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Session: B4 Adapting Urban Water Management

Presentation: Improving the bulk water supply to the town of Walvis Bay, Namibia

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Abstract:

The town of Walvis Bay on the West coast of Namibia is the country's main port and also the hub of the fishing industry. The port serves as a gateway to and from the South-Western parts of Africa via a well developed network of road- and rail infrastructure. The town's population is a fast growing one of around 80,000.

The town is dependent on 30 to 40 aquifers in the nearby Kuiseb river for its fresh water supply which has been growing rapidly over the past two years. A number of pipelines and reservoirs connect the aquifers with the town's final, 10ML reservoir, called Mile 7. The Kuiseb, one of 12 Namibian ephemeral rivers flowing into the Atlantic Ocean, has experienced severe flooding on 4 occasions over the past decade.

Flooding of the river is accompanied by damage to infrastructure like electricity supply, borehole pumps and supply lines. In turn, this results in water shortages to the town, leading to great discomfort and economic losses, especially in the fishing industry, the third largest contributor to the GDP.

The Municipality of Walvis Bay, in co-operation with the bulk water supplier of Namibia, NamWater, has designed a solution to augment water supply to Walvis Bay from other sources, including future desalination. The presentation focusses on the details of the arrangement.

Keywords: Damage, Flooding, Kuiseb , Link Line, Walvis Bay

1. Background

1.1 Walvis Bay

Walvis Bay, closed in on side by the Atlantic ocean and on the other by the sand of the Namib desert, has a colourful history. First discovered by Portuguese sea explorers and later followed by land explorers, the town was officially established by Britain in 1878. The town derives its name from a lucrative whaling industry in the previous century.

Walvis Bay became part of the Union of South Africa in 1910 and remained under South African control until 1994, three years after Namibia became independent.

1.2 Water supply

After making use of a very expensive condensation plant to desalinate sea water, the first fresh water well was sunk in the Kuiseb river near Rooibank, approximately 30km away, in 1923. The catchment area of the Kuiseb covers an area of around 21,000km², but most of its water originates from the annual 100-350mm of rainfall in the 6,600km² east of the escarpment.

The Kuiseb serves commercial farmers in its upper reaches, the Namib-Naukluft Park and the Topnaar community in the middle reaches, and the town of Walvis Bay along the coast

For much of the year it is typically dry, and is little more than a broad, sandy riverbed, flooding only when sufficient rain fall in its catchment area. Prior to 2000, the pattern was a flow for 2 or 3 weeks a year and stopping around 100km from Walvis Bay where the water would seep into the sand before reaching the sea. Although the river ends in the dunes near Walvis Bay, it may still force its way through the dunes to the sea due to heavy flooding. Records show that this happened in 1934, flowing for several months and once again in 1963.

The 1934 major floods inundated Walvis Bay and drinking water was in short supply. As a response, a diversion wall was built in 1962 to protect the town. Large flows can no longer threaten Walvis Bay directly, but they do interrupt the electricity supply used to pump the water from the boreholes and to the reservoirs. Ironically, “more water in the river – less to drink in town” (Zeelly : 2007).

Boreholes were mostly constructed in the alluvial aquiver in the river bed as there is little or no water outside the river bed. This makes for a very vulnerable system.

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Typical borehole installation in river bed – vulnerable to floods

After having been in charge of its own water supply system since 1962, the Municipality of Walvis Bay handed over the borehole- and pipeline scheme to a newly formed parastatal, NamWater, in March 1998.

There are 8 reservoirs in total with a current storage capacity of approximately 50,000 m³. The final reservoir, feeding the town of Walvis Bay, is called Mile 7 and has a storage capacity of 10,000m³. The Municipality assumes responsibility from the reservoir outlet. The port authority, Namport, has a separate reservoir and supply agreement with NamWater.

The consumption of Walvis Bay over the past decade remained fairly constant at around 4,5mil m³/annum or 12,500m³/day which equates to an average hourly consumption of 520m³. The low growing water consumption, despite annual growth in population and economic activity was probably the result of a combination of annual tariff increases and artificial restriction of the supply by the local authority at times to secure sufficient reservoir backup. The more recent requirement is around 650 m³/hr average.

2. Problem statement

Over the past decade, it has become obvious that, whether as a result of climate change or not, the rainfall in the catchment area has increased dramatically, resulting in more frequent flooding of the lower

Kuiseb where the boreholes are located in the river bed. Above normal rainfall and resultant floods, exceed the design capacities and robustness of the infrastructure and water supply disruptions have become a regular occurrence.



2004 Floods

The sustainable yield of the Kuiseb aquifer is estimated at around 7,2mill m³/annum, but after the recent recharge events, this figure could be as high as 10mil/annum. Walvis Bay currently consumes around 5,5mill m³/annum. This effectively leaves a “surplus” of between 2,2 and 4.5 mill m³/annum which enables NamWater to also supply water from the Kuiseb to consumers to the north, such as the town of Swakopmund and the mines.

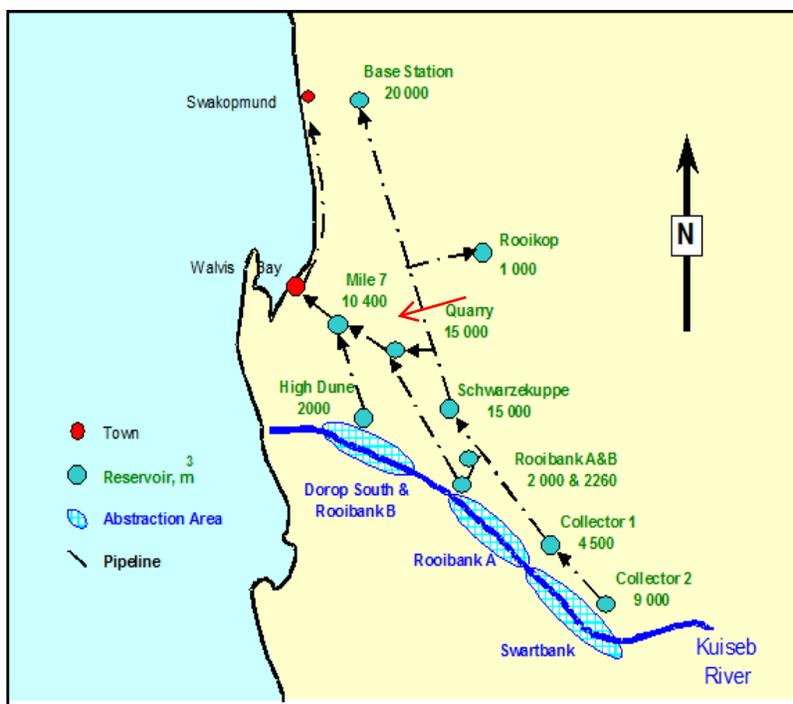
Currently, a 800mm pipeline links the Swartbank water abstraction scheme in the river with Swakopmund and the uranium mines in the Namib desert . This is a gravity fed line, supplying water in a south – north direction only. This flow is currently not reversible in a opposite direction, meaning that, should there be water supply interruptions in the Kuiseb, water cannot be supplied from north to south.

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Kuiseb borehole area, supply lines and reservoirs

3. Solution – New Link Line

As far back as after the 2006 floods, a project, consisting of 3 main components, was identified. It has since been referred to as the “link line” project:

It comprises of (a) the upgrading of the 800mm gravity line to a pump line (b) the installation of pumps at Swakopmund reservoir and (c) the construction of a new 6,2km link line of at least 500mm diameter to the Mile 7 reservoir (indicated in red above). This was identified as the best option to secure the water supply to Walvis Bay. Preliminary designs were done at the time and NamWater already replaced a section of the pipeline which would enable a pumped, reverse flow if necessary.

More recently, and following further supply disruptions in 2009 and 2011, both parties realised that the need for the link line is now more urgent than ever before. Not only to be able to get water from Swakopmund in case of total Kuiseb disruptions but, becoming more import, to augment the limited supply capacity of only 780m³/hr from the Kuiseb schemes to the Mile 7 reservoir.

Increasing infrastructure problems on the ageing Kuiseb scheme, affects the supply from there regularly and even short disruptions, forces the town to make water cuts during the night.

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The economic loss to the town of Walvis Bay due to water disruptions and restrictions far outweighs the construction costs of this link line which is now estimated at around N\$30 million. Potential investors are also edgy about the lack of water supply surety.



Kuiseb reaching the Atlantic Ocean at Walvis Bay lagoon in 2011 for 3rd time since 1934 and 1963.

3.1 Detailed project proposal

- 3.1.1 A Heads of Agreement was reached earlier in 2013 which entails the following:
Namwater will construct a 500mm link line with a carrying capacity of 500m³/hr if water is to be supplied from Swakopmund by pumping. However, the capacity is significantly higher at around 700m³ if water is supplied under gravity feed from the high lying, Swartzekuppe reservoir.
- 3.1.2 The estimated cost is N\$30 million.
- 3.1.3 The initial funding will be secured by NamWater.
- 3.1.4 The Walvis Bay City Council will repay the capital investment by means of a tariff increase in the purchase price of water from NamWater.
- 3.1.5 The payback period would not exceed 20 years.

3.2 Financial viability

This increase in the buy-in price of water, in addition to an expected 10-12% annual inflationary increases, will have to be recovered from consumers, both domestic and business. Details, like which party and tariff groups will contribute how much, must still be calculated and decided upon. As this line will also benefit the port who, like a few smaller consumers outside the town's perimeters, purchase water directly from NamWater, a contribution from them will also be sought.

There is also still the possibility of a contribution from Central Government as the project is of national importance in view of the economic contribution of Walvis Bay to the country. A request in this regard must still be motivated and submitted.

This link line, together with the pumping system and upgrading of the existing 800mm gravity line, will also enable NamWater to supply Walvis Bay with desalinated water from a plant north of Swakopmund, if necessary. Plans for this are in an advanced stage.

It is anticipated that Tenders can be called for in early 2014 and with an estimated construction period of 18 months. It will mean that Walvis Bay should be in a more secure, resilient water supply position for the 2016 rainy season.

The project is indicative of how relatively straight-forward engineering solutions can contribute to improving resilience against threats emanating from climate change. As is usually the case, funding will be the most challenging aspect of this intervention.

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