Environmental Impact Assessment (EIA) for the proposed construction, operation and decommissioning of the Saldanha Regional Marine Outfall Project of Frontier Saldanha Utilities (Pty) Ltd. at Danger Bay in the Saldanha Bay region

FINAL EIA REPORT

CHAPTER 8:

ENVIRONMENTAL IMPACT ASSESSMENT

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8 ASSESSMENT OF POTENTIAL IMPACTS

This chapter provides an assessment of the impacts identified in the specialist studies undertaken for the SRMO Project and proposes management actions and mitigation measures to avoid or reduce negative impacts or to enhance positive benefits. For a description of the affected environment that provides the context for these impacts, please refer to Chapter 3 of this FEIAR. The complete specialist studies are provided in Appendices A-F of Volume II of this report.

The impact assessment is provided under the following sections:

- Marine ecology;
- Terrestrial ecology;
- Wetlands;
- Visual impacts;
- Heritage (including Palaeontology and Archaeology); and
- Economic impacts.

For each of these sections, an introductory summary is provided of the context for and key factors influencing this impact assessment, followed by a table of the potential impacts with associated impact assessment ratings and mitigation measures (extracted from the specialist studies).

8.1 MARINE ECOLOGY

Dr Andrea Pulfrich of *Pisces Environmental Services (Pty) Ltd* was commissioned by the CSIR to undertake a Marine Ecology specialist study as part of the EIA for the proposed SRMO Project. The compilation of her specialist report followed a review process of published (peer reviewed) and unpublished literature and the assessment of potential impacts based on proposed activities and identification of impacts (and their mitigation) within the available literature.

The coastal zone, intertidal and shallow subtidal areas around Danger Bay are still comparatively “pristine” due to limited development and accessibility from the landward side. The impacts associated with the construction activities, which are the impacts primarily affecting the coastal zone, are predicted as reversible in the short term and no difference in impact between marine outfall options 1 and 2 would be expected. As explained in Chapter 1, the marine outfall option 3 was not assessed in the EIA phase as it was not deemed feasible in the Scoping phase.

The principal impacts to the marine environment will be those associated with the effluent itself, which will constitute a hypersaline brine containing various potential co-pollutants. In the case of the effluent from the Chlor-Alkali Production Facility (CAPF) these comprise primarily salts, antiscalants and water softeners, which either occur naturally in seawater (such as Na+, Ca+ and Mg+ salts), have low toxicity or will be readily biodegradable once discharged. Assuming that the outfall is fitted with a suitable diffuser to ensure maximum

dilution of the discharged effluent, no long-term negative effects of the waste stream from the CAPF) is anticipated.

In the case of the REE Saldanha Separation Plant (SSP), the concentrations provided in Table 2-1 of the Marine Ecological Specialist study (Appendix A of Volume II) are the worst-case scenario anticipated only under upset conditions. Concentrations of Rare Earth Elements (REEs) and heavy metals in the effluent under normal operation of the plant should be negligible. Nonetheless, bioaccumulation of REEs and heavy metals may occur in marine organisms and sediments within Danger Bay, but concentrations are unlikely to reach levels at which ecotoxicological effects would manifest themselves. However, due to the dearth of information on the effects of REEs on marine organisms, a conservative approach should be taken, and both the effluent from the separation plant and the receiving environment should be regularly monitored for traces of REEs.

The effluent from the proposed Saldanha Bay Waste Water Treatment Works (WWTW) will be treated to the General Waste Water Limit before being discharged through the proposed regional marine outfall pipeline, and no significant long-term effects associated with the discharge are thus expected.

Appropriate mitigation measures should, however, further reduce both the risks of ecotoxicity and the extent of the footprints. The key findings of this study (which were informed by the modelled plume footprints) are that, in the worst case scenario, the brine and thermal plumes (exceeding water quality guidelines) will periodically overlap with recreational, commercial rock-lobster and line fisheries and should the desalination plant come online, limited overlap with subtidal reefs within Danger Bay to varying degrees. Impacts associated with the effluent are irreversible during the operational life time of the outfall, and future cumulative effects due to further developments contributing to the waste stream can thus not be excluded. In the majority of cases the extent of the area of overlap would be relatively small at less than 0.35 km^2. In those cases where it would be larger, such as in the case of combined discharges from the proposed SSP, CAPF, WWTW and West Coast District Municipality (WCDM) Desalination Plant, it is noted that a worst case scenario will only occur for very short periods under very calm weather conditions. This would also be the only case in which there is potential overlap of plume footprints with a small section of sub-tidal reef within the bay. Under no scenarios are plumes predicted to extend beyond the entrance to Danger Bay implying no risks to fishing outside the Bay or mariculture further up the coast in Jacobsbaai.

8.1.1 Identification of impacts

For the **construction phase** of the proposed SRMO Project, the main impact on the marine environment is the disturbance of the shoreline and the seabed (and possibly associated sediment dynamics) as a result of the discharge pipeline. Most of the **major potential impacts** are associated with the **operational phase** and include:

- Altered flows at the discharge resulting in ecological impacts (e.g. flow distortion/changes and effects on natural sediment dynamics);

- Potential for habitat health impacts/losses resulting from elevated salinity in the vicinity of the discharge;
- The effect of the discharged effluent potentially having a higher temperature than the receiving environment;
- Potential toxicity to marine organisms of constituents in the waste-water streams from the REE separation plant, the CAPF, and the WWTW;
- The effect of elevated organic inputs and nutrient levels on marine biota in the effluent stream from the WWTW;
- Biocidal action of residual chlorine (or other alternative biocides) in the effluent stream from the WWTW; and
- Direct changes in dissolved oxygen content due to the difference between the ambient dissolved oxygen concentrations and those in the discharged effluent, and indirect changes in dissolved oxygen content of the water column and sediments as a result of nutrient inputs.

8.1.2 Assessment of impacts

Five negative impacts of medium significance (before mitigation) associated with the **construction phase** of the Frontier Utilities regional marine outfall (Scenario 1) were identified:

- Disturbance and destruction of intertidal beach macrofauna during pipeline construction as a result of vehicular traffic, jetty construction and excavations;
- Accidental spillage or leakage of fuel, chemicals, or lubricants that may cause water or sediment contamination and/or disturbance to beach and subtidal biota;
- Disturbance and destruction of subtidal sandy and rocky reef biota during laying of the discharge pipeline, jetty construction, surf-zone excavation and rock blasting;
- Effects of blasting on macrophytes, invertebrates and fish communities; and
- Effects of blasting on marine communities, particularly turtles and marine mammals.

Should construction of the WCDM Desalination Plant (Scenario 2) go ahead at some time in the future, the same impacts may be expected during the construction of that discharge pipeline. Depending on the time between construction periods, cumulative impacts on intertidal and shallow subtidal beach and rocky reef communities may need to be considered for the construction of the second pipeline.

The footprints for salinity, seawater temperature and achievable dilutions resulting from model simulations undertaken by WorleyParsons for the various discharge scenarios were used in assessing the significance of the impacts of the operational discharges to the marine environment. The modelling was undertaken using a far-field model, which assumed the discharge of the effluent near the seabed (worst case) rather than through a diffuser. This approach is conservative and will likely over-estimate the extent of the plume footprints. As this would in turn result in an over-estimation of any negative ecological impacts, this must be kept in mind when scrutinising the significance ratings of the ecological assessment.

Assuming that the effluent would comprise the combined waste streams from the SSP, the CAPF and the WWTW (*i.e*. Scenario 1 – Frontier Utilities SRMO), three alternatives were assessed, namely:

- **Scenario 1 (via Outfall Option 1)**: Discharge into Danger Bay through pipeline Option 1 (sandy beach west end of Danger Bay); discharge of the SRMO effluent only;
- **Scenario 1 (via Outfall Option 2)**: Discharge into Danger Bay through pipeline Option 2 (sandy beach in centre of Danger Bay); discharge of the SRMO effluent only; and
- **Scenario 2 (via WCDM brine return pipeline)**: Co-discharge with a hypersaline brine from the proposed WCDM desalination plant.

Note that the impacts of a hypersaline discharge from the desalination plant on the marine ecology of Danger Bay have been assessed as part of the EIA for the proposed WCDM desalination plant (Application Ref No. E12/2/4/2-F4/16-3037/11, Environmental Authorisation granted on 13 August 2013).

Two negative impacts of high significance (before mitigation) associated with the **operational phase** of the SRMO Project (Scenario 1 and Scenario 2) were identified:

- Effects of biocide plume on marine communities in the mixing zone; and
- Potential synergistic and antagonistic effects of a combined effluent.

Seven negative impacts of medium significance (before mitigation) associated with the **operational phase** of the SRMO (Scenario 1 and Scenario 2) were identified:

- Discharge of high density saline brine may cause sinking of the plume, seafloor spreading and increases in porewater salinity;
- Increased salinity in the mixing zone affects biota;
- Reduction in dissolved oxygen concentrations of the receiving water as a result of dechlorination or elevated nutrients from the WWTW;
- Heavy metals may affect dissolved metal concentrations in the receiving water.
- Effects of REEs on marine communities in the mixing zone;
- Effects of discharged co-pollutants; and
- Avoidance behaviour by fish, marine mammals and/or turtles of the discharge area.

One positive impact of medium significance associated with the **operational phase** of the SRMO (Scenario 1 and Scenario 2) was identified:

- Submerged pipeline acts as an artificial reef.

The management actions and mitigation measures recommended below (Scenario 1 and Scenario 2) will reduce the negative impacts of 'high', 'medium to high' and of 'medium' significance to 'low' significance. If the recommended mitigation measures are applied effectively, no negative residual impacts of high significance are predicted.

No-Go Alternative

In the case of the "no-go" alternative, disturbance and elimination of beach and shallow subtidal macrofauna, through pipeline installation will not occur. Anthropogenic activities on the beach will be limited, shorebirds feeding and nesting in the area will remain undisturbed and dune vegetation preserved. Likewise, with the "no-development" alternative, no brine effluent (and associated co-discharges) will be released into the marine environment, and the risks associated with such a discharge will thus be absent. From a marine perspective this is undeniably the preferred alternative, as all impacts associated with shoreline disturbance and effluent discharge will no longer be an issue. This must, however, be seen in the context of existing proposed development in the Saldanha Bay area. Furthermore, it needs to be weighed up against the potential positive socio-economic impacts undoubtedly associated with the project itself.

8.1.3 Management actions and mitigation measures

The recommended **mitigation** measures for the **construction phase** are:

- Keep heavy vehicle traffic associated with pipeline or breakwater construction on the beach to a minimum;
- Restrict vehicles to clearly demarcated access routes and construction areas only;
- All construction activities in the coastal zone must be managed according to a strictly enforced Environmental Management Programme (EMP);
- Good house-keeping must form an integral part of any construction operations on the beach from start-up;
- All blasting activities (if required) should be conducted in accordance with recognised and applicable standards and safety requirements at the time;
- Search the area around the blasting area immediately prior to planned blasting and postpone blasting if turtles, marine mammals or flocks of diving or swimming birds are spotted within a 2-km radius of the blasting point;
- Restrict the number of blasts to the absolute minimum required, and to smaller, quick succession blasts directed into the rock using a time-delay detonation; and
- Undertake only one blasting activity (*i.e.* a single series of small ripple blasts) per day.

The recommended **mitigation** measures for the **operational phase** are:

- Undertake intermittent chlorination to prevent bacterial re-growth in the brine;
- Ensure that any residual chlorine is suitably neutralised, so that residual chlorine in the brine discharge is below the No Observed Effect Concentration (NOEC) and/or the relevant water quality target values;
- Monitor the brine for dissolved oxygen levels; and
- As far as possible, use only biocides, chemicals and additives with low toxicity to aquatic invertebrate and fish species.

Monitoring recommendations include:

- Establish a pre-construction marine ecology baseline against which long-term monitoring results can be compared;

- Prior to commencement of operations, conduct additional studies on the chemical and physical properties of the receiving water in Danger Bay to provide a reference baseline;
- Once in operation, conduct a study to ensure that the diffuser is performing to the expected specifications and that required dilution levels are achieved;
- Confirm brine and thermal footprints by sampling with a conductivity-temperature-depth probe to confirm the performance of the discharge system and the numerical model predictions;
- Undertake toxicity testing of the discharged effluent for a full range of operational scenarios to ensure complete confidence in the potential effects of co-discharged constituents;
- Continuously monitor the effluent for residual chlorine and dissolved oxygen levels;
- Periodically assess bacterial re-growth in the brine;
- Regularly monitor the effluent for heavy metals until a profile of the discharge in terms of heavy metal concentrations is determined. This will depend upon whether the WWTW will treat industrial effluent in addition to domestic effluent;
- Check corrosion levels of plant constituent parts and the physical integrity of the outlet pipes to reduce the risk of failure of the pipeline infrastructure and subsequent impacts on the marine ecosystem. If excessive corrosion is identified or specific maintenance is required, relevant components must be replaced or modified; and
- Implement a monitoring programme to study the effects of the effluent on the receiving water body, which is associated with the validation of the model results, and use the information to develop a contingency plan that examines the risk of contamination, and considers procedures that must be implemented to mitigate any unanticipated impacts.

Table 8.1 Assessment of impacts to the marine ecology associated with the proposed Saldanha Regional Marine Outfall Project

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Construction Phase											
Disturbance and destruction of beach macrofauna and/or intertidal rocky shore biota during pipeline construction as a result of vehicular traffic, jetty construction, and excavations	**Negative**	**Site Specific**, i.e. within the immediate area of the pipeline route	**Short**, beach biota is expected to recover within 2-3 years	**Medium**, as the site is already partly disturbed by 4x4 traffic on the beach	**Definite**, construction is unavoidable if the project is approved	**Reversible** as beach communities will recovery within the short term	**Low**	**Medium**	• Restrict traffic on upper beach to minimum required, • Restrict traffic to clearly demarcated access routes and construction areas only, • Good house-keeping and active rehabilitation following completion of construction activities.	**Low**, since any mitigation measures will reduce the impacts further and rehabilitation will speed-up the recovery of beach biota	**High**
Accidental spillage or leakage of fuel, chemicals, or lubricants may cause water or sediment contamination and/or disturbance to beach and subtidal biota	**Negative**	**Site Specific**, i.e. within the immediate area of the pipeline route	**Short**, potentially affected biota is likely to recover in 2-3 years	**High**, hydrocarbons are highly toxic	**Possible**, if 'good-house-keeping' measures are not in place	**Reversible** as beach communities will recovery within the short term	**Low**	**Medium**	• Have good house-keeping practices in place, • For equipment maintained in the field, oils & lubricants to be contained & correctly disposed of off-site, • Maintain vehicles and equipment to ensure that no oils, diesel, fuel or hydraulic fluids are spilled, • Vehicles used for the construction activity should have a spill kit (peatsorb/ drip trays) onboard in the event of a spill.	**Low**, since good house-keeping measures will reduce the risk of spills	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Disturbance and destruction of subtidal sandy and rocky reef biota during pipeline laying, jetty construction, surf-zone excavation and rock blasting	**Negative**	**Site Specific**, i.e. within the immediate area of the pipeline route	**Short**, subtidal sandy biota and rocky reef biota is expected to recover in 2-3 years	**High**, as affected sandy and rocky biota will be totally destroyed	**Definite**, construction is unavoidable of the project is approved	**Reversible** as beach communities will recovery within the short term	**Low**	**Medium**	• Restrict disturbance of the sea bottom to the smallest area possible, • Lay pipeline in such a way that required rock blasting is kept to a minimum, • Active rehabilitation of sandy subtidal substrate is not required as sediment redistribution will be fast in the turbulent surf zone, • Rehabilitation of rocky reefs is not possible but exposed pipeline will serve as new hard-bottom substrate.	**Medium**, since no mitigation measure will eliminate the need for rock blasting	**High**
Increased turbidity in surf-zone as a result of excavations and mobilising of sediments.	**Negative**	**Local**, within a couple of hundred meters to a few (< 5 km) kilometres	**Very short**, construction is likely to continue over a 6-12 month period but increased turbidity is expected to last only for a couple of hours to a few days after cessation of excavation activities	**Low**, surf-zone is highly productive and suspended sediment concentrations are naturally elevated	**Definite**, construction is unavoidable if the project is approved	**Reversible** over the very short term as plumes will be ephemeral only	**Low**	**Low**	• No mitigation possible other than the no-project alternative	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Deposition of excavated sediments in the surf-zone will smother benthic communities on both unconsolidated and hard substrata down-current of the construction site.	**Negative**	**Local**, within a couple of hundred meters to a few (< 5 km) kilometres	**Very short**, the surf and wave influenced (<40 m) zone is turbulent and redistributio n of deposited sediments will be fast	**Low**, surf-zone is highly productive and suspended sediment concentratio ns are naturally elevated	**Definite**, construction is unavoidable if the project is approved	**Reversible** over the very short term as deposited sediments will be constantly re-suspended	**Low**	**Low**	• No mitigation possible other than the no-project alternative	**Low**	**High**
Disturbance and avoidance behaviour of surf-zone fish communities, shore birds and marine mammals through pylon driving and construction noise.	**Negative**	**Local**	**Very short**, construction is likely to continue over a 6-12 month period	**Low**, exposed open coastline with a wide surf-zone and high densities of shore birds. No seal colonies in the vicinity of the proposed pipelines.	**Highly probable**	**Reversible** over the very short term as blast/noise impacts will have primarily nuisance value	**Low**	**Low**	• No direct mitigation possible, other than to restrict vibration-generating activities to the absolute minimum required.	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Effects of blasting on macrophytes, invertebrates and fish communities	**Negative**	**Site Specific to Local**	**Very short**, construction is likely to continue over a 6-12 month period	**Medium to High**, most phyla will only be affected in the immediate blasting zone and only fish with swim bladders are more susceptible	**Definite**	**Reversible** over the very short term as blast/noise impacts will have primarily nuisance value	**Low**	**Low to Medium**	• No direct mitigation possible, other than to restrict blasting to the absolute minimum required (one blast per day). • Use blasting methods which minimise the environmental effects of shock waves through the use of smaller, quick succession blasts directed into the rock. • Avoid onshore blasting during the breeding season of shore-birds.	**Low to Medium**, mitigation measures may reduce the frequency of blasting but will not eliminate the need for blasting	**Medium**, blasting schedule (extend and frequency) not known at this stage

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Effects of blasting on turtles and marine mammals.	**Negative**	**Local**	**Very short**, construction is likely to continue over a 6-12 month period	**Medium**, Exposed open coastline with a wide surf-zone. No seal colonies in the vicinity of the proposed pipeline. Res ident and migratory cetaceans present further offshore.	**Definite**	**Reversible** over the very short term as blast/noise impacts will have primarily nuisance value	**Low**	**Medium**	• No direct mitigation possible, other than to restrict blasting to the absolute minimum required (one blast per day). • Use blasting methods which minimise the environmental effects of shock waves through the use of smaller, quick succession blasts directed into the rock. • Visual observation limiting blasting to periods when there are no marine mammals present in the immediate vicinity (approximately 2 km radius).	**Low**, mitigation measures will reduce the risk of marine mammals being affected by blasting	**Medium**, blasting schedule (extend and frequency) not known at this stage

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Permanent loss of habitat under submerged discharge pipeline	**Negative**	**Site Specific**, i.e. within the immediate area of the submerged structures	**Permanent**, if pipelines are left in place after decommissio ning of the plant	**Medium**, a portion of the original benthic habitat is lost	**Definite**, impact will occur if this alternative is chosen	**Irreversible** as structures will be left in place on de-commission-ing	**Low**	**Low**	• No mitigation possible other than the no-project alternative, • Impact will be ameliorated by the fact that the submerged structures offer a new settling substrate for hard bottom species, • Leave pipeline in place post closure to prevent unnecessary disturbance of the seabed and associated communities.	**Low**, impact will be ameliorated by the fact that the submerged structures offer a new settling ground for hard bottom species	**High**
Submerged pipelines and associated structures act as artificial reefs	**Positive**	**Site Specific** i.e. within the immediate area of the submerged structures	**Permanent**, if pipelines are left in place after de-commission-ing of the plant	**Low** a new settling habitat for reef dwellers is created but this community might be different to the original one prior to the construction of the pipelines	**Definite**, impact will occur if this alternative is chosen	**Irreversible** as structures will be left in place on de-commission-ing	**Low**	**Medium**	• Leave pipeline in place post closure to prevent unnecessary disturbance of the seabed and associated communities.	**Low**, community on submerged structures is likely to be different from the original community prior to the construction of the pipelines	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Flow distortion at the discharge, and effects of pipeline on natural sediment dynamics	**Negative**	**Site Specific** i.e. within the immediate area of the pipeline	**Long** over the entire operational life time of the plant	**Low**	**Improbable**	**Irreversible** during operational life time of plant	**Low**	**Low**, since it is unlikely to happen	• No mitigation possible other than the no-project alternative	**Low**	**Medium**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Operational Phase											
Scenario 1: Marine Outfall Option 1 (Sandy beach at west end of Danger Bay)											
Flow distortion at the discharge, and effects of pipeline on natural sediment dynamics	**Negative**	**Site Specific**, i.e. within the immediate area of the pipeline	**Long**, over the entire operational life time of the outfall	**Low**	**Improbable**	**Irreversible** during operational life time of the outfall	**Low**	**Low**, since it is unlikely to happen	• No mitigation possible other than the no-project alternative	**Low**	**Medium**
Discharge of high density saline brine may cause sinking of the plume, seafloor spreading and increases in porewater salinity	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.10 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, increases in salinity at the seafloor will affect benthic communities	**Definite**, the brine may have a salinity of between 57.2 and 104.4 psu	**Irreversible** during operational life time of outfall	**Low**	**Medium to High**	• Ensure sufficient mixing of the effluent with the receiving water body by adjusting the discharge configuration appropriately, • Limit increased salinity to mixing zone.	**Low**, an appropriate discharge configuration will reduce the risk of seafloor spreading considerably	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Increased salinity in the mixing zone affects biota	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.10 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, increased salinity may be harmful to some biota	**Definite**, the brine may have a salinity of between 57.2 and 104.4 psu	**Irreversible** during operational life time of outfall	**Low**	**Medium**	• Ensure sufficient mixing of the effluent with the receiving water body by adjusting the discharge configuration appropriately, • Limit increased salinity to mixing zone.	**Low**, an appropriate discharge configuration will reduce the size of the mixing zone even under calm weather conditions	**High**
Increased temperature in the mixing zone affects biota	**Negative**	**Local**, i.e. worst case scenario footprint is 0.16 km^2 for near-bottom discharge	**Long**, over the entire operational life time of the outfall	**Low** temperature differences lie within the range defined by the 20%ile and 80%ile of the seasonal distribution of the ambient temperature for the system	**Definite**, the effluent will be heated above ambient	**Reversible** as temperature differences lie within the tolerances of marine biota	**Low**	**Low**	• Ensure sufficient mixing of the discharged effluent with the receiving water body by adjusting the discharge configuration appropriately, • Limit increased temperature to mixing zone.	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Reduction in dissolved oxygen concentrations of the receiving water as a result of dechlorination with sodium bisulphite, elevated nutrients from the WWTW	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Very short term to long,** dechlorina-tion will be done over the entire operational life time of the plant but overdosing may occur only intermittently	**Medium**, low-oxygen events can occur in the area	**Probable**, if overdosing with sodium bisulphite (SBS) occurs or excessive organic matter in the effluent decomposes	**Reversible** as biota adapted to natural seasonal hypoxic conditions	**Low**	**Medium**	• Aeration of the effluent prior to discharge • Effective screening of organic matter in the WWTW	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Eutrophication due to elevated nutrient levels in the effluent from the WWTW, and use of antiscalants	**Negative**	**Site Specific to local,** i.e. worst case scenario footprint for 100x dilution is 0.026 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, antiscalants are non- toxic at the concentra-tions used but they may bind nutrients and ions needed for plant growth. Polyphos-phonate antiscalants and elevated nutrient levels from WWTW may cause a nutrient surplus potentially leading to algal blooms	**Probable**	**Reversible** over the very short term as micro-nutrients unlikely to be limited	**Low**	**Low**	• Ensure that effluent from WWTW complies with General Waste Water Limits. • Avoid antiscalants that increase nutrient levels (e.g. polyphosphate antiscalants),	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Heavy metals (from corrosion processes in the plants, effluent from the WWTW and generated by the SSP) may affect dissolved metal concentrations in the receiving water	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Long**, over the entire operational life time of the outfall	**Medium**, heavy metals are toxic and may accumulate in sediments and biota	**Probable**	**Irreversible** during operational life time of outfall as heavy metals may accumulate in the sediments	**Low**	**Medium**	• Design outfall properly, e.g. by eliminating dead spots and threaded connections to reduce corrosion to a minimum. • Corrosion resistance is considered good when the corrosion rate is <0.1 mm/a (UNEP 2008). • Monitor corrosion rate in the various plants. • Monitor effluents for metal concentrations.	**Low**	**High**
Effects of REEs on marine communities in the mixing zone	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Long**, over the entire operational life time of the outfall	**Medium**, REEs may accumulate in biota and be toxic if present in higher concentratio ns	**Improbable** REEs will be extracted and precipitated out and trace amounts are expected under upset conditions only	**Irreversible** during operational life time of outfall as REEs may accumulate in biota	**Low**	**Medium**	• Monitor effluents from SSP regularly for REE concentrations.	**Low**	**Medium**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Effects of discharged co-pollutants (assessment based on an assumed required dilution of 100x)	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.026 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, toxicity varies depending on the pollutant in question, some are highly toxic (cyanide, naphthenic acids)	**Highly** probable, if discharged with effluent	**Reversible** over the very short term as dilution is expected to be rapid and effects of chemicals benign at the concentra-tions involved	**Low**	**Medium**	• Treat backwash from brine purification filters in slurry tank, neutralize, and remove solids for alternative disposal on land. • Monitor effluents from all plants regularly for the presence of toxic constituents. • Wherever possible, select constituents and chemicals that have relevant eco-toxicological testing. • Regularly conduct Whole Effluent Toxicity (WET) testing of the effluent.	**Low**	**High**
Effects of discharge of other residual solutions (assessment based on an assumed required dilution of 100)	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.026 km^2	**Very short** term, RO membrane maintenance cleaning (CIP) to be undertaken ~3 times per year. The cleaning solutions will be blended into and discharged with the brine	**Low,** cleaning solutions have low toxicity but may have lower pH values (see 3.14)	**Definite**	**Reversible** over the very short term as effects of chemicals benign at the concentra-tions discharged	**Low**	**Low**	• Collect residual cleaning solutions and membrane filter washes and neutralize and remove solids before discharge.	**Low**, treatment of the residual cleaning solutions in the sludge handling facility will reduce the impact	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Discharge of acidic or alkaline solutions (cleaning chemicals or from CAPF) may affect the ambient pH of seawater	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Very short** term, RO membrane maintenance cleaning (CIP) undertaken intermittently and releases from CAPF expected only under expected upset conditions only	**Low**, buffering capacity of seawater will neutralize surplus acidity quickly	**Probable** (RO cleaning chemicals) Unlikely (CAPF)	**Reversible** over the very short term as effects of chemicals benign at the concentra-tions discharged	**Low**	**Low**	• Collect residual cleaning solutions and membrane filter washes and neutralize before discharge. • Regularly monitor pH of effluents from the various plants.	**Low**, neutralizing of the cleaning solutions or reject streams will avoid the impact	**High**
Effects of biocide on marine communities in the mixing zone (used in WWTW and CAPF cooling)	**Negative**	**Local**, i.e. the worst case scenario footprint is 0.026 km^2 for near bottom discharge	**Long**, over the entire operational life time of the outfall	**High**, biocides are highly toxic to aquatic life	**Definite**, if WWTW effluent and cooling water are not dechlori-nated	**Irreversible** biocides are highly toxic to aquatic life	**Low**	**High**	• Dechlorinate effluent with SBS prior to discharge. • Pigging of intake and discharge pipeline should be undertaken as it can reduce the need for and costs of biocides.	**Low**, the dechlorination process will reduce residual chlorine in the brine to below detectable level if SBS dosing is done properly	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Excessive bacterial re-growth in the brine after chlorination and pathogens in the WWTW effluent	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Long**, over the entire operational life time of the outfall	**Low**, pathogens and heavy bacterial loading may cause human health risk but area around discharge is not used extensively for recreational activities where humans may come in contact with the water (e.g. swimming, diving, etc.)	**Probable**, depends on the bacteria naturally occurring in the feed water and waster water	**Irreversible** during operational life time of outfall	**Low**	**Low**	• Use intermittent shock dosing with a biocide to avoid bacterial resistance to the biocide. • Monitor the brine for excessive bacterial re-growth and if necessary use sodium bisulfite shock dosing to reduce bacteria numbers (note that the brine will be oxygen depleted after this treatment and needs to be aerated before discharge). • Ensure pathogen levels in the WWTW effluent comply with General Waster Water Limits before discharge.	**Low**, mitigation measures will reduce the risk of bacterial re-growth and pathogens in the effluent	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Chlorinated-dechlorinated brine may still have chronic effects due to the presence of halogenated by-products	**Negative**	**Site Specific**, i.e. within the immediate area of the brine outlet	**Long**, over the entire operational life time of the outfall	**Medium**, chlorination by-products are also powerful biocides	**Improbable**, as only a very small percentage of the chlorine will transform into toxic by-products that are not eliminated by dechlorina-tion	**Irreversible** during operational life time of outfall	**Low**	**Low**	• No mitigation possible as chlorine chemistry is very complex and type and concentrations of by-product formation cannot be predicted.	**Low**	**Medium**, chlorine chemistry is very complex and type and concentratio ns of by-product formation cannot be predicted
Synergistic and antagonistic effects of a combined effluent	**Negative**	**Site Specific**, i.e. within the immediate area of the brine outlet	**Long**, over the entire operational life time of the outfall	**Medium to High**	**Probable**	**Irreversible** during operational life time of outfall	**Low**	**High**	• Should concentrations of heavy metals and Rare Earth Elements in the effluent generated during normal operation of the separation plant not fall within the guidelines (DWAF 1995; ANZECC 2000 or others that may be applicable), polishing of the brine by metals precipitation should be undertaken. • Investigate the use of lime as the alkali. • Commission a specialist study to investigate potential synergistic and antagonistic effects of the effluents.	**Low**	**Low**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Avoidance behaviour by fish and marine mammals of the discharge area	**Negative**	**Site Specific**, i.e. within the immediate area of the brine outlet	**Long**, over the entire operational life time of the outfall	**Low**, mobile biota will avoid the area but this may result in loss of potential feeding or breeding grounds	**Probable**, depends on species sensitivity	**Irreversible** during operational life time of outfall	**Low**	**Medium**	• Ensure sufficient mixing of the discharged brine with the receiving water body by adjusting the discharge configuration appropriately. • Limit the size of the mixing zone to a minimum.	**Low**, an appropriate discharge configuration will reduce the size of the mixing zone	**High**
Scenario 1: Marine Outfall Option 2 (Sandy beach at centre of Danger Bay)											
Flow distortion at the discharge, and effects of pipeline on natural sediment dynamics	**Negative**	**Site Specific**, i.e. within the immediate area of the pipeline	**Long,** over the entire operational life time of the outfall	**Low**	**Improbable**	**Irreversible** during operational life time of the outfall	**Low**	**Low**, since it is unlikely to happen	• No mitigation possible other than the no-project alternative.	**Low**	**Medium**
Discharge of high density saline brine may cause sinking of the plume, seafloor spreading and increases in porewater salinity	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.001 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, increases in salinity at the seafloor will affect benthic communities	**Definite**, the brine may have a salinity of between 57.2 and 104.4 psu	**Irreversible** during operational life time of outfall	**Low**	**Medium to High**	• Ensure sufficient mixing of the effluent with the receiving water body by adjusting the discharge configuration appropriately. • Limit increased salinity to mixing zone.	**Low**, an appropriate discharge configuration will reduce the risk of seafloor spreading considerably	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Increased salinity in the mixing zone affects biota	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.001 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, increased salinity may be harmful to some biota	**Definite**, the brine may have a salinity of between 57.2 and 104.4 psu	**Irreversible** during operational life time of outfall	**Low**	**Medium**	• Ensure sufficient mixing of the effluent with the receiving water body by adjusting the discharge configuration appropriately. • Limit increased salinity to mixing zone.	**Low**, an appropriate discharge configuration will reduce the size of the mixing zone even under calm weather conditions	**High**
Increased temperature in the mixing zone affects biota	**Negative**	**Local**, i.e. worst case scenario footprint is 0.002 km^2 for near-bottom discharge	**Long**, over the entire operational life time of the outfall	**Low** temperature differences lie within the range defined by the 20%ile and 80%ile of the seasonal distribution of the ambient temperature for the system	**Definite**, the effluent will be heated above ambient	**Reversible** as temperature differences lie within the tolerances of marine biota	**Low**	**Low**	• Ensure sufficient mixing of the discharged effluent with the receiving water body by adjusting the discharge configuration appropriately. • Limit increased temperature to mixing zone.	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Reduction in dissolved oxygen concentrations of the receiving water as a result of dechlorination with sodium bisulphite, elevated nutrients from the WWTW	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Very short term to long**, dechlorina-tion will be done over the entire operational life time of the plant but overdosing may occur only intermittently	**Medium**, low-oxygen events can occur in the area	**Probable**, if overdosing with SBS occurs or excessive organic matter in the effluent decomposes	**Reversible** as biota adapted to natural seasonal hypoxic conditions	**Low**	**Medium**	• Aeration of the effluent prior to discharge. • Effective screening of organic matter in the WWTW.	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Eutrophication due to elevated nutrient levels in the effluent from the WWTW, and use of antiscalants	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.004 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, antiscalants are non-toxic at the concentra-tions used but they may bind nutrients and ions needed for plant growth. Polyphos-phonate antiscalants and elevated nutrient levels from WWTW may cause a nutrient surplus potentially leading to algal blooms	**Probable**	**Reversible** over the very short term as micro-nutrients unlikely to be limited	**Low**	**Low**	• Ensure that effluent from WWTW complies with General Waste Water Limits. • Avoid antiscalants that increase nutrient levels (e.g. polyphosphate antiscalants).	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Heavy metals (from corrosion processes in the plants, effluent from the WWTW and generated by the SSP) may affect dissolved metal concentrations in the receiving water	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Long**, over the entire operational life time of the outfall	**Medium**, heavy metals are toxic and may accumulate in sediments and biota	**Probable**	**Irreversible** during operational life time of outfall as heavy metals may accumulate in the sediments	**Low**	**Medium**	• Design outfall properly, e.g. by eliminating dead spots and threaded connections, to reduce corrosion to a minimum. • Corrosion resistance is considered good when the corrosion rate is <0.1 mm/a (UNEP 2008). • Monitor corrosion rate in the various plants. • Monitor effluents for metal concentrations.	**Low**	**High**
Effects of REEs on marine communities in the mixing zone	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Long**, over the entire operational life time of the outfall	**Medium**, REEs may accumulate in biota and be toxic if present in higher concentratio ns	**Improbable** REEs will be extracted and precipitated out and trace amounts are expected under upset conditions only	**Irreversible** during operational life time of outfall as REEs may accumulate in biota	**Low**	**Medium**	• Monitor effluents from SSP regularly for REE concentrations.	**Low**	**Medium**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Effects of discharged co-pollutants (assessment based on an assumed required dilution of 100x)	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.004 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, toxicity varies depending on the pollutant in question, some are highly toxic (cyanide, naphthenic acids)	**Highly** probable, if discharged with effluent	**Reversible** over the very short term as dilution is expected to be rapid and effects of chemicals benign at the concentra-tions involved	**Low**	**Medium**	• Treat backwash from brine purification filters in slurry tank, neutralize, and remove solids for alternative disposal on land. • Monitor effluents from all plants regularly for the presence of toxic constituents. • Wherever possible, select constituents and backwash chemicals that have relevant eco-toxicological testing. • Regularly conduct WET testing of the effluent.	**Low**	**High**
Effects of discharge of other residual cleaning solutions used during periodical RO membrane maintenance cleaning (assessment based on an assumed required dilution of 100)	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.004 km^2	**Very short** term, RO membrane maintenance cleaning (CIP) to be undertaken ~3 times per year. The cleaning solutions will be blended into and discharged with the brine	**Low**, cleaning solutions have low toxicity but may have lower pH values	**Definite**	**Reversible** over the very short term as effects of chemicals benign at the concentra-tions discharged	**Low**	**Low**	• Collect residual cleaning solutions and membrane filter washes and neutralize and remove solids before discharge.	**Low**, treatment of the residual cleaning solutions in the sludge handling facility will reduce the impact	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Discharge of acidic or alkaline solutions (cleaning chemicals or from CAPF) may affect the ambient pH of seawater	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Very short** term, RO membrane maintenance cleaning (CIP) undertaken intermittently and releases from CAPF expected only under expected upset conditions only	**Low**, buffering capacity of seawater will neutralize surplus acidity quickly	**Probable** (RO cleaning chemicals) Unlikely (CAPF)	**Reversible** over the very short term as effects of chemicals benign at the concentra-tions discharged	**Low**	**Low**	• Collect residual cleaning solutions and membrane filter washes and neutralize before discharge. • Regularly monitor pH of effluents from the various plants.	**Low**, neutralizing of the cleaning solutions or reject streams will avoid the impact	**High**
Effects of biocide on marine communities in the mixing zone (used in WWTW and CAPF cooling)	**Negative**	**Local**, i.e. the worst case scenario footprint is 0.004 km^2 for near bottom discharge	**Long**, over the entire operational life time of the outfall	**High**, biocides are highly toxic to aquatic life	**Definite**, if WWTW effluent and cooling water are not de-chlorinated	**Irreversible** biocides are highly toxic to aquatic life	**Low**	**High**	• Dechlorinate effluent with SBS prior to discharge. • Pigging of discharge pipeline should be undertaken as it can reduce the need for and costs of biocides.	**Low**, the dechlorination process will reduce residual chlorine in the brine to below detectable level if SBS dosing is done properly	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Excessive bacterial re-growth in the brine after chlorination and pathogens in the WWTW effluent	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Long**, over the entire operational life time of the outfall	**Low**, pathogens and heavy bacterial loading may cause human health risk but area around discharge is not used extensively for recreational activities where humans may come in contact with the water (e.g. swimming, diving, etc.)	**Probable**, depends on the bacteria naturally occurring in the feed water and waste water	**Irreversible** during operational life time of outfall	**Low**	**Low**	• Use intermittent shock dosing with a biocide to avoid bacterial resistance to the biocide. • Monitor the brine for excessive bacterial re-growth and if necessary use sodium bisulfite shock dosing to reduce bacteria numbers (note that the brine will be oxygen depleted after this treatment and needs to be aerated before discharge). • Ensure pathogen levels in the WWTW effluent comply with General Waster Water Limits before discharge.	**Low**, mitigation measures will reduce the risk of bacterial re-growth and pathogens in the effluent	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Chlorinated-dechlorinated brine may still have chronic effects due to the presence of halogenated by-products	**Negative**	**Site Specific**, i.e. within the immediate area of the brine outlet	**Long**, over the entire operational life time of the outfall	**Medium**, chlorination by-products are also powerful biocides	**Improbable**, as only a very small percentage of the chlorine will transform into toxic by-products that are not eliminated by dechlorination	**Irreversible** during operational life time of outfall	**Low**	**Low**	• No mitigation possible as chlorine chemistry is very complex and type and concentrations of by-product formation cannot be predicted.	**Low**	**Medium**, chlorine chemistry is very complex and type and concentrations of by-product formation cannot be predicted
Synergistic and antagonistic effects of a combined effluent	**Negative**	**Site Specific**, i.e. within the immediate area of the brine outlet	**Long**, over the entire operational life time of the outfall	**Medium to High**	**Probable**	**Irreversible** during operational life time of outfall	**Low**	**High**	• Should concentrations of heavy metals and Rare Earth Elements in the effluent generated during normal operation of the separation plant not fall within the guidelines (DWAF 1995; ANZECC 2000 or others that may be applicable), polishing of the brine by metals precipitation should be undertaken. • Investigate the use of lime as the alkali. • Commission a specialist study to investigate potential synergistic and antagonistic effects of the effluents.	**Low**	**Low**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Avoidance behaviour by fish and marine mammals of the discharge area	**Negative**	**Site Specific**, i.e. within the immediate area of the brine outlet	**Long**, over the entire operational life time of the outfall	**Low**, mobile biota will avoid the area but this may result in loss of potential feeding or breeding grounds	**Probable**, depends on species sensitivity	**Irreversible** during operational life time of outfall	**Low**	**Medium**	• Ensure sufficient mixing of the discharged brine with the receiving water body by adjusting the discharge configuration appropriately. • Limit the size of the mixing zone to a minimum.	**Low**, an appropriate discharge configuration will reduce the size of the mixing zone	**High**
Scenario 2: Marine Outfall and WCDM Desalination Plant											
Flow distortion at the discharge, and effects of pipeline on natural sediment dynamics	**Negative**	**Site Specific**, i.e. within the immediate area of the pipeline	**Long**, over the entire operational life time of the outfall	**Low**	**Improbable**	**Irreversible** during operational life time of the outfall	**Low**	**Low**, since it is unlikely to happen	• No mitigation possible other than the no-project alternative.	**Low**	**Medium**
Discharge of high density saline brine may cause sinking of the plume, seafloor spreading and increases in porewater salinity	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.423 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, increases in salinity at the seafloor will affect benthic communities	**Definite**, the brine may have a salinity of between 57.2 and 64.0 psu	**Irreversible** during operational life time of outfall	**Low**	**Medium to High**	• Ensure sufficient mixing of the effluent with the receiving water body by adjusting the discharge configuration appropriately. • Limit increased salinity to mixing zone.	**Low**, an appropriate discharge configuration will reduce the risk of seafloor spreading considerably	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Increased salinity in the mixing zone affects biota	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.423 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, increased salinity may be harmful to some biota	**Definite**, the brine may have a salinity of between 57.2 and 64.0 psu	**Irreversible** during operational life time of outfall	**Low**	**Medium**	• Ensure sufficient mixing of the effluent with the receiving water body by adjusting the discharge configuration appropriately. • Limit increased salinity to mixing zone.	**Low**, an appropriate discharge configuration will reduce the size of the mixing zone even under calm weather conditions	**High**
Increased temperature in the mixing zone affects biota	**Negative**	**Local**, i.e. worst case scenario footprint is 0.109 km^2 for near-bottom discharge	**Long**, over the entire operational life time of the outfall	**Low** temperature differences lie within the range defined by the 20%ile and 80%ile of the seasonal distribution of the ambient temperature for the system	**Definite**, the effluent will be heated above ambient	**Reversible** as temperature differences lie within the tolerances of marine biota	**Low**	**Low**	• Ensure sufficient mixing of the discharged effluent with the receiving water body by adjusting the discharge configuration appropriately. • Limit increased temperature to mixing zone.	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Reduction in dissolved oxygen concentrations of the receiving water as a result of dechlorination with sodium bisulphite, elevated nutrients from the WWTW	**Negative**	**Site Specific,** i.e. within the immediate area of the outlet	**Very short** term to long, dechlorina-tion will be done over the entire operational life time of the RO plant but overdosing may occur only intermittently	**Medium**, low-oxygen events can occur in the area	**Probable**, if overdosing with SBS occurs or excessive organic matter in the effluent decomposes	**Reversible** as biota adapted to natural seasonal hypoxic conditions	**Low**	**Medium**	• Aeration of the effluent from the RO plant prior to discharge. • Effective screening of organic matter in the WWTW.	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Eutrophication due to elevated nutrient levels in the effluent from the WWTW, and use of antiscalants	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint for 100x dilution is 0.895 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, antiscalants are non-toxic at the concentra-tions used but they may bind nutrients and ions needed for plant growth. Polyphospho nate antiscalants and elevated nutrient levels from WWTW may cause a nutrient surplus potentially leading to algal blooms	**Probable**	**Reversible** over the very short term as micro-nutrients unlikley to be limited	**Low**	**Low**	• Ensure that effluent from WWTW complies with General Waste Water Limits. • Avoid antiscalants that increase nutrient levels (e.g. polyphosphate antiscalants).	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Heavy metals (from corrosion processes in the RO Plant, effluent from the WWTW and generated by the SSP) may affect dissolved metal concentrations in the receiving water	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Long**, over the entire operational life time of the outfall	**Medium**, heavy metals are toxic and may accumulate in sediments and biota	**Probable**	**Irreversible** during operational life time of outfall as heavy metals may accumulate in the sediments	**Low**	**Medium**	• Design outfall properly, e.g. by eliminating dead spots and threaded connections, to reduce corrosion to a minimum. • Corrosion resistance is considered good when the corrosion rate is <0.1 mm/a (UNEP 2008). • Monitor corrosion rate in the various plants. • Monitor effluents for metal concentrations.	**Low**	**High**
Effects of REEs on marine communities in the mixing zone	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Long**, over the entire operational life time of the outfall	**Medium**, REEs may accumulate in biota and be toxic if present in higher concentratio ns	**Improbable** REEs will be extracted and precipitated out and trace amounts are expected under upset conditions only	**Irreversible** during operational life time of outfall as REEs may accumulate in biota	**Low**	**Medium**	• Monitor effluents from SSP regularly for REE concentrations.	**Low**	**Medium**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Effects of discharged co-pollutants (assessment based on an assumed required dilution of 100x)	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.895 km^2	**Long**, over the entire operational life time of the outfall	**Medium**, toxicity varies depending on the pollutant in question, some are highly toxic (cyanide, naphthenic acids)	**Highly** probable, if discharged with effluent	**Reversible** over the very short term as dilution is expected to be rapid and effects of chemicals benign at the concentra-tions involved	**Low**	**Medium**	• Treat backwash sludge from RO plant in sludge handling facility, neutralize, and remove solids for alternative disposal on land. • Treat backwash from brine purification filters in slurry tank, neutralize, and remove solids for alternative disposal on land. • Monitor effluents from all plants regularly for the presence of toxic constituents. • Wherever possible, select constituents and backwash chemicals that have relevant eco-toxicological testing. • Regularly conduct WET testing of the effluent.	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Effects of discharge of other residual cleaning solutions used during periodical RO membrane maintenance cleaning (assessment based on an assumed required dilution of 100)	**Negative**	**Site Specific** to local, i.e. worst case scenario footprint is 0.895 km^2	**Very short** term, RO membrane maintenance cleaning (CIP) to be undertaken ~3 times per year. The cleaning solutions will be blended into and discharged with the brine	**Low**, cleaning solutions have low toxicity but may have lower pH values (see 3.14)	**Definite**	**Reversible** over the very short term as effects of chemicals benign at the concentra-tions discharged	**Low**	**Low**	• Collect residual cleaning solutions and membrane filter washes and neutralize and remove solids before discharge.	**Low**, treatment of the residual cleaning solutions in the sludge handling facility will reduce the impact	**High**
Discharge of acidic or alkaline solutions (cleaning chemicals or from CAPF) may affect the ambient pH of seawater	**Negative**	**Site Specific**, i.e. within the immediate area of the outlet	**Very short** term, RO membrane maintenance cleaning (CIP) undertaken intermittently and releases from CAPF expected only under expected upset conditions only	**Low**, buffering capacity of seawater will neutralize surplus acidity quickly	**Probable** (RO cleaning chemicals) Unlikely (CAPF)	**Reversible** over the very short term as effects of chemicals benign at the concentra-tions discharged	**Low**	**Low**	• Collect residual cleaning solutions and membrane filter washes and neutralize before discharge. • Regularly monitor pH of effluents from the various plants.	**Low**, neutralizing of the cleaning solutions or reject streams will avoid the impact	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Effects of biocide on marine communities in the mixing zone (used in RO plant, WWTW and CAPF cooling)	**Negative**	**Local**, i.e. the worst case scenario footprint is 0.895 km^2 for near bottom discharge	**Long**, over the entire operational life time of the outfall	**High**, biocides are highly toxic to aquatic life	**Definite**, if RO Plant feedwater, WWTW effluent and cooling water are not dechlori-nated	**Irreversible** biocides are highly toxic to aquatic life	**Low**	**High**	• Dechlorinate effluent with SBS prior to discharge. • Pigging of intake and discharge pipeline should be undertaken as it can reduce the need for and costs of biocides.	**Low**, the dechlorination process will reduce residual chlorine in the brine to below detectable level if SBS dosing is done properly	**High**
Excessive bacterial re-growth in the brine after chlorination and pathogens in the WWTW effluent	**Negative**	**Site Specific,** i.e. within the immediate area of the outlet	**Long**, over the entire operational life time of the outfall	**Low**, pathogens and heavy bacterial loading may cause human health risk but area around discharge is not used extensively for recreational activities where humans may come in contact with the water (e.g. swimming, diving, etc.)	**Probable**, depends on the bacteria naturally occurring in the feed water and waster water	**Irreversible** during operational life time of outfall	**Low**	**Low**	• Use intermittent shock dosing with a biocide to avoid bacterial resistance to the biocide. • Monitor the brine for excessive bacterial re-growth and if necessary use sodium bisulfite shock dosing to reduce bacteria numbers (note that the brine will be oxygen depleted after this treatment and needs to be aerated before discharge). • Ensure pathogen levels in the WWTW effluent comply with General Waster Water Limits before discharge.	**Low**, mitigation measures will reduce the risk of bacterial re-growth and pathogens in the effluent	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Chlorinated-dechlorinated brine may still have chronic effects due to the presence of halogenated by-products	**Negative**	**Site Specific**, i.e. within the immediate area of the brine outlet	**Long**, over the entire operational life time of the outfall	**Medium**, chlorination by-products are also powerful biocides	**Improbable**, as only a very small percentage of the chlorine will transform into toxic by-products that are not eliminated by dechlorina-tion	**Irreversible** during operational life time of outfall	**Low**	**Low**	• No mitigation possible as chlorine chemistry is very complex and type and concentrations of by-product formation cannot be predicted.	**Low**	**Medium**, chlorine chemistry is very complex and type and concentratio ns of by-product formation cannot be predicted
Synergistic and antagonistic effects of a combined effluent	**Negative**	**Site Specific**, i.e. within the immediate area of the brine outlet	**Long**, over the entire operational life time of the outfall	**Medium to High**	**Probable**	**Irreversible** during operational life time of outfall	**Low**	**High**	• Should concentrations of heavy metals and Rare Earth Elements in the effluent generated during normal operation of the separation plant not fall within the guidelines (DWAF 1995; ANZECC 2000 or others that may be applicable), polishing of the brine by metals precipitation should be undertaken. • Investigate the use of lime as the alkali. • Commission a specialist study to investigate potential synergistic and antagonistic effects of the effluents.	**Low**	**Low**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Avoidance behaviour by fish and marine mammals of the discharge area	**Negative**	**Site Specific**, i.e. within the immediate area of the brine outlet	**Long**, over the entire operational life time of the outfall	**Low**, mobile biota will avoid the area but this may result in loss of potential feeding or breeding grounds	**Probable**, depends on species sensitivity	**Irreversible** during operational life time of outfall	**Low**	**Medium**	• Ensure sufficient mixing of the discharged brine with the receiving water body by adjusting the discharge configuration appropriately. • Limit the size of the mixing zone to a minimum.	**Low**, an appropriate discharge configuration will reduce the size of the mixing zone	**High**

8.2 TERRESTRIAL ECOLOGY

Mr Nick Helme of *Nick Helme Botanical Surveys* was commissioned by the CSIR to undertake the Terrestrial Ecological study (fauna and flora) for the SRMO Project. Two alternative pipeline routes (i.e. Jacobsbaai Western and Eastern Corridors) were assessed in this study, although for about 70% of their length they either share the same alignment or are on opposite sides of the same road.

It is assumed that the installation of the pipeline will result in disturbance of a corridor up to 12 m wide, including an adjacent access track (at least for construction, where the pipeline is not close enough to any existing road), trenches and temporary piling of fill. It is also assumed that the pipeline will run either within or just outside the existing or new proposed road reserves (in the case where roads are proposed for upgrade).

The study area is within the planning domain of the Saldanha Fine Scale Conservation Plan (Pence 2008), which has identified and mapped Critical Biodiversity Areas (CBAs) throughout the region. Critical Biodiversity Areas are regarded as essential areas for the achievement of regional conservation targets, and are designed to ensure minimum land take for maximum result (Maree & Vromans 2010). The Fine Scale Plan indicates that both pipeline routing alternatives cross significant CBAs. As many as 25 different plant species of special concern (SCC) are potentially found within 200 m of both proposed routes, usually where these cross CBAs. If any of these SCC are within the study area they are likely to be within the mapped areas of Very High Sensitivity, and are not likely to be found in significant numbers outside the Very High Sensitivity areas.

Faunal sensitivity is expected to mirror the botanical sensitivity. Two faunal Species of Conservation Concern have been recorded from the study area (Rose's Rainfrog (*Breviceps rosei)* – SW coastal endemic, and Black Girdled Lizard (*Cordylus niger)* – Near Threatened), and a further six reptile SCC may occur (probably in low numbers) within the study area.

Approximately 8 500 m of the Jacobsbaai Western Corridor (blue) alternative is within mapped CBAs, whereas this figure is about 9 615 m for the Jacobsbaai Eastern Corridor (purple) alternative. The latter thus crosses about 11 % more CBA than the former.

The SA vegetation map (Mucina & Rutherford 2006) and the more accurate and higher resolution Saldanha Fine Scale Vegetation Map (Helme & Koopman 2007) indicate that the proposed route crosses four main terrestrial vegetation types. **Saldanha Flats Strandveld** is regarded as Endangered on a national basis (Rouget *et al* 2004; DEA 2011). **Saldanha Granite Strandveld** is listed as an Endangered vegetation type (DEA 2011), and the coastal form in the area between Jacobsbaai and Danger Bay supports an unusual assemblage of species that does not occur elsewhere (pers. obs). **Saldanha Limestone Strandveld** was previously listed as an Endangered vegetation type (Rouget et al 2004), and then was unfortunately downgraded to Least Threatened (DEA 2011), due to an oversight by the SANBI, and this error will apparently only be rectified in about 2015. The unit has the highest number of threatened and localised plant species of all vegetation types in the Saldanha region, and the Jacobsbaai area is one of two primary hotspots for highly localised species (Helme & Koopman 2007). The unit is also poorly conserved (represented) in the West Coast National Park. **Langebaan Dune Strandveld** was regarded as Vulnerable in

terms of the National Spatial Biodiversity Assessment (Rouget *et al* 2004), but the unit is now not listed as a Threatened Ecosystem on the National List (DEA 2011), mainly because large areas are well protected within the West Coast National Park.

At least twenty five plant SCC (Raimondo *et al* 2009) have been recorded from the vicinity of the project area (defined as being within 200 m of the proposed route) (Section 5.1 of the Terrestrial Ecological Study in Appendix B of Volume II of this report). If any of these SCC are within the study area they are likely to be within the Very High Sensitivity areas shown in Figures 6 and 7 of the Ecological Study (Appendix B of Volume II), and are not likely to be found in significant numbers outside the Very High Sensitivity areas. It should however be noted that the Very High Sensitivity areas shown are only shown within 200 m of the proposed routes, and even though they may extend more than 200 m away they are not shown in those areas.

The pipeline through Jacobsbaai has the potential to cause significant damage to sensitive habitat and SCC (along the Jacobsbaai Western Corridor), but if located west of the main road this damage is likely to be significantly less than if located east of the road, as most of the SCC are located east of the road. The only four SCC known from within 12 m of the west side of the road are *Zaluzianskya parviflora* (Near Threatened), *Limonium capense* (Near Threatened), *Felicia elongata* (Vulnerable) and *Ruschia langebaanensis* (Threatened). It is recommended that for the section pipeline of approximately 2 000 m traversing through an area with endangered vegetation, the pipeline footprint should be entirely within the road reserve west of the main road to reduce impacts on sensitive vegetation along the pipeline corridor. This recommendation has been accepted by Frontier Saldanha Utilities.

PIPELINE ROUTING ALTERNATIVES

A full description of the pipeline routing alternatives and the discussion on offsets is provided in Section 1.4.2 of Chapter 1. The section below provides a summary of Section 1.4.2.

BACKGROUND TO THE WEST COAST DISTRICT MUNICIPALITY DESALINATION PLANT APPLICATION

It is proposed that the Frontier transfer pipeline will follow to a large extent the same terrestrial corridor as that proposed in the EIA for the proposed WCDM desalination plant potable water pipeline leading to the Besaansklip reservoir. Authorisation for this pipeline was granted by DEA&DP on 13 August 2013. In this EA, the 'Jacobsbaai Road Eastern Corridor' was approved as the preferred corridor. Subsequently, the CSIR has lodged an Application for Amendment to the Environmental Authorisation to DEA&DP on 15 August 2014 to approve the 'Jacobsbaai Road Western Corridor' as the preferred alternative instead. This is as certain land owners along the 'Jacobsbaai Road Eastern Corridor' were not amiable to negotiate the potential for registering a servitude over their properties.

FURTHER NEGOTIATIONS ON ERF 299

Subsequent to lodging the Application for an EA Amendment for the WCDM Desalination Plant, Frontier Saldanha Utilities started negotiating with land owners along the Jacobsbaai Eastern Corridor to register a servitude. Frontier Saldanha Utilities issued a letter dated 25 February 2015 to Mr Smit to formally request Forellendam to indicate whether they would be amenable towards negotiations with regard to the registering of a proposed servitude over Erf 299 (see Appendix B2 (i)). Mr Smit issued a letter of objection dated 18 March 2015 in response (see Appendix B2(ii)). Attached to the letter from Mr Smit is a letter from the SBM granting development rights for erven 299, 892 and 889, which also includes a layout plan (dated April 1994).

Following this interaction, the Jacobsbaai Eastern Corridor was identified as not being a viable alternative, and Frontier has reconsidered routing alternatives including the 'Afrisam' and 'Jacobsbaai Road Western' Corridors which were previously considered by the CSIR EIA project team during the WCDM desalination plant EIA.

Discussions between representatives of Frontier Saldanha Utilities and Afrisam revealed that Afrisam object to the pipeline crossing their property. Afrisam issued a letter of objection dated 9 February 2015 (see Appendix B3).

The Jacobsbaai Western Corridor was thus included as the preferred pipeline routing alternative in the Final Scoping Report and was assessed in the EIA phase of the SRMO Project (see Figure 1.1). The Jacobsbaai Western Corridor was assessed in the Terrestrial Ecological specialist study undertaken by Nick Helme for the SRMO Project (Appendix B of Volume II of this report). The study concluded that the Jacobsbaai Western Corridor will have a HIGH negative botanical impact without mitigation, which could be reduced to MEDIUM negative with mitigation. The required mitigation involves rerouting a portion of the route (from Pump station C to D) to the northern side of the Jacobsbaai Road, thereby avoiding sensitive wetland areas on the southern side of the Jacobsbaai Road. The Jacobsbaai Western Corridor will have a HIGH negative botanical impact without mitigation, which could be reduced to LOW to MEDIUM with a financial contribution to a biodiversity offset. The Jacobsbaai Eastern Corridor will have a MEDIUM negative botanical impact, both before and after mitigation. Thus if rerouting of a portion of the Jacobsbaai Western Corridor is undertaken as mentioned above, and all mitigation is sufficiently implemented and executed, then there is no clear routing preference from a botanical perspective evident to the EAP.

The Jacobsbaai Western Corridor is the preferred alternative from a visual perspective since the pipeline will follow the existing road and will not open up a new corridor in the landscape.

DISCUSSIONS AROUND BOTANICAL OFFSETS

Frontier Saldanha Utilities is willing to enter into an agreement with CapeNature or another relevant authority or institution (e.g. WWF) to provide an offset in the form of a financial contribution for the conservation and management of valuable land parcels as identified by CapeNature or another authority or institution. This option was discussed at the meeting

which was held at the offices of DEA&DP in Cape Town on 12 March 2015 with representatives of Frontier, DEA&DP, CapeNature, CSIR and the ecological specialist, Mr Nick Helme (see meeting notes and the attendance register included in Appendix I1). The purpose of the meeting was to discuss the challenges associated with the Jacobsbaai Eastern Corridor and to provide motivation why the Jacobsbaai Western Corridor has become the only viable corridor alternative.

It is the opinion of the EAP that the offset in the form of a financial contribution is appropriate considering the nature and the scale of the proposed development. It is recommended that it is not necessary for Frontier Saldanha Utilites to conduct a separate botanical offset study. Motivation to this effect is provided in Section 1.4.2 of Chapter 1.

It is assumed that the installation of the pipeline will result in disturbance of a corridor up to 12 m wide, including an adjacent access track (at least for construction, where the pipeline is not close enough to any existing road), trenches and temporary piling of fill. It is also assumed that the pipeline will run either within or just outside the existing or new proposed road reserves (in the case where roads are proposed for upgrade).

The study area is within the planning domain of the Saldanha Fine Scale Conservation Plan (Pence 2008), which has identified and mapped Critical Biodiversity Areas (CBAs) throughout the region. Critical Biodiversity Areas are regarded as essential areas for the achievement of regional conservation targets, and are designed to ensure minimum land take for maximum result (Maree & Vromans 2010). The Fine Scale Plan indicates that both pipeline routing alternatives cross significant CBAs. As many as 25 different plant species of special concern (SCC) are potentially found within 200 m of both proposed routes, usually where these cross CBAs. If any of these SCC are within the study area they are likely to be within the mapped areas of Very High Sensitivity, and are not likely to be found in significant numbers outside the Very High Sensitivity areas.

Faunal sensitivity is expected to mirror the botanical sensitivity. Two faunal Species of Conservation Concern have been recorded from the study area (Rose's Rainfrog (*Breviceps rosei)* – SW coastal endemic, and Black Girdled Lizard (*Cordylus niger)* – Near Threatened), and a further six reptile SCC may occur (probably in low numbers) within the study area.

Approximately 8 500 m of the Jacobsbaai Western Corridor (blue) alternative is within mapped CBAs, whereas this figure is about 9 615 m for the Jacobsbaai Eastern Corridor (purple) alternative. The latter thus crosses about 11 % more CBA than the former.

The SA vegetation map (Mucina & Rutherford 2006) and the more accurate and higher resolution Saldanha Fine Scale Vegetation Map (Helme & Koopman 2007) indicate that the proposed route crosses four main terrestrial vegetation types. **Saldanha Flats Strandveld** is regarded as Endangered on a national basis (Rouget *et al* 2004; DEA 2011). **Saldanha Granite Strandveld** is listed as an Endangered vegetation type (DEA 2011), and the coastal form in the area between Jacobsbaai and Danger Bay supports an unusual assemblage of species that does not occur elsewhere (pers. obs). **Saldanha Limestone Strandveld** was previously listed as an Endangered vegetation type (Rouget et al 2004), and then was unfortunately downgraded to Least Threatened (DEA 2011), due to an oversight by the SANBI, and this error will apparently only be rectified in about 2015. The unit has the

highest number of threatened and localised plant species of all vegetation types in the Saldanha region, and the Jacobsbaai area is one of two primary hotspots for highly localised species (Helme & Koopman 2007). The unit is also poorly conserved (represented) in the West Coast National Park. **Langebaan Dune Strandveld** was regarded as Vulnerable in terms of the National Spatial Biodiversity Assessment (Rouget *et al* 2004), but the unit is now not listed as a Threatened Ecosystem on the National List (DEA 2011), mainly because large areas are well protected within the West Coast National Park.

At least twenty five plant SCC (Raimondo *et al* 2009) have been recorded from the vicinity of the project area (defined as being within 200 m of the proposed route) (Section 5.1 of the Terrestrial Ecological Study in Appendix B of Volume II of this report). If any of these SCC are within the study area they are likely to be within the Very High Sensitivity areas shown in Figures 6 and 7 of the Ecological Study (Appendix B of Volume II), and are not likely to be found in significant numbers outside the Very High Sensitivity areas. It should however be noted that the Very High Sensitivity areas shown are only shown within 200 m of the proposed routes, and even though they may extend more than 200 m away they are not shown in those areas.

The pipeline through Jacobsbaai has the potential to cause significant damage to sensitive habitat and SCC, but if located west of the main road this damage is likely to be significantly less than if located east of the road, as most of the SCC are located east of the road. The only four SCC known from within 12 m of the west side of the road are *Zaluzianskya parviflora* (Near Threatened), *Limonium capense* (Near Threatened), *Felicia elongata* (Vulnerable) and *Ruschia langebaanensis* (Threatened). It is recommended that for the section pipeline of approximately 2 000 m traversing through an area with endangered vegetation, the pipeline footprint should be entirely within the road reserve west of the main road to reduce impacts on sensitive vegetation along the pipeline corridor. This recommendation has been accepted by Frontier Saldanha Utilities.

8.2.1 Identification of impacts

The following potential negative impacts on the terrestrial ecology were identified:

- Direct, permanent loss of natural vegetation and associated plant and faunal SCC within the development footprint at the construction phase (the loss of Very High sensitivity vegetation in the Jacobsbaai area being the primary concern);
- Temporary to long term direct loss and degradation of natural vegetation and faunal habitat at the construction phase (laydown and soil storage areas; work areas); and
- Indirect ecological impacts at the operational phase (introduction of invasive alien plants; fragmentation of natural habitat and ecological corridors; fragmentation and reduction of sub-populations of rare/threatened plant species).

Indirect positive impact for Ecology:

No potentially positive benefits of this project have been identified in terms of vegetation or fauna. However, if a suitable financial contribution to a biodiversity offset is

implemented then certain positive impacts could be realized, notably by providing funding for ecological management of valuable land parcels as identified by CapeNature or another authority or institution. It should be noted that the magnitude and hence significance of the positive impact is related to the scale of the offset.

8.2.2 Assessment of impacts

- Pump Stations A, B, C and D (and their proposed access roads) have **negligible botanical impact** and require no specific mitigation;
- Pump Station E is likely to have a **Medium negative** botanical impact, **before and after mitigation (Low – Medium negative faunal impact)**. Pump station E is located within Langebaan Dune Strandveld of Medium sensitivity. This is not currently a threatened vegetation type, and no SCC are known from that particular area;
- Both proposed pipeline routes (Jacobsbaai Western and Eastern Corridors) will have some negative botanical and faunal impacts which cannot be avoided or mitigated. Without mitigation the Jacobsbaai Western corridor will have a High negative botanical impact (Medium negative faunal impact), which could be reduced to **Medium negative with mitigation.**
- **The required mitigation includes rerouting a portion of the route along the Jacobsbaai Western Corridor (from Pump station C to D**) to the northern side of the Jacobsbaai Road, thereby avoiding sensitive wetland areas on the southern side of the Jacobsbaai Road;
- Without mitigation the Jacobsbaai Western corridor will have a High negative botanical impact (Medium negative faunal impact), which could be reduced to **Low – Medium negative with financial contribution to a biodiversity offset (Low negative for faunal impact);** and
- The Jacobsbaai Eastern Corridor will have a **Medium negative botanical impact**, **both before and after mitigation.** Faunal impact is likely to be Medium negative before mitigation, and **Low negative after mitigation.**

Thus if rerouting of a portion of the Jacobsbaai Western Corridor is undertaken, and all mitigation is put in place then there is **no strongly preferred routing** alternative from a botanical perspective.

8.2.3 Management actions and Mitigation Measures

The following mitigation measures are proposed during the construction and operational phases:

Jacobsbaai Eastern Corridor:

- Search & Rescue of rare species;
- Rehabilitation of disturbed areas; and
- Alien vegetation management on an annual basis along route for a minimum of five years after construction.

Jacobsbaai Western Corridor:

- Reroute pipeline to north of Jacobsbaai road between Pump Stations C and D in order to avoid the two sensitive areas south of this road;
- Should an EA be granted, DEA&DP must include a condition wherein Frontier Saldanha Utilities must undertake a plant rehabilitation programme (including a Search and Rescue Programme of all bulbs and succulents in footprint) as specified by the botanical specialist, Mr Nick Helme in the Ecological study (Appendix B of Volume I) and the EMP of the SRMO Project (Section B of Volume I of the FEIAR);
- Alien vegetation management on an annual basis along route for a minimum of five years after construction
- It is recommended that for the section pipeline of approximately 2 000 m traversing through an area with endangered vegetation, the pipeline footprint should be entirely within the road reserve west of the main road to reduce impacts on sensitive vegetation along the pipeline corridor. Most of the SCC are located east of the main road. This recommendation has been accepted by Frontier Saldanha Utilities;
- It is recommended that for the section pipeline of approximately 2 000 m traversing through an area with endangered vegetation the proposed pipeline must be buried on the western (seaward) side of the road as this corridor is already disturbed in places; and
- The submission of the FEIAR to DEA&DP, and the comments received on the FEIAR from CapeNature should be used by DEA&DP to guide the conditions of the EA (if applicable). Should an EA be granted, DEA&DP must include a condition wherein Frontier Saldanha Utilities must enter into a shared agreement with CapeNature (or another appropriate institution) regarding the nature and value of the financial contribution to a suitable offset programme in the Vredenburg/Saldanha area.

Mr Nick Helme indicates that all the construction and operational phase mitigation and management requirements outlined in Section 8 of the Terrestrial Ecological Report (Appendix B of Volume II) must be included as Conditions of Authorisation. A summary of these management actions are included below.

Rehabilitation guidelines, construction phase EMP & operational phase EMP requirements and mitigation

Areas requiring rehabilitation include all areas of natural or partly natural vegetation disturbed during the construction phase and that are not required for regular maintenance operations. The main areas thus requiring rehabilitation will be disturbance to the edges of any new access roads that pass through natural vegetation, pipeline routes through natural vegetation, and areas around the Pump Station E.

Rehabilitation should only commence once all construction related disturbance associated with the project has been completed.

Detailed requirements for the **Construction Phase Environmental Management Plan (CEMP)** are as follow:

1) All approved development footprints within areas of natural vegetation should be surveyed and fenced/cordoned off with coloured rope.
2) Prior to any construction a plant Search and Rescue program (S&R) should be undertaken within all development footprints that occur within areas of natural vegetation. Search and Rescue shall involve translocation of selected succulents, shrubs and bulbs occurring in the pipeline footprint, with emphasis on any SCC.
3) The S&R must be undertaken just after flowering has been completed.
4) All rescued species should be bagged (and cuttings taken where appropriate) and kept in the horticulturist's nursery, and should be returned to site once all construction is completed and rehabilitation of disturbed areas is required. Replanting should only occur in autumn or early winter (April – May), once the first rains have fallen, in order to facilitate establishment. The consultant botanist must confirm in writing that this process has been completed successfully.
5) A suitably qualified specialist, horticulturist or on-site advisor should be appointed for the S&R work in the Very High sensitivity areas in Jacobsbaai.
6) If the Jacobsbaai Western corridor is chosen it must be rerouted to run north of the Jacobsbaai road between Pump stations C and D, in order to avoid the two sensitive areas south of this road.
7) For the section pipeline of approximately 2 000 m traversing through an area with endangered vegetation along the Jacosbaai Western Corridor, the pipeline footprint should be entirely within the road reserve west of the main road to reduce impacts on sensitive vegetation. Most of the SCC are located east of the main road. This recommendation has been accepted by Frontier Saldanha Utilities;
8) For the section pipeline of approximately 2 000 m traversing through an area with endangered vegetation along the Jacobsbaai Western Corridor the proposed pipeline must be buried on the western (seaward) side of the road as this corridor is already disturbed in places;
9) Disturbance must be minimised during construction in the Very High Sensitivity areas through Jacobsbaai, and in this regard all heavy machinery and soil piles should be kept within the current road shoulder edge. In other words, no disturbance may take place west of the actual trench to be dug – no vehicular activity, and no pipe or soil storage.
10) An Environmental Control Officer (ECO) must visit the area at least twice a week for the duration of the construction phase, or more often as required.
11) The ECO must ensure that no laydown or material storage areas are located within areas of natural vegetation.
12) Topsoil (top 30 cm) must be replaced last when infilling the trenches, and compacted only by hand once replaced.
13) All open trenches must be fenced off at ground level on the open side (the side opposite the side where the excavated soil is stacked) in order to prevent small animals like frogs, snakes and tortoises falling in and becoming trapped.
14) No sections of pipeline trenches more than 50 m long may be left open for more than a week, and they should preferably be closed up within a day, using the carefully stockpiled soil that came out of the trench.
15) If trenches are left open for more than a day the ECO must inspect all such sections every morning and evening and remove any animals that may have fallen into the trench. If the ECO is not on site the contractor must designate a team member to do this checking and removal twice a day.

16) No dumping or temporary storage of any materials may take place outside designated and demarcated laydown areas. Laydown areas may not be located within areas of natural vegetation.
17) Only suitable locally indigenous Strandveld plant species should be used for rehabilitation or planting anywhere on site. This means that no exotic or invasive species should be used for rehabilitation, and this includes the commonly used but highly invasive grass species such as ryegrass (*Lolium* spp).

Operational Phase EMP Requirements:

18) All temporary fencing (or coloured rope) and danger tape should be removed once the construction phase has been completed.
19) Ongoing invasive alien plant monitoring and removal must be undertaken in all areas of natural vegetation within the project area on an annual basis (in October or November), for a minimum of five years after completion, using DWA approved methods.
20) The applicant must engage with CapeNature (or another appropriate conservation body) and an experienced biodiversity offset advisor prior to the project being executed, in order to formalise the form and quantum of a biodiversity offset, as an important element of mitigation for degradation of Limestone Strandveld habitat in the Jacobsbaai area.
21) The applicant must ensure that there is sufficient budget to implement all management recommendations noted above.

MONITORING OPERATIONS REQUIRED

Impact	Mitigation/Management action	Monitoring		
		Method	***Frequency***	***Responsibility***
Construction Phase: Permanent loss of vegetation due to construction in natural vegetation	ECO to ensure that all proposed infrastructure footprints within natural vegetation are fenced/cordoned off prior to construction, using coloured rope or similar; ensure that no disturbance occurs outside of these designated corridors; ensure laydown areas are not in natural vegetation; ensure that Search and Rescue is undertaken prior to disturbance	Visual checking and supervising to ensure compliance	Daily during construction	ECO
Construction Phase: Animals trapped in open pipe trenches	ECO to monitor open sections of trenches every morning and evening and remove any animals	Visual inspection	Twice daily	ECO or contractor
Construction & Operational Phases: Degradation of natural vegetation within development footprint	Search and Rescue - make sure that all movable plants within designated development footprints in areas of natural vegetation are removed before construction commences; make sure that they are replanted in areas requiring rehabilitation once construction ceases; prior to any development, and after S&R.	Appointed horticulturist to liaise with botanist	Once off	ECO and appointed horticulturist
Operational Phase: Alien vegetation invasion	Annual removal of all invasive alien vegetation from within project footprint, using DWA approved methods	DWA methodology; cut stems and paint immediately with suitable herbicide; no herbicide spraying in areas with >10% natural vegetation.	Annually, in October or November, for five years after construction.	Alien vegetation contractor to undertake work; independent botanist to audit two years after construction has been completed.

Table 8.2 A Assessment of terrestrial ecological impacts of the proposed Saldanha Regional Marine Outfall Project

Alternative	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Construction Phase											
Impact assessment for permanent loss of vegetation and associated species of conservation concern on site											
Pump Station A	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station B	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station C	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station D	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station E	Negative	Local	Permanent	Medium	Definite	Low	Medium	**Medium**	None required	**Medium**	High
Jacobsbaai Eastern Corridor	Negative	Local & regional	Permanent	Medium	Definite	Medium	Medium - High	**Medium**	Search & Rescue of rare species; Rehabilitation	**Medium**	High
Jacobsbaai Western Corridor	Negative	Local & regional	Permanent	Medium - High	Definite	Low - Medium	High	**High**	Reroute to north of road between Pump Stations C and D; Search & Rescue of all bulbs and succulents in footprint; Confine construction footprint within road reserve for section of 2 000 m traversing sensitive vegetation; Bury pipeline on the western (seaward) side of the road (for approximately 2 000 m section traversing through an area with endangered vegetation (within and to the south of Jacobsbaai); Determine an appropriate financial contribution to a biodiversity offset.	**Medium or Low – Medium with financial contribution to a biodiversity offset**	High

Alternative	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Impact assessment for long term disturbance and degradation of natural vegetation											
Pump Station A	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station B	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station C	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station D	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station E	Negative	Local	Permanent	Medium	Definite	Low	Medium	**Medium**	None required	**Medium**	High
Jacobsbaai Eastern Corridor	Negative	Local & regional	Permanent	Medium	Definite	Medium	Medium - High	**Medium**	Rehabilitation	**Medium**	High
Jacobsbaai Western Corridor	Negative	Local & regional	Permanent	Medium - High	Definite	Low - Medium	High	**High**	Reroute to north of road between Pump Stations C and D; Search & Rescue of all bulbs and succulents in footprint; Confine construction footprint within road reserve for section of 2 000 m traversing sensitive vegetation; Bury pipeline on the western (seaward) side of the road (for approximately 2 000 m section traversing through an area with endangered vegetation (within and to the south of Jacobsbaai); Determine an appropriate financial contribution to a biodiversity offset.	**Medium or Low – Medium with financial contribution to a biodiversity offset**	High

Table 8.2 B Assessment of faunal impacts of the proposed Saldanha Regional Marine Outfall Project

Alternative	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Construction Phase											
Impact assessment for loss of faunal habitat, direct impact on fauna and faunal species of conservation concern on site during construction phase.											
Pump Station A	Negative	Local	Long term	Low	Likely	Low	Low	**Low**	None required	**Low**	High
Pump Station B	Negative	Local	Long term	Low	Likely	Low	Low	**Low**	None required	**Low**	High
Pump Station C	Negative	Local	Long term	Low	Likely	Low	Low	**Low**	None required	**Low**	High
Pump Station D	Negative	Local	Long term	Low	Likely	Low	Low	**Low**	None required	**Low**	High
Pump Station E	Negative	Local	Long term	Medium	Likely	Medium	Medium	**Low-Medium**	None required	**Low-Medium**	High
Jacobsbaai Eastern Corridor	Negative	Local	Long term	Medium	Likely	Medium	Medium	**Medium**	Search & Rescue of all animals that fall into open trenches; catchfences along all open trenches	**Low**	High
Jacobsbaai Western Corridor	Negative	Local	Long term	Medium	Likely	Medium	Medium	**Medium**	Reroute to north of road between Pump Stations C and D; Search & Rescue of all animals that fall into open trenches; catchfences along all open trenches	**Low**	High
Operational Phase											
Impact assessment table for all indirect ecological impacts of development on vegetation and fauna, mainly during the operational phase. Note that only botanical mitigation is included in this table.											
Pump Station A	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station B	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station C	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station D	Negative	Local	Permanent	Low	Definite	Low	Low	**Low**	None required	**Low**	High
Pump Station E	Negative	Local	Permanent	Medium	Definite	Low	Medium	**Medium**	None required	**Medium**	High

Alternative	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Jacobsbaai Eastern Corridor	Negative	Local & regional	Permanent	Medium	Definite	Medium	Medium - High	**Medium**	Rehabilitation of disturbed areas; alien vegetation management along route for a minimum of five years after construction	**Medium**	**High**
Jacobsbaai Western Corridor	Negative	Local & regional	Permanent	Medium	Definite	Low - Medium	High	**Medium**	Rehabilitation of disturbed areas; Re-route to north of road between Pump Stations C and D; alien vegetation management along route for a minimum of five years after construction	**Medium**	**High**

8.3 WETLANDS

Ms Luanita van der Walt (CSIR) prepared the Wetlands Study for the SRMO Project EIA (Appendix C of Volume II of this report). This study was adapted from the Freshwater Ecological Study that was done by Dr Liz Day of *Freshwater Consulting cc* for the Saldanha Desalination plant EIA of the WCDM (Day, 2013).

The proposed SRMO pipeline routing corridors lie within DWA quaternary catchment G10M, in the Berg River Water Management Area. Two aquatic ecosystems were identified along the Jacobsbaai road (within the 10 m servitude of the WCDM) which may potentially be affected by the proposed SRMO Project. These two wetlands were assessed in the Freshwater Ecology study and are referred to as Wetland 1 and Wetland 2. Wetland 1 lies within minor catchments, which either dissipates or drains directly into the sea to the west. Wetland 2 is situated in the catchment of the Bok River which flows south into Saldanha Bay (Figure 1 of Appendix C). Both pipeline routing alternatives (Jacobsbaai Western and Eastern corridors) follow the same route along this section of the pipeline.

8.3.1 Identification of impacts

The following potential impacts were identified:

- Disturbance of wetland habitat along the disturbed area;
- Compaction of the surface over the pipeline footprint, potentially making re-establishment of wetland plants difficult; and
- Effective infilling of wetland habitat, if infilling of the pipeline trench resulted in a final surface that was raised above pre-construction levels – not only would this result in loss of wetland habitat and the creation of a disturbed terrestrial corridor, prone to alien and weedy plant invasion, but it would potentially contribute to localised habitat fragmentation and changes in flow in channelled portions of the wetland.

8.3.2 Assessment of impacts

The above impacts would be considered highly undesirable in the case of the delineated wetland 1 on the southern side of the Jacobs Bay Road. The impacts are likely to be permanent and of medium intensity, and although taking place within only a small portion of the wetland, would be considered as taking place at a regional scale, given the conservation importance of Wetland 1. The overall significance of the above impacts in this area would be considered negative and **high before mitigation and negative and low after mitigation.**

In the case of the wetlands north of wetland 1, on the northern side of the Jacobsbaai Road, although the impacts would still be negative, their scale and intensity would all be low, given the extent of degradation that has already occurred in this area. The overall significance of the above impacts in this area would be considered **negative and medium to low**.

In the case of wetland 2, comprising the Bok River valley bottom wetland, installation of the pipelines would be likely to trigger most of the above impacts, over a highly localised area, but nevertheless an area with implications for flow along the channel. Creation of a raised mound over the pipeline to ensure sufficient cover would potentially result in pooling of flows upstream of the culvert. The intensity of these impacts is considered low, and they would occur at a very local scale. They would however affect a system earmarked for long-term improvement and would thus be considered **negative and of medium significance without mitigation. After mitigation, the impacts are rated as negative and of low significance.**

8.3.3 Management actions and mitigation measures

The following mitigation measures are recommended:

- Avoidance of wetland 1 on the southern side of the road, by routing the pipelines along the northern side of the Jacobsbaai Road only (along the Jacobsbaai Western Corridor);
- Compilation of, and strict adherence to, a construction phase EMPR which outlines measures to:
    - prevent the passage of sediment or other contaminated material into adjacent wetlands;
    - minimise the disturbance footprint; and
    - ensure that all wetlands south of the road are treated as no go areas – including the wetland margins in the southern road reserve;
- Managing the timing of construction through wetland areas such that it takes place outside of the wet season, and preferably during late summer / autumn, so that the period before plants re-establish in the wet season is limited; and
- Rehabilitation of disturbed areas so that pre-construction levels are achieved, and such that the pipeline does not result in the creation of a longitudinal raised mound – this measure could entail spreading of excess fill into disturbed terrestrial areas; fill should not be spread into any wetland areas.

Table 8.3 Assessment of impacts to freshwater ecosystems associated with the proposed Saldanha Regional Marine Outfall Project.

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confid level
CONSTRUCTION PHASE											
Jacobs Bay Corridor (assuming unmitigated alternative is along southern side of the road)											
Wetland 1: Wetland disturbance, compaction and infilling	**Negative**	**Regional**	**Permanent**	**Medium**	**High**	**Low**	**High** – wetland 1 is considered of high ecological importance	**High**	• Avoidance of wetland 1 by routing pipeline along northern side of road • Implement measures to prevent contamination of wetlands with construction material and minimise disturbance footprint, as per CEMP • Time construction within wetland areas for outside of the wet season • Rehabilitate disturbed areas north of the road such that pre-construction levels are retained along the pipeline corridor and wetlands are not thus infilled.	**Low**	**Medium** – visual assessments only

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confid level
Wetland 2: Wetland disturbance, compaction and infilling	**Negative**	**Local**	**Permanent**	**Low to medium**	**High**	**Medium to high**	**Medium to high** – system earmarked for rehabilitation	**Medium**	• Implement measures to prevent contamination of wetlands with construction material and minimise disturbance footprint, as per CEMP • Time construction within wetland areas for outside of the wet season • Rehabilitate disturbed areas such that pre-construction levels are retained along the pipeline corridor and wetlands are not thus infilled	**Low**	**Medium** – visual assessments only

8.4 VISUAL ASSESSMENT

Mr Henry Holland of *MapThis* was commissioned by the CSIR to undertake the visual study for the SRMO Project (Appendix D of Volume II).

The proposed development will potentially affect a number of landscape character types in the region as well as surrounding sensitive visual receptors.

The following sensitive visual receptors will also potentially be affected by the proposed SRMO Project:

- Recreational users of beach and rocky shore near Danger Bay. These are receptors with a medium sensitivity to the development;
- Visitors to, and viewpoints in, SAS Saldanha Contractual Nature Reserve are highly sensitive visual receptors;
- Residents of, and visitors to, Jacobsbaai are highly sensitive visual receptors;
- Residents and viewpoints on farms along the pipeline corridor. These are classified as highly sensitive receptors;
- Visitors to Swartriet Private Nature Reserve are highly sensitive visual receptors;
- Residents of Vredenburg are low sensitivity visual receptors;
- Motorists using main roads in the region (R79, R559, R27 and R238). These are low sensitivity visual receptors; and
- Workers and views in the industrial zone. Their sensitivity to the development is likely to be negligible due to the complexity of their existing views.

Pump stations with associated structures, 11 kV power lines and a terrestrial as well as a marine outfall pipeline will be introduced into a coastal recreational landscape.

The SRMO pipeline will be buried and will therefore only have a visual impact on sensitive visual receptors during the construction phase. The marine outfall pipeline will not be visible after construction and the effluent streams will be colourless and will not cause discolouration of the sea water at the outlet points. The servitude for the pipeline for the most part will be adjacent to the road along the Jacobsbaai Western Corridor.

The overhead power lines are medium voltage distribution lines (11 kV) which are familiar features of the existing landscape and for Pump Stations A to D are unlikely to cause visual intrusion on existing views. However the power line from Pump Station E to Jacobsbaai will be a new element in the Danger Bay landscape. It will also increase the visual clutter in Jacobsbaai caused by existing power lines.

The only pump station that will potentially cause significant visual intrusion is Pump Station E in Danger Bay, but careful siting among the dunes can reduce the impact since the structures are no larger than existing buildings in the area. Night lighting of Pump Station E at Danger Bay may also affect sensitive receptors. The other proposed pump stations are located in areas where they will not seem out of place in the landscape since they are similar in size and form to farm buildings and structures.

8.4.1 Identification of key issues

The key impacts identified are:

- Intrusion of construction activity on views of sensitive visual receptors at Danger Bay;
- Intrusion of construction activity along power line and pipeline corridors on views of sensitive visual receptors;
- Impact of introducing marine outfall structures into a coastal recreational landscape;
- Visual intrusion of a pump station and associated structures at Danger Bay on the views of sensitive visual receptors; and
- Visual intrusion of 11 kV overhead power lines from Pump Station E to Jacobsbaai on views of sensitive visual receptors.

8.4.2 Assessment of impacts

The rural coastal recreational landscape of the Danger Bay/Jacobsbaai region is the only one that is **moderately** sensitive to the proposed development. The others have a **low** sensitivity to the SRMO project. The significance of the landscape impact is anticipated to be **medium** without mitigation and **low** with the implementation of mitigation measures.

Two negative impacts of medium significance (before mitigation) associated with the **construction phase** of the proposed pipeline and associated infrastructures were identified:

- Intrusion of construction activity on views of sensitive visual receptors at Danger Bay Site;
- Intrusion of construction activity along power line and pipeline corridors on views of sensitive visual receptors;
- Impact of introducing marine outfall structures into a coastal recreational landscape;
- Visual intrusion of a pump station and associated structures at Danger Bay on the views of sensitive visual receptors; and
- Visual intrusion of 11 kV overhead power lines from Pump Station E to Jacobsbaai on views of sensitive visual receptors.

Three negative impacts of medium significance (before mitigation) associated with the **operation phase** of the proposed pipeline and associated infrastructures were identified:

- Impact of introducing marine outfall structures into a coastal recreational landscape;
- Visual intrusion of a pump station and associated structures at Danger Bay on the views of sensitive visual receptors; and
- Visual intrusion of 11 kV overhead power lines from Pump Station E to Jacobsbaai on views of sensitive visual receptors.

With the implementation of the recommended management actions, all impacts are anticipated to be **negative and of low significance**, with the exception of the visual intrusion of the 11 kV overhead powerlines from Pump station E to Jacobsbaai which will remain a **negative impact of medium significance**. This is due to the fact that there are a number of highly sensitive visual receptors along this corridor that will potentially be affected by proposed power lines. They

include residents of Jacobsbaai, residents and viewpoints of farms along the path of the corridor, and visual receptors in Swartriet Private Nature Reserve.

The West Coast District Municipality has proposed to build a Desalination Plant in the Danger Bay area near the site for Pump Station E. If the plant is built at this site then the SRMO pipeline will connect directly with the disposal infrastructure of the desalination plant and a separate pump station with associated structures and power lines will not be necessary. The cumulative impact of the SRMO project will be **low** since the desalination plant will be the only development visible in the area.

In terms of visual impact the Jacobsbaai Western Corridor is the preferred corridor for the pipeline since it will follow the existing road and will not open up a new corridor in the landscape.

8.4.3 Management actions and mitigation measures

In addition to assumed best environmental practices (refer to section 1.2.4 of the visual specialist study, Appendix D of Volume II), the following mitigation measures are recommended:

- Construction duration should be kept as short as is practical in order to reduce the visual impact of the construction phase on visual receptors;
- Laydown areas and stockyards should be located in low visibility areas (e.g. between high dunes) and limited night lighting, and existing vegetation should be used to screen them from views where possible;
- Night lighting of the construction sites should be minimised within requirements of safety and efficiency;
- Locate structures such that they are screened by dunes, using non-reflective paints on structures to reduce contrast and using paint colours for structures and buildings so that they blend in with the natural background (e.g. RAL-9010, RAL-9016, RAL-9003 or RAL-9001);
- The dunes are quite high in this area and careful placing of structures and buildings, as well as appropriate colour schemes for buildings can lower their visibility.
- Wooden power line pylons will maintain a rural feel to the landscape;
- Keep building and structure heights as low as possible in order to reduce structure visibility; and
- The maintenance plan should include regular maintenance of exterior facades since the pump station and associated structures are likely to be highly exposed to the elements.

The mitigation measures below target lighting features that will contribute to light pollution and attempt to reduce light trespass, glare and sky glow (see Lighting Research Center website for more information on light pollution).

- Lighting of the facility should not exceed, in number of lights and brightness, the minimum required for safety and security;
- Uplighting and glare (bright light) should be minimised using appropriate light screening features on all external lights;
- Low-pressure sodium light sources should be used to reduce light pollution;
- Light fixtures should not spill light beyond the project boundary (light trespass); and
- Lights should be switched off when not in use whenever it is in line with safety and security.

Table 8.4 Visual impact criteria and impact intensity for the proposed development

Sensitive Viewer	Criteria	Rating	Reasoning
Recreational users of beach and rocky shore of Danger Bay.	Visual Sensitivity	**Medium**	Fishermen and recreational users of the beach are likely to be more focussed on their activity than the landscape
	Visual Exposure	**High**	Recreational users of the beach will be in close proximity to Pump Station E (200 m) while fishing spots are between 600 m and 1 km from the pump station.
	Visual Intrusion	**Moderate**	The proposed pump station and transfer tank are similar to existing structures in the area and the power line is medium voltage. These structures will be noticeable but will partially fit into the surroundings.
	Impact Intensity	**Medium**	Moderately sensitive visual receptors will be highly exposed to a development that partially fits into the surroundings. There are very few sensitive visual receptors in the area.
Visitors to, and viewpoints in, SAS Saldanha Contractual Nature Reserve	Visual Sensitivity	**High**	Hikers visiting the reserve are classified as highly sensitive since they have an active interest in the surrounding landscape.
	Visual Exposure	**Low**	The reserve is more than 2.5 km from development structures and these will not be particularly noticeable to observers.
	Visual Intrusion	**Low**	Viewpoints in the reserve are more than 2.5 km from proposed structures. There are similar buildings and ruins in the same views and it is likely that the pump station and its associated structures will not be noticeable from the reserve.
	Impact Intensity	**Low**	The reserve is quite far from the site and the pump station is unlikely to be a prominent feature from the distance.
Residents of, and visitors to, Jacobsbaai	Visual Sensitivity	**High**	Residents have an active interest in the surrounding landscape.
	Visual Exposure	**High**	The power line from Pump Station E will pass in close proximity to residences in Jacobsbaai.
	Visual Intrusion	**Low**	The existing distribution power lines are common features of existing views in town and the proposed overhead lines will follow the same route.
	Impact Intensity	**Medium**	Highly sensitive visual receptors will be highly exposed to proposed structures even though the structures will be congruent with the existing landscape.
Residents and viewpoints on farms along the pipeline corridor	Visual Sensitivity	**High**	Residents have an active interest in the surrounding landscape.
	Visual Exposure	**High**	There are viewpoints and farmsteads in close proximity to some components of the development (pump stations, power lines and transfer tank).
	Visual Intrusion	**Low**	Proposed structures are very similar in size and form to structures in the current landscape.
	Impact Intensity	**Medium**	Highly sensitive visual receptors will potentially be highly exposed to elements of the project but proposed structures are congruent with the current landscape.

Sensitive Viewer	Criteria	Rating	Reasoning
Visitors to Swartriet Private Nature Reserve	Visual Sensitivity	**High**	Visitors to the nature reserve are likely to value the surrounding landscape.
	Visual Exposure	**High**	There are a number of structures of the proposed development that will be in close proximity to the reserve. These include the power line from Pump Station E, and Pump Station D and its power line and transfer tank.
	Visual Intrusion	**Low**	Proposed structures are very similar in size and form to structures in current views.
	Impact Intensity	**Medium**	Highly sensitive visual receptors will potentially be highly exposed to elements of the project but proposed structures are congruent with the current landscape.
Residents of Vredenburg	Visual Sensitivity	**Low**	The existing views of these residents already contain a number of industrial structures much larger than the proposed development.
	Visual Exposure	**Low**	The town is further than 5 km from any of the proposed development structures.
	Visual Intrusion	**Low**	Views from Vredenburg towards the proposed development will include much larger and more prominent industrial structures such as Port structures, Arcelormittal Steel Works and Namakwa Sands smelter.
	Impact Intensity	**Low**	Residents are living too far from the proposed development to be affected.
Motorists on roads surrounding the site (R27, R79 and R238).	Visual Sensitivity	**Low**	The roads are most often used by motorists in transit to work or home and there attention will not be on the landscape.
	Visual Exposure	**High**	High for motorists on R79 for sections in close proximity to pump stations. High for a 6 km section of R27 where it passes Pump Stations A and B. Low for R238 after construction of the pipeline.
	Visual Intrusion	**Low**	Proposed structures are very similar in size and form to structures in current views in areas outside the industrial area.
	Impact Intensity	**Low**	Low sensitivity visual receptors are highly exposed to proposed elements of the development but will experience low visual intrusion on their views.
Workers and views in industrial area.	Visual Sensitivity	**Negligible**	The landscape is made up of industrial structures and activity and workers are not focussed on the landscape.
	Visual Exposure	**High**	There will be workers at Transnet Salcor Yard and Namakwa Sands smelter (and other industrial developments along the R79) that will be in close proximity to some of the proposed structures.
	Visual Intrusion	**Low**	Low since their existing views contain large industrial developments.
	Impact Intensity	**Low**	The quality of views of workers will not be altered by the proposed development.

Table 8.5 Significance of landscape impacts.

Nature of impact	Status (Negative or Positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Significance (no mitigation)	Mitigation/Management Actions)	Significance (with mitigation)	Confidence level
Operational Phase											
Change in landscape character due to introduction of proposed structures to a coastal recreational landscape.	**Negative**	**Local** – the effect of the impact will be limited to Danger Bay.	**Long term** – 20 to 25 years.	**Medium** – elements incongruent with the existing landscape type are introduced.	**Probable** – there are no industrial elements in the current landscape, but those to be introduced are small in scale.	**High** – Removal of the structures and buildings will remove the industrial elements from the landscape.	**Medium** – there are similar landscapes with a better chance of preservation further north along the coast.	**Medium** – due to the long duration of the impact.	Utilising high dunes to screen the plant as much as possible. Using paint colours on buildings and structures which will reduce contrast with surroundings.	**Low** – lowering the visibility will reduce the intensity of the impact.	**High** – based on site visit and available information.

Table 8.6 Significance of potential visual impact on sensitive viewers

Nature of impact	Status (Negative or Positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
CONSTRUCTION PHASE											
Intrusion of construction activity on views of sensitive visual receptors at Danger Bay Site	**Negative**	**Local** – the viewshed for this development is small.	**Temporary** – less than a year.	**High** – medium sensitivity visual receptors, high visual exposure and high visual intrusion.	**Probable** – construction activities are common in the Saldanha industrial area.			**Medium** – local extent and temporary nature of impact, but high intensity.	Laydown areas and stockyards should be located in low visibility areas (e.g. between high dunes) and existing vegetation should be used to screen them from views where possible. Night lighting of the construction sites should be minimised within requirements of safety and efficiency.	**Low** – lowering the visibility will reduce the intensity of the impact.	**High** – based on site visit and available information.

Nature of impact	Status (Negative or Positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Intrusion of construction activity along power line and pipeline corridors on views of sensitive visual receptors	**Negative**	**Local –** the effect of the impact will be limited immediate surroundings of construction site. The point of construction moves along corridor and does not include the whole corridor	**Temporary** – less than a year.	**High –** There are highly sensitive visual receptors that will be highly exposed to construction activity. Visual intrusion will be high.	**Probable** – construction activities are common in the Saldanha industrial area.			**Medium –** local extent and temporary nature of impact, but high intensity.	Construction duration should be kept as short as is practical in order to reduce the visual impact of the construction phase on visual receptors. Temporary laydown areas should be located in low visibility areas and existing vegetation should be used to screen these where possible.	**Medium –** lowering the visibility will reduce the intensity of the impact somewhat, but construction of the pipeline and power line in Jacobsbaai will still be highly intrusive on existing views.	**High –** based on site visit and available information.

Nature of impact	Status (Negative or Positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
OPERATIONAL PHASE											
Visual intrusion of a pump station and associated structures at Danger Bay on the views of sensitive visual receptors	**Negative**	**Local** – visual exposure will be low beyond 2 km..	**Long Term** – lifetime of the project.	**Medium** - Moderately sensitive visual receptors will be highly exposed to a development that partially fits into the surroundings. There are very few sensitive visual receptors in the area	**Probable** – the pump station and associated structures fit in partially with the landscape.	**High** – visible structures can be completely removed from the landscape/views.	**Medium** – there are other sites similar to that of Danger Bay further north along the coast, but these are much further away from towns like Diazville This means that for some recreational fishermen important visual resources are altered.	**Medium** – due to medium intensity, local extent and long term of the impact.	Use existing dunes to conceal as much development as possible. Keep building and structure heights as low as possible in order to reduce structure visibility. Use non-reflective paint for buildings and structures in a colour that blends in as well as possible with the background (e.g. RAL-9010, RAL-9016, RAL-9003 or RAL-9001). The maintenance plan should include regular maintenance of exterior facades since the pump station and associated structures are likely to be highly exposed to the elements.	**Low** – lowering the visibility will reduce the intensity of the impact and will lower the effect on visual resources.	**High** – based on site visit and available information.

Nature of impact	Status (Negative or Positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplaceability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Visual intrusion of 11 kV overhead power lines from Pump Station E to Jacobsbaai on views of sensitive visual receptors	**Negative**	**Local** – even though the power line is 4 km long it is only the section within Jacobsbaai that will potentially affect residents.	**Long term** – lifetime of project	**Medium** – Highly sensitive visual receptors will be in close proximity to the power line.	**Highly Probable** – Residents of Jacobsbaai will be affected by another power line through town.	**High** – visible structures can be completely removed from views.	**Low** – there is an existing power line along the route and views along the road are complex and to an extent, cluttered.	**Medium** – medium intensity impact of local extent and long term duration.	Pylons should be similar to existing pylons.	**Medium** – mitigation measures are unlikely to reduce the significance of the impact unless the power lines can be buried.	**High** – based on site visit and available information.
Impact of night lighting of Pump Station E at Danger Bay on the nightscape.	**Negative**	**Local** – considering the existing light pollution in the region night lighting at Danger Bay is expected to affect only a few visual receptors.	**Long term** – lifetime of the project (20 to 25 years)	**Low** – lighting is unlikely to be more intense than that of a farmstead..	**Probable** – since it is unclear whether there are visual receptors with night views on Danger Bay that will be impacted.	**High** – removal of lights from site will restore the original nightscape state.	**Low** – it is unlikely that views of Danger Bay are without lights and nightglow.	**Low** – low intensity impact with a local extent.	Lighting of the facility should not exceed, in number of lights and brightness, the minimum required for safety and security. Uplighting and glare (bright light) should be minimised using appropriate light screening features on all external lights. Low-pressure sodium light sources should be used to reduce light pollution. Light fixtures should not spill light beyond the project boundary (light trespass). Lights should be switched off when not in use whenever it is in line with safety and security.	**Low**	**High** – based on site visit and available information.

8.5 HERITAGE (ARCHAEOLOGY AND PALAEONTOLOGY)

Dr Jayson Orton of *ASHA Consulting (Pty) Ltd (referred to as "ASHA")* was commissioned by the CSIR to conduct an assessment of the potential impacts to heritage resources that might occur as a result of the proposed construction of the SRMO Project (Appendix E of Volume II of this report).

ASHA was requested to produce an integrated Heritage Impact Assessment (HIA) that addresses archaeology, palaeontology, built environment, graves, cultural landscapes and scenic routes. The palaeontological specialist study was undertaken by John Pether and was integrated into the HIA.

A Notification of Intent to Develop (NID) dated 1 August 2014 was submitted to HWC. A reference number was assigned to the project, i.e. 14070705AS0707E. Heritage Western Cape responded to the NID and requested the undertaking of a Heritage Impact Assessment (HIA) that includes specialist studies of archaeological and palaeontological resources (letter from HWC dated 13 August 2014). A HIA was undertaken by ASHA Consulting which includes an Archaeological and a Palaeontological Assessment (Appendix E of Volume II of this FEIAR) and was submitted to HWC for approval. Heritage Western Cape provided their response in a letter dated 10 December 2014. It states that the SRMO Project was tabled at the meeting of the Impact Assessment Committee of 17 November 2014 and that the Committee supports the recommendations of the consultant (see letter in Appendix G of Volume I which includes the specific recommendations).

Palaeontological and archaeological resources may be affected by the proposed development. Palaeontological impacts, in the form of disturbance or destruction of fossil material may occur anywhere along the route with the Velddrif and Prospect Hill Formations being most sensitive. Archaeological impacts to shell scatters and middens will occur in the western part of the study area, closest to the coast. The archaeological sites numbered JB001 and DB022 (see Section 3.6 in Chapter 3 of this report) are of concern and will require mitigation actions. Impacts to unmarked human burials are possible but unlikely. Scenic routes will experience very limited indirect temporary impacts during construction.

8.5.1 Identification of impacts

The following potential impacts have been identified:

- Loss of Archaeological resources;
- Loss of Palaeontological resources;
- Impact on scenic routes; and
- Impact on unmarked graves.

8.5.2 Assessment of impacts

8.5.2.1 Loss of Palaeontological Resources

There is a chance of encountering buried fossils during the construction phase, thereby incurring direct impacts. These impacts are negative and of medium significance before mitigation, do not constitute a fatal flaw and can be mitigated to some extent. Successful mitigation would actually result in **positive impacts** because new fossils and new information on the local geology could be brought to light. Impacts are only expected during the construction phase, since, once the trenches have been excavated, no new impacts would occur during maintenance work or during decommissioning, even if the pipe line was removed. Cumulative impacts are of relatively low significance, since the overall area to be impacted is quite small. In certain geological formations, that have a more limited spatial extent, such as the Prospect Hill Formation, cumulative impacts could be slightly greater.

8.5.2.2 Loss of Archaeological Resources

A number of archaeological sites were identified along the proposed routes. Some would definitely be impacted while others might be, depending on the width of the disturbance corridor. Direct, negative impacts of medium significance before mitigation could be expected. These do not constitute a fatal flaw. Successful mitigation would reduce the impacts to **negative and of low significance**. Impacts are only expected at the construction phase, since, once the trenches are excavated, no new impacts would occur during maintenance work or during decommissioning, even if the pipe line was removed. Cumulative impacts are of relatively low significance because large numbers of archaeological sites do remain on the Vredenburg Peninsula. However, it should be remembered that such resources are irreplaceable and unique.

8.5.2.3 Impact on Scenic routes

Scenic routes will experience very limited indirect temporary impacts during construction. These impacts are **negative and of very low significance before and after mitigation** and need not be considered further. No impacts would occur during the operation and decommissioning phases. Impacts would likely be similar to those of the construction phase, but only if the pipeline is removed from its trench.

8.5.2.4 Impact on unmarked graves

There is a very small chance that unmarked human burials could be found during the construction phase. Should these unmarked graves be found impacts would be negative and of high significance before mitigation, but they are easily mitigated if the graves are protected immediately on discovery and then reported to an archaeologist for exhumation. The significance rating will then be changed to **negative and of low significance after mitigation**.

8.5.3 Management actions and Mitigation Measures

The following mitigation measures are proposed:

- At the start of the construction phase a palaeontologist will need to be contracted and a monitoring schedule established;
- A pre-construction palaeontological survey of the final pipeline route should take place where the Velddrif and Prospect Hill Formations will be crossed;
- Monitoring and site inspection should take place for palaeontology during construction;
- Archaeological test excavation should take place at site JB001 and along the pipeline route within about 200 m of Danger Bay;
- In situ recording or full excavation should take place at JB001 depending on the outcome of the test excavation;
- Site DB022 must be avoided or, or if this is not possible, excavated;
- During construction, any graves intersected should be immediately protected and reported to an archaeologist or to HWC; and
- Construction workers must be informed about the possibility of encountering fossils, shell middens during excavation and instructed to protect and report any such finds immediately to an archaeologist or to HWC. Work in the immediate area should be halted as the find may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Table 8.7 Assessment of impacts to the Heritage resources associated with the proposed Saldanha Regional Marine Outfall Project

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Construction Phase											
Loss of Palaeon-tological resources	**Negative and Positive**	**Site Specific**	**Permanent**	**High**	**Probable**	**Irreversible**	**Low**	**Medium** (negative)	• Inspection of the final route should take place in areas where it crosses the Prospect Hill and Velddrif Formations. • Inform workers of the possibility of finding fossils and to report it to an Archaeologist or HWC immediately. • Monitoring and inspection of excavations during construction.	**Medium** (Positive), since new fossils and new information on the local geology could be brought to light	**High**
Loss of Archaeological resources	**Negative**	**Site Specific**	**Permanent**	**High**	**Highly Probable**	**Irreversible**	**Low**	**Medium**	• Test excavation and, if of low significance, in situ recording of JB001. If medium-high significance then full mitigation required. • Avoid site DB022. If it cannot be avoided then full mitigation is required. • Test excavations along pipeline route within 200 m of Danger Bay to check for buried shell middens. It is important to establish the width of the disturbance corridor prior to commencement. • Keep disturbance corridor as narrow as possible. • Monitoring of excavations by workers/ECO in case of buried shell middens being intersected.	**Low**	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Impact on scenic routes	**Negative**	**Local**	**Temporary**	**Low**	**Definite**	**Reversible**	**High**	**Very Low**	• Keep construction period as short as possible.	**Very Low**	**High**
Impact to unmarked graves	**Negative**	**Site Specific**	**Permanent**	**High**	**Improbable**	**Irreversible**	**Low**	**High**	• During construction, any graves intersected should be immediately protected and reported to an Archaeologist or to HWC. Exhumation by an archaeologist will be required.	**Low**	**High**

8.6 ECONOMIC ASSESSMENT

Dr Hugo van Zyl of Independent Economic Researchers was commissioned by the CSIR to undertake the Economic specialist study of the proposed SRMO Project (Appendix F of Volume II of this report).

The significance of impacts is often highly dependent on the economic environment or context within which they occur. For example, job creation or loss in a small local community with a stagnating economy will be far more significant than it would be in a larger community with a healthy economy. With this in mind, the Economics assessment describes the economic environment focusing on the local area and region where the majority of impacts are likely to be felt. The main information sources used were Census data, IDPs, SDFs and Demarcation Board data.

Given the scale of the project, the economic context includes information on the Western Cape, the West Coast District and the Saldanha Bay Municipal area. It also includes information on the key individual towns or areas within these areas which will potentially be impacted the most, namely: Saldanha Bay, Vredenburg, Jacobsbaai and Diazville.

The Saldanha Bay area has long been recognised as an area of significant economic opportunity. The Provincial Growth and Development Strategy of 2006 identified the Saldanha- and Mossel Bay areas as the two 'regional motors' in the province (PGWC, 2006). Van der Merwe et al. (2005) found Saldanha Bay and Vredenburg to have a very high growth potential in their survey of the growth potential of towns in the Western Cape. This study is in the process of being updated and the draft version also classifies Saldanha Bay as an area with high growth potential. The growth potential of the Saldanha Bay municipal area with its proximity to Cape Town and natural deep water harbour have also resulted in it being recognised as a Presidential Development Growth Node.

The fishing and mariculture industries play a pivotal role in the economy of Saldanha Bay. Fishing is also a popular recreational activity in the area making it important to consider risks and impacts in this regard.

There are no mariculture operations in Danger Bay. Jacobsbaai Sea Products (JSP) is the only mariculture operation relatively nearby - approximately 6.5 km along the shoreline to the north of Danger Bay. Jacobsbaai Sea Products has registered as an I&AP for the EIA and has expressed concern regarding potential impacts on their operations. They operate a facility which was established in 1992 and represent an investment of between R25 million and R30 million in plant and equipment. Current annual production volumes are approximately 70 tonnes of abalone. This is practically all exported to the East.

Apart from mariculture operations in Jacobsbaai, the coastline and sea near the proposed marine outfall are used for fishing. Recreational and small-scale commercial line and rock-lobster fishing occurs in Danger Bay and on the rocky shoreline adjacent to the Bay. Danger Bay is also used for swimming, other water-based activities such as surfing and kajaking as well as walking.

The proposed SRMO Project would be a pre-requisite for the development of the SSP as the latter would only be technically feasible if process effluent can be legally disposed of. The benefits associated with the SSP can therefore be viewed as indirect or facilitated benefits of the SRMO Project.

From a municipal service provision perspective, the SRMO Project would facilitate wastewater service provision by the SBM. Frontier Utilities would take the primary financial risks associated with the construction of the project to the ultimate benefit of the SBM. The option of using the facility will then be open to the SBM once the mooted new WWTW proceeds. This would support efforts by the SBM to keep future wastewater services provision costs (and therefore service charges to users) as low as possible.

The plant would have a positive impact on economic activity in the local area and region given the size of the new spending injections associated with it. An estimated R113 million expenditure on the project is anticipated. Approximately 164 temporary construction jobs of 12 to 18 months are expected - the majority of which would be medium and low skilled positions in keeping with the nature of the construction required. A total direct labour income of R20 million would be associated with the construction phase. The annual operational expenditures would be approximately R2.6 million per year. Approximately eight permanent jobs will be associated with the operation phase of the plant resulting in a total operational labour local salary bill of approximately R1.2 million per year. In addition to the above direct employment and associated income opportunities, a number of temporary indirect opportunities would be associated with the project

8.6.1 Identification of impacts

The following potential impacts have been identified:

1. Impacts on industrial development opportunities;
2. Impacts on municipal services provision and costs;
3. Impacts on mariculture and fishing;
4. Impacts on tourism and recreation; and
5. Impacts on local economy (impacts associated with expenditure linked to the construction and operation of the development).

8.6.2 Assessment of impacts

This section provides an assessment of the impacts identified above and suggests management and mitigation actions to avoid or reduce negative impacts or to enhance positive benefits. A summary table of impacts is provided at the end of the section containing all impact ratings.

- Impacts in terms of facilitating municipal services provision would be **positive** and of **medium significance during operations** for all pipeline and outfall alternatives;
- Overall impacts on mariculture and fishing are expected to be **negative** and **low with mitigation** for both outfall alternatives;
- Overall impacts on tourism are anticipated to be **negative** and **low to medium with mitigation** for all pipeline and outfall alternatives. Note however that the

Jacobsbaai Western Corridor along the existing road is slightly preferred given its lower visual impacts; and

- The project will have a **positive impact on economic activity** in the local area and region given the size of the new spending injections associated with it. The impact will be **positive with a medium significance rating with mitigation** during construction. The impact during the operational phases will be **positive with a low significance rating** given jobs and income effects.

The key sources of potential negative cumulative impacts identified in this assessment are those associated with impacts on mariculture and fishing along with those on tourism and recreation. Risks to mariculture and fishing would flow from cumulative impacts on the marine environment which are assessed in the marine ecology specialist study (Pisces, 2014). Cumulative risks to mariculture and fishing should therefore remain low with mitigation. Cumulative risks to tourism and recreation are equally difficult to predict, but should remain at a low to medium level of significance.

Positive cumulative impacts are also likely as the project should set a positive precedent for further investment in the wider area. The project would represent a commitment to investment in infrastructure and service development that facilitates the development of other industries and creates a partnership with the local municipality. It would thus be a strong 'vote of confidence' in the local economy. This has the potential to influence other investors to also act with similar confidence thereby resulting in cumulative impacts on overall investment levels and the 'crowding in' of further investment. Its positive cumulative impacts in this regard have therefore been given a high significance rating.

8.6.3 Management actions and Mitigation measures

The following mitigation measures are proposed:

- Implement recommendations of the marine ecology specialist study (Appendix A of Volume II of this report);
- The measures recommended in other specialist reports for this EIA to minimise biophysical impacts (primarily the minimisation of water quality, botanical and visual impacts) would also minimise impacts on tourism and recreation (Appendix A, B and D of Volume II of this report);
- Set targets for use of local labour and maximise opportunities for the training of unskilled and skilled workers;
- Use local sub-contractors where possible ; and
- Explore ways to enhance local community benefits with a focus on broad-based BEE.

Table 8.8 Assessment of impacts to the Economic associated with the proposed Saldanha Regional Marine Outfall Project

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Construction Phase											
Impacts on mariculture and fishing	**Negative**	**Local**	**Short term**, i.e. 2 years	**Low**, since construction activity would be relatively localised	**Highly probable**, since construction will entail significant activity on site	**High**, mariculture and fishing would return to normal if construction stopped	**Medium**, given importance and value of mariculture and fishing near the site to the local economy	**Medium**, given potential risks without mitigation	• The measures recommended in the marine ecology specialist study would minimise impacts.	**Low**, considering potential for mitigation	**Medium**
Impacts on tourism and recreation	**Negative**	**Local**	**Short term**, i.e. 2 years	**Low** to medium, since construction activity would be disruptive but relatively localised	**Highly probable,** since construction will entail significant activity on site	**High**, tourism potential would return to normal if construction stopped provided the site is adequately rehabilitated	**Medium**, given future potential and value of tourism and recreational assets around the site	**Low to medium**, since recreational and tourist activities may be disrupted and negative visual impacts would be introduced	• The measures recommended in the visual, botanical and marine specialist studies would minimise impacts.	**Low**, considering potential for mitigation	**Medium to high**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Impacts associated with project investment / expenditure	**Positive**	**Local and regional**	**Short term**, i.e. 2 years	**Medium**, since construction expenditure would be a significant injection	**Highly probable**, since construction will entail significant activity on site and investment	**Moderate**, even if expenditure flows fall away, income can be invested and converted to other forms of capital to provide ongoing benefits	**Low**, as project expenditure can be replaced by expenditure on other projects	**Low to Medium,** given significance of injection relative to economy	• Set targets for use of local labour and maximise opportunities for the training of unskilled and skilled workers. • Use local sub-contractors where possible • Explore ways to enhance local community benefits with a focus on broad -based BEE.	**Medium**, given potential for mitigation to enhance benefits	**High**
Operational Phase											
Impacts on industrial development opportunities	**Positive**	**Local and regional**	**Long term**	**High**, given magnitude of opportunities	**Highly probable**, since operations would continue for at least 25 years	**High** as gains would be reversed if the facility is closed	**High**, given limited availability of other opportunities	**High**, given economic significance of opportunities	• No mitigation possible beyond approval of the project	**High**, given economic significance of opportunities	**High**
Impacts on municipal services provision	**Positive**	**Local**	**Long term**	**Medium**, given magnitude of opportunities	**Highly probable**, since operations would continue for at least 25 years	**High** as gains would be reversed if the facility is closed	**Medium**, , given limited availability of other wastewater disposal options	**Medium**, given potential to facilitate lower cost services provision	• No mitigation possible beyond approval of the project	**Medium**, given potential to facilitate lower cost services provision	**High**

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Reversibility	Irreplace-ability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
Impacts on mariculture and fishing	**Negative**	**Local**	**Long term**	**Medium to high**, given sensitivity of marine environment	**Highly probable**, since operations would continue for at least 25 years	High, mariculture and fishing would return to normal if operations stopped	Medium, given importance and value of mariculture and fishing near the site to the local economy	**Medium to high**, considering risk levels	• The measures recommended in the marine ecology specialist study would minimise impacts.	**Low**, considering potential for mitigation and residual risk	**Medium**
Impacts on tourism and recreation	**Negative**	**Local**	**Long term**	**Medium**, given sensitivity and tourism and recreational use	**Highly probable**, since operations would continue for at least 25 years	**High**, tourism potential would return to normal if operations stopped provided the site is adequately rehabilitated	**Medium to high**, given future potential and value of tourism assets around the site	**Medium**, considering risk levels	• The measures recommended in the visual, botanical and marine ecology specialist studies would minimise impacts.	**Low to Medium**, considering potential for mitigation	**Medium to high**
Impacts associated with project investment / expenditure	**Positive**	**Local**	**Long term**	**Low**, in keeping with modest operational expenditure levels and employment	**Highly probable**, since expenditure on operations would continue for at least 25 years	**Moderate**, even if expenditure flows fall away, income can be invested and converted to other forms of capital to provide ongoing benefits	**Low**, as project expenditure can be replaced by expenditure on other projects	**Low**, given significance of injection relative to economy	• Set targets for use of local labour and maximise opportunities for the training of unskilled and skilled workers. • Use local sub-contractors where possible. • Explore ways to enhance local community benefits with a focus on broad-based BEE.	**Low**, given potential for mitigation to enhance benefits	**High**