Environmental Impact Assessment (EIA) for the Proposed Construction, Operation and Decommissioning of a Sea Water Reverse Osmosis Plant and Associated Infrastructure Proposed at Lovu on the KwaZulu-Natal South Coast

DRAFT EIA REPORT

CHAPTER 11: NOISE IMPACTS

ABBREVIATIONS, UNITS & GLOSSARY

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: $L_{pA} = 10 \text{Log} \left(\frac{P_A}{P_O} \right)^2$ 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:
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 Lovu 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 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 and will be similar for the preferred and the alternative site for the desalination plant. However, there may be some short term increase in noise in the immediate areas surrounding either option for the desalination plant site and pipeline route alternatives as well as areas in the vicinity of the proposed powerline route, as the ambient noise levels may be exceeded in some areas. It must be noted that the blasting and drilling impact during the construction phase will be difficult to mitigate.

The conclusion is that the Lovu Desalination Plant noise impact on receptors is predicted to be of **low** and **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> <u>key</u> 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.

Construction Phase

- 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.

Operation Phase

During the commissioning phase an environmental noise survey is conducted to determine if the noise emissions on the Mother of Peace site boundary are within the noise rating limits and to identify potential further mitigation measures, if required.

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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11. NOISE IMPACT ASSESSMENT

11.1 INTRODUCTION

This chapter is based on the noise specialist study conducted by Brett Williams of Safetech, as part of the EIA for the proposed desalination project at Lovu in Kwazulu Natal, South Africa.

11.1.1 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.

11.1.2 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.

11.1.2.1 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.

11.1.2.2 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 18th 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 (NSAs).

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.

11.1.3 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.
- Information on similar plant sourced from an internet search on Google and Google Scholar.

11.1.4 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 layout for the alternative site was not supplied and is estimated. Noise Sensitive Area No. 10, a private house, will be removed if the alternative site is chosen.
- The sound power levels for the operational equipment were not available as the exact equipment has not been specified yet. Information on similar equipment from previous studies was used in the modelling.
- The infrastructure construction impacts include all pipelines and additional electrical supply lines that may be needed. The construction noise for all infrastructures, 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 various noise impact receptors along the different alternative pipeline routes are the same as the plant and pump station receptors.
- 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 (Dr M. Shand).

11.2 PROJECT DESCRIPTION

Umgeni Water is proposing to construct a seawater reverse osmosis desalination plant in the Lovu area, KwaZulu-Natal. The plant will also 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 11.4) and operations (Table 11.5).

11.2.1 Potential Noise Sources for the Construction Phase

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

- Main plant and alternate plant 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.
- Construction of the salt water intake, brine discharge and potable water pipelines. Four alternative routes for the intake/discharge pipelines are proposed.

The number and frequency of use of the various types of vehicles and equipment has been estimated and is presented in Table 11.1 below.

Table 11-1 - 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
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

It is probable that the project will use blasting during the construction of the seawater feed and brine discharge pipelines. 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).

11.2.2 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.

11.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The proposed site is set in a rural area with residential areas to the north. A school and small settlement are situated on the southern boundary. The site is situated in a valley with the Lovu River mouth approximately 2700 meters to the south east of the main plant. The N2 highway is situated to the east of the plant.

11.3.1 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. Three 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 11-2 below and the locations of these various receptors are indicated in Figures 11.1 – 11.4.

Table 11-2 - Location of Noise Sensitive Areas

NSA	Description	Longitude	Latitude	Field Measured	Distance to Desalination plant - Preferred site (m)	Distance to Desalination plant - Alternative site (m)	Distance to pump station (m)	Distance to preferred intake/ discharge pipeline (m)	Distance to Alternative 2 intake/ discharge pipeline (m)
NSA 1	Private House	30°51'18.27"	30°06'23.54"	Yes	-	-	76	80-90	80
NSA 2	Private House	30°51'15.73"	30°06'23.14"	No	-	-	114	100	60
NSA 3	Private House	30°51'15.49"	30°06'18.95"	No	-	-	128	30	70
NSA 4	Private House	30°51'06.38"	30°06'49.69"	No	-	-	925	940	890
NSA 5	Private House	30°51'25.37"	30°06'07.71"	No	-	-	442	430	480
NSA 6	Private House	30°51'07.09"	30°06'13.46"	No	-	-	405	60	220
NSA 7	Private House	30°50'48.81"	30°06'36.57"	No	-	-	934	770	500
NSA 8	Private House	30°49'22.09"	30°05'46.65"	No	370	390	-	500	780
NSA 9	Private House	30°49'52.25"	30°05'47.38"	No	540	880	-	150	720
NSA 10	Private House	30°49'21.66"	30°06'01.10"	Yes	130	-	-	370	540
NSA 11	Private House	30°49'08.22"	30°06'07.73"	No	530	140	-	780	860
NSA 12	Private House	30°49'07.65"	30°05'50.83"	No	570	370	-	790	1 000
NSA 13	Northern portion of school property	30°49'34.66"	30°06'09.24"	Yes	52	170	-	300	150
NSA 14	Southern portion of school property	30°49'40.43"	30°06'13.56"	No	190	320	-	440	150
NSA 15	Private House	30°49'03.44"	30°05'55.80"	No	600	360	-	830	1 000
NSA 16	Private House	30°49'32.88"	30°05'50.08"	No	210	390	-	180	550
NSA 17	Private House	30°50'45.85"	30°06'47.53"	No	-	-	1205	1 110	830
NSA 18	Private House	30°50'36.99"	30°06'54.60"	No	-	-	1506	1 400	1 050

Note: All field measurement location co-ordinates are referenced to WGS84. The distances are the closest distance measured from the sensitive receptors to the noise source (i.e. site boundary at the Main Plant, Pump Station at the shoreline and pipeline/powerline route. Given that the proposed powerline will, where applicable, follow the preferred pipeline route, distances from sensitive receptors to both routes are assumed to be of similar range. Distances to the preferred pipeline route and Alternative 1 and 3 routes are the same.

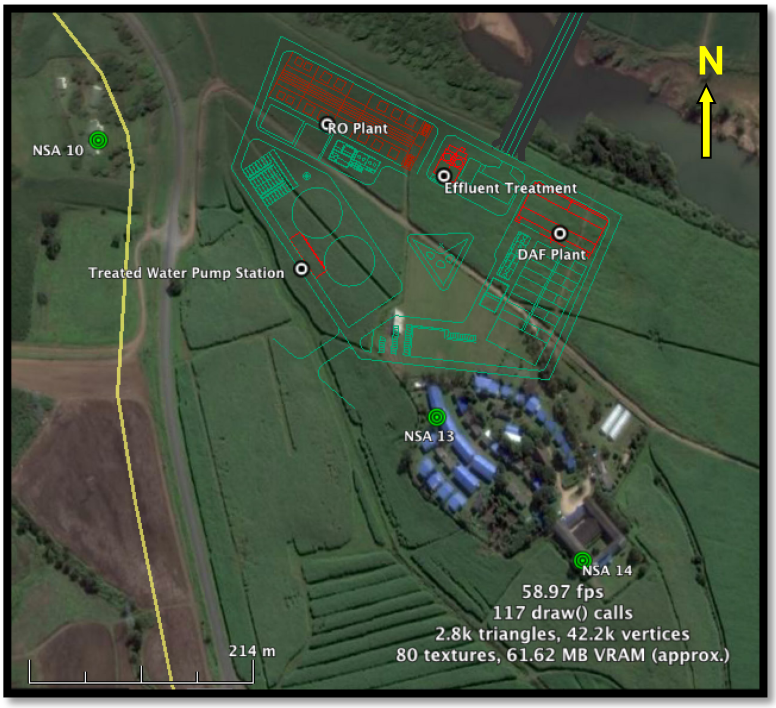

Figure 11-1 – Proposed site layout of the preferred facility (including all associated infrastructure)

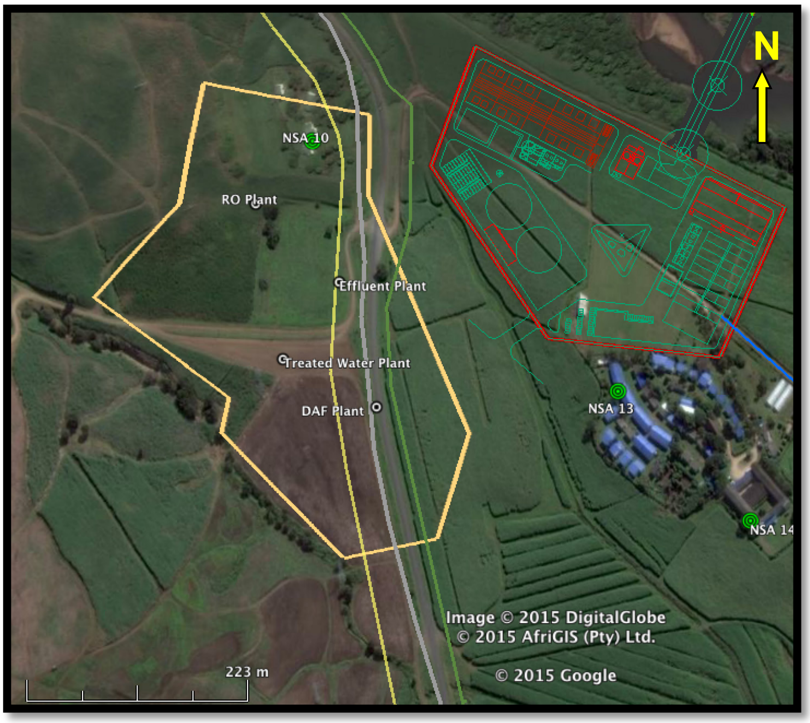

Figure 11-2 – Estimated site layout of the alternative site in yellow (showing possible layout)

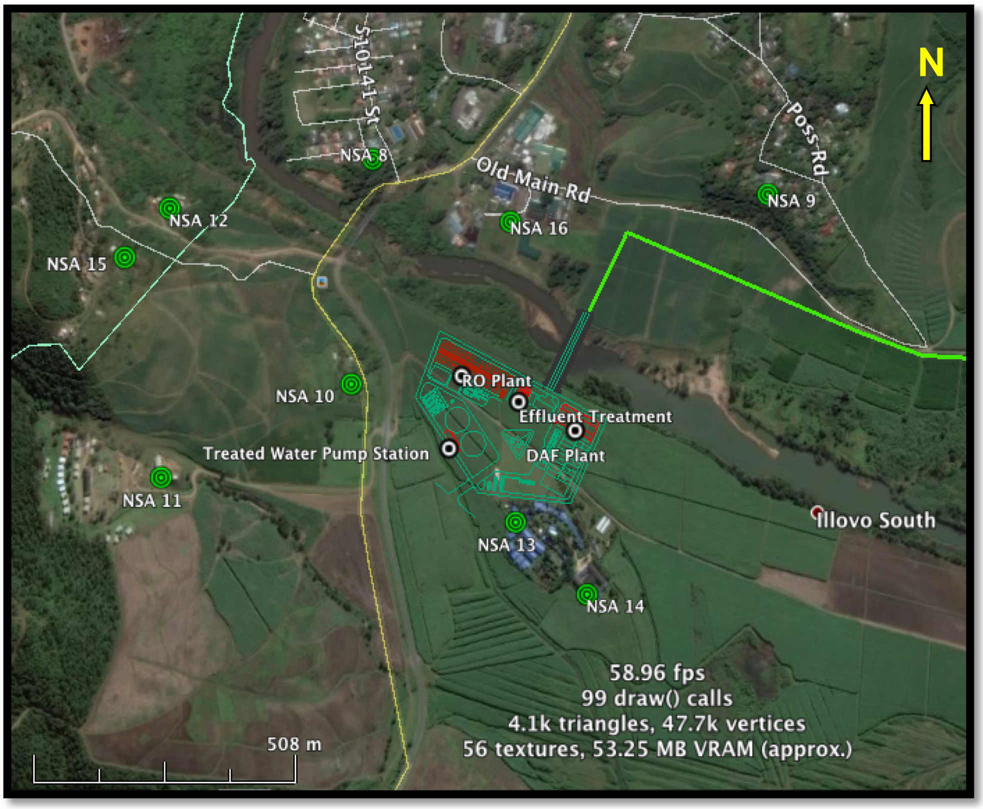

Figure 11-3 - Map of the proposed facility showing noise sensitive receptors

Figure 11-4 - Map of the proposed Pump Station

Figure 11-5 - Map of the proposed Pump Station and nearby NSA's

11.3.2 Results of Field Study

The ambient noise was measured at five locations for at least 10 minutes at each point as described above in Section 11.3. The results thereof are presented in Table 11.3.

Table 11-3 – Noise measurements during Field Study

Location	Start Time	$L_{Req.T}$ dB(A)	Comments
NSA 1 – House at Lovu River Mouth	11:15	51.2	Sea noise, birds
NSA 10 – House opposite Proposed Plant	12:15	68.1	6 Trucks, 3 cars
NSA 13 – Northern portion of school property	13:00	48.3	Cars in distance, people talking
NSA 1 – House at Lovu River Mouth	22:00	46.8	Sea noise very prevalent over other sounds.
NSA 10 – House opposite Proposed Plant	22:30	40.1	1 Truck
NSA 13 – Northern portion of school property	22:55	35.3	Birds

11.4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

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 11-4 below.

Table 11-4 - 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 11-3), the influence of the sea results in the ambient noise exceeding the recommended rating levels in Table 11-4 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.

11.5 IDENTIFICATION OF KEY ISSUES AND POTENTIAL IMPACTS

11.5.1 Key Issues Identified During the Scoping Phase

The key issues associated with the construction and operation of the Umgeni Water Desalination Plant at Lovu 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, in particular due to the proximity of the Mother of Peace Illovo orphanage/school, 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.

11.5.2 Key Issues Identified During Public Consultation

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

- Potential impacts of noise associated with operating the SWRO on humans, avifauna and terrestrial fauna
- Impact of noise generated by the proposed plant (operate 24 hours a day) on a proposed 240 unit housing estate at the Old Country Club. Compliance with noise requirements, with respect to houses that will be near the site.

11.5.3 Identification of Potential Impacts

11.5.3.1 Construction Phase

- Impact on the immediate surrounding environment, in particular the Mother of Peace Illovo school located directly to the south of the proposed plant, 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.

11.5.3.2 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.

11.5.4 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 11-5 below.

Table 11-5 - 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 11-6 - 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
1600	47.5	50.3	58.7

Frequency (Hertz)	CAT 320D Excavator	Mobile Crane on Jetty	Drilling Rig on Jetty
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

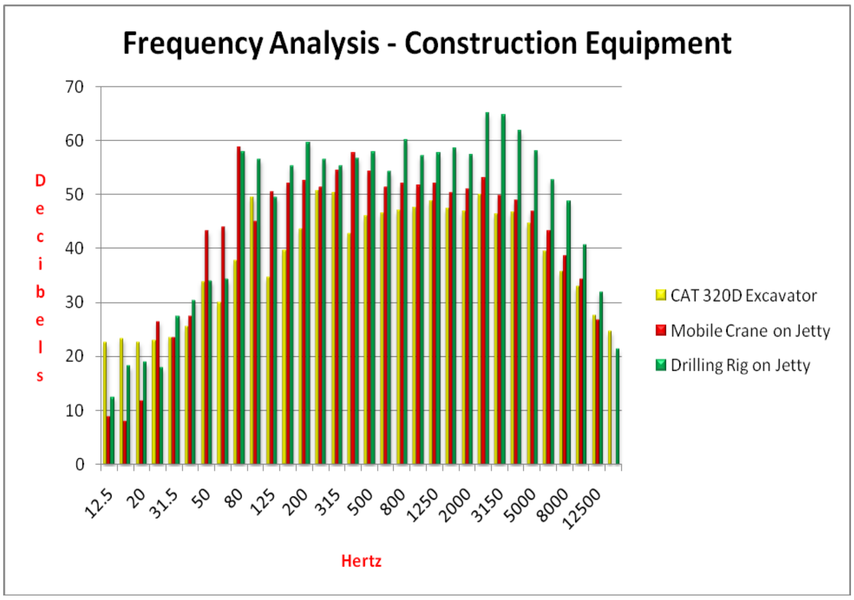

Figure 11-6 – Frequency Analysis for a selection of construction equipment

Figure 11.6 shows that the construction equipment noise is distributed with higher values at the higher frequencies. Based on Table 11-5 and 11-7, 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 11.7 and 11.8) 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 11-7 - Combining Different Construction Noise Sources – High Impact (Worst Case)

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 11-8 - Combining Different Construction Noise Sources – Typical construction activities

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 11.9 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 11-9 - Attenuation by Distance for the construction phase

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

11.5.5 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 11-10 below. The results of the modelling are presented in Table 11-11 and Figures 11-6 and 11-7 below.

Table 11-10 - 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

Table 11-11 - Operational Phase Modelling Results

NSA	Noise from Preferred Plant site or Pump Station under no wind conditions dB(A)	Noise from Alternative site for the Plant or 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	34.4	34.4	40	50	Sub-Urban
NSA 2	28.5	28.5	40	50	Sub-Urban
NSA 3	26.3	26.3	40	50	Sub-Urban
NSA 4	10.7	10.7	40	50	Sub-Urban
NSA 5	14.6	14.6	40	50	Sub-Urban
NSA 6	15.7	15.7	40	50	Sub-Urban
NSA 7	12.9	12.9	40	50	Sub-Urban
NSA 8	27.8	26.7	40	50	Sub-Urban
NSA 9	26.2	21.9	40	50	Sub-Urban
NSA 10	34.9	Removed	35	45	Rural
NSA 11	25.8	31.3	35	45	Rural
NSA 12	24.7	26.3	35	45	Rural
NSA 13	**36.2**	33.0	35	45	Rural
NSA 14	31.0	28.6	35	45	Rural
NSA 15	23.7	26.5	35	45	Rural
NSA 16	31.7	27.2	40	50	Sub-Urban
NSA 17	11.8	11.8	40	50	Sub-Urban
NSA 18	11.7	11.7	40	50	Sub-Urban

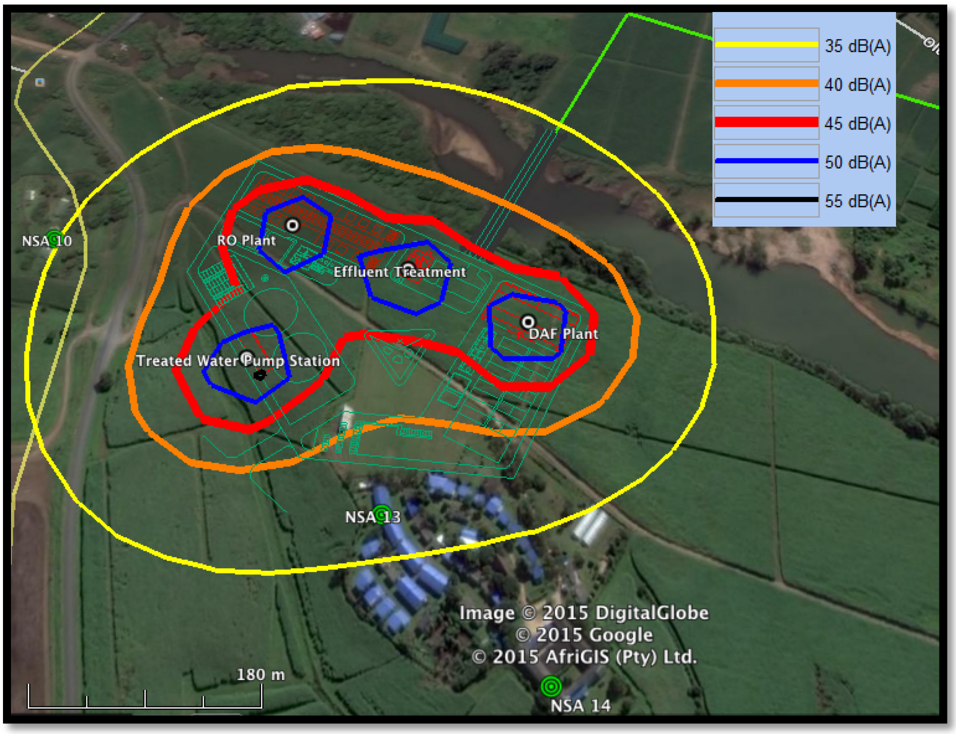

Figure 11-7 - – Noise levels generated by the proposed desalination plant during the Operational Phase – Preferred Site

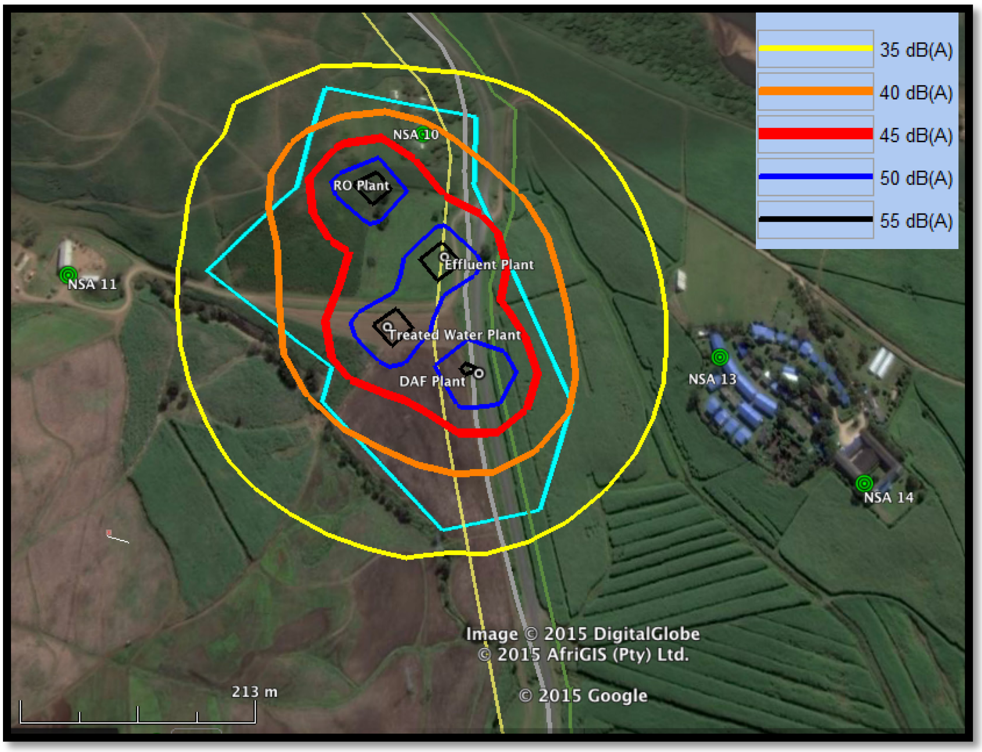

Figure 11-8 – Noise levels generated by the proposed desalination plant during the Operational Phase – Alternative Site

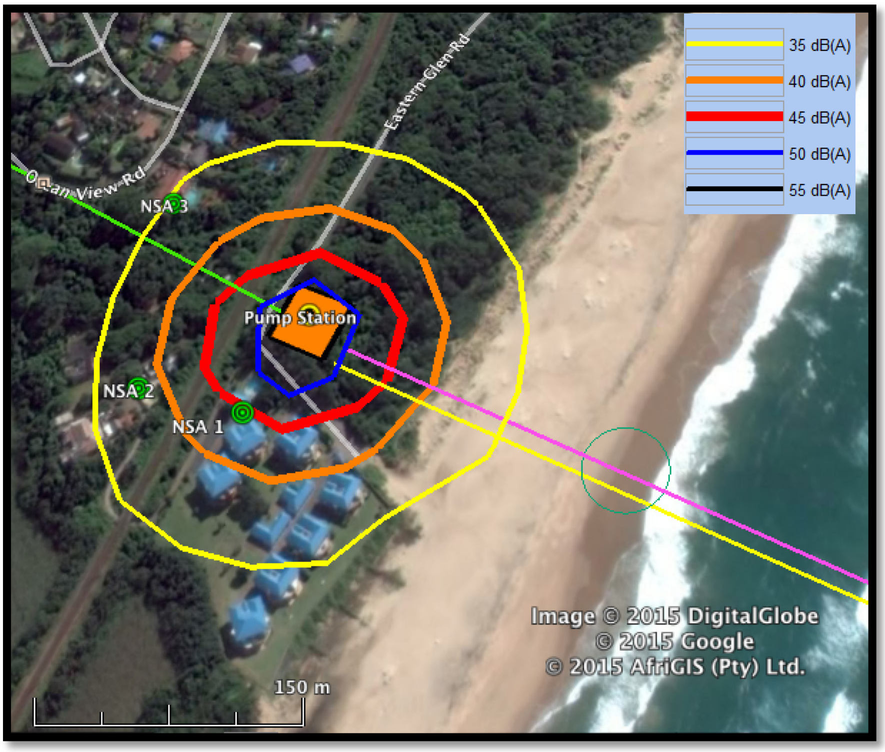

Figure 11-9 - Noise levels generated by the proposed Pump Station during the Operational Phase

11.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

11.6.1 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 11-9 (1st column).

It can be seen from the modelling results (Table 11-9) that, based on similar noise characteristics, construction noise will reach levels of 45 dB(A) and 35 dB(A) (i.e. typical rating levels for noise during the day and night in rural areas, as defined by SANS 10103:2008 guideline) at approximately 580 metres and 1200 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 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).

Construction noise levels would reach 52 dB(A) at about 280 m from the source and 42 dB(A) at approximately 750 m. Therefore, only receptors in very close proximity to the preferred site for the proposed desalination plant (up to 280 m) will be affected by the construction noise during the day. On the other hand, receptors up to 750 m could be affected by construction noise at night - this would include all sensitive receptors identified in this study.

Similarly, in sub-urban areas construction noise will reach levels of 50 dBA (i.e. typical rating levels for noise during the day – refer to Table 11.4) at approximately 350 metres from the source, in all directions; and 40 dB(A) at approximately 800 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 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). Such levels would be reached at approximately 180 m (57 dB(A)) and 480 m (47 dB(A)) from the noise source.

11.6.1.1 Desalination Plant – Preferred site

The closest receptors to the preferred site for the proposed plant are the Mother of Peace Illovo school (NSA 13 and NSA 14) and private housing (NSA 10 and NSA 16), which are situated approximately 52 m (NSA 13) and 190 m (NSA 14) south, 130 m west and 210 m north of the proposed site respectively (these distances are measured from the boundary fence). The predicted noise levels at these distances have been calculated to be approximately 68 dB, 56 dB, 60 dB and 55 dB respectively. Ambient noise levels in the northern area of the school (NSA 13) have been measure at 48.3 dB(A) in the day and 35.3 dB(A) at night. When construction activities are undertaken at the southern boundary of the proposed site, receptors at the Mother of Peace school could therefore be affected by construction noise as predicted noise levels could exceed ambient noise measured at NSA 13 by more than 7dB (during the day and night). Assuming that ambient noise levels at the southern area of the school are similar to the northern area, it is anticipated that receptors in that area could also be affected by construction noise when construction activities will be carried out in the southern section of the proposed site for the desalination plant. As construction activities move towards the northern section of the preferred desalination site, noise impacts on receptors at the Mother of Peace Illovo school will decrease; i.e. NSA13 is located approximately 200 m from the centre of the proposed desalination plant site. At that distance, predicted construction noise levels would be approximately 55 dB(A), i.e. when construction activities are undertaken in the northern area of the proposed site, predicted noise levels at the Mother of Peace Illovo school would not exceed ambient noise level by more than 7dB(A) during the day. However, these could constitute still disturbing noise at the school at night.

Receptors at NSA10 would not be affected by construction noise during the day as it was predicted to be below the ambient noise measured in that area (68.1 dB(A)). These receptors could however be affected should construction be carried out during the night as ambient noise level at night in this area has been measured at 40.1 dB(A), i.e. predicted noise level would exceed ambient noise level by more than 7dB(A).

Receptor NSA16 is located approximately 210 m from the preferred site boundary and may therefore be affected by construction noise during the day and night (i.e. predicted noise levels are approximately 55 dB(A) which is above the typical rating level of 50dB(A) for noise during the day and 40 dB(A) during the night in suburban area). It must however be noted that the current ambient noise in all areas monitored during this study already exceeds the typical noise rating levels.

The proposed housing development at the Old Country Club is located north east of NSA9 which is situated approximately 570 m from the proposed desalination plant boundary. Predicted noise levels at NSA9 are approximately 45 dB(A). Receptors at the proposed housing development are therefore not anticipated to be impacted by noise generated during construction activities at the preferred site.

Given the above, during the day, impacts associated with noise generated during construction activities at the preferred desalination plant area are anticipated to be of low to medium intensity for NSAs 10 and 16 and high intensity for NSAs 13 and 14, although local and of temporary nature. These impacts are therefore predicted to be of **low** to **medium** significance before mitigation during the day. During the night, impacts associated with construction noise are anticipated to be of **medium** significance for all sensitive receptors.

11.6.1.2 Desalination Plant – Alternative site

The only sensitive receptors within 280 m of the Alternative site are NSA 11 (private housing) and NSA 13 (northern section of the school) – i.e. those receptors may be affected by construction noise during the day as the predicted noise levels are 59 dB(A) and 57 dB(A) respectively. Sensitive receptors within 750 m from the site may be affected by construction noise during the night. These include all sensitive receptors identified in this study.

Given the above, during the day, impacts associated with noise generated during construction activities at the alternative desalination plant area are anticipated to be of low to medium intensity for all identified sensitive receptors, except NSAs 11 and 13 for which impacts are expected to be of high intensity, although local and of temporary nature. These impacts are therefore predicted to be of **low** to **medium** significance before mitigation during the day. During the night, impacts associated with construction noise are anticipated to be of **medium** significance for all sensitive receptors.

11.6.1.3 Pump station and marine pipelines

The closest receptors to the proposed pump station are residential houses located at approximately 76 m south (NSA 1), 114 m south-west (NSA 2) and 128 m north-west (NSA 3) of the pump station. These receptors could be impacted during the construction phase as predicted noise at these areas (ranging between approximately 60 dB(A) and 65 dB(A)) would exceed typical rating levels for noise during day and night. Although ambient noise levels in these areas currently exceed the typical rating levels, construction noise is also anticipated to constitute disturbing noise in areas where it would exceed the day and night ambient noise levels by more than 7 dB (e.g. 65 dB(A) versus 51.2 dB(A) (day) and 46.8dB(A) (night) for NSA1).

Similarly, the closest sensitive receptors to the temporary jetty (if constructed) are located approximately 187 m to the west. Should a number of main pieces of equipment be used simultaneously during constructions activities, the closest receptors would be exposed to construction noise predicted to be approximately 57 dB(A). However, the predicted noise levels would not exceed the expected ambient noise levels by more than 7 dB and would therefore not constitute a disturbing noise during the day.

As mentioned in Section 11.2.1, 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.

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 the pump station and the marine pipelines are anticipated to be of high intensity for NSAs 1, 2 and 3 and low to medium intensity for the other sensitive areas, although local to regional and of temporary nature. These impacts on the surrounding environment are therefore predicted to be of **low** to **medium** significance before mitigation. During the night, impacts associated with construction noise are anticipated to be of **medium** significance for all sensitive receptors, except for NSAs 4, 7, 17 and 18 for which impacts during the night are expected to be of **low** significance.

11.6.1.4 Powerline and Preferred/Alternative 1/Alternative 3 intake and discharge pipeline route

The construction of the first portion of the preferred pipeline and powerline route (near the pump station) could affect private houses within the noise sensitive areas (NSAs) 1, 2, 3 and 6, which are all located between approximately 30 to 100 m from the proposed route. The predicted noise levels within these sensitive areas (Table 11-9) range between 73 dB(A) and 62 dB(A) which will be regarded as a disturbance as it exceeds the day and night ambient noise by more than 7 dB. However, the noise will be for short duration and will diminish as the pipeline/powerline construction progresses towards the proposed desalination plant to the west.

The construction of the last section of the preferred pipeline and powerline route (near the proposed desalination plant) may impact private houses within NSA 9 as predicted noise level in this area (approximately 58 dB(A)) exceeds typical rating levels for noise during the day and night in rural areas. However, all ambient noise levels measured as part of this study currently exceed typical rating levels for day and night.

It is not envisaged that the pipeline and powerline construction will affect the Mother of Peace Illovo school during the day as it is situated further than 280m from the proposed route. However, these noise receptors would be impacted should construction occurs at night.

The additional sensitive receptor areas which may be impacted by construction noise during the night include NSA 5 (private housings along the beach) for the first portion of the pipeline and powerline route, and NSAs 8, 10 and 16 for the last section of the proposed route.

Given the above, impacts associated with noise generated during construction of the intake/discharge pipelines and powerline are anticipated to be of high intensity for NSAs 1, 2, 3, 6 and 9 and low to medium intensity for the other sensitive areas, although local to regional and of temporary nature. These impacts on the surrounding environment are therefore predicted to be of **low** to **medium** significance before mitigation. During the night, impacts associated with construction noise are anticipated to be of **medium** significance for all sensitive receptors, except for NSAs 4, 7, 11, 12, 15, 17 and 18 for which impacts during the night are expected to be of **low** significance.

11.6.1.5 Alternative 2 intake and discharge pipeline route

The construction of the first portion of Alternative 2 pipeline (near the pump station) will have similar impacts as the preferred route during day and night, with the exception of predicted noise levels which may affect NSA 7 during the night. Noise generated during the construction of the last section of Alternative 2 pipeline may affect the Mother of Peace Illovo school as predicted noise levels (58 dB(A)) would exceed ambient noise by more than 7 dB.

Should construction activities be undertaken along the proposed Alternative 2 route at night, NSAs 10 and 16 may also be impacted as these are all within approximately 750 m from the proposed route.

Given the above, impacts associated with noise generated during construction activities along the Alternative 2 pipeline route are anticipated to be of high intensity for NSAs 1, 2, 3, 6, 13 and 14 and low to medium intensity for the other sensitive areas, although local to regional and of temporary nature. These impacts on the surrounding environment are therefore predicted to be of **low** to **medium** significance before mitigation. During the night, impacts associated with construction noise are anticipated to be of **medium** significance for all sensitive receptors, except for NSAs 4, 8, 9, 11, 12, 15, 17 and 18 for which impacts during the night are expected to be of **low** significance.

11.6.1.6 Recommended key mitigation measures

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

- All blasting and piling driving, if required, should only occur during the day.
- Construction operations should only occur during daylight hours if possible;
- Construction equipment should not all be used at the same time if possible;
- Ensure all equipment is of good quality and regularly maintained ;
- Ensuring that all operators of construction equipment receive proper training in the use of the equipment and that the equipment is serviced regularly.
- 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 for all components of the proposed project are predicted to be of **low** significance for the Preferred and Alternative options.

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

11.6.2 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 11.5.5) associated with the operational phase indicate the following main findings:

- Pump Station - The results indicate that there will be little impact on the identified noise sensitive areas around the pump station. The impact will be dependent on the sea state, as any vigorous wave action will result in a higher ambient noise level in this area. The houses to the south of the pump station are just below the SANS 10103:2006 noise rating limit of 40dB(A) at night. The worst case has been modelled and it is highly unlikely that the pumps will be heard due to the depth of the pump station. The only noise emissions from the pump station will be the ventilation system, if fitted. The daytime noise rating limit is not exceeded.
- Preferred Site -Desalination Plant – The noise emissions from the main plant (36.5 dB(A)) will exceed the rural night limit of 35 dB(A) at the northern most portion of the school. The northern portion of the school property may be affected at night if occupied at night in this area. It is however difficult to quantify the exact impact due to the shielding effect the current buildings have on the noise emissions. It is however not anticipated that the noise impact will exceed the limits indoors. The daytime noise rating limit is not exceeded.
- Alternative Site -Desalination Plant – The noise emissions from the main plant will not exceed the rural night limit of 35 dB(A) at any of the NSA's providing that NSA 10 is removed. The daytime noise rating limit is not exceeded for any receptor.

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. The ambient noise levels are not exceeded for more than 140m from the site.

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

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 have solid walls (at least 200mm thick) of at least a sound reduction index (Rw) of Rw55-60.
- All ventilation outlets should be properly attenuated.
- All access doors to the high noise buildings should be 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 and to identify potential further mitigation measures, if required.

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 **very low** significance.

11.6.3 Decommissioning Phase

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

11.6.4 Cumulative Impacts

There are no cumulative noise impacts for this study.

11.7 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 are collated in Table 11.12 and 11.13 below.

Table 11-12 - 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 - Preferred site										
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 NSAs 10, 13 and 14, during the day.	**Negative**	Local (2)	Temporary (1)	High	High (8)	Probable (0.5)	**Medium (5.5)**	▪ 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.	**Low (2.5)**	High, since based on actual measures and predictive modelling
1.2 Direct Impact of the construction noise during the day on NSAs 1 to 9, NSA 11, NSA 12 and NSAs15 to 18.	**Negative**	Local (2)	Temporary (1)	High	Medium - Low (2)	Probable (0.5)	**Low (2.5)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
1.3 Direct Impact of the construction noise during the night on all NSAs	**Negative**	Local (2)	Temporary (1)	High	High (8)	Highly Probable (0.75)	**Medium (8.25)**		**Low (2.5)**	High, since based on actual measures and predictive modelling

Desalination plant - Alternative site										
1.4 Direct Impact of the construction noise during the day on NSAs 11 and 13.	**Negative**	Local (2)	Temporary (1)	High	High (8)	Probable (0.5)	**Medium (5.5)**	▪ 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.	**Low (2.5)**	High, since based on actual measures
1.5 Direct Impact of the construction noise during the day on NSAs 1 to 10, NSA 12 and NSAs14 to 18.	**Negative**	Local (2)	Temporary (1)	High	Medium - Low (2)	Probable (0.5)	**Low (2.5)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
1.6 Direct Impact of the construction noise during the night on all NSAs, except NSA 9.	**Negative**	Local (2)	Temporary (1)	High	High (8)	Highly Probable (0.75)	**Medium (8.25)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
1.7 Direct Impact of the construction noise during the night on NSA 9.	**Negative**	Local (2)	Temporary (1)	High	Medium - Low (2)	Probable (0.5)	**Low (2.5)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
Pump station										
1.8 Direct Impact of the construction noise during the day on NSAs 1, 2 and 3.	**Negative**	Local (2)	Temporary (1)	High	High (8)	Probable (0.5)	**Medium (5.5)**	▪ 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	**Low (2.5)**	High, since based on actual measures and predictive modelling
1.9 Direct Impact of the construction noise during the day on sensitive areas around the pump station (excluding NSAs 1, 2 and 3)	**Negative**	Local (2)	Temporary (1)	High	Medium - Low (2)	Probable (0.5)	**Low (2.5)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
1.10 Direct Impact of the construction noise during the night on NSAs 1, 2, 3, 5 and 6.	**Negative**	Local (2)	Temporary (1)	High	High (8)	Highly Probable (0.75)	**Medium (8.25)**		**Low (2.5)**	High, since based on actual measures and predictive

								monitoring survey should be conducted during the construction phase to assess the impact and recommend further actions if required.		modelling
1.11 Direct Impact of the construction noise during the night on NSA 4, 7, 17 and 18.	**Negative**	Local (2)	Temporary (1)	High	Medium - Low (2)	Probable (0.5)	**Low (2.5)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
Preferred pipeline route, Alternative 1 and 3 routes and powerline route										
1.8 Direct Impact of the construction noise during the day on NSAs 1, 2, 3, 6 and 9.	**Negative**	Local (2)	Temporary (1)	High	High (8)	Probable (0.5)	**Medium (5.5)**	▪ 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.	**Low (2.5)**	High, since based on actual measures and predictive modelling
1.9 Direct Impact of the construction noise during the day on remaining sensitive areas	**Negative**	Local (2)	Temporary (1)	High	Medium - Low (2)	Probable (0.5)	**Low (2.5)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
1.11 Direct Impact of the construction noise during the night on NSA 4, 7, 11, 12, 15, 17 and 18.	**Negative**	Local (2)	Temporary (1)	High	Medium - Low (2)	Probable (0.5)	**Low (2.5)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
1.10 Direct Impact of the construction noise during the night on remainder NSAs.	**Negative**	Local (2)	Temporary (1)	High	High (8)	Highly Probable (0.75)	**Medium (8.25)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
Alternative 2 pipeline route										
1.8 Direct Impact of the construction noise during the day on NSAs 1, 2, 3, 6, 13 and 14.	**Negative**	Local (2)	Temporary (1)	High	High (8)	Probable (0.5)	**Medium (5.5)**	▪ Ensuring that all operators of construction equipment receive proper training in the use of the equipment and that the equipment is serviced	**Low (2.5)**	High, since based on actual measures and predictive modelling

1.9 Direct Impact of the construction noise during the day on remaining sensitive areas	**Negative**	Local (2)	Temporary (1)	High	Medium - Low (2)	Probable (0.5)	**Low (2.5)**	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.	**Low (2.5)**	High, since based on actual measures and predictive modelling
1.11 Direct Impact of the construction noise during the night on NSA 4, 8, 9, 11, 12, 15, 17 and 18.	**Negative**	Local (2)	Temporary (1)	High	Medium - Low (2)	Probable (0.5)	**Low (2.5)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
1.10 Direct Impact of the construction noise during the night on remainder NSAs.	**Negative**	Local (2)	Temporary (1)	High	High (8)	Highly Probable (0.75)	**Medium (8.25)**		**Low (2.5)**	High, since based on actual measures and predictive modelling
1.2. Direct Impact of the construction noise on fauna (e.g. birds and other animals)	Negative	Local to regional (2-3)	Temporary (1)	High	Low – Medium (2)	Probable (0.5)	Low (3)	▪ Restricted work hours (day time) will ensure that impact is reduced	Low (2.5)	High, since based on actual measures

Table 11-13 - 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 noise emitting equipment (e.g. 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 – Preferred and Alternative Site

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 operational noise on the Communities around Lovu River	**Negative**	Local (2)	Long Term (4)	High	Medium to Low (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	Medium to Low (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**

11.8 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;
- Impacts associated with noise generated during the construction of the pipeline route will be of similar significance for the Preferred and for the Alternative routes;
- Noise impacts during construction of the proposed desalination plant will be slightly less significant for the Alternative site than for the preferred site; and
- The long term noise impact from the plant during the operation phase will be concentrated in the immediate area around the facility and will be similar for the preferred and the alternative site for the desalination plant.

The conclusion is that the Lovu 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:

11.8.1 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.

11.8.2 Operational Activities / Design

The following noise reduction techniques should be considered as inherent 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 additional key mitigation measures:

- 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.

11.8.3 Operation Phase

During the commissioning phase an environmental noise survey is conducted to determine if the noise emissions on the Mother of Peace site boundary are within the noise rating limits and to identify potential further mitigation measures, if required.

11.9 REFERENCES

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