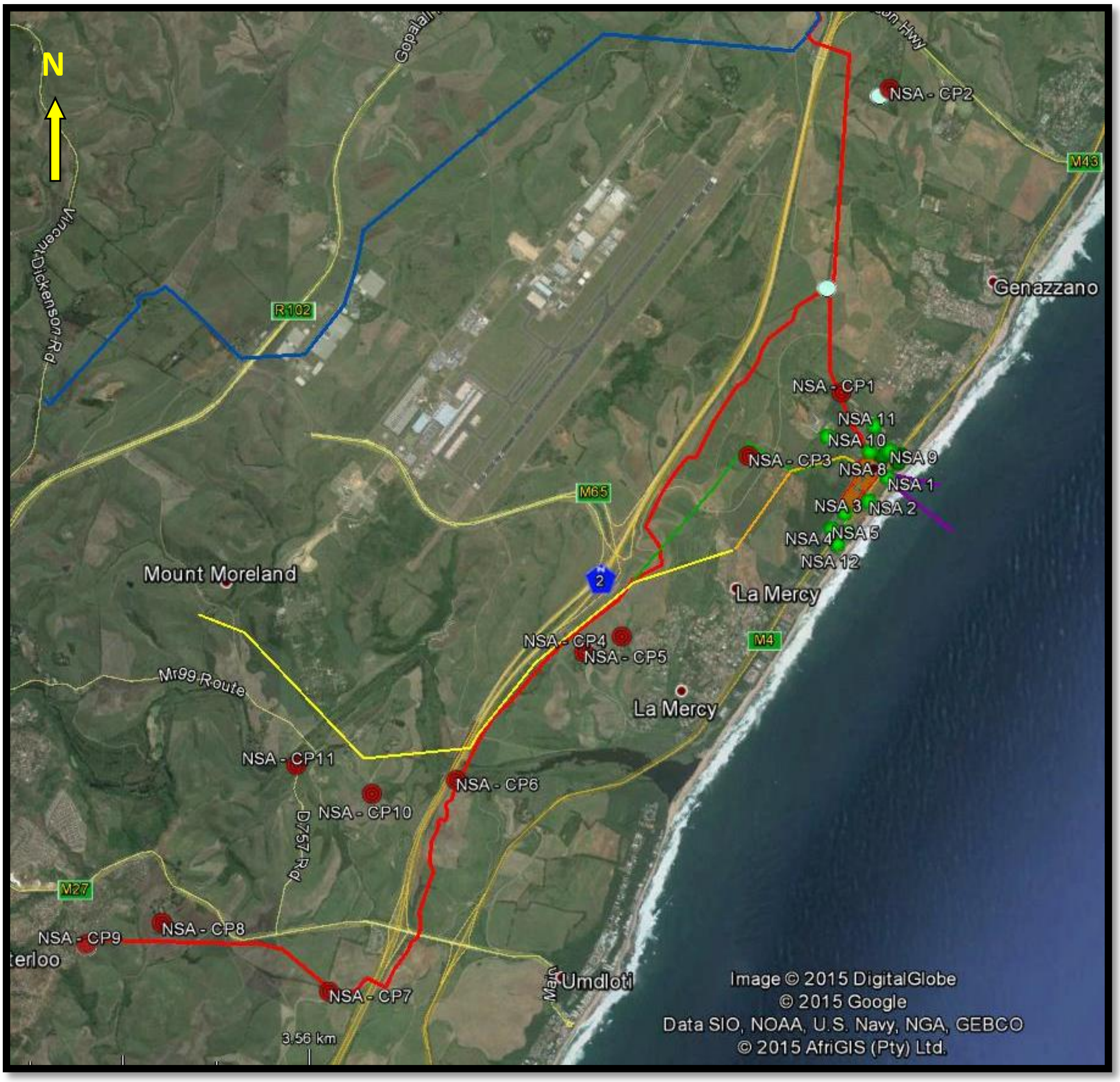

Figure 9-3 - Map of the proposed pipeline (red) and powerline (yellow (Proposed route) and green (Alternative 1 route)) showing noise sensitive receptors

Disturbance to the Lake Victoria wetlands and associated fauna and flora associated with the proposed powerline crossing would result in a fatal flaw from an aquatic ecology perspective. The freshwater specialist study (Chapter 8) has therefore recommended an alternative route to avoid Lake Victoria (Figure 9-4 - Alternative 2).

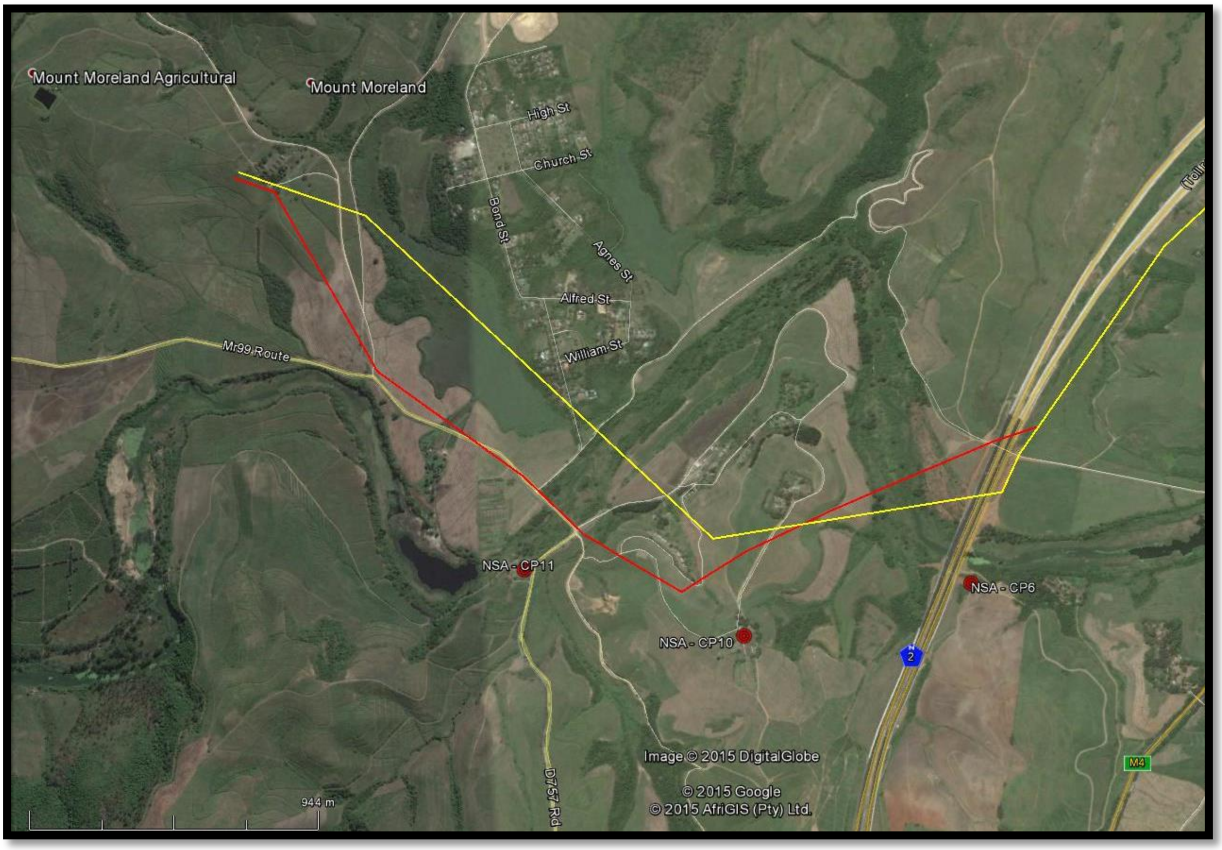

Figure 9-3: Aerial image indicating proposed powerline routes to be constructed to serve the desalination plant (Yellow: Proposed powerline route, Red: Alternative 2).

9.3.2 Results of Field Study

The ambient noise was measured at four locations for at least 10 minutes at each point as described above in Section 9.3. The results thereof are presented in Table 9.3.

Table 9-4 – Noise measurements during Field Study

Location		Start Time	$L_{Req.T}$ dB(A)	Exceeding typical rating levels for noise	Comments
NSA 1	Sub-Urban	09:10	56.8	Yes	Sea noise, 5 cars on M4
NSA 2	Sub-Urban	09:30	58.9	Yes	Sea noise, 7 cars on M4
NSA 3	Rural	10:05	62.5	Yes	Sea noise, 6 cars, 2 trucks on M4
NSA 7	Rural	10:45	55.4	Yes	Sea noise, 4 cars on M4
NSA 1	Sub-Urban	22:05	46.0	Yes	Sea noise, 1 cars on M4
NSA 2	Sub-Urban	22:35	45.1	Yes	Sea noise, 0 cars on M4
NSA 3	Rural	22:55	47.2	Yes	Sea noise, 1 cars on M4
NSA 7	Rural	23:20	41.8	Yes	Sea noise, 0 cars on M4

9.4 APPLICABLE LEGISLATION

The environmental legal requirements for this project are summarised in Chapter 3, which indicates that environmental legislation places an onus on the developer to ensure that the environment is not affected negatively by the development. The eThekwini Municipality has no noise control by-laws.
The following standards have been used to aid this study and guide the decision making process with regards noise pollution:

- South Africa - GNR.154 of January 1992: Noise control regulations in terms of section 25 of the Environment Conservation Act (ECA), 1989 (Act No. 73 of 1989);
- South Africa - GNR.155 of 10 January 1992: Application of noise control regulations made under section 25 of the Environment Conservation Act, 1989 (Act No. 73 of 1989);
- South Africa - SANS 10103:2008 Version 6 - The measurement and rating of environmental noise with respect to annoyance and to speech communication;
- South Africa - SANS 10357:2004 Version 2.1 - The calculation of sound propagation by the Concawe method);
- United Nations Environment Programme - 2008 Desalination Resource and Guidance Manual for Environmental Impact Assessments; and
- International Finance Corporation – 2007 General EHS Guidelines: Environmental Noise.

SANS 10103:2008 provides typical rating levels for noise in various types of districts, as described in Table 9-4 below.

Table 9-5 - Typical rating levels for noise in various types of districts

Type of District	Equivalent Continuous Rating Level, LReq.T for Noise					
	Outdoors (dB(A))			Indoors, with open windows (dB(A))		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
Rural Districts	45	45	35	35	35	25
Suburban districts with little road traffic	50	50	40	40	40	30
Urban districts	55	55	45	45	45	35
Urban districts with one or more of the following: Workshops; business premises and main roads	60	60	50	50	50	40
Central business districts	65	65	55	55	55	45
Industrial districts	70	70	60	60	60	50

The rating levels above indicate that in suburban districts the ambient noise should not exceed 40 dB(A) at night and 50 dB(A) during the day. The noise sensitive areas to the west of the proposed desalination plant are viewed as being situated in a rural area. The rating levels above indicate that in rural districts the ambient noise should not exceed 35 dB(A) at night and 45 dB(A) during the day.

These levels can thus be seen as the target levels for any noise emissions from a desalination plant. As can be seen from the ambient monitoring results (Table 9-3), the influence of the sea results in the ambient noise exceeding the recommended rating levels in Table 9-4 above for suburban districts.

Furthermore the South African noise control regulations describe a disturbing noise as any noise that exceeds the ambient noise by more than 7dB. This difference is usually measured at the complainants location should a noise complaint arise. There are no legal permits or licenses required that are related to noise emissions.

9.5 IDENTIFICATION OF KEY ISSUES AND POTENTIAL IMPACTS

9.5.1 Key Issues Identified During the Scoping Phase

The key issues associated with the construction and operation of the Umgeni Water Desalination Plant at Tongaat will include the following:

- Current noise profile for the proposed desalination plant site, by day and night;
- Noise impact during construction and operation of the plant and associated infrastructure, by day and night;
- Extent of noise impacts for different frequencies, in particular low frequency vibrations;
- Location of local sensitive human receptors (e.g. closest residential areas); and
- Potential noise impacts on fauna and avifauna.

9.5.2 Key Issues Identified During Public Consultation

The key issues regarding noise impact identified during the public commenting periods include the following:

- Noise generated by the proposed seawater reverse osmosis plant, in particular because of the use of high pressure pumps
- Concern over the noise/droning effect in the residential area (Is there plans for acoustic ceilings to drown out the noise from the pumps etc.)?
- Noise impacts are to be adequately mitigated to comply with SANS 10103-2008 and other relevant Noise Control Regulations and Guidelines. Furthermore, the terms of reference for the noise study must also include possible vibration impacts which may arise from the proposed development.
- With the opening of the King Shaka Airport, it is possible that the proposed development may be impacted by aircraft noise. The applicant/developer must investigate whether the proposed development will fall within the noise sensitive contour/s and appropriate remedial/mitigatory measures must be implemented in this regard.
- Noise pollution was defined as audible and low frequency sound. There are several decided cases and scientific research that concludes that often low frequency sound over a long period can cause more damage to the average human than high frequency sounds.

9.5.3 Identification of Potential Impacts

9.5.3.1 Construction Phase

- Impact on the immediate surrounding environment from the construction activities, especially the pile driving if this is required.
- Impacts of blasting activities on the fauna in the immediate vicinity of the blast area.

9.5.3.2 Operational Phase

- Impact on the immediate surrounding environment due to noise from the operation of the Desalination Plant, in particular noise from the high pressure pumps and energy recovery turbines.

9.5.4 Predicted Noise Levels for the Construction Phase

The construction noise at a similar desalination plant (Wlotzkasbaken in Namibia) was measured by the author in 2010. These readings can be used as a reference for this study. The results are presented in Table 9-6 below.

Table 9-6 - Example of Construction Equipment Noise Emissions

Noise Source	$L_{Req.T}$ dB(A)
CAT 320D Excavator measured at approximately 50 m.	67.9
Mobile crane on jetty measured at approximately 70 m	69.6
Drilling rig / Pile Driver on jetty measured at approximately 70 m	72.6

Table 9-7 - Frequency Analysis Construction Equipment (dB)

Frequency (Hertz)	CAT 320D Excavator	Mobile Crane on Jetty	Drilling Rig on Jetty
12.5	22.6	9	12.6
16	23.4	8	18.3
20	22.6	11.8	19
25	23	26.5	18
31.5	23.6	23.5	27.5
40	25.6	27.5	30.5
50	33.9	43.3	34.1
63	30	44.1	34.3
80	37.8	58.8	58
100	49.6	45.1	56.6
125	34.7	50.5	49.6
160	39.7	52.1	55.3
200	43.7	52.7	59.7
250	50.7	51.5	56.5
315	50.4	54.5	55.4
400	42.9	57.7	56.8
500	46	54.4	57.9
630	46.6	51.5	54.3
800	47.2	52.1	60.2
1000	47.6	51.7	57.2
1250	48.9	52.1	57.7

Frequency (Hertz)	CAT 320D Excavator	Mobile Crane on Jetty	Drilling Rig on Jetty
1600	47.5	50.3	58.7
2000	47	51.1	57.5
2500	50.1	53.2	65.1
3150	46.4	49.9	64.8
4000	46.8	49	61.9
5000	44.7	47	58.1
6300	39.6	43.3	52.8
8000	35.8	38.7	48.8
10000	33	34.3	40.8
12500	27.7	26.9	31.9
16000	24.7	18.2	21.4

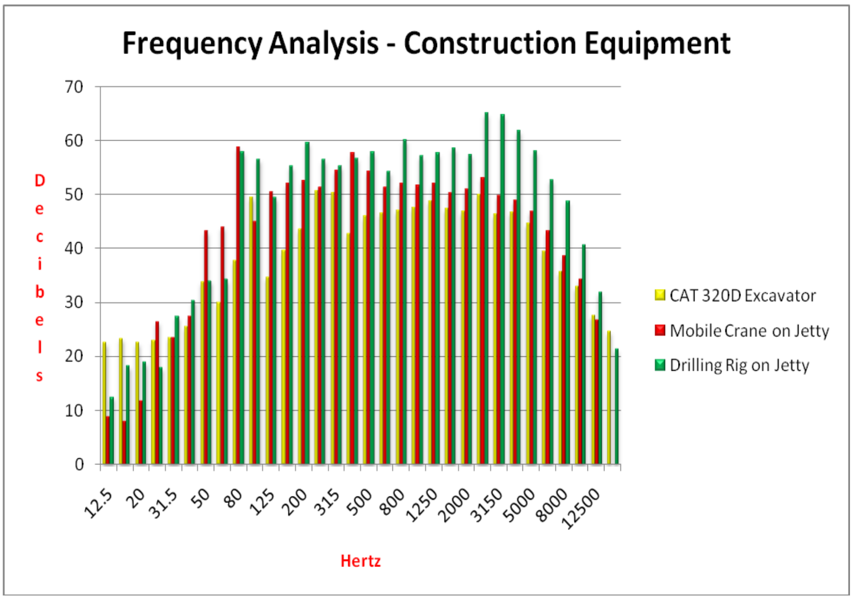

Figure 9-4 – Frequency Analysis for a selection of construction equipment

Table 9-7 and Figure 9-3 above shows that the construction equipment noise is distributed with higher values at the higher frequencies. The operation of the equipment therefore is not expected to create any long-term low frequency effects as raised in the public participation process. Based on Tables 9-1, 9-6 and 9-7, the expected noise associated with the construction of the proposed site can be extrapolated. As an example, if a number of pieces of equipment are used simultaneously, the noise levels can be added logarithmically (Tables 9-8 and 9-9) and then calculated at various distances from the site (i.e. attenuation by distance) to determine the distance at which the ambient level will be reached.

Table 9-8 - Combining Different Construction Noise Sources – High Impact

Description	Typical Sound Power Level (dB)
Overhead and mobile	109
Front end loaders	100
Excavators	108
Bull Dozer	111
Piling machine (mobile)	115
Total	117.7

Table 9-9 - Combining Different Construction Noise Sources – Low Impact

Description	Typical Sound Power Level (dB)
Front end loaders	100
Excavators	108
Truck	95
Total	111.8

Noise will also be attenuated by topography and atmospheric conditions such as temperature, humidity, wind speed and direction, but these were not considered in this calculation. Therefore, the distance calculated below would be representative of the maximum distance to reach ambient noise levels.

Table 9.10 below gives an illustration of attenuation by distance for a noise of 117dB and 111dB (Sound Power) Levels measured at the source. This is the worst case scenario if all the construction machines were operating at the same time).

Table 9-10 - Attenuation by Distance for the construction phase (worst case)

Distance from noise source (metres)	**Typical Machinery Sound Pressure dB(A)**	**Heavy Machinery Sound Pressure dB(A)**
10	83	89
20	77	83
40	71	77
80	65	71
160	58	64
320	51	57
640	44	50

9.5.5 Predicted noise levels for the Operational Phase

The likely extent of the operational noise pollution was modelled according to the Concawe method (with the lowest frequency used being 63 Hertz). Low frequency noise below 20 Hertz, potentially generated by on site machinery, is therefore not considered as part of this modelling. These, however, should not be overlooked. The effects of low frequency noise include sleep disturbance, nausea, vertigo etc. These effects are unlikely to affect residents due to the distance between the plant and the nearest communities. Sources of low frequency noise also include wind, sea noise and vehicular traffic, which are all current noise sources.

The sound power levels that were chosen for the model were taken from a study conducted for the Australian Water Corporation - Southern Seawater Desalination Plant. The general sound power level used at each of these processes is presented in Table 9-10 below. The results of the modelling are presented in Table 9-12 and Figure 9-4 below.

Table 9-11 - Sound Power Levels used for Operational Phase Modelling

Frequency (Hertz)	63	125	250	500	1000	2000	4000
Sound Power (dB)	91	90	87	89	87	85	79

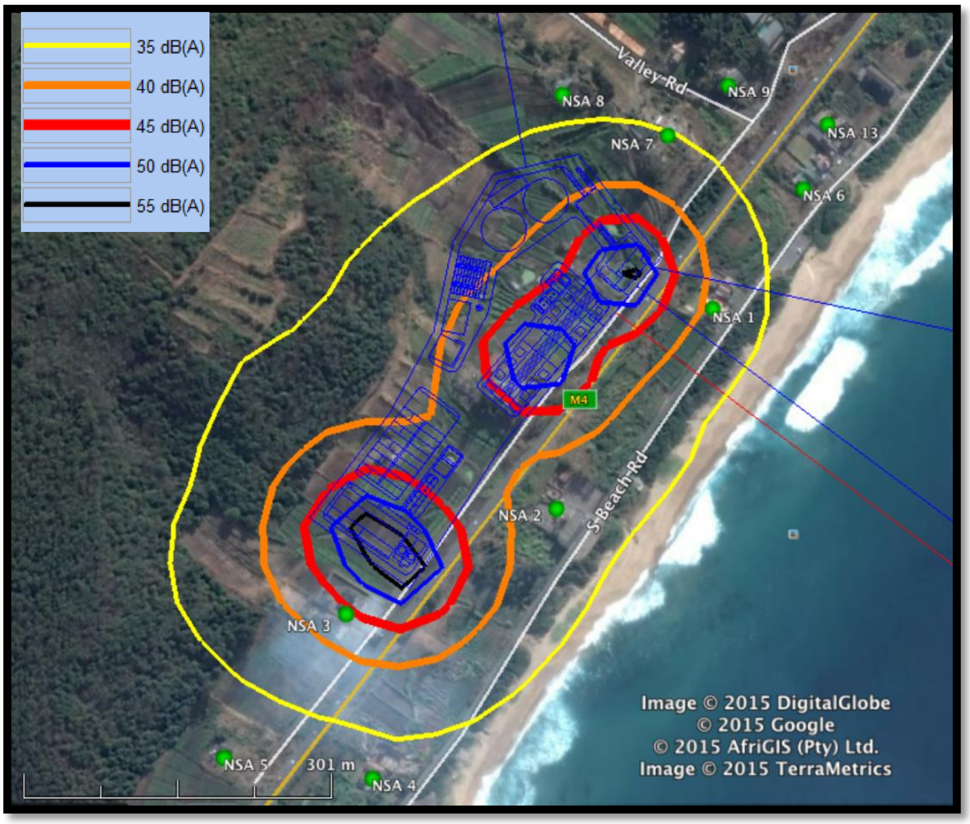

Figure 9-5 - Operational Phase – Main Plant Noise Impact

Table 9-12 - Operational Phase Modelling Results

NSA	Longitude	Latitude	Noise from Plant and Pump Station under no wind conditions dB(A)	Night Noise Rating Limit as per SANS 10103:2008	Day Noise Rating Limit as per SANS 10103:2008	Type of District as per SANS 10103:2008
NSA 1	31°08'52.96"	29°37'25.35"	38.8	40	50	Sub-Urban
NSA 2	31°08'46.50"	29°37'32.70"	37.4	40	50	Sub-Urban
NSA 3	31°08'38.07"	29°37'36.44"	43.8	35	45	Rural
NSA 4	31°08'39.23"	29°37'42.21"	33.1	40	50	Sub-Urban
NSA 5	31°08'33.44"	29°37'41.41"	32.0	35	45	Rural
NSA 6	31°08'56.79"	29°37'20.85"	32.2	40	50	Sub-Urban
NSA 7	31°08'51.03"	29°37'18.95"	35.3	35	45	Rural
NSA 8	31°08'46.56"	29°37'17.46"	33.6	35	45	Rural
NSA 9	31°08'53.59"	29°37'17.07"	31.9	40	50	Sub-Urban
NSA 10	31°08'31.66"	29°37'13.10"	26.1	40	50	Sub-Urban
NSA 11	31°08'48.15"	29°37'09.66"	27.6	40	50	Sub-Urban
NSA 12	31°08'35.63"	29°37'45.93"	29.3	40	50	Sub-Urban
NSA 13	31°08'57.84"	29°37'18.40"	30.2	40	50	Sub-Urban

9.6 Assessment of impacts and identification of management actions

9.6.1 Construction Phase

All the equipment used to construct the plant will generate noise. The noise impact is dependent on the following factors:

- The age and service state of the equipment.
- The time of day and duration the equipment is used for.
- The type of equipment.
- The level of operator expertise.

Given that it is not anticipated that piling activities would be undertaken at the same time as other construction activities and that all equipment would be used simultaneously, the following discussion is based on results when using typical machinery (i.e. excluding piling operations) – Table 9-10 (1st column).

It can be seen from the modelling results (Table 9-10) that, based on similar noise characteristics, construction noise will reach levels of 50 dB(A) and 40 dB(A) (i.e. typical rating levels for noise during the day and night in sub-urban areas, as defined by SANS 10103:2008 guideline) at approximately 350 metres and 800 m from the source respectively. Furthermore, the South African noise control regulations define a disturbing noise as a noise exceeding the ambient noise level by more than 7 dB. Given that the current ambient noise level in the areas monitored as part of this study already exceeds the typical noise rating levels, it is reasonable to assume that predicted noise levels exceeding 57 dB(A) during the day and 47 dB(A) at night may constitute a disturbing noise unless these are not exceeding ambient noise levels by more than 7 dB(A).

Construction noise levels would reach 57 dB(A) at about 170 m from the source and 47 dB(A) at approximately 500 m. Therefore, only receptors in very close proximity to the preferred site for the proposed desalination plant (up to 170 m) will be affected by the construction noise during the day. On the other hand, receptors up to 500 m could be affected by construction noise at night - this would include all sensitive receptors in the vicinity of the proposed desalination plant.

Similarly, in rural areas construction noise will reach levels of 45 dBA (i.e. typical rating levels for noise during the day – refer to Table 9-4) at approximately 580 metres from the source, in all directions; and 35 dB(A) at approximately 1 200 m from the noise source (rating level for noise at night). Applying the same approach as above, it is assumed that predicted noise levels exceeding 52 dB(A) during the day and 42 dB(A) at night may constitute a disturbing noise unless these are not exceeding ambient noise levels by more than 7 dB(A). Such levels would be reached at approximately 280 m (52 dB(A)) and 750 m (42 dB(A)) from the noise source.

9.6.1.1 Desalination plant and marine pipelines

The closest receptors to the plant, located within 170 m from the proposed plant, are private houses (NSAs 1, 2, 3, 7 and 8) which are all situated less than 100 m of the proposed desalination site. Ambient noise levels at these sensitive receptors areas have been measure between 55.4 and 62.5 dB(A) in the day and between 41.8 and 47.2 dB(A) at night. The predicted noise levels at these distances have been calculated to be range between 57 and 62 dB (A). These receptors could therefore be affected by noise associated with construction activities at the plant. It must however be noted that during the day, construction noise at these receptors areas would not be considered as a "disturbing noise" as predicted construction noise would not exceed current ambient noise by more than 7dB. It would nevertheless be a disturbing noise for these receptors should construction be carried out during the night as ambient noise level in this area has been measured at between 41.8 and 47.2 dB(A) at night, i.e. predicted noise level would exceed current ambient noise level at night by more than 7dB(A).

NSA5 is located approximately 260 m from the proposed desalination site boundary and is classified as a rural area. The predicted noise level in this area during construction is approximately 53 dB(A) and ambient noise levels range between 62.5 dB(A) during the day and 47.2 dB(A) at night (assuming noise levels are similar to those at NSA3). Construction noise at these receptors areas would not be considered as a "disturbing noise" as predicted construction noise would not exceed current ambient noise by more than 7dB.

King Shaka Estate (NSA 11) is located approximately 310 m from the proposed site boundary and is classified as a sub-urban area. Predicted noise level in this area during construction is approximately 51.4 dB(A) which exceeds typical rating levels of 50 dB(A) and 40 dB(A) for noise during the day and night in sub-urban areas. These receptors may therefore be affected by the construction noise. Note that if current ambient noise level are, as expected, above 45 dB(A), then construction noise will not be considered as a disturbing noise.

As mentioned in Section 8.2.1, during blasting, instantaneous atmospheric levels can reach 125 dB. The noise level generated by the blasting will be similar to ambient noise level at approximately 3.5 to 4 km from the source. It is anticipated that impacts associated with noise during blasting are not significant given the occasional and short duration of the blasting noise.

Blasting activities will most likely have an effect on fauna in the immediate vicinity of the blast area – this has been covered by the marine ecology specialist study (Chapter 6).

The effect of the construction noise on the fauna surrounding the site is not predicted to be significant either as it will be of short duration, local and low-medium intensity.

Given the above, impacts associated with noise generated during construction activities at desalination plant area are anticipated to be of low-medium intensity during the day and high intensity at night for all sensitive receptors areas identified in this study, although local and of temporary nature. These impacts are therefore predicted to be of **low** to **medium** significance before mitigation.

9.6.1.2 Potable water pipelines and Power Lines

Construction noise along the corridors for the potable water and powerlines will be transient in nature as the lines progress. The chosen corridors for both the power line and potable water lines run parallel to the N2 for most of the distance. The construction noise characteristics for both the potable water line and powerline are the same as similar equipment is used. Construction of the powerline may therefore affect sensitive receptors within 350 m from the proposed route in sub-urban areas (e.g. NSA-CP4, 3, NSAs 1, 3, 7, 8, 9, 10) and within 580 m within rural areas (e.g. NSA-CP5, 6, 10 and 11) as predicted noise levels at these receptors would range between 47 and 55 dB(A) which would exceed typical rating for noise levels during the day and at night.

All receptors within rural areas along the proposed potable water pipeline, except NSA-CP10 and 11 and NSA 5, are within 580 m from the proposed route and may therefore be impacted by construction noise as predicted noise levels (ranging from 47 to 67 dB(A)) are exceeding typical rating for noise levels in rural areas during the day and night. NSA-CP10 is located approximately 780m from the proposed pipeline route and may therefore also be affected by construction noise at night.

NSA-CP4, 8 and 9 and NSAs 1, 6, 9, 10, 11, 13 are located in a sub-urban area and may be affected by noise generated during construction of the potable water pipeline during day and night as predicted noise levels would exceed typical rating for noise in sub-urban areas (i.e. 50 dB(A) during the day and 40 dB(A) at night).

It must however be noted that the noise will be for very short duration and will diminish as the pipeline construction progresses away from the receptor. In addition, if current ambient noise levels already exceed the typical rating for noise, construction noise would only be considered a disturbance when the predicted noise levels exceed ambient noise by more than 7 dB.

Given the above, impacts associated with noise generated during construction activities along the proposed powerline and potable water pipeline route are anticipated to be of low-medium intensity for all sensitive receptors areas identified in this study, although local/regional and of temporary nature. These impacts are therefore predicted to be of **low** significance before mitigation.

9.6.1.3 Recommended mitigation measures

The following key mitigation actions will assist in reducing the noise impact during construction:

- Construction operations should only occur during daylight hours if possible;
- Ensuring that all operators of construction equipment receive proper training in the use of the equipment and that the equipment is serviced regularly.
- All blasting and piling driving, if required, should only occur during the day.
- All reverse noise emitting warning devices on mobile vehicles should be set as low as possible.
- An environmental noise monitoring survey should be conducted during the construction phase to assess the impact and recommend further actions if required.

In summary, for the construction phase it is unlikely that the construction noise will significantly impact on the noise sensitive areas. With the effective implementation of the above recommended mitigation measures, the residual noise impacts associated with construction activities are predicted to be of **very low** to **low** significance.

It is also recommended that the ambient noise around the project and at the closest residential areas be monitored twice during the construction phase.

9.6.2 Operational Phase

The operation of desalination plants is known to be source of noise pollution. The major noise sources from these plants are the following:

- High-pressure pumps used in the plants to overcome the resistance in membrane filters.
- Ventilation outlets that generate noise from moving air streams.
- Compressors and other pumps in open areas.

Results of the noise levels modelling (refer to Section 8.5.5) associated with the operational phase indicate that noise emissions from the main plant will exceed the suburban night limit of 40 db(A) at NSA 3. However, the current ambient noise is higher than this level (47.2 dB(A)) and it may therefore

provide a masking effect. The predicted noise levels associated with the operation of the proposed desalination plant are below current ambient noise levels for all noise sensitive areas assessed.
The effect of the operational noise on the fauna surrounding the site will not be significant as the noise emissions are mostly contained on the site.

A cumulative effect of the desalination plant and the aircraft noise traffic from the King Shaka International Airport is not anticipated as the plant noise is mostly contained on site if the mitigation factors inherent to the design are implemented. Similarly, vibration effects will be constrained to the equipment on site and no effects are anticipated beyond the buildings that house the equipment.

Given the above, impacts associated with noise generated during the operational phase are anticipated to be permanent and of low-medium intensity, although local. These impacts on the surrounding environment are therefore predicted to be of **low** significance before the implementation of key mitigation measures.

The following key mitigation actions will assist in reducing the noise impact during operation:

- All buildings should be designed to acoustically contain as much of the noise emissions as possible. This will include choosing equipment with the lowest noise emissions if a choice is available.
- Ensuring that all equipment that produces that has a high noise impact is placed inside buildings that have been designed to reduce noise emissions.
- All buildings containing high pressure pumps should be housed in buildings that have solid walls (at least 200mm thick) of at least a sound reduction index (Rw) of R_w55-60.
- All ventilation outlets are properly attenuated.
- All access doors to the high noise buildings are kept closed when not in use.
- During the commissioning phase an environmental noise survey is conducted to determine if the noise emissions on the site boundary are within the noise rating limits as described in SANS 1013:2008.

If generators are installed, the above mitigation measures (i.e. Soundproofing, rubber mounts on the generators, silencer on the exhausts) should apply to the buildings that the generators are housed in. If used, it will be for a very short period and therefore do not need to be modelled, providing the recommended management actions are effectively implemented.

With the effective implementation of the above key mitigation measures, the impacts associated with noise generated during the operational phase are anticipated to be of low significance.

9.6.3 Decommissioning Phase

The noise impacts during de-commissioning are the same as the impacts during construction.

9.6.4 Cumulative Impacts

There are no cumulative noise impacts for this study.

9.7 IMPACT ASSESSMENT SUMMARY

The impact of the noise pollution that can be expected from the site during the construction and operational phase will largely depend on the climatic conditions at the site and how the site infrastructure is designed to mitigate noise. An important consideration is that the noise energy reduces in the air by 6 decibels as the distance doubles. The results above indicate that there will be little impact on the identified noise sensitive areas if the proposed noise mitigation measures are implemented. The assessment of impacts and recommendation of mitigation measures as discussed above a collated in **Error! Reference source not found.**Tables 9-13 and 9-14 below.

Table 9-13 - Impact assessment summary table for the Construction Phase

Construction Phase										
Management actions inherent to the current project design: **All buildings will be constructed out of solid walls of at least 200mm thickness.** **The Pump Station equipment will be below ground level and the ventilation exit points will be fitted with sound attenuation devices.** **All high pressure pumps installed in an enclosed building where sound attenuation properties have been considered for the walls, roofs and access doors.** **Access doors are kept closed when not in use.**										
Desalination Plant										
Impact Description	Status	Spatial Extent	Duration	Reversibility	Potential Intensity	Probability	Significance (Without Mitigation)	Key Management actions	Significance (With Mitigation)	**Confidence**
1.1 Direct Impact of the construction noise on the Communities around Tongaat (day activities)	**Negative**	Local (2)	Temporary (1)	High	Low – Medium (2)	Probable (0.5)	**Low (2.5)**	– Ensuring that all operators of construction equipment receive proper training in the use of the equipment and that the equipment is serviced regularly. – All blasting and piling driving, if required, should only occur during the day. – All reverse noise emitting warning devices on mobile vehicles should be set as low as possible. – An environmental noise monitoring survey should be conducted during the construction phase to assess the impact and recommend further actions if required.	**Very Low (1)**	**High,** since based on actual measures
1.2 Direct Impact of the construction noise on the Communities around Tongaat (night activities)	**Negative**	Local (2)	Temporary (1)	High	High (4)	Highly Probable (0.75)	**Medium (8.25)**		**Low (2.5)**	**High,** since based on actual measures

1.3 Direct Impact of the construction noise on the fauna (e.g. birds and other animals)	**Negative**	Local to re-gional (2-3)	Tempo-rary (1)	High	Low – Medium (2)	Probable (0.5)	**Low (3)**	– Restricted work hours (day time) will ensure that impact is reduced	**Low (3)**	**High,** since based on actual measures
Potable water pipelines and Powerline route										
1.4 Direct Impact of the construction noise on the Communities around the potable water pipeline and powerline route	**Negative**	Local to re-gional (2-3)	Tempo-rary (1)	High	Low to medium (2)	Probable (0.5)	**Low (3)**	– Ensuring that all operators of construction equipment receive proper training in the use of the equipment and that the equipment is serviced regularly. – All blasting and piling driving, if required, should only occur during the day. – All reverse noise emitting warning devices on mobile vehicles should be set as low as possible. – An environmental noise monitoring survey should be conducted during the construction phase to assess the impact and recommend further actions if required.	**Very Low**	**High,** since based on actual measures

Table 9-14 - Impact assessment summary table for the Operational Phase

Operational Phase										
Management actions inherent to the current project design: **All buildings will be constructed out of solid walls of at least 200mm thickness.** **The Pump Station equipment will be below ground level and the ventilation exit points will be fitted with sound attenuation devices.** **All high pressure pumps will be installed in an enclosed building where sound attenuation properties have been considered for the walls, roofs and access doors.** **All access doors are kept closed when not in use.**										
Desalination plant										
Impact Description	Status	Spatial Extent	Duration	Revers-ibility	Potential Intensity	Probability	Significance (Without Mitigation)	Key Management actions	Significance (With Mitigation)	**Confidence**
1.1 Direct Impact of the operational noise on the Communities around Tongaat	**Negative**	Local (2)	Long Term (4)	High	Low to medium (2)	Low Probability (0.25)	**Low (2)**	– Choosing equipment that has a lower noise emission than comparative equipment.	**Very Low (1.75)**	**High,** since based on actual **measures**
1.2 Direct Impact of the operational noise on the fauna (e.g. birds and other animals)	**Negative**	Local (2)	Long Term (4)	High	Low to medium (2)	Low Probability (0.25)	**Low (2)**	– Placing high noise emitting equipment inside specifically constructed buildings. – Choosing equipment that has a lower noise emission than comparative equipment.	**Very Low (1.75)**	**High,** since based on actual **measures**

9.8 CONCLUSION AND RECOMMENDATION

The results of the study indicate the following:

- There will be a short term increase in noise in the immediate vicinity of the site during the construction phase as the ambient noise levels will be exceeded;
- The blasting and drilling impact during the construction phase will be difficult to mitigate; and
- The long term noise impact from the plant during the operation phase will be concentrated in the immediate area around the facility and is not anticipated to affect identified sensitive receptors.

The conclusion is that the Tongaat Desalination Plant noise impact on receptors is predicted to be of **low** to **very low** significance during the construction and operational phases respectively, provided the recommendations for mitigating noise impacts are applied effectively.
The following key management actions are recommended:

9.8.1 Construction Activities

- All construction operations should only occur during daylight hours if possible;
- No construction blasting should occur at night. Blasting should only occur during the hottest part of the day to take advantage of unstable atmospheric conditions; and
- Blasting should only occur if there are no signs of birds feeding in the immediate vicinity or marine mammals present if blasting is conducted at sea.

9.8.2 Operational Activities / Design

The following noise reduction techniques should be considered as <u>inherent</u> to the project design:

- Ensuring building walls are at least 200mm thick with an R_w55-60
- Acoustic attenuation devices should be installed on all ventilation outlets;
- No noisy plant and equipment is to be contained in buildings that have been cladded in thin sheeting (such as corrugated metal or cement fibre sheets);

The following noise reduction techniques should be considered as <u>additional</u> mitigation measures to the project design:

- Selecting equipment with lower sound power levels;
- Installing silencers on fans;
- Installing suitable mufflers on exhausts and compressor components.
- Installing acoustic enclosures for equipment to stop noise at source;
- Improving the acoustic performance of buildings by applying sound insulation where possible;
- Installing vibration isolation products for mechanical equipment.
- High pressure gas or liquid should not be ventilated directly to the atmosphere, but through an attenuation chamber or device;

It is not possible to eliminate all low frequency noise during the construction phase, but it should be noted that there are already existing sources of low frequency noise sources (e.g. traffic, sea noise etc.) in the area. The potential low frequency noise from the project is therefore not anticipated to be of significance.

9.9 REFERENCES

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