PISCES

ENVIRONMENTAL SERVICES (PTY) LTD

PO Box 31228, Tokai 7966, South Africa. Ph: +27-21-7829553, Fax: +27-21-7829552
E-Mail: apulfrich@pisces.co.za

Report on Swakopmund Field Survey - Marine Baseline Assessment

Prepared by
Andrea Pulfrich and Nina Steffani

for
CSIR Environmentek

1. Introduction

The Namibia Water Corporation (NamWater) intends to establish a Desalination Plant with an output capacity (treated water) of 25 Mm^3/annum just north of Swakopmund at Mile 6, on Namibia's central coast. Associated with the plant will be a Sea Water Intake structure designed for a maximum of 110 Mm^3/annum, with an installed abstraction capacity of 63 Mm^3/annum complete and a brine disposal system through which 38 Mm^3/annum of brine will be discharged back into the sea.

With respect to the proposed project, and in line with Namibia's Environmental Assessment Policy (1994) and the provisions contained in the Environmental Management Act (2007), NamWater requires the compilation of an Environmental Impact Assessment (EIA). As an important input into this EIA, NamWater has asked the CSIR for their consultancy services to conduct marine and geophysical surveys and to compile a Marine Specialist and Geophysical Marine Report. CSIR in turn has appointed Pisces Environmental Services (Pisces) to provide the biological marine studies and the Marine Specialist Report.

Following the Scope of Work specified by NamWater, one of the two components to the marine study was to conduct a biological survey of the nearshore marine environment in the vicinity of the proposed desalination plant to establish baseline conditions (diversity and abundance of macrofaunal communities) before the commencement of construction of, and subsequent brine discharge from, the proposed desalination plant. The results of the survey were to provide input into the Marine Specialist Report. It was also intended that the survey provide the baseline for a potential monitoring study assessing the impacts of the brine disposal on the benthic marine environment.

2. Survey Period and Survey Team

Having closely followed swell and weather predictions with BuoyWeather (www.buoyweather.com) over a 6 week period, the forecast was particularly favourable for the period 28 February - 1 March 2009, with swell increasing again to over 2.5 m on the 2 March. Figures 1a and 1b show the 7-day BuoyWeather predictions in the week preceeding the survey. The proposed diving survey was therefore scheduled for 27th February - 2 March 2009.

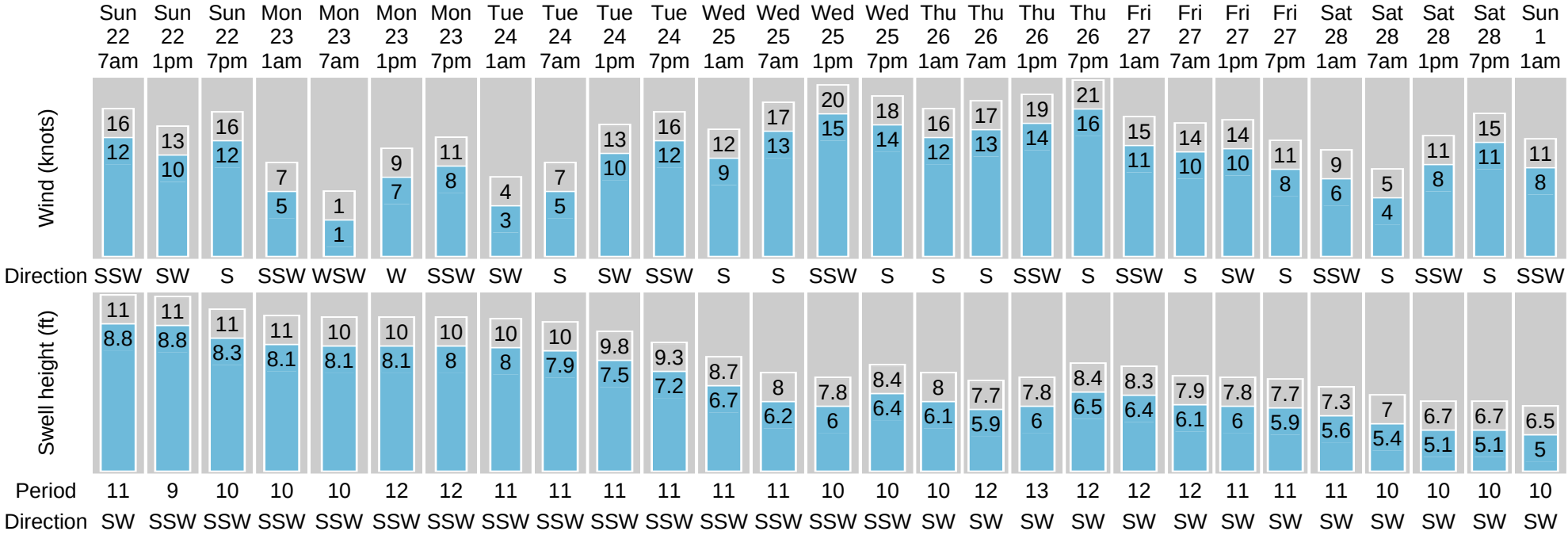

Figure 1a: BuoyWeather Wind & Wave Forecast for Swakopmund during the week preceding the survey (Download Sunday 22nd February 2009).

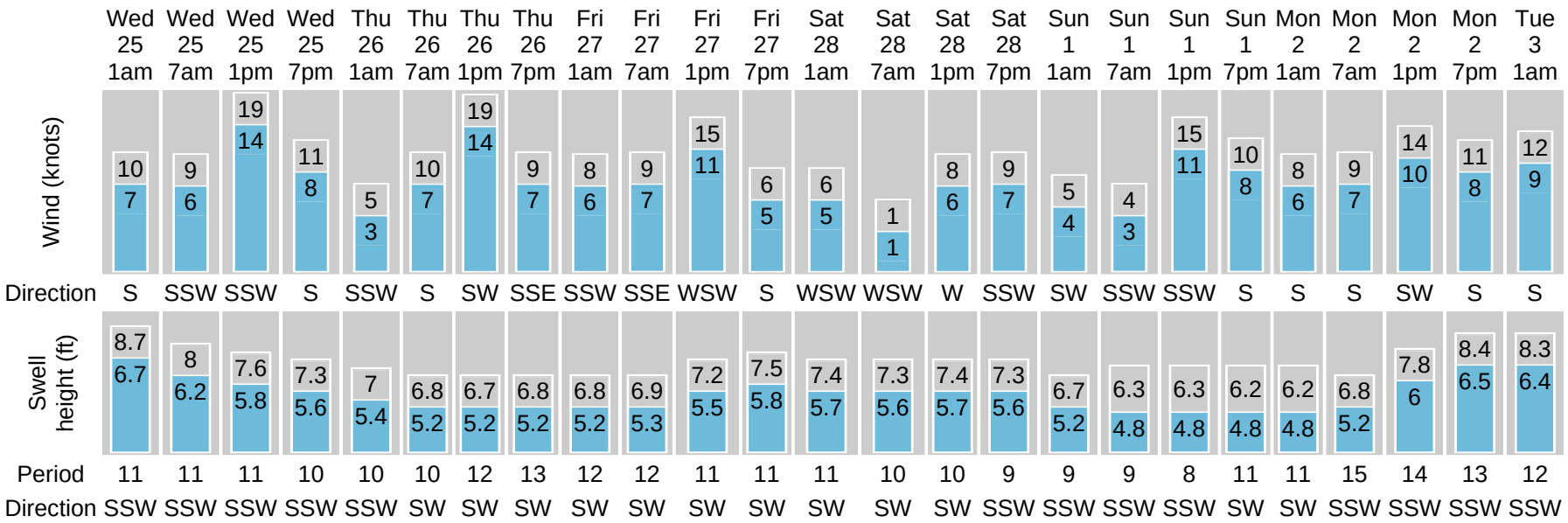

Figure 1b: BuoyWeather Wind & Wave Forecast for Swakopmund during the week preceding the survey (Download Tuesday 24th February 2009).

The survey team consisted of:

Andrea Pulfrich	- Survey team leader and diving supervisor.
Nina Steffani	- Scientific diver and benthic expert.
Mark Noffke	- Scientific diver and technical manager.

3. Daily Survey Log

Date	Notes
Friday 27th Feb.	Flight to Walvis Bay SA7122 arrival 15h30. Arranged transport and accommodation.
Saturday 28th Feb.	Arranged diving equipment through Walvis Bay Diving. Made final arrangements with skipper and viewed and loaded skiboat. Site visit to Mile 6 to take GPS co-ordinates of shore markers placed previously.
Sunday 1st Mar.	Launched at 06h00, ran up to Mile 6, First dive at southern site: 08h13-08h37, 08h55 - 09h10. Ran to northern site, second dive: 09h32 - 09h50. Ran back to Walvis Bay - delayed by engine problems. Analysed samples in afternoon, returned diving equipment.
Monday 2nd Mar.	Flight to Cape Town SA1721, arrival at 15h00.

4. Results

On the day of the survey, the sea was flat with <1 m swell from the southwest and there was no wind at all. The surface water was unusually clean and the fishermen overheard over the skiboat radio were complaining that fish were not biting because of the clean water. Water temperature was 19-20 °C.

4.1 Southern Site

The southern dive site was positioned ~600 m offshore of the southern shore-marker on the beach in ~ 5 m depth (Figure 2). The dive team went down on the anchor line and returned to the surface almost immediately reporting that there was black water on the bottom and the underwater visibility was very poor (Figure 3). As agreed during the dive planning, the proposed approach of 2 transects at each site with 3-5 point counts every 5 m along each transect line, was modified to keep the divers together with one diver holding the torch whilst the other conducted the quantitative point assessment. Unfortunately, this approach also had to be abandoned, as even with torches the divers were not able to see the benthic communities or the seabed. To collect at least some benthic information, the divers swam randomly over the area collecting whatever material could be remove from the seabed for later identification. A 250 ml sand sample was also collected.

Figure 2: GoogleEarth image showing GPS tracks, southern and northern sampling positions, and shore markers.

Figure 3: Diving at southern sampling site.

Analysis of the collected material indicated that the benthic communities at the southern site were dominated by tube-worm colonies that build compact sandy reefs of 0.75 - 1.0 m in diameter and up to 0.6 m in height. The colonies were partly covered in a "fuzz" of small red filamentous algae and hydroids. From the reef samples collected, it could not be determined which polychaete had constructed the reefs. Two polychaetes that were found in great numbers inside the colonies were the orbiniid *Naineris laevigata* (Figure 4a) and the flabellagerid *Pherusa swakopiana* (Figure 4b). These two species, however, are not known to be reef-building (Day 1967). Typically, *Naineris* is found on harder substrate among the holdfasts of algae, whereas *Pherusa* is commonly dredged from muddy bottoms where it can inhabit mud-filled crevices or abandoned tubes or burrows. It is possible that a previous sulphur eruption or low-oxygen event had killed the reef-building worms and the colonies were then subsequently occupied by other animals utilising the abandoned burrows. Alternatively, only 'empty' pieces of the colonies were incidentally collected. The extremely poor visibility at the southern site hindered selective collection of material by the divers.

a) b)

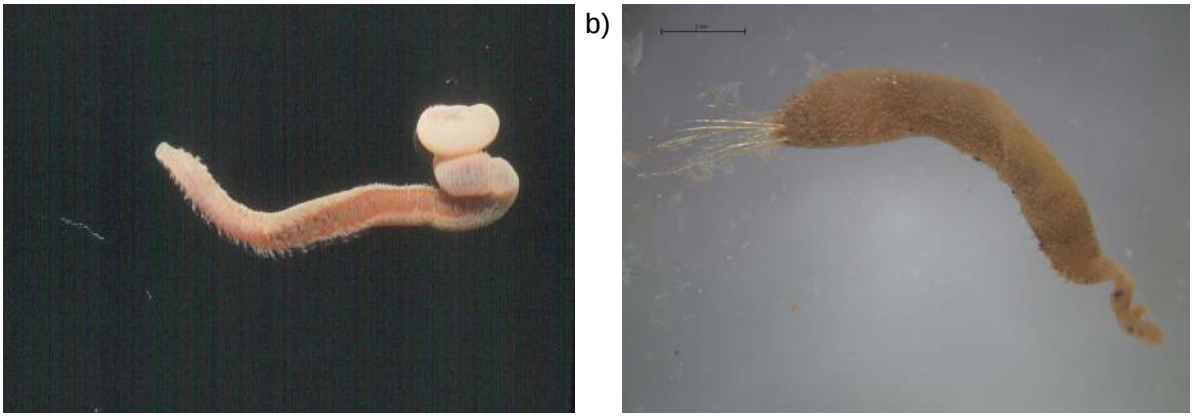

Figure 4: The polychaete worms a) *Naineris laevigata*, and b) *Pherusa swakopiana* found within the sandy tube-worm reefs at the southern sampling site.

Various other macrofaunal species were observed living on or within the colonies including anthurid isopod *Apanthura africana*, another non-reef building polychaete (*Nereis* spp.), the amphipod *Maera hinderella*, and boring bivalves (*Petricola bicolor* and *Gregariella petagnae)*. The sea anemone *Actinia* sp. was encountered on the sides of the colonies. Empty shells of the disc lamp shell *Discinisca tenuis* were also present. Small boulders occurred beneath and adjacent to the tube-worm reefs. These hard substrata were colonised by barnacles, brittle stars and encrusting bryozoans. Interspersed between the tube-worm colonies were scattered patches of fine black, mica-rich sand up to 5 m^2 in extent, and patches of 8-10 cm long mussels (*Perna perna*). Within the unconsolidated substrate a further species of polychaete was found, which uses fragments of algae, fine gravel and shelly grit to construct a protective tube. Again, the worm itself was not found.

No fish or rock lobsters were observed.

4.2 Northern Site

The northern dive site was also positioned about 600 m offshore and slightly to the north of the of the northern shore-marker (Figure 2). As this position was close to a shallow reef or blinder,

a shot-line was thrown for the divers as the skiboat needed to constantly motor into the oncoming swells which peaked at 1.5 - 2 m over the reef. The swells broke on occasions whilst the divers were in the water. Although the underwater visibility was better at this location, point counts were again not possible due to the strong underwater surge conditions. As done at the southern site, the divers swam randomly over the seabed collecting what biological material they could. A 250 ml sand sample was also collected.

In marked contrast to the southern site, the seabed at the northern site consisted of ~55% cover of fine sand with occasional interspersed large boulders and rocks (~5%) and drifts of dead *Perna* shells, overlying bedrock. The sediment cover varied between 10-20 cm in thickness. The remaining rocky seabed (40%) was covered by various species of red filamentous and foliose algae commonly with encrusting bryozoans on the stipes and fronds (Figure 5). The ephemeral green alga *Ulva* sp. was also seen, but sparsely. Between the algal patches were clumps of very large *Perna perna* (up to 135 mm in length) covered with encrusting bryozoans, encrusting coralline algae and encrusting orange sponge (*Hymeniacedon* sp.) (Figure 6). The mussels occurred in groups of 2-5 individuals giving a total coverage of ~15%. Other species encountered were the horseshoe sea cucumber (R*oweia frauenfeldii*), disc lampshells, Flabelligeridae living in the orange encrusting sponge, and two small crab species and klipvis occurring amongst the algae. A large specimen of *Thais haemastoma* (known locally as "alikreuk") was also collected. No rock lobsters were seen.

Figure 5: Mussel cluster with diversity of red foliose algae and encrusting sponge (left) and filamentous red algae (right) in benthic samples from the northern site.

Figure 6: Large mussels (*Perna perna*) and associated benthos typical of the northern sampling site (left) and the large gastropod mollusc *Thais haemastoma* (right).