

SPRING GROVE – A new dam rising in the KZN Midlands



It is a race against time as the water requirements in the Umngeni Water area of supply push the construction of the Spring Grove Dam, outside Rosetta town in the KwaZulu-Natal midlands. Lani van Vuuren visited the site earlier this year.

Set amid the rolling hills of the KwaZulu-Natal midlands, activity is abuzz at the Spring Grove Dam construction site where the main structure and associated works are taking shape. It has been more than 18 months since the start of construction, and with the

excavation and foundation work now complete, work is continuing at breakneck speed to meet the February 2013 deadline for impoundment.

Situated on the Mooi River, Spring Grove Dam is the main component of Phase 2 of the Mooi-Mgeni Transfer Scheme. This is a much needed water resource development project to bring additional water to the ever expanding KwaZulu-Natal coastal metropolitan area. The project was approved a few years ago following extensive studies by the Department of Water Affairs (DWA) into the future water requirements of the region.

The first phase of the Mooi-Mgeni Transfer Scheme, which comprised the construction of the

Mearns Weir, was implemented in 1983 to transfer water to the Midmar Dam and to address the impact of prolonged droughts in the region. The original Mearns Weir had virtually no storage and the scheme was essentially a run-of-river scheme that could only transfer water when there was sufficient flow in the Mooi and Little Mooi rivers.

In 2003, the scheme was upgraded with a 5 m raising of Mearns Weir to create sufficient storage to allow for longer periods of abstraction by the existing 3,2 m³/s pump station. Midmar Dam was also subsequently raised. The present system supplies water through a 13,3 km rising main to a break pressure tank at

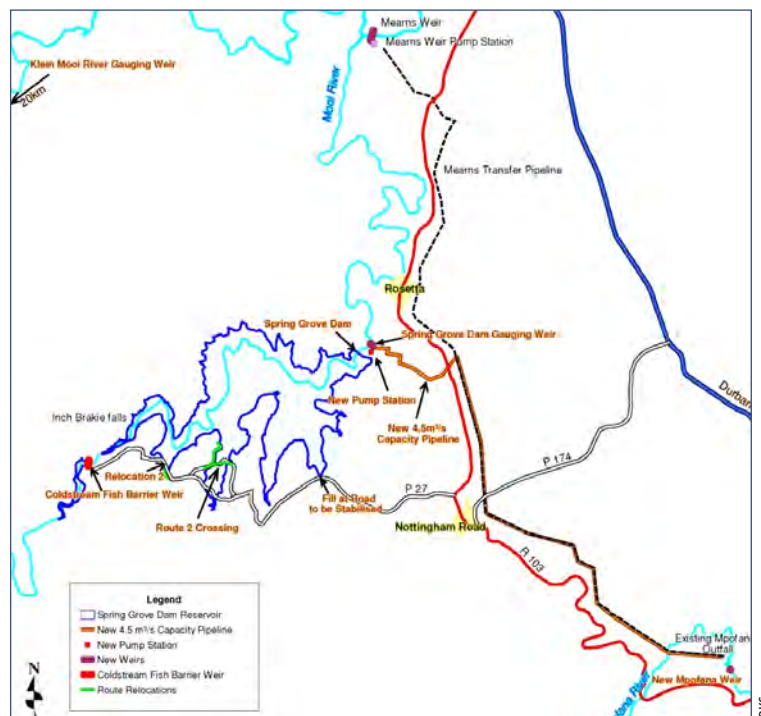
Nottingham Road. From there, it flows via an 8,3 km gravity main to an outfall works and is discharged into the Mpofana River and flows along the Lions and uMgeni rivers into Midmar Dam.

Water demand is again outstripping available supply, as is illustrated by the fact that assurance of supply periodically drops to less than 95% despite the implementation of water conservation and water demand measures. This has led to the fast-tracking of the Spring Grove Dam project.

During construction of the new dam and associated works, the Mooi-Mgeni Transfer Scheme Phase 1 infrastructure will remain operational and will be refurbished to prolong its life. In addition to the dam and additional water transfer scheme, three flow gauging structures will be constructed to monitor the system. Road realignment is also required to avoid the reservoir and flooding backwaters. (Construction of the new pump station and pipeline under Phase 2 has been postponed for the time being to allow for further environmental impact assessment after an appeal against the pipeline route was upheld by authorities).

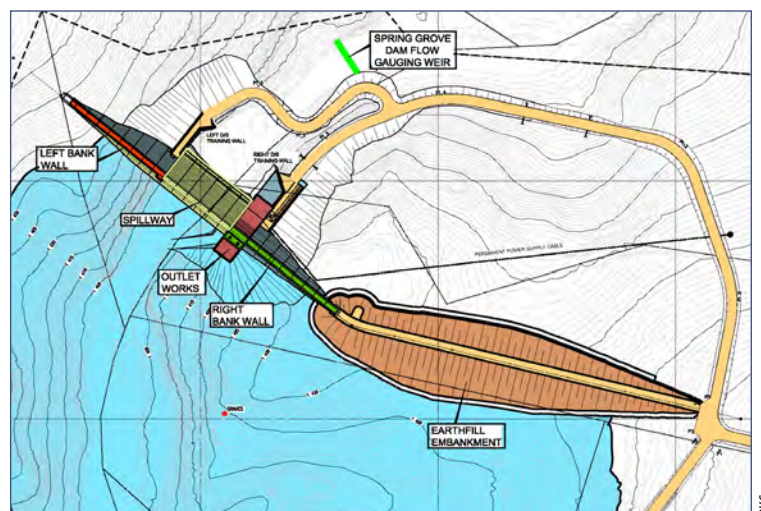
Spring Grove is the fifth dam to be built in the Mooi-Mgeni system, which already comprises Midmar, Albert Falls, Nagle and Inanda dams. Together, these dams provide water to more than five million people and industries in Durban, Pietermaritzburg and surrounding towns. The new dam will augment the yield of the system by 60 million m³/year, taking the total system yield to 394 million m³/year.

TCTA was appointed to implement the project on behalf of the Department of Water Affairs (DWA). BKS is the main consultant on the project, with Group 5-Pandev Joint Venture being the main contractor. Once complete, the dam and associated pipelines will be handed over to DWA to operate and maintain. The department will most likely engage Umgeni Water to operate the system



Top left: The location of Spring Grove Dam and associated works.

Bottom left: The layout of the Spring Grove Dam wall.



as is currently the case on Phase 1. The project is being financed off-budget, and the long-term funding arrangements have been signed with several European development banks as well as the Development Bank of Southern Africa. Nedbank SA provided the bridging finance.

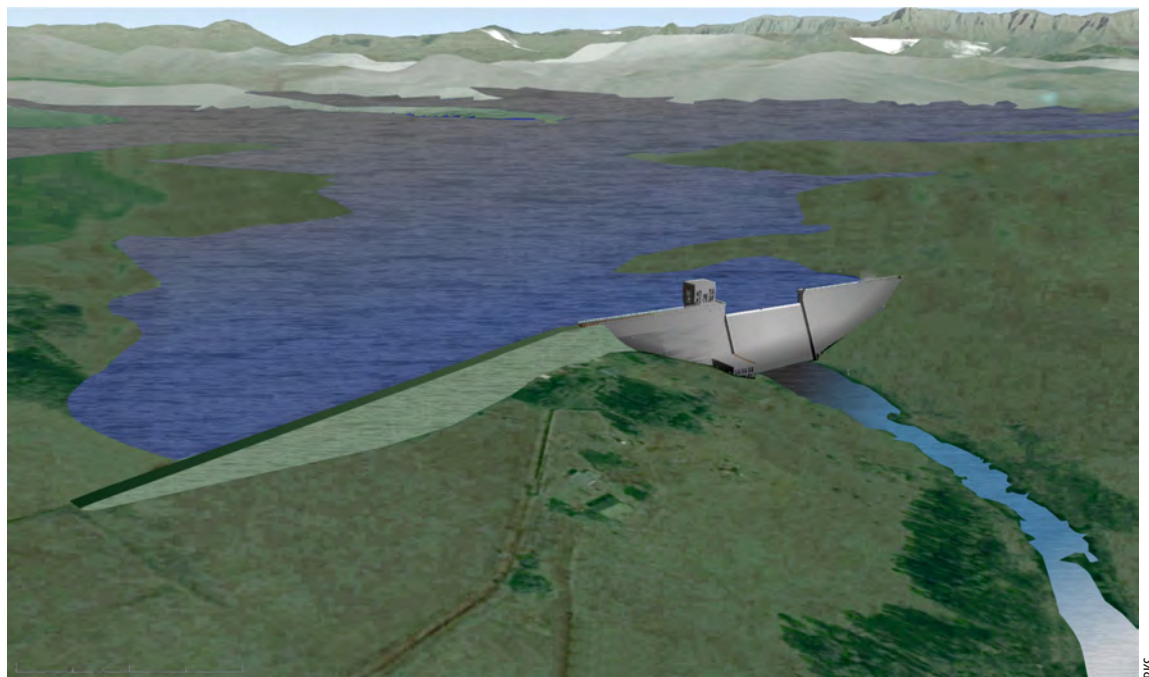
DESIGN AND CONSTRUCTION

Spring Grove Dam has been designed as a composite dam, with a roller-compacted concrete

(RCC) gravity section and an earth-fill embankment. It will have a maximum capacity of 139,5 million m³, and a wall height of 37,7 m. Due to its proximity to the town of Rosetta, it has a high hazard potential, and is therefore classified as a Category III dam.

The dam's main features comprise left and right non-overspill sections with a central spillway and an ogee crest as well as an outlet structure between the spillway and the right bank structures. The intake will be situated on the upstream side of the

An artist's impression of what the completed Spring Grove Dam will look like.



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dam, with a dam crossing located on the downstream side. River diversion culverts as well as upstream and downstream coffer walls were provided to accommodate river flows during construction.

Compared to De Hoop Dam – currently being completed on the Steelpoort River in Limpopo – Spring Grove is a small RCC dam, only requiring about 90 000 m³ of rollcrete. Still, this has not prevented the project team from being

innovative. A specially-developed high paste RCC (known as a wet paste RCC mix) is being used which, to date, is proving not only efficient, but cost-effective.

The high workability RCC has a number of advantages and offers the benefit of minimum segregation during placement. In addition, the RCC placement programme is such that it minimises the number of cold joints, where a complete stop of concrete placement and exposing of

aggregates in the top of the receiving layer and green cutting thereof are required.

“From a logistical point of view, the high paste RCC is a substantial improvement as the same mix can be hauled with dumpers and conveyors, compacted with a 10 t vibratory roller in the body of the dam as well as compacted against formwork with 50 mm poker needle vibrators,” says consultant Resident Engineer Peet Viljoen of BKS. “Placing is therefore much easier in confined areas and it is relatively easy to achieve a good finish on exposed areas.”

Due to the speed of construction the placement time can be reduced, with significant savings in preliminary and general items. “The RCC mix used for Spring Grove Dam is saving us R85 per cubic metre of RCC compared to the mix used at De Hoop Dam (using Spring Grove Dam contract prices),” notes BKS Technical Director Danie Badenhorst.

To ensure the workability of the RCC mix, a full-scale (60 m-long by 12 m-wide by 6 m-high) trial section was constructed in the dam reservoir before RCC placement commenced in the dam. Laboratory tests confirmed that the mix should create an

Rip-rap being placed against the slopes of the earthfill embankment. The embankment will be 11 m high and 315 m long upon completion.



Lani van Vuuren

impermeable dam wall with acceptable concrete strengths (minimum 6,5 MPa at five days and 15 MPa at 365 days).

High paste RCC requires particular attention to the shape and grading of aggregates and fine tuning of the mix to ensure a fine balance between workability, cost of binder, shrinkage and strength, Viljoen explains. "In order to improve workability and to reduce segregation the maximum aggregate size of 38 mm with relatively high paste content is required. Visually, this mix tends towards conventional concrete, has the benefits of low cement content but is still dry enough to be placed with earthworks equipment."

Construction of the embankment and central spillway section is currently progressing, with RCC placement having started in July. Badenhorst says that placement is being undertaken on a continuous (day and night) basis, with fresh RCC compacted on the previous layer, which has not yet hardened. Instead of articulated dump trucks – which may contaminate fresh RCC with the dirt on their wheels – slew conveyors are used to discharge the rollcrete onto transfer trucks which remain on the RCC during placement. Around 200 workers are currently on site, with labour mostly sourced from the area. Many are women.

Construction of the earth embankment is also underway. This embankment was designed as a zoned embankment with a clay core and semi-pervious shells, as well as a chimney filter and blanket drain with strip drains and a toe drain. Slopes are protected by rip rap or gravel.

Special arrangements have been made at the concrete dam/embankment contact to prevent piping where soil was compacted on a sloped surface from 8 m below ground surface to the non-overspill crest. The provision of a thicker chimney drain and a pipe in the strip drain adds an additional safety



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measure to prevent possible piping failure, notes Badenhorst.

ENVIRONMENTAL AND SOCIAL ASPECTS

As with any new infrastructure development in South Africa, the developers of Spring Grove Dam have to adhere to strict environmental and management plans as part of compliance with the Record of Decision. The public and other stakeholders have been widely consulted, and an Environmental Monitoring Committee – made up of independent persons – has been established to monitor environmental compliance of activities on site.

With Spring Grove sourcing its aggregate from a commercial supplier near Pietermaritzburg, local roads, particularly the R103, have now temporarily become major travel routes for vehicles hauling construction materials to site, and much time has been spent in consultation with local residents of Nottingham Road and Rosetta to find a solution that suits all.

Initially only 30 deliveries were allowed on the road per day between 08:00 and 17:00. This proved highly inhibitive to dam construction and the condition was later amended to

Above: The Mooi River downstream from the Spring Grove Dam construction site.

Below: Slew conveyors are used to discharge the rollcrete onto transfer trucks which remain on the RCC during placement.



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Top right: In order to meet the February 2013 impoundment deadline, construction continues day and night.

Bottom right: The Spring Grove inlet tower with the Mooi River diversion on the foreground. The dam has been designed with outlet works capable of river releases that will meet the demands of downstream users and the aquatic environment.



60 deliveries per day between 08:00 and 22:00. All vehicles have been fitted with GPS devices to track, among others, speed, and have to

follow a loop system so that no trucks pass each other on their way to/from site. The D146 road from the R103 to the dam construction site has been upgraded and is being maintained during construction so that it can accommodate the extra traffic burden.

Several privately-owned properties are affected by the construction of the dam. In addition to the land owners who are compensated for loss of land and loss of economic income, there are several labourers resident on some of the properties. TCTA aims to not only find alternative suitable accommodation for these households, but preferably to give them full title over the new space, thus leaving a positive legacy, says TCTA environmental manager, Kogi Govender.

In addition, more than 180 graves have been identified to date, all of which require careful exhumation and reburial with consent from the affected families and permission from municipalities and provincial government. A key stumbling block at the time of writing, however, is the lack of cemetery space in Mpofana Local Municipality which

most families have identified as their preferred reburial location. It is hoped that a workable solution will be found soon.

MAIN CHARACTERISTICS OF SPRING GROVE DAM

- Dam type:** RCC gravity dam with earthfill embankment
- Catchment area:** 339 km²
- Gross storage volume at full supply level (FSL):** 139,5 million m³
- Water surface area at FSL:** 1 021,8 ha
- Total length of dam wall:** 607 m
- Maximum height (above river level):** 37,7 m
- Total length of concrete section:** 274 m
- Crest length of spillway:** 70 m
- Total freeboard:** 5,7 m
- Earthfill embankment crest length:** 315 m
- Earthfill embankment height:** 11 m
- Outlet works:** Twin system with multi-level intakes
- Outlet capacity:** 29,5 m³/s



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Rock containing San paintings discovered just below Inchbrakie Falls on the Mooi River has been carefully removed and is now curated in the Natal Museum. Various rare plant species are also being removed and re-established out of harm's way.

Like all new dams in South Africa, Spring Grove has been designed with outlet works capable of river releases that will meet the demands of downstream users as well as the Ecological Reserve. Among others, the bottom two outlets are designed to jointly accommodate the in-stream flow requirement of 30 m³/s peak for freshets as well as releasing 4,5 m³/s for transfer to the uMgeni River catchment area. Normal instream flow requirements are accommodated with the smaller 600 mm-diameter sleeve valves provided as off-takes from the outlet's large bottom pipes.

FISH BARRIER

One of the more unusual environmental aspects of the project is the construction of a fish barrier structure in the Mooi River upstream of the Spring Grove reservoir. Environmental studies conducted during the initial stages of the project discovered that the Inchbrakie Falls forms a natural barrier between smallmouth bass downstream of the falls and trout upstream of the falls, the latter being an important money spinner for tourism in the midlands area.

The Inchbrakie Falls will be inundated once Spring Grove Dam reaches full supply level, and the possibility existed that the bass would find their way upstream where they would compete with trout for foraging and breeding habitats and nutrients in the river. Bass are fiercely protective of their chosen habitats and would likely exclude trout from those areas once they were established.

This prompted the decision to construct the fish barrier, which will mimic the effect of the falls in



Top left: The Spring Grove batch plant. Around eight days' worth of material is stored on site.

Bottom left: The formwork has been designed to hold fresh concrete and accommodate the placement of layers above.

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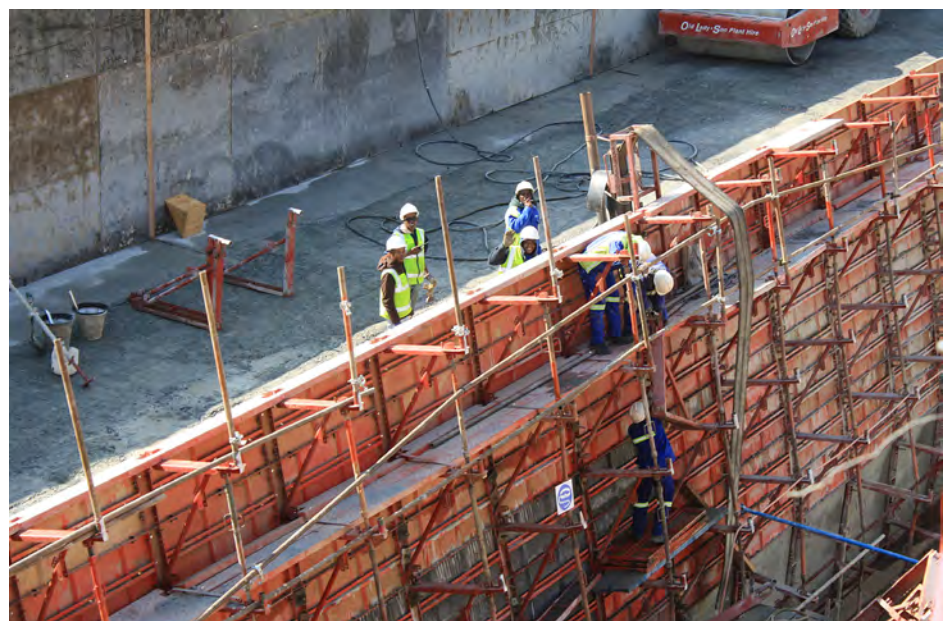
providing a barrier between the two fish species. The fish barrier will take the form of a concrete wall across the river that creates a step and resultant flow that exceeds the burst speed of the smallmouth bass. The barrier will have a storage volume of 450 000 m³ and a maximum height of 9,4 m.

WATER FOR THE FUTURE

Unfortunately, the KwaZulu-Natal Coastal Metropolitan Area will continue to be under stress even when Phase 2 of the Mooi-uMgeni Transfer Scheme comes into operation, and additional water resources will need to be developed in conjunction with the need for

ongoing water demand management. DWA, in close consultation with stakeholders and water user groups, is tending to opportunities for further development of the available water resources. This includes alternative water supply options, such as desalination of seawater, and re-use of effluent. One of the options currently being investigated is the development of the uMkhomazi River (Smithfield Dam).

In the meantime authorities will walk a thinly stretched tightrope between water supply and demand. It is up to all the water users of the cities and towns affected to treat their water with the utmost care and respect. □



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