C11070.MP02

WEST COAST FOSSIL PARK

CONCEPTUAL FRAMEWORK

REPORT ON THE PROVISION OF CIVIL ENGINEERING SERVICES - REV 1

March 2013

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1 INTRODUCTION

1.1 Introduction

The West Coast Fossil Park (WCFP) is characterised by:

- Fossil deposits of international paleontological significance.
- Being one of few fossil sites in the world lending itself to public viewing and interaction.
- Being unique in South Africa in terms of age, species, species richness, or abundance.

The current project to is prepare a conceptual framework in support of a land use application for consent to build an interpretive centre at the WCFP. The interpretive centre has its origins in a master plan developed following a workshops held in July 2005.

Storey ENG (Pty) Ltd have been briefed to:

- Investigate the existence of existing civil engineering services.
- Conceptualize the provision of civil engineering services to the site at large and interpretive centre specifically.
- Provide support regarding these services to the planning team and consultants involved with environmental and heritage authorizations.

This Report on the Provision of Civil Engineering Services was prepared in response to this brief.

1.2 Site Description

Site location (see drawings C11070/c/001 and C11070/c/002):

- Located on Cape West Coast near the towns of Saldanha Bay, Langebaan, and Vredenburg.
- Boarders onto R45, the Vredenburg - Hopefield provincial main road – with access being obtained off this road.
- Near to the Langebaanweg Air Force base.
- Approximately 15 km east of Saldanha Bay.
- Within the Saldanha Bay Local and West Coast District municipal areas.

The site comprises primarily Farm 1223, Saldanha Bay, although some other smaller erven form part of the overall WCFP site.

The site was previously mined but now has been rehabilitated. The mine dumps / overburden stockpiles and the mine excavations form the major topographical features of the site.

No rivers or significant water courses cross the site.

Water bodies and wetland or "vlei" areas exist which were formed due to the mining activities. These, with the exception of one vlei area, are remote from the existing buildings and the site of the proposed interpretive centre.

The existing buildings utilized by the WCFP and others sublet to Vula Environmental Services (Vula) are located to the north – east of the site. To the west of this and some 500 m and more away is located the Green Village, a small and fragmented residential village. This village is located on separate erven which project into the overall WCFP site.

2 CONCEPTUAL DEVELOPMENT FRAMEWORK

The conceptual development framework has been prepared by NM & Associates Planners & Designers (NM&A) and provides for (see NM&A drawing):

- Various precincts and sub-precincts.
- A nature area.
- A potential voluntary conservation area.
- A potential agricultural areas.

Three precincts are identified, namely:

1A - Tourism / Educational Precinct.

1B - Interpretive Centre / Fossil dig Precinct.

2 - Use to be confirmed.

In addition to the conceptual framework a conceptual site development plan has been prepared which provides greater detail on the planning for Precinct 1).

This provides for:

- A number of buildings all making up the interpretive centre.
- Structures enclosing the actual dig site.
- An educations centre.
- Access road and pedestrian routes.

3 EXISTING SERVICES

3.1 Introduction

The site is located outside of urban areas and thus only limited civil engineering services are available. These are provided by local and regional authorities.

Authorities with jurisdiction for the provision of services are:

- Western Cape Government Provincial Roads Department.
- Saldanha Bay Municipality (SBM).
- West Coast District Municipality (WCDM).

Depending on the specifics of the services to be provided, the following Provincial and National departments may have regulatory jurisdiction:

- Department of Environmental Affairs and Development Planning (DEA&DP).
- Department of Water Affairs (DWA).

3.2 Sewerage

No local authority (LA) regional water borne sewerage system exists in the vicinity of the WCFP to which the WCFP can connect. A sewerage system with a package treatment plant operated by the SBM serves Green Village.

The WCFP has its own in-house arrangements, namely:

- Sewerage from the Blue Building, Vula, and residential units drains to an AMPAK 1-6 treatment plant.
- This plant has a capacity of 1.25 m^3/day.
- The discharge from plant was intended to infiltrate into the soil.
- The plant is located adjacent to railway tracks at the WCFP station.

The package plant is not functioning adequately or at all due to:

- It having too little capacity.
- It being damaged by used motor car oil that was disposed of in sewers.

As a result the AMPAK 1-6 unit is emptied on average once a week by a honey-sucker of the SBM.

3.3 Potable Water

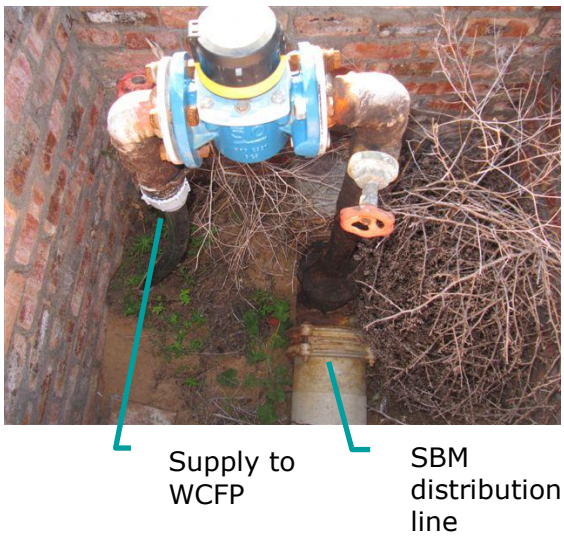
Potable water is provided to the WCFP by the Saldanha Bay Municipality:

- Supply is from the WCDM Vergeleë reservoirs via distribution main (225 mm dia) to Langebaanweg air force base.
- Adequate capacity exists for the needs of the WCFP.
- The pressure in the pipeline is in the region of 5 – 6 Bar.

The above-mentioned existing distribution main is located adjacent to the R45 (Vredenburg / Hopefield Road).

The WCFP connection (see drawing C11070/c/004):

- Is located adjacent to the R45 near visitors' entrance to the WCFP.
- Comprises a tee into the supply pipe with 50 mm dia connection pipe to the WCFP.



The internal distribution within the WCFP comprises:

- A new PE pipe (60mm dia) from meter to near to the Blue Building.
- Various new PE pipes, some of which are located above ground, to individual buildings.

The supply to the buildings is adequate for current needs.

The fire hydrant supply and pressure is inadequate.

The Green Village is supplied by a new 110 mm dia pipe from the north-east which terminates at the houses closest to the WCFP buildings.

This supply is probably connected to the same SBM distribution main as that from which the WCFP is supplied.

Currently there is no supply to the WCFP from this pipe to the Green Village.

The existing water supply to the WCFP:

- Does not provide for future developments.
- Is inadequate for fire fighting purposes.
- Is vulnerable to damage due to its partial above ground installation.

3.4 Stormwater Drainage

No LA services are provided.

Stormwater runs off onto ground around buildings and infiltrates soil.

3.5 Roads

Access to the WCFP is obtained off R45.

Pendulum Consulting prepared a traffic study and impact report. The reader is referred to this report for a more detailed discussion on road access to the WCFP.

Internal roads within the WCFP are either asphalt / bitumen sealed or gravel.

The road alignments follow the needs of the erstwhile mine that operated on the site.

The existing roads are deemed to be adequate for the current traffic loads.

These roads will require maintenance and upgrading going into the future.

4 PROPOSED SERVICES

4.1 Objectives

The objectives of the civil engineering service provision are to:

- As far as possible make use of sustainable technologies.
- Be environmentally friendly / sensitive.
- Where possible link to LA infra-structure.
- Be able to be managed / operated by non-specialist staff.
- Be provided and operated as cost-effectively as possible.
- Where possible, provide for current, immediate future, and long term future demands / uses.

4.2 Applicable Standards

The civil engineering services are to be provided in accordance with National, Provincial, and Local requirements.

The applicable standards are the:

- National Building Regulations.
- Guidelines for Engineering Services and Amenities (Red Book).
- National Water Act (Act 36 of 1998) and associated regulations.

4.3 Selection Criteria

Satisfying the development objectives of the WCFP offers alternatives and requires that a systematic process be followed for the selection of the preferred solution for each service to be provided.

The discussion on each service provides the alternatives and the selection criteria available or which need to be considered.

4.4 Potable and Fire Water

4.4.1 Introduction

The water supply to the WCFP needs to be upgraded, both for the immediate needs of the interpretive centre and the longer term needs of the WCFP as a whole. A supply needs to be provided to the proposed interpretive centre and associated facilities and the supply to the existing buildings for fire fighting purposes needs to be upgraded. Consideration also needs to be given to the upgrading of main supply from the LA connection point to the existing buildings.

4.4.2 Water Demand

The water demand for the WCFP has been determined from the following projections of visitor numbers as provided by the curator, P Haarhoff in a meeting on 2013-01-21:

Average periods:

- 40 people per tour in 6 tours per day = 240 people/day.
- Total of 5000 people per month.

Peak periods:

Double the figures of the average periods.

For design purposes the following figures were adopted:

- 5000 visitors/month on average.
- 250 visitors/day on average.
- 500 visitors/day in peak times.

In addition provision is made for:

- 10 staff members.
- Half the visitors to eat a meal at the restaurant.

Using consumption figures of:

- 40 l/visitor.
- 70 l/staff member/day.
- 70 l/meal.

The average daily water consumption at peak visitor times is calculated at 38.9 kl/day.

Assuming most of the water will be consumed over a 10 hour period and applying a peak factor using the formula of Harmon the instantaneous peak demand is calculated to be:

$Q_p = 4.3$ l/s

No additional demand is provided for the consumption in the existing buildings as this demand is negligible by comparison to the demands of the interpretive centre. Also the demand of the Blue Building will decrease once the visitor centre is relocated to the new facilities.

The fire demand is calculated in accordance with the requirements of the Red Book for a low risk area to be 15 l/s.

The LA supply has sufficient capacity to provide these demands.

4.4.3 Water Storage

The WCFP is located outside on an urban area and served by a uni-direction water supply without redundancy. Thus, in the event in a break in this supply no alternative supply options exist. Consideration should therefore be given to the provision of on-site storage.

Two approaches can be adopted:

- The water supply pipe from the LA connection point can be upgraded to a 110 mm dia pipe. This will provide sufficient flow for the potable demand as well as the fire fighting requirements for "first aid" fire fighting. Thus fire hydrants will draw water directly from the supply main. Consideration will however need to be given to the provision of storage for water for fire fighting for the individual buildings and in particular the interpretive

centre. The architects and engineers for the buildings will need to advise on this with reference to fire-fighting standards and the National Building Regulations which empirically requires a storage volume of 9 m^3.

- The water supply pipe can remain as is but in this case the WCFP will need to be considered to be a localised development with water storage for the development. In this instance the requirements of the Red Book apply and a storage facility with the capacity of the 2 hour domestic and fire demand needs to be provided – a storage volume of some 124 m^3. Drawing C11070/c/004 shows the location of the proposed storage tank.

Based on the above storage volume requirements it is recommended that the main supply pipeline be upgraded and the limited "first-aid" storage volume be provided.

4.4.4 Distribution Network

Drawing C11070/c/004 shows the proposed water distribution network. This comprises:

- A new 110 dia pipe from the LA connection point to the existing buildings (if this option is decided upon).
- A new 110 mm dia pipe to the interpretive centre complex.
- A 110 mm dia link to the storage tanks.

Valves, fire hydrants, and other appurtenances will be installed as determined at the detail design stage.

From the connection point to the existing buildings and from there to the parking area near the interpretive centre the water pipes will be buried with 900 mm cover. From the parking area to the interpretive centre buildings it is proposed the water pipes either be fixed above ground to the walkways that are to be constructed or are routed above ground through the buildings themselves.

4.5 Groundwater, rainwater, and Re-Cycled Water

A number of boreholes exist on the WCFP site. These are used for research purposes to monitor groundwater levels. The results from these boreholes suggest consideration can be given to the use of groundwater from boreholes.

The groundwater can be used for:

- Irrigation.
- Non-potable uses such as toilet flush water.

The determination of viable groundwater sources must be the subject of a specialist investigation.

The potential exists to re-cycle treated effluent water. The extent to which this will be possible depends on the process adopted for the treatment of sewerage and the cost of providing pumps and pipelines with which to re-cycle the treated effluent.

The treated effluent can be used for:

- Irrigation.
- Non-potable uses such as toilet flush water.

In the latter use care will need to be taken to ensure that the quality of the treated effluent is at all times of a high enough standard and that the toilet flush water is well aerated and not stored for any length of time. Distinctive pipe materials will also need to be used to prevent the accidental connection of treated effluent pipes to potable water supplies.

Rainwater is to be harvested from the buildings for re-use for irrigation purposes. As the demand for irrigation water is in a different season to when it rains, some considerable storage will need to be provided for this to be viable. Hence it is proposed that the use of rainwater be limited to a few select areas such as internal gardens.

4.6 Sewerage

4.6.1 Introduction

Provision needs to be made at the WCFP for the treatment and disposal or re-use of the sewerage. As the existing buildings are currently served by gravity sewers that drain to a package plant located at the train station, the focus will be on treating the sewerage from the proposed interpretive centre and associated facilities.

4.6.2 Sewerage Flows

The determination of the sewerage flows is premised on the assumption that 85% of the potable water consumption ends up in the sewers. This is deemed to be an acceptable assumption as the water consumption calculations have been based on use in public facilities and kitchens with no provision for irrigation. Hence the sewerage flows are:

- For average visitor periods – 16.5 kl/day
- For peak visitor periods – 33.1 kl/day

Depending on the type of treatment adopted different multipliers will be applied as provision for peak flows / safety factors (see section below).

4.6.3 Treatment Options

A number of options were investigated for the treatment of the sewerage. Each has pros and cons, and different capital and operating demands.

- Package Treatment Plant

The sewage can be treated in "package" plants which for the most part comprise a prefabricated or manufactured unit that is delivered to or assembled at the site where treatment is to take place. The specifics of the treatment process and the equipment involved is in most instances proprietary and thus varies depending on the supplier of the package plant.

In general the treatment process comprises a number of discrete stages:

- Screening / settlement of solid.
- Biological digestion (aerobic / anaerobic / activated sludge, etc).
- Post treatment / polishing, typically in a reed bed (optional).
- Disinfection

Options considered at this stage ⇨	AMPAC	Activated sludge
	Biobox	Aerobic biological filtration

HWT	Activated sludge
Lilliput	Bioreactor
Biolytix	Aerobic filtration

For the WCFP it is proposed that this option would include post treatment so that the treated effluent can be re-cycled.

The advantages of package pants are that they are compact and produce a high quality effluent when they are operating properly.

The disadvantages are that they require skilled operator oversight, have higher operation costs (they need electricity to operate), and do not cope well with either too little flow or too high flow.

Should this option be adopted it is proposed that the package plant be located near the parking area for ease of access and for close proximity to electrical power, with the stabilisation pond and polishing reed beds some distance away (see drawing C11070/c/006) so that odours from do not impact on visitors to the WCFP.

Should this option be adopted it is proposed the package plant design provide for two phases – one for the flow from average visitor numbers and one for the peak visitor numbers. Phase 2 will thus see a doubling of capacity and the end result will be two identical plants operating side by side. Provision will need to be made in future operating budgets for the second package plant.

The design flows will be 16.5 kl/d for each plant.

The area required for the package plants will be approximately 500 m^2 and 0.25 Ha for the stabilisation pond and reed bed.

- Waste Stabilisation Ponds (Oxidation Ponds)

Treatment of sewerage in waste stabilisation ponds (WSP) involves the sewerage passing through a series of shallow dams in each of which a different treatment process takes place – anaerobic in the 1st and 2nd pond and aerobic in the other. The number and size of the individual ponds is determined based on the treatment volumes, but at least 5 ponds will be required.

The ponds do not require any mechanical equipment.

It is recommended that the discharge from the ponds pass through a reed bed to polish the effluent for re-cycling.

Should this option be adopted it is proposed it be located in a valley to the east of the site for the interpretive centre so that it is not visible and odours do not impact on visitor to the WCFP.

The advantage of WSP's are that they do not require skilled operators, they do not require electricity, they deliver a good quality effluent, they are very forgiving for fluctuations in inflow (they can cope with short period over-loading), and they can easily be expanded by adding an addition pond to the system. The potential also exists for the recovery of bio-gas from the 1st pond in the system.

Because of the capacity of WSPs' to cope with overload it is proposed that the WSP's be designed for an inflow of 1.25 x the flow generated by the average visitor numbers, ie a flow of 20.6 kl/day.

During times of peak visitor numbers the WSP's will be "over-loaded" but as this will generally be for short periods at a time, little impact will be noticed on the quality of the treated effluent discharge.

The WSPs' will require an area of approximately 0.5 Ha.

Waste stabilisation ponds are considered to be the preferred option for the treatment of the sewerage.

4.6.4 Septic Tanks

The current designs for the interpretive centre are a second iteration and see the buildings located on the slopes on the eastern rim of the basin in which the dig sites are located. The first iteration saw the buildings located to the north of the dig site. This gave rise to the opportunity to locate sewage treatment facilities on the slopes on the eastern rim of the basin. In particular the opportunity existed to locate septic tanks and soak-aways (French drains) / reed beds in this area.

The current design precludes this option as a very real risk exists that the discharge from the soak-aways will daylight on the slope (as it would have with the previous iteration). Because these slopes now are part of or close to areas incorporated into the visitor experience, this daylighting of effluent will create a negative impact and may make the area unacceptable to visitors.

The location of a septic tank near the interpretive centre with soak-aways further away is also not deemed viable. Septic tanks require de-sludging from time to time. This requires access to the tanks for large vehicles, which in the case of the interpretive centre will not be possible.

It would be possible to locate a septic tank and soak-away at a remote location.

4.6.5 Sewerage System

The sewerage system alternatives are shown on drawings C11070/c/005 and C11070/c/006.

Option 1 details the WSP treatment system. A pumpstation will be located at the southern end of the interpretive centre. Gravity sewers will connect the buildings to this. From the pumpstation a rising main will be provided to a high point and from there a gravity sewer will connect to the WSP.

It is proposed that self-composting or aqua-privi toilets be provided at the bird hide and a septic tank and soak-away be provided at the entrance gate to the WCFP.

Option 2 details the package plant system which in essence will be the same except that the package plant is to be located near the parking area with a gravity sewer from there to the maturation pond and reed–bed.

4.7 Stormwater Drainage

It is proposed that stormwater drainage be dealt with above ground as informally as possible.

Thus stormwater will run off built structures onto the ground and from their either drain away along natural topographical features or infiltrate the ground.

Where formal interventions are required use will be made of current best practice and will include devises such as:

- Infiltration beds.
- Swales and enhanced swales.

4.8 Roads

Access to the WCFP will be obtained off the R45. The report of the transport planners and engineers (Pendulum Consulting) details this.

The internal roads will be surfaced with an appropriate wearing course of either asphalt / bitumen sealed (black top), interlocking pavers, or gravel. The final selection will be made at the detail design stage and will be influenced by available funding. The endeavour will be to have road surfaces that blend in with the environment as much as possible, that are able to carry the traffic loads, and that have a low ,maintenance cost.

At this stage it is anticipated that the access road from the entrance to the WCFP to the existing buildings will remain a black top road and that the road from there to the parking area at the interpretive centre and the parking area itself will have a laterite wearing course.

The road alignments will, where possible, follow the roads of the erstwhile mine.

5 CONCLUSION

The investigations undertaken show that either services are available or can be provided to satisfy the needs if the proposed development of the WCFP. In particular:

- Water is available from the SBM supply to satisfy the needs of the developments to take place at the WCFP.
- The water supply infra-structure in the WCFP needs to be upgraded and extended and it is recommended that the supply pipeline form the connection point to the Blue Building be upgraded as part of the provision of water supply infra-structure.
- Provision will need to be made for the storage of water. The size of the storage provided will depend on the water supply option selected.
- Sewage treatment must be dealt with on the site of the WCFP.
- Two viable options are deemed to exist, namely a package plant system or a waste stabilisation pond system.
- The waste stabilisation pond system is recommended as it is easy to operate, requires no electrical power at the treatment works, provides outflow suitable for re-use for irrigation, and can cope with varied inflow conditions.
- Stormwater drainage and roads can easily be dealt with and will be addressed in more detail as part of the detail design phases for Precinct 1.

The investigation supports the approval of the development planning for the site.

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