Water Sewage and Effluent
January 2011
AVE:

WATER SEWAGE & EFFLUENT
01 Jan 2011
Page : 21 #

Five phases over six years

King William's Town bulk upgrade

The King William's Town Bulk Sewerage Scheme is divided into five phases which will be spread over a number of years and the total cost of the project is estimated at approximately R400-million. The completion of the project, due to commissioning, should take between four and six years. Dave Clark, project director at GIBB, says: "Our objective is to create a consolidated regional network with a treatment facility at Zwelitsha that will serve the entire area." The existing Zwelitsha works will eventually be upgraded to a 35 Ml/day plant. GIBB has been involved in the strategic planning and financial evaluation of the bulk sewerage scheme since its inception some years ago. Phase 1 sees the construction of a 7 km-long bulk outfall sewer from the existing works at Schornville to the Zwelitsha works. Phase 2 comprises the upgrade of the Zwelitsha works to a 17,5 Ml/day activated sludge plant. Once this added capacity has been created, the area of Bridgbach will be connected to the scheme in Phase 3. Phase 4 will incorporate the sewage from the Breidbach area into the scheme via a 12 km bulk outfall. In Phase 5, the treatment works will be upgraded to a 35 Ml/day capacity to allow for the planned future growth.

"Aspects that have been particularly challenging with regards to this project include the widespread location of the existing small works, difficult terrain conditions and the new sludge handling requirements issued by the Department of Water Affairs," says Clark. "All sludge handling options must be investigated and only if other options have proved unsuitable is the dumping of dried sludge allowed." The treatment works will generate 5 t/day to 8 t/day of sludge at full flow capacity. Various sludge handling options are being investigated in order to determine the most economical and sustainable solution. The decommissioning of ineffective and overloaded treatment works will contribute towards the overall improvement of water quality within the Buffalo River System. The water treatment works is sited downstream of the wastewater treatment works. By improving the treated effluent quality, the clear water system will also benefit.

Water Sewage and Effluent
January 2011
AVE:

Three dams and a pipeline

With underground water resources becoming depleted, Botswana is increasing its surface water supply with the build of three dams and a new pipeline, finds *Dominic Uys*.

Dominic Uys

Dam serious
Three dams being built in north-east Botswana and the imminent construction of the North South Carrier 2 pipeline will increase surface water supply to around 939 000 Mℓ up from the 409 000 Mℓ of existing capacity.

Based on the prevailing water demand in the country, the Botswana government started with plans to expand its water infrastructure once its 2006 National Water Master Plan Report was completed.

Project coordinator for the Botswana Department of Water Affairs, Thatayaone Dedede, tells *Water Sewage & Effluent* that the entire project, which has cost the country 2,4 billion Botswana pula (about US$ 365,52-million) so far, will be completed in 2016 and should serve the demand for water in the country until around 2035, when infrastructure will need to be expanded again. According to the latest information from the Botswana Department of Water Affairs, the country's water demand to is grow to about 225 000 Mℓ/year over the next 10 years.

The infrastructure scheme consists of two types of undertaking which are underway; the three dams at Dikgathong, Thune and Lotsane, and the construction of the 74 km pipeline connecting Dikgathong to the yet to be built North South Carrier 2 (NSC2) pipeline which will run parallel to the existing North South Carrier pipeline.

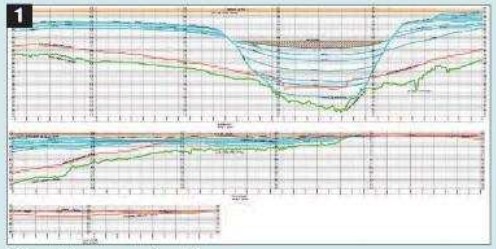
The dams will have a combined capacity of about 530-million m³. Added to the 409-million m³ of existing surface water capacity, the expansion project will bring the country's total installed water capacity to around 939 million m³, also pushing up the country's reserve margin from 15 million m³ to 55 million m³.

The reason for building the three dams, according to Tefo Tobelo, principal water engineer at Botswana's Ministry of Minerals, Energy and Water Resources, is to completely remove the country's dependency on underground water which supplies around 66% of its water demand. "It is a known fact that the groundwater does not get replenished as rapidly as it is being used. Our plan is to stop pumping water from the underground resources once the three dams are operating at full capacity in 2016. Groundwater can then be stored to augment Botswana's water supply in times of drought," Tobelo says.

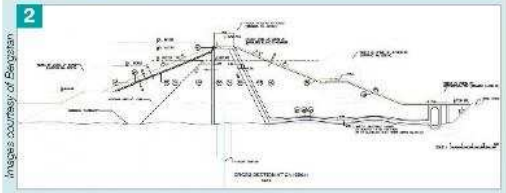
Water Sewage and Effluent
January 2011
AVE:

Contents

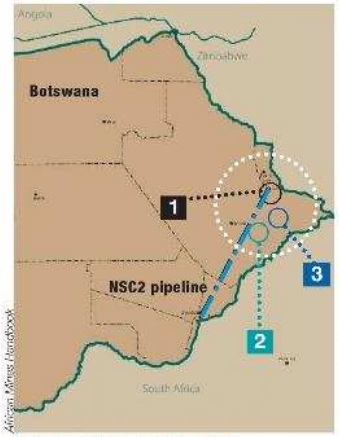
Scope of project



Dikgatlhong project team:
Project management: Joint venture: Bergstan Gauff and Jeffares & Green
Land surveyor: Bergstan Gauff
Electrical and mechanical consulting: G4 Consulting Engineers
Civils and electrical contractor: Sinohydro Corporation

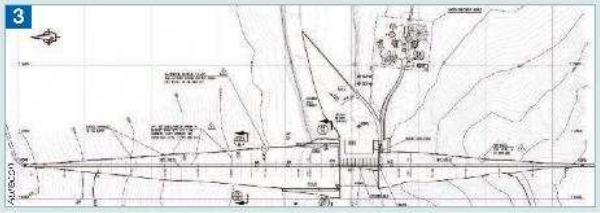


Lotsane Dam project team:
Project Management: Joint venture: SMEC, CPP Botswana and ARUP Botswana
Quantity surveyor: SMEC
Consulting engineers electrical and mechanical: CPP Botswana and SMEC
Contractor civils and electrical: Sinohydro Corporation



Increased reserve margin

The three dams will have a combined capacity of about 530-million m³ which will increase the country's water supply reserve margin from 15-million m³ to 55-million m³. Water demand is expected to grow to about 225 000 Mℓ/year over the next 10 years.



Thune Dam project team:
Project management: Joint venture: Aurecon, ACE GIBB, Goba and Pula consultants
Mechanical Consultant: Aurecon
Electrical consultant: Goba
Contractor civils and electrical: Zhong Gan Engineering and Construction

Water Sewage and Effluent
January 2011
AVE:

Location justified

The choice of location for the dams baffles an Australian consulting engineer and high evaporation rates are a concern.

The dams are situated in the best possible locations, considering Botswana's rainfall and topography, states Dededede. "The Palapye/Serowe area has very good rainfall for Botswana and the dams are located at three major confluences which makes for good catchment areas." The three major confluences are the Shashe and Tati rivers at Dikgatlhong, Motloutse River and Thune River at Thune Dam, and the Lotsane and Tshokane rivers at the Lotsane Dam.

The Serowe/Palapye region, around which the three new dams are situated, has an annual rainfall of 400 mm to 450 mm. According to the most recent statistics, compiled by Botswana's Central Statistics Office, this is 50 mm to 100 mm more then the average of Botswana's central region and almost double that of the western region.

Project manager for SMEC Engineering Consultants on Lotsane Dam, Murray Johnston, makes an interesting observation with reference to the location of the three dams. "I am originally from Queensland, Australia, which has almost identical conditions to central Botswana. The difference, however, is that in Queensland they would not even consider constructing a dam because of all the difficulties and impracticality such a project would present. However, I suppose that there are different considerations in this instance which makes the building of dams in these parts necessary" he says.

One aspect perplexing Johnston is the massive surface areas of the very shallow dams which pose serious challenges in terms of evaporation rates. The predominantly flat topography means that the three dams will have an average depth of around 15 m. The evaporation rate of surface water in Botswana is significant with the average loss estimated at 2 000 mm/year, according to a recent statement made by Botswana's Minister of Minerals, Energy and Water Resources, Ponatshego Kedikilwe. This will account for a loss of considerable amounts of water in Dikgatlhong, Lotsane and Thune, according to Dededede. "We are still open to proposals and suggestions to find solutions by the time that the dams are operational to benefit from them. We have entertained a number of ideas so far but without success," Dededede says.

"One suggestion was a specialised kind of oil that would form a film on top of the dam surface. That solution presented quite a few problems though. Firstly, the environmental impact of this oil is not fully understood yet and, secondly, the oil needs to be reapplied every time that it rains. Another suggestion was to cover the entire surface area of the dam with a protective net," Dededede continues.

Six times annual average

Taking into account Botswana's rainfall, the dams are situated in the best possible locations and should receive at least 400 mm to 450 mm annually. The dams are located at three major confluences which make for good catchment areas:
Dikgatlhong: Shashe and Tati Rivers
Thune: Motloutse River and Thune Rivers
Lotsane: Lotsane and Tshokane Rivers.

Photographs by Caroline Uys

Evaporation challenge

The dams will have an average depth of around 15 m. The evaporation rate is estimated at 2 000 mm/year. Several suggestions, including an oil coating and a net covering, have been considered.

Clay core

The choice of earthfill clay core dams for these areas was made as it was considered the most cost effective, according to consulting engineer for Bergstan Africa at Dikgatlhong Dam, Jim Dayton. "The materials for the dam are relatively easy to source. It requires the minimum amount of concrete, consisting mainly of locally sourced clay, sand and rock. It is difficult to say how much more expensive different kinds of dams would have been because the earthfill dam was the only one considered," Dayton says.

Water Sewage and Effluent
January 2011
AVE:

Village reliance surfaces

Two dams will be completed this year and another in 2013, supplying Gaborone and at least 32 villages.

Dikgatlhong for Gaborone

Dikgatlhong Dam in the Selebi-Phikwe region will be the largest dam in Botswana upon its completion at the end of September 2011. Started in early 2008, the dam will be capable of holding some 400-million m³ of water, easily surpassing the next largest dam, Gaborone Dam, which has a maximum capacity of 141-million m³. The dam is on the lower Shashe River, just downstream of the confluence of the Shashe and Tate rivers. It is approximately 55 km north-east of the town of Selebi Phikwe. About 80 km upstream of the Shashe River is the existing Shashe Dam.

The dam wall being built has a maximum height of 40 m and is 4,6 km in length. The project is managed by a joint venture between supervising engineers Bergstan Gauff and Jeffares and Green.

The water from Dikgatlhong is in large part destined for the Gaborone Dam, to feed Gaborone and Lobatse districts where the demand for water is in the order of 26 583 M/year. Industries close to the route of the pipeline, like CIC Energy's Mmamabula Energy Project, will also benefit from the water transported via the NSC2 pipeline.

Thune for 10 Bopirwa villages

The 650-million Botswana pula Thune Dam in the Bopirwa region was started in September 2010 and is situated upstream of the confluence of the Motloutse River and Thune River. It is expected to be completed at the end of 2013. With a holding capacity of 90-million m³, Thune Dam is 1,63 km long and 34,5 m high.

Water from this dam is primarily intended for the 10 surrounding villages in the Bopirwa region, augmenting the underground water supply in that area. Irrigation for some 300 ha of agricultural land will also be supplied. "Government intends to lease the land in that area to competent farmers for agricultural development in future," Lobelo says.The project is managed by consulting engineers, ACE GIBB, based in Gaborone.

Lotsane for 22 central villages

Close to the town of Maunatlala is the Lotsane Dam project. It is being built on the Lotsane River in central Botswana, less than 100 km from Dikgatlhong. The dam is a 1,5 km long, 30 m high earthfill embankment with a clay core. At full capacity, the dam will be about 1 km wide and 12 km long, holding 40-million m³. Started in February 2009, the dam is to be completed in October 2011. Lobelo reports that Lotsane Dam is intended to augment the underground water supply of the 22 villages in that area. "We are also anticipating that the improved water infrastructure in that area will stimulate the growth of industries in that area," Lobelo says.

Scope of three dams

Dikgatlhong Dam

Location
55 km north-east of Selebi-Phikwe on the lower Shashe River, downstream of the confluence of Shashe and Tati rivers.
Timelines
2008 to February 2012
Capacity:
400-million m³ of water, easily surpassing the next largest dam, Gaborone Dam, which has a maximum capacity of 141-million m³.
Scope:
Wall: 41 m high

Lotsane Dam

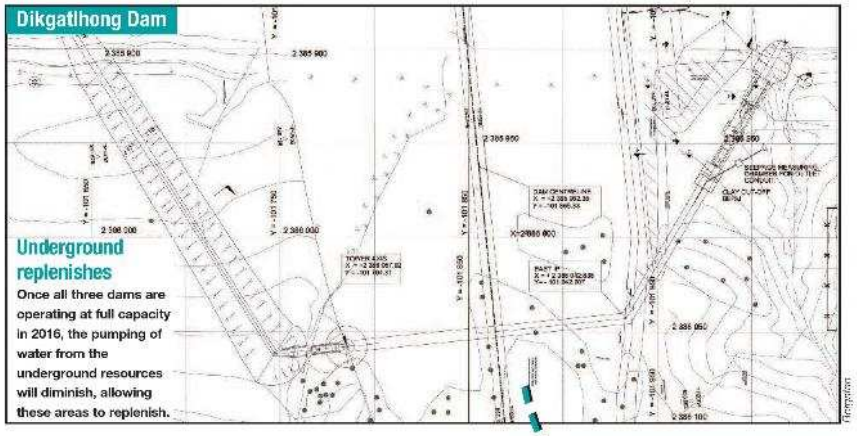
Location
Close to the town of Maunatlala on Lotsane River, Central Botswana, 100 km from Dikgatlhong.
Timelines
February 2009 to October 2011
Capacity:
40-million m³
Scope:
Wall: 30 m-high earthfill embankment
Length: 1,5 km

Thune dam

Location
Bobirwa region at the confluence of the Motloutse River and Thune River.
Timelines
September 2010 to 2013
Capacity:
90-million m³
Scope:
Wall: 34,5 m high
Length: 1,63 km long

Water Sewage and Effluent
January 2011
AVE:

NSC2 pipeline



Between Dikgatlhong Dam in the north-east of the country and the Palapye reservoirs near the town of Palapye, moving southwards towards Gaborone, the Department of Water Affairs of Botswana is commissioning a 74 km pipeline (NSC2A) to link to the yet to be built NSC2 pipeline. This will also pass the Letsibogo Dam near Selebi Phikwe. The 1-billion Botswana pula NSC2A will provide an additional 2 100 ℓ/second of raw water delivery from Dikgatlhong to the NSC2 system which currently only transports water from the Letsibogo Dam, near Selebi Phikwe, to Botswana's capital, Gaborone.

The water does rely on gravity feed for part of the way but the NSC2 pipeline will also need to rely on four pump stations.

Upcoming tenders

While most available contracts for this major bulk water upgrade have already been awarded, awards for the tenders on the NSC2 pipeline have yet to be decided. These include the supply of additional infrastructure such as pump stations. Tenders for the latter are in adjudication and will be awarded in early 2011, with construction expected to start in September 2011.

Interested parties

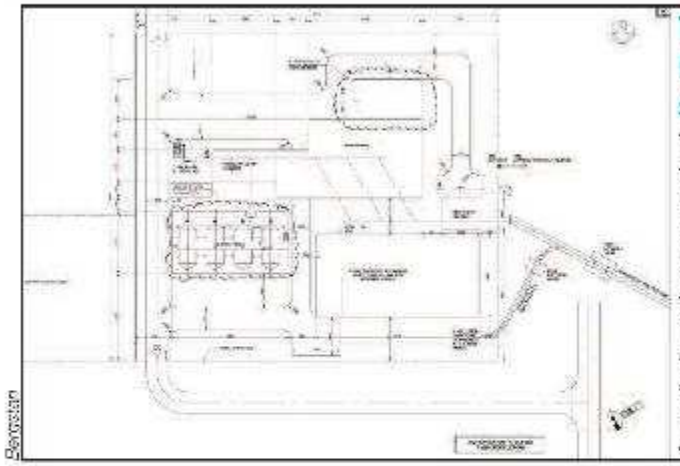
While no formal agreements have been signed with government yet, Lobelo states that the main offtake agreements from the NSC2 pipeline will be with CIC Energy's flagship project, the Mmamabula Energy Project, as well as the town of Palapye under which the Morepule Colliery also falls and the large villages of Molepolole and Kanye. The quantities of these are still to be decided.

Dedede says that many of the mining operations being supplied by boreholes have expressed interest in signing offtake agreements with the Water Utilities Corporation. He adds that tariffs are still to be decided.

According to a report by the Botswana Central Statistics Office published in October of 2009, Morepule Colliery's total annual water consumption is around 62,22 kℓ, with 44,82 kℓ being supplied by groundwater and the rest being supplied by the Botswana Power Corporation. A 17 km pipeline running through the town of Palapye is under construction to connect the colliery to the NSC2 pipeline.

The report states that other major mining operations making use of groundwater supplies are the Jwaneng Mines, which hold the rights to 1 200 Mℓ/year of water pumped from the Northern Wellfields; the Orapa and

Water Sewage and Effluent
January 2011
AVE:



Tenders for NSC2 pump stations

The tenders for the 1-billion Botswana pula NSC2 pipeline, including supply and additional infrastructure such as pump stations, are to be awarded in early 2011.

Letlhakane mines require around 2 000 Mℓ/year; and the Botash mines use about 724 kℓ/year.

Future views

With the progress made to date, albeit being done at the eleventh hour, Botswana is addressing its depleting underground resources. However, the country still faces a number of challenges, not least of which is the future transportation of water to sites like the Orapa diamond mines some 600 km west of Dikgatlhong – not to mention the issue of evaporation of surface water from its new dams. ■

Associated opportunities

Two water treatment works

Calculated into the costs of Dikgatlhong and Thune dams are water-treatment plants, each with a capacity of 11 Mℓ/day, to be constructed once the two dams are complete. The plant at Thune will serve the 10 villages in the area while the plant at Dikgatlhong will be serving the large village of Robelela, Matopi and others. The tender for the Thune plant was awarded at the same time as the tender for the Thune Dam, while that for Dikgatlhong plant will be awarded in early 2011.

Distribution postponed

What does remain are water-distribution networks around Thune and Lotsane. The distribution network around Lotsane has been postponed indefinitely owing to cost factors but Thune's irrigation network has recently ended its design phase. The tender for this network is to be announced in February 2011.