OPWAG 730 HOUSING DEVELOPMENT

Engineering Services Investigation Report

Investigation of the available and required bulk civil and electrical services for the Opwag village development in the !Kheis municipal area

AUGUST 2020

Prepared for:
MACROPLAN

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bvi ENGINEERING PROCUREMENT MANAGEMENT

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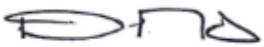
Author signature		Approver signature	

EXECUTIVE SUMMARY

This report was compiled to investigate the bulk infrastructure serving the Opwag village and to determine whether the existing bulk infrastructure is adequate for the development of an additional 730 stands, through a low-cost housing development.

The bulk engineering services report includes the following categories:

- Bulk Water Infrastructure
- Bulk Sewer Infrastructure
- Bulk Road and Storm Water Infrastructure
- Bulk Electrical Infrastructure

After investigating the infrastructure, it was found that the existing bulk infrastructure is not sufficient to accommodate the Opwag 730 Houses project. The bulk services for each category that require attention before the project can commence is summarised below:

- **Bulk Water Infrastructure**

  Upgrading of the entire bulk water supply system is required as these 730 houses will almost triple the demand related to the existing 135 households currently located within the area to be developed.

- **Bulk Sewer Infrastructure**

  Construction of one(1) new pump station (28 l/s).
  Construction of one new 250mm rising mains (0.34km).up to Oxidation Pond.
  Construction of a new 0.5ML/day waste water treatment works(Oxidation Pond);

- **Bulk Electrical Infrastructure**

  Upgrading and exstension of the exsiting bulk electrical supply system is required by Eskom,the exstension of the electrical system will not be a problem as the main sub-station in Groblershoop is currently being upgraded and will be commissioned in December 2020

This report can be used both for business plans and funding applications from the various funding schemes available.

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1. INTRODUCTION

1.1 Disclaimer

This is a draft report and only outlines some of the findings of the investigation to date and should not be used as the final or complete report. No recommendations or conclusions have been made and some portions of the report may be incomplete as the investigation is still in process.

1.2 Terms of Reference

I. BVI Consulting Engineers was appointed by Macroplan to undertake this Bulk Engineering Services Study (Water, Sewer, Electricity and Roads & Storm Water) for the proposed Opwag 730 housing project. Opwag is one of six villages located close to the Orange river within the jurisdiction of !Kheis Local Municipality.

1.3 Site Location

I. The site is situated approximately 18 km to the north of Groblershoop in the Northern Cape (Figure 1 – Locality Plan).

II. The development is located at the following coordinates: 28°50'14.90"S; 21°57'24.58"E

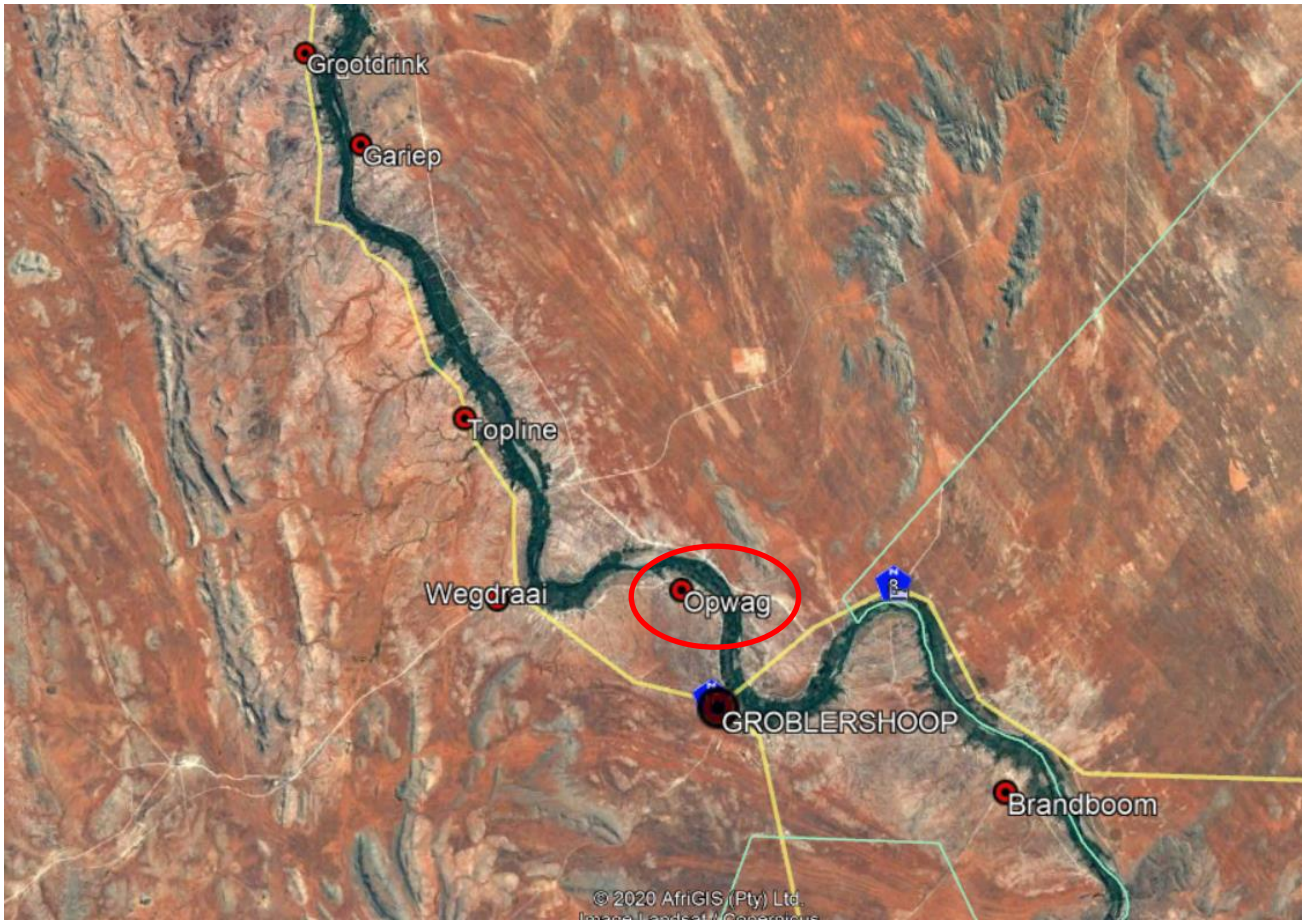


Figure 1: Opwag 730 Housing Development Locality Plan

II. The planned development consists of 730 low-cost houses next to the existing village (Figure 2: 730 Stands Development Area).

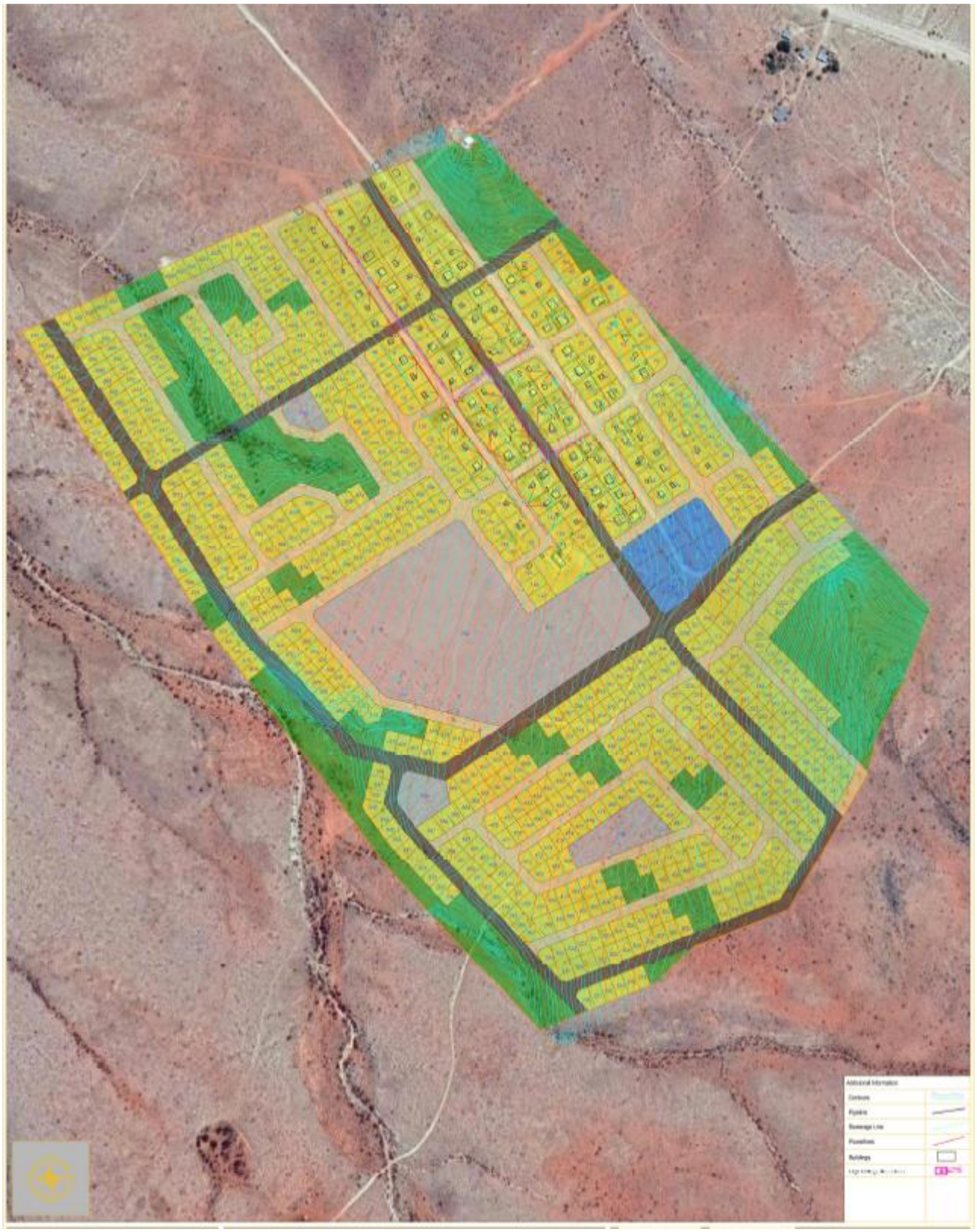


Figure 2: Opwag 730 Housing Development Locality Plan

III. The purpose of the Bulk Engineering Services Assessment is to determine the availability and capacity of existing bulk services to service the proposed development. This report presents the findings of a preliminary visual inspection and desktop investigation relating to bulk services and further sets out the criteria and standards for the internal services for the new development.

IV. The Bulk Engineering Services addressed in this report are the following:

- Water Supply
- Sewerage
- Roads and Access
- Storm Water Management
- Electricity Supply

2. TOPOGRAPHY

The physical characteristics of the site can be summarized as follows:

- Ground cover comprises mostly of natural veld with short grass;
- Topographically, the site has a relatively gentle sloping terrain from the village perimeter towards the north west.Kindly refer to Figure below..
- Calcrete is close to the surface of the natural ground level, which makes excavations very hard.

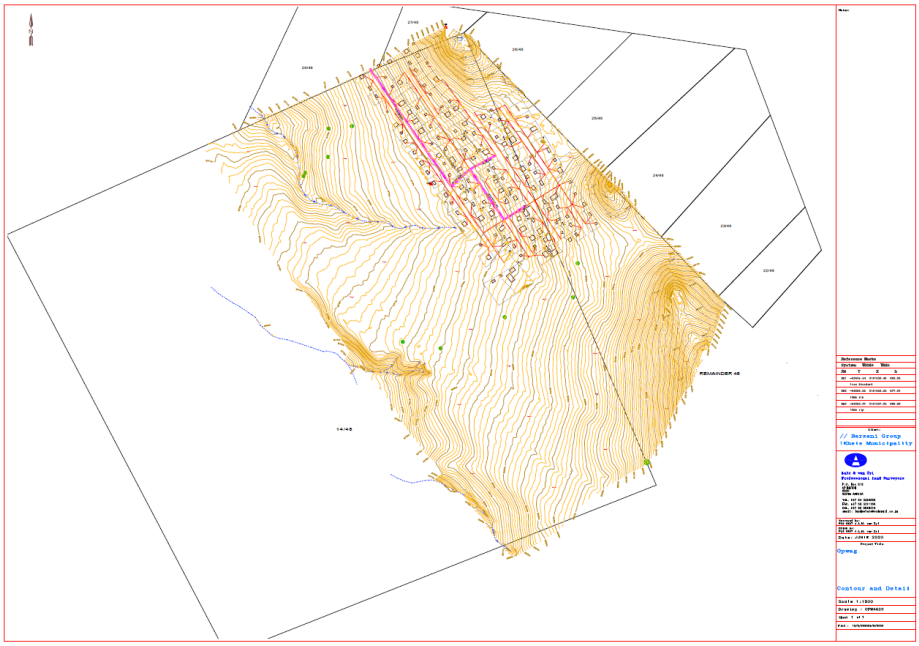


Figure 3: Opwag 730 Stands Contour Plan

3. WATER SUPPLY

3.1 Existing Water Infrastructure

Overview

The bulk water infrastructure supplying Opwag village with water can be summarised as follows:

- A raw water canal pump station delivering 6l/s to Water treatment plant.
- A 150mm long, 90mm diameter PVC raw water supply line between the canal and the water purification works.
- The water treatment works consisting of:
    - A 5000L raw water storage dam
    - A package type water treatment plant,
    - A high lift pump station
- A 545mm long, 110mm diameter PVC potable water supply line between the Water treatment works and the potable storage in the village.
- A 128m^3 potable storage zinc reservoir located near the village.
- Distribution into the village via a 90mm PVC pipe up to five (5) stand pipes in the streets.

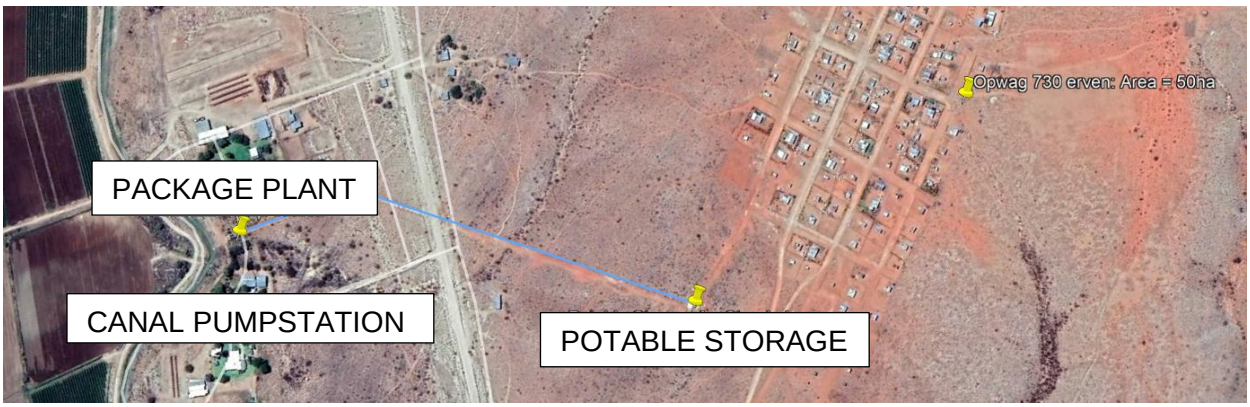


Figure 4: Existing Bulk Water Infrastructure

Raw Water Supply and Water Treatment Works

Water supplied to Opwag is extracted from the Canal by means of a mobile pump station fitted. The pump station consists of one(1) pump that delivers 6l/s.

Raw water is pumped from the canal pump station to the purification plant, delivering a maximum flow rate of 6l/s through a 150m long, 90mm diameter PVC pipeline to a 5m^3 raw water storage JoJo Tank next to the Package Plant Water Treatment Works.

Storage site

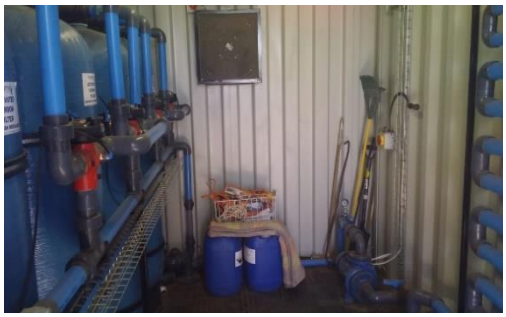
The purified water is thereafter pumped to the potable zinc reservoir located, approximately 545m towards the village. The potable storage reservoir is secured and in a good condition. The photo below, shows the 128m^3 potable zinc storage reservoir.

From here, it gravitates into the village. The village makes use of five (5) communal stand pipes.

Water Treatment Plant

The Package Plant Water Treatment Works (WTW) was constructed in 2008 to supply water at a rate of 2l/s.

Photo's below shows the settlement tank, as well as the filters inside the container:



Reticulation System

The reticulation system consists of communal stand pipes located within in the streets. There is five (5) stand pipes connected to a 90mm PVC ring feed.

Condition of the water supply system

Most of the elements of the water supply system are currently manually operated. These include the canal pump, the water treatment works, and the reservoir levels. Water is distributed to the village from the circular storage steel that stores potable water. Most of the water meters and pressure gauges are out of service.

3.2 Current water demands and capacity of the existing bulk water supply system

The Red Book was used as a basis for calculations of the theoretical capacity for the current bulk water supply system as well as required infrastructure.

The table blow shows factors capacities and operating hours used in the calculations:

FACTORS	1	Design Loss Factor Water treatment works (LFw)		10,0%
	2	Design Loss Factor Total conveyance losses (LFr)		15,0%
	3	Summer peak factor (SPF)		1,5
	4	Peak factor reticulation (PFR) From Red Book (Instantenous Peak)		6
OPERATING HOURS	1	Source Pump Station (SPSH)	(Maximum operating hours per day that required volume of	16 hours
	2	Water purification plant (WTPH)	(Maximum operating hours per day that required volume of	16 Hours
	3	Lifting Pump Station **(LPS%)**	(% of Instantanious peak flow)	150%
STORAGE	1	Storage in elevated tanks	(Hours of Instantanous Peak Demand)	3 hours
	2	Potable Water Storage Reservoirs	(Hours of Annual Average Daily Demand*SPF)	48 hours
	3	Raw Water Storage Reservoirs	(Hours of Summer Average Daily Demand)	10 days

The table below and on the next page shows the current theoretical demands and capacity of the existing bulk water infrastructure:

	BULK AND CONNECTOR SERVICES CAPACITY CALCULATION : CURRENT					
	NO.	DESCRIPTION	UNITS		DEMAND PER UNIT	Criteria
GENERAL	1	Sub-Economical Houses (Existing)	135	Houses	600 l/ household per day	81 m^3/d
	2	Sub-Economical Houses (730 houses development)	0	Houses	600 l/ household per day	0 m^3/d
	4	Economical Houses (Existing)	0	Houses	1200 l/ household per day	0 m^3/d
	5	Economical Houses (730 houses development)	0	Houses	1200 l/ household per day	0 m^3/d
	7	Primary School Hostel	0	Learners	150 l/ Learner per day	0 m^3/d
	8	Schools	0	Learners	25 l/ Learner per day	0 m^3/d
	9	High School Hostel	0	Learners	150 l/ Learner per day	0 m^3/d
	10	High School	0	Learners	25 l/ Learner per day	0 m^3/d
	11	Clinics	0	m^2 x	500 l/100m^2 per day	0 m^3/d
	12	Businesses, Government and Municipal	0	m^2 x	400 l/100m^2 per day	0 m^3/d
	13	Developed Parks, Sportsgrounds and Day Cares	0,50	ha	5 mm water per day	25 m^3/d
		ANNUAL AVERAGE DAILY DEMAND (AADD)				106 m^3/d

THEORETICAL DEMANDS	1	Annual Average Daily Demand (AADD)	AADD	106,0 m^3/day	4,4 m^3/hour	1,2 l/s	CURRENT CAPACITY		
	2	Gross Annual Average Daily demand (GAADD)	(1+Lfr)*AADD	121,9 m^3/day	5,1 m^3/hour	1,4 l/s			
	3	Summer Gross Daily Demand (SGDD)	SPF*GAADD	182,9 m^3/day	7,6 m^3/hour	2,1 l/s			
	4	Instantanious Peak Demand (IPD) (Main supply pipeline to reticulation)	AADD*PFR		26,5 m^3/hour	7,4 l/s			
	5	Storage Capacity Elevated Storage	hours*IPD			79,5 m^3	0,0 m^3	0%	
	6	Lifting Pump Station Capacity and Pipeline Flow between Main Storage and Elevated tank	IPD***LPS%**	119 mm dia	39,8 m^3/hour	11,0 l/s	10,0 l/s	91%	
	7	Potable Water Storage Capacity (Main Storage)	hours*AADD			212,0 m^3	127,6 m3	60%	
	8	**Water Treatment Plant Capacity (WTPC)**	**SGDD*24/WTPH**	**274,3 m3/day**	**11,4 m3/hour**	**3,2 l/s**	**2,0 l/s**	**63%**	
	9	**Source Pump Station Capacity and Pipeline Flow**	**WTPC*(1+LFW)*24/SP**	**83 mm dia**	**19,7 m3/hour**	**5,5 l/s**	**6,0 l/s**	**####**	
	10	Raw Water Storage Capacity	Days*SGDD			1829,0 m^3	5,0 m3	0%	

It is clear from the table that the existing infrastructure is already under pressure to handle the demand. The biggest problems are with bulk and elevated storage.

3.3 Bulk Water Infrastructure Requirements

The table below compares the current infrastructure capacities with the capacity that is required for the 730 stands development.

	BULK AND CONNECTOR SERVICES CAPACITY CALCULATION : FUTURE					
	NO.	DESCRIPTION	UNITS		DEMAND PER UNIT	Criteria
GENERAL	1	Sub-Economical Houses (Existing)	0	Houses	600 l/ household per day	0 m^3/d
	2	Sub-Economical Houses (730 houses development)	730	Houses	600 l/ household per day	438 m^3/d
	4	Economical Houses (Existing)	0	Houses	1200 l/ household per day	0 m^3/d
	5	Economical Houses (730 houses development)	0	Houses	1200 l/ household per day	0 m^3/d
	7	Primary School Hostel	0	Learners	150 l/ Learner per day	0 m^3/d
	8	Schools	0	Learners	25 l/ Learner per day	0 m^3/d
	9	High School Hostel	0	Learners	150 l/ Learner per day	0 m^3/d
	10	High School	0	Learners	25 l/ Learner per day	0 m^3/d
	11	Clinics	0	m^2 x	500 l/100m^2 per day	0 m^3/d
	12	Businesses, Government and Municipal	0	m^2 x	400 l/100m^2 per day	0 m^3/d
	13	Developed Parks, Sportsgrounds and Day Cares	1,00	ha	5 mm water per day	50 m^3/d
		ANNUAL AVERAGE DAILY DEMAND (AADD)				**488 m^3/d**

							CURRENT CAPACITY	
THEORETICAL DEMANDS	1	Annual Average Daily Demand (AADD)	AADD	488,0 m^3/day	20,3 m^3/hour	5,6 l/s		
	2	Gross Annual Average Daily demand (GAADD)	(1+Lfr)*AADD	561,2 m^3/day	23,4 m^3/hour	6,5 l/s		
	3	Summer Gross Daily Demand (SGDD)	SPF*GAADD	841,8 m^3/day	35,1 m^3/hour	9,7 l/s		
	4	Instantanious Peak Demand (IPD) (Main supply pipeline to reticulation)	AADD*PFR		122,0 m^3/hour	33,9 l/s		
	5	Storage Capacity Elevated Storage	hours*IPD			366,0 m^3	0,0 m^3	0%
	6	Lifting Pump Station Capacity and Pipeline Flow between Main Storage and Elevated tank	IPD*LPS%	254 mm dia	183,0 m^3/hour	50,8 l/s	10,0 l/s	20%
	7	Potable Water Storage Capacity (Main Storage)	hours*AADD			976,0 m^3	127,6 m3	13%
	8	Water Treatment Plant Capacity (WTPC)	SGDD*24/WTPH	##### m3/day	52,6 m3/hour	14,6 l/s	2,0 l/s	14%
	9	Source Pump Station Capacity and Pipeline Flow	WTPC*(1+LFW)*24/SP	179 mm dia	90,8 m3/hour	25,2 l/s	6,0 l/s	24%
	10	Raw Water Storage Capacity	Days*SGDD			8418,0 m^3	5,0 m3	0%

Recommended upgrades to the Opwag bulk water infrastructure are as follows (shown on the drawing below):

- Construction of a new 25l/s canal pump station with a duty and standby pump.
- New 160mm diameter Class 9 PVC pipeline between the canal pump station and the water treatment works.
- Water Treatment Works to be re-alocated to proposed site and upgraded to deliver 24m^3/h potable water to the potable storage reservoirs.
- A new 848m^3 sectional steel reservoir in the proposed site..
- One (1) new 355 m^3 sectional steel pressure tower on the highest point in the village.
- A new 52l/s lifting pump station at the treatment works.
- A new 250mm pipeline between the lifting pump station and the pressure tower.

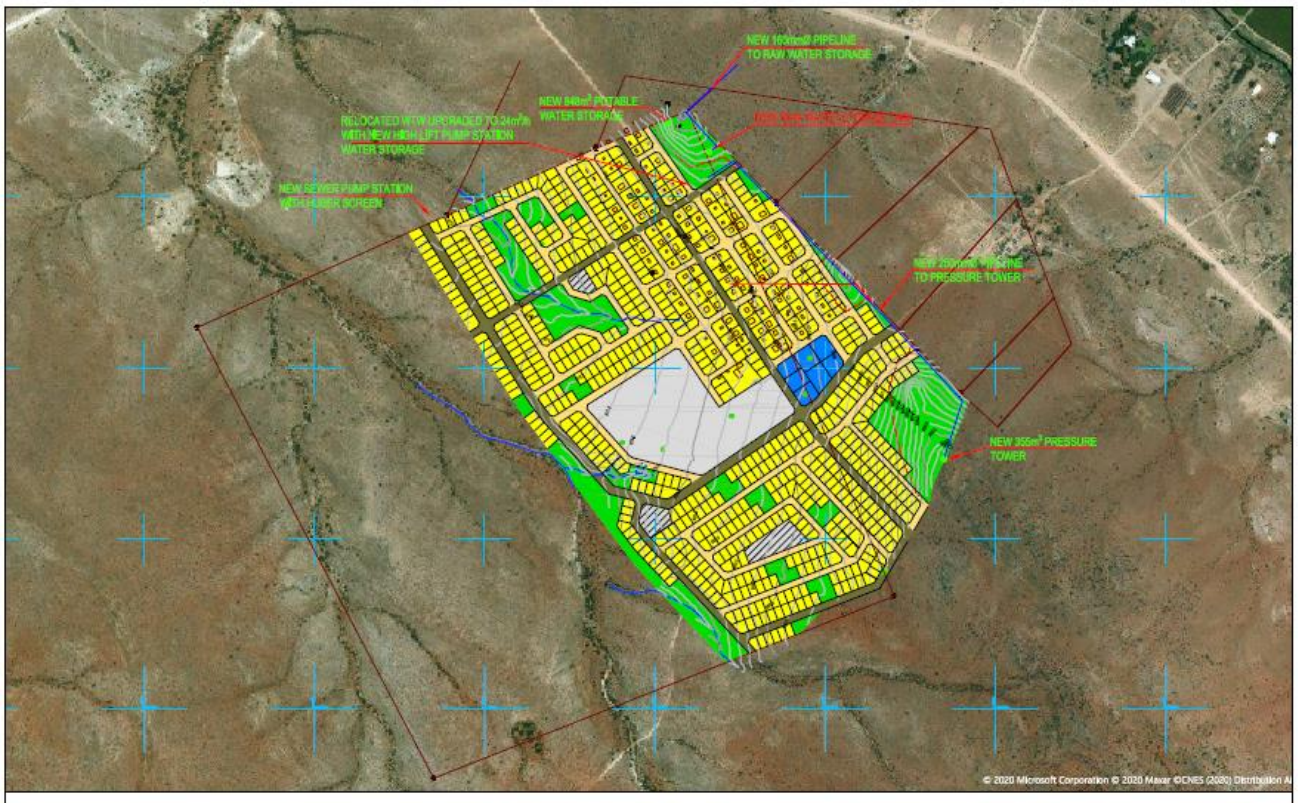


Figure 5: Proposed Water Bulk Infrastructure

3.4 Fire Fighting Requirements

Areas to be protected by a fire service should be classified according to a fire-risk category. The new development can be classified as a “Low risk – Group 4” according to the “Guidelines for Human Settlement Planning and Design”.

No specific provision for fire fighting water is required in water storage, or reticulation mains in these areas. Hydrants should, however, be located at convenient points in the area on all mains of 75 mm nominal internal diameter and larger, and in the vicinity of all schools, commercial areas and public buildings.

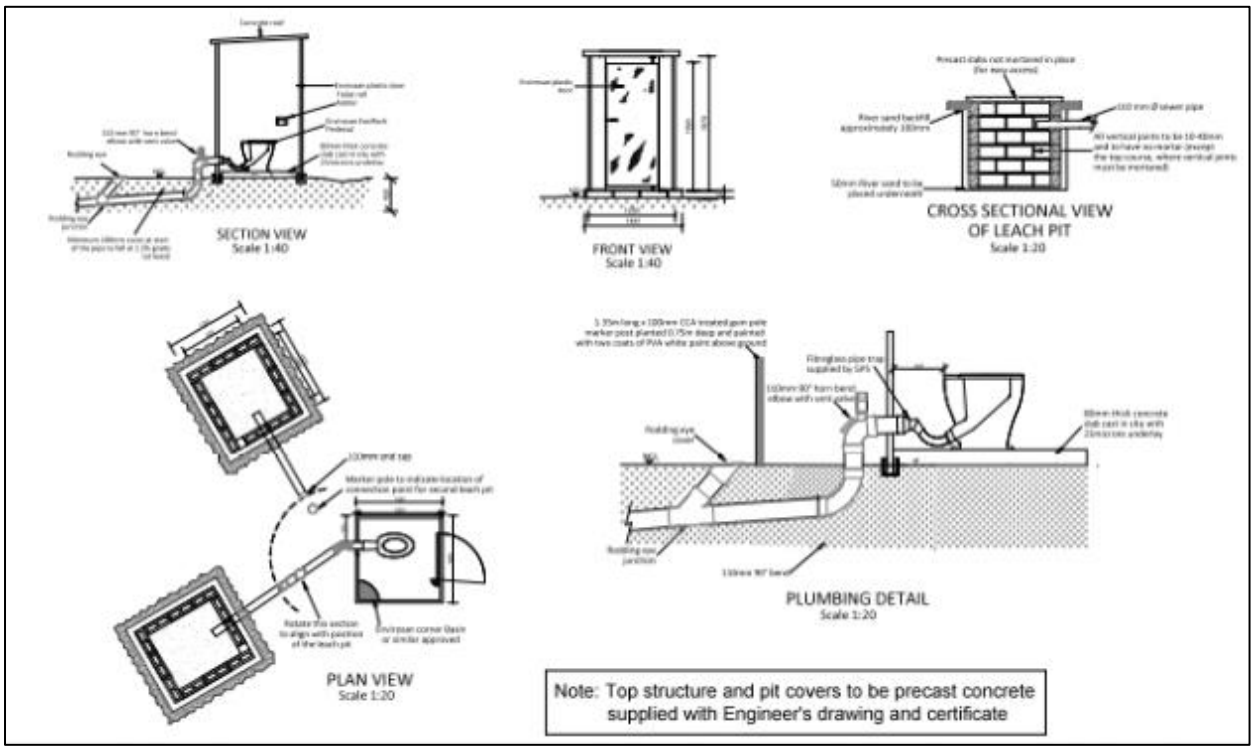
Fire fighting in areas zoned “Low-risk – Group 4” should generally be carried out using trailer-mounted water tanks or fire appliances that carry water, which can be replenished from the hydrants provided in the reticulation, if necessary.

4. SEWERAGE

4.1 Existing Sewage Infrastructure overview

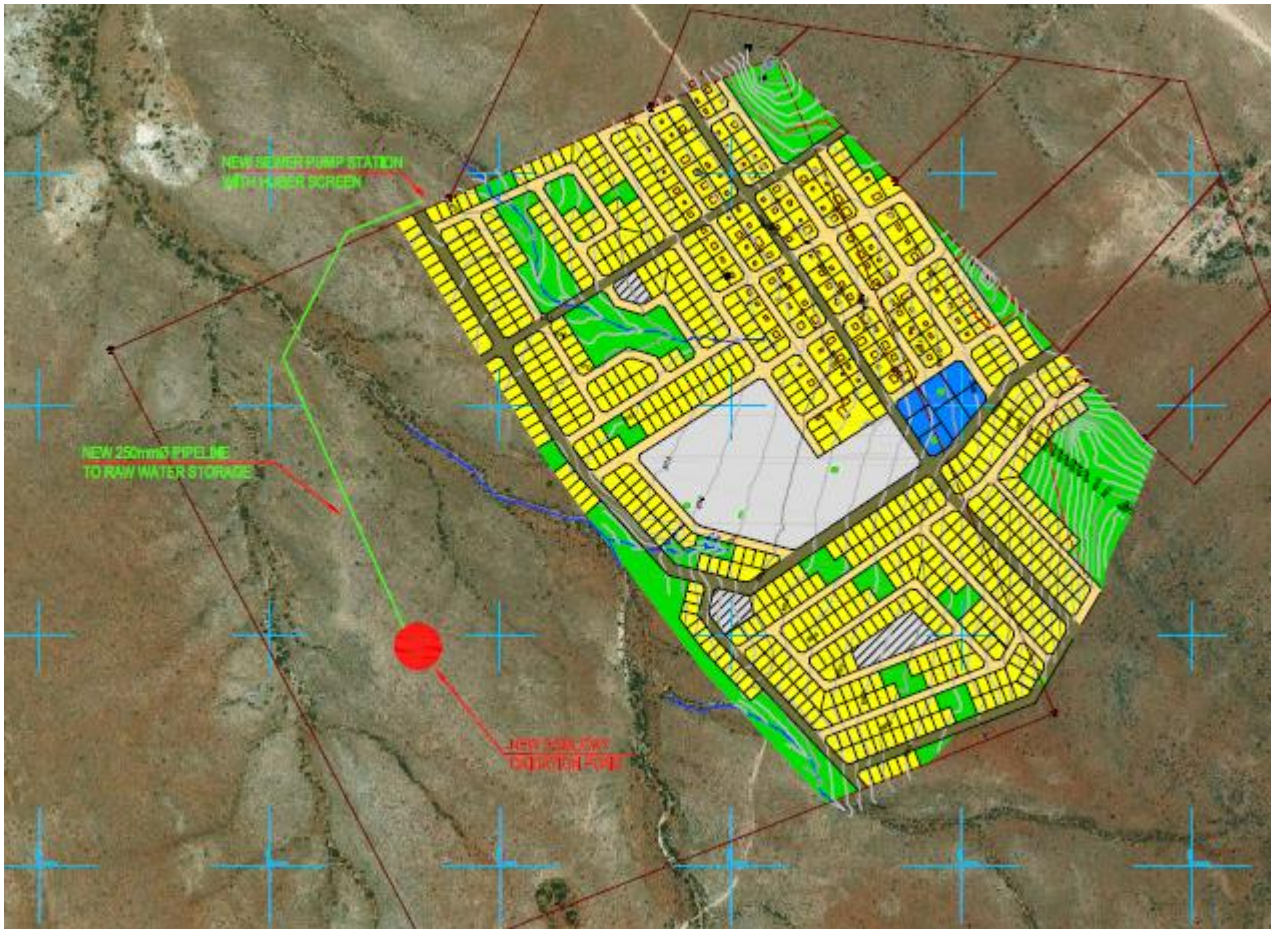
All the houses in the Opwag village currently consists of Pour Toilets with a Leach Pit. There is no sewer bulk infrastructure and would be recommended.

Kindly refer to the figure below, illustrating the toilets currently installed.



4.2 Bulk Sewer Infrastructure Requirements

If a full borne sewer sewerage system is required for the new 730 houses development, the associated bulk infrastructure will most possibly consist of a pumpstation, rising main pipeline and oxidation ponds as shown on the Google image below.



The total sewer flow is calculated as follows:

OPWAG TOTAL SEWER FLOW					
Sewer flow per day - Sub economical houses	730	sub economical houses @	500 l/day	365 000	l/day
Sewer flow per day - Economical houses	0	economical houses @	750 l/day	-	l/day
Sewer flow per day - Hostels	0	persons @	140 l/day	-	l/day
Sewer flow per day - Schools	0	persons @	20 l/day	-	l/day
Businesses and State Institutions	0	buildings	100 l/day	-	l/day
SEWER FLOW PER DAY - TOTAL				**365 000**	**l/day**

The sizes and capacities of the proposed pump stations and rising mains were calculated as follows:

PUMP STATION No 1 AND RISING MAIN					
Sewer flow per day - Sub economical houses	730	sub economical houses @	500 l/day	365000	l/day
Sewer flow per day - Economical houses		economical houses @	750 l/day	0	l/day
Sewer flow per day - Hostels	0	persons @	140 l/day	0	l/day
Sewer flow per day - Schools	0	persons @	20 l/day	0	l/day
Businesses and State Institutions	0	buildings	100 l/day	0	l/day
SEWER FLOW PER DAY - TOTAL				365000	l/day
Average sewer flow				4,2	l/s
Factor for inflow from other sources	15%			0,6	l/s
Sewer flow with inflow from other sources				4,9	l/s
PEAK NETWORK SEWER FLOW	4,9		3,5	17,0	l/s
FLOWRATE FROM OTHER PUMP STATIONS				0	l/s
TOTAL PEAK FLOW				17,00	l/s
ACTUAL PUMP ABILITY	1,63	times peak flow		27,7	l/s
Theoretical pump station capacity for normal pump operation	1	hours of peak flow		61	m^3
Theoretical pump station capacity for emergency storage	2	hours of normal flow		35	m^3
TOTAL REQUIRED THEORETICAL PUMP STATION CAPACITY				96	m^3
Pump details		Gorman Rupp V4		15	kW
Rising main diameter				225	mm
Rising main material				PVC	
Rising main length				340	m
Static pump height				10	m
Friction losses				10	m
Total pump height				20	m

Recommended Opwag bulk sewer infrastructure construction (excluding internal sewer lines) are as follows (shown on the drawing above):

- Construction of one(1) new sewer pump stations capable of delivering 28 l/s direct to the Oxidation Ponds
- New 250mm diameter PVC pipelines (340m) between the pump stations and a new Waste Water Treatment Plant (oxidation ponds).
- Construction of a Waste Water Treatment Plant (oxidation ponds) with a capacity of 0.5Ml per day.

5. ROADS AND STORMWATER

5.1 Roads and Access

Access to the development will be from the existing Residential Collector Streets (Class 4b), as shown on the drawing below:

No problems are foreseen regarding roads and access.

5.2 Stormwater Management

The guiding principle underlying the storm water management strategy is that, where possible, the peak run-off from the post-developed site should not exceed that of the pre-developed site for the full range of storm return periods (1:2 to 1:50). Where possible, measures should be incorporated into the site development plan to attenuate the post-development flows to pre-development rates.

The storm water network must be designed to accommodate (flood frequencies as prescribed by "The Red Book") the minor storm event (1:5 year) in open channels or side drains of streets. The major storm (1:50 year) should be managed through controlled overland flows, above-ground attenuation storage (if required) and berms at the higher end of the site (if required). As no formal storm water system exists in the area, concentration of storm water must be avoided as far as possible. Earthworks on plots should therefore encourage free drainage of the area.

Opwag is a small village that generally drains from the centre. Existing roads will be adequate for this purpose.

6. SOLID WASTE DISPOSAL

NO PHOTOS OR INFORMATION AVAILABLE AT THIS STAGE.

7. ELECTRICAL SUPPLY

7.1 Electrical Demands and Availability

This section of the report covers the availability of the Bulk Electrical connection to the future 135 Community stands, an expected additional load of the proposed development will initially be 876 KVA as per INEP guidelines and the accommodation of this load will form the basis of this report. The community of Opwag falls directly under “Eskom Distribution” and the existing electrified homes in the community purchase electricity directly from Eskom and not through the Kheis local Municipality.

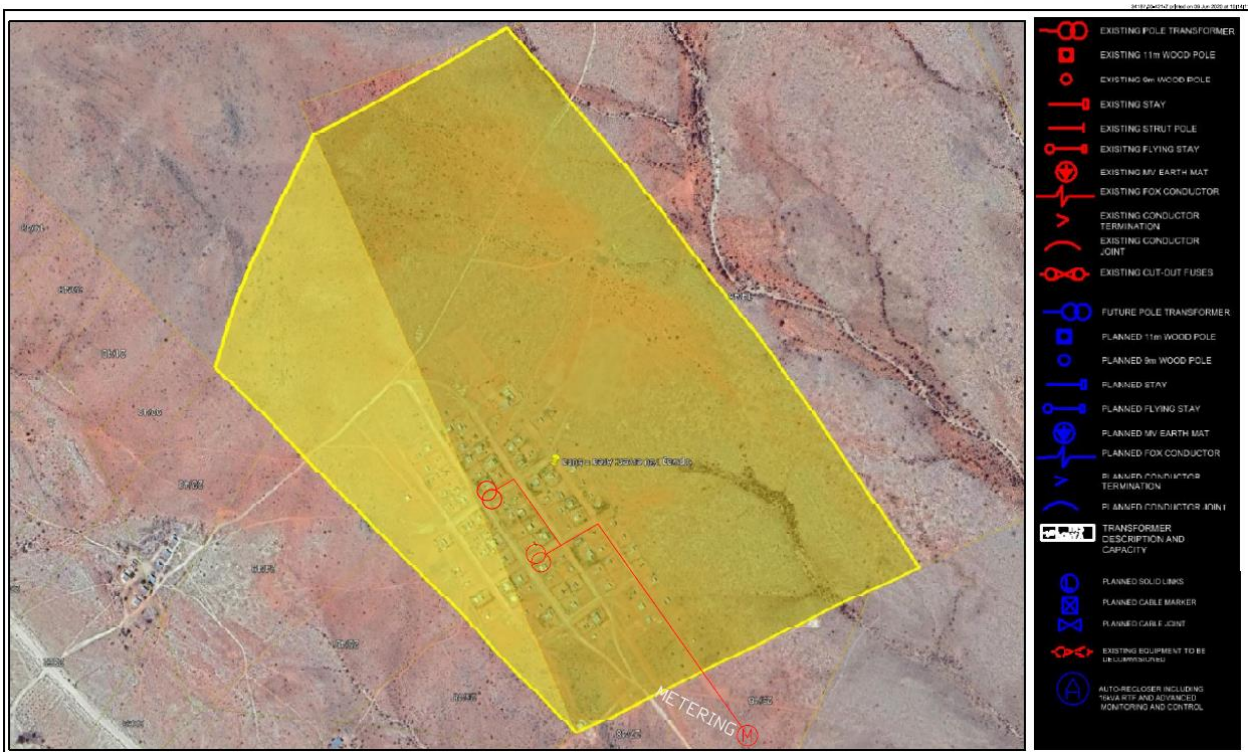
The bulk connection to the community / town is via a 22kV overhead line fed from the 10MVA Grobelershoop sub-station.

7.2 Existing Electrical Network

The bulk connection to the community / town is via a 22kV overhead line fed from the Eskom 10MVA Grobelershoop sub-station , this sub-station is currently in the process of being upgraded to 20MVA and will be commissioned in December 2020.

The existing MV electrical network in the Opwag area runs through the town via 22 KV overhead line feeder connecting to various pole mounted transformers (see figure 1 below). The existing overhead line feed is running through a section of the proposed development.

The existing feeder can easily handle the future additional 876 KVA load only after the upgraded Eskom Groblershoop sub-station is brought online as indicated by Eskom’s network planning department.



7.3 Electrical Network Extension

The internal electrical network extension in the Opwag community will only be done by Eskom after the formulation processes are completed as this area falls under the Eskom Distribution.

8. COST ESTIMATE

The cost estimate for the proposed activities are as provided below. The level of accuracy is commensurate with a concept level design.

Description	Amount
Water Bulk Services	
New mobile 12l/s river pump station	R 850 000,00
0,85km 125mm Ø supply line	R 722 500,00
Upgrading of Water Treatment Works	R 700 000,00
New 360m^3 storage reservoir	R 900 000,00
New 240m^3 storage reservoir	R 840 000,00
New 24l/s lifting pump station	R 240 000,00
0,3km 200mm Ø line from lifting PS to elevated storage	R 285 000,00
Sub-Total (Water)	**R 4 537 500,00**
Bulk Sewer Services	R -
New 0,25 ML oxidation pond system	R 2 675 662,36
New sewer pump station No 1	R 1 676 508,10
New sewer pump station No 2	R 1 676 508,10
2,1km 110mm Ø uPVC rising main (PS No.1)	R 2 233 596,40
1,3km 110mm Ø uPVC rising main (PS No.2)	R 1 451 837,66
Sub-Total (Sewer)	**R 8 262 274,95**
Roads and Access	R -
None	R -
Stormwater	R -
None	R -
Electrical	R -
O/H ACSR line ring	R 2 300 000,00
Circuit breaker (11kV, LC1&2)	R 1 550 000,00
O/H ACSR line to POC	R 1 850 000,00
Sub-Total (Electrical)	**R 5 700 000,00**
Sub-Total	**R 18 499 774,95**
15% P&G's	R 2 774 966,24
Sub-Total	**R 21 274 741,19**
10% Contingencies	R 2 127 474,12
Sub-Total	**R 23 402 215,31**
10% Professional fees	R 2 340 221,53
Sub-Total	**R 25 742 436,84**
15% VAT	R 3 861 365,53
Grand Total	**R 29 603 802,37**

Notes:

1) Base date of the calculations is April 2020;
2) No provision was made for EIA, registration and/or land acquisition;
3) No allowance was made for institutional and/or social development.

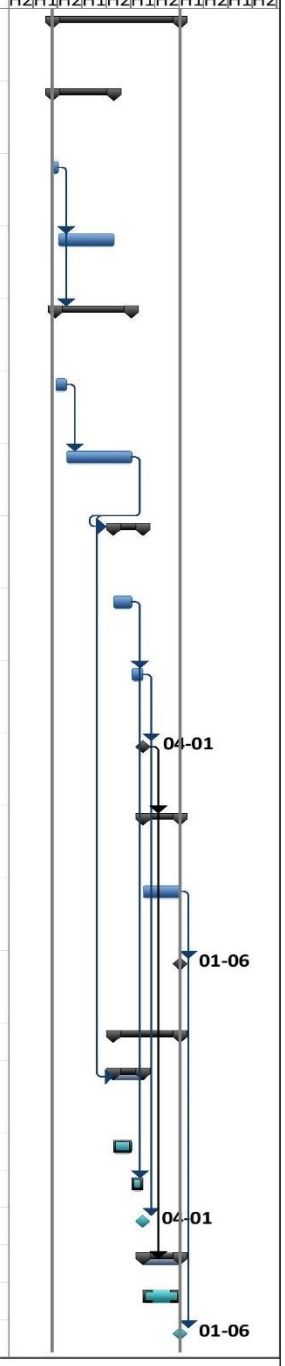
7.1 Funding

Funding can be applied for through the Municipal Infrastructure Grant (MIG) and Regional Bulk Infrastructure Grant (RBIG). For repair work at the water treatment works, the Water and Sanitation Infrastructure Grant (WSIG) can also be applied for.

This report can be used for funding application from the various schemes available.

9. PROJECT TIMELINE

ID	Task Mode	Task Name	Duration	Start	Finish
1		**BULK INFRASTRUCTURE TIMELINE**	**685 days?**	**Mon 20-05-25**	**Fri 23-01-06**
2		**APPLICATION FOR FUNDS**	**330 days**	**Mon 20-05-25**	**Fri 21-08-27**
3		Application for RBIG & Mig funding	30 days	Mon 20-05-25	Fri 20-07-03
4		Approval of feasibility study & readyness report	300 days	Mon 20-07-06	Fri 21-08-27
5		**EIA PROCESS**	**410 days**	**Mon 20-06-15**	**Fri 22-01-07**
6		Appointment of EIA Specialist	60 days	Mon 20-06-15	Fri 20-09-04
7		EIA study	350 days	Mon 20-09-07	Fri 22-01-07
8		**DESIGN, DOCUMENTATION AND PROCUREMENT**	**160 days**	**Mon 21-08-23**	**Fri 22-04-01**
9		Design and documentation	100 days	Mon 21-08-23	Fri 22-01-07
10		Procurement	60 days	Mon 22-01-10	Fri 22-04-01
11		Contractor appointed	0 days	Fri 22-04-01	Fri 22-04-01
12		**CONSTRUCTION**	**200 days**	**Mon 22-04-04**	**Fri 23-01-06**
13		Construction period	200 days	Mon 22-04-04	Fri 23-01-06
14		Construction completed	0 days	Fri 23-01-06	Fri 23-01-06
15		**INTERNAL SERVICES CONSTRUCTION**	**360 days?**	**Mon 21-08-23**	**Fri 23-01-06**
16		**DESIGN, DOCUMENTATION AND PROCUREMENT**	**160 days**	**Mon 21-08-23**	**Fri 22-04-01**
17		Design and documentation	100 days	Mon 21-08-23	Fri 22-01-07
18		Procurement	60 days	Mon 22-01-10	Fri 22-04-01
19		Contractor appointed	0 days	Fri 22-04-01	Fri 22-04-01
20		**CONSTRUCTION**	**200 days?**	**Mon 22-04-04**	**Fri 23-01-06**
21		Construction period	200 days	Mon 22-04-04	Fri 23-01-06
22		Construction completed	0 days	Fri 23-01-06	Fri 23-01-06



Project: 34702 Gamakor Developm
Date: Sat 20-05-23

Task		Inactive Summary	
Split		Manual Task	
Milestone		Duration-only	
Summary		Manual Summary Rollup	
Project Summary		Manual Summary	
External Tasks		Start-only	
External Milestone		Finish-only	
Inactive Task		Deadline	
Inactive Milestone		Progress	

10. CONCLUSION

Engineering services were assessed to determine spare capacity on the existing bulk infrastructure and compared to the estimated demand of the newly proposed Opwag 730 houses development.

The findings and conclusions in this report are based on a preliminary desktop study, as well as site visits.

- Bulk Water Infrastructure – The current capacity of the bulk water infrastructure is not enough to accommodate the proposed 730 houses development as is. It is proposed that the infrastructure should be upgraded, not only to provide adequate capacity for the Opwag 730 development, but also for future water demand increases. The following upgrades are proposed:
    - Construction of a new 12l/s mobile river pump station with a duty and standby pump.
    - New 125mm diameter Class 6 PVC pipeline between the river pump station and the existing potable water storage reservoir.
    - Upgraded Water Treatment Works capable of delivering 24m^3/h on the existing treatment works site
    - A new 360m^3 sectional steel reservoir next to the upgraded water treatment works
    - A new 250m3 sectional steel pressure tower on the highest point to the north.
    - A new 24l/s uplifting pump station at the treatment works.
    - A new 200mm pipeline between the lifting pump station and the pressure tower.

- Bulk Sewage Infrastructure – There is currently no bulk sewer infrastructure. Recommended OPWAG bulk sewer infrastructure construction (excluding internal sewer lines) are as follows (shown on the drawing above):
    - Construction of two new sewer pump stations capable of delivering 6.7 l/s direct to the Waste Water Treatment plant.
    - New 110mm diameter Class 6 PVC pipelines (2100m & 1300m) between the pump stations and a new Waste Water Treatment Plant (oxidation ponds).
    - Construction of a Waste Water Treatment Plant (oxidation ponds) with a capacity of 0.5Ml per day.
- Roads and Access: No bulk infrastructure upgrading required on the roads.
- Storm Water Management: No bulk infrastructure upgrading required on the storm water.
- Electricity Supply – Formal bulk upgrade process to be finalised between Eskom and !Kheis Municipality.
- Electrical Load Centre – The existing Load Centre “Keimoes Nommer 2” can accommodate the future additional load, with only minor modification to be done in the Load Centre and as agreed with the Municipality’s Electrical Department.

In conclusion, the engineering services are not in place (water and sewer) to meet the standard requirements. The infrastructure will have to be upgraded regardless of the implementation of the Opwag 730 houses development in order to meet current and expected future needs. The upgrading should be done in such a way as to take into consideration the Opwag 730 Houses development.