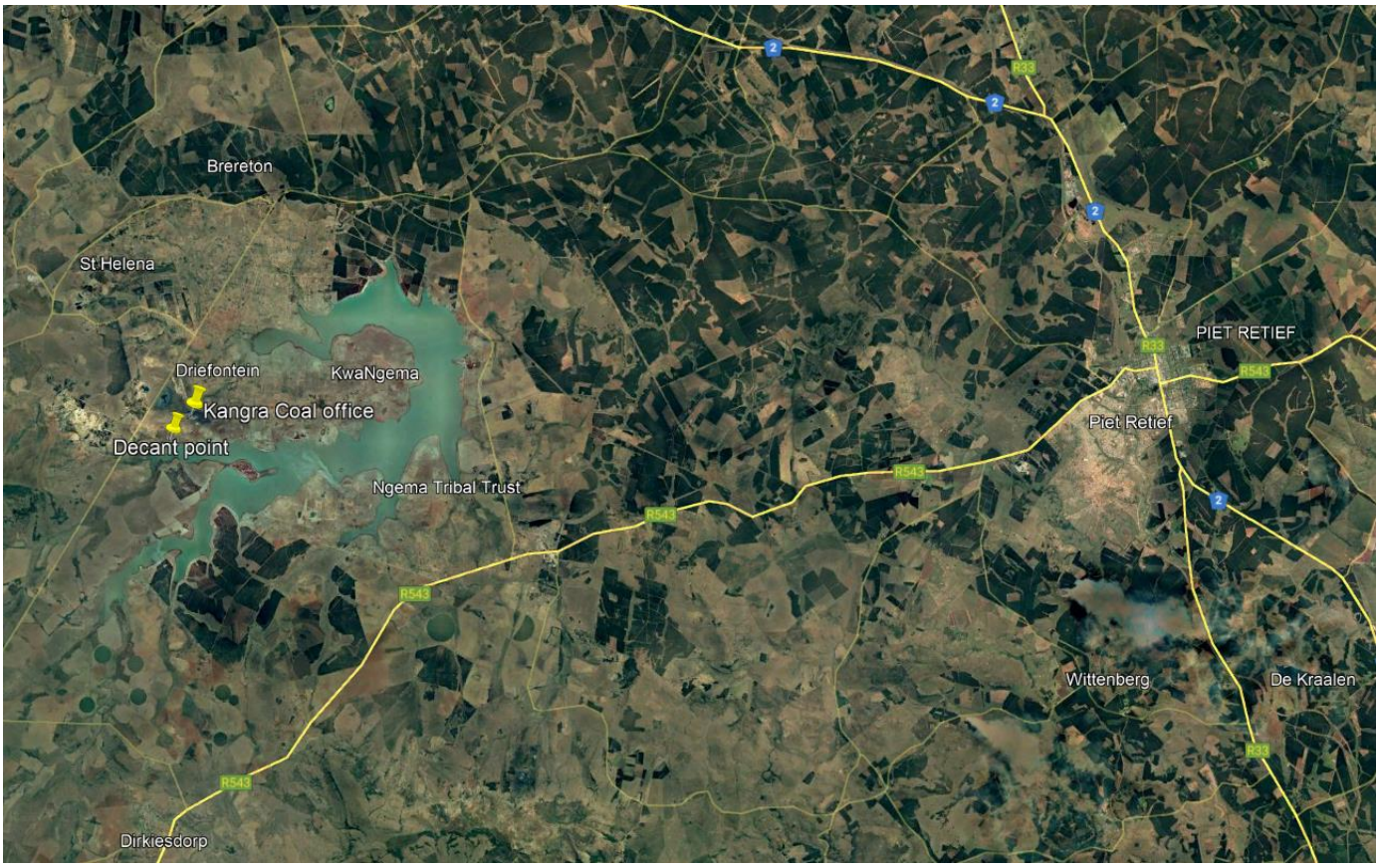
PROPOSED DISCHARGE WATER QUALITIES AND DESIGN FLOWS FOR THE MAQUASA EAST WATER TREATMENT PLANT

13 APRIL 2022



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PROPOSED DISCHARGE WATER QUALITIES AND DESIGN FLOWS FOR THE MAQUASA EAST WATER TREATMENT PLANT

13 APRIL 2022

1. QUALITY MANAGEMENT AND APPROVALS

Status of report: **Final**

Approved by GFK Consulting Engineers cc:

…….. 13/04/2022……

F. Krugel (ECSA reg.no. 910142) Date

Recommended by the Employer:

…….. ……..

N. Dlamini Date

(Environmental Manager)

Accepted and Approved by the Employer:

…….. ……..

Date

(Print name) ……..……

2. EXECUTIVE SUMMARY

GFK Consulting Engineers cc was appointed by Kangra Coal (Pty) Ltd to design and implement a strategy to manage and treat the current decanting water which is flowing into the Heyshope dam.

During investigations of the decant point is has become evident that numerous surplus water exists on the Maquasa mine operations.

It is thus recommended by GFK to manage the decant water, including all other surplus water on the mine by pumping it to the current Maquasa East Pollution Control Dams. These PCD's will be used as a centralised point to collect all water from the mine from where it will be pumped to a new proposed water treatment plant located directly adjacent to the se PCD's.

A design flow of 4500m³/day for the prescribed treatment plant is determined from the water balance.

No Water Use Licence is available for this specific proposed treatment plant in which the discharge qualities or discharge point are approved. It is however the mine's intention to implement treatment and management of the surplus water.

The treated discharge water qualities and discharge point are therefore proposed in this report as various discharge qualities exist on the current mine WUL's for different operations. None of these have the same discharge qualities and all refer to groundwater, not surface water.

The Resource Quality Objectives (RQO) are currently not determined for the specific Usuthu Catchment area in which this site falls, which would typically then be the qualities to use for such a treatment plant.

The final recommended discharge quality in Table 8: Discharge water quality, was determined by comparing the qualities of various standards available, the existing Water Use Licences of the current Kangra operations in the area and baseline river quality in a nearby stream which has not been affected by mining.

Each constituent was analysed and the most suitable quality for the type of site conditions and circumstances was selected. In most cases this has resulted in taking the most stringent water quality of the different standards.

The discharge point is dependent on the location of the treatment plant. Upgrading of an existing grass lined channel to a concrete lined channel will be required to minimise erosion due to a constant flow. A new 600ND pipe culvert will also be required.

3. INTRODUCTION

Kangra Coal operates the Maquasa East, Maquasa West and Maquasa West Extension properties, as well as the most recent Block C and Twyfelhoek extensions. These are located about 60km Northwest of Piet Retief in Mpumalanga.

GFK Consulting Engineers cc was appointed by Kangra Coal (Pty) Ltd to design and implement a strategy to manage and treat the current decanting water which is flowing into the Heyshope dam.

During investigations of the decant point it has become evident that surplus water exists on the Maquasa mine operations which must also be managed.

It is thus recommended by GFK to manage the decant water, including all other surplus water on the mine by pumping it to the current Maquasa East Pollution Control Dams. These PCD's will be used as a centralised point to collect all water from the mine from where it will be pumped to a new proposed water treatment plant located directly adjacent to the se PCD's.

Figure 1 below indicates all the operations which are either already connected or will be connected via a pipe system, which eventually all leads to Maquasa East where the PCD's and water treatment plant are.

All the above mentioned have separate approved Water Use Licenses (WUL's) with different water quality standards.

The objective of this report is to:

- Address the discharge water qualities to which the water from all these operations must be treated after being pumped to the PCD's and treatment facility.
- Indicate the design flows to which the treatment plant will be sized according to ta site wide water balance.

Figure 1: Kangra operations considered for the treatment plant design

4. HYDROLOGY GENERAL

The Maquasa East and West mine is located in the Usutu- Mhlathuze catchment management area and lies within quaternary catchment W51B.

The Twyfelhoek Adit, Pit G and Block H lies within quaternary catchment W52A

The catchment information obtained from WR2012 [1] is indicated in Table 1 below.

Table 1: Quaternary Catchment Information

Quaternary Catchment	BASIC INFORMATION							1920 - 2009
	Catchment area		S-pan evaporation			Rainfall		MAR (WR2012)
	Gross (km2)	Net (km2)	evap zone	MAE WR2005 (mm)	MAE WR90 (mm)	Rainfall zone	MAP (mm)	Net (mcm)
W52A	289	289	13A	1400	1400	W5C	836	31.72
W51B	496	496	13A	1400	1400	W5A	864	51.37

Monthly rainfall and evaporation are obtained from South African Weather Station W5E009. The station is located approximately 12km east of the site.

A MAP of 852mm is observed, while the Mean Annual S-Pan Evaporation from this station is 1632mm.

Table 2: Monthly Evaporation and Rainfall

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
S-Pan Evaporation (mm)	158	166	183	165	139	144	120	106	91	96	121	145	1632
Rain (mm)	110	121	163	138	101	102	46	16	8	8	14	26	852

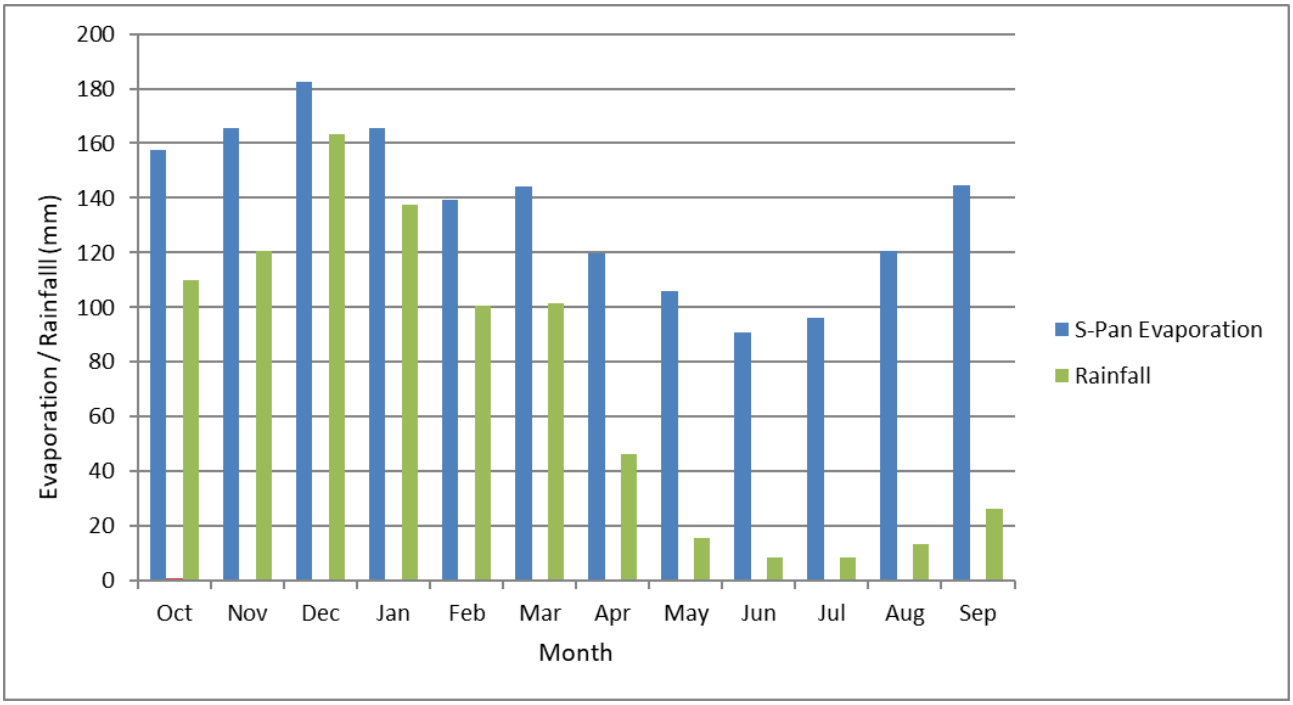


Figure 2: Monthly rainfall and evaporation, from SAWS Station W5E009.

5. LOCATION OF THE TREATMENT PLANT AND DISCHARGE POINT

The proposed location of the treatment plant and discharge location is indicated in Figure 3. This location is preferred due to following reasons:

- There is an existing network of pipes from the decant point, Pit D, Block C and other operations on the greater Maquasa operations that all pump water to the existing Maquasa East PCD's.
- The existing pipe network allows all water to the managed at a centralised location, which will allow for better control and monitoring.
- The plant will be in close proximity to the mine offices allowing for easy maintenance access and closely controlled security.
- Electricity is already available at the proposed location, with only minor upgrades to meet the plant electrical requirements.

Figure 3: Location of proposed treatment plant and discharge location

- Treatment plant location is 27° 1'9.40"S ; 30°24'50.73"E
- Final discharge location is 27° 1'2.31"S ; 30°24'47.14"E

The discharge point is dependant on the location of the treatment plant. Refer to drawing number G2021/03/02/100-01 for details of the discharge point. It is proposed to discharge the water into the veld, which will flow into a non-perennial stream and wetland area and eventually into the Heyshope dam.

In essence, the treated water will be discharged into an existing grass lined channel. Due to the constant discharge flow this grass lined channel will need to be concrete lined to prevent erosion.

A new 600ND pipe culvert will be required at location 27° 1'5.03"S ; 30°24'46.45"E. The outlet of the is culvert will then daylight and discharge to the veld.

Where the water crosses the road a 'low level' concrete crossing is recommended to prevent erosion. It should be noted that this road is not a district road, but a local unnamed access road used by the mine and local community to access their houses. A 600ND pipe culvert can also be considered for this road crossing.

6. DESIGN FLOW AND WATER BALANCE

6.1. GENERAL

The primary function of the water treatment plant is to treat the current decanting water from the decant point at the Heyshope dam. However, numerous surplus water exists on the mine. This water is currently managed by storing water the in Maquasa East PCD's, Pit D and Pit G. It is also used to provide water to the plant, for dust control and operations in the mining.

A new discard dump will also be constructed with a new associated PCD. Surplus water from this PCD will also need to be managed.

It is thus recommended by GFK to manage the decant water, including all other surplus water on the mine by pumping it to the current Maquasa East Pollution Control Dams. These PCD's will be used as a centralised point to collect all water from the mine from where it will be pumped to a new proposed water treatment plant located directly adjacent to the PCD's. Existing infrastructure and pipes already exist to make this possible.

Only one new pipe would be required to pump from the new discard dump PCD to the East PCD's.

In essence all the PCD's must Regulation No. GN 704 of the National Water Act (1998) which states that a PCD is not allowed to spill more than once in 50 years which will be used as the baseline requirement to design the flows.

The potential spills of the PCD's are analysed in the water balance, which is done using a monthly time step method, with WRSM 2000 (Pitman model) software. The model is set up using the available 89-year rainfall and quaternary catchment data period available in South Africa. This data record period starts in 1920 and ends 2009.

The water balance model considers all inflows and outflows of the PCD which are summarised as:

Inflows:

- Decant water from the decant point obtained from the Kangra water meter readings which currently pumps water from the decant point to Pit D and the Maquasa PCD's.
- Stormwater run-off water from Maquasa East and West plant and product stockpile and dirty area.
- Stormwater run-off water and seepage from the existing discard dump to the East PCD's.

- Stormwater run-off water from the Block C pit working area & overburden dumps which is pumped to the East PCD's from the pit sump.
- Stormwater run-off from the new discard dump.
- Stormwater run-off from Pit D and Pit G.
- Groundwater infiltration into the underground mine working area, due to drawdown of the water table for Block C and Twyfelhoek obtained from Gradient Groundwater consulting. The Block C groundwater flows where compared with the water meter flows obtained from Kangra which pumps water from Block C to the Maquasa PCD's.

Outflows:

- Plant demands from the PCD's. See Figure 4 for calculation of the plant water demands for the 350 ton per hour plant on site.
- Dust control abstraction applicable to the immediate adit/pit working area, haul roads and at the hard parks. This includes the current dust water use obtained from water meter readings, as well as calculated new dust suppression that would be required at the new discard dump.
- Natural evaporation from the PCD and pit sumps.
- Underground mine continues miner: 2300 m^3/month for two machines for 20 hours/day 27 days/month at 80% utilization. This amount of water is assumed to be "lost" in dust and material transported out and away of the mine with no return flow to the system.
- Drill and blast: 800m^3/month (used at other mines in the Piet Retief area) for 20 hours/day 27days/month. This figure tallies with volumes used by other mines but is variable as it depends on requirement for blasting and will occur on an ad hoc basis. This amount of water is assumed to be lost for re-use.
- Water treatment of surplus water

It must be noted that the H-Block water has not been taken into consideration for this water balance as it is understood that that area is nearing its completion.

The storage capacity of the PCD's as well as the current pits has also been taken into account. The Pits D & G, currently form an integral part of the system as they function as connecting sumps to pump water from one mining part to the other.

As will be described later in this report, during the dry season when rain fall will be less and surplus water decreased, the additional available capacity at the treatment plant must be used to start treating water from these pits. Over the years these pits can then be dewatered and eventually rehabilitated. In the event that they are rehabilitated provision must be made for connecting pipes from one mine area to the Maquasa PCD.

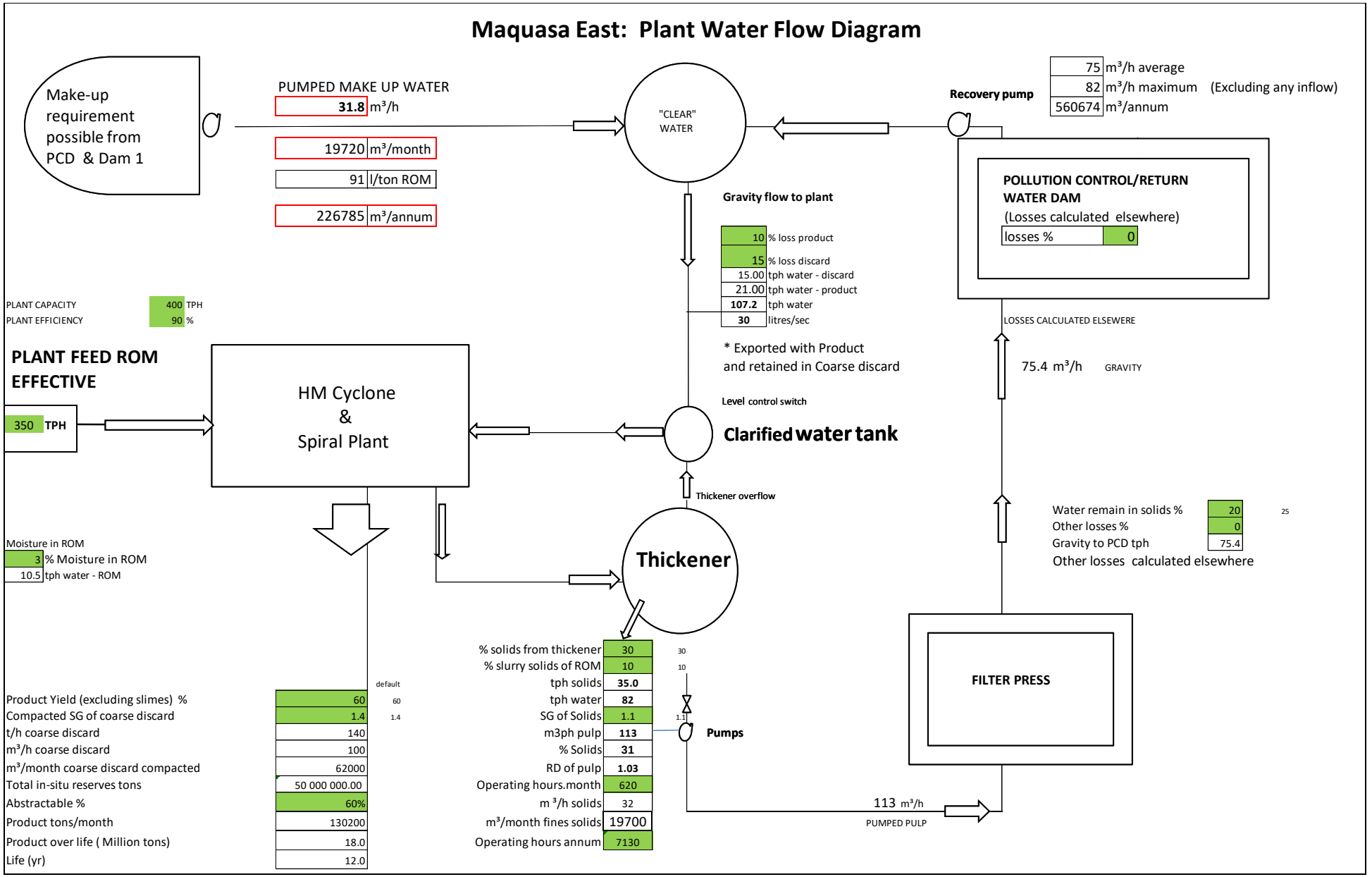


Figure 4: Plant water demands calculated

6.2. WATER USE AREAS

The areas contributing to evaporation, runoff and dust control are indicated in Table 3 below.

Table 3: Water use areas

Description	Area (Ha)
Dust control: Haul roads in dirty area	6.18
New discard dump runoff (PCD New)	75.00
Existing discard dump	61.80
Maquasa East dirty runoff area	27.00
Block C opencast runoff	3.00
Pit G & D runoff	4.60
Twyfelhoek runoff area	7.00
PCD 1 East surface area	0.78
PCD 2 East surface area	1.06
PCD 3 East surface area	1.12
PCD New Discard dump	1.38
Pit G Surface area	0.55
Pit D Surface area	3.02
Nooitgesien PCD	2.60
Twyfelhoek sump surface area	0.08

6.3. WATER BALANCE RESULTS

The water balance was conducted to determine the surplus water that would be present on the wider mining operations which must be treated.

Regulation No. GN 704 of the National Water Act (1998) which states that a PCD is not allowed to spill more than once in 50 years was used as the baseline requirement to design the flows.

The period under investigation is 20 years as it is envisaged that the mine will still be operating for the next 20 years obtaining reserves from Twyfelhoek and possibly other planned operations.

The water balance is however modelled over a 89-year period. Taking the life of the project and simulation period into consideration, it can be seen from Table 4 that only a 33% probability exists of a spill happening over the 20 years if the model indicates 6 spills over the 89-year simulation.

From Figure 5 it can be seen that the spills are limited to 6 over the analysis period if the maximum of 135 000 m³/month water treatment is applied. The maximum flows to minimise spills can be seen in Figure 6.

It should be noted that all flows in the WRSM results must be divided by 100. In order to obtain more accurate results and minimise low flows being ignored by the WRSM (Pitman model), all inputs were multiplied by 100. It is therefore important to divide the results again by 100 for interpretation

The small ‘spills’ (years 1940 and 1990) in Figure 5 are thus negligible.

Table 4: Allowed number of exceedances over simulation period

LIFE OF PROJECT (LOP)(YEARS)	20
REQUIRED NON EXCEEDANCE RETURN PERIOD (YEARS)	50
FLOOD EVENT DATA BASE AND SIMULATION (YEARS)	89
PROBABILITY OF A 1: 50 YEAR FLOOD DURING LOP (%)	33.2
MAXIMUM ALLOWED NUMBER OF EXCEEDANCES OVER DATA PERIOD TO SATISFY RETURN PERIOD CRITERIA FOR PROJECT LIFE	6

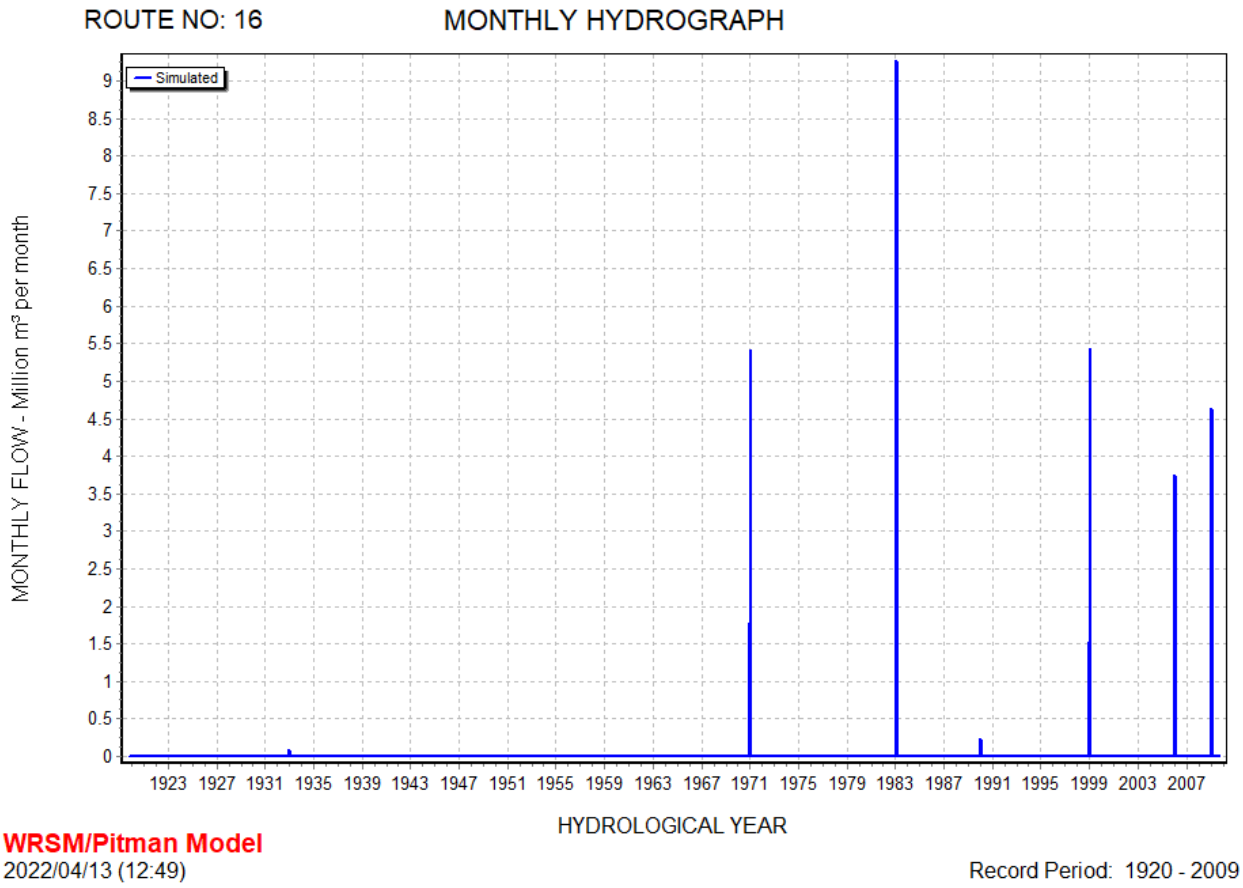


Figure 5: Spills over 89-year period

Table 5: Mean monthly flows over life of mine

INFLOWS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
Runoff Existing Discard dump (m^3)	2200	7000	13000	14400	11000	7000	4000	1800	1000	700	600	500	63200
Runoff Block C (m^3)	150	400	700	800	630	430	240	100	50	30	30	40	3600
Runoff Maquasa East PCD's (m^3)	1000	3100	5800	6800	5000	3200	1700	800	400	300	100	100	28300
Runoff New Discard dump (m^3)	3000	8000	13800	15600	14200	10400	5500	2700	1200	1000	1000	1100	77500
Runoff Twyfelhoek (m^3)	300	800	1400	1700	1420	900	500	300	100	50	40	50	7560
Runoff Pit G & D (m^3)	200	550	950	1400	950	600	350	150	80	50	50	50	5380
Monthly groundwater inflows Twyfelhoek (m^3)	12200	11600	11800	10800	9400	14600	13300	11800	11200	11300	11200	10700	139900
Monthly groundwater inflows Block C (m^3)	11140	9120	22640	21570	12890	12840	13510	8890	10190	9180	11420	11180	154570
Decant water	44630	51630	40530	50870	32140	31980	28190	38840	49460	47630	40940	49490	506330
Total inflows (m^3)	**74820**	**92200**	**110620**	**123940**	**87630**	**81950**	**67290**	**65380**	**73680**	**70240**	**65380**	**73210**	**986340**
OUTFLOWS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
Evaporation PCD's (m^3)	615	470	-535	-120	415	520	1755	2430	2255	2400	2920	3155	16280
Evaporation Pits (m^3)	670	510	-580	-130	460	575	1915	2650	2460	2610	3170	3420	17730
Monthly Dust Control (m^3)	14500	12360	10530	9300	8340	9570	7990	7680	8530	15290	11850	14590	130530
New Dust Control (new discard dump)	550	400	750	830	650	800	850	700	570	530	1100	1180	8910
Drill & blast, Continous miner(m^3)	3100	3100	3100	3100	3100	3100	3100	3100	3100	3100	3100	3100	37200
Plant (m^3)	19700	19700	19700	19700	19700	19700	19700	19700	19700	19700	19700	19700	236400
Water treatment (m^3) (Surplus water)	33900	57560	59720	77430	49620	56350	40670	38800	41930	29870	23810	29630	539290
Total outflows (m^3)	**73035**	**94100**	**92685**	**110110**	**82285**	**90615**	**75980**	**75060.4**	**78545**	**73500**	**65650**	**74775**	**986340**
Balance (m^3)	-1785	1900	-17935	-13830	-5345	8665	8690	9680	4865	3260	270	1565	0

NOTE: The difference in volume between the monthly inflows and outflows indicated in the balance is accounted for in the PCD’s storage volumes to allow for the annual inflows and outflows to balance.

Considering all inflows and outflows the average monthly flows are indicated in Table 5. On average 77430m³/month water would need to be treated in the peak rainfall season and a lower average of 23810m³/month in the winter/drier season.

The treatment plant however must be sized to accommodate the maximum flows of 135 000 m³/month to minimise the spills. Sizing the plant for the average flows would result in more spills than allowed according to Regulation GN 704.

However,

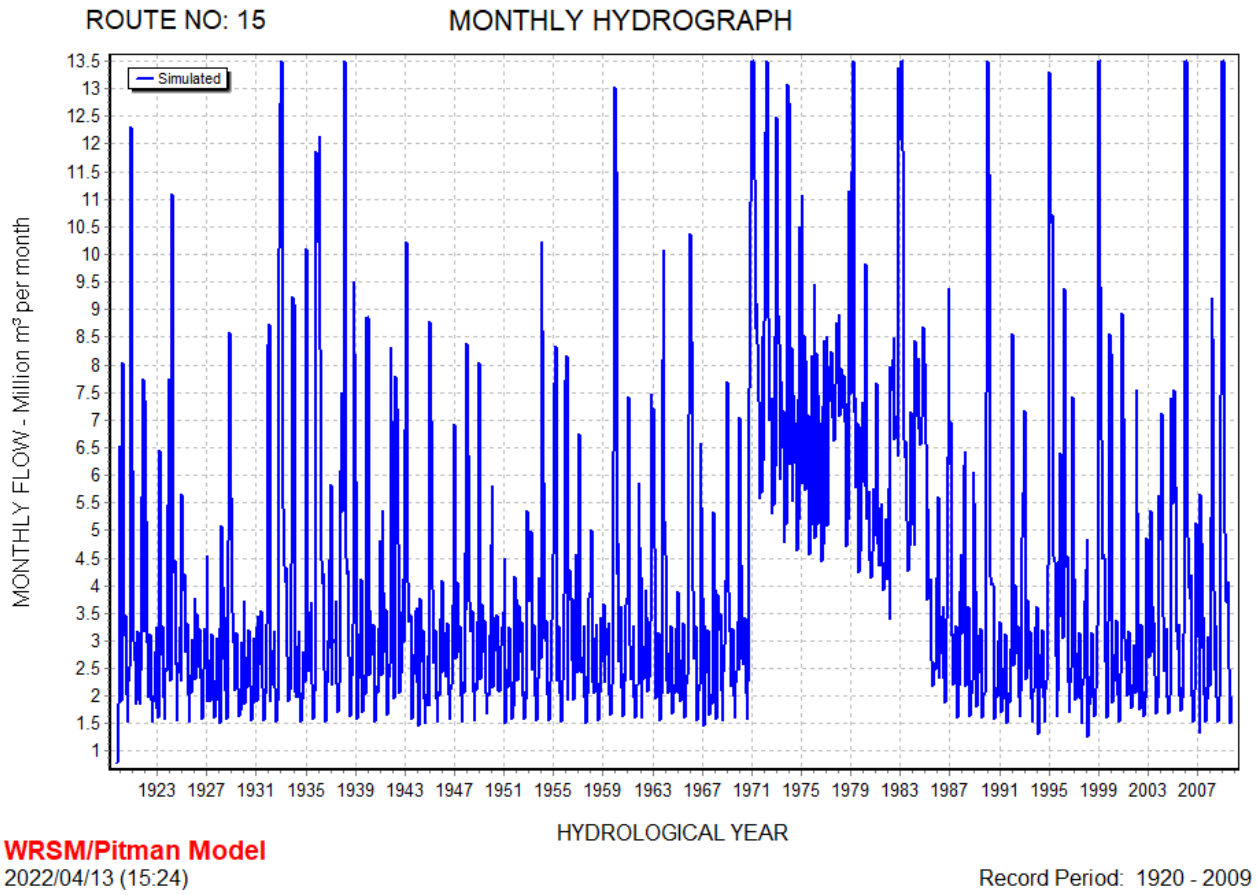


Figure 6: Monthly hydrograph of the required water treatment to minimise spills

In summary the water treatment plant (WTP) will be designed for the 4 500m³/day flow (135000 m³/month ÷ 30 days).

It must also be noted that the water balance is based on historical rainfall data. Even though accuracy is deemed high, the exact rain events will not be repeated as is in the futre. In the event that a much higher flood should occur the surplus water should be temporarily stored in the existing Pits D and G until a time where the seasonal flows become less during the winter season, in which these pits can then be dewatered.

Items to also consider during these 20 years:

- Block C of which water will now be treated, has approximately another 1-year life before it is rehabilitated, maximum 2 years. Water from here would then not need to be treated anymore after closure in the next 2 years.

- Block C decant will occur about 11-year after closure (Gradient Groundwater Study). The capacity initially used for the Block C surplus water (above) can then be used to treat the new decant estimated at about 18 m^3/day to 118m^3/day.
- After the 20 years the new discard dump will be rehabilitated resulting in significantly less surplus water from the new discard dump.
- The additional capacity in the treatment plant used for the new discard dump which becomes available due to rehabilitation on the dump, can then be used to dewater and treat the Pit D or possibly water that may arise from future planned operations (Donkerhoek). A revised water balance would be required at a later stage.
- During dry months, the additional capacity in available to treat water must be used to start dewatering Pits G and D.

7. INFLUENT QUALITY

Initially water from the East PCD's will be treated to create capacity to pump in the decant and other water. Refer to Table 6 below which indicates the current qualities of the PCD.

During operation however water with typical qualities observed as the decant point will be expected. The treatment plant must thus be able to accommodate both these qualities.

Table 6: PCD water quality to be treated initially

SiteName	DateTimeMeas	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	MALK CaCO3/L	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammonium mg/l	TotHardness mg/l	CaHardness mg/l	MgHardness mg/l	NO2-N mg/l
Plant Set Pond Dam 2	2017/12/18	8.10	277.00	2500.00	429.00	81.00	346.00	16.00	170.00	6.30	1760.00	1.30	-0.05	0.00	-0.05	0.64	1.50	1400.00	1070.00	332.00	-0.50
Plant Set Pond Dam 2	2018/01/13	7.60	216.00	1900.00	299.00	65.00	179.00	9.50	65.00	3.20	1190.00	1.10	0.12	0.02	-0.05	0.01	0.21	1020.00	747.00	269.00	-0.50
Plant Set Pond Dam 2	2018/02/06	7.90	240.00	2300.00	238.00	81.00	234.00	11.00	75.00	3.30	1100.00	1.00	-0.05	0.00	-0.05	0.12	0.28	929.00	595.00	334.00	-0.50
Plant Set Pond Dam 2	2018/04/10	8.10	254.00	2400.00	298.00	93.00	299.00	15.00	48.00	3.60	1420.00	-0.10	-0.05	0.02	-0.05	0.00	0.10	1130.00	744.00	382.00	-0.50
Plant Set Pond Dam 2	2018/04/14	7.80	270.00	2400.00	353.00	103.00	262.00	13.00	125.00	5.00	1500.00	0.60	-0.05	0.00	-0.05	0.01	0.03	1310.00	880.00	425.00	-0.50
Plant Set Pond Dam 2	2018/05/20	7.80	317.00	2700.00	374.00	117.00	293.00	14.00	98.00	4.10	1860.00	-0.10	-0.05	0.01	-0.05	0.01	0.16	1420.00	934.00	481.00	-0.50
Plant Set Pond Dam 2	2018/06/09	7.60	347.00	3100.00	381.00	133.00	316.00	15.00	95.00	6.20	1810.00	404.00	-0.05	0.02	-0.05	0.01	0.14	1500.00	952.00	547.00	-0.50
Plant Set Pond Dam 2	2018/07/17	7.70	452.00	3900.00	476.00	187.00	409.00	28.00	165.00	8.80	2310.00	0.30	0.12	0.00	-0.05	0.00	1.20	1960.00	1190.00	770.00	-0.50
Plant Set Pond Dam 2	2018/08/09	7.50	598.00	5600.00	429.00	240.00	508.00	39.00	140.00	12.00	2720.00	-0.10	-0.05	0.02	-0.05	0.01	1.70	2060.00	1070.00	987.00	-0.50
Plant Set Pond Dam 2	2018/09/11	8.00	400.00	3400.00	328.00	165.00	203.00	22.00	170.00	-0.05	1600.00	-0.10	-0.05	0.01	-0.05	0.31	1.20	1500.00	819.00	681.00	-0.50
Plant Set Pond Dam 2	2018/10/14	8.20	386.00	3700.00	552.00	189.00	383.00	25.00	135.00	13.00	2350.00	1.80	-0.05	0.03	-0.05	0.00	0.51	2160.00	1380.00	777.00	-0.50
Plant Set Pond Dam 2	2018/11/12	7.90	384.00	3700.00	387.00	187.00	260.00	25.00	116.00	9.90	1840.00	0.70	-0.05	0.01	-0.05	0.00	0.07	1740.00	966.00	769.00	-0.50
Plant Set Pond Dam 2	2018/12/13	7.70	396.00	3600.00	539.00	172.00	424.00	26.00	5.70	95.00	3040.00	-0.10	-0.05	0.01	-0.05	0.00	0.08	2050.00	1350.00	709.00	-0.50
Plant Set Pond Dam 2	2019/01/01	6.30	269.00	2400.00	383.00	112.00	256.00	16.00	55.00	8.40	1530.00	0.10	-0.05	0.02	-0.05	0.00	-0.01	1420.00	955.00	462.00	-0.50
Plant Set Pond Dam 2	2019/02/01	7.40	234.00	2000.00	307.00	85.00	197.00	14.00	48.00	4.40	1270.00	1.00	-0.05	0.01	-0.05	0.05	0.23	1120.00	767.00	349.00	-0.50
Plant Set Pond Dam 2	2019/03/01	7.50	253.00	2200.00	309.00	101.00	225.00	9.50	55.00	3.80	1470.00	-0.10	-0.05	0.01	1.30	0.00	0.19	1190.00	772.00	416.00	-0.50
Plant Set Pond Dam 2	2019/09/27	8.10	715.00	5000.00	798.00	411.00	929.00	59.00	115.00	19.00	4560.00	0.30	0.09	-0.02	-0.05	0.03		3690.00	1990.00	1690.00	-0.50
Plant Set Pond Dam 2	2019/11/19	7.70	225.00	1900.00	221.00	0.38	192.00	11.00		4.70	1080.00	1.60	0.15	0.02	0.05	86.00	0.45	907.00	553.00	354.00	0.50
Plant Set Pond Dam 2	2019/12/11	7.30	198.00	1600.00	204.00	85.00	178.00	8.50		3.60	1100.00	2.00	0.33	-0.02	-0.05	0.31	0.16	858.00	509.00	349.00	-0.50
Plant Set Pond Dam 2	2020/01/25	7.90	384.00	2700.00	475.00	175.00	369.00	25.00	56.00	10.00	2390.00	0.20	-0.05	-0.02	-0.05	-0.01	0.10	1910.00	1190.00	721.00	-0.50
Plant Set Pond Dam 2	2020/02/25	7.60	349.00	2600.00	510.00	145.00	341.00	16.00	58.00	4.40	2320.00	0.20	-0.05	-0.02	-0.05	-0.01		1870.00	1270.00	597.00	-0.50
Plant Set Pond Dam 2	24/03/2020	7.70	221.00	2200.00	286.00	106.00	156.00	17.00	40.00	3.50	1460.00	0.90	0.11	0.02	-0.05	0.11		1150.00	714.00	436.00	-0.50
Plant Set Pond Dam 2	2020/06/17	7.90	255.00	1800.00	314.00	132.00	238.00	13.00	75.00	6.00	1540.00	0.30	-0.05	-0.02	-0.05	0.02		1330.00	783.00	542.00	-0.50
Plant Set Pond Dam 2	2020/07/24	8.20	252.00	2200.00	255.00	125.00	195.00	13.00	131.00	6.30	1590.00	0.05	-0.05	-0.02	-0.05	-0.01		1150.00	637.00	514.00	-0.20
Plant Set Pond Dam 2	2020/08/27	8.10	279.00	2400.00	326.00	147.00	263.00	15.00	128.00	6.50	1740.00	-0.10	-0.05	-0.02	-0.05	-0.01		1420.00	815.00	607.00	-0.50
Plant Set Pond Dam 2	2020/09/22	8.00	293.00	2600.00	352.00	159.00	293.00	16.00	126.00	7.70	1900.00	0.20	-0.05	-0.02	-0.05	-0.01		1530.00	878.00	656.00	-0.50
Plant Set Pond Dam 2	2020/10/29	7.30	254.00	2300.00	301.00	129.00	168.00	13.00	55.00	4.10	1580.00	0.60	<0.05	0.06	<0.05	0.21		1280.00	751.00	532.00	<0.5
Plant Set Pond Dam 2	2020/11/24	7.70	258.00	1900.00	343.00	128.00	196.00	13.00	48.00	4.90	1610.00	<0.1	0.05	<0.02	<0.05	<0.01		1380.00	856.00	528.00	<0.5
Plant Set Pond Dam 2	2020/12/13	7.50	168.00	1600.00	233.00	65.00	72.00	5.70	128.00	2.20	587.00	1.50	0.45	0.06	<0.05	0.54		849.00	581.00	268.00	<0.5

Table 7: Decant point water quality to be used as operational influent quality of the treatment plant

Date	2016/03/02	2016/06/02	2016/07/02	2016/08/02	2016/09/02	2016/10/02	2016/11/05	2016/12/02	2017/01/06	2017/02/06	2017/03/06	2017/04/06	2017/05/10	2017/06/08	2017/07/06	2017/08/03	2017/09/06	2017/10/05	2018/04/01	2018/07/01	2018/10/01	2019/01/01
pH	7.36	6.98	6.99	7.10	7.39	7.15	7.19	7.15	7.43	7.69	7.37	7.21	7.11	7.08	7.23	7.10	7.43	7.00	7.60	7.40	8.00	7.50
EC mS/m	263.00	293.00	279.00	284.00	276.00	281.00	282.00	279.00	274.00	282.00	277.00	278.00	275.00	270.00	269.00	270.00	263.00	255.00	217.00	214.00	194.00	195.00
TDS mg/l	2126.73	2273.43	2278.37	2377.26	2367.46	2231.46	2294.48	2170.39	2186.39	2406.38	2223.20	2352.32	2255.26	2186.16	2352.88	2399.76	2345.24	2127.64	1900.00	1800.00	1600.00	1700.00
Ca mg/l	300.97	309.54	313.00	332.05	337.00	340.00	370.00	325.00	326.30	388.00	311.00	336.00	318.00	335.00	333.00	362.00	337.00	341.74	276.00	291.00	296.00	252.00
Mg mg/l	101.94	110.14	105.00	112.00	105.00	102.00	105.81	104.74	104.49	109.00	111.00	116.00	117.00	113.00	111.55	107.00	112.00	100.38	90.00	93.00	87.00	82.00
Na mg/l	202.19	213.74	213.00	238.00	213.00	207.00	201.10	198.00	205.88	228.00	206.00	213.00	194.00	193.00	200.88	198.00	205.00	173.46	172.00	170.00	145.00	138.00
K mg/l	11.67	13.12	11.30	13.60	10.30	11.40	11.72	11.30	11.53	12.30	12.60	12.60	11.60	13.10	13.10	12.70	12.40	8.75	13.00	13.00	12.00	13.00
TALK mg/l	264.00	253.00	252.00	242.00	255.00	258.00	244.00	243.00	235.00	245.00	240.60	230.00	234.00	243.00	244.00	241.00	251.00	285.00	288.00	293.00	265.00	247.00
Cl mg/l	6.28	6.08	6.18	6.67	6.70	6.89	6.60	6.65	6.74	6.31	6.42	5.82	5.70	5.60	5.56	6.05	5.84	5.95	6.20	5.40	7.40	7.90
SO4 mg/l	1342.00	1467.00	1476.68	1529.36	1542.00	1408.00	1452.00	1378.00	1390.00	1514.00	1431.00	1529.00	1467.00	1379.00	1540.91	1568.00	1518.95	1322.00	1180.00	970.00	1030.00	870.00
NO3-N mg/	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	0.40	0.55	1.50	<0.1	1.40	1.50
F mg/l	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.05	<0.05	<0.05	<0.05
Al mg/l	0.08	0.04	0.11	0.03	<0.01	0.07	0.09	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	0.06
Fe mg/l	0.22	0.42	0.86	0.28	0.03	0.13	0.07	0.07	0.05	0.61	0.11	0.51	0.32	0.36	0.38	0.17	0.07	0.23	<0.05	<0.05	<0.05	<0.05
Mn mg/l	2.76	1.20	1.04	<0.01	0.31	1.01	0.53	0.80	0.40	1.04	0.63	1.31	1.12	1.18	1.10	1.24	1.53	1.62	0.21	0.54	0.23	<0.002
N_Amonia r	<0.45																		<0.01	0.12	0.05	0.02
Tot_Hardne	1171.29	1226.47	1213.95	1290.33	1273.88	1269.02	1359.62	1242.84	1245.06	1417.70	1233.67	1316.68	1275.85	1301.83	1290.86	1344.54	1302.71	1266.67	1060.00	1110.00	1100.00	966.00
Ca_Hardnes	751.51	772.91	781.56	829.12	841.49	848.98	923.89	811.53	814.77	968.84	776.57	838.99	794.05	836.50	831.50	903.91	841.49	853.32	689.00	727.00	740.00	629.00
Mg_Hardne	419.78	453.56	432.39	461.22	432.39	420.04	435.73	431.32	430.29	448.86	457.10	477.69	481.81	465.33	459.36	440.63	461.22	413.35	369.00	381.00	359.00	336.00
SS mg/l	20.00	8.80	18.00	11.20	14.40	8.00	130.00	4.40	<0.4	16.00	26.00	16.80	52.80	33.20	7.20	19.60	10.40	36.00	<21	<21	<21	<21
PO4 mg/l			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03				
Si mg/l	4.27	5.71	4.24	4.34	4.59	4.25	4.95	4.70	4.23	5.60	3.79	5.52	4.48	6.89	6.57	4.12	4.56	6.37	5.10	7.50	7.70	
B mg/l	0.06	0.09	<0.01	0.02	0.03	0.04	0.04	<0.01	<0.01	0.03	0.02	0.02	0.03	0.03	<0.01	<0.01	0.02	0.02	0.04	0.02	0.04	0.05

8. DISCHARGE WATER QUALITY

The different Kangra operations ranging from the Maquasa East, West and Nooitgesien to Block C and the new discard dump all operate under sperate Water Use Licences (WUL). All these WUL's refer to different discharge water qualities. It must also be noted that these WUL's specific mention groundwater and not surface water.

The Resource Quality Objectives (RQO) are currently not determined for the specific Usuthu Catchment area in which this site falls. These would be the typical accepted discharge standards for such a site if no qualities are prescribed int eh WUL's.

In general the South African Target Water Quality Guidelines of DWS are also used as the basis of determining the discharge qualities.

Various standards and guidelines are available and should be considered when determining the discharge requirements.

It is therefore recommended to consolidate the various standards and guidelines available and set a limit that will be applicable specifically to the new proposed water treatment plant.

The surface discharge water quality proposed for the new water treatment plant is therefore based on evaluation of the following and are indicated in Table 8:

- South African Water Quality Guidelines for Irrigation, Aquatic and Aquaculture (DWS, 1996)
- SANS 241:2015
- World Health Organisation (WHO) standard
- Aquatic standard EPA
- Baseline river quality in nearby streams (Balgarthern area) not affected by mining
- Block C WUL
- Maquasa East WUL

The final recommended discharge quality was determined by comparing the qualities of all the above mentioned. Each constituent was analysed and the most suitable quality for the type of site conditions and circumstances was selected. In most cases this has resulted in taking the most stringent water quality of the different standards.

The two final columns in Table 8 refer to the eventual release quality. The 'Maximum recommended for dam' column refers to the quality the water should be just before and when it enters the Heyshope dam.

The 'Final Recommended Effluent Quality for plant design' refers to the quality the treatment plant should be designed for. This allows for a 20% safety factor as it is possible that particularly during first commissioning the plant may not achieve the desired quality. The plant should thus be designed at a 20% stricter margin to ensure that he eventual water which is released into the dam is of an acceptable standard.

The final discharge quality will ultimately depend on those provided by DWS in the Water Use License which will influence the treatment plant design.

Table 8: Discharge water quality

RECOMMENDED FULL LIST OF DETERMINANTS FOR RIVER WATER TO BE TESTED TO PROVIDE A BASELINE FOR MINES, WITH STANDARDS (USED A GUIDELINE TO DETERMINE FINAL RELEASE WATER QUALITY IN CONJUNCTION WITH BASELINE MONITORED QUALITY AND RELEASE QULITY OF EXISITNG WUL'S OF THE MINE)													**FINAL RECOMMENDED EFFLUENT QUALITY FOR PLANT DESIGN** (USE THIS COLUNM FOR FINAL PLANT DESIGN AND RELEASE QUALITY OF TREATED WATER) Approximatly 20% safety margin
DETERMINANT	**UNITS**	**DETECTION LIMIT REQUIRED**	**IRRIGATION WATER STANDARDS DWS SA**	**AQUACULTURE WATER STANDARDS DWS SA**	**AQUATIC LIFE WATER STANDARDS DWS SA**	**DOMESTIC STANDARDS**		**AQUATIC LIFE EPA**	**Maquasa Operations WUL water quality (groundwater)**	**Block C WUL water quality (groundwater). Table 3**	**Baseline river at Balgarthen (Based on data range from 2010-2020 at monitoring points**	**MAXIMUM RECOMMENDED FOR DAM. THIS IS WHAT SHOUL BE ACHIEVED IF WATER IS TESTED JUST PRIOR TO**	
						SANS 241	**WHO**						
pH	pH units	0-14 (0.001)	6.5-8.5	6.5-9	pH values should not be allowed to vary from the range of the background pH values for a specific site and time of day, by > 0.5 of a pH unit, or by > 5 %, and should be assessed by whichever estimate is the more conservative.	5-9.7			6.5-8	6.5-9	5.7-8.9	6.5-8	6.5-8.5
Dissolved Oxygen (DO)/BOD	mg/ℓ	0-20 (0.1)		6-9 (Cold water species) 5-8 (Warm water	80% -120% of saturation						80% -120% of saturation	80% -120% of saturation	90% -110% of saturation
Electrical Conductivity	mS/m	0.01-20000 (0.01)	40			170			27	23	22	40	30
Chloride	mg Cl/ℓ	10-500	100			300	250	250	3	3	14	100	80
Ammonia as N	mg N/ℓ	0.11				1.5	1.5	0.9			0.11	0.9	0.7
Ammonia	mg NH_3/ℓ	0.02		0.025 (Cold water fish) 0.30 (Warn water fish)	0.007			0.2			N/A	0.2	0.16
Ammonium	mg NH_4/ℓ	0.05						Not toxic			N/A	Test not required	Test not required
Chromium IV	µg CR IV/ℓ	2		20	7			0.3			N/A	7	5.6
Cyanides Free and Total	µg Cn/ℓ	0.1		0.02	1	200	70	2			200	2	1.6
Dissolved Aluminium	µg Al/ℓ	2	5000	0-30 (pH >6.5)	5 (pH<6.5) ; 10 (pH >6.5)	300		1.3	620		2230	10	8
Dissolved Antimony	µg Sb/ℓ	1				20	20	not tested			N/A	20	15
Dissolved Arsenic	µg As/ℓ	6	100	0-50	10	10	10		1		N/A	10	8
Dissolved Beryllium	µg Be/ℓ	1				700		not tested			N/A	700	560
Dissolved Barium	µg Ba/ℓ	1	100					not tested			N/A	100	80
Dissolved Boron	µg B/ℓ	1	500			2400	2400	1200			N/A	500	400
Dissolved Cadmium	µg Cd/ℓ	0.1	10	0.2	0.07	3	3	0.25	10		N/A	0.2	0.16
Dissolved Calcium	mg Ca/ℓ	0.12				150			29	27	73	150	58
Dissolved Cobalt	µg Co/ℓ	3	50		5	500					N/A	5	4
Dissolved Copper	µg Cu/ℓ	0.3		5	0.3	50	50				N/A	0.3	0.24
Dissolved Chromium	µg Cr/ℓ	3	200			2000	2000	100			N/A	100	80
Dissolved Iron	µg Fe/ℓ	4	200 drippers	10	>10% of background Fe	2000	2000		2330	300	380	300	240
Dissolved Lead	µg Pb/ℓ	0.3	200	10	0.2	10	10	0.75	10		N/A	10	8
Dissolved Lithium	µg Li/ℓ	1	2500					not tested			N/A	2500	2000
Dissolved Manganese	µg Mn/ℓ	1	20 crops	100	180	400	400		220	200	470	180	145
Dissolved Magnesium	mg Mg/ℓ	0.07						not tested	9	82	9.22	82	82
Dissolved Mercury	µg Hg/ℓ	0.15		1	0.04	6	6	1.3			6	1.3	1
Dissolved Nickel	µg Ni/ℓ	2	200			70	70	30			N/A	30	24
Dissolved Potassium	mg K/l	0.08				50		not tested	3		3.2	50	40
Dissolved Selenium	µg Se (vi)/ℓ	2	20	300	2	40	10				10	10	8
Disolved Sodium	mg Na/ℓ	0.19				200	50	not tested	21		9.1	50	40
Disolved Uranium	µg U/ℓ	1				30		not tested			30	30	25
Dissolved Vanadium	µg V/ℓ	1	100			200					200	200	160
Dissolved Zinc	µg Zn/ℓ	2	1000	30	2	5000	3000		20			2	1.6
Fluoride	mg F/ℓ	0.26	2		0.75	1.5	1.5		0.31	0.3	0.92	0.75	0.6
Nitrogen as N	mg N/ℓ	0.5	0.5 algae growth		0.5			0.3 ece			0.5	0.5	0.3
Nitrate	mg NO_3/ℓ	0.19		300		11	50		0.24	0.5	1.1	11	8.8
Nitrite	mg NO_2/ℓ	0.01		0.05		0.9					0.7	0.9	0.72
Phosphorus as P	mg P/ℓ	0.01						0.03			N/A	0.03	0.024
Phosphate (ortho phosphate)	mg PO_4/ℓ	0.1		0.1							N/A	0.1	0.08
Sulphate	mg SO_4/ℓ	0.5	200			500			45	25	45	200	160
Total Alkalinity	mg $CaCO_3$/ℓ	2	60-120	20-100				200	100	93	68	100	80
Total Dissolved Solids	mg/ℓ 180°C	10.2		2000	<15% variation of normal TDS cycle	1200			177	130	148	130	100

Constituent used as limit

Difficult to find lab that can test detection limits

9. OTHER REQUIREMENTS OF THE TREATMENT PLANT

The treatment plant installer shall indicate how much brine is expected to be removed per month. Sludge drying beds are proposed on which the brine will be placed to dry. When dried this will be removed by the mine and discarded on the new Class C lined discard dump.

The treatment plant supplier shall also indicate any other possible brine handling solutions.

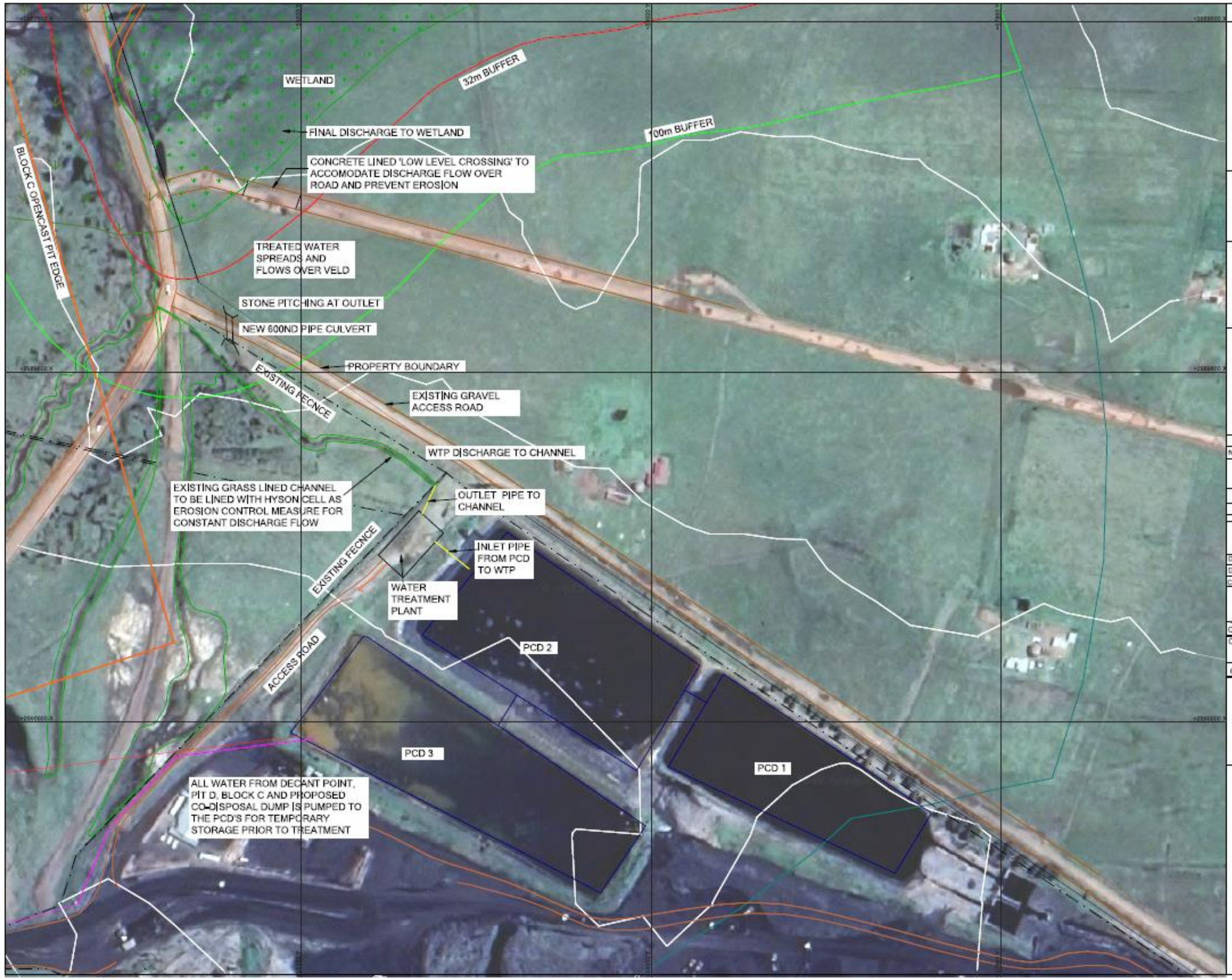
10. REFERENCES

[1] WR2012 : Water Resources of South Africa : Water Reseach Commision and Royal Haskoning.

[2] SA Atlas of Climatology en Agrohydrology : University of Kwazulu Natal.

11. ANNEXURE

11.1. DRAWINGS



NOTES

DATUM:
Transverse Mercator
WGS 84
31°E

CONSULTING ENGINEERS CC
119 Deputasie Street
P O Box 2266 VRYHEID
3100
Tel / Fax: 034 982 3425

DRAWING REFERENCE

No	Drg No	Title

REVISIONS

No	Description	Date	By

Drawn	B MUHL
Designed	B MUHL
Checked	G.F.KRUGEL

13/04/2022
Consulting Engineer (ECSA 200870316) Date

Client Approval

Client Date

EMPLOYER/OWNER

KANGRA

KANGRA COAL PTY LTD
7th Floor, 15 Fredman Drive, Fredman Towers, Sandton, 2196, Johannesburg, South Africa

PROJECT
MAQUASA EAST WATER TREATMENT

SERVICE
CIVIL

DRAWING TITLE
WATER TREATMENT PLANT LOCATION AND DISCHARGE LAYOUT PLAN

SCALE
1:1000

G2021/03/02/100-01 Drawing No. 19/10/2021 Date