

Table 7: Projected Effects of Proposed Artificial Wetlands

ARTIFICIAL WETLAND	SCENARIO	INITIAL SATURATED THICKNESS ABOVE BASIN BASE (m)	RADIUS OF DRAWDOWN INFLUENCE (m) ^(1,2)	CALCULATED GROUNDWATER INFLOW (m ³ /day) ⁽²⁾	DRAWDOWN AT NEAREST EXISTING BUILDING (m)	DISTANCE TO NEAREST EXISTING BUILDING (m)
Wetland A	Winter Construction Dry	1.57	90	5,361	1.06	8
	Summer Construction Dry	1.04	15	3,434	0.45	
	Winter Permanent Level	1.57	80	3,703	0.87	
	Summer Permanent Level	1.04	10	1,789	0.30	
Wetland B	Winter Construction Dry	1.67	89	4,000	0.91	15
	Summer Construction Dry	1.14	17	2,617	0.31	
	Winter Permanent Level	1.67	80	2,876	0.78	
	Summer Permanent Level	1.14	12	1,474	0.22	
Wetland C	Winter Construction Dry	1.22	60	3,648	0.05	133
	Winter Permanent Level		59	3,504	0.05	
Wetland D	Winter Construction Dry	1.27	60	3,284	0.00	200
	Winter Permanent Level		49	2,100	0.00	
Wetland E	Winter Construction Dry	1.25	57	3,018	0.00	250
	Winter Permanent Level		49	2,080	0.00	
Wetland F	Winter Construction Dry	0.80	25	1,702	0.00	420
	Winter Permanent Level		12	869	0.00	

Notes:

⁽¹⁾ Radius of influence considered to be 0.25 m drawdown.

⁽²⁾ Drawdown extents and inflows do not take account of changes in permeability such as Walton Subgroup sediments underlying the Hinuera Formation.

Table 8: Existing and Design Elevations of Artificial Wetlands Compared to Neighbouring Stream/Drain Heights

ARTIFICIAL WETLAND	EXISTING GROUND ELEVATION (mRL) ⁽¹⁾	DESIGN INVERT ELEVATION (m RL) ⁽¹⁾	DESIGN EXCAVATION DEPTH (m)	DESIGN PERMANENT WATER ELEVATION (mRL) ⁽²⁾	STREAM/DRAIN INVERT (mRL)	DEPTH FROM DESIGN INVERT TO STREAM/DRAIN INVERT (m)
A	41.74	37.00	4.74	37.50	36.67	0.33
B	39.95	36.90	2.69	37.40	35.85	1.05
C	39.74	37.35	2.39	37.40	36.67	0.68
D	39.74	37.48	2.26	37.95	37.70	-0.22
E	41.02	37.46	3.56	37.90	37.70	-0.20
F	40.24	38.40	1.84	38.80	37.83	0.57

5 DRAWDOWN EFFECTS OF WASTEWATER INFRASTRUCTURE

5.1 Introduction

WGA has modelled the drawdown effect of the dewatering required for the construction of two proposed wastewater pump stations and the associated wastewater pipeline network. The modelling used hydrogeological parameters from on-site testing (Section 3.4) and the design provided by Maven (Drawing no. R1-C440 Rev C).

Dewatering is not anticipated to be required in association with the installation of the proposed water supply pipeline, due to its depth being above the groundwater level (Maven Drawing no. C340 TYP RD Section). If extraordinary wet conditions require dewatering, any dewatering effects will be less than those required and assessed in Section 5.3 for wastewater pipelines.

5.2 Drawdown Effects of Wastewater Pump Station Installation

5.2.1 Construction

Two wastewater pumping stations (WWPS) are planned for construction: “WWPS A” located on the northern boundary and “WWPS B” positioned centrally within the development (Figure 2). The engineering design team has provided an outline of the proposed WWPS designs (Appendix F).

Earthworks associated with the wastewater pumping stations involve excavations below the groundwater table and beneath the confining aquifer's low permeability aquitard layer. The wet wells' depth necessitates specialised construction techniques to minimize excavation size and the groundwater dewatering required. In accordance with best practice, the contractor will implement erosion and sediment control measures as stipulated by the Waikato Regional Standard TR2009/02, as required by the proposed consent conditions.

For the purposes of this assessment, it is assumed that installation of the WWPS wet well and related infrastructure will require 10 days. Therefore, dewatering has been modelled to be achieved within 15 days.

Due to the position of the low permeability aquitard layer within the wet well excavation, this determines that the disconnected shallow aquifer and deep aquifer are both required to be dewatered. To achieve this, a combination of top-down and bottom-up dewatering methods is anticipated. Assessments assume the use of a sheet pile wall to support each excavation. A dewatering bore situated outside the sheet pile wall is to be employed to facilitate dewatering beneath the low permeability aquitard layer. Additionally, a surface water pump may be utilized during earthworks to temporarily lower shallow groundwater levels, where necessary, ensuring safe and efficient excavation above the low permeability aquitard layer. The sheet pile wall is expected to reduce horizontal groundwater inflows from the shallower aquifer.

Groundwater dewatering is not required for earthworks associated with the pump station pipework, as these excavations are above the groundwater table.

5.2.2 Dewatering for Wet Well Installation

As described above, excavation for the installation of each wet well is expected with the following dimensions:

- **WWPS A** will require a 2.5 m width and 6.6 m depth for wet well installation beneath the aquitard.
- **WWPS B** will require a 2.5 m width and 6.2 m depth for wet well installation beneath the aquitard.
- Any further excavations required for WWPS infrastructure are not anticipated to extend beneath the aquitard with the design information provided (Appendix F). Excavations for WWPS infrastructure can be dewatered with similar volumes as the trenching dewatering excavations described in Section 5.3.

It is assumed that the excavation will be completed and the walls of the wet well sealed within a maximum of 10 days. The wet well excavation will intersect the confined aquifer. An assessment applying the Hunt and Scott (2007) solution for pumped drawdown in a two-aquifer system has been used to assess the drawdown effects of the excavation.

Due to the limited area of the excavation, it is expected that one bore will be sufficient to achieve the required dewatering for wet well construction. Multiple bores may be used for dewatering, but for modelling purposes, using one bore is a reasonable assumption. A number of hydraulic tests and drillhole logs are available in the area, and aquifer transmissivities have been derived from hydraulic conductivity values from on-site testing (Section 3.4). Table 9 presents the hydraulic parameters applied to each drawdown assessment. A period of 15 days of dewatering was modelled to allow for delays over the planned duration of the works.

Table 9: Input Parameters for Hunt and Scott Assessment of Dewatering WWPS A and WWPS B

INPUT PARAMETER	WWPS A	WWPS B
Transmissivity in pumped confined aquifer	192 m ² /day Based on an aquifer thickness of 5.55 m at WWPS A and K value of 34.56 m/day (Table 3)	501 m ² /day Based on an aquifer thickness of 14.49 m at WWPS B and K value of 34.56 m/day (Table 3)
Storativity of pumped aquifer	0.001 Typical of a semi-confined aquifer in the Hinuera Formation	
Transmissivity in overlying aquifer	4.71 m ² /day Based on an aquifer thickness of 2.18 m and a K value of 2.16 m/day (Table 3)	1.0152 m ² /day Based on an aquifer thickness of 0.47 m and a K value of 2.16 m/day (Table 3)
Specific yield in overlying aquifer	0.2 Value for sandy material as described in the Castlegrace Farms bore log (Heath, 1983).	
Aquitard thickness	0.2 m (thickness of layer in piezometer P1, Appendix A).	0.2 m (thickness of layer in piezometer P4, Appendix A).
Vertical hydraulic conductivity for the aquitard	3.46 x 10 ⁻⁴ m/day (Table 3)	
Starting groundwater level	3.82 m bgl (38.02 mRL from P1)	1.05 m bgl (38.74 mRL from P4)
Target drawdown required to dewater 0.5 m below excavation	3.28 m	5.65 m

5.2.2.1 Deep Dewatering Results

Results of the Hunt and Scott analysis are shown in Figure 13 and Figure 14.

The WWPS A analysis indicates that pumping from a bore at a rate of 10.5 L/s (907 m³/day) will achieve a drawdown in the confined aquifer of 3.28 m at a distance of 5 m from the pumped bore. Provided the bore is positioned alongside the wet well, this drawdown would enable the excavation to be undertaken while maintaining a dry floor (Table 9). After 15 days pumping at this rate, the area of influence (drawdown of 0.25 m) extends 412 m from the pumping bore within the confined aquifer. Drawdown in the overlying unconfined aquifer reaches 0.25 m at 19 m from the pumped bore.

The WWPS B analysis indicates that pumping from a bore at a rate of 42.4 L/s (3,661 m³/day) will achieve a drawdown in the confined aquifer of 5.65 m at a distance of 5 m from the pumped bore. Provided the bore is positioned alongside the wet well, this drawdown would enable the excavation to be undertaken while maintaining a dry floor (Table 9). After 15 days pumping at this rate the area of influence (drawdown of 0.25 m) extends 854 m from the pumping bore in the confined aquifer and 107 m in the overlying unconfined aquifer.

WGA notes that the aquifer described as 'confined' is technically 'semi-confined' due to the confining layer being leaky. However, for simplicity, the lower aquifer is described in this report as confined.

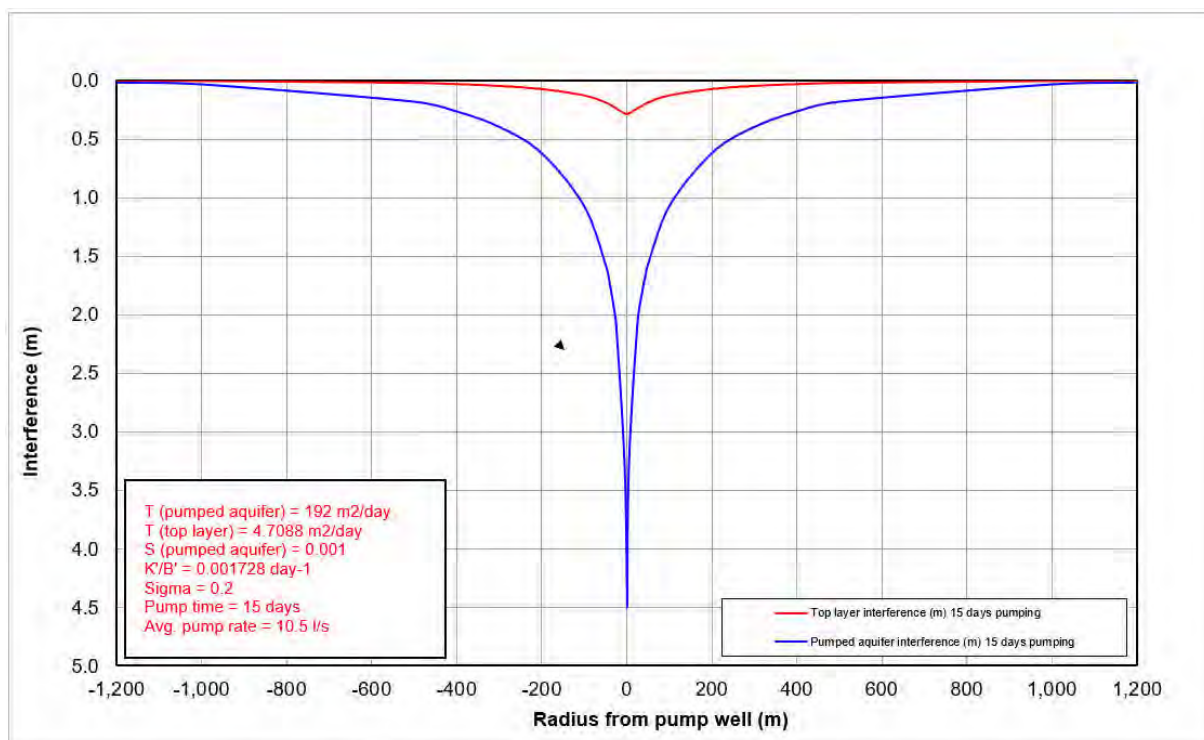


Figure 13: Projected Drawdown in confined and unconfined Aquifers Following Dewatering of Wet Well Excavation WWPS A

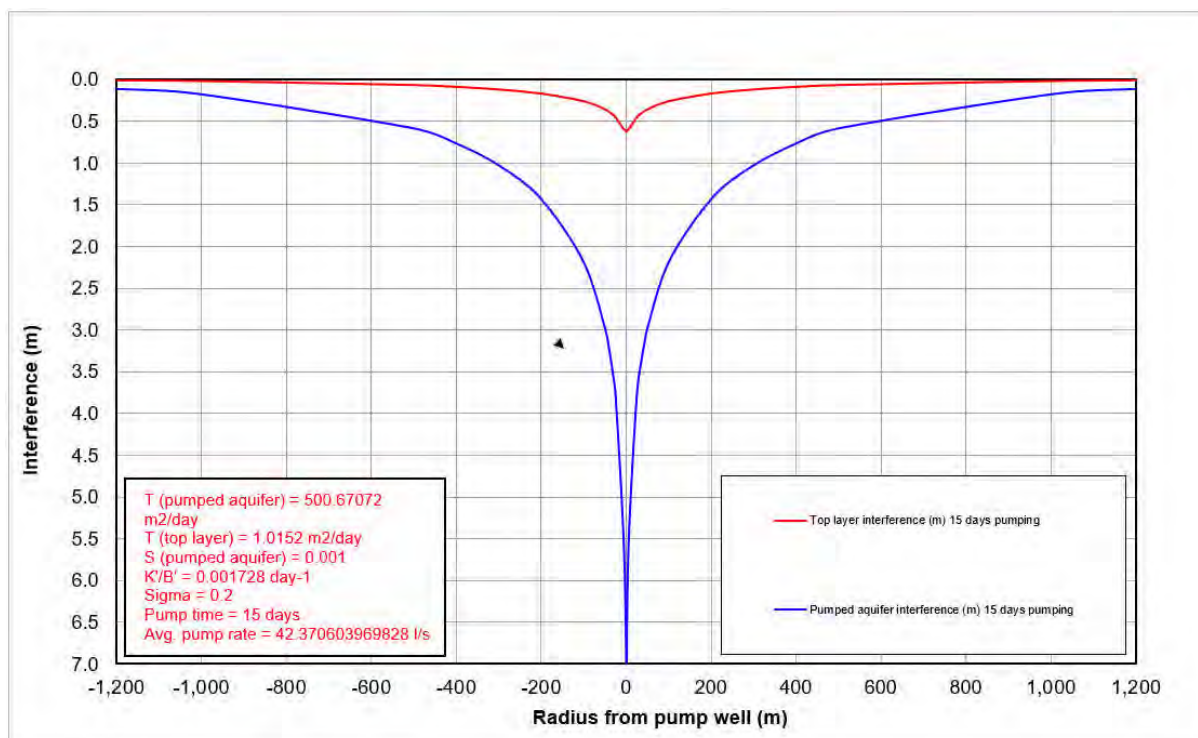


Figure 14: Projected Drawdown in confined and unconfined Aquifers Following Dewatering of Wet Well Excavation WWPS B

5.2.3 Shallow Aquifer Dewatering During Wet Well Excavation

If construction of the wet well is undertaken using a technique that requires dewatering of the unconfined aquifer until the excavation reaches the confining layer, temporary dewatering of the aquifer may be required to support the excavation process. This dewatering would result in a direct drawdown of the groundwater table. For completeness, an assessment has been undertaken to estimate how much water would flow into this excavation and therefore, require pumping. The extent of the consequent drawdown in the unconfined aquifer has been estimated from these assessments. The modelling has a conservative assumption that the dewatering method leads to floor heave within the excavation and consequent unhindered flows upward from the underlying confined aquifer.

The shallower excavation dewatering has been assessed using the published method of estimating groundwater inflows to open-cut pits (Marinelli & Niccoli 2000), as was applied to the assessment of the Artificial Wetland dewatering in Section 4. The pit model accounts for two zones of inflow, the upper zone being Zone 1 and the lower being Zone 2, with a no flow boundary between them at a level equivalent to the position of the confining layer. The hydraulic conductivity for the Upper Hinuera Formation has been applied to Zone 1 and Lower Hinuera Formation to Zone 2 (as described with modelling parameters in Table 3). The input parameters for the pit models are shown in Figure 15 and Figure 16. The highest recorded localised groundwater level was used for the assessment.

The pit dewatering model applied in this assessment functions on a steady-state basis, which means the equations used apply for permanent dewatering. As the wet well construction process is expected to require only a few days, the extent of the zone of influence calculated using this methodology is conservatively large.

The pit model assumes Zone 2 is infinite in depth. However, according to lithological logs from local bores, this aquifer is between 5.5 m and 14.5 m thick (for WWPS A and WWPS B, respectively). Therefore, inflows from Zone 2 may be overestimated in the modelling.

The results of the pit dewatering modelling are summarised in Table 10.

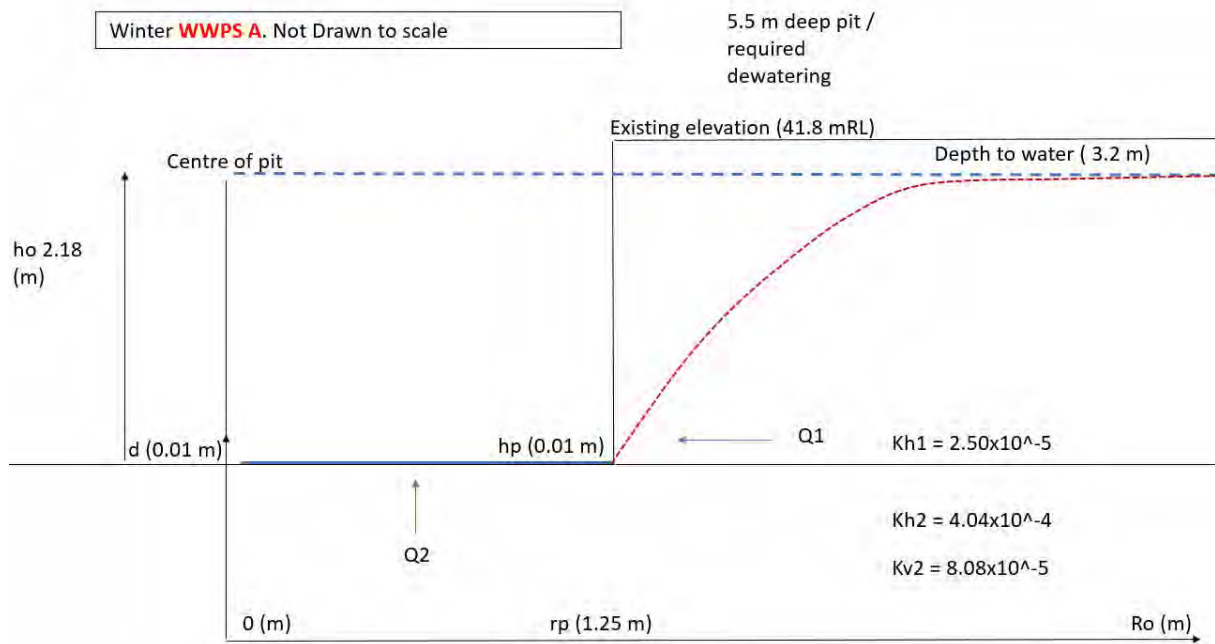


Figure 15: Inputs for Pit Model Assessing Potential Dewatering of Unconfined Aquifer of Planned WWPS A Installation

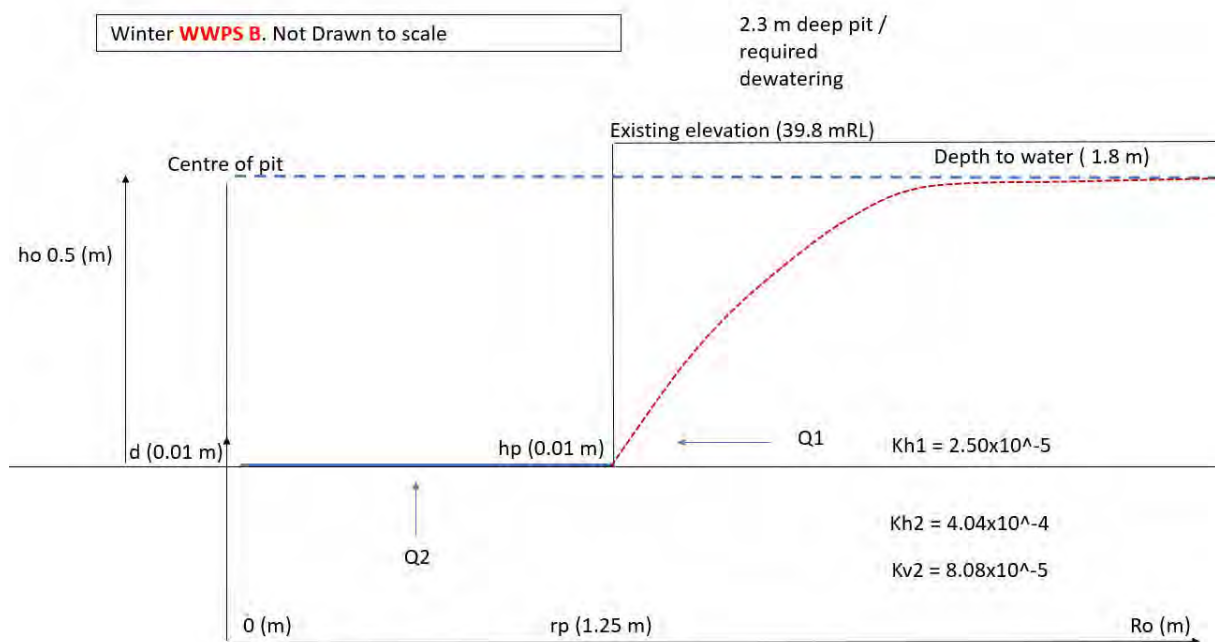


Figure 16: Inputs for Pit Model Assessing Potential Dewatering of Unconfined Aquifer of Planned WWPS B Installation

Table 10: Projected Effects of Wet Well Excavation Through Upper Aquifer Only

SITE	DEPTH TO GROUNDWATER (m)	INITIAL SATURATED THICKNESS ABOVE BASIN BASE (m)	RADIUS OF INFLUENCE (m) ⁽¹⁾	CALCULATED GROUNDWATER INFLOW (m ³ /day)	DISTANCE TO NEAREST BUILDING (m)	DRAWDOWN AT NEAREST BUILDING (m)
WWPS A	3.2	2.18	20	179	8	0.59
WWPS B	1.8	0.51	2.2	40	15	0

Notes:

⁽¹⁾ Radius of influence is considered to be defined by 0.25 m drawdown.

5.3 Drawdown Effects of Wastewater Pipeline Trenching

5.3.1 Wastewater Pipeline Modelling Methodology

The construction of the planned wastewater pipeline network requires the excavation of trenches below the water table, with the requirement that these trenches are maintained in a dry state until backfilling starts. WGA have assumed the wastewater pipeline will be constructed in 20 m sections, and that each section will be completed within a period of 10 days. This has been used as the basis of the groundwater drawdown and inflow modelling. The trench excavation depths have been provided by Maven to WGA (version 16 March 2026).

An analytical modelling approach for the wastewater pipeline was used to calculate temporary groundwater drawdown curves and expected inflows to the trenches. The analytical model used equations from McWhorter and Sunada (1977), which estimate transient drawdown and groundwater inflows into trenches.

WGA understands that the wastewater pipelines will be constructed at varying depths throughout the Residential Development. As hydraulic conductivity varies with depth at the Residential Development site, WGA has completed two worst case scenarios for consideration of drawdown effects, in order to provide a conservative assessment:

1. A section of 20 m pipeline trench on the northern residential boundary of the site, requiring temporary dewatering in the upper Hinuera formation, above the low permeability aquitard layer.
2. A section of 20 m pipeline in one of the deepest pipeline trenches located centrally in the site, requiring temporary dewatering in the lower Hinuera formation, below the low permeability aquitard layer.

The differing hydraulic conductivities for the upper and lower Hinuera Formations (Section 3.4) are applied to reflect the different dewatering aquifer depths of the wastewater pipeline trench (Table 11).

For these models, WGA has assumed that the trenching for the wastewater pipeline will occur during the summer earthworks season. WGA understands that settlement effects occur when groundwater draws down below normal seasonal fluctuation ranges. Therefore, summer drawdown is considered the most relevant for the geotechnical assessment. Tabulated drawdown scenarios and dewatering rates for winter have been provided for comparison.

Table 11: Input Parameters for Wastewater Pipeline Analytical Modelling

WASTEWATER PIPELINE	HYDRAULIC CONDUCTIVITY (m/s)	AQUIFER SPECIFIC YIELD	NUMBER OF DAYS TRENCH OPEN	RECHARGE (mm/year)	TRENCH DRAWDOWN REQUIRED (m)
Wastewater Pipelines on the Edges of the Residential Development Summer	2.5×10^{-5}	0.25	10	250	1.44
Wastewater Pipelines at the Centre of the Residential Development Summer	4.04×10^{-4}	0.25	10	250	1.27
Wastewater Pipelines on the Edges of the Residential Development Winter	2.5×10^{-5}	0.25	10	250	1.97
Wastewater Pipelines at the Centre of the Residential Development Winter	4.04×10^{-4}	0.25	10	250	2.38

5.3.2 Wastewater Pipeline Analytical Modelling Results

Projected drawdown from the wastewater pipeline trenches is summarised in Table 12, Figure 18 and Figure 19. Projected groundwater inflows are shown in Figure 20 and Figure 21.

Table 12: Projected Distance of Influence

WASTEWATER PIPELINE	DISTANCE OF INFLUENCE (m)
Wastewater Pipelines on the Edges of the Residential Development Summer	73
Wastewater Pipelines at the Centre of the Residential Development Summer	250
Wastewater Pipelines on the Edges of the Residential Development Winter	83
Wastewater Pipelines at the Centre of the Residential Development Winter	330

Note: Distance of influence considered to be defined at 0.25 m drawdown.



LEGEND

- WWPS
- Proposed Wastewater Infrastructure
- Residential Development
- Southern Links Boundary
- 20m Trench Sections
- Summer Drawdown Contours

Scale 1:5,000 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure 17

Southern Links Stage 1

Summer Drawdown

Contours for Wastewater

Pipeline 20m Trenches

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2028

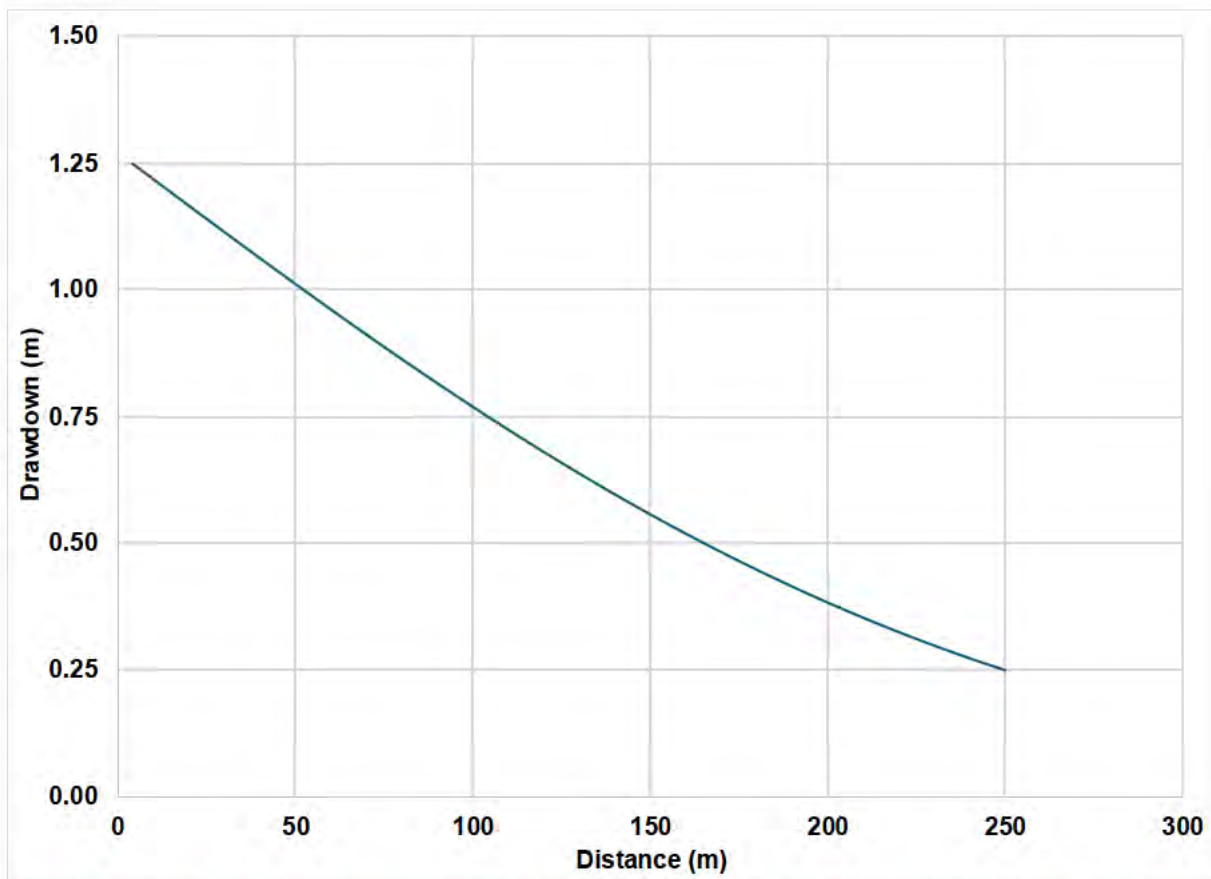


Figure 18: Projected Drawdown from Wastewater Pipelines at the Centre of the Residential Development During Summer

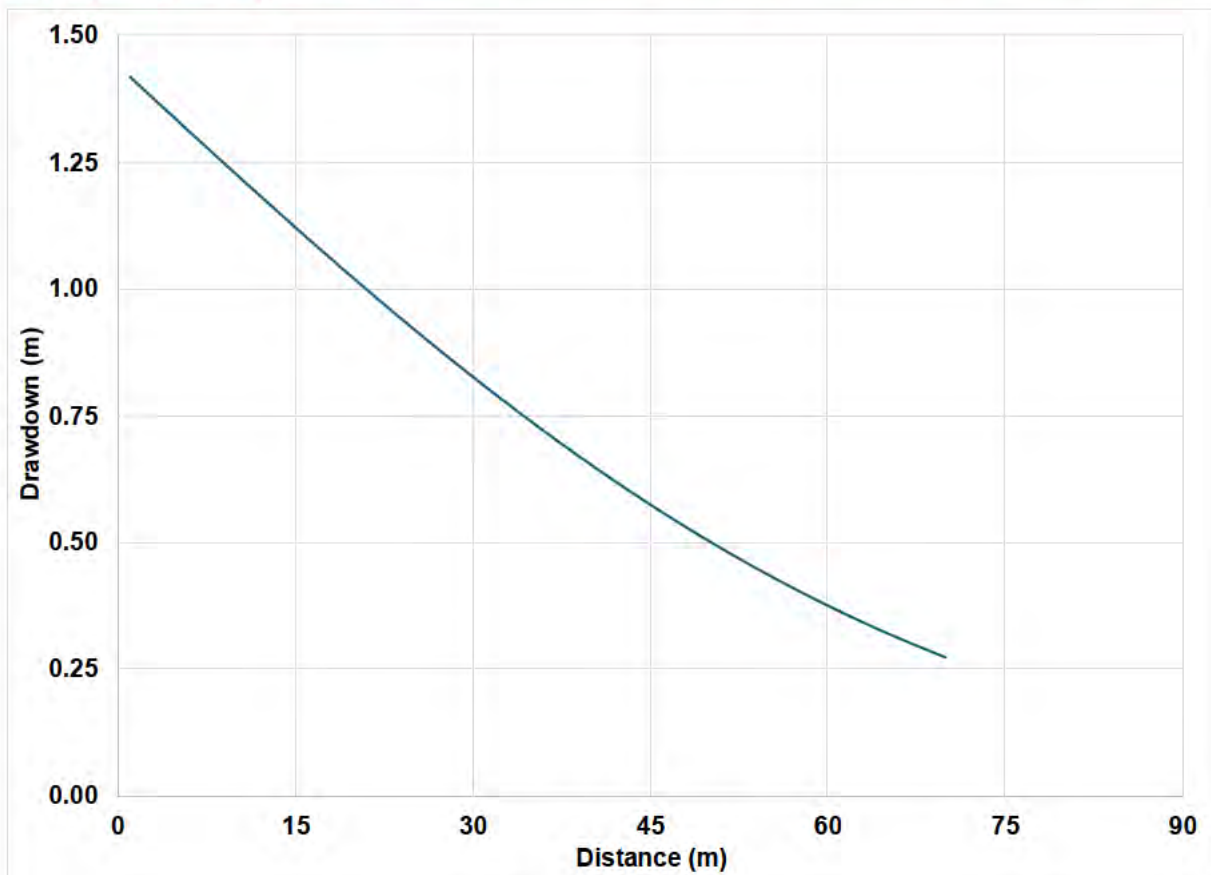


Figure 19: Projected Drawdown from Wastewater Pipelines at the Edges of the Residential Development During Summer

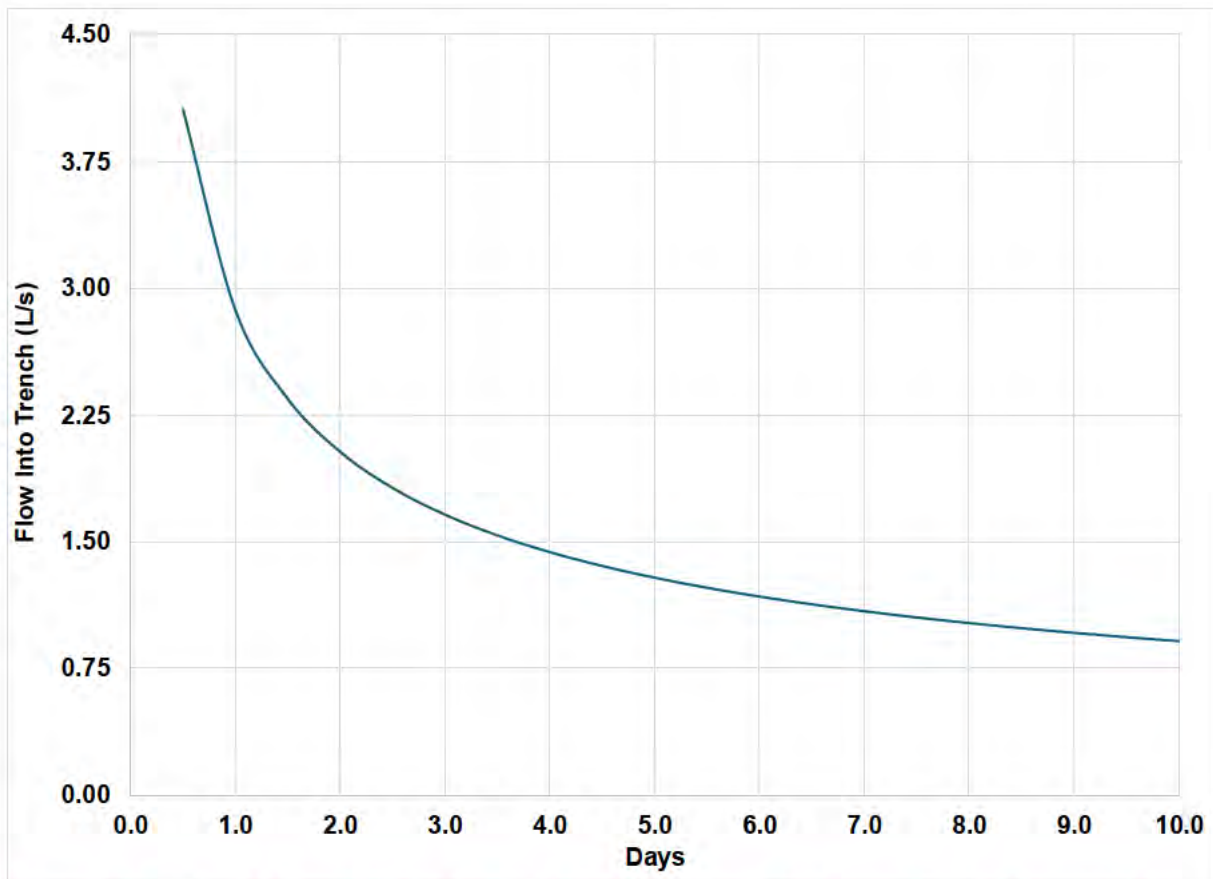


Figure 20: Projected Groundwater Inflows Over Time into a 20 m Trench at the Centre of the Residential Development During Summer

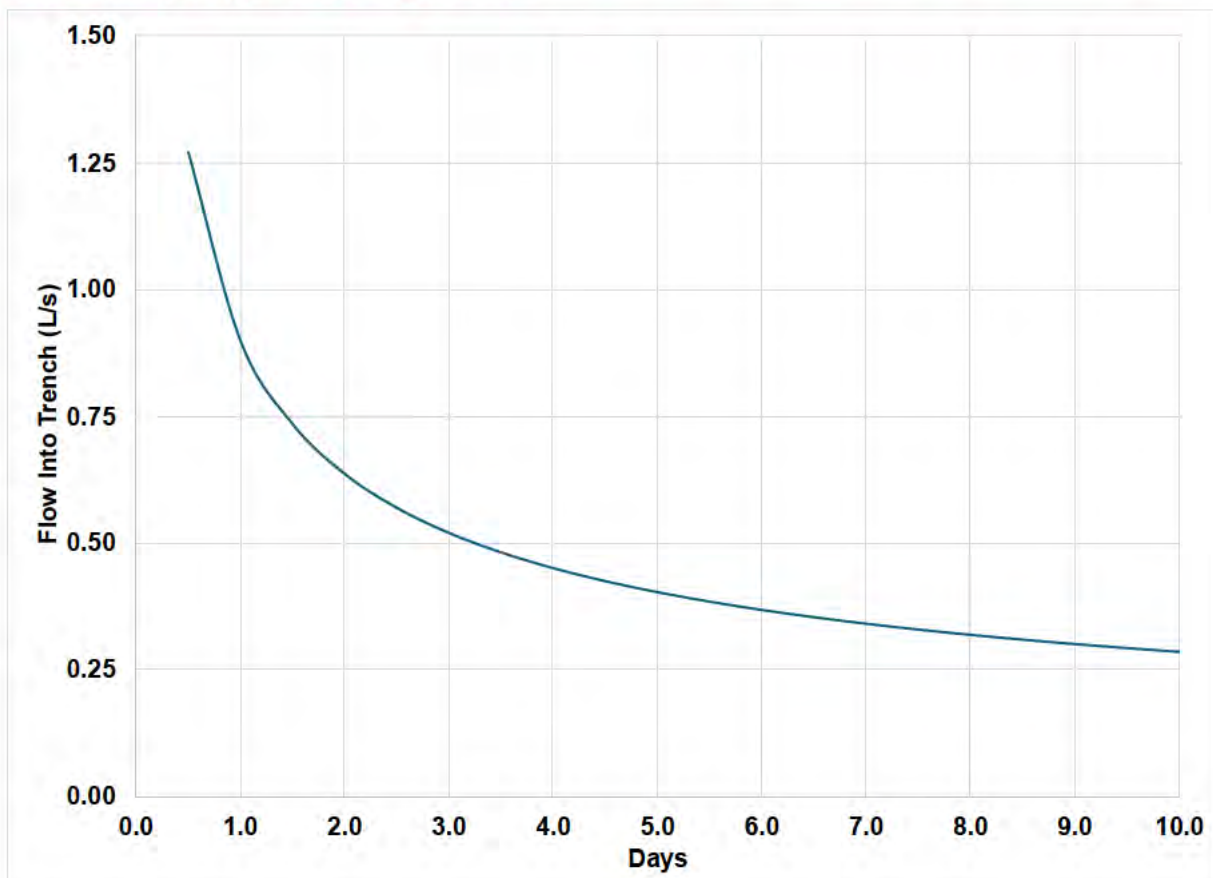


Figure 21: Projected Groundwater Inflows over Time into a 20 m Trench at the Edges of the Residential Development During Summer

6 GROUNDWATER EFFECTS ASSESSMENT

6.1 Effects Overview on Catchment Water Balance

The proposed development is located within the upper Mangakōtukutuku catchment, where the catchment's hydrology is characterised by strong interaction between groundwater and surface water features. The groundwater contributes flows to drains; natural wetlands, and headwater stream reaches (as described in Section 3.5). This connectivity influences local groundwater flow paths and supports the persistence of flow through the catchment.

The proposed Residential Development has two main groundwater-related components that have the potential to influence the catchment water balance (Figure 22):

1. Short-term temporary dewatering during construction of the Artificial Wetlands and wastewater infrastructure.
2. Long-term groundwater interception and diversion to the proposed Artificial Wetlands, which will act as persistent hydraulic features within the developed catchment.

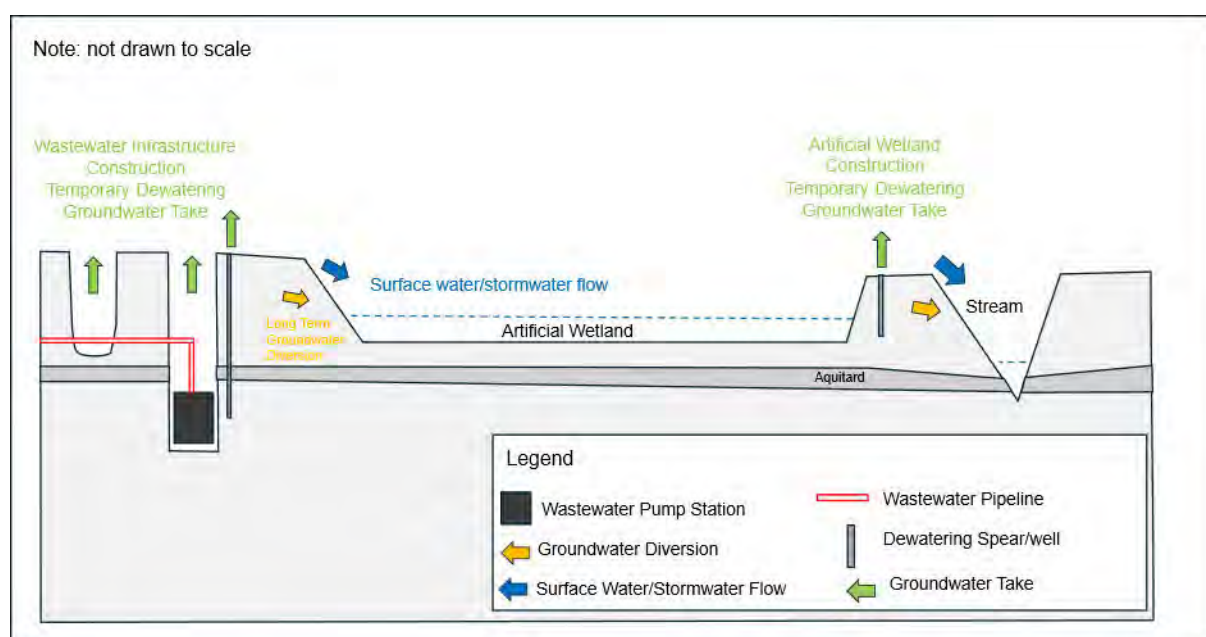


Figure 22: Conceptual Schematic of Water Flow Required and Induced by the Proposed Activity

The development represents a land use change from existing dairy farmland to residential. This land use change is expected to alter the way rainfall is divided between infiltration (recharge), evapotranspiration, and runoff. A typical residential development ratio for impervious/pervious land is approximately 70 % impervious and 30 % pervious. A similar ratio is anticipated across the Residential Development (Maven 2026). Rainfall recharge is expected to reduce beneath impervious surfaces relative to the existing rural state, with a corresponding increase in runoff captured by the proposed stormwater management system (Figure 22).

In the long term, the Residential Development site water balance is expected to shift from predominantly distributed recharge and surface runoff toward a more managed regime, where a larger proportion of the rainfall is routed to engineered Artificial Wetlands, stored within, and subsequently discharged to existing drains and the Mangakōtukutuku Stream. Because the catchment currently exhibits close groundwater–surface water connectivity, maintaining hydraulic continuity to headwater drains and wetlands is an important consideration in the design and staging of temporary dewatering activities.

6.2 Dewatering Effects Assessment

Artificial Wetland construction is planned to be staged. The combined rate of groundwater abstraction during the construction phase is expected to vary as each wetland is excavated and brought online (Table 13). Based on current design and staging, the largest construction groundwater abstraction is expected to occur for Wetland A (5,361 m³/day during construction). Pumped groundwater (where required during construction) and diverted inflows will be managed under a Water Management Plan (WMP) and an Erosion and Sediment Control Plan (ESCP) for the Residential Development.

Table 13: Summary of Construction Dewatering Flow Rates and Operational Cumulative Groundwater Diversions

EXCAVATION TYPE	TOTAL INFLOW (WINTER) CONSTRUCTION (m ³ /day)	TOTAL INFLOW (WINTER) OPERATIONAL GROUNDWATER DIVERSION (m ³ /day)	CUMULATIVE OPERATIONAL GROUNDWATER DIVERSION (m ³ /day)
See Section 4			
Artificial Wetland A	5,361	3,703	15,132
Artificial Wetland B	4,000	2,876	
Artificial Wetland C	3,648	3,504	
Artificial Wetland D	3,284	2,100	
Artificial Wetland E	3,018	2,080	
Artificial Wetland F	1,702	869	
See Section 5.2			
WWPS A	907 (Deep Aquifer) + 179 (Shallow Aquifer)	N/A	
WWPS B	3,661 (Deep Aquifer) + 40 (Shallow Aquifer)		
See Section 5.3			
Shallow 20 m Trench for Wastewater Pipeline	< 153	N/A	
Deep 20 m Trench for Wastewater Pipeline	< 690		

Notes: Table 11 combines results from different groundwater assessment methods, including steady state and transient dewatering analyses. These values are not directly comparable and should be interpreted with reference to the relevant methodology in Sections 4 and 5. Those listed with "<" are the starting rates for dewatering analyses.

Wastewater infrastructure is anticipated to be constructed progressively, based on the installation of consecutive 20 m lengths of pipeline in similar dewatered trench sections. The WWPSs will be constructed separately, with construction schedules that will probably overlap the construction schedule for the pipelines. Based on the current design, the largest individual groundwater abstraction to enable for wastewater infrastructure construction is expected to occur for WWPS B (3,661 m³/day).

Similarly, the largest abstraction for pipeline summer installation is expected to occur for the deepest section of pipe, at **690 m³/day**. While overlapping works may increase the overall rate of groundwater abstraction on any one day during construction, they do not alter the groundwater drawdown required for individual trench sections or the nature of the associated effects. Accordingly, the pipeline trenching assessments presented in Section 4.3 remain representative of the anticipated groundwater effects associated with construction of the wastewater network. During dewatering initial flow rates may need to be higher than the modelled flow rates to initiate local drawdown. Therefore, to accommodate initial higher flow rates and multiple pipelines being installed simultaneously a daily maximum abstraction rate of **1,500 m³/day** is proposed.

6.2.1 Effects on Nearby Bores

Of the surrounding groundwater users, there are four current groundwater-related consents within one kilometre of the Residential Development site (Table 5, Figure 12), however, only two authorise groundwater abstraction for consumptive use. The furthest radial extent of dewatering impacts from proposed site activities assessed in this report is the 854 m extent of drawdown from WWPS B in Winter conditions. Neither of the two groundwater takes exists within this radius from WWPS B.

Of the existing groundwater bores within one kilometre of the Residential Development site, one bore may be impacted by drawdown during construction of WWPS B, during winter conditions of high groundwater levels (Section 5.2.2.1). Bore 70_501 is located 770 m from WWPS B (Figure 12). At this distance, it may experience up to 0.30 m of drawdown after 15 days of dewatering. As this drawdown effect would only apply during otherwise high groundwater conditions, the impact on water availability at Bore 70_501 is expected to be less than minor and within the range of annual groundwater level fluctuations.

There are no other drawdown effects, assessed in this report, that extend to nearby bores.

6.2.2 Effects on Nearby Surface Water Features

For Artificial Wetlands D and E, where construction dewatering is expected to intercept groundwater that would otherwise contribute to flows in the adjacent drains and headwaters of the Mangakōtukutuku Stream, groundwater intercepted during construction will be discharged to the receiving drain upstream of the works, as proposed through the Residential Development consent conditions. This measure will maintain continuity of surface water flows and mitigate temporary stream depletion effects during construction. For the remaining Artificial Wetlands, intercepted groundwater may be discharged in accordance with the construction management framework, as stream depletion effects are not predicted to occur. With these measures in place, no sustained reduction in surface water flows or material changes to downstream hydrology are anticipated, and effects on stream flows are assessed to be minor and temporary.

6.2.3 Effects on Natural Wetlands

Two natural inland wetlands have been identified within the site (EcoLogical Solutions Ltd, 2025). These include a small pasture wetland and a floodplain wetland associated with the Mangakōtukutuku Stream. The pasture wetland will be unavoidably removed as part of the proposed development. The ecological effects of this wetland removal, and effects management measures proposed in relation to this wetland loss, are addressed in separate ecological assessment for the Residential Development. However, given the loss of this wetland and the assessment of effects being undertaken on the basis of complete loss, any effects of groundwater drawdown on this feature are not relevant to the construction or operational assessment.

The floodplain wetland is hydraulically connected to the Mangakōtukutuku Stream and is primarily supported by surface water runoff rather than local groundwater discharges. During construction at the Residential Development site, stream flows will be maintained (as outlined in Section 4.3.2). No sustained reduction in stream level is anticipated as a result of groundwater drawdown. Where dewatering discharge may be directed to or near the floodplain wetland, the discharge location and method will be managed through the construction management framework, including the Erosion and Sediment Control Plan (ESCP). Any sediment treatment or removal measures required to manage discharge water quality will be implemented in accordance with the ESCP prior to discharge to the wetland.

Groundwater drawdown arising from construction operations is therefore not expected to alter the hydrological regime, extent, or ecological function of the floodplain wetland. Overall effects on natural wetlands are assessed to be minor and temporary.

6.2.4 Effects on Ground Subsidence

The groundwater drawdown predictions presented in Sections 4 and 5 have been provided to CMW for assessment of potential settlement and other geotechnical effects associated with the proposed construction and operational dewatering activities. Assessment of ground settlement, including any implications for existing and proposed buildings and infrastructure, falls outside the scope of this hydrogeological assessment and is addressed in the accompanying Geotechnical Assessment (CMW, 2026c).

6.3 Anticipated Implications for Water Quality

The land use change from dairy farming to residential land use, together with the introduction of Artificial Wetlands, is expected to result in reduced nutrient inputs to shallow groundwater and the Mangakōtukutuku Stream over time (relative to the existing rural baseline). While construction activities can temporarily elevate sediment related risks, for the Residential Development this risk will be addressed through the proposed Erosion and Sediment Control Plan (ESCP).

As presented in Section 3.5.3, there is existing discolouration of drain water due to oxidation of dissolved iron carried in groundwater discharges. This discolouration is expected to continue in the existing streams during low flow conditions.

7 MONITORING AND MITIGATION

7.1 Groundwater Monitoring

Groundwater levels across the Residential Area have been characterised using a network of five piezometers installed and monitored between July 2025 and January 2026. This monitoring period captured both winter and summer groundwater conditions and confirmed the presence of a shallow aquifer overlying a confined deeper aquifer, separated by a thin, laterally persistent, low-permeability aquitard. The monitoring data were sufficient to define seasonal groundwater level variability, hydraulic connectivity with local drains, and baseline groundwater conditions for the purposes of the effects assessment.

The investigations and modelling completed for this assessment indicate that the predicted groundwater drawdown effects associated with construction dewatering and long-term operation of the proposed artificial wetlands are localised, temporary (during construction), and have been conservatively assessed using site-specific hydraulic parameters. Groundwater drawdown effects do not impact the availability of water at nearby groundwater abstraction bores. The long-term groundwater diversion to the artificial wetlands represents a redistribution of groundwater discharge within the Residential Development site catchment rather than a net loss.

Based on the investigations, monitoring and assessments completed for this report, no additional permanent groundwater monitoring sites are considered necessary to manage or verify effects, assessed in this report, from the proposed development.

WGA understands that targeted short-term groundwater level monitoring will be required to support the identification and mitigation of potential ground settlement effects during construction to confirm groundwater behaviour remains consistent with predictions (CMW 2026b).

The existing piezometer network may provide a useful opportunity for collection of long-term groundwater level information should the consent holder wish to retain the installations following completion of construction. However, such monitoring is not considered necessary to manage, mitigate or verify the groundwater effects assessed in this report.

Should the existing site piezometers be destroyed during construction, replacement piezometers may be required for the above reasons.

7.2 Surface Water Monitoring

The investigations completed for this assessment indicate that the surface water features within and downstream of the Residential Area comprise farm drains and the headwaters of the Mangakōtukutuku Stream. At least some of these features are hydraulically connected to the confined groundwater system identified within the Residential Area. Potential effects on surface waters are limited to localised interception of groundwater contributions during construction dewatering for artificial wetlands and wastewater infrastructure. With the proposed management measures (Section 6.2.2 and Section 6.2.3), these effects have been assessed as minor and temporary (i.e. they will be appropriately managed through the proposed construction methodology and the placement of temporary water discharge points).

In the above context, including the short duration of dewatering activities, the absence of predicted long-term surface water effects, and the implementation of erosion and sediment control measures under the Residential Development's construction management framework (namely, the ESCP), additional surface water flow or level monitoring is not considered necessary for the operational phase of the development. Visual inspections of drains and stream reaches during construction, undertaken as part of standard environmental compliance checks and incorporated into proposed consent conditions, are considered sufficient to confirm expected performance.

8 CONCLUSIONS

This assessment has considered the potential groundwater effects associated with the construction and operation of the Southern Links 1 Residential Development, including construction dewatering for artificial wetlands and wastewater infrastructure, and the long-term groundwater diversion associated with the proposed artificial wetlands. The investigations, monitoring and analytical assessments undertaken indicate that the predicted groundwater effects are localised and can be appropriately managed through the proposed development design and associated management measures. Accordingly, groundwater effects associated with the proposed Residential Development are assessed as no more than minor.

No additional permanent groundwater or surface water monitoring is considered necessary for hydrogeological assessment, with standard construction-phase environmental controls, as proposed, providing sufficient verification of predicted effects. Visual inspections of drains and stream reaches during construction, undertaken as part of standard environmental compliance checks and incorporated into proposed consent conditions, are considered sufficient to confirm expected performance.

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APPENDIX A LITHOLOGICAL INVESTIGATIONS AND GROUNDWATER LEVELS



BOREHOLE LOG - BH25-P1

Client: Colliers Project Leaders Ltd
 Project: Southern Links Stage 1 Residential Area
 Site Location: Deanwell, Hamilton
 Project No.: HAM2025-0056
 Date: 09/07/2025
 Borehole Location: Refer to Site Plan



Logged by: DB Checked by: WD Scale: 1:50 Sheet 1 of 1

Position: 445348.9mE; 694955.0mN Projection: Mt Eden 2000
 Datum: NZVD 2016

Survey Source: Handheld GPS

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Recovery	Drilling Method/Support	Dynamic Cone Penetrometer (Blows/100mm)			Structure & Other Observations Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
		Depth	Type & Results									5	10	15	
					0		OL: Organic SILT: dark brown. Low plasticity. (Topsoil)								
					0.5		SP: Fine SAND: with some silt. Light brown. Poorly graded. (Hinuera Formation)								
					1		SW: Fine to coarse SAND: with trace silt. Light brown. Well graded. (Hinuera Formation)			77					
					1.5		SW: Fine to coarse SAND: with trace fine gravel. Grey. Well graded. Gravel; subrounded, pumiceous. (Hinuera Formation)	M							
					2			TP		75					
					3		... from 2.90m to 3.36m, sand becoming coarse with some fine gravel.				DPP				
					3.5		... from 3.36m to 3.70m, becoming light orange brown.								
					4		OL: Organic SILT: black. Low plasticity. (Hinuera Formation)			97					
					4.5		ML: SILT: with some fine sand. Grey. Low plasticity. (Hinuera Formation)	S							
					5		SW: Fine to coarse SAND: with trace fine gravel. Grey. Well graded. Gravel; subrounded, pumiceous. (Hinuera Formation)								
					6		Borehole terminated at 6.0 m								
					7										
					8										
					9										
					10										

Termination Reason: Target Depth Reached.

Shear Vane No: DCP No:

Remarks: Groundwater encountered at 2.42m. Piezometer screened from 4.5 to 6.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - BH25-P2

Client: Colliers Project Leaders Ltd
Project: Southern Links Stage 1 Residential Area
Site Location: Deanwell, Hamilton
Project No.: HAM2025-0056
Date: 08/07/2025
Borehole Location: Refer to Site Plan



Logged by: DB Checked by: WD Scale: 1:60 Sheet 1 of 1

Position: 445423.8mE, 694892.5mN

Projection: Mt Eden 2000
Datum: NZVD 2016

Survey Source: Handheld GPS

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Weathering						Recovery	RQD	Estimated Strength						Defect Spacing (mm)	Drilling Method/Support	Structure & Other Observations Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks				
		Depth	Type & Results							RS	CW	HW	MW	SW	UW			EW	VW	WS	MS	VS	ES				<20	20-60	60-200	200-600
							OL: Organic SILT: dark brown. Low plasticity. (Topsoil) GW: Silty Sandy fine GRAVEL: dark orange. Well graded. Gravel; angular. Iron pan. (Hinuera Formation) SW: Fine to coarse SAND: with trace silt. Light brown. Well graded. (Hinuera Formation) ... at 0.54m, silt becoming absent. ... at 1.12m, becoming grey. ... at 2.00m, containing trace fine pumiceous gravel. ... at 2.50m, becoming slightly iron stained.	M	TP							75														
					1																									
					2																									
					3																									
					4																									
					5			OL: Organic SILT: black. Low plasticity. (Hinuera Formation) SW: Fine to coarse SAND: with trace fine gravel. Well graded. Gravel; subrounded. (Hinuera Formation) ... from 6.00m to 6.70m, sand becoming medium to coarse.	M	F to St								85												
					6																									
					7																									
					8			... from 8.00m to 8.70m, sand becoming fine to medium.	S	TP																				
					9																									
					10			SW: Fine Gravelly fine to coarse SAND: grey. Well graded. Gravel; subrounded, some pumiceous gravel. (Hinuera Formation)																						
					11			Borehole terminated at 10.50 m																						
					12																									

Termination Reason: Target Depth Reached.

Shear Vane No: DCP No:
Remarks: Groundwater measured at 3.7m. Deep piezometer screened from 8.5 to 10m, shallow piezometer screened from 3.5 to 5.0m.

BOREHOLE LOG - BH25-P3

Client: Colliers Project Leaders Ltd
 Project: Southern Links Stage 1 Residential Area
 Site Location: Deanwell, Hamilton
 Project No.: HAM2025-0056
 Date: 08/07/2025
 Borehole Location: Refer to Site Plan



Logged by: DB Checked by: WD Scale: 1:50 Sheet 1 of 1

Position: 445342.6mE; 694873.7mN

Projection: Mt Eden 2000

Datum: NZVD 2016

Survey Source: Handheld GPS

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Recovery	Drilling Method/Support	Dynamic Cone Penetrometer (Blows/100mm)			Structure & Other Observations Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
		Depth	Type & Results									5	10	15	
					1		OL: Organic SILT: dark brown. Low plasticity. (Topsoil)	M		80					
							SW: Fine to coarse SAND: with trace silt. Brown. Well graded. (Hinuera Formation)								
							... at 0.65m, becoming light grey, containing trace fine gravel.								
					2			TP		79					
					3		... at 3.00m, becoming grey.	DPP							
							ML: SILT: with some clay. Dark grey. Low plasticity. (Hinuera Formation)								
							... from 3.65m to 3.75m, lens of organic silt, black, low plasticity.								
					4		SW: Fine to coarse SAND: with trace fine gravel. Grey. Well graded. Pumiceous. (Hinuera Formation)	S		100					
					5		... from 4.96m to 5.15m, lens of fine pumiceous gravel.	TP		100					
							SW: Gravelly fine to coarse SAND: grey. Well graded. Gravel; fine to medium, subrounded. (Hinuera Formation)								
					6		Borehole terminated at 6.0 m								
					7										
					8										
					9										
					10										

Termination Reason: Target Depth Reached.

Shear Vane No: DCP No:

Remarks: Groundwater encountered at 2.12m. Piezometer screened from 4.5 to 6.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - BH25-P4

Client: Colliers Project Leaders Ltd
 Project: Southern Links Stage 1 Residential Area
 Site Location: Deanwell, Hamilton
 Project No.: HAM2025-0056
 Date: 08/07/2025
 Borehole Location: Refer to Site Plan



Logged by: DB Checked by: WD Scale: 1:50 Sheet 1 of 1

Position: 445349.9mE; 694563.3mN

Projection: Mt Eden 2000

Datum: NZVD 2016

Survey Source: Handheld GPS

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/Relative Density	Recovery	Drilling Method/Support	Dynamic Cone Penetrometer (Blows/100mm)			Structure & Other Observations Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
		Depth	Type & Results									5	10	15	
08-07-2025					1		OL: Organic SILT: dark brown. Low plasticity. (Topsoil) ML: Fine Sandy SILT: grey streaked orange brown. Low plasticity. (Hinuera Formation)	M	F to St	47					
					2		SP: Silty Fine SAND: grey streaked orange brown. Poorly graded. (Hinuera Formation) ... at 1.77m, containing lens of clayey silt. SW: Gravelly fine to coarse SAND: grey. Well graded. Gravel; fine, subrounded, pumiceous. (Hinuera Formation) SP: Fine SAND: with some silt. Grey. Poorly graded. (Hinuera Formation) ML: SILT: with some clay. Grey. Low plasticity. (Hinuera Formation) OL: Organic SILT: black. Low plasticity. (Hinuera Formation) ML: Clayey SILT: grey. Low plasticity. (Hinuera Formation) SW: Fine to coarse SAND: with trace silt. Grey. Well graded. (Hinuera Formation)		TP	83					
					3						DPP				
					4			S		97					
					5		... at 4.60m, containing minor fine gravel, pumiceous.		TP	73					
					6		Borehole terminated at 6.0 m								
					7										
					8										
					9										
					10										

Termination Reason: Target Depth Reached.

Shear Vane No: DCP No:

Remarks: Groundwater encountered at 1.57m. Piezometer screened from 4.5 to 6.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

PHOTOGRAPH SHEET - BH25-P1

Client: Colliers Project Leaders Ltd
Project: Southern Links Stage 1 Residential Area
Location: Deanwell, Hamilton
Project ID: HAM2025-0056
Date: 9/07/2025



This borehole report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination.

PHOTOGRAPH SHEET - BH25-P2

Client: Colliers Project Leaders Ltd
Project: Southern Links Stage 1 Residential Area
Location: Deanwell, Hamilton
Project ID: HAM2025-0056
Date: 8/07/2025



PHOTOGRAPH SHEET - BH25-P3

Client: Colliers Project Leaders Ltd
Project: Southern Links Stage 1 Residential Area
Location: Deanwell, Hamilton
Project ID: HAM2025-0056
Date: 8/07/2025



This borehole report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination.

PHOTOGRAPH SHEET - BH25-P4

Client: Colliers Project Leaders Ltd
Project: Southern Links Stage 1 Residential Area
Location: Deanwell, Hamilton
Project ID: HAM2025-0056
Date: 8/07/2025



This borehole report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination.

Table A1: Groundwater Levels Recorded in April 2025 by CMW

SITE NUMBER	GROUNDWATER LEVEL (m bgl)	GROUNDWATER LEVEL (m RL)
TP25-01	3.5	36.5
TP25-02	2.8	37.8
TP25-03	2.8	36.8
TP25-04	5	36.6
TP25-05	5.5	36.5
TP25-05 B	2.8	38.8
TP25-06	2.5	37.5
TP25-07	1.7	38.3
TP25-08	3.9	36.8
TP25-09	4.5	38
TP25-10	3.1	39.2
TP25-10	2	38.5
TP25-10	3.2	36.8
TP25-10	3.7	38.8
TP25-10	2	38.4
TP25-10	3.5	37.2
CPT25-01	3.5	36.5
CPT25-02	2.8	37.2
CPT25-03	2.8	39
CPT25-04	2.5	37.5
CPT25-05	5	35.9
CPT25-06	2.8	39.2
CPT25-07	4.5	37.8
CPT25-08	2	38
CPT25-09	3.2	36.8
CPT25-10	3.7	38.8
CPT25-11	3.5	39

Note: Source CMW (2026)

Table A2: Nearby Bores within 1 km of Proposed Residential Development Activities from the WRC Database (March 2026)

BORE ID	TYPE	STATUS	EASTING	NORTHING	EXTERNAL CASING DIAMETER (mm)	DRILLED DEPTH (m)
69_1208	Well/Bore	Existing	1800661	5811970	100	10.3
70_388	Well/Bore	Existing	1799262	5811368	100	26.8
70_363	Well/Bore	Existing	1801264	5810271	100	8.2
70_512	Well/Bore	Existing	1801664	5810371	100	34
70_501	Well/Bore	Existing	1799862	5810869	100	24
70_506	Well/Bore	Existing	1799262	5811268	100	28
70_476	Well/Bore	Existing	1801364	5809871	75	9.09
72_192	Well/Bore	Existing	1801664	5810371	200	76.7
72_1264	Well/Bore	Existing	1799363	5810768		61.5
72_1628	Well/Bore	Existing	1799962	5811269	100	23
72_3943	Well/Bore	Existing	1799461	5810252	104	42
72_3754	Well/Bore	Existing	1801210	5811472	75	2.5
72_3755	Well/Bore	Existing	1801204	5811459	50	2.5
72_3756	Well/Bore	Existing	1801213	5811454	50	2.5
72_3757	Well/Bore	Existing	1801222	5811452	50	2.5
72_3219	Well/Bore	Existing	1801266	5811455	100	3.5
72_3220	Well/Bore	Existing	1801252	5811439	100	2.9
72_3221	Well/Bore	Existing	1801235	5811452	100	2.7
72_3222	Well/Bore	Existing	1801231	5811460	100	2.7
72_3223	Well/Bore	Existing	1801257	5811469	100	4.2
72_3765	Well/Bore	Existing	1801230	5811445	50	2.5
72_3766	Well/Bore	Existing	1801271	5811507	50	5
72_3767	Well/Bore	Existing	1801251	5811473	50	2.2
72_3768	Well/Bore	Existing	1801250	5811481	50	2.1
72_3769	Well/Bore	Existing	1801243	5811477	50	2.15
72_3218	Well/Bore	Existing	1801262	5811440	100	3.5
72_3715	Well/Bore	Existing	1801255	5811489	50	4
72_3469	Well/Bore	Existing	1801219	5811483	50	2.5
72_3716	Well/Bore	Existing	1801272	5811475	50	5
72_3717	Well/Bore	Existing	1801268	5811463	50	4
72_4049	Well/Bore	Existing	1800564	5809970	100	40
70_348	Well/Bore	Existing	1801863	5810572	150	83.82
70_1042	Well/Bore	Existing	1799162	5811268		
72_5293	Well/Bore	Existing	1801014	5809500		6
72_11515	Well/Bore	Existing	1801585	5810417	100	54.7
72_11662	Piezometer	Existing	1800153	5811891	50	15
72_11665	Well/Bore	Existing	1800145	5811864	50	13.95

BORE ID	TYPE	STATUS	EASTING	NORTHING	EXTERNAL CASING DIAMETER (mm)	DRILLED DEPTH (m)
72_11989	Well/Bore	Existing	1800171	5811880		16
72_11990	Piezometer	Existing	1800155	5811876	50	4
72_11992	Piezometer	Existing	1799950	5811960	50	4
72_11661	Piezometer	Existing	1800223	5811911		10.95
72_11663	Well/Bore	Decommissioned	1799658	5812063	32	3.8
72_11664	Well/Bore	Decommissioned	1799950	5811960	32	3.9
72_11666	Well/Bore	Existing	1800155	5811876	32	4
72_11667	Well/Bore	Existing	1800128	5811858		2.7
72_11668	Well/Bore	Decommissioned	1800155	5811876	32	4
72_11669	Well/Bore		1799659	5812056		
72_11670	Well/Bore		1799949	5811951		
72_12408	Well/Bore	Existing	1800157	5811887	101	15.9
72_12409	Well/Bore	Existing	1800130	5811869	101	15.9
72_12410	Well/Bore	Existing	1800120	5811884	200	19
72_12411	Well/Bore	Existing	1800123	5811905	200	20
72_12412	Well/Bore	Existing	1800146	5811903		20.7
72_12413	Well/Bore	Existing	1800146	5811858		18.5
72_12414	Well/Bore	Existing	1800167	5811875		20.1
72_12527	Well/Bore	Existing	1800153	5811891		4
72_12835	Well/Bore	Existing	1800172	5811878	200	18
72_12836	Well/Bore	Existing	1800168	5811886		18
72_12837	Well/Bore	Existing	1800114	5811922	150	18
72_12838	Well/Bore	Existing	1800133	5811916	150	17
72_12839	Well/Bore	Existing	1800152	5811913		18
72_12840	Well/Bore	Existing	1800167	5811904		18
72_12841	Well/Bore	Existing	1800182	5811902	150	18
72_12842	Well/Bore	Existing	1800136	5811864		16
72_12843	Well/Bore	Existing	1800136	5811906		16
72_12844	Well/Bore	Existing	1800162	5811877		16
72_12845	Well/Bore	Existing	1800165	5811859	32	14.5
72_12846	Well/Bore	Existing	1800168	5811901	32	15
72_12847	Well/Bore	Existing	1800101	5811877	32	15
72_12848	Well/Bore	Existing	1800130	5811915	32	15
72_12977	Piezometer	Existing	1800593	5811145		6
72_12978	Piezometer	Existing	1800673	5811072		10.5
72_12979	Piezometer	Existing	1800670	5811073		10.5
72_12980	Piezometer	Existing	1800589	5811047		6
72_12981	Piezometer	Existing	1800595	5810750		6
72_13299	Well/Bore	Proposed				

BORE ID	TYPE	STATUS	EASTING	NORTHING	EXTERNAL CASING DIAMETER (mm)	DRILLED DEPTH (m)
72_13300	Well/Bore	Proposed				
72_13301	Well/Bore	Proposed				
72_13302	Well/Bore	Proposed				
72_13303	Well/Bore	Proposed				
72_13320	Well/Bore	Proposed				
72_13321	Well/Bore	Proposed				
72_13322	Well/Bore	Proposed				
72_13327	Well/Bore	Proposed				
72_13328	Well/Bore	Proposed				

APPENDIX B

HYDRAULIC TESTING



Introduction

The hydraulic conductivity of the geological layers found at the Residential Development site has been determined by WGA. Hydraulic conductivities were determined by the use of slug tests; the results of each test are presented in this Appendix.

Slug Testing

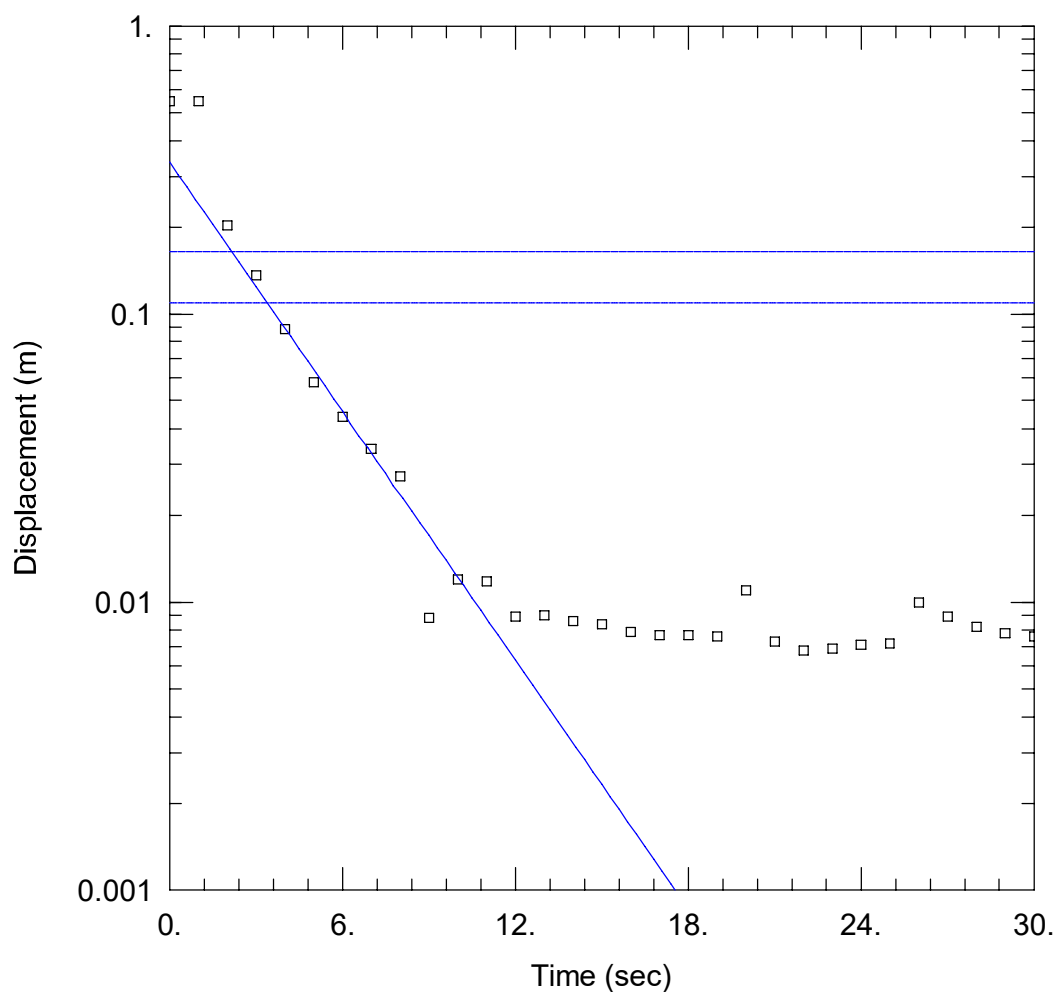
WGA conducted slug testing on the five piezometers within the site area, targeting the sands of the Hinuera Formation. Slug test results were analysed using the Bouwer and Rice (1974). Both falling head and rising head tests were analysed where data was available. AQTESOLV Pro v4.5 software package from HydroSolve Inc was used to analyse the datasets.

Slug tests across the site reacted very rapidly, typically recovering within the first two seconds of each test. Resulting hydraulic conductivities were on average 4×10^{-4} m/sec, which is considered a representative value for the site.

WGA notes that due to the rapid recovery of the slug tests, resulting hydraulic conductivities should be treated as minimum values as they may be representing the screen and filter pack rather than the target aquifer.

Table B1: Results of Slug Testing

BORE	TEST TYPE	HYDRAULIC CONDUCTIVITY (m/sec)
BH25-P1	RHT 1	1.23×10^{-4}
	FHT 3	3.35×10^{-4}
	RHT 3	8.75×10^{-5}
BH25-P2D	FHT 1	1.03×10^{-3}
	FHT 2	3.50×10^{-4}
BH25-P2S	RHT 1	1.25×10^{-4}
	FHT 2	1.83×10^{-4}
BH25-P3	RHT 2	5.53×10^{-4}
	RHT 4	4.34×10^{-4}
BH25-P4	RHT 2	4.72×10^{-4}
	RHT 3	7.51×10^{-4}



WELL TEST ANALYSIS

Data Set: V:\...\P1 - Test 1 - Rising Head.aqt

Date: 03/03/26

Time: 08:23:00

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 8.104 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P1)

Initial Displacement: 0.5478 m

Static Water Column Height: 3.77 m

Total Well Penetration Depth: 3.77 m

Screen Length: 1.5 m

Casing Radius: 0.02 m

Well Radius: 0.0375 m

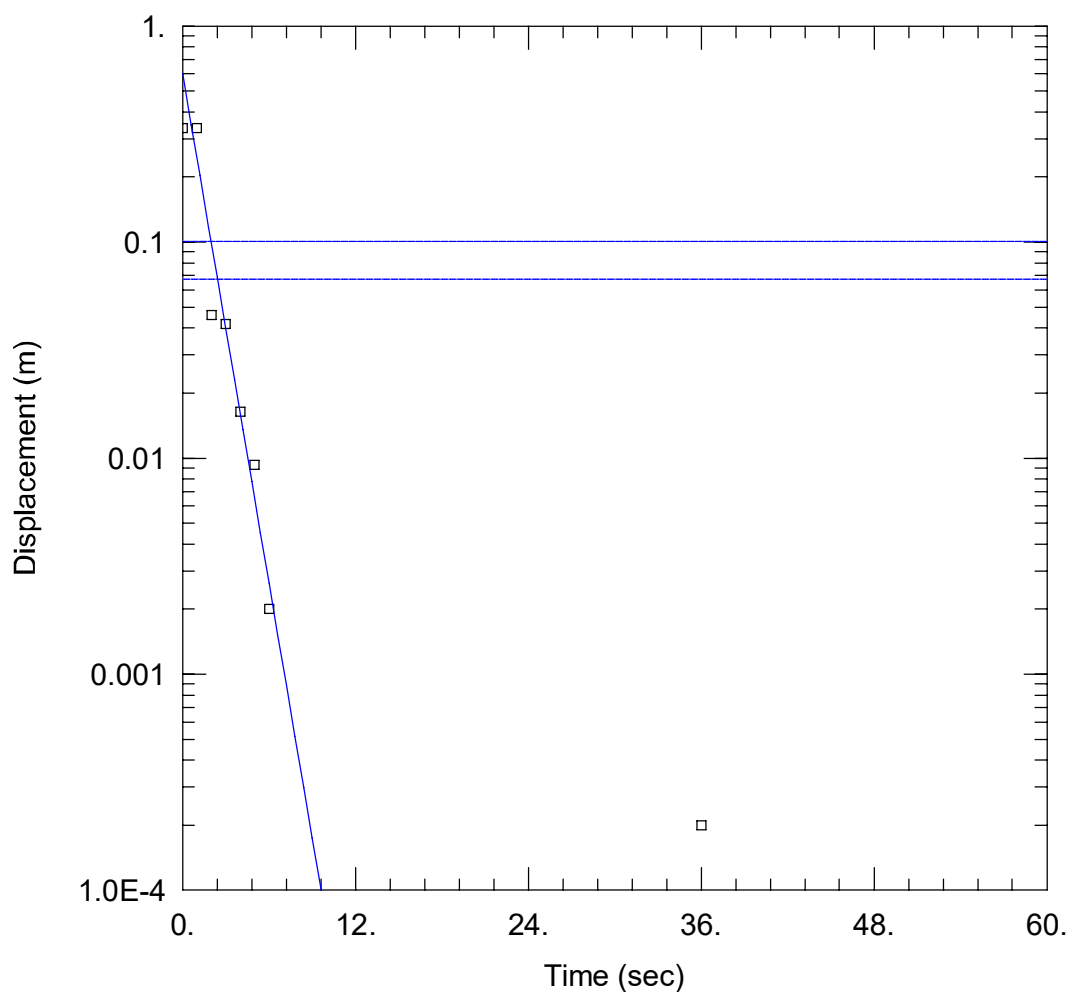
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 10.59 m/day

y_0 = 0.3367 m



WELL TEST ANALYSIS

Data Set: V:\...\P1 - Test 3 - Falling Head.aqt

Date: 03/03/26

Time: 08:28:33

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 8.104 m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (P1)

Initial Displacement: 0.3361 m

Total Well Penetration Depth: 3.77 m

Casing Radius: 0.02 m

Static Water Column Height: 3.77 m

Screen Length: 1.5 m

Well Radius: 0.0375 m

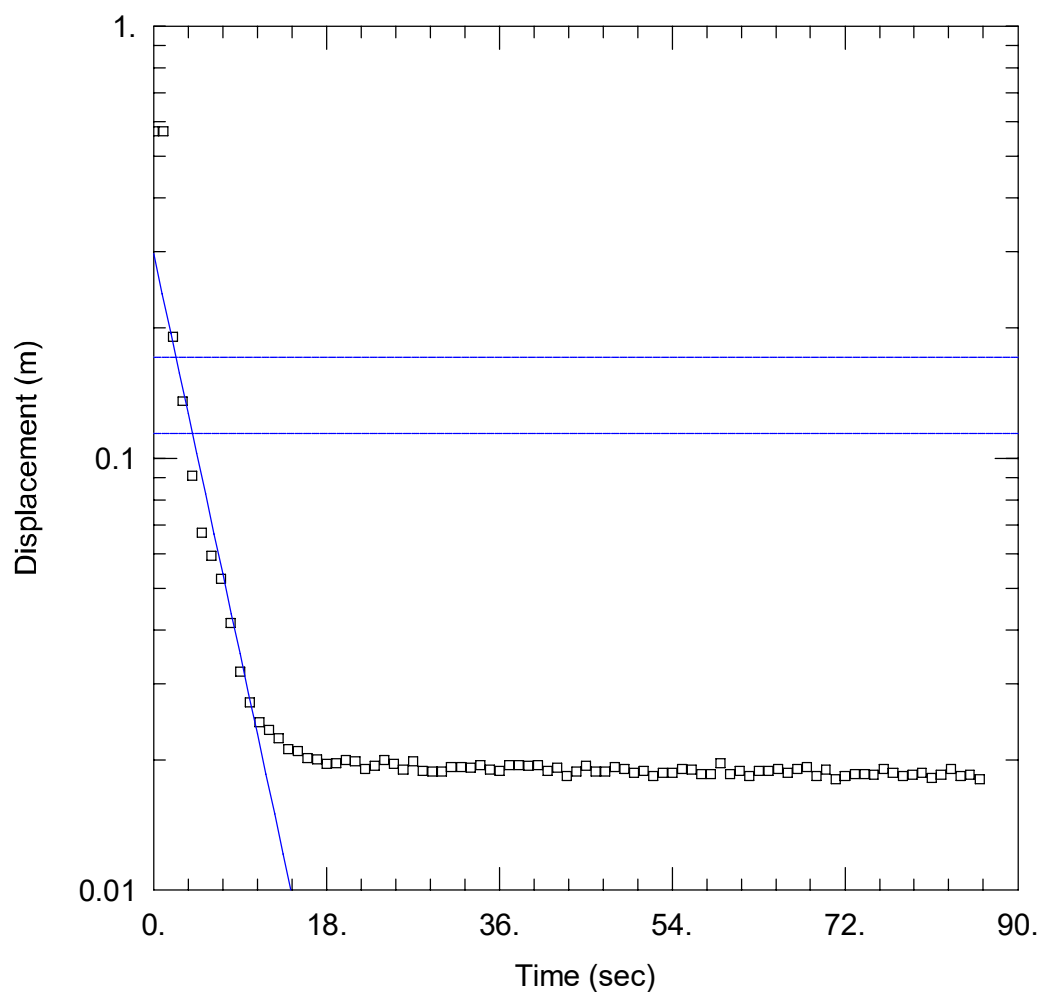
SOLUTION

Aquifer Model: Unconfined

K = 28.91 m/day

Solution Method: Bouwer-Rice

y0 = 0.6019 m



WELL TEST ANALYSIS

Data Set: V:\...\P1 - Test 3 - Rising Head.aqt

Date: 03/03/26

Time: 08:31:56

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 8.104 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P1)

Initial Displacement: 0.5698 m

Total Well Penetration Depth: 3.77 m

Casing Radius: 0.02 m

Static Water Column Height: 3.77 m

Screen Length: 1.5 m

Well Radius: 0.0375 m

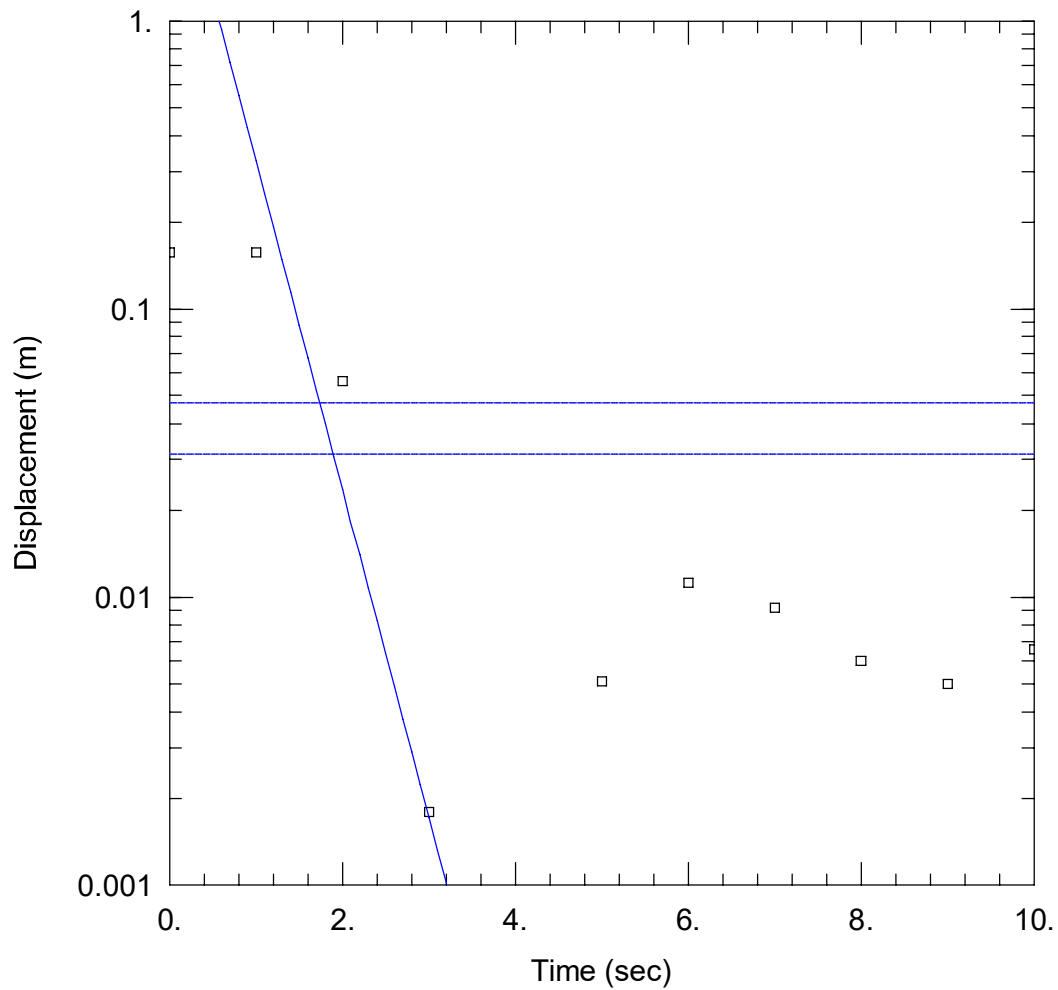
SOLUTION

Aquifer Model: Unconfined

$K = 7.562$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.297$ m



WELL TEST ANALYSIS

Data Set: V:\...\P2D - Test 1 - Falling Head.aqt

Date: 03/03/26

Time: 08:34:11

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 10.71 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P2D)

Initial Displacement: 0.1572 m

Static Water Column Height: 6.18 m

Total Well Penetration Depth: 6.18 m

Screen Length: 1.5 m

Casing Radius: 0.02 m

Well Radius: 0.0375 m

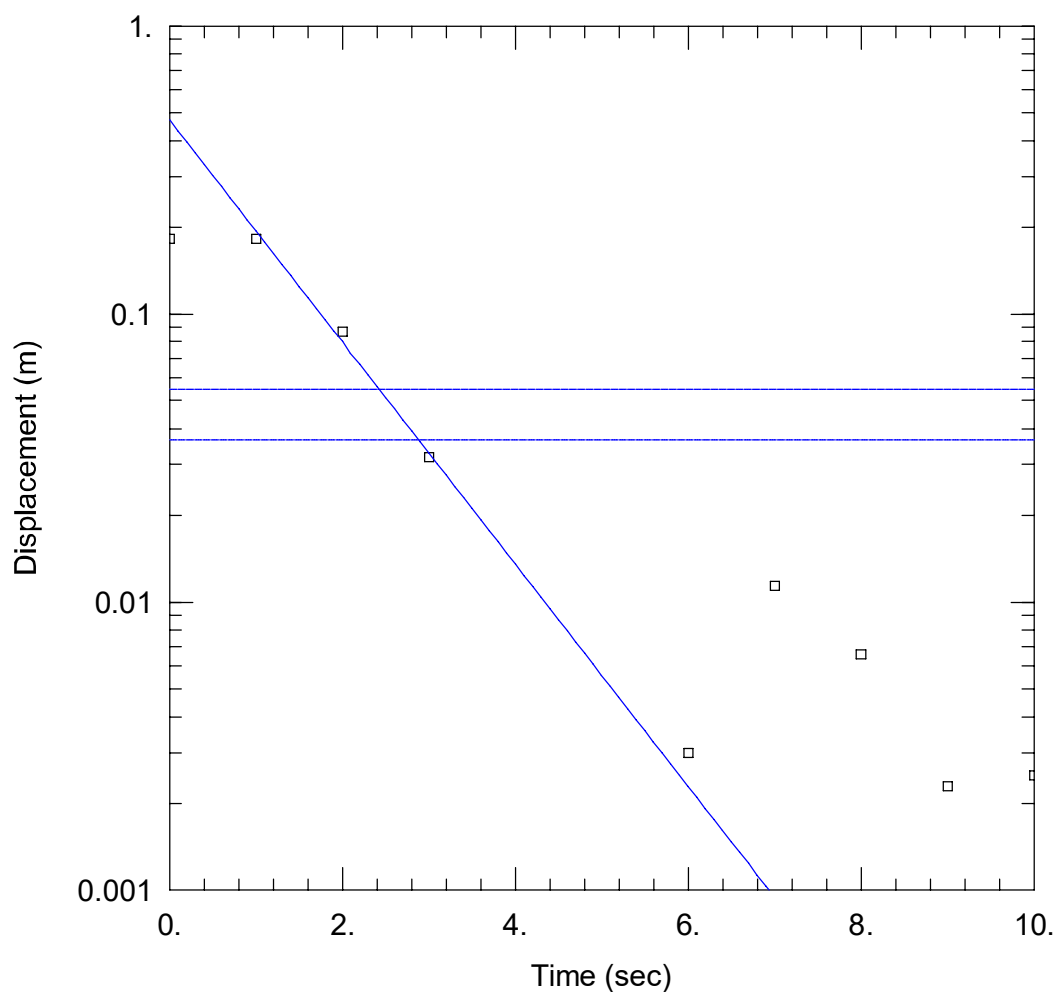
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 89.4$ m/day

$y_0 = 4.507$ m



WELL TEST ANALYSIS

Data Set: V:\...\P2D - Test 2 - Falling Head.aqt

Date: 03/03/26

Time: 08:34:58

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 10.71 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P2D)

Initial Displacement: 0.1826 m

Total Well Penetration Depth: 6.18 m

Casing Radius: 0.02 m

Static Water Column Height: 6.18 m

Screen Length: 1.5 m

Well Radius: 0.0375 m

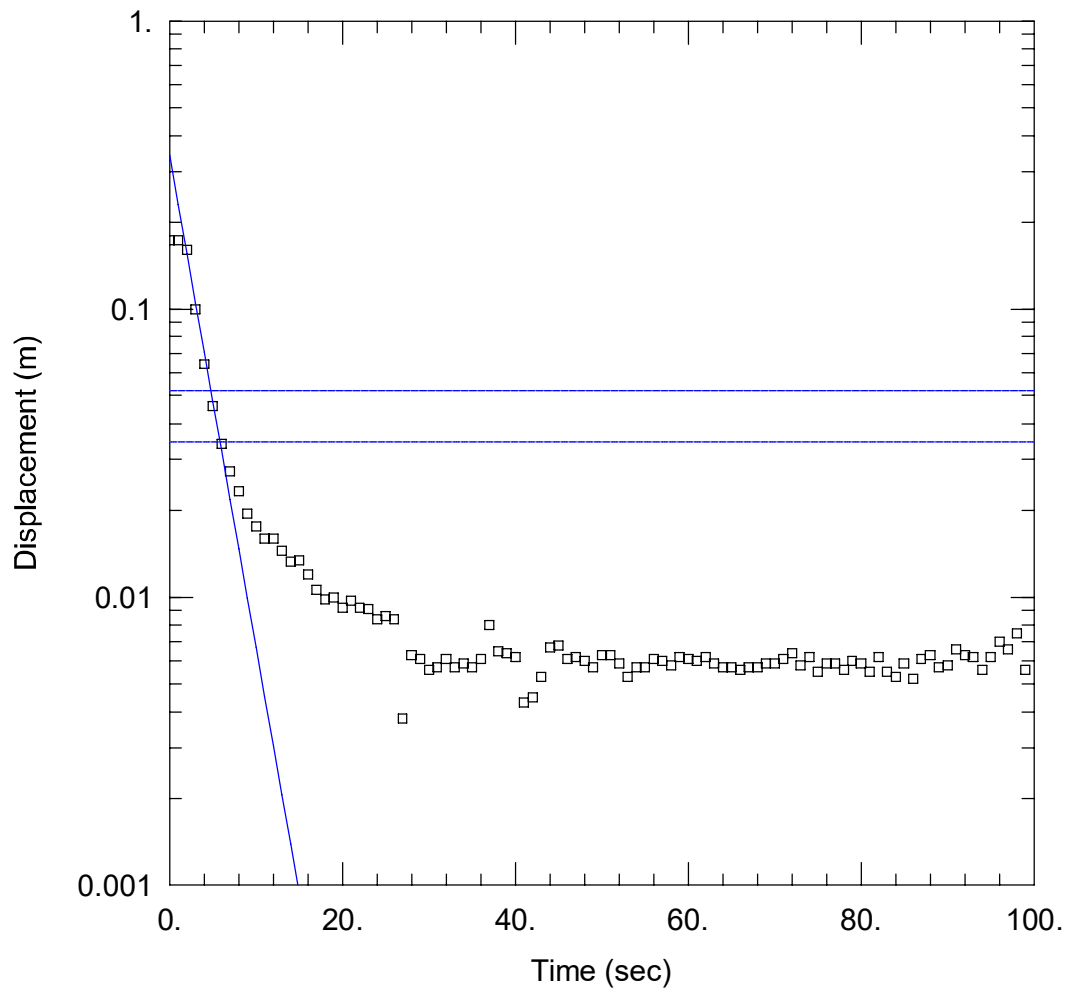
SOLUTION

Aquifer Model: Unconfined

$K = 30.23$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.4716$ m



WELL TEST ANALYSIS

Data Set: V:\...\P2S - Test 1 - Rising Head.aqt

Date: 03/03/26

Time: 08:36:40

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 11.16 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P2S)

Initial Displacement: 0.1733 m

Static Water Column Height: 1.71 m

Total Well Penetration Depth: 1.71 m

Screen Length: 1.5 m

Casing Radius: 0.02 m

Well Radius: 0.0375 m

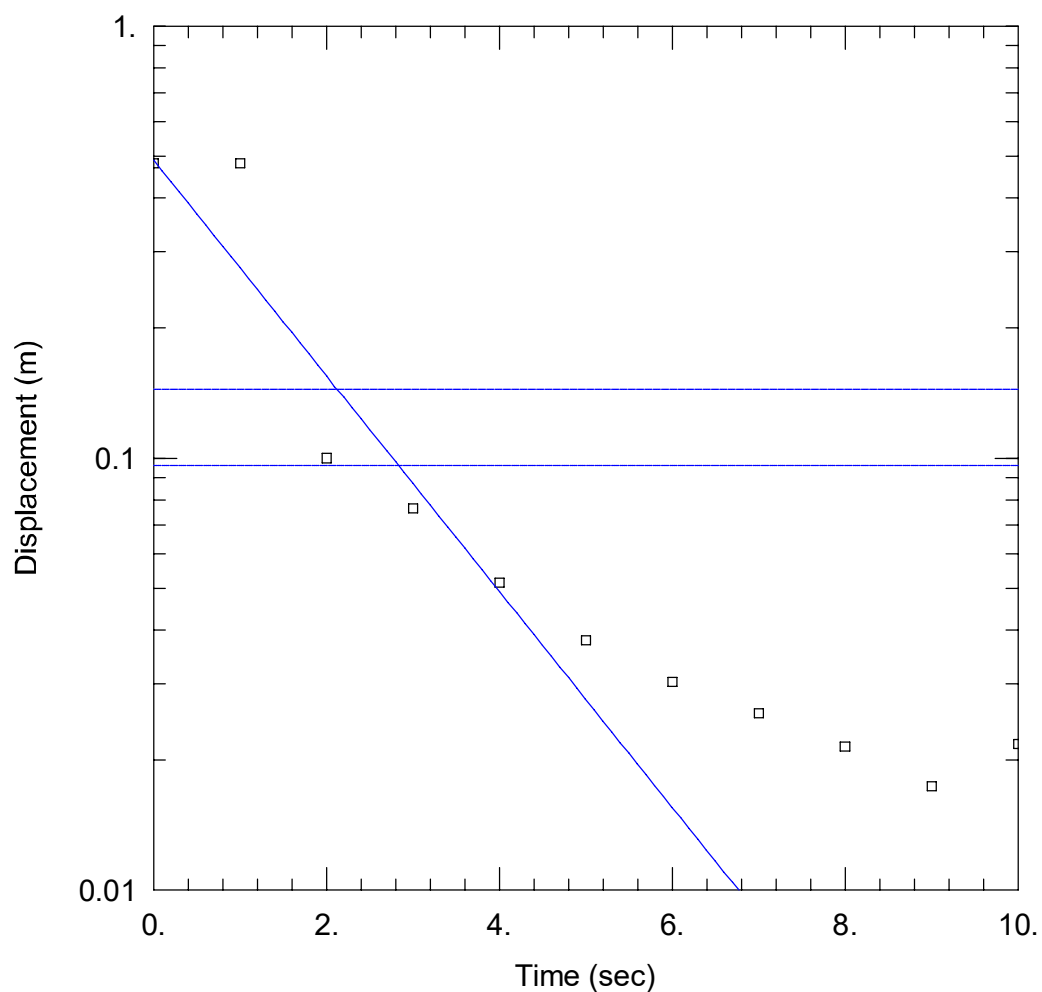
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 10.82$ m/day

$y_0 = 0.3418$ m



WELL TEST ANALYSIS

Data Set: V:\...\P2S - Test 2 - Falling Head.aqt

Date: 03/03/26

Time: 08:37:13

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 11.16 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P2S)

Initial Displacement: 0.4804 m

Static Water Column Height: 1.71 m

Total Well Penetration Depth: 1.71 m

Screen Length: 1.5 m

Casing Radius: 0.02 m

Well Radius: 0.0375 m

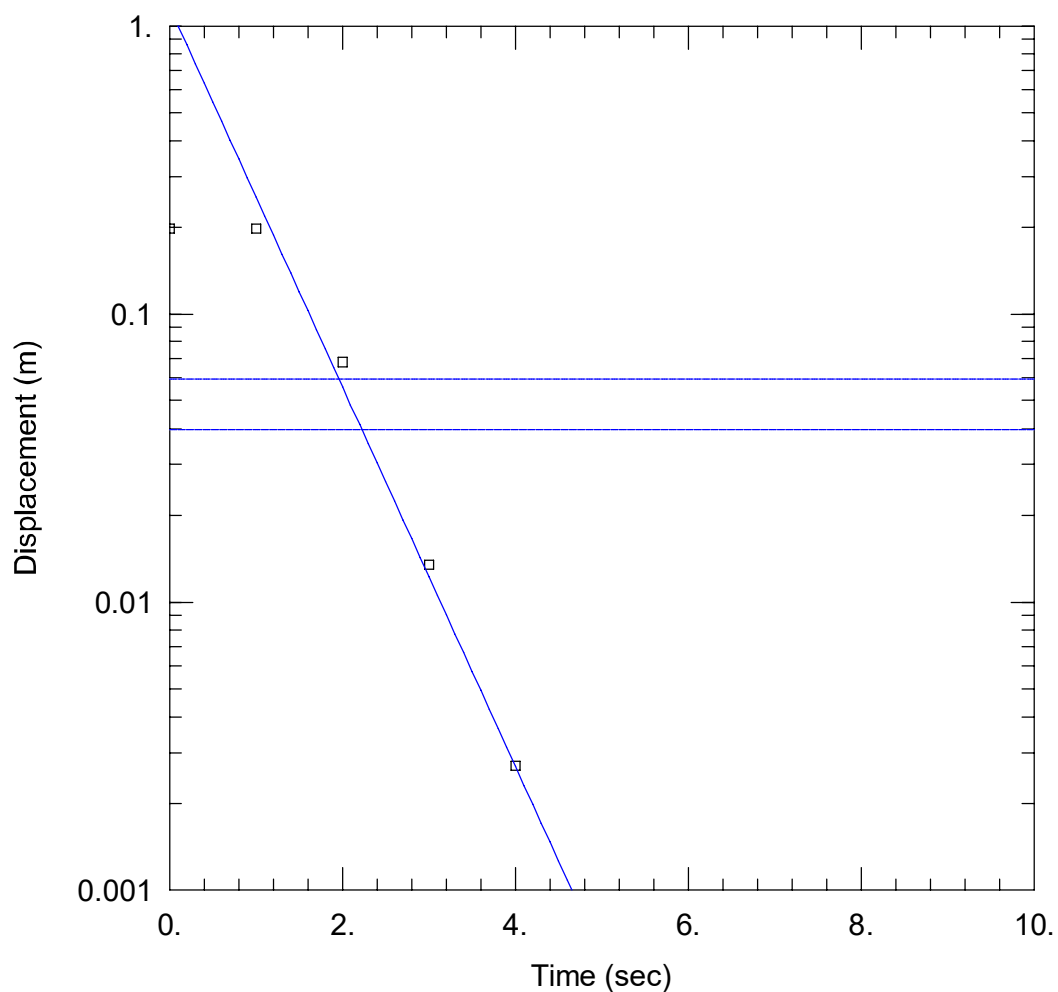
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 15.8$ m/day

$y_0 = 0.4896$ m



WELL TEST ANALYSIS

Data Set: V:\...\P3 - Test 2 - Rising Head.aqt

Date: 03/03/26

Time: 08:35:46

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 12.61 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P3)

Initial Displacement: 0.198 m

Total Well Penetration Depth: 3.955 m

Casing Radius: 0.02 m

Static Water Column Height: 3.955 m

Screen Length: 1.5 m

Well Radius: 0.0375 m

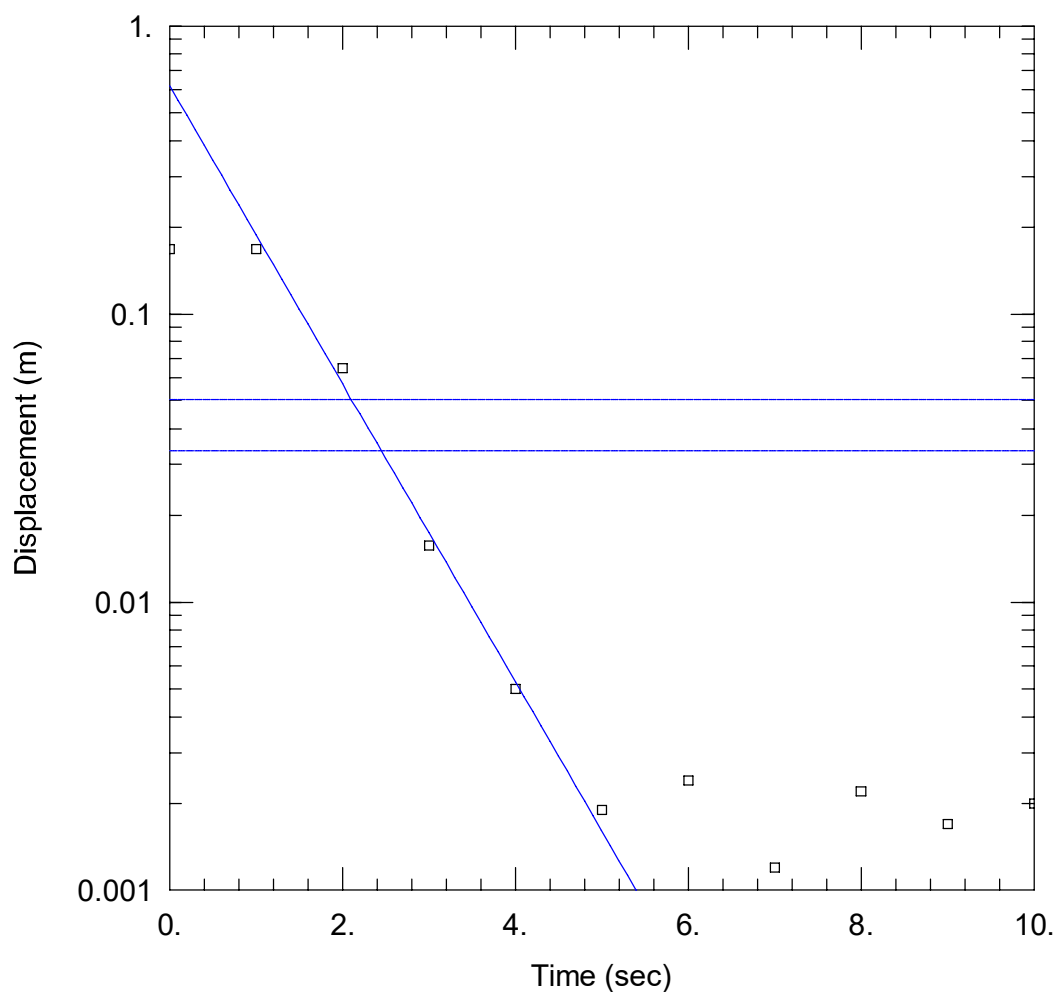
SOLUTION

Aquifer Model: Unconfined

$K = 47.75$ m/day

Solution Method: Bouwer-Rice

$y_0 = 1.162$ m



WELL TEST ANALYSIS

Data Set: V:\...\P3 - Test 4 - Rising Head.aqt

Date: 03/03/26

Time: 08:37:54

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 12.61 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P3)

Initial Displacement: 0.1681 m

Total Well Penetration Depth: 3.955 m

Casing Radius: 0.02 m

Static Water Column Height: 3.955 m

Screen Length: 1.5 m

Well Radius: 0.0375 m

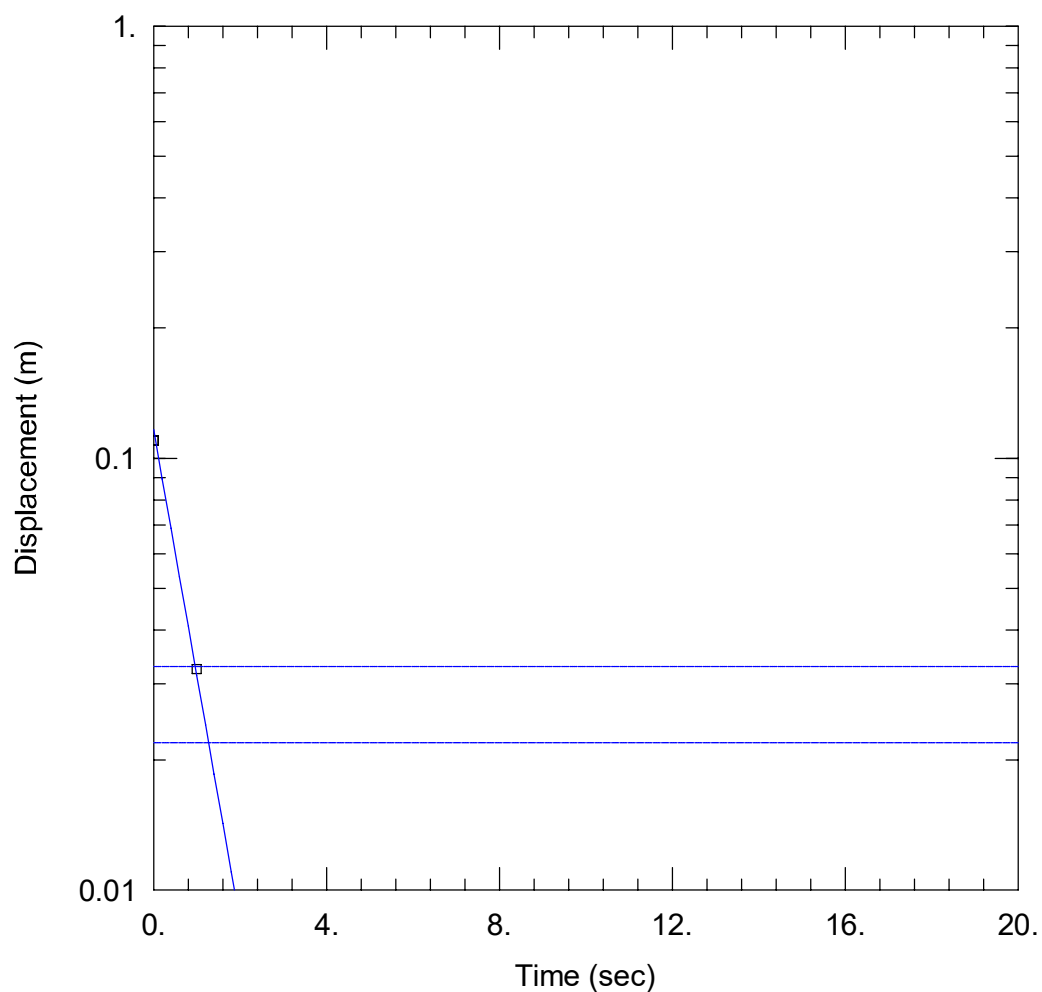
SOLUTION

Aquifer Model: Unconfined

K = 37.47 m/day

Solution Method: Bouwer-Rice

y_0 = 0.6202 m



WELL TEST ANALYSIS

Data Set: V:\...\P4 - Test 2 - Rising Head.aqt

Date: 03/03/26

Time: 08:41:03

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 10.68 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P4)

Initial Displacement: 0.1097 m

Total Well Penetration Depth: 4.5 m

Casing Radius: 0.02 m

Static Water Column Height: 4.5 m

Screen Length: 1.5 m

Well Radius: 0.0375 m

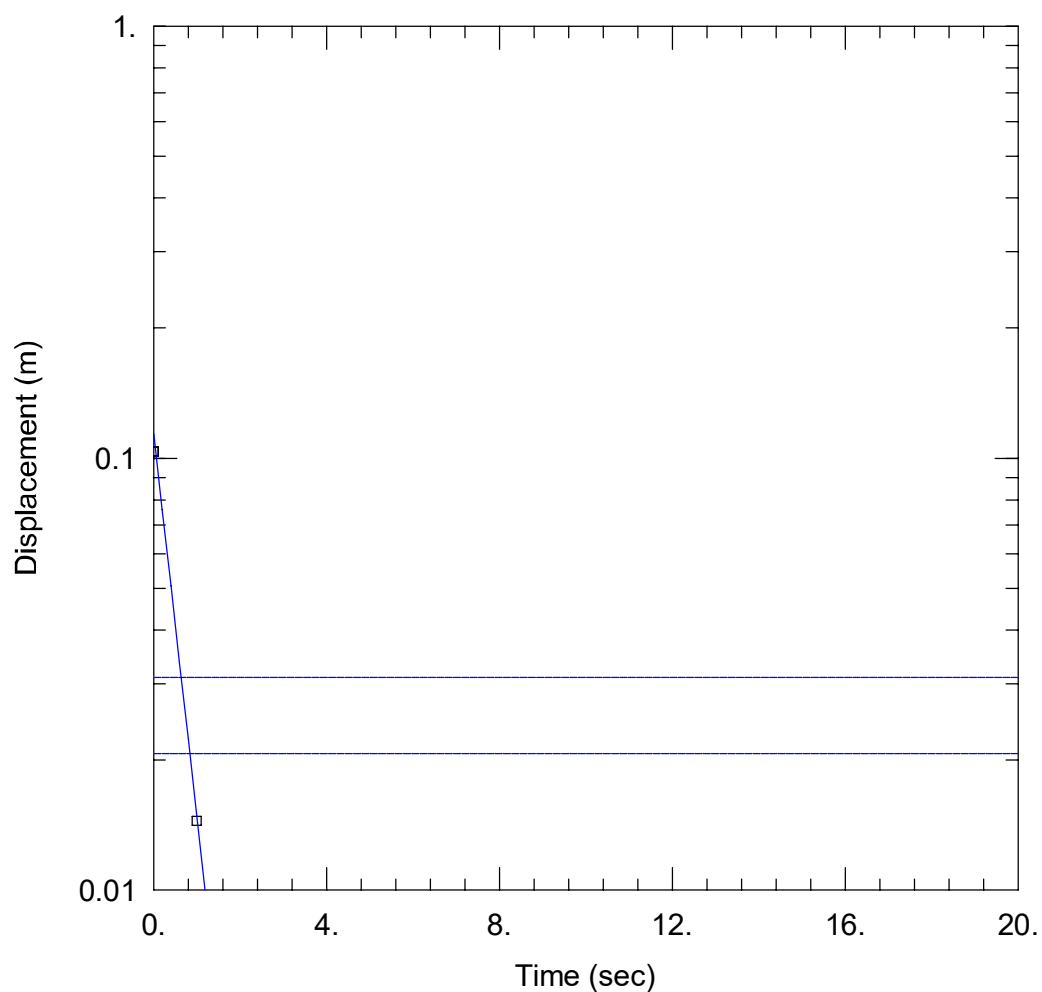
SOLUTION

Aquifer Model: Unconfined

$K = 42.41$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.1164$ m



WELL TEST ANALYSIS

Data Set: V:\...\P4 - Test 3 - Rising Head.aqt

Date: 03/03/26

Time: 08:41:41

PROJECT INFORMATION

Company: WGA

Client: SL - Southern Block

Project: 242463

Location: Hamilton

Test Well: P1

Test Date: 18/07/2025

AQUIFER DATA

Saturated Thickness: 10.68 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (P4)

Initial Displacement: 0.1035 m

Total Well Penetration Depth: 4.5 m

Casing Radius: 0.02 m

Static Water Column Height: 4.5 m

Screen Length: 1.5 m

Well Radius: 0.0375 m

SOLUTION

Aquifer Model: Unconfined

$K = 65.88$ m/day

Solution Method: Bouwer-Rice

$y_0 = 0.1142$ m

APPENDIX C
WGA MARKUP ON MAVEN DESIGN
DRAWING NO. R1-C440 REV C





SAXBYS ROAD

RHONDA AVENUE

STORMWATER WETLAND B

DEANWELL AVENUE

LESUE PLACE

SAXBYS ROAD

FORTH CRESCENT

STORMWATER WETLAND A

CAESAR ROOSE DRIVE

MACMURDO AVENUE

REYNOLDS DRIVE

STORMWATER WETLAND C

ROAD 3

ROAD 4

ROAD 3

ROAD 6

ROAD 5

ROAD 6

ROAD 3

ROAD 6

ROAD 5

ROAD 6

ROAD 5

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ROAD 5

ROAD 6

ROAD 7

ROAD 8

ROAD 16

ROAD 9

COLLECTOR ROAD 1

COLLECTOR ROAD 2

ROAD 13

ROAD 14

ROAD 12

ROAD 10

ROAD 12

ROAD 10

ROAD 11

STORMWATER WETLAND E

Croft Lane

EX DRAIN CHANNEL

STORMWATER WETLAND D

STORMWATER DETENTION POND F

DRAFT FOR REVIEW

NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATIONS.
2. CO-ORDINATES IN TERMS OF NZ GEODETIC DATUM MT EDEN 2000. LEVELS IN TERMS OF THE NEW ZEALAND VERTICAL DATUM 2016. CONVERSION TO MOTURIKI 1953 CAN BE ACHIEVED BY ADDING 777m.
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6. HEAVY DUTY MANHOLE LIDS AND FRAMES TO BE USED IN TRAFFICKED AREAS.
7. ALL CESSPIT LEADS SHALL HAVE MIN COVER 0.9m.
8. ALL LINES ARE TO BE CLASS4 RCRRJ UNLESS SHOWN OTHERWISE.
9. ALL LINES TO BE ABANDONED SHALL BE SEALED AT EACH END. TIMING OF ALL SEALING TO BE COORDINATED WITH COUNCIL STAFF.

LEGEND

- EX BOUNDARY
PROP BOUNDARY

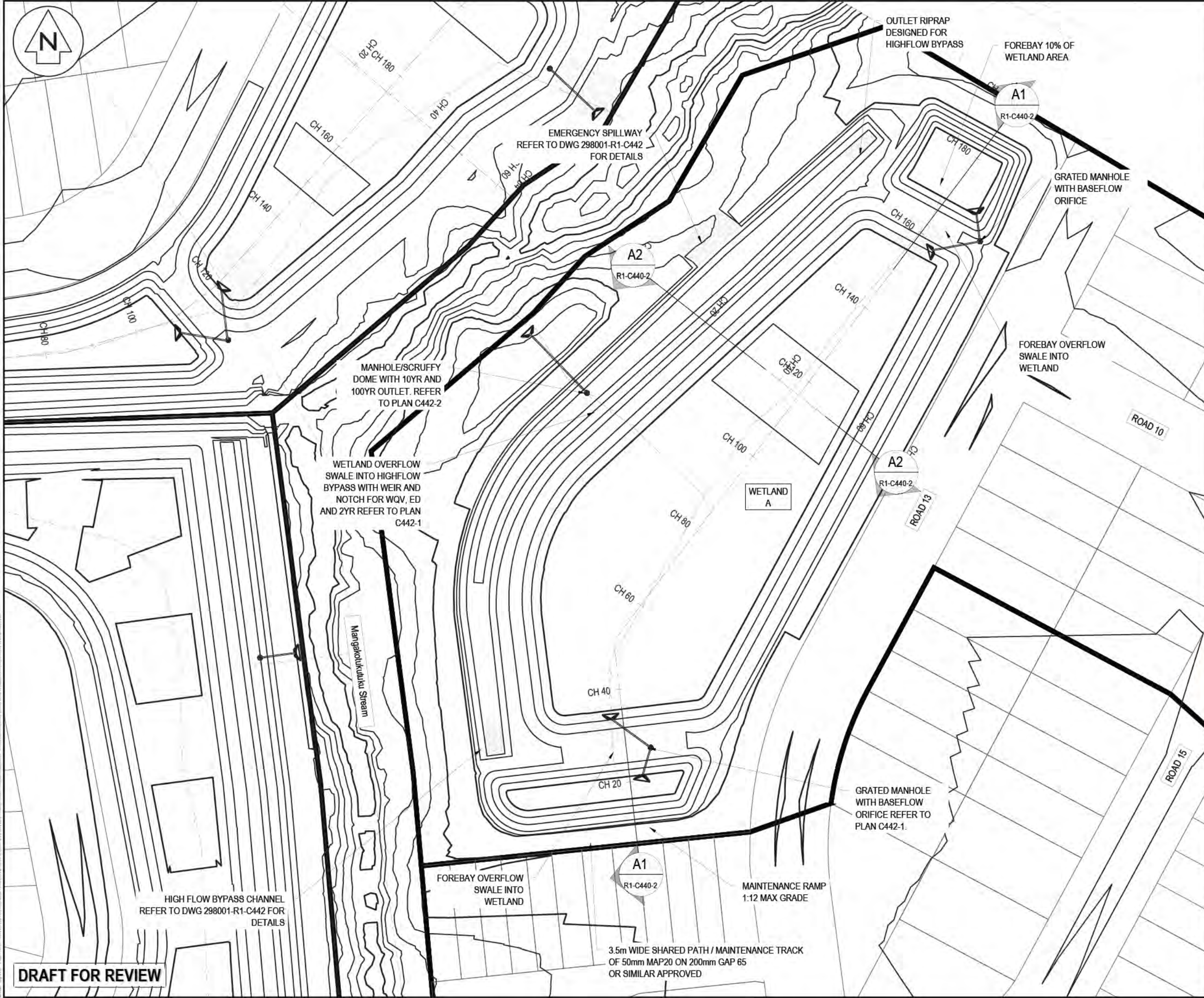
Rev	Description	By	Date
C	DRAFT	MJRA	02/2026
B	DRAFT	MJRA	02/2026
A	DRAFT	MJRA	11/2025
Survey	MAVEN		06/2025
Design	MKS		07/2025
Drawn	MJRA		11/2025
Checked	DJM		11/2025



Project
**SOUTHERN LINKS 1
RESIDENTIAL STAGE 1
HAMILTON, WAIKATO
FOR
SL1 CONSORTIUM GROUP**

Title
**PROPOSED STORMWATER
WETLAND + DETENTION
POND - OVERVIEW PLAN**

Project no.	298001-R1 SL1
Scale	1:4000 @ A3
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440
Rev	C



NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATIONS.
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LEGEND

EX BOUNDARY

PROP BOUNDARY

C	DRAFT	MJRA	02/2026
B	DRAFT	MJRA	02/2026
A	DRAFT	MJRA	11/2025
Rev	Description	By	Date
		By	Date
Survey	MAVEN		06/2025
Design	MKS		07/2025
Drawn	MJRA		11/2025
Checked	DJM		11/2025



Maven Waikato
07 242 0601
info@maven.co.nz
www.maven.co.nz
Level 1 286 Victoria Street, Hamilton
New Zealand

Project

**SOUTHERN LINKS 1
RESIDENTIAL STAGE 1
HAMILTON, WAIKATO
FOR
SL1 CONSORTIUM GROUP**

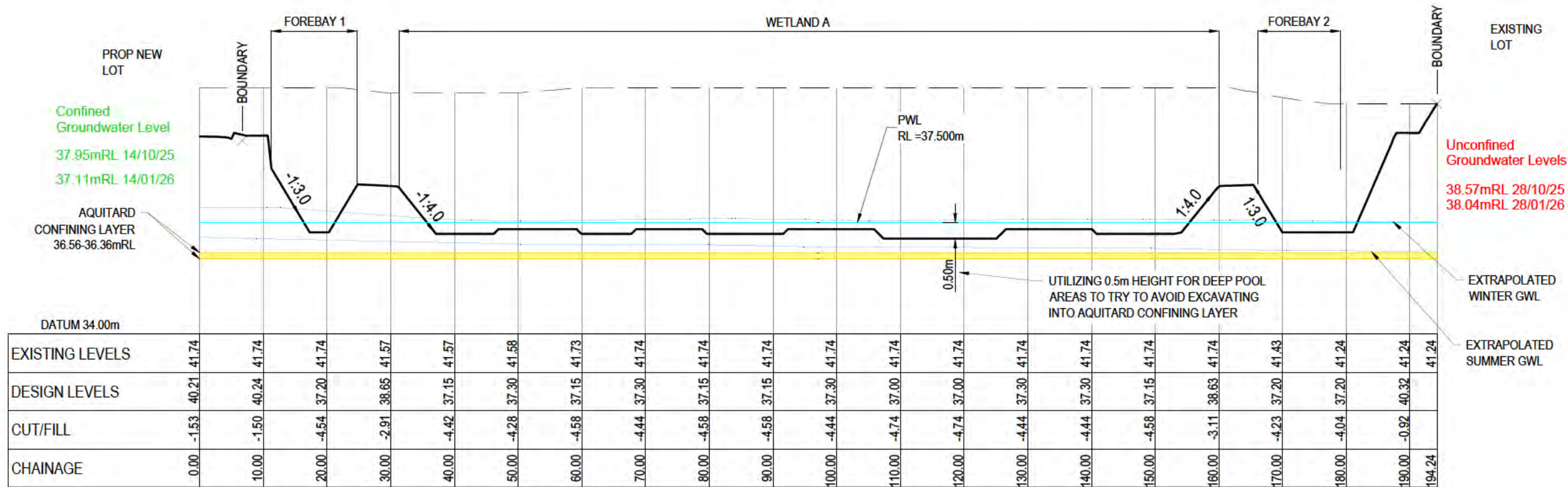
Title

**PROPOSED STORMWATER
WETLAND A
PLAN**

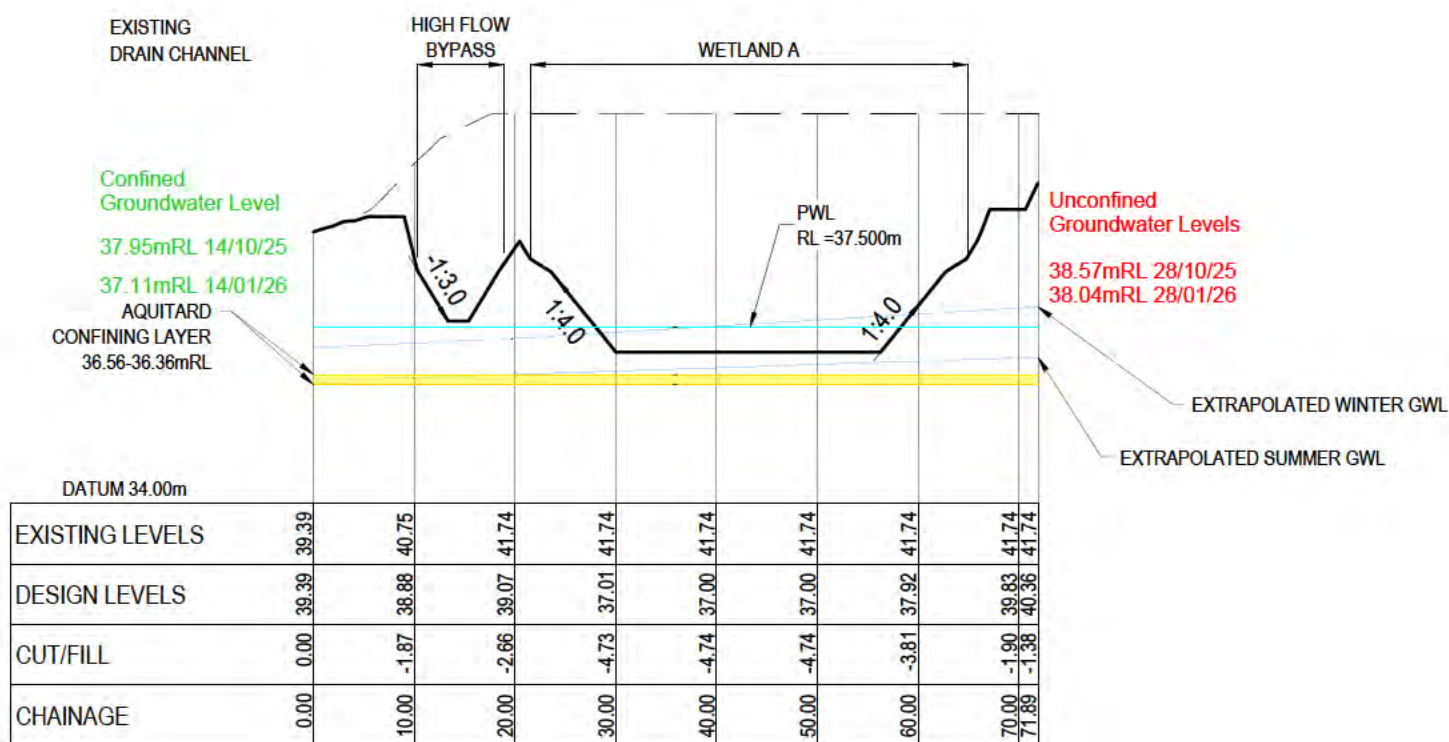
Project no.	298001-R1 SL1		
Scale	1:750 @ A3		
Cad file	298001-R1-C440 SW WETLAND.DWG		
Drawing no.	R1-C440-1	Rev	C

DRAFT FOR REVIEW

DATE: 09/08/25 FILE: R1-C440-1 SW WETLAND PLAN DWG PROJECT: SOUTHERN LINKS 1 RESIDENTIAL STAGE 1 HAMILTON, WAIKATO FOR SL1 CONSORTIUM GROUP



PROPOSED - Section - A1 CH 0+00.00 TO CH 1+94.24
SCALE: 1:750 H / 1:150 V



PROPOSED - Section - A2 CH 0+00.00 TO CH 0+71.89
SCALE: 1:750 H / 1:150 V

DRAFT FOR REVIEW

- NOTES
- ALL WORKS TO BE IN ACCORDANCE WITH WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATIONS.
 - CO-ORDINATES IN TERMS OF NZ GEODETIC DATUM MT EDEN 2000. LEVELS IN TERMS OF THE NEW ZEALAND VERTICAL DATUM 2016. CONVERSION TO MOTURIKI 1953 CAN BE ACHIEVED BY ADDING 777m.
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Legend

- EX GROUND LEVEL
- PROP GROUND LEVEL
- 100YR - 10 YR LEVEL
- GROUNDWATER LEVEL

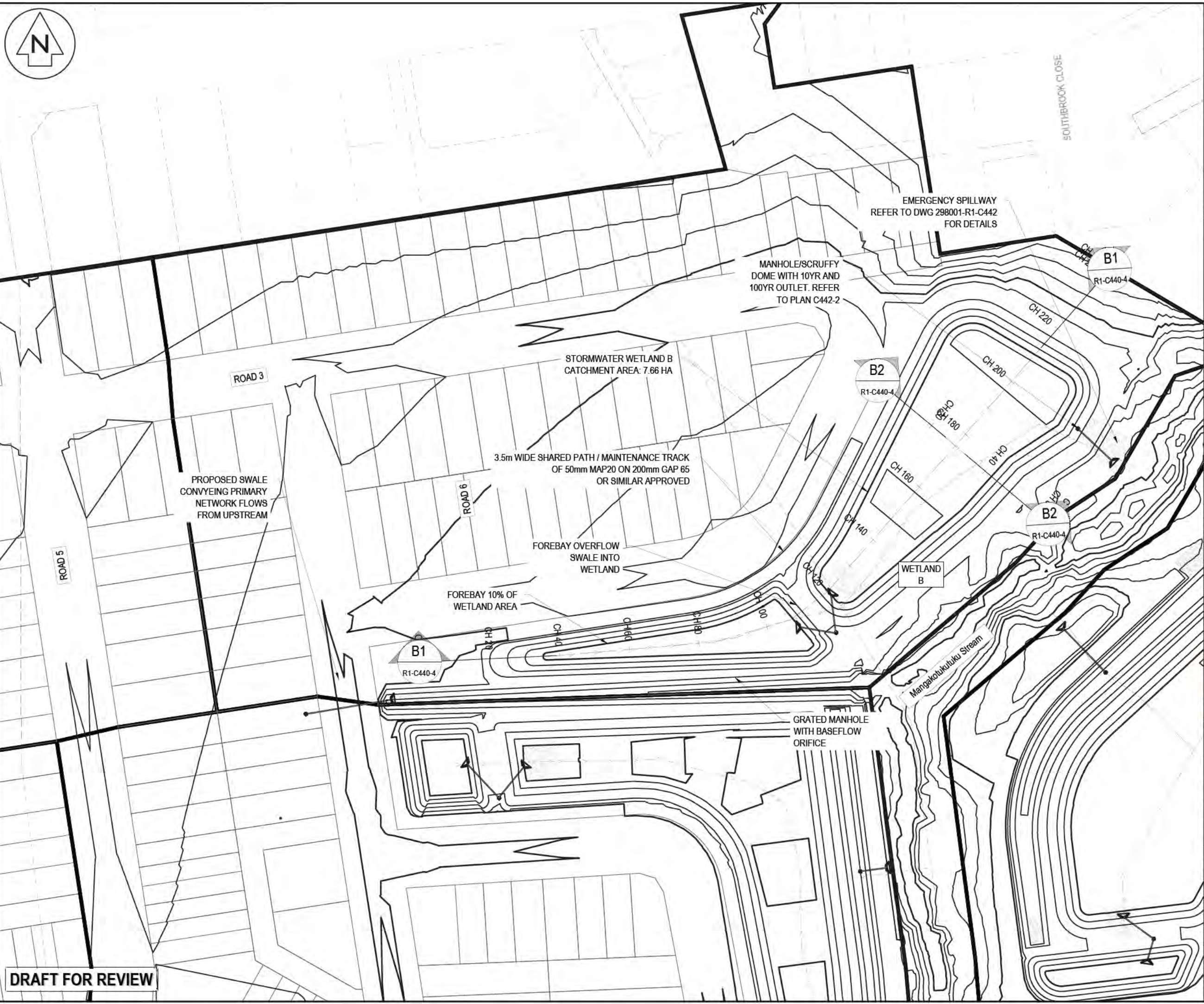
Rev	Description	By	Date
C	DRAFT	MJRA	02/2026
B	DRAFT	MJRA	02/2026
A	DRAFT	MJRA	11/2025
Rev	Description	By	Date
Survey	MAVEN		06/2025
Design	MKS		07/2025
Drawn	MJRA		11/2025
Checked	DJM		11/2025

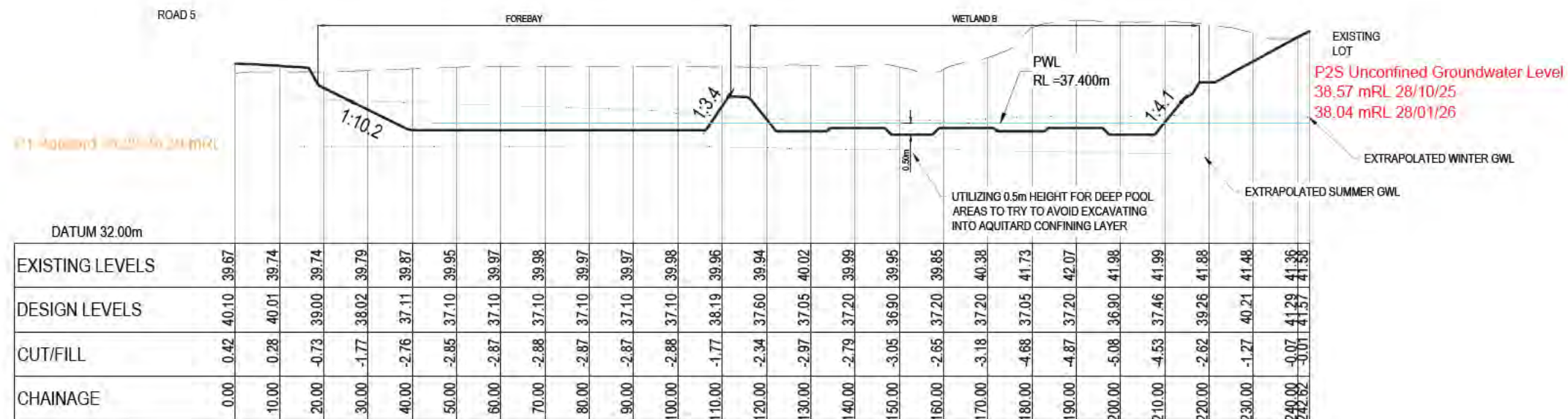


Project
**SOUTHERN LINKS 1
RESIDENTIAL STAGE 1
HAMILTON, WAIKATO
FOR
SL1 CONSORTIUM GROUP**

Title
**PROPOSED STORMWATER
WETLAND A
SECTIONS**

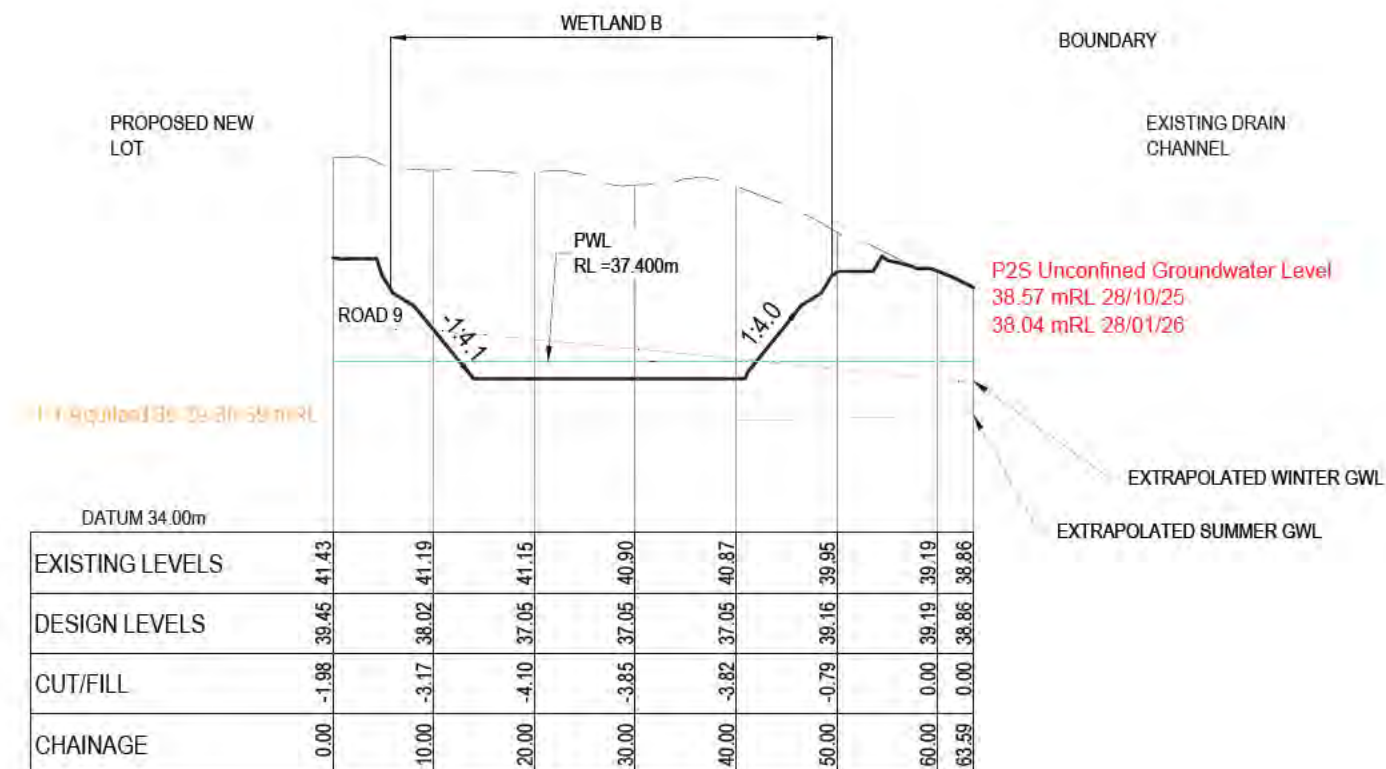
Project no.	298001-R1 SL1
Scale	AS SHOWN
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-2
Rev	C





PROPOSED - Section - B1 CH 0+00.00 TO CH 2+42.62
SCALE: 1:750 H / 1:150 V

SCALE: 1:1250 H / 1:250 V (pers. comm. M.Shon 25/02/26)



PROPOSED - Section - B2 CH 0+00.00 TO CH 0+63.59
SCALE: 1:750 H / 1:150 V

DRAFT FOR REVIEW

- NOTES
1. ALL WORKS TO BE IN ACCORDANCE WITH WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATIONS.
 2. CO-ORDINATES IN TERMS OF NZ GEODETIC DATUM MT EDEN 2000. LEVELS IN TERMS OF THE NEW ZEALAND VERTICAL DATUM 2016. CONVERSION TO MOTURIKI 1953 CAN BE ACHIEVED BY ADDING ???m.
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LEGEND

EX BDY
PROP BDY

Rev	Description	By	Date
C	DRAFT	MJRA	02/2026
B	DRAFT	MJRA	02/2026
A	DRAFT	MJRA	11/2025
Rev	Description	By	Date
Survey	MAVEN		06/2025
Design	MKS		07/2025
Drawn	MJRA		11/2025
Checked	DJM		11/2025



Project
**SOUTHERN LINKS 1
RESIDENTIAL STAGE 1
HAMILTON, WAIKATO
FOR
SL1 CONSORTIUM GROUP**

Title
**PROPOSED STORMWATER
WETLAND B
SECTIONS**

Project no.	298001-R1 SL1
Scale	AS SHOWN
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-4
Rev	C



- NOTES
1. ALL WORKS TO BE IN ACCORDANCE WITH WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATIONS.
 2. CO-ORDINATES IN TERMS OF NZ GEODETIC DATUM MT EDEN 2000. LEVELS IN TERMS OF THE NEW ZEALAND VERTICAL DATUM 2016. CONVERSION TO MOTURIKI 1953 CAN BE ACHIEVED BY ADDING 777m.
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LEGEND

EX BOUNDARY

PROP BOUNDARY

C	DRAFT	MJRA	02/2026
B	DRAFT	MJRA	02/2026
A	DRAFT	MJRA	11/2025
Rev	Description	By	Date
Survey	MAVEN	06/2025	
Design	MKS	07/2025	
Drawn	MJRA	11/2025	
Checked	DJM	11/2025	



Project

SOUTHERN LINKS 1

RESIDENTIAL STAGE 1

HAMILTON, WAIKATO

FOR

SL1 CONSORTIUM GROUP

Title

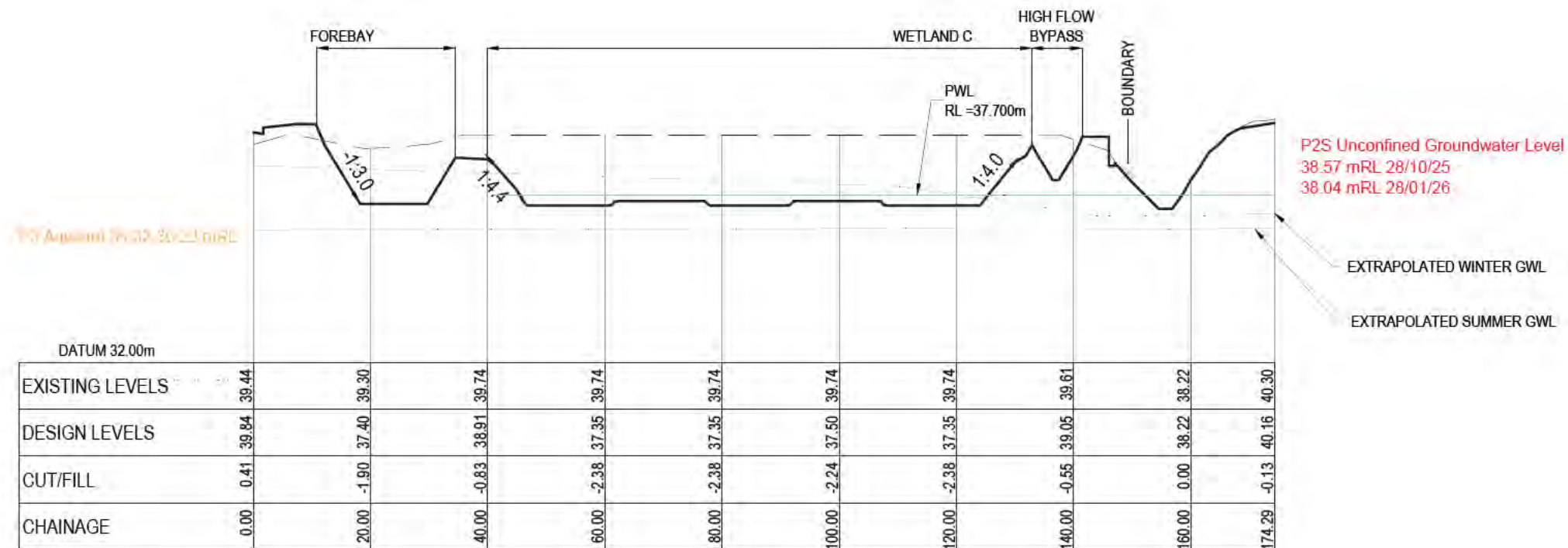
PROPOSED STORMWATER

WETLAND C

PLAN

Project no.	298001-R1 SL1
Scale	1:750 @ A3
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-5
Rev	C

DRAFT FOR REVIEW



- NOTES
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LEGEND

EX BDY
PROP BDY

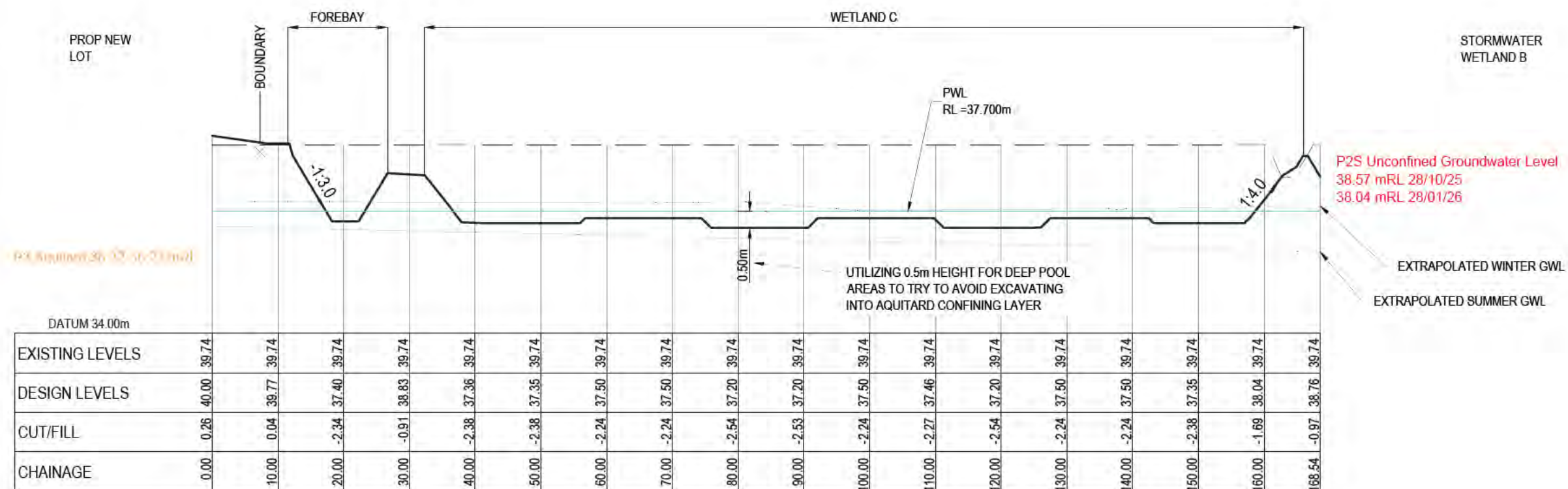
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B:	DRAFT	MJRA	02/2026
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Rev	Description	By	Date
		By	Date
Survey	MAVEN		06/2025
Design	MKS		07/2025
Drawn	MJRA		11/2025
Checked	DJM		11/2025



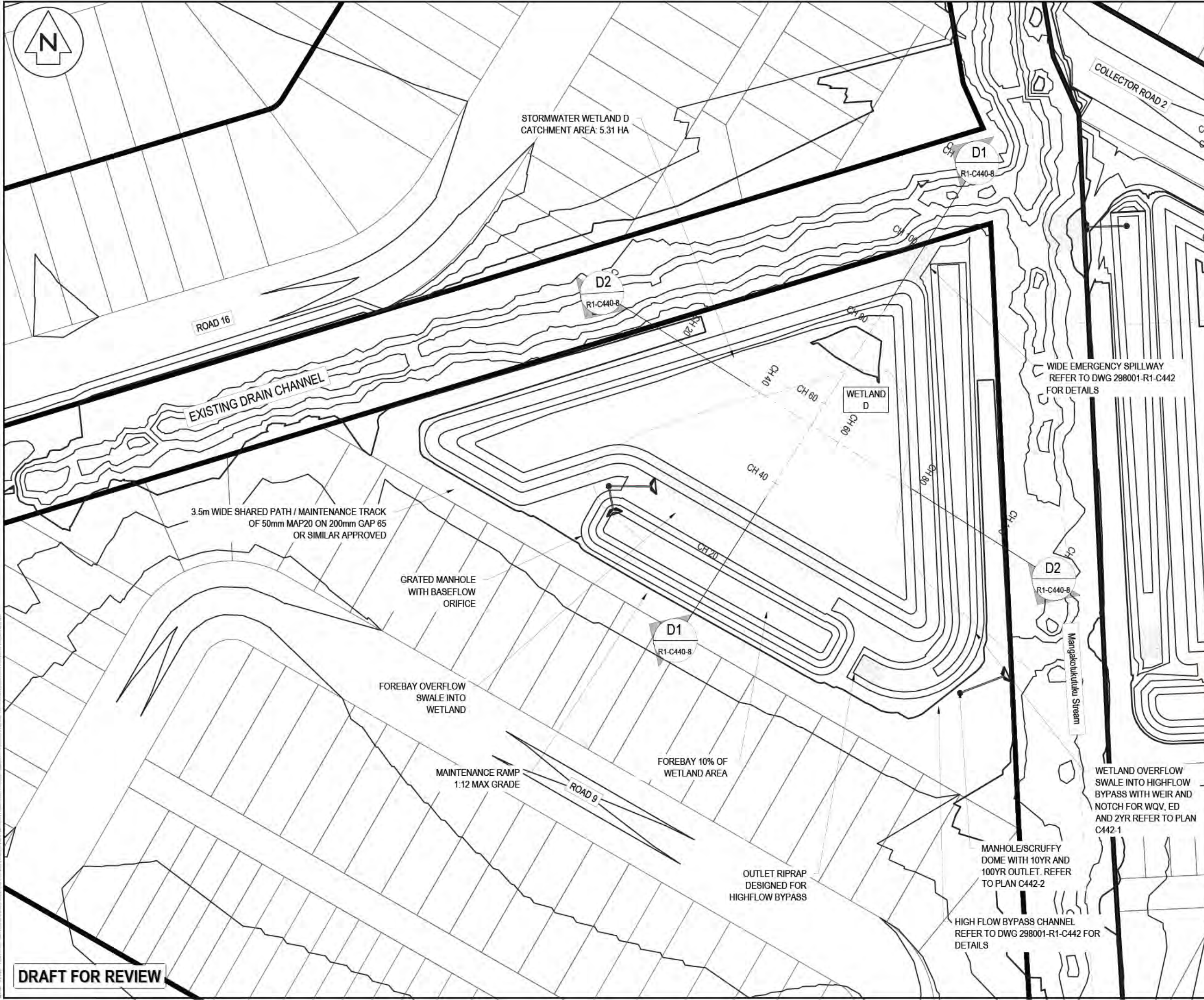
Project
**SOUTHERN LINKS 1
RESIDENTIAL STAGE 1
HAMILTON, WAIKATO
FOR
SL1 CONSORTIUM GROUP**

Title
**PROPOSED STORMWATER
WETLAND C
SECTIONS**

Project no.	298001-R1 SL1
Scale	AS SHOWN
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-6
Rev	C



DRAFT FOR REVIEW



- NOTES
1. ALL WORKS TO BE IN ACCORDANCE WITH WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATIONS.
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LEGEND

EX BOUNDARY

PROP BOUNDARY

C	DRAFT	MJRA	02/2026
B	DRAFT	MJRA	02/2026
A	DRAFT	MJRA	11/2025
Rev	Description	By	Date
Survey	MAVEN		06/2025
Design	MKS		07/2025
Drawn	MJRA		11/2025
Checked	DJM		11/2025



Project

SOUTHERN LINKS 1

RESIDENTIAL STAGE 1

HAMILTON, WAIKATO

FOR

SL1 CONSORTIUM GROUP

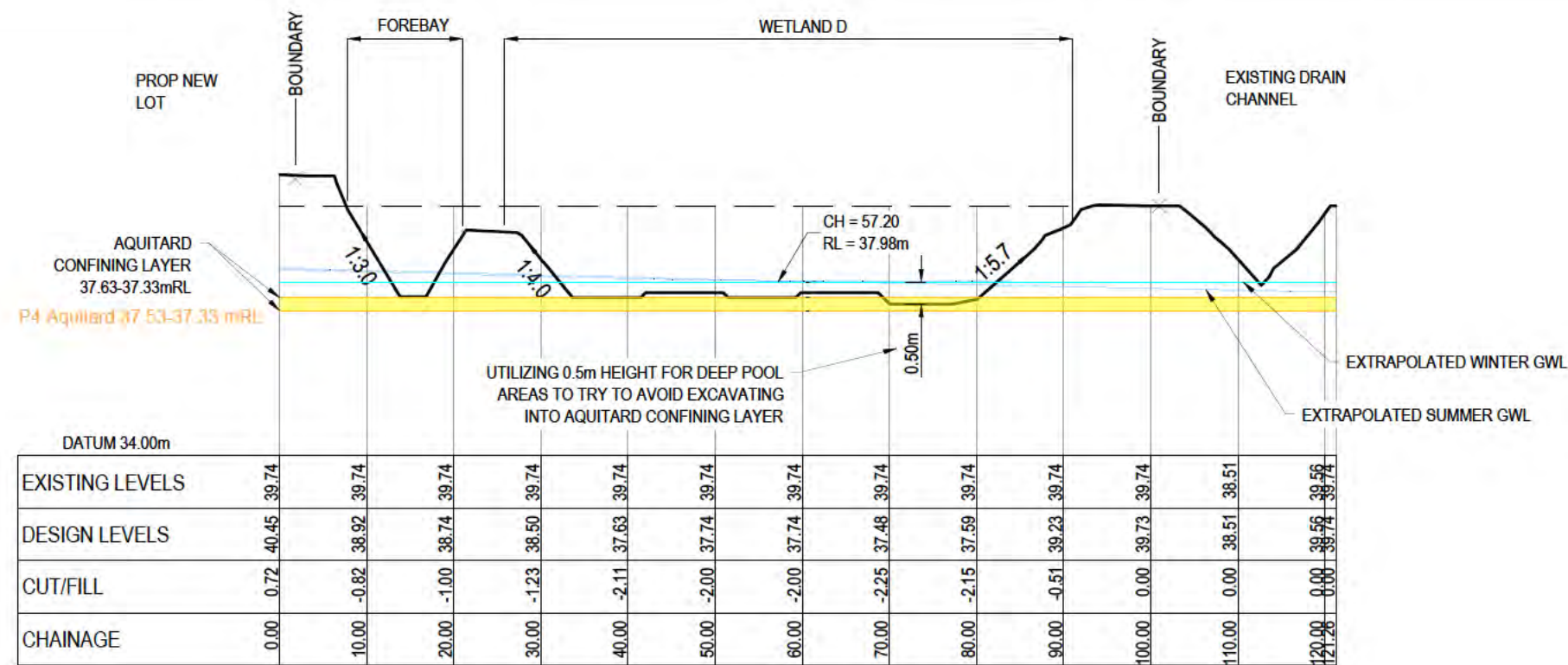
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PROPOSED STORMWATER

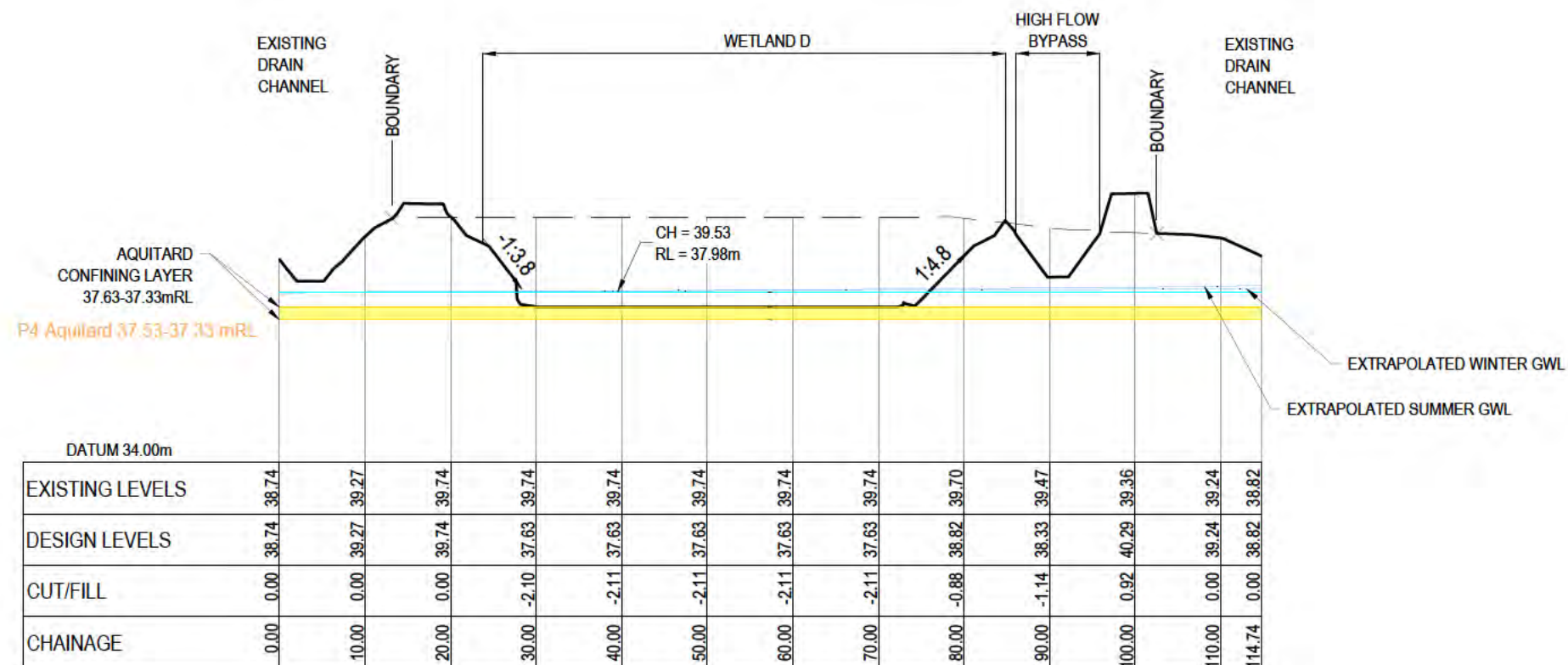
WETLAND D

PLAN

Project no.	298001-R1 SL1
Scale	1:750 @ A3
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-7
Rev	C



PROPOSED - Section - D1 CH 0+00.00 TO CH 1+21.26
SCALE: 1:750 H / 1:150 V



PROPOSED - Section - D2 CH 0+00.00 TO CH 1+14.74
SCALE: 1:750 H / 1:150 V

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PROP BDY

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	Survey	MAVEN	06/2025
	Design	MKS	07/2025
	Drawn	MJRA	11/2025
	Checked	DJM	11/2025

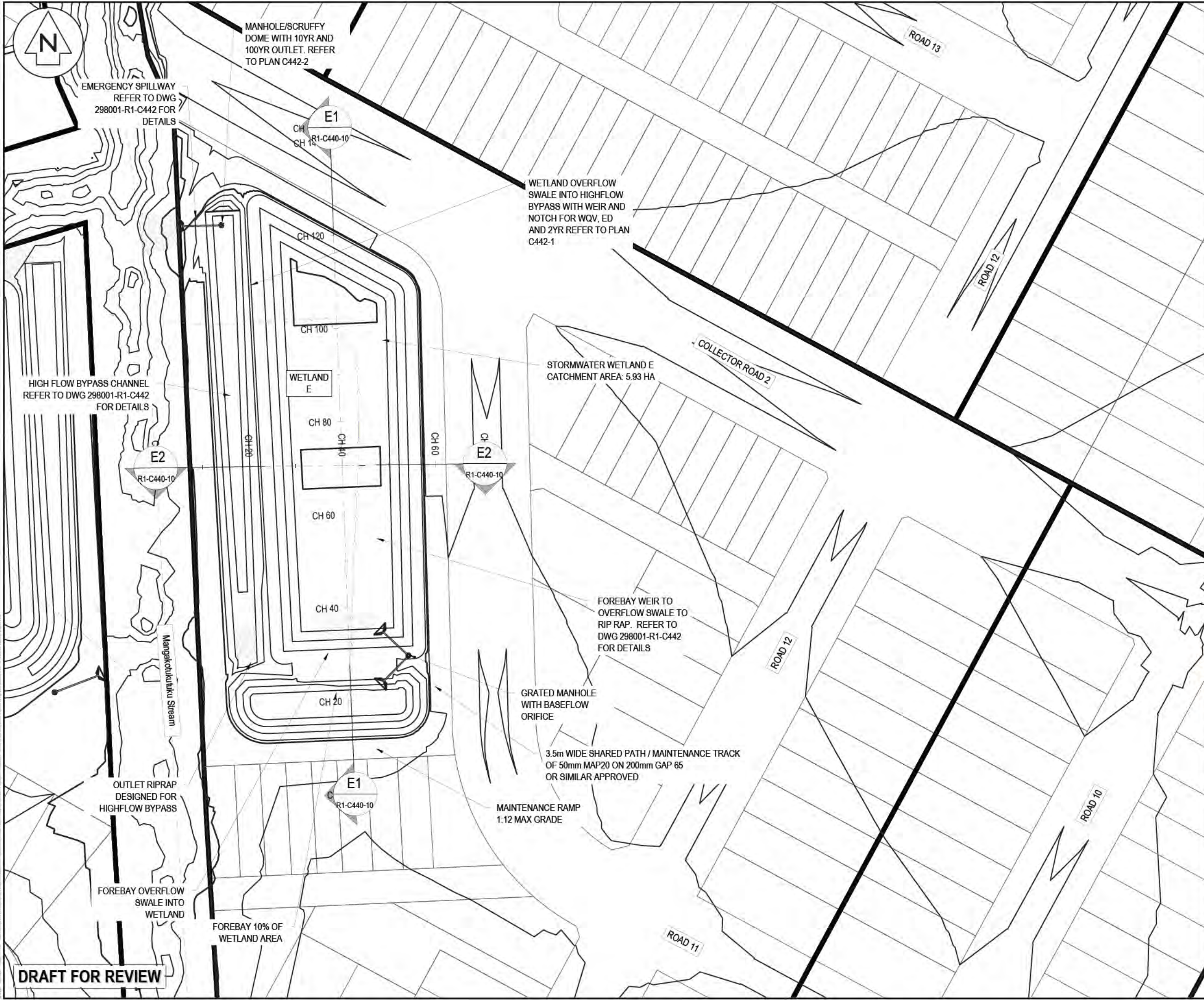


Project
**SOUTHERN LINKS 1
RESIDENTIAL STAGE 1
HAMILTON, WAIKATO
FOR
SL1 CONSORTIUM GROUP**

Title
**PROPOSED STORMWATER
WETLAND D
SECTIONS**

Project no.	298001-R1 SL1
Scale	AS SHOWN
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-8
Rev	C

DRAFT FOR REVIEW



- NOTES
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C	DRAFT	MJRA	02/2026
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A	DRAFT	MJRA	11/2025

Rev	Description	By	Date
Survey	MAVEN	06/2025	
Design	MKS	07/2025	
Drawn	MJRA	11/2025	
Checked	DJM	11/2025	

M Maven Waikato
07 242 0601
info@maven.co.nz
www.maven.co.nz
Level 1 286 Victoria Street, Hamilton
New Zealand

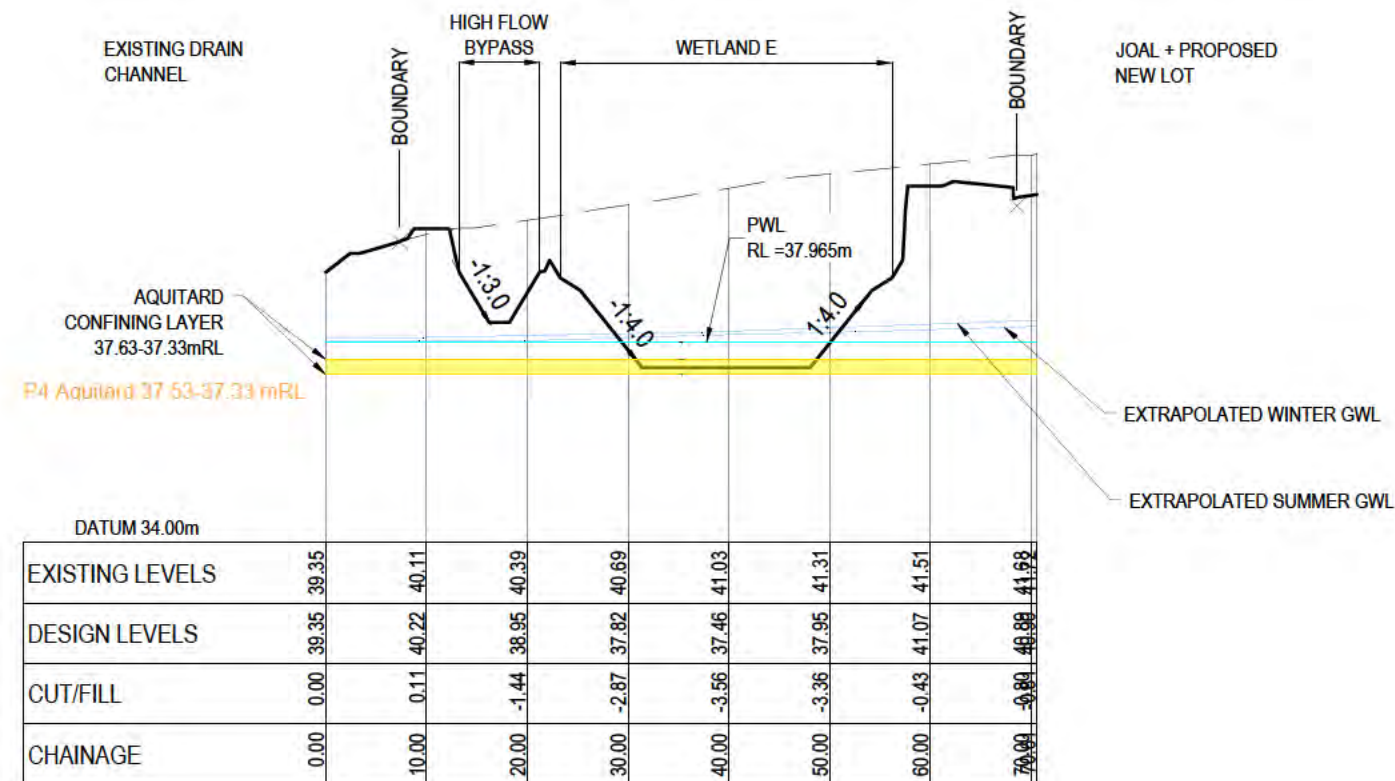
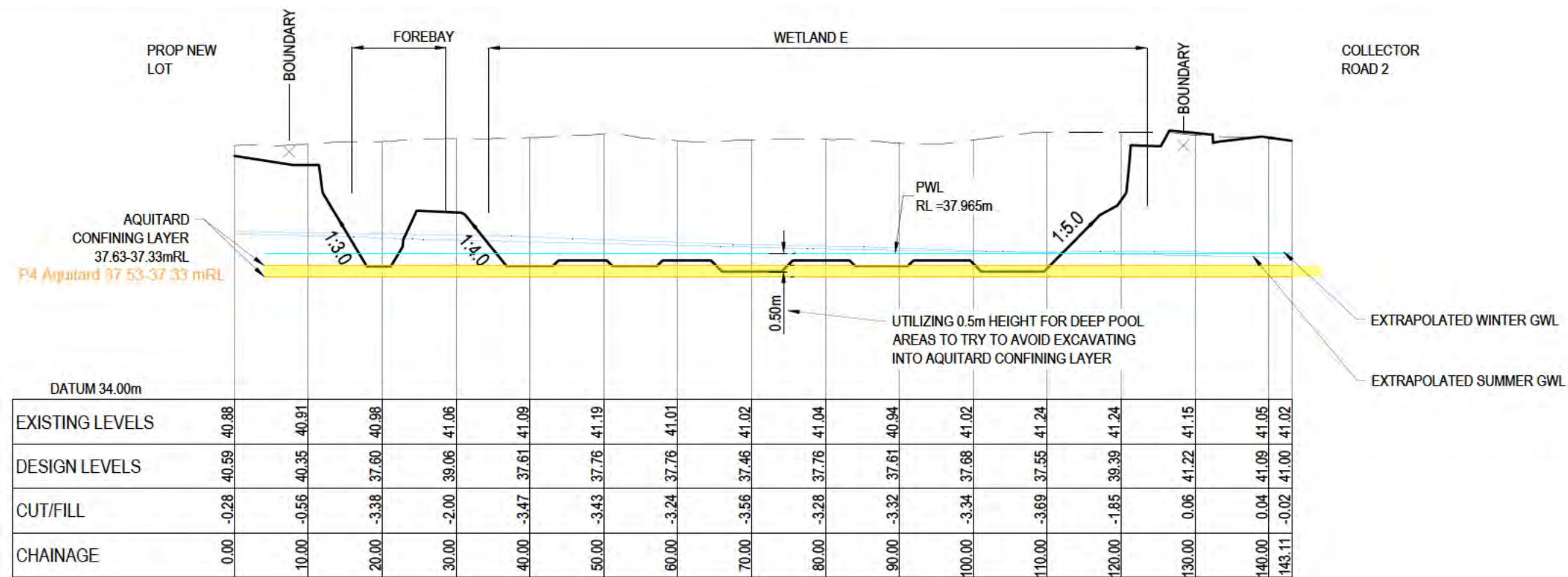
Project

**SOUTHERN LINKS 1
RESIDENTIAL STAGE 1
HAMILTON, WAIKATO
FOR
SL1 CONSORTIUM GROUP**

Title

**PROPOSED STORMWATER
WETLAND E
PLAN**

Project no.	298001-R1 SL1
Scale	1:750 @ A3
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-9
Rev	C



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PROP BDY

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A	DRAFT	MJRA	11/2025
Rev	Description	By	Date
Survey	MAVEN		06/2025
Design	MKS		07/2025
Drawn	MJRA		11/2025
Checked	DJM		11/2025



Project
**SOUTHERN LINKS 1
RESIDENTIAL STAGE 1
HAMILTON, WAIKATO
FOR
SL1 CONSORTIUM GROUP**

Title
**PROPOSED STORMWATER
WETLAND E
SECTIONS**

Project no.	298001-R1 SL1
Scale	AS SHOWN
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-10
Rev	C

DRAFT FOR REVIEW



STORMWATER DETENTION D
CATCHMENT AREA: 4.20 HA

DETENTION
POND F

F1

R1-C440-12

F2

R1-C440-12

F2

R1-C440-12

F1

R1-C440-12

Mangakotukutuku Stream

ROAD 8

ROAD 16

ROAD 9

WIDE EMERGENCY SPILLWAY
REFER TO DWG 298001-R1-C442
FOR DETAILS

NOTES

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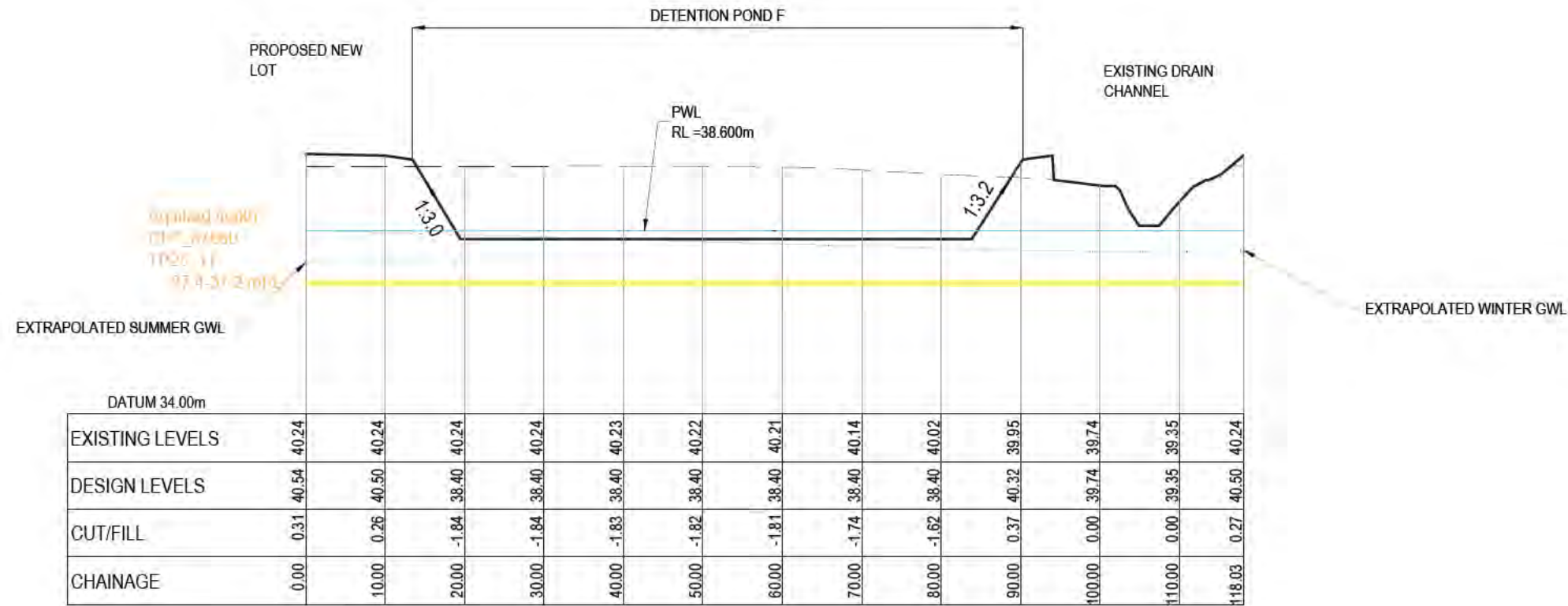


Project
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RESIDENTIAL STAGE 1
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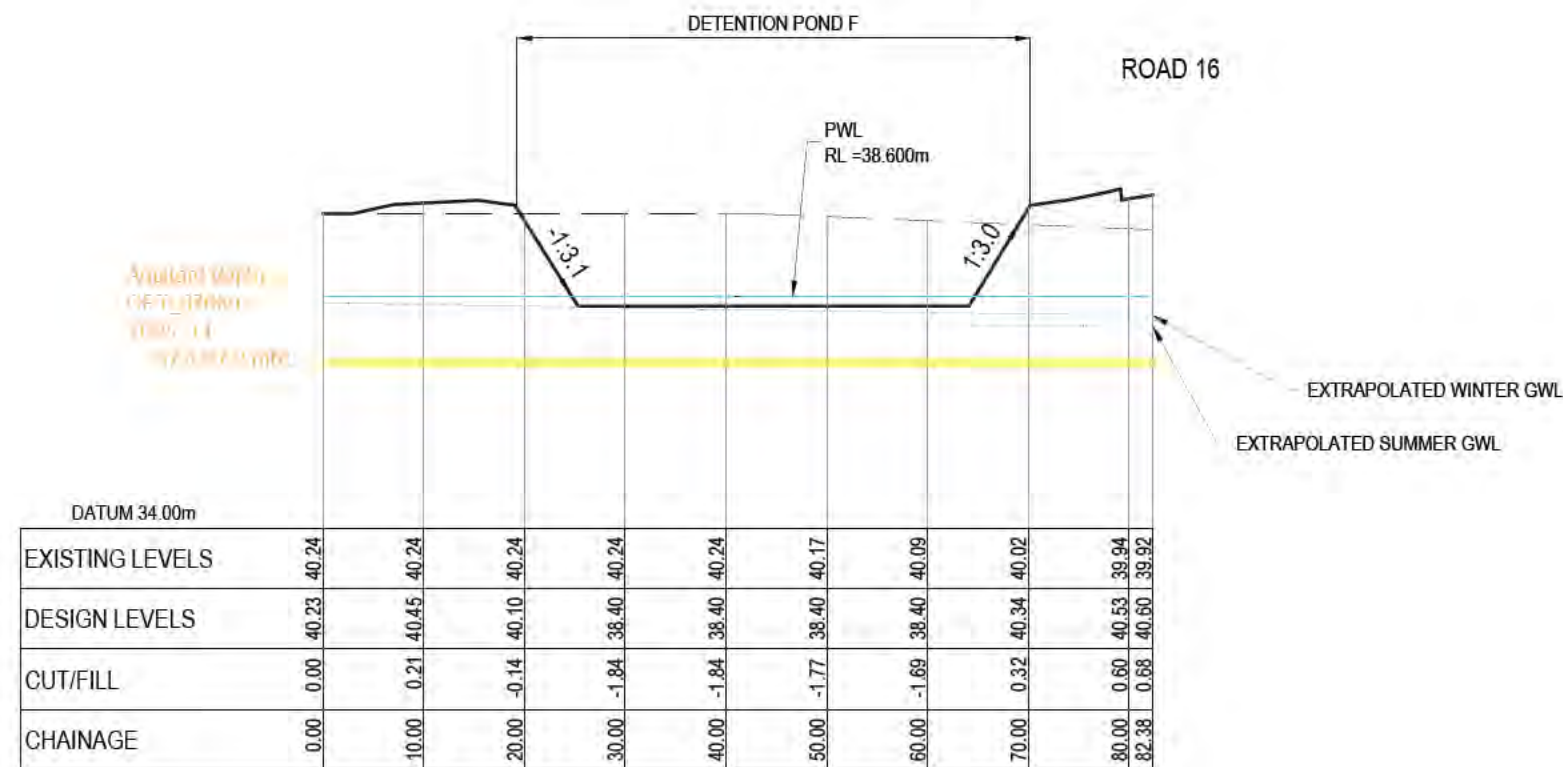
Title
**PROPOSED STORMWATER
DETENTION POND F
PLAN**

Project no.	298001-R1 SL1
Scale	1:750 @ A3
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-11
Rev	C

DRAFT FOR REVIEW



PROPOSED - Section - F1 CH 0+00.00 TO CH 1+18.03
SCALE: 1:750 H / 1:150 V



PROPOSED - Section - F2 CH 0+00.00 TO CH 0+82.38
SCALE: 1:750 H / 1:150 V

DRAFT FOR REVIEW

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PROP BDY

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A	DRAFT	MJRA	11/2025

Rev	Description	By	Date
Survey	MAVEN		06/2025
Design	MKS		07/2025
Drawn	MJRA		11/2025
Checked	DJM		11/2025



Project
**SOUTHERN LINKS 1
RESIDENTIAL STAGE 1
HAMILTON, WAIKATO
FOR
SL1 CONSORTIUM GROUP**

Title
**PROPOSED STORMWATER
DETENTION POND F
SECTIONS**

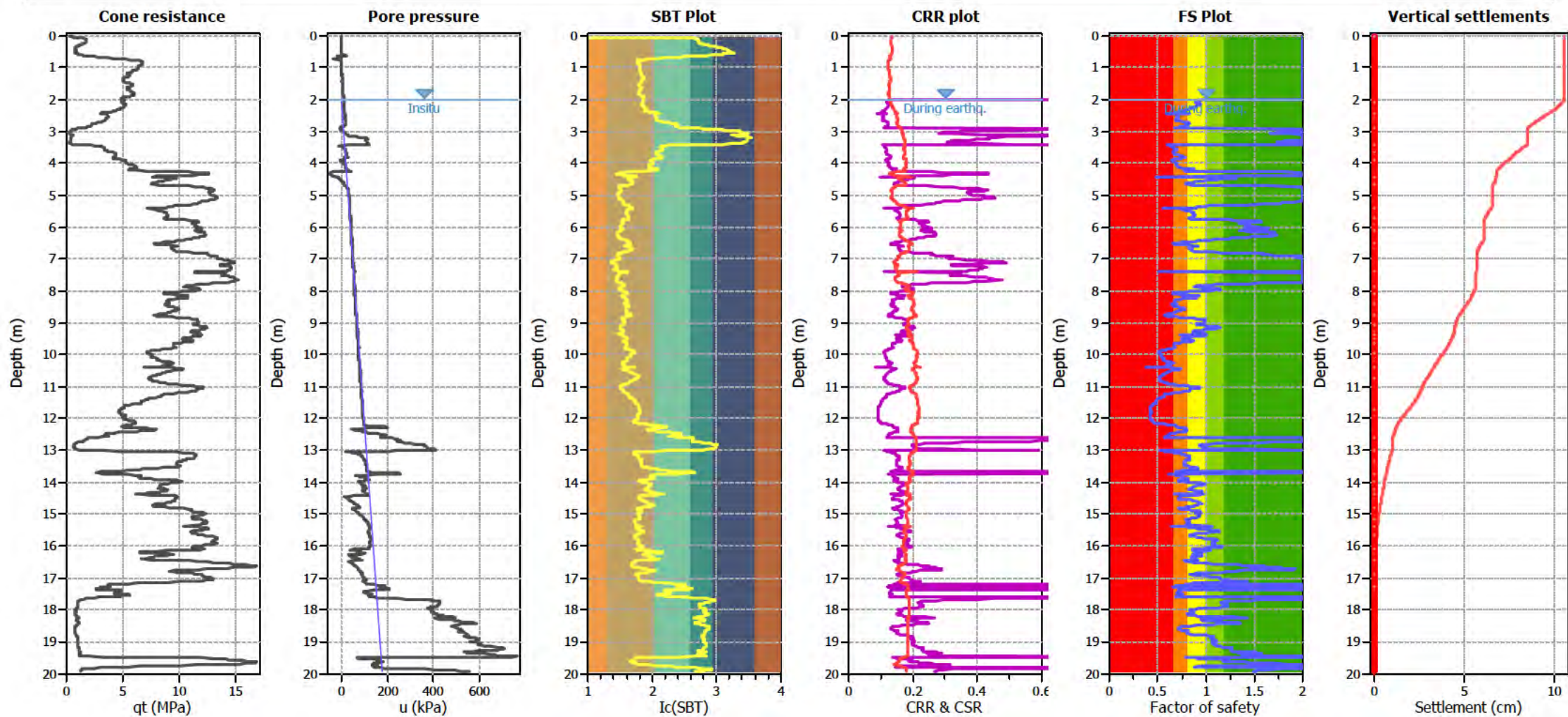
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Scale	AS SHOWN
Cad file	298001-R1-C440 SW WETLAND.DWG
Drawing no.	R1-C440-12
Rev	C

Project:

Location:

CPT: CPT_87660

Total depth: 19.93 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w : 5.90
Peak ground acceleration: 0.25

G.W.T. (in-situ): 2.00 m
G.W.T. (earthq.): 2.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: No
 K_a applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

TEST PIT LOG - TP25-11

Client: Colliers Project Leaders Ltd
Project: Southern Links Stage 1 Residential Area
Site Location: Deanwell, Hamilton
Project No.: HAM2024-0017
Date: 23/04/2025
Test Pit Location: Refer to Site Plan



CMW Geosciences
Great People | Practical Solutions

Logged by: DB Checked by: MM Scale: 1:25 Sheet 1 of 1

Position: 445066.9mE; 694588.0mN Projection: Mt Eden 2000 Pit Dimensions: 4.0m by 1.0m
Elevation: 40.50m Datum: NZVD 2016 Survey Source: Hand-held GPS

Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/1 mm)			Structure & Other Observations Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks	
	Depth	Type & Results							5	15	20		
23-04-2025			40.5			OL: Organic SILT: brown. Low plasticity. (Topsoil)						2	
			40.3			ML: SILT: with some fine sand. Light brown. Low plasticity. (Hinuera Formation) ... at 0.30m, Becoming light grey.		F				1	
			39.9			SW: Fine to coarse SAND: with trace silt. Light grey. Well graded (Hinuera Formation)						7	
				1				MD				7	
												5	
												5	
												6	
												4	
												4	
												4	
												4	
												6	
												6	
												7	
												5	
				2		... at 2.00m, Becoming grey and becoming more silty.		S				6	
	2.3	Peak = 44kPa Residual = 15kPa	38.3			Moderate silty silt: some clay and trace silt. Grey. Low plasticity. (Hinuera Formation)						5	
											4		
											4		
											3		
	2.8	Peak = 74kPa Residual = 29kPa					M					5	
							St to VSt					5	
												3	
												4	
				3								5	
			37.4			Organic SILT: brown. Low plasticity. Moderately sensitive. (Hinuera Formation)		St				5	
			37			ML: Fine to medium liquid clay SILT: grey. Low plasticity. (Hinuera Formation)						4	
		Peak = 53kPa Residual = 22kPa					St					5	
												7	
												7	
												7	
							S					8	
												7	
			36.7			SW: Fine to coarse SAND: with some fine gravel and minor silt. bluish grey. Well graded. Gravel: pumiceous. (Hinuera Formation)		MD				7	
Test pit terminated at 4.20 m													

Termination Reason: Pit collapse.
Shear Vane No: 2955 DCP No: 34
Remarks: Groundwater encountered at 2.0m.

PHOTOGRAPH SHEET - TP25-11

Client:
Project: Southern Links
Location: Hamilton
Project ID: HAM2024-0017
Date: 23/04/2025



TP25-11:



TP25-11:

This borehole report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination.

APPENDIX D

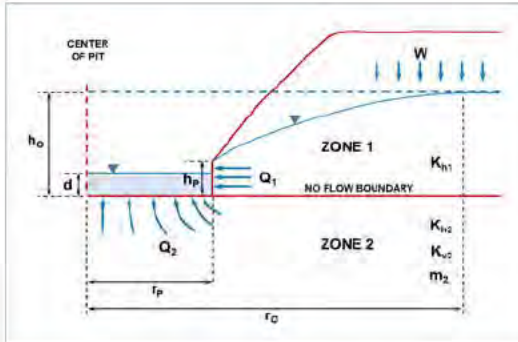
ARTIFICIAL WETLAND DRAWDOWN PIT MODELLING



INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland A - Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.57	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	52.6241	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	312	m
Known h _o	1.57	m
h _o calculated using Equation A	1.57	m

Q ₁	2.4E-03	m ³ /s
	2.0E+02	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

Q ₂	6.0E-02	m ³ /s
	5.2E+03	m ³ /day

Total Pit Inflow

Q _{TOT}	6.2E-02	m ³ /s
	5361.39	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

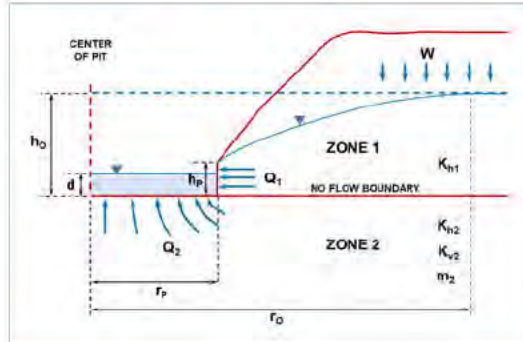
Analysed by: Toby Beisly
 Checked by:

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland A - Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone1} = h_0 - \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

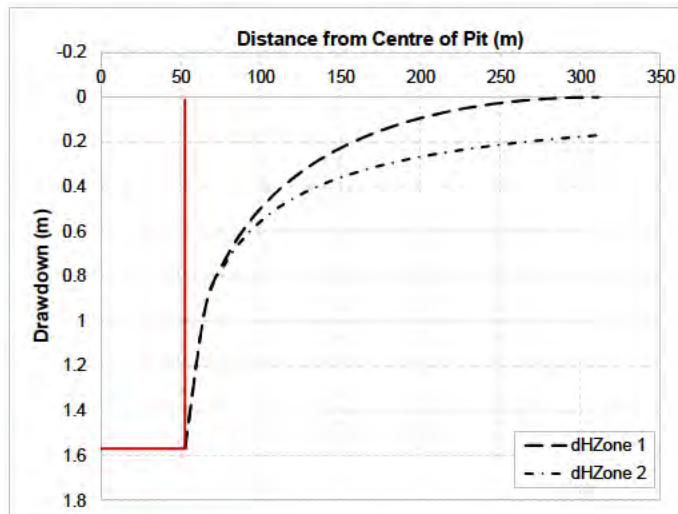
$$dH_{Zone2} = \frac{2(h_0 - d)}{\pi} \sin^{-1}\left(\frac{r_p}{r}\right)$$

$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h ₀	1.57	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	52.6241	m	effective pit radius
d	0	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1 312 m



Drawdown curves		
r	dHZone1	dHZone2
52.6241	1.57	1.6
65.6	0.9	0.9
78.5	0.7	0.7
91.5	0.6	0.6
104.4	0.5	0.5
117.4	0.4	0.5
130.3	0.3	0.4
143.3	0.3	0.4
156.3	0.2	0.3
169.2	0.2	0.3
182.2	0.1	0.3
195.1	0.1	0.3
208.1	0.1	0.3
221.0	0.06	0.2
234.0	0.04	0.2
246.9	0.03	0.2
259.9	0.02	0.2
272.8	0.01	0.2
285.8	0.00	0.2
298.7	0.00	0.2
311.7	0.00	0.2

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

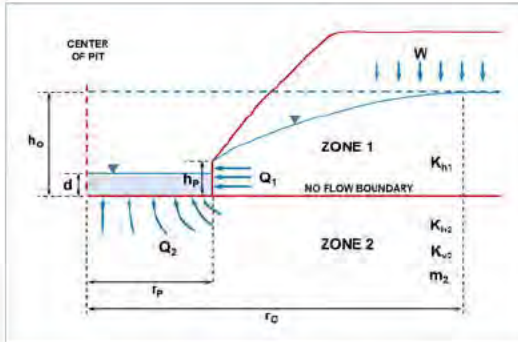
Analysed by: Toby Beisly
 Checked by:

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland B Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	1.67	m	initial saturated thickness above the base of Zone 1
hp	0	m	saturated thickness at the pit wall
rp	36.56366	m	effective pit radius
d	0	m	depth of the pit lake

ro is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence ro calculated by iterating equation A	298	m
Known h0	1.67	m
h0 calculated using Equation A	1.67	m

Q1	2.2E-03	m ³ /s
	1.9E+02	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

	2.236068	
Q2	4.4E-02	m ³ /s
	3.8E+03	m ³ /day

Total Pit Inflow

QTOT	4.6E-02	m ³ /s
	4000.06	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

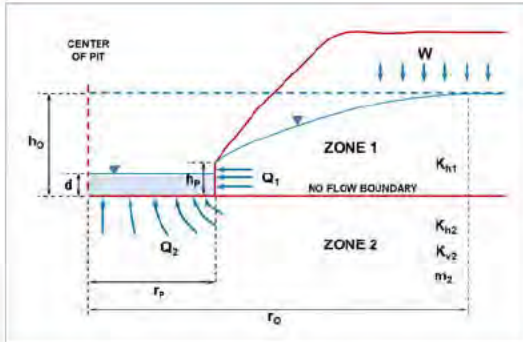
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland B Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r} \right))$$

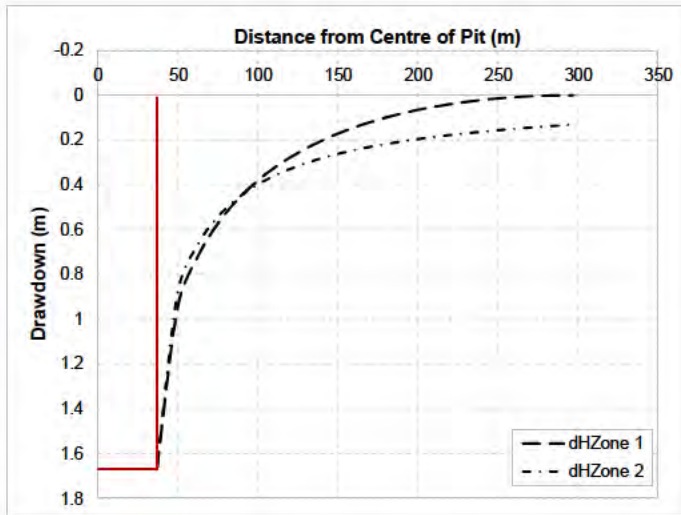
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	1.67	m	initial saturated thickness above the base of Zone 1
hp	0	m	saturated thickness at the pit wall
rp	36.56366	m	effective pit radius
d	0	m	depth of the pit lake

ro is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence ro calculated by iterating equation A in analysis sheet 1

298 m



Drawdown curves		
r	dHZone 1	dHZone 2
36.56366	1.67	1.7
49.6	0.9	0.9
62.7	0.7	0.7
75.7	0.6	0.5
88.8	0.5	0.5
101.8	0.4	0.4
114.9	0.3	0.3
127.9	0.2	0.3
141.0	0.2	0.3
154.1	0.2	0.3
167.1	0.1	0.2
180.2	0.1	0.2
193.2	0.1	0.2
206.3	0.06	0.2
219.3	0.04	0.2
232.4	0.03	0.2
245.4	0.02	0.2
258.5	0.01	0.2
271.5	0.00	0.1
284.6	0.00	0.1
297.6	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

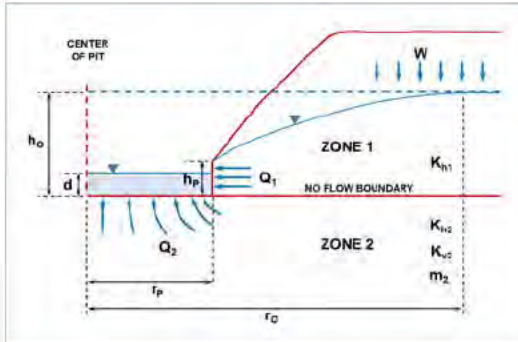
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dHZone2 line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland C Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K_{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K_{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K_{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h_o	1.22	m	initial saturated thickness above the base of Zone 1
h_p	0	m	saturated thickness at the pit wall
r_p	46.18091	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r_o calculated by iterating equation A

251 m

Known h_o

1.22 m

h_o calculated using Equation A

1.22 m

Q_1 1.5E-03 m³/s
1.3E+02 m³/day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

2.236068

Q_2 4.1E-02 m³/s
3.5E+03 m³/day

Total Pit Inflow

Q_{TOT} 4.2E-02 m³/s
3648.07 m³/day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

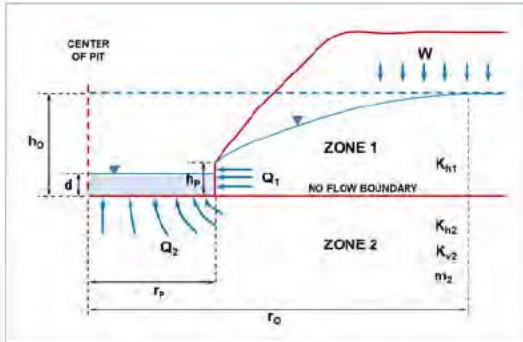
Analysed by: Toby Beisly
 Checked by:

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland C Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r} \right))$$

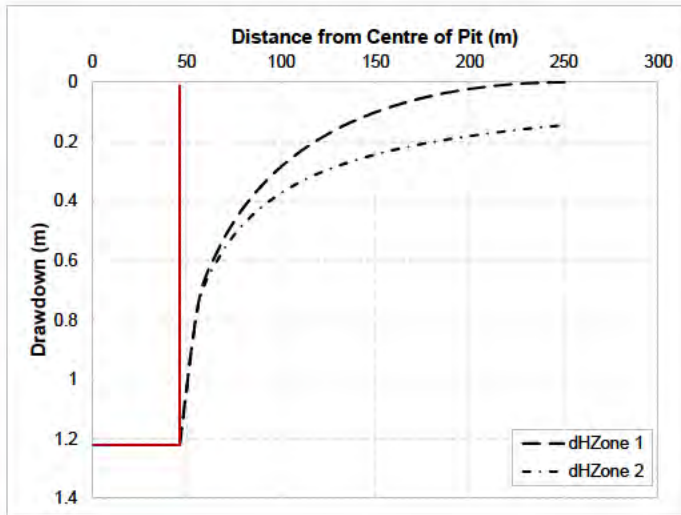
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	1.22	m	initial saturated thickness above the base of Zone 1
hp	0	m	saturated thickness at the pit wall
rp	46.18091	m	effective pit radius
d	0	m	depth of the pit lake

ro is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence ro calculated by iterating equation A in analysis sheet 1

251 m



Drawdown curves		
r	dHZone 1	dHZone 2
46.18091	1.22	1.2
56.4	0.7	0.7
66.6	0.6	0.6
76.8	0.5	0.5
87.1	0.4	0.4
97.3	0.3	0.4
107.5	0.2	0.3
117.7	0.2	0.3
127.9	0.2	0.3
138.2	0.1	0.3
148.4	0.1	0.2
158.6	0.1	0.2
168.8	0.1	0.2
179.0	0.05	0.2
189.2	0.03	0.2
199.5	0.02	0.2
209.7	0.01	0.2
219.9	0.01	0.2
230.1	0.00	0.2
240.3	0.00	0.2
250.6	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

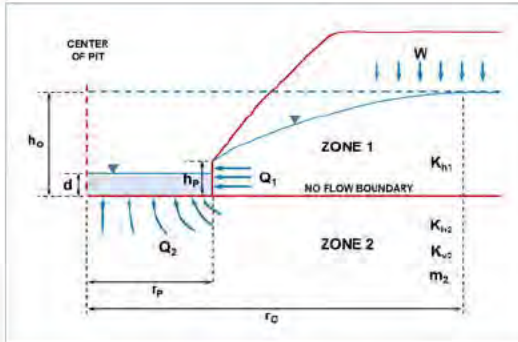
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dHZone2 line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland D Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.266998	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	39.89423	m	effective pit radius
d	0	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	248	m
Known h _o	1.27	m
h _o calculated using Equation A	1.27	m

Q ₁	1.5E-03	m ³ /s
	1.3E+02	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

	2.236068	
Q ₂	3.7E-02	m ³ /s
	3.2E+03	m ³ /day

Total Pit Inflow

Q _{TOT}	3.8E-02	m ³ /s
	3284.48	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

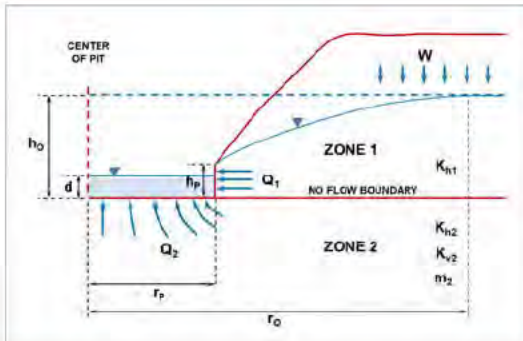
Analysed by: Toby Beisly
 Checked by:

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland D Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r}\right))$$

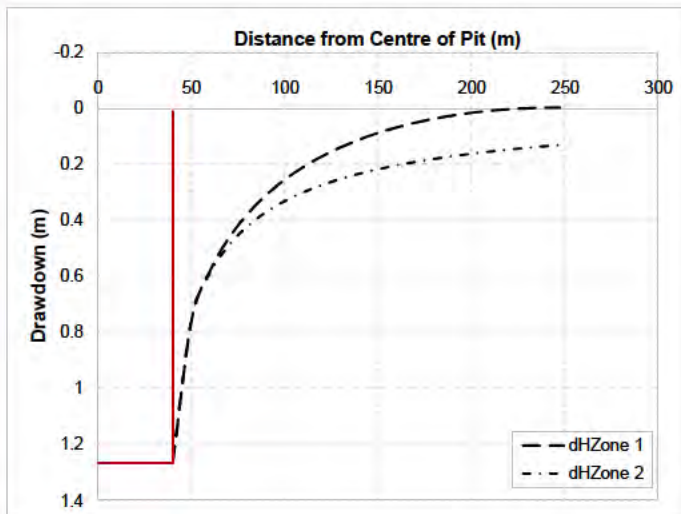
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h ₀	1.266998	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	39.89423	m	effective pit radius
d	0	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1

248 m



Drawdown curves		
r	dH _{Zone 1}	dH _{Zone 2}
39.89423	1.266998	1.3
50.3	0.7	0.7
60.7	0.6	0.6
71.1	0.5	0.5
81.5	0.4	0.4
91.9	0.3	0.4
102.3	0.2	0.3
112.7	0.2	0.3
123.1	0.2	0.3
133.4	0.1	0.2
143.8	0.1	0.2
154.2	0.1	0.2
164.6	0.1	0.2
175.0	0.04	0.2
185.4	0.03	0.2
195.8	0.02	0.2
206.2	0.01	0.2
216.6	0.00	0.1
227.0	0.00	0.1
237.4	0.00	0.1
247.8	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

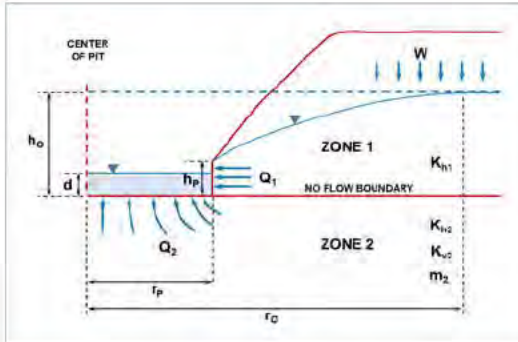
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland E Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.246998	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	37.21086	m	effective pit radius
d	0	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r₀ calculated by iterating equation A

240 m

Known h₀

1.25 m

h₀ calculated using Equation A

1.25 m

Q₁ 1.4E-03 m³/s
1.2E+02 m³/day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

2.236068

Q₂ 3.4E-02 m³/s
2.9E+03 m³/day

Total Pit Inflow

Q_{TOT} 3.5E-02 m³/s
3018.46 m³/day

Reference: Marinelli, F. & Niccoli W. L. 2000.
Simple analytical equations for estimating ground water inflow to a mine pit. Ground Water 38, no. 2: 311-314.

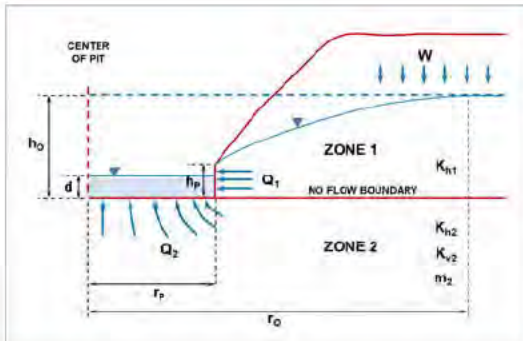
Analysed by: Toby Beisly
 Checked by:

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland E Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r}\right))$$

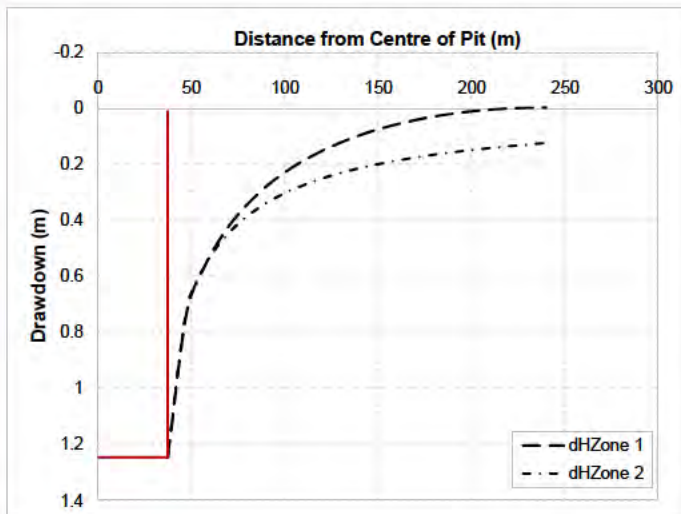
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.246998	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	37.21086	m	effective pit radius
d	0	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1

240 m



Drawdown curves		
r	dH _{Zone 1}	dH _{Zone 2}
37.21086	1.246998	1.2
47.4	0.7	0.7
57.5	0.6	0.6
67.7	0.4	0.5
77.9	0.4	0.4
88.0	0.3	0.3
98.2	0.2	0.3
108.3	0.2	0.3
118.5	0.2	0.3
128.7	0.1	0.2
138.8	0.1	0.2
149.0	0.1	0.2
159.1	0.1	0.2
169.3	0.04	0.2
179.5	0.03	0.2
189.6	0.02	0.2
199.8	0.01	0.1
209.9	0.00	0.1
220.1	0.00	0.1
230.3	0.00	0.1
240.4	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow to a mine pit. Ground Water 38, no. 2: 311-314.

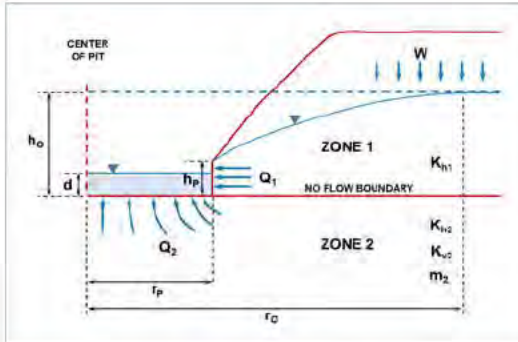
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland F Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	0.8	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	32.89762	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	168	m
Known h _o	0.80	m
h _o calculated using Equation A	0.80	m

Q ₁	6.8E-04	m ³ /s
	5.9E+01	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

	2.236068	
Q ₂	1.9E-02	m ³ /s
	1.6E+03	m ³ /day

Total Pit Inflow

Q _{TOT}	2.0E-02	m ³ /s
	1701.87	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

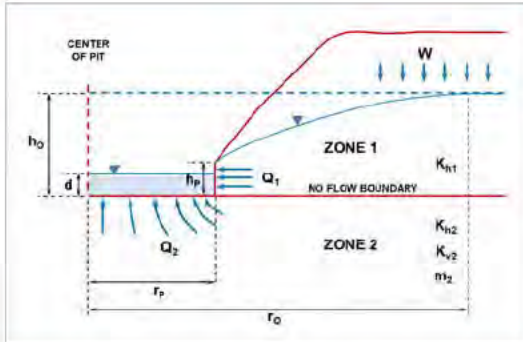
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland F Winter Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r}\right))$$

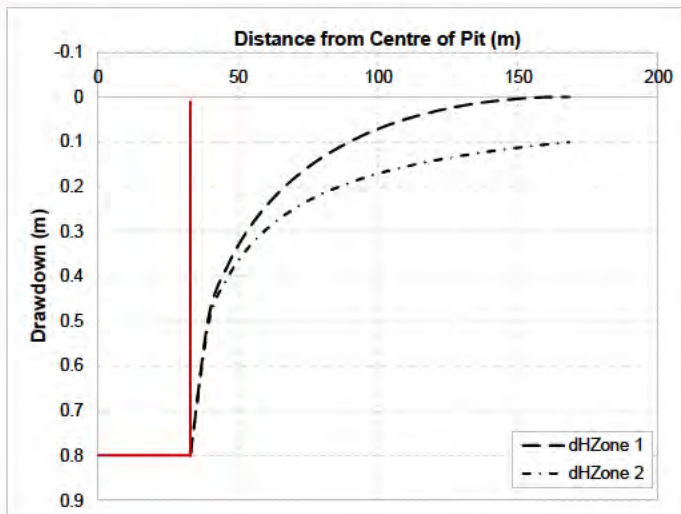
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	0.8	m	initial saturated thickness above the base of Zone 1
hp	0	m	saturated thickness at the pit wall
rp	32.89762	m	effective pit radius
d	0	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1

168 m



Drawdown curves		
r	dH _{Zone 1}	dH _{Zone 2}
32.89762	0.8	0.8
39.7	0.5	0.5
46.5	0.4	0.4
53.2	0.3	0.3
60.0	0.2	0.3
66.8	0.2	0.3
73.6	0.2	0.2
80.3	0.1	0.2
87.1	0.1	0.2
93.9	0.1	0.2
100.7	0.1	0.2
107.4	0.1	0.2
114.2	0.0	0.1
121.0	0.03	0.1
127.8	0.02	0.1
134.6	0.01	0.1
141.3	0.01	0.1
148.1	0.00	0.1
154.9	0.00	0.1
161.7	0.00	0.1
168.4	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

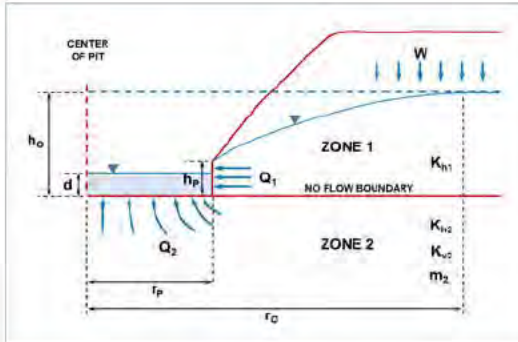
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland A Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.57	m	initial saturated thickness above the base of Zone 1
h _p	0.5	m	saturated thickness at the pit wall
r _p	52.62	m	effective pit radius
d	0.5	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	300	m
Known h _o	1.57	m
h _o calculated using Equation A	1.57	m

Q ₁	2.2E-03	m ³ /s
	1.9E+02	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

	2.236068	
Q ₂	4.1E-02	m ³ /s
	3.5E+03	m ³ /day

Total Pit Inflow

Q _{TOT}	4.3E-02	m ³ /s
	3703.05	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

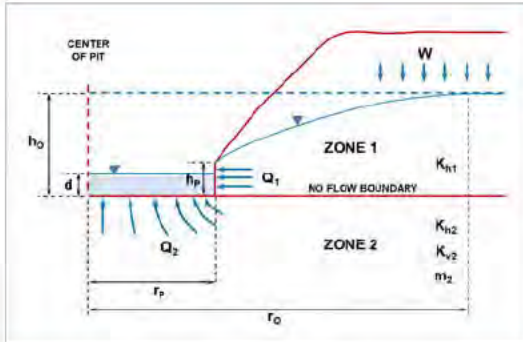
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland A Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r} \right))$$

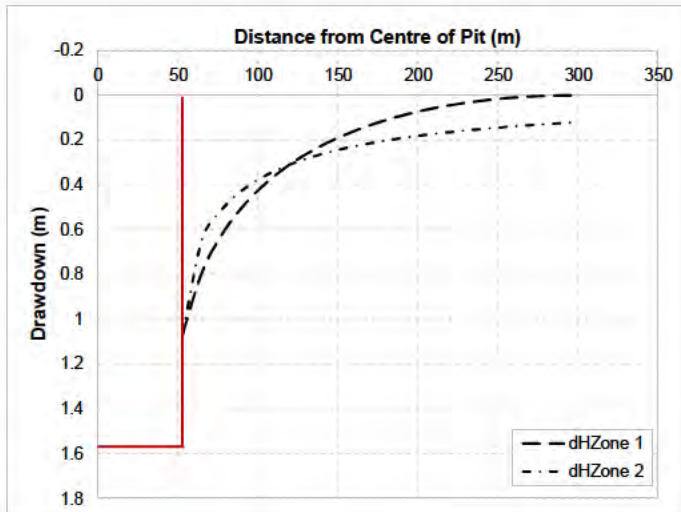
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h ₀	1.57	m	initial saturated thickness above the base of Zone 1
h _p	0.5	m	saturated thickness at the pit wall
r _p	52.6241	m	effective pit radius
d	0.5	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1

300 m



Drawdown curves		
r	dH _{Zone 1}	dH _{Zone 2}
52.6241	1.07	1.1
65.0	0.8	0.6
77.3	0.6	0.5
89.7	0.5	0.4
102.1	0.4	0.4
114.4	0.3	0.3
126.8	0.3	0.3
139.2	0.2	0.3
151.5	0.2	0.2
163.9	0.1	0.2
176.2	0.1	0.2
188.6	0.1	0.2
201.0	0.1	0.2
213.3	0.05	0.2
225.7	0.04	0.2
238.1	0.03	0.2
250.4	0.02	0.1
262.8	0.01	0.1
275.1	0.00	0.1
287.5	0.00	0.1
299.9	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

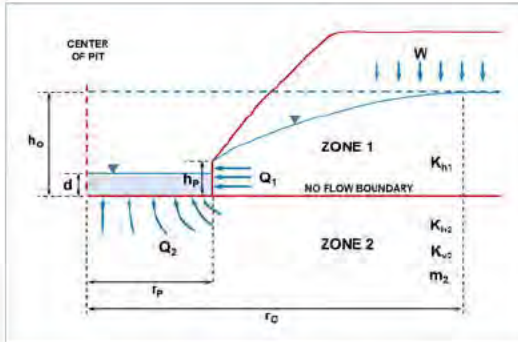
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland B Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.67	m	initial saturated thickness above the base of Zone 1
h _p	0.5	m	saturated thickness at the pit wall
r _p	36.56366	m	effective pit radius
d	0.5	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r_o calculated by iterating equation A

287 m

Known h_o

1.67 m

h_o calculated using Equation A

1.67 m

Q₁ 2.0E-03 m³/s
1.7E+02 m³/day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

2.236068

Q₂ 3.1E-02 m³/s
2.7E+03 m³/day

Total Pit Inflow

Q_{TOT} 3.3E-02 m³/s
2845.51 m³/day

Reference: Marinelli, F. & Niccoli W. L. 2000.
Simple analytical equations for estimating ground water inflow to a mine pit. Ground Water 38, no. 2: 311-314.

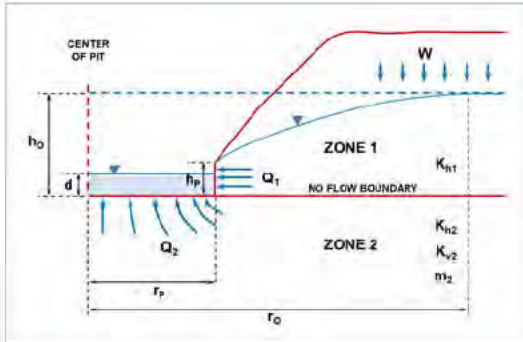
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland B Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r} \right))$$

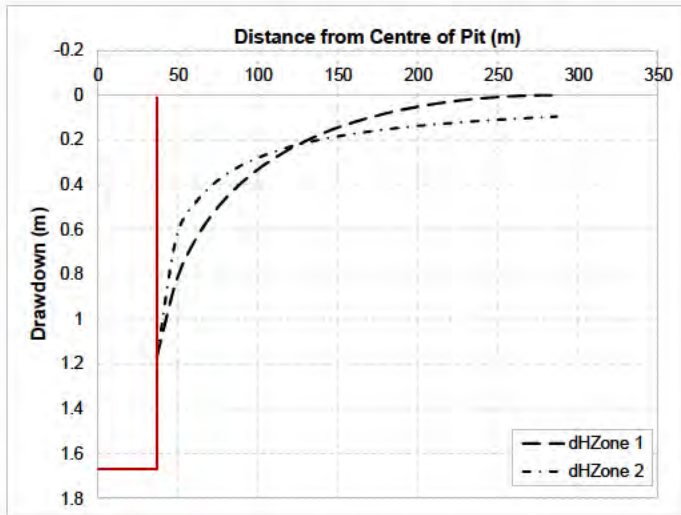
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	1.67	m	initial saturated thickness above the base of Zone 1
hp	0.5	m	saturated thickness at the pit wall
rp	36.56366	m	effective pit radius
d	0.5	m	depth of the pit lake

r_0 is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r_0 calculated by iterating equation A in analysis sheet 1

287 m



Drawdown curves		
r	dHZone 1	dHZone 2
36.56366	1.17	1.2
49.1	0.8	0.6
61.6	0.6	0.5
74.2	0.5	0.4
86.7	0.4	0.3
99.2	0.3	0.3
111.8	0.3	0.2
124.3	0.2	0.2
136.8	0.2	0.2
149.4	0.1	0.2
161.9	0.1	0.2
174.4	0.1	0.2
186.9	0.1	0.1
199.5	0.05	0.1
212.0	0.04	0.1
224.5	0.02	0.1
237.1	0.02	0.1
249.6	0.01	0.1
262.1	0.00	0.1
274.7	0.00	0.1
287.2	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

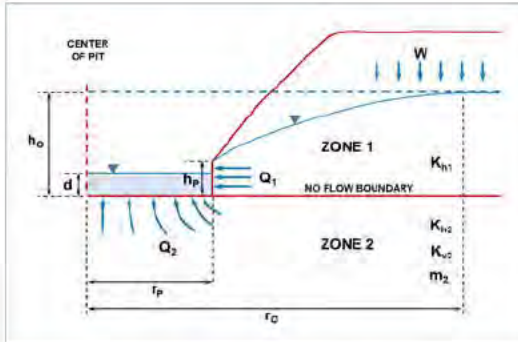
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The $dH_{Zone 2}$ line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland C Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.22	m	initial saturated thickness above the base of Zone 1
h _p	0.05	m	saturated thickness at the pit wall
r _p	46.18091	m	effective pit radius
d	0.05	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	250	m
Known h _o	1.22	m
h _o calculated using Equation A	1.22	m

Q ₁	1.5E-03	m ³ /s
	1.3E+02	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

Q ₂	3.9E-02	m ³ /s
	3.4E+03	m ³ /day

Total Pit Inflow

Q _{TOT}	4.1E-02	m ³ /s
	3503.75	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

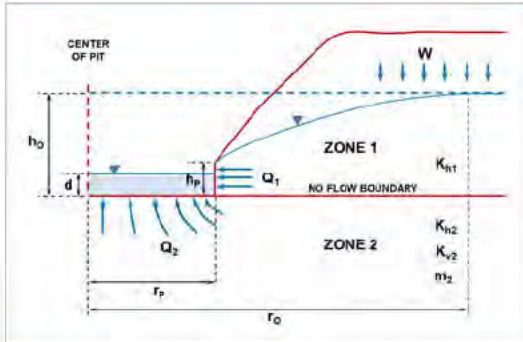
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland C Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r}\right))$$

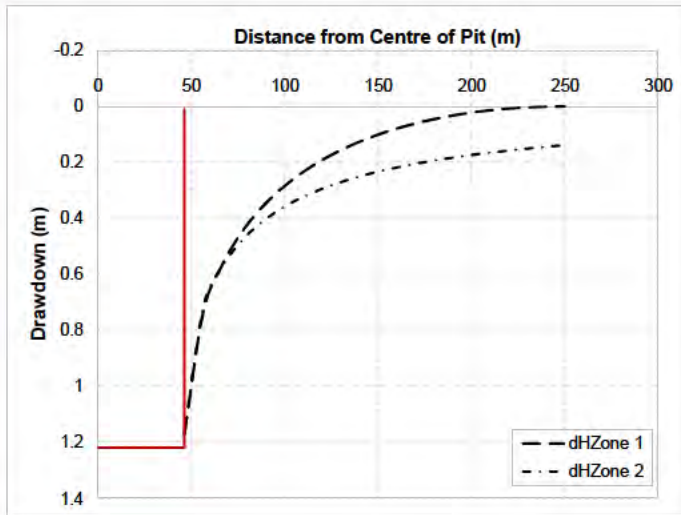
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	1.22	m	initial saturated thickness above the base of Zone 1
hp	0.05	m	saturated thickness at the pit wall
rp	46.18091	m	effective pit radius
d	0.05	m	depth of the pit lake

r_0 is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r_0 calculated by iterating equation A in analysis sheet 1

250 m



Drawdown curves		
r	dH _{Zone1}	dH _{Zone2}
46.18091	1.17	1.2
56.4	0.7	0.7
66.6	0.6	0.6
76.8	0.5	0.5
87.0	0.4	0.4
97.2	0.3	0.4
107.4	0.2	0.3
117.7	0.2	0.3
127.9	0.2	0.3
138.1	0.1	0.3
148.3	0.1	0.2
158.5	0.1	0.2
168.7	0.1	0.2
178.9	0.05	0.2
189.1	0.03	0.2
199.4	0.02	0.2
209.6	0.01	0.2
219.8	0.01	0.2
230.0	0.00	0.2
240.2	0.00	0.1
250.4	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

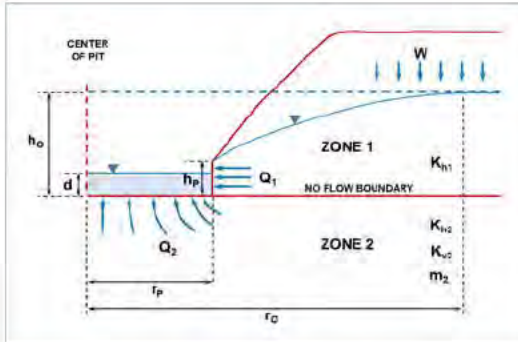
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland D Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.266998	m	initial saturated thickness above the base of Zone 1
h _p	0.47	m	saturated thickness at the pit wall
r _p	39.89423	m	effective pit radius
d	0.47	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	235	m
Known h _o	1.27	m
h _o calculated using Equation A	1.27	m

Q ₁	1.3E-03	m ³ /s
	1.2E+02	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

	2.236068	
Q ₂	2.3E-02	m ³ /s
	2.0E+03	m ³ /day

Total Pit Inflow

Q _{TOT}	2.4E-02	m ³ /s
	2100.34	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

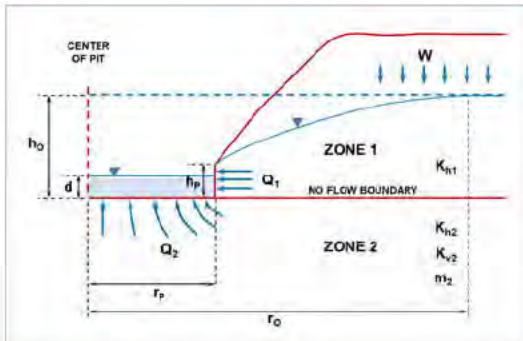
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland D Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r}\right))$$

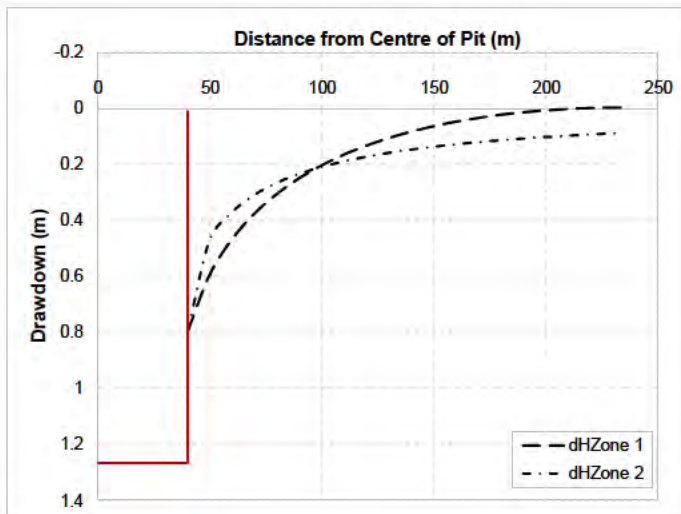
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	1.266998	m	initial saturated thickness above the base of Zone 1
hp	0.47	m	saturated thickness at the pit wall
rp	39.89423	m	effective pit radius
d	0.47	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1

235 m



Drawdown curves		
r	dH _{Zone 1}	dH _{Zone 2}
39.89423	0.796998	0.8
49.6	0.6	0.5
59.4	0.5	0.4
69.1	0.4	0.3
78.9	0.3	0.3
88.6	0.3	0.2
98.4	0.2	0.2
108.1	0.2	0.2
117.9	0.1	0.2
127.6	0.1	0.2
137.3	0.1	0.1
147.1	0.1	0.1
156.8	0.1	0.1
166.6	0.04	0.1
176.3	0.03	0.1
186.1	0.02	0.1
195.8	0.01	0.1
205.6	0.00	0.1
215.3	0.00	0.1
225.1	0.00	0.1
234.8	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

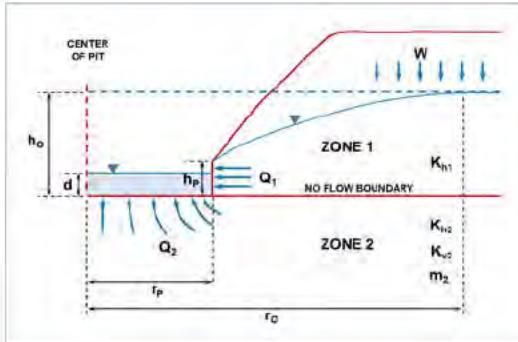
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland E Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.246998	m	initial saturated thickness above the base of Zone 1
h _p	0.4	m	saturated thickness at the pit wall
r _p	37.21086	m	effective pit radius
d	0.4	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r_o calculated by iterating equation A

231 m

Known h_o

1.25 m

h_o calculated using Equation A

1.25 m

Q₁ 1.3E-03 m³/s
1.1E+02 m³/day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

2.236068

Q₂ 2.3E-02 m³/s
2.0E+03 m³/day

Total Pit Inflow

Q_{TOT} 2.4E-02 m³/s
2079.67 m³/day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

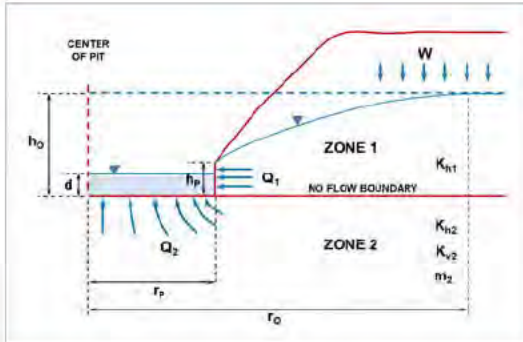
Analysed by: Toby Beisly
 Checked by:

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland E Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r} \right))$$

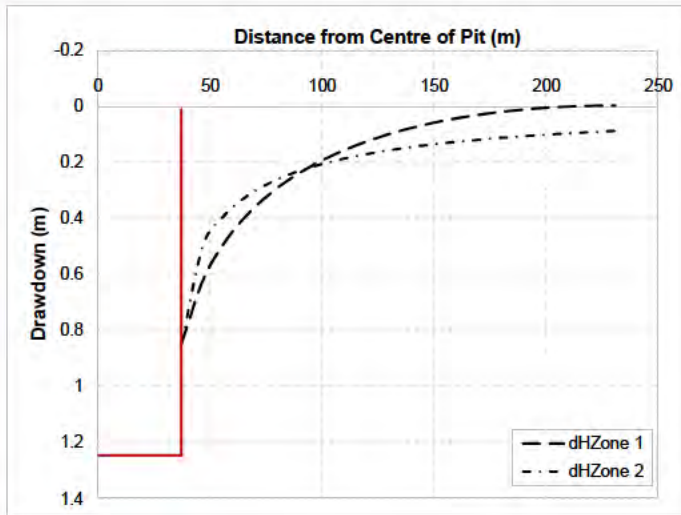
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	1.246998	m	initial saturated thickness above the base of Zone 1
hp	0.4	m	saturated thickness at the pit wall
rp	37.21086	m	effective pit radius
d	0.4	m	depth of the pit lake

ro is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence ro calculated by iterating equation A in analysis sheet 1

231 m



Drawdown curves		
r	dHZone 1	dHZone 2
37.21086	0.846998	0.8
46.9	0.6	0.5
56.6	0.5	0.4
66.3	0.4	0.3
76.0	0.3	0.3
85.7	0.3	0.2
95.4	0.2	0.2
105.1	0.2	0.2
114.8	0.1	0.2
124.4	0.1	0.2
134.1	0.1	0.2
143.8	0.1	0.1
153.5	0.1	0.1
163.2	0.04	0.1
172.9	0.03	0.1
182.6	0.02	0.1
192.3	0.01	0.1
202.0	0.00	0.1
211.7	0.00	0.1
221.4	0.00	0.1
231.1	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

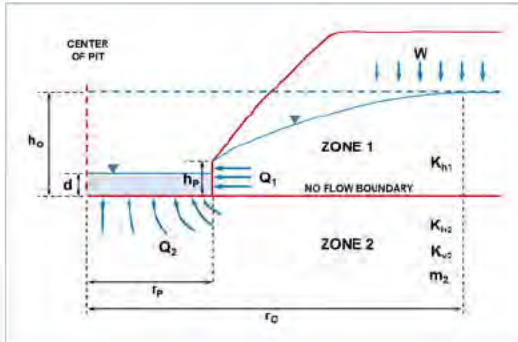
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dHZone2 line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland F Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	0.8	m	initial saturated thickness above the base of Zone 1
h _p	0.4	m	saturated thickness at the pit wall
r _p	32.89762	m	effective pit radius
d	0.4	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	152	m
Known h _o	0.80	m
h _o calculated using Equation A	0.80	m

Q ₁	5.5E-04	m ³ /s
	4.8E+01	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

Q ₂	9.5E-03	m ³ /s
	8.2E+02	m ³ /day

Total Pit Inflow

Q _{TOT}	1.0E-02	m ³ /s
	869.11	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

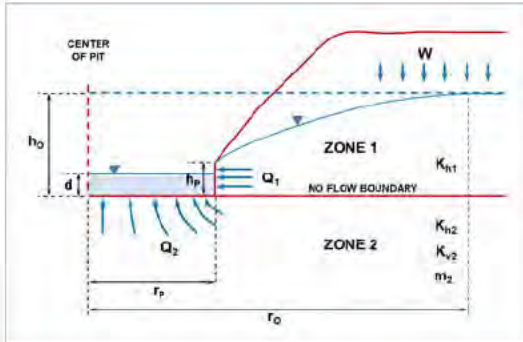
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland F Winter PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

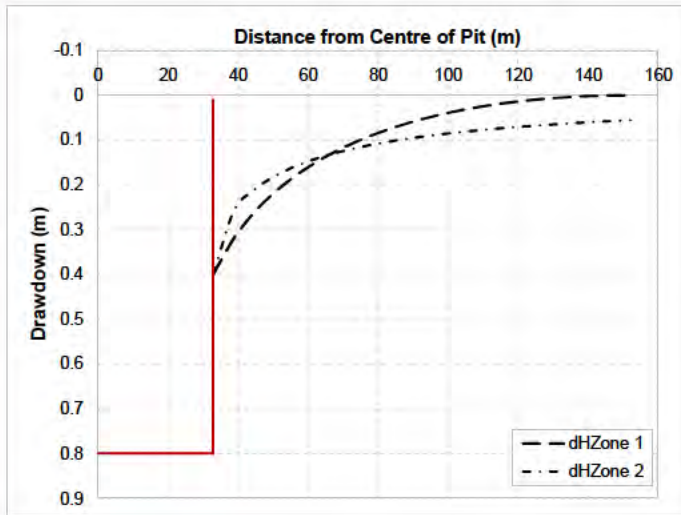
$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r} \right))$$

$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	0.000404	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h ₀	0.8	m	initial saturated thickness above the base of Zone 1
h _p	0.4	m	saturated thickness at the pit wall
r _p	32.89762	m	effective pit radius
d	0.4	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1 152 m



Drawdown curves		
r	dH _{Zone 1}	dH _{Zone 2}
32.89762	0.4	0.4
38.9	0.3	0.3
44.8	0.3	0.2
50.8	0.2	0.2
56.8	0.2	0.2
62.7	0.1	0.1
68.7	0.1	0.1
74.7	0.1	0.1
80.6	0.1	0.1
86.6	0.1	0.1
92.6	0.1	0.1
98.5	0.0	0.1
104.5	0.0	0.1
110.5	0.02	0.1
116.4	0.02	0.1
122.4	0.01	0.1
128.4	0.01	0.1
134.3	0.00	0.1
140.3	0.00	0.1
146.3	0.00	0.1
152.2	0.00	0.1

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

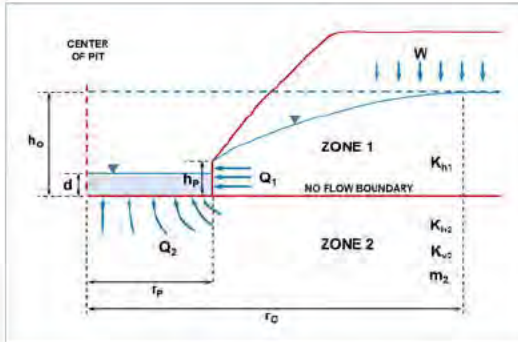
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland A - Summer Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K_{h1}	2.50E-05	m/s	horizontal hydraulic conductivity in Zone 1
K_{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K_{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h_o	1.04	m	initial saturated thickness above the base of Zone 1
h_p	0	m	saturated thickness at the pit wall
r_p	52.62	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r_o calculated by iterating equation A	105	m
Known h_o	1.04	m
h_o calculated using Equation A	1.04	m

Q_1	2.0E-04	m ³ /s
	1.8E+01	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

	2.236068	
Q_2	4.0E-02	m ³ /s
	3.4E+03	m ³ /day

Total Pit Inflow

Q_{TOT}	4.0E-02	m ³ /s
	3434.50	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

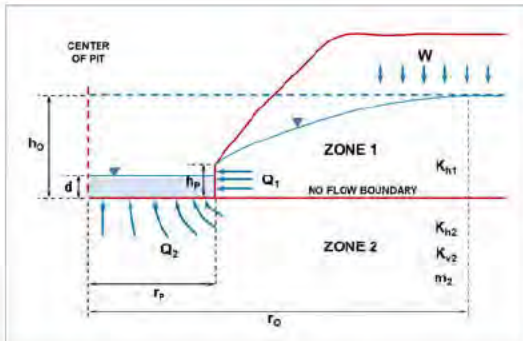
Analysed by: Toby _____ Beisly _____
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland A - Summer Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r} \right))$$

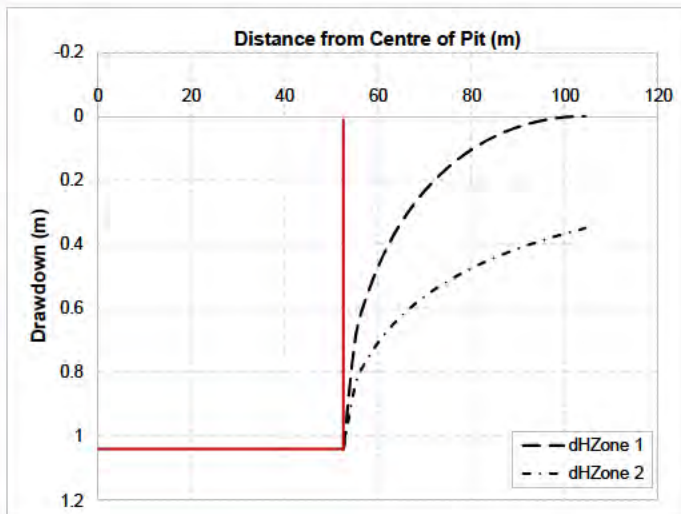
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	0.000025	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.04	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	52.6241	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r_o calculated by iterating equation A in analysis sheet 1

105 m



Drawdown curves		
r	dH _{Zone 1}	dH _{Zone 2}
52.6241	1.04	1.0
55.2	0.7	0.8
57.8	0.6	0.8
60.4	0.5	0.7
63.0	0.4	0.7
65.6	0.3	0.6
68.2	0.3	0.6
70.8	0.2	0.6
73.4	0.2	0.5
76.0	0.1	0.5
78.6	0.1	0.5
81.2	0.1	0.5
83.8	0.1	0.5
86.3	0.05	0.4
88.9	0.04	0.4
91.5	0.03	0.4
94.1	0.02	0.4
96.7	0.01	0.4
99.3	0.00	0.4
101.9	0.00	0.4
104.5	0.00	0.3

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

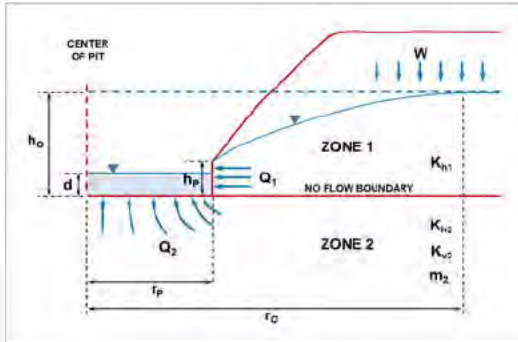
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland B - Summer Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	2.50E-05	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.14	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	36.56366	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	91	m
Known h _o	1.14	m
h _o calculated using Equation A	1.14	m

Q ₁	1.7E-04	m ³ /s
	1.5E+01	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

	2.236068	
Q ₂	3.0E-02	m ³ /s
	2.6E+03	m ³ /day

Total Pit Inflow

Q _{TOT}	3.0E-02	m ³ /s
	2617.41	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

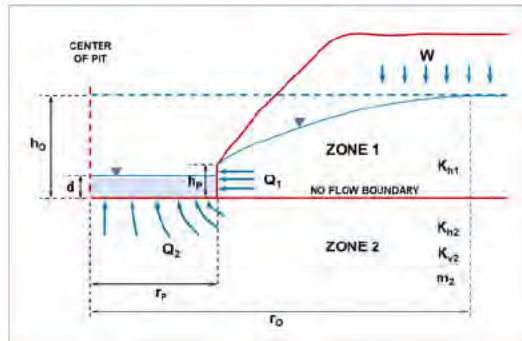
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland B - Summer Dry Pit
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone1} = h_0 - \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone2} = \frac{2(h_0 - d)}{\pi} \sin^{-1}\left(\frac{r_p}{r}\right)$$

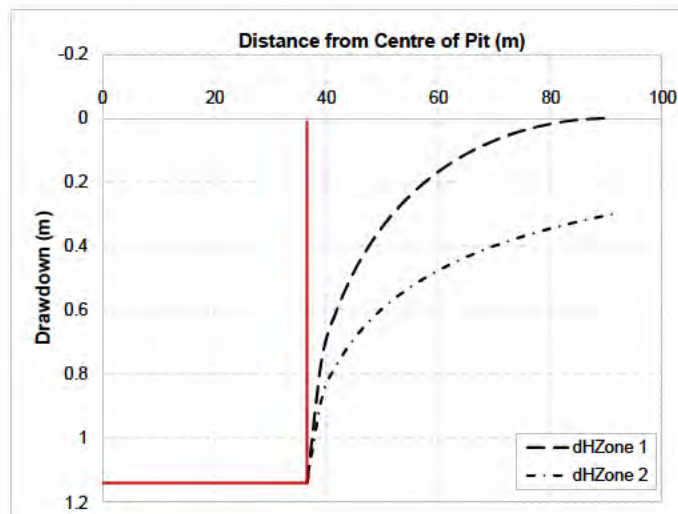
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	0.000025	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h ₀	1.14	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	36.56366	m	effective pit radius
d	0	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1

91 m



Drawdown curves

r	dH _{Zone 1}	dH _{Zone 2}
36.56366	1.14	1.1
39.3	0.7	0.9
42.0	0.6	0.8
44.8	0.5	0.7
47.5	0.4	0.6
50.2	0.3	0.6
52.9	0.3	0.6
55.7	0.2	0.5
58.4	0.2	0.5
61.1	0.2	0.5
63.9	0.1	0.4
66.6	0.1	0.4
69.3	0.1	0.4
72.0	0.06	0.4
74.8	0.04	0.4
77.5	0.03	0.4
80.2	0.02	0.3
83.0	0.01	0.3
85.7	0.00	0.3
88.4	0.00	0.3
91.1	0.00	0.3

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

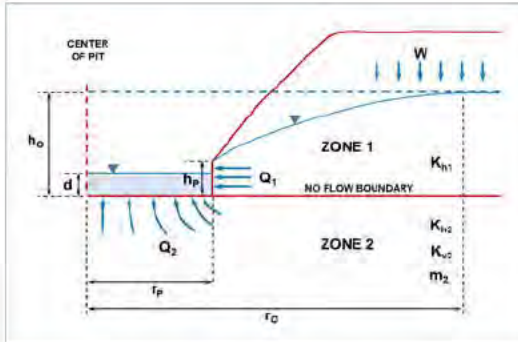
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland A Summer PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	2.50E-05	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.04	m	initial saturated thickness above the base of Zone 1
h _p	0.5	m	saturated thickness at the pit wall
r _p	52.62	m	effective pit radius
d	0.5	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	99	m
Known h _o	1.04	m
h _o calculated using Equation A	1.04	m

Q ₁	1.7E-04	m ³ /s
	1.5E+01	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

Q ₂	2.1E-02	m ³ /s
	1.8E+03	m ³ /day

Total Pit Inflow

Q _{TOT}	2.1E-02	m ³ /s
	1789.13	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

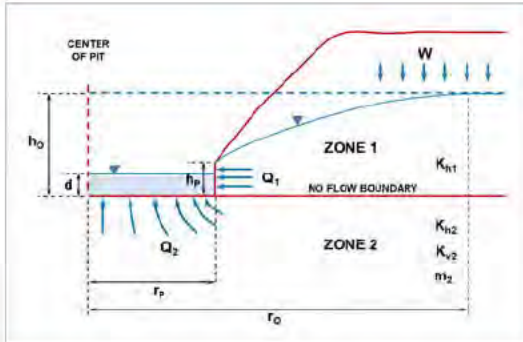
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland A Summer PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r}\right))$$

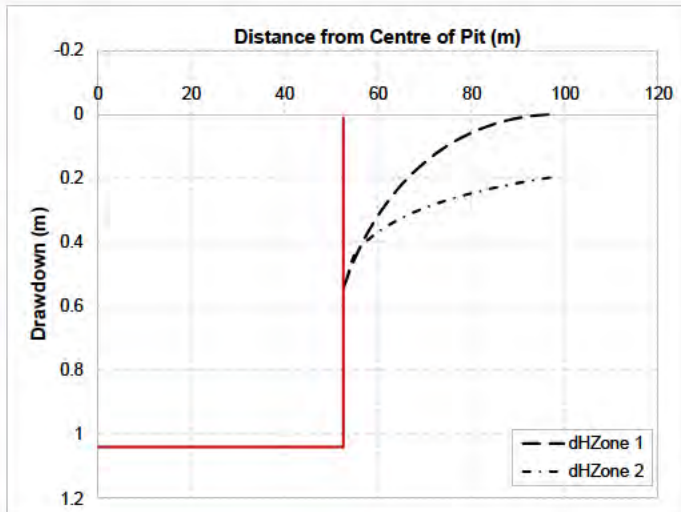
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000025	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.04	m	initial saturated thickness above the base of Zone 1
h _p	0.5	m	saturated thickness at the pit wall
r _p	52.6241	m	effective pit radius
d	0.5	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1

99 m



Drawdown curves		
r	dH _{Zone 1}	dH _{Zone 2}
52.6241	0.54	0.5
54.9	0.5	0.4
57.2	0.4	0.4
59.5	0.3	0.4
61.8	0.3	0.4
64.1	0.2	0.3
66.4	0.2	0.3
68.7	0.2	0.3
71.0	0.1	0.3
73.3	0.1	0.3
75.6	0.1	0.3
77.9	0.1	0.3
80.2	0.1	0.2
82.5	0.04	0.2
84.8	0.03	0.2
87.1	0.02	0.2
89.4	0.01	0.2
91.7	0.01	0.2
94.0	0.00	0.2
96.3	0.00	0.2
98.6	0.00	0.2

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

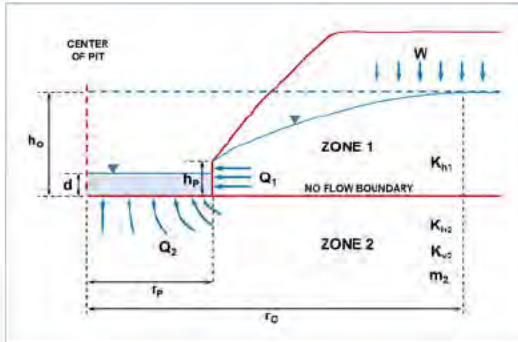
Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The dH_{Zone2} line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland B Summer PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	2.50E-05	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	1.14	m	initial saturated thickness above the base of Zone 1
h _p	0.5	m	saturated thickness at the pit wall
r _p	36.56366	m	effective pit radius
d	0.5	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	86	m
Known h _o	1.14	m
h _o calculated using Equation A	1.14	m

Q ₁	1.5E-04	m ³ /s
	1.3E+01	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

	2.236068	
Q ₂	1.7E-02	m ³ /s
	1.5E+03	m ³ /day

Total Pit Inflow

Q _{TOT}	1.7E-02	m ³ /s
	1474.08	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

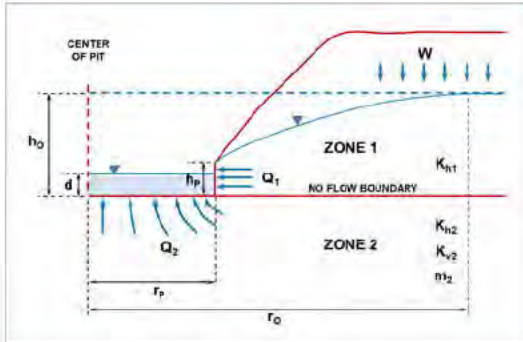
Analysed by: Toby Beisly
 Checked by: _____

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: Wetland B Summer PWL
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone\ 2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r} \right))$$

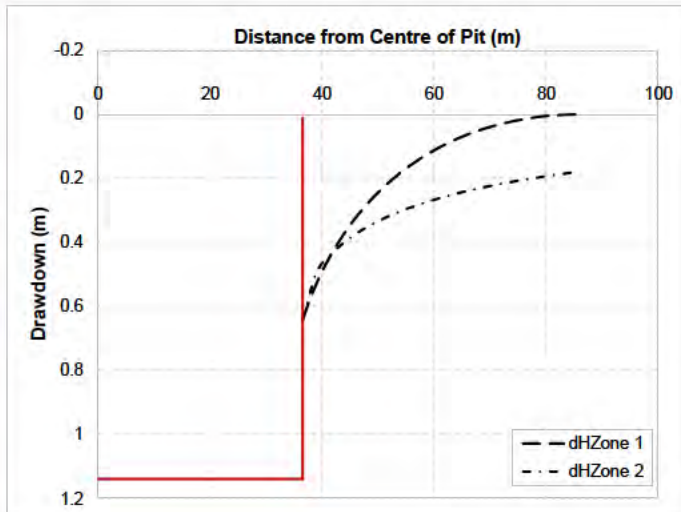
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
Kh1	0.000025	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	1.14	m	initial saturated thickness above the base of Zone 1
hp	0.5	m	saturated thickness at the pit wall
rp	36.56366	m	effective pit radius
d	0.5	m	depth of the pit lake

r_0 is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r_0 calculated by iterating equation A in analysis sheet 1

86 m



Drawdown curves		
r	dHZone 1	dHZone 2
36.56366	0.64	0.6
39.0	0.5	0.5
41.5	0.4	0.4
44.0	0.4	0.4
46.5	0.3	0.4
48.9	0.3	0.3
51.4	0.2	0.3
53.9	0.2	0.3
56.4	0.2	0.3
58.9	0.1	0.3
61.3	0.1	0.3
63.8	0.1	0.2
66.3	0.1	0.2
68.8	0.05	0.2
71.2	0.03	0.2
73.7	0.02	0.2
76.2	0.01	0.2
78.7	0.01	0.2
81.1	0.00	0.2
83.6	0.00	0.2
86.1	0.00	0.2

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

Analysed by: Toby
 Checked by: Beisly

Notes: The drawdown curves apply along the no-flow boundary line at an elevation equivalent to the base of the pit.
 The $dH_{Zone\ 2}$ line does not take into account recharge from above.
 Drawdown projections are initial approximations only.

APPENDIX E

ARTIFICIAL WETLAND DRAWDOWN CONTOURS





LEGEND

- Drawdown Contours
- Artificial Wetland A



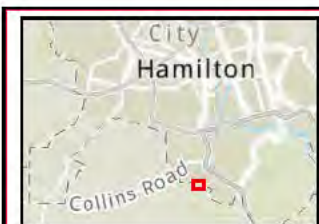
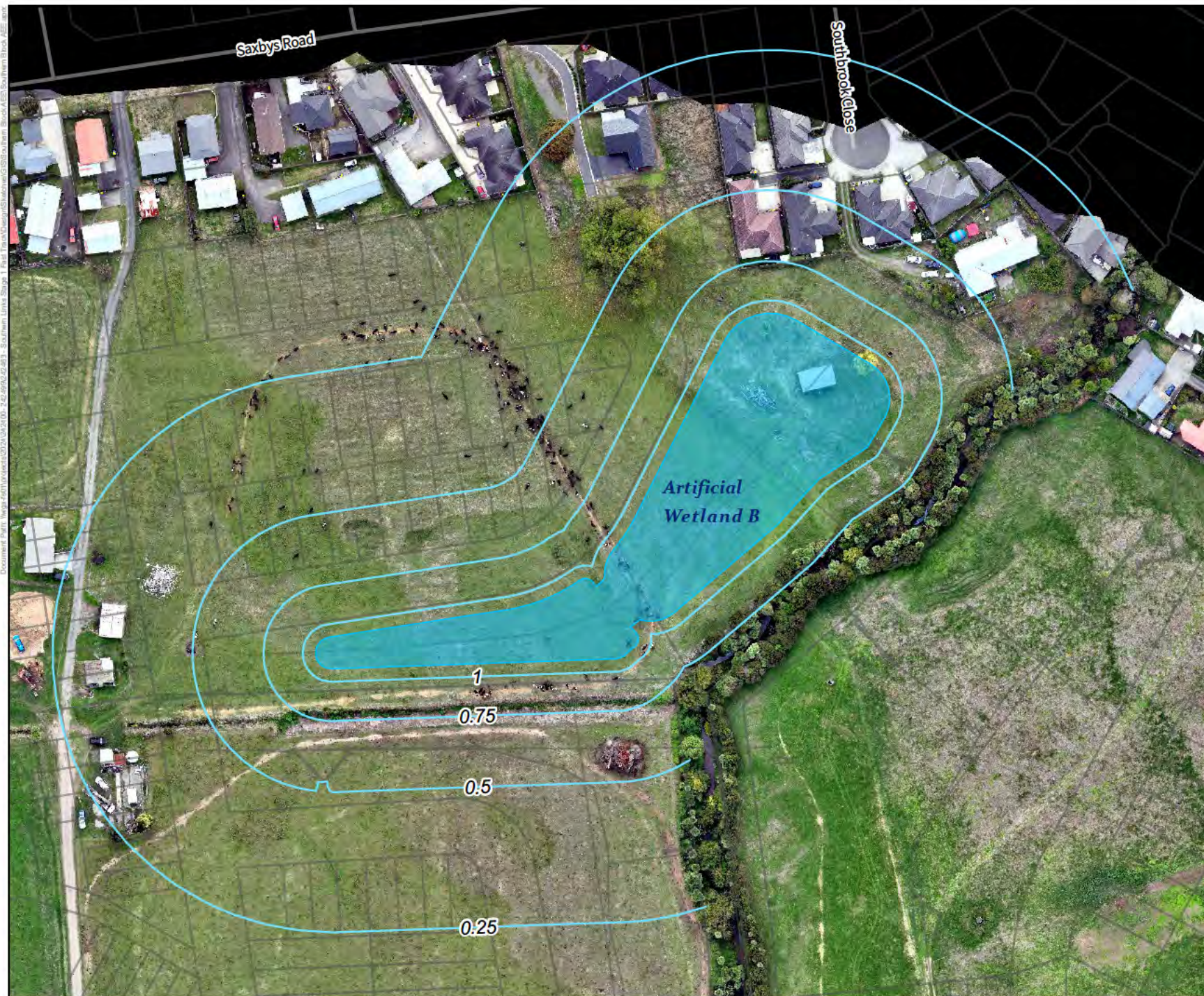
Scale 1:2,000 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

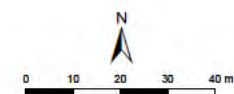
Figure E1
Southern Links Stage 1
Drawdown Contours For
Artificial Wetland A

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland B



Scale 1:1,600 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure E2

Southern Links Stage 1
Drawdown Contours For
Artificial Wetland B

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland C



Scale 1:1,600 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure E3

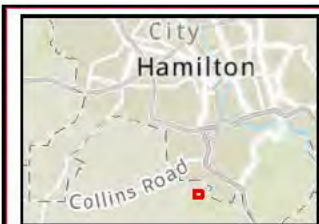
Southern Links Stage 1

Drawdown Contours for

Artificial Wetland C

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland D



Scale 1:1,200 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

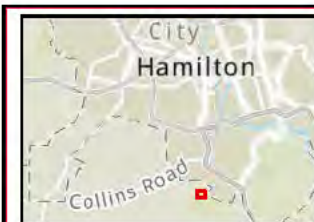
WGA

Figure E4

Southern Links Stage 1
Drawdown Contours for
Artificial Wetland D

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland E



Scale 1:1,200 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure E5

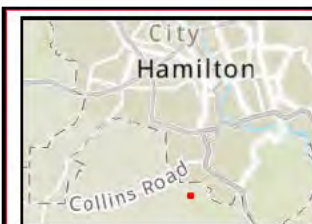
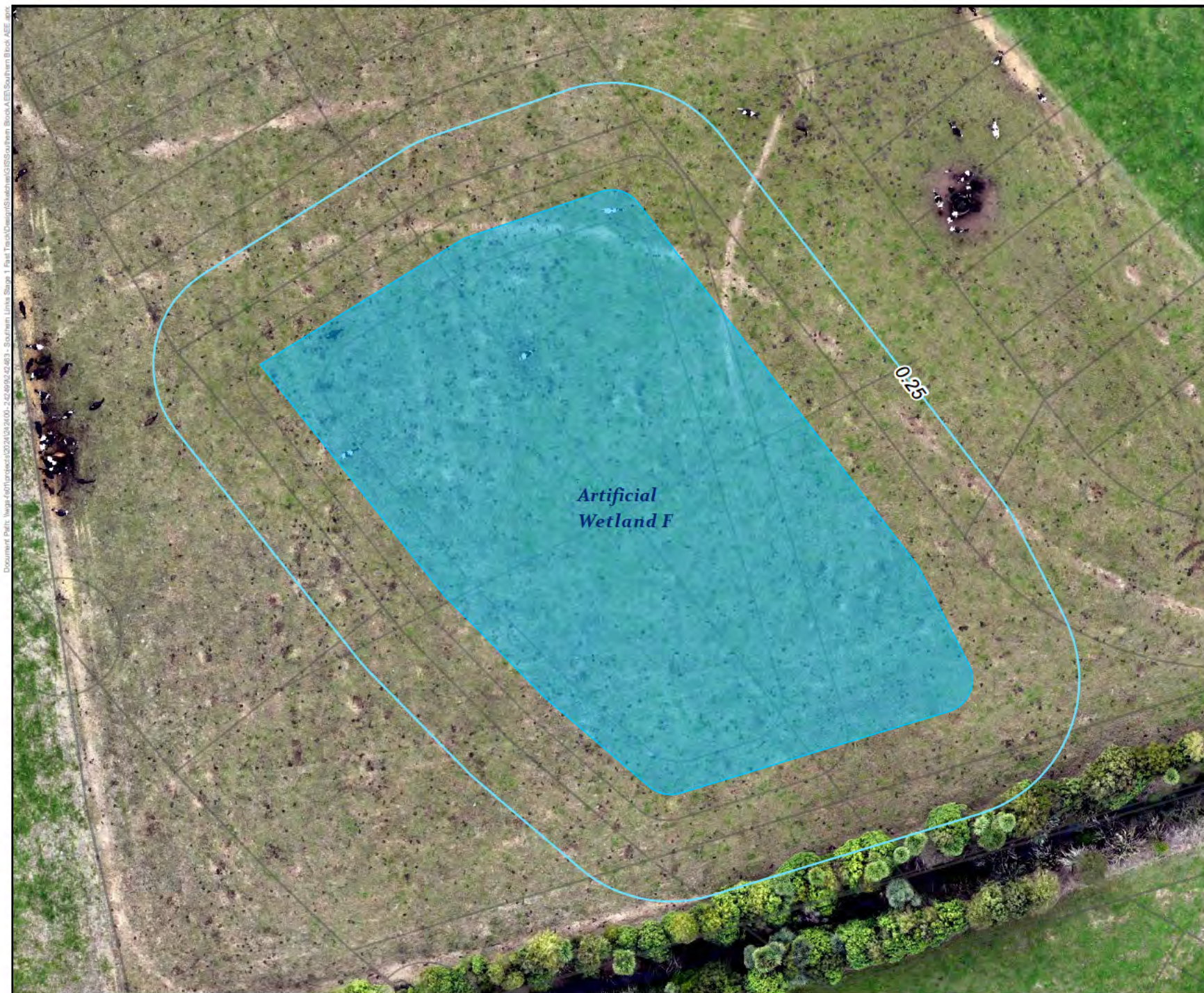
Southern Links Stage 1

Drawdown Contours

for Wetland E

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland F



Scale 1:500 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure E6

Southern Links Stage 1
Drawdown Contours for
Artificial Wetland F

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Summer Drawdown Contours
- Artificial Wetland A



Scale 1:1,200 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure E7

Southern Links Stage1

Summer Drawdown Contours

Artificial Wetland A

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Summer Drawdown Contours
- Artificial Wetland B



Scale 1:1,200 @ A4

Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

Figure E8

Southern Links Stage1

Summer Drawdown

Artificial Wetland B

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2028

APPENDIX F

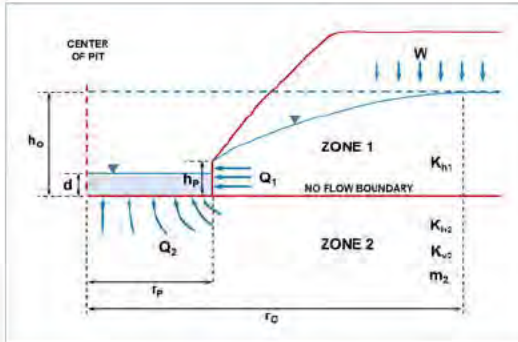
WASTEWATER INFRASTRUCTURE DRAWDOWN MODELLING



INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: WWPS A
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	2.50E-05	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	2.18	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	1.25	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	66	m
Known h _o	2.18	m
h _o calculated using Equation A	2.18	m

Q ₁	1.1E-04	m ³ /s
	9.3E+00	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

	2.236068	
Q ₂	2.0E-03	m ³ /s
	1.7E+02	m ³ /day

Total Pit Inflow

Q _{TOT}	2.1E-03	m ³ /s
	179.44	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow to a mine pit. Ground Water 38, no. 2: 311-314.

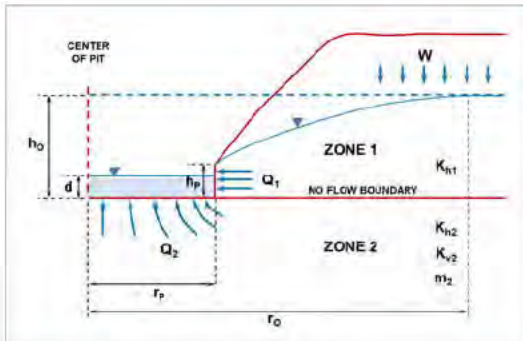
Analysed by: T Beisly 19/03/2026
 Checked by: B Sinclair 19/03/2026

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.
 Inflows from Zone 2 do not apply. This analysis is specific to Zone 1 only.
 Also note that if a sheet pile wall is used to support the excavation, the likely inflows through the pile wall will be much smaller than those calculated in this sheet.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: WWPS A
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone\ 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone2} = \frac{2(h_0 - d)}{\pi} s(n^{-1} \left(\frac{r_p}{r} \right))$$

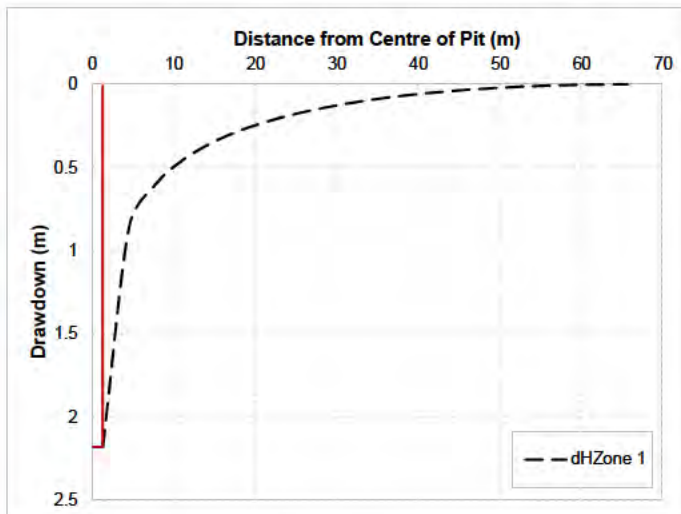
$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	0.000025	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	2.18	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	1.25	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r_o calculated by iterating equation A in analysis sheet 1

66 m



Drawdown curves

r	dH _{Zone 1}	dH _{Zone 2}
1.25	2.18	2.2
4.5	0.9	0.4
7.7	0.6	0.2
10.9	0.5	0.2
14.2	0.4	0.1
17.4	0.3	0.1
20.6	0.2	0.1
23.8	0.2	0.1
27.1	0.2	0.1
30.3	0.1	0.1
33.5	0.1	0.1
36.7	0.1	0.0
40.0	0.1	0.0
43.2	0.04	0.0
46.4	0.03	0.0
49.6	0.02	0.0
52.9	0.01	0.0
56.1	0.01	0.0
59.3	0.00	0.0
62.5	0.00	0.0
65.8	0.00	0.0

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

Analysed by: T Beisly 19/03/2026
 Checked by: B Sinclair 19/03/2026

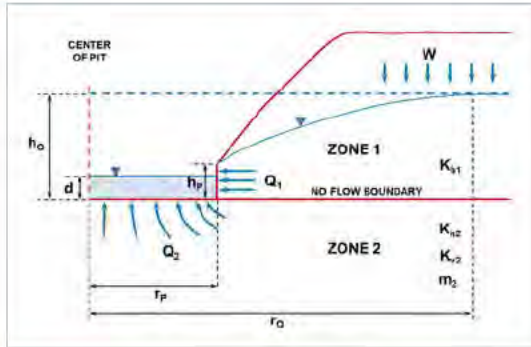
Notes: Drawdown projections are initial approximations only.

If a sheet pile wall is used to support the excavation, the likely inflows through the pile wall and consequent drawdown will be much smaller than that calculated in this sheet.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: WWPS B
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$\begin{aligned} \text{A } h_o &= \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]} \\ \text{B } Q_1 &= W \pi (r_o^2 - r_p^2) \\ \text{C } Q_2 &= 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d) \\ \text{D } m_2 &= \sqrt{\frac{K_{h2}}{K_{v2}}} \end{aligned}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	2.50E-05	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	0.507	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	1.25	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	19	m
Known h _o	0.51	m
h _o calculated using Equation A	0.51	m
Q ₁	9.1E-06	m ³ /s
	7.9E-01	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D	2.236068	
Q ₂	4.6E-04	m ³ /s
	4.0E+01	m ³ /day

Total Pit Inflow

Q _{TOT}	4.7E-04	m ³ /s
	40.36	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water
 inflow to a mine pit. Ground Water 38, no. 2: 311-314.

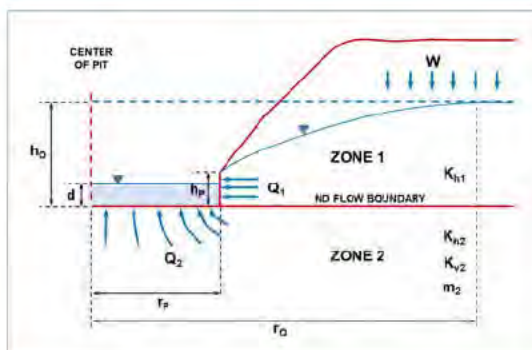
Analysed by: T Beisly 19/03/2026
 Checked by: B Sinclair 19/03/2026

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.
 Inflows from Zone 2 do not apply. This analysis is specific to Zone 1 only.
 If a sheet pile wall is used to support the excavation, the likely inflows through the pile wall will be much smaller than those calculated in this sheet.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: WWPS B
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone 1} = h_o - \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone 2} = \frac{2(h_o - d)}{\pi} \sin^{-1}\left(\frac{r_p}{r}\right)$$

$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

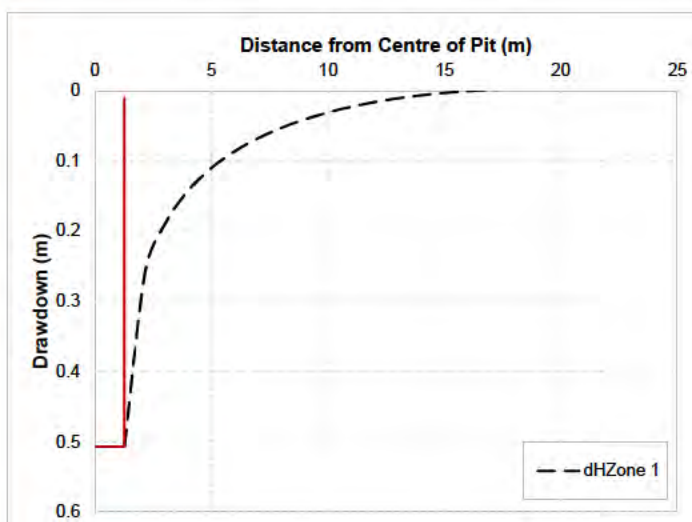
W	7.93E-09	m/s	recharge flux
K _{h1}	0.00025	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	0.507	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	1.25	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r_o calculated by iterating equation A in analysis sheet 1

19 m

Drawdown curves



r	dH _{Zone 1}	dH _{Zone 2}
1.25	0.507	0.5
2.1	0.3	0.2
3.0	0.2	0.1
3.9	0.1	0.1
4.8	0.1	0.1
5.7	0.1	0.1
6.6	0.1	0.1
7.5	0.1	0.1
8.4	0.0	0.0
9.3	0.0	0.0
10.2	0.0	0.0
11.1	0.0	0.0
12.0	0.0	0.0
12.9	0.01	0.0
13.8	0.01	0.0
14.7	0.00	0.0
15.6	0.00	0.0
16.5	0.00	0.0
17.4	0.00	0.0
18.3	0.00	0.0
19.2	0.00	0.0

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water
 inflow to a mine pit. Ground Water 38, no. 2: 311-314.

Analysed by: T Beisly 19/03/2026
 Checked by: B Sinclair 19/03/2026

Notes: Drawdown projections are initial approximations only.
 If a sheet pile wall is used to support the excavation, the likely inflows through the pile wall and consequent drawdown will
 be much smaller than that calculated in this sheet.

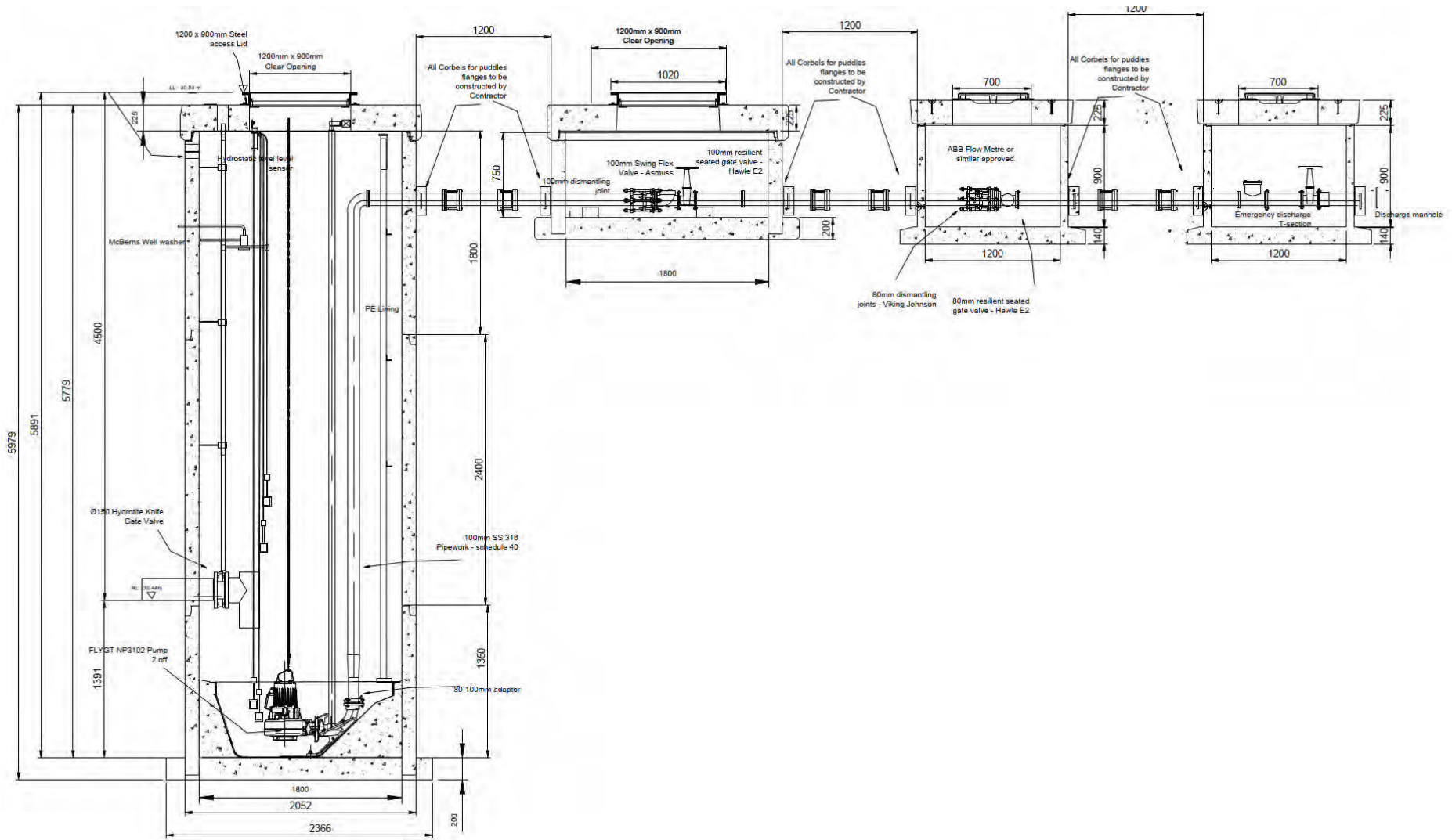


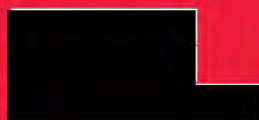
Figure F2: Proposed Wastewater Pump Station B Design, Provided by Maven



FOR FURTHER INFORMATION CONTACT:

Joanne Ferry
Senior Hydrogeologist

T
M
E



WGA.COM.AU
WGANZ.CO.NZ



Appendix G – AQUATE WWPS Specifications

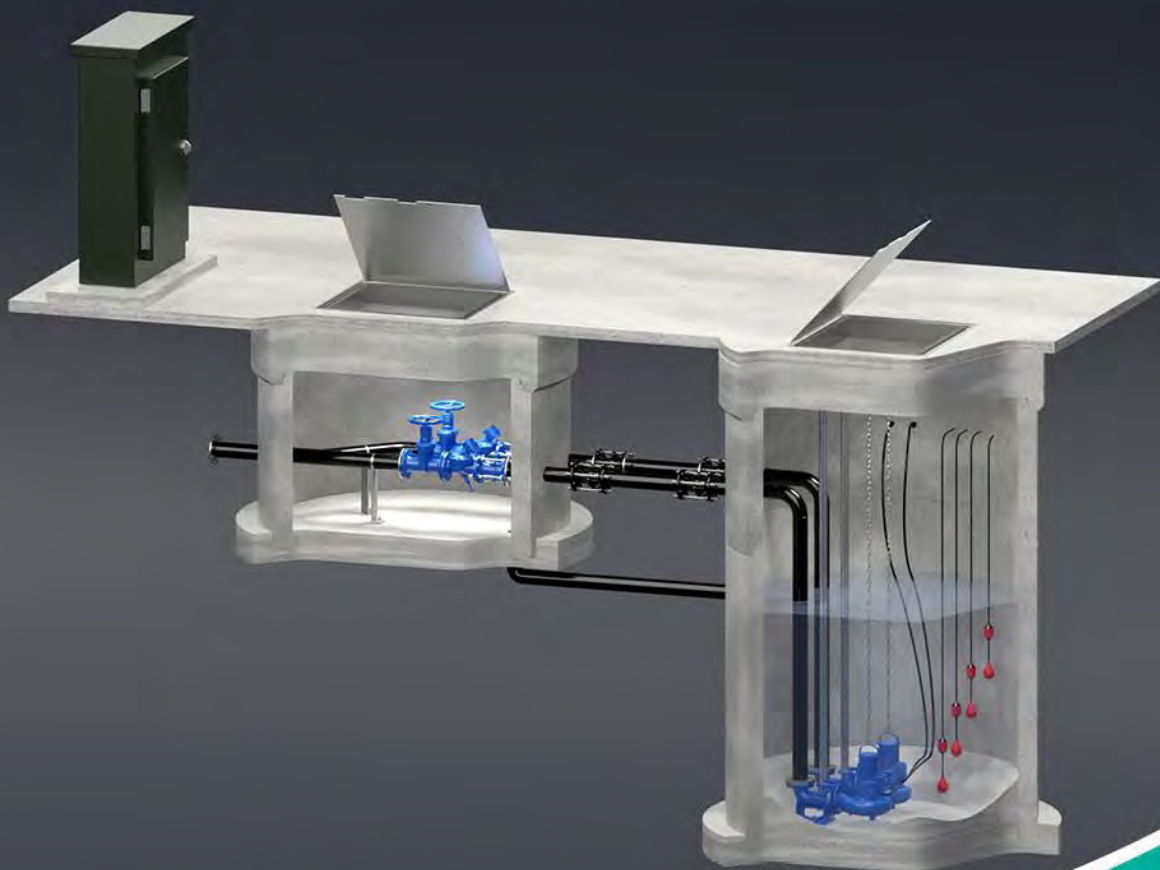
PUMP STATION

WWPS A, SOUTHERN LINKS 1, INDUSTRIAL 1, HAMILTON

TECHNICAL SPECIFICATIONS

MAVEN WAIKATO LIMITED

22 May 2026



Peter Carroll – Aquate Director
BE Civil, MBA, CPEng, FEngNZ
www.aquate.co.nz

Foreward

This installation manual is a guide only. All relevant Health and Safety laws and codes of construction must be adhered to and take precedence over any information in this manual. Installers must practice good professional practice and are required to understand all National and Local regulations in respect to the installation of drainage materials.

Contents

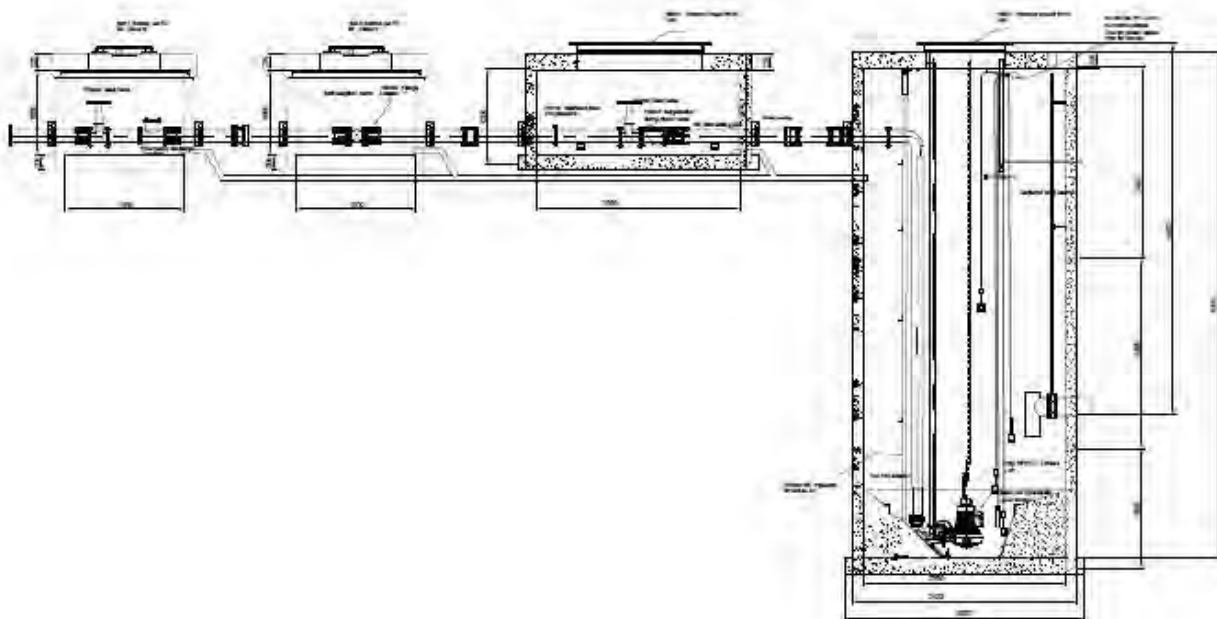
1	Technical Specifications.....	3
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APPENDICES

12

1 Technical Specifications

Tank Volume:	31.9 m ³
Effective volume:	26.8 m ³
Storage tank vol:	190.5 m ³
Tank material:	Concrete
Lining :	HDPE lining in wetwell and storage tank
Manufacturing Std:	AS/NZS 4058:2007 and NZS 3101
Loading:	The standard lid is suitable for pedestrian loading only.
Inlet Connections:	the inlet pipe to be installed on site and sealed by the drainage contractor.
Outlet connection:	A flanged stainless steel is installed for connection to the outlet pressure pipe
Venting:	External venting required (see section 1.6 for venting details if required)
Dimensions:	see drawing below



1.1 Pumps/Pump Performance

See full specifications in the Appendices

Manufacturer: Xylem Pumps

Type: Flygt NP3171 HT3 455

Connection: 415 V, 50 Hz

Power: 15 kW

Phases: Three



1.2 Design Information

1.2.1 Storage Calculations

The total Average Dry Weather flow has been calculated from the expected flow rate with the following assumption:

Average dry weather flow = 2844 people = 568.8 m³/day

Total emergency storage required is 9 hours = 213.3 m³

Total emergency storage in wet-well and emergency storage tank is 217.3 m³ so 9.2 hours storage has been provided.

1.2.2 Pump Design

The system above has been designed based on the information provided below.

Rising main length : 1185m

Static Lift : – 4.5 m

Rising main – PE100 (HDPE) PE 4710 / SDR 11 (PN 16) / DN 200 (250x22.7 mm)

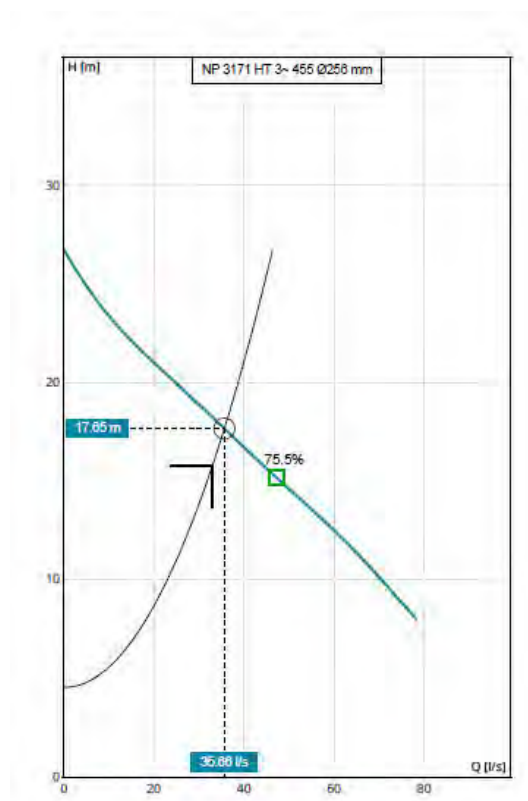
Rising main – OD – 250mm, ID – 204.6mm

Option 1 $K = 1.5$

Flygt NP3171 - Flow rate = 35.66 l/s with a total head loss of 17.65 m (single pump).

Pumps to operate in a duty / assist / standby function

Velocity in PE pipe = 1.09 m/s

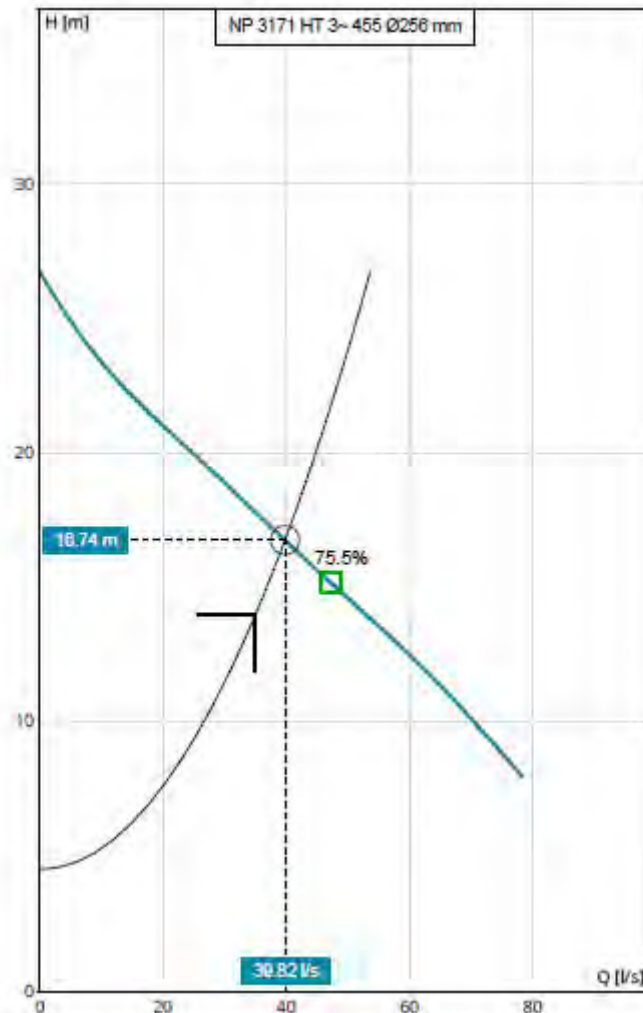


Option 2 $K = 0.5$

Flygt NP3171 - Flow rate = 39.82 l/s with a total head loss of 16.74 m (single pump).

Pumps to operate in a duty / assist / standby function

Velocity in PE pipe = 1.21 m/s



1.2.3 Pump Operational Levels

The operational levels will be set as follows (dimensions taken from floor of wet-well) :

Set point		Description	Control function
Value	Unit		
300mm	4.9 %	Low Level Alarm	Stops both pumps/ alarms
350 mm	5.7%	Duty/ Standby Pump OFF	Stops Duty and Standby pump
800 mm	13.1%	Duty Pump ON	Starts duty pump
900 mm	14.8 %	Assist Pump ON	Assist Pump ON
1200 mm	19.6%	Hi Level Alarm	Hi Level alarm activated
250 mm		Stop Both Pumps - Float Switch	Stop Both Pumps
900 mm		Start Duty Pump – Float Switch	Start Duty Pump
1000 mm		Start Assist Pump – Float Switch	Start Assist Pump
1500 mm		Critical High Alarm – Float Switch	Critical High Alarm

1.2.4 Pump Stop/Start Calculations

Expected daily flow:	568800	litres
Infiltration (l/day)	0	litres
SWI (l/day)	0	litres
Peaking factor :	3	
ADDWF	6.58	l/s
PDDWF	16.46	l/s
PWWF	30.83	l/s

Pump Station diameter	2.55	m
Pump station depth (total)	6.25	m
Pump station depth (effective)	5.25	m
Volume (effective)	26.80	m ³

Pump Stop Level	0.4	m
Pump Start Level	1	m
Volume to pump:	3063	litres

Discharge rate:	32	l/s
-----------------	----	-----

Time to empty: (PDDWF)	3.3	minutes
Time to empty: (PWWF)	43.6	minutes
Time to fill (PDDWF)	3.1	minutes
Time to fill (PWWF)	1.7	minutes
No starts/ hour (PDDWF)	9.4	
No starts/ hour (PWWF)	1.3	
No starts per pump (PDDWF)	4.7	
No starts per pump (PWWF)	0.7	
Max Start/Hour permissible	30	Okay

1.3 Pipework, Valves and Fittings

Discharge connection: 150 mm diameter flange coupler

Inlet and outlets: the inlet pipe to be installed on site and sealed by the drainage contractor. The outlet pipe is pre-installed in the factory.

Discharge pipework: Includes a non-return valve, dismantling joint and an isolation valve.

Lifting chains: a stainless steel chain is connected from the pump to the underside of the chamber for ease of pump removal if required.

Materials: All pipework will be 150mm 316 Stainless steel Schedule 40 and will be manufactured to the relevant AUS/ NZ Standards

Guide rails: Stainless steel

1.4 Access lids

Steel access lids (1600 x 1000mm) will be supplied as per the RITS design

1.5 Magflow metre

An ABB ProcessMaster DN150 is included installed in a 1500mm diameter manhole

1.6 Level Sensors

1 off – ABB Black Box Hydrostatic level sensor

4 off – Flygt ENM10 float switches for Low level, duty pump operation, standby pump operation, and High-level alarm

1.7 Electrical & Controls

This controller is designed on the latest 2023 HCC drawings which are quite different to their previous standards. Any comparison to a competing proposal should ensure that the same standards have been used in the pricing.

This allows for the design, including production of electrical drawings, build and factory acceptance testing (FAT) of the pump station controller.

The design will include::

- 1 x Allen Bradley Micro800 PLC and IO modules as per their standard design.
- 1 x programming of Allen Bradley PLC.
- 1 x Trio Radio unit for communicating to HCC's SCADA system.
- 1 x battery backup for communication and PLC 24VDC circuits.
- 1 x supply of aerial for radio communication to base station.
- 2 x DOL starting configuration with overload and short circuit protection as per HCC standards, for each pump.
- 2 x current transducers and amp meters.
- 2 x capacitors for power factor correction.
- 1 x phase failure relay with output to PLC.
- 1 x surge divertor with output to PLC.
- 1 x level indicator input.
- 1 x flow indicator input.
- 22mm dia push buttons and selector switches for pump circuitry and control.
- Cabinet door switches and internal lights.
- Anticondensation heaters for cabinet.
- 2 x isolation switches for the pumps.
- 1 x Cubic internal panel. Note this differs to the HCC drawing but is of an equal or better quality to the Bremca 250 series panel.
- 1 x generator connection with interlocked mains/generator breakers.
- RCD protected service plugs mounted within cabinet.
- 1 x painted aluminium pillar box approximately 1.95 x 1.525 x 0.5m (l x h x d) with multiple door access, and internal panels.
- 1 x full CAD drawings.

We have not allowed for any of the following:

- Supply of any boosting to the radio signal if the standard Trio radio unit and standard aerial is insufficient.
- Supply of any site metering although space left in cabinet for a smart meter.
- Any civil works including construction of plinth for controller to mount to.

- Any on site installation including running of cable to and from controller, or mounting revenue meter (if required), or installing any on site lighting, installing the aerial or aerial base. It is suggested the site electricians are engaged to do this where required.

1.8 Odour Control System

This has been excluded as per RITS standards. See section 5.3.7.16 RITS.

1.9 Protective lining

The wet-well including the underside of the lid will be lined with Blue-seal HDPE lining for sulphuric acid resistance (see Appendices)

1.10 Well-washer

A McBerns well washer has been specified by RITS – see appendices for details

A sprinkler system using BETE nozzles has been included in the storage tanks to RITS design

1.11 RPZ Cabinet

A steel cabinet to RITS design has been included along with an RPZ standpipe and two off solenoid valves for the well washer and sprinkler system

1.12 Inlet valve

A 225mm diameter knife-gate valve will be installed on the inlet pipe in to the wetwell. This includes a spindle to the underside of the lid

2 Construction

The pump station has been design using reinforced precast concrete components. The system will be fabricated off site and delivered to site ready for installation. The tank will have a 31,900 litre capacity and a total depth of 6.25 m.

The pump stations will be delivered to site in a kit-set format and will need to be installed in the ground by the drainage contractor.

The construction and commissioning of the Aquate pump station will then be completed by a trained Hynds Environmental Construction Technician.

3 Safety in Design

This pump station has been designed to minimise any risk to operators and service personnel.

Access into the pump station should not be required for ongoing maintenance as almost all servicing work can be completed from ground level. The main components can be accessed as follows:

- Pumps – these can be removed from the pump station by lifting them up out of the wet-well and inspecting above ground. Note : the pumps weight 147 kg each.
- Floats – can be lifted from the connection points in the access hole in the lid.
- Non-return valves/Isolation valves –can be access from ground level without the need to enter the chamber
- Venting will be required and will need to be installed on site. The access lids are air-tight.

Risk register

The risk register is a live document which requires continuous monitoring updating. This will need to be completed by the maintenance company for the pump station. The items below are a guide only. The safety and design and Hazops workshops have encompassed risks for normal operation of the vacuum wastewater pump station. Specific risks for the maintenance process are outlined below.

Risk matrix

			Consequence / potential severity				
			Minimal Non-injury or First Aid injury (FAI)	Minor Medical treatment injury	Moderate Medical treatment injury, with lost time (LTI)	Major Injury requiring hospital-/notifiable event	Catastrophic Fatality or multiple fatalities
Likelihood	Very high	Almost certain: Commonly occurs	3: Medium	4: High	4: High	5: Very high	5: Very high
	High	Likely: Could easily happen	2: Low	3: Medium	4: High	4: High	5: Very high
	Medium	Possible: Could happen or has been known to happen	2: Low	2: Low	3: Medium	4: High	4: High
	Low	Unlikely: Hasn't happened yet but could happen	1: Very Low	2: Low	3: Medium	3: Medium	4: High
	Very low	Rare: Very unlikely but could happen in exceptional circumstances	1: Very Low	2: Low	2: Low	3: Medium	4: High

Hazards (<i>one per line</i>)		Existing risk level (<i>use risk matrix</i>)	Hazard controls – what do we need to do to make it safe?	
What are we doing? (<i>step by step</i>)	What could cause harm?		Eliminate/ Controls	Residual risk level
Wet-well inspection	The wet-well is classified as a confined space, an inspection is required prior to wet commissioning.	3	Elimination: The vessel will be isolated from the system at all exit points and inspected from the access hole in the lid . Isolate/Engineering Controls/PPE: Entry will only be required if debris is identified and cannot be removed by any other means. Entry to the vessel should follow confined space protocols, including ensuring all persons involved have the required training, admin and PPE controls.	1 1
Sewage Pump Testing	The wet well will be filled up for wet testing. This is a potential drowning hazard.	3	Elimination Barriers around the access hatch to be erected so no one can enter the wet-well. Engineering Controls/PPE: All essential persons to wear appropriate protection. Sewage pump shall only operate when required for wet testing..	1 1
Removing lids for access	Traffic moving through area Back strain	3 2	Isolate/Engineering Controls/PPE: Place cones around service area so vehicles cannot enter site Engineering Controls/PPE – use appropriate lifting equipment if lifting pumps / lids on site	
Removing pumps	This is a falling hazard	4	Elimination Barriers around the access hatch to be erected so no one can enter the wet-well.	
Electrical checks	Electrical shock	3	Engineering Controls/PPE: Only fully certified electricians to complete electrical work	

4 Warrantees

Aquate guarantees the performance and quality of its pump stations provided:

- The product is only used for the intended purposes as stated in the quote
- The control panel and pump station is correctly installed and commissioned by a suitable installer
- The fault is due to a defect in design, materials or workmanship
- The fault is reported to an Aquate agent or representative during the guarantee period
- No pump station components have been replaced by alternative products
- This guarantee does not cover faults resulting from misuse of the system, blockages or breakdowns caused by the introduction of inappropriate materials into the system, incorrect electrical installation of the control unit, deficient maintenance or normal wear and tear.

Aquate assumes no liability for bodily harm, property damage or economic losses as a result of its pump stations.

4.1 Pumps

The pumps come with a 12 month year warranty against faulty components and/or workmanship. If prohibited substances are introduced to the system causing the pump to block and burn out, the warranty is null and void.

Flygt undertakes to remedy faults in products sold by Flygt provided that:

- The fault is due to defects in design, materials or workmanship;
- The fault is reported to a Flygt representative during the guarantee period;
- The product is used only under conditions described in the care and maintenance instructions and in applications for which it is intended;
- The monitoring equipment incorporated in the product is correctly connected;
- All service and repair work is done by a workshop authorized by Flygt or the original manufacturer;
- Genuine manufacturer's parts are used
- Storage should be in accordance with the care and maintenance manual.
- The equipment is operated and maintained in accordance with the Operation and Care and Maintenance Manual.

Failure to comply with these requirements will render warranty void unless, due to the nature of the warranty claim, such voiding of warranty is prevented by law, regulation, act and/or ordinance.

Hence, the guarantee does not cover faults caused by deficient maintenance, abuse, incorrectly executed repair work or normal wear and tear.

5 Maintenance schedule

A certain amount of system maintenance is required on an ongoing basis to ensure that the system is working correctly. This is the responsibility of the owner

5.1 Six monthly

The following procedures should be completed every six months:

- The pumping station should be inspected to check the build-up of grease and fat particularly on the float switches and pumps. They may need to be withdrawn for cleaning.
- Visually inspect the pump station walls and hose down if necessary
- Ensure the pump station access lid is securely fastened and bolted down.
- Lift the pumps and inspect for any damage or blockages around the impellers
- Lift the floats and test the alarm system/pump operation
- Consult with the electrical control supplier for additional checks

5.2 Annually

The following procedures should be completed at least once every 12 months:

- The pumping station should be inspected to check the build-up of grease and fat particularly on the float switches and pumps. They may need to be withdrawn for cleaning.
- Visually inspect the pump station walls and hose down if necessary
- Lift the floats and test the alarm system/pump operation
- Press the mute button (audio alarms only) to check the audio alarm turns off.
- Visually check the pump station for any structural damage to the tank and pipework
- Ensure the pump station access lid is securely fastened and bolted down.
- Lift the pumps and inspect for any damage or blockages around the impellers
- Have the pump station sucked out to remove any debris/stones if necessary

5.3 Maintenance requirements

The pump maintenance and repair operations must be carried out by workers authorised by the manufacturer; Failure to comply with these instructions will result in forfeiture of the warranty and jeopardise the unit's safety.

Before any cleaning and/ or maintenance operations are carried out on the electric pump, the power supply must be switched off.

To disconnect the submersible electric pump from the electricity mains, first disconnect the phase conductors, then the yellow –green earth wires.

Use the special handle to remove the submersible electric pump from the tank.

ATTENTION: Before carrying out any operations, check the pump temperature. Only work on the pump when it is at room temperature.

Clean the electric pump thoroughly, using a jet of water or specific products to clean all its parts. When disposing of the waste material, follow the antipollution rules in force.

Replace any broken or worn parts with original spare parts only.

Given the likelihood that work on the electric pump will be carried out in confined spaces such as vats, wells, cesspools, tanks or cisterns, do not underestimate the risks caused by potentially poisonous exhalations.

APPENDICES

General Arrangement Drawing – Plan

General Arrangement Drawing – Section

General Arrangement Drawing – Plan with tank

General Arrangement Drawing – Section with tank

Flygt NP3171 HT3 455 Specifications k 1.5

Flygt NP3171 HT3 455 Specifications k 0.1

McBerns well washing brochure

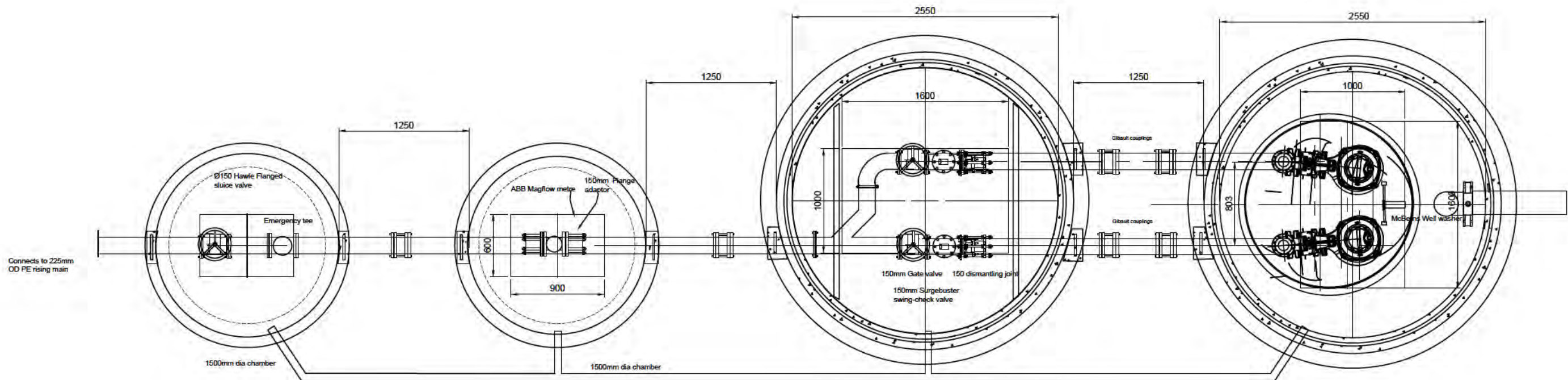
BlueSeal-AKS data sheet

Hyliner HDPE liner – data sheet

ABB Magflow Meter Specifications

ABB Blackbox level sensor specifications

Flygt ENM10 float switch specifications



NOTES:

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REVISIONS

REV #	REVISION DESCRIPTION	DATE	DRAWN
A	Issued For Approval	22/5/26	PC
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—	—	—	—
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—	—	—	—
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PO Box 58142, Botany, Auckland, 2316
Tel: 09-274 0316
Fax: 09-272 7485
email: hwwsupport@hynds.co.nz

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ISO 9001 CERTIFIED MANAGEMENT SYSTEM



PROJECT:

Southern Links Industrial 1
Hamilton

WW Pump Station WWPS - A

DRAWING TITLE:

Plan View

REFERENCE/QUOTE
NUMBER:

AQ2286 - 2

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DESIGN: PC
SIGNATURE:

CHECKED: JB
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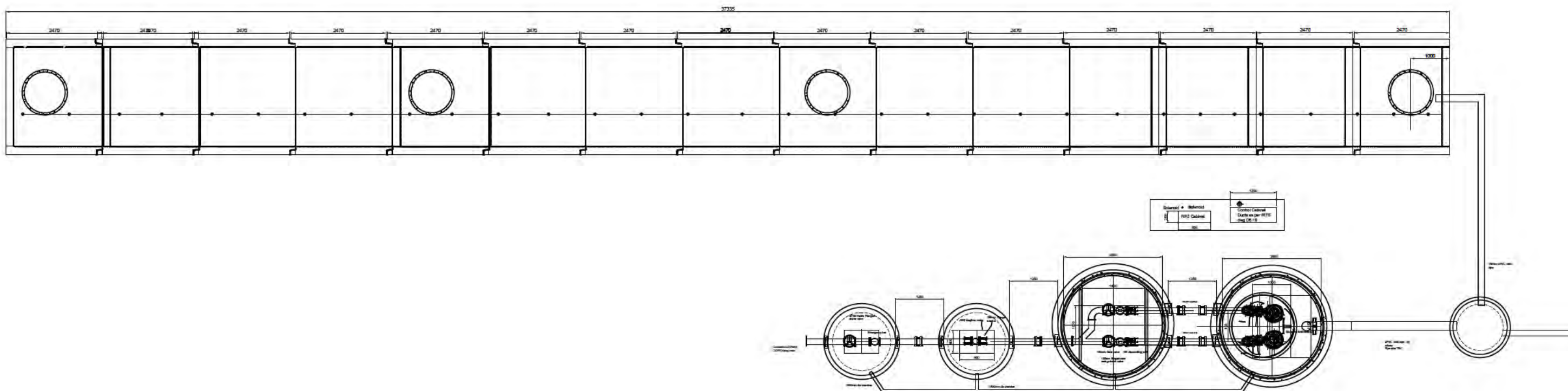
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22/5/26

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AQ2286 - 21

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of 4

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ISO 9001 CERTIFIED MANAGEMENT SYSTEM

PROJECT:

Southern Links Industrial 1
Hamilton

WW Pump Station WWPS - A

DRAWING TITLE:

Plan View with tank

REFERENCE/QUOTE
NUMBER:

AQ2286 - 2

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DESIGN: PC
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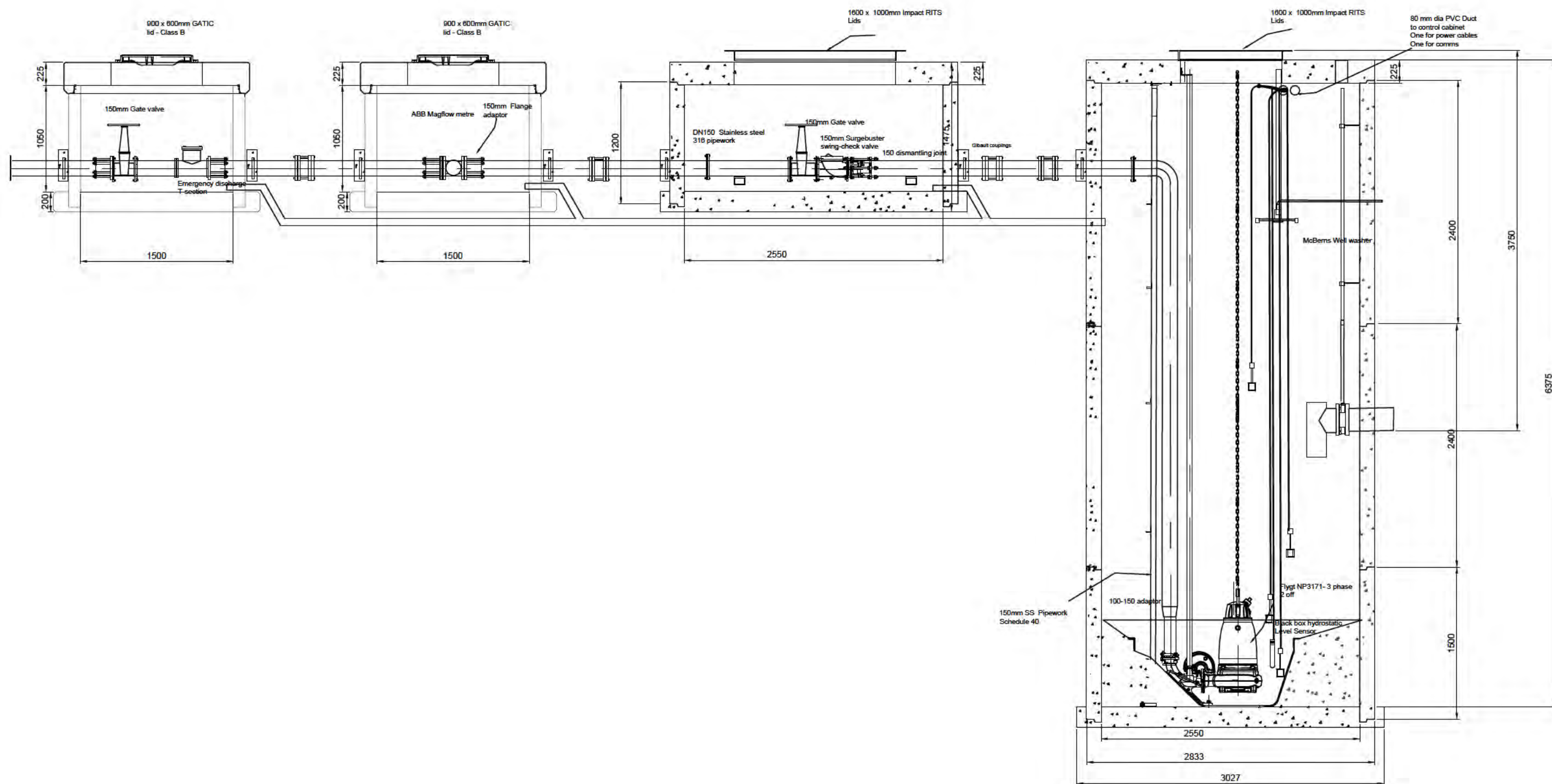
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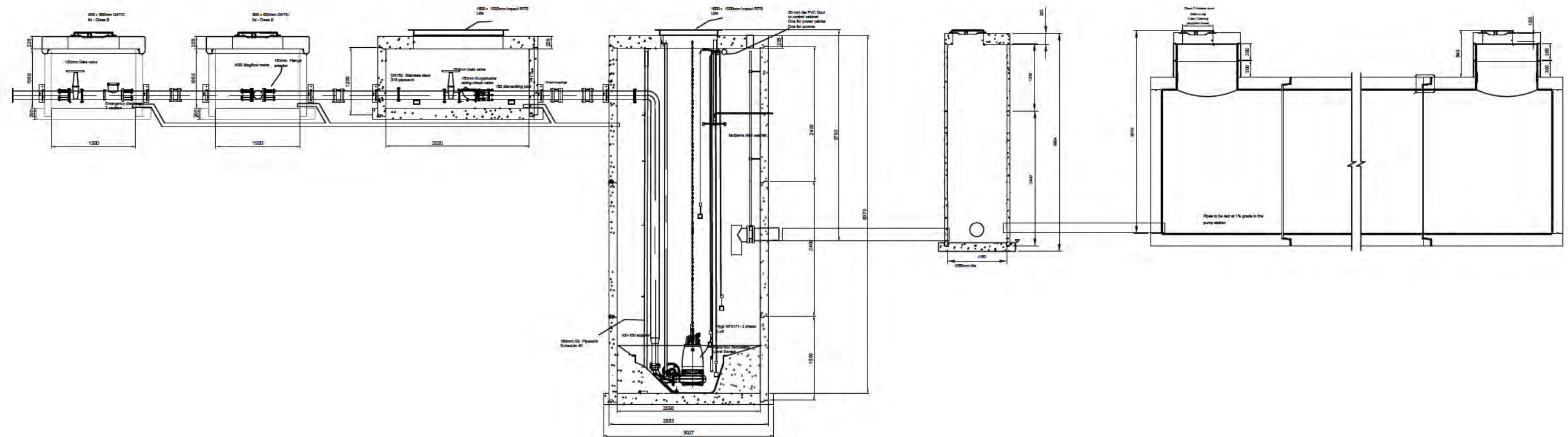
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of 4

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ISO 9001 CERTIFIED MANAGEMENT SYSTEM



PROJECT:
Southern Links Industrial 1
Hamilton

WW Pump Station WWPS - A

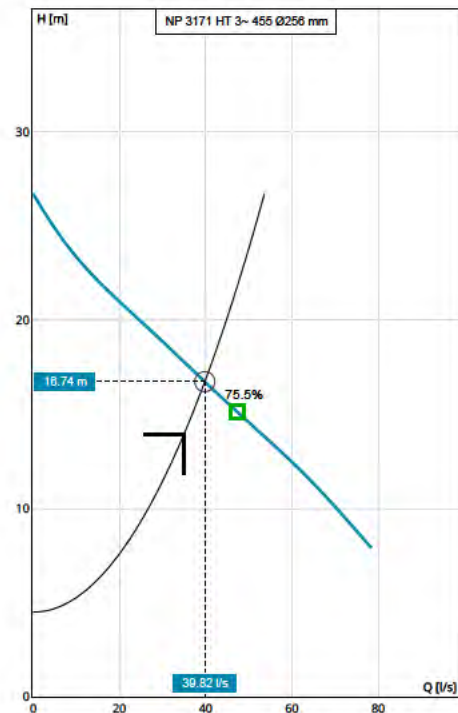
DRAWING TITLE:
Section View with tank

REFERENCE/QUOTE NUMBER:			AQ2286 - 2
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SIGNATURE:	SIGNATURE:	SIGNATURE:	
SCALE: As Shown	Note: Do not scale drawing if in doubt ASK!!!	DATE:	22/5/26
PAPER SIZE: A3			
DRAWING NUMBER:	SHEET NUMBER:	REVISION NUMBER:	
AQ2286 - 21	of 4	A	

NP 3171 HT 3~ 455 | Configuration Summary



Flygt's self-cleaning non-clog N-pumps feature innovative designs and functions that deliver high sustained efficiency and the most reliable operation. This makes them the most reliable choice available for a broad range of wastewater applications for tough applications such as unscreened sewage, wastewater and sludge up to an 8 percent solids concentration. Impeller material available in Hardened cast Iron, Hard Iron and Stainless Steel to fit any wastewater application.



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

GENERAL

Explosion Proof	Impeller Diameter
No	256 mm
Max. Pumped Media Temp.	
40 °C	

MATERIAL AND COATING

Impeller Material
Hard-Iron
Volute Material
Grey Cast Iron

MOTOR

Rated Voltage	Motor Efficiency Class
400 V	Standard
Coupling	Rated Power
Y	15 kW

INSTALLATION

Installation Type
P - Semi-Permanent, Wet

NP 3171 HT 3~ 455 | Product Details

Description

N 3171

The Flygt N-series are equipped with the Flygt invented N-technology with its innovative self-cleaning impeller. Solid objects entering the pump will pass through the impeller between the impeller vanes. If an object gets caught on the leading edge of one of the vanes, it will slide along the backswept shape towards the perimeter of the inlet where it will be guided by a relief groove through the pump housing. This ensures a high sustained total efficiency over time. Due to the mechanical self-cleaning design, a sludge concentration of solids up to 8% can easily be pumped. The pump can easily be installed in either permanently or temporary submerged, or horizontally or vertically dry installations.

Flexible and Modular Design

The modular hydraulic design enables customization of the hydraulics to meet the requirements of many applications.

- o Replaceable wear ring in two materials, gray iron or Hard Iron, for different operation conditions
- o Hardened gray iron impeller for typical wastewater applications
- o Hard-Iron impeller for heavy duty wastewater applications containing abrasive and corrosive content
- o Chopper ring intended for tough wastewater applications where cutting is required due to long fibres and solid concentrations up to 10-12%
- o Stainless steel impeller for special applications that require duplex stainless steel

Robust and Reliable

- o Short shaft overhang reduces shaft deflection and increases seal and bearing life
- o Class H Motor designed for submersible use. Heat is concentrated to the stator core for improved cooling properties.
- o The Plug-in seal with Active Seal system eliminates the risk associated with incorrect installation and careless handling. All in one unit. Available in Tungsten carbide (WCCR) or Silicone carbide (SiC) depending on pumped media.
- o Motor cable SUBCAB® specially developed for submersible use
- o Offers flexible cooling systems, e.g. closed-loop cooling system, media cooled or external cooling that allows full motor potential in dry installations.
- o Premium brand bearings, greased for life, ensures a minimum of 50 000 hours of duty
- o Leakage sensor and motor temperature sensor as standard

The N 3171 is available with the following options:

- o ATEX, FM, CSA-approvals
- o Premium efficiency motors
- o Hard Iron hydraulic design
- o Stainless Steel hydraulic design
- o Vibration-sensor, extended motor temperature sensors, additional leakage-sensor, current-sensor and pump memory
- o Compatible with SmartRun® Wastewater pump controller
- o Compatible with MAS 801 monitoring system

Product Features

- o State-of-the-art wastewater pump with N-technology
- o Sustained high efficiency pumping with energy savings up to 25%
- o Flexible and modular design
- o Robust and reliable

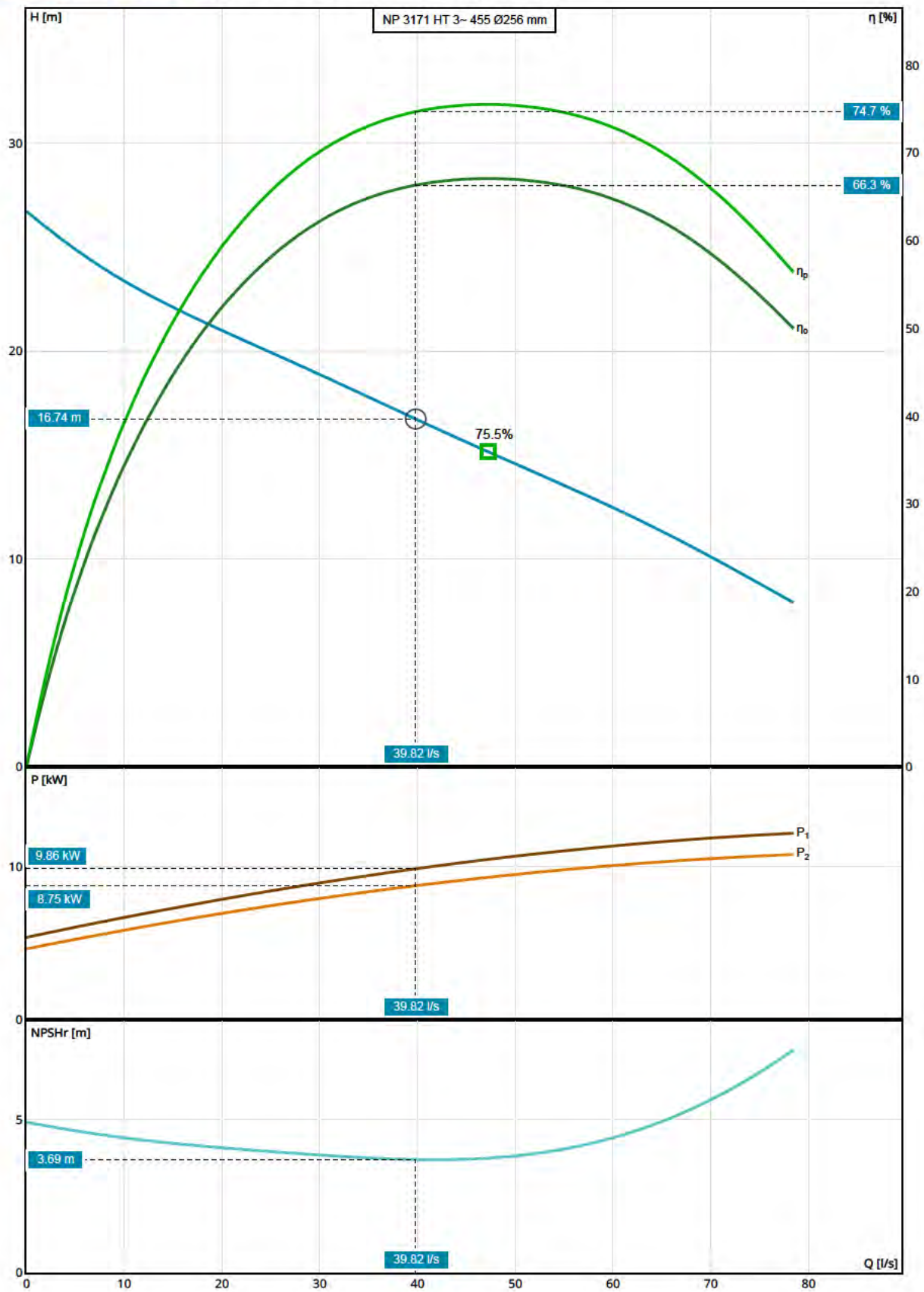
Construction Materials

Impeller Material	Volute Material	Stator Cover Material
Hard-Iron	Grey Cast Iron	-

Motor

Rated Power	Number Of Phases	Start Current Ratio	Motor Issue
15 kW	3	6.34	12
Motor Denomination	Rated Motor Speed	Insulation Class	Locked Rotor Code
25-14-4AA	1,460 RPM	H	H
Motor Efficiency Class	Rated Voltage	Approval	Max starts per hour
Standard	400 V	STD	30
Version Code	Rated Current	Total moment of inertia	Power Factor 100%
185	30 A	0.14 kgm ²	0.83
Frequency	Start Current	Type of duty	Power Factor 75%
50 Hz	189 A	S1	0.78
Max P2 (1x)	Starting Current, Direct Starting	Stator Variant	Power Factor 50%
10.79 kW	189 A	2	0.66
Number Of Poles	Starting Current, Star Delta	Motor Module	Efficiency 100%
4	63 A	131	87.2 %
			Efficiency 75%
			88.1 %
			Efficiency 50%
			87.5 %

NP 3171 HT 3~ 455 | Hydraulic Data & Performance Curve



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Selection

Series	Curve Code
N 3000	455
Name	Impeller Diameter
NP 3171 HT 3~ 455	256 mm
Frequency	Inlet Diameter
50 Hz	150 mm
Total Flow	Outlet Diameter
35 l/s	100 mm
Total Head	Number Of Vanes
13.96 m	2
Pump Flow	
35 l/s	
Pump Head	
13.96 m	
System Type	
Single Pump	
Operating Pumps	
1	
Standby Pumps	
No Standby Pump	

Design Point

Flow	Shaft power (P2)
39.82 l/s	8.75 kW
Head	NPSHR
16.74 m	3.69 m
Overall Efficiency (η_o)	Speed
66.33 %	1,479 RPM
Pump Efficiency (η_p)	Static Head
74.71 %	4.5 m
Input Power (P1)	Flow To BEP Ratio
9.86 kW	84.31 %

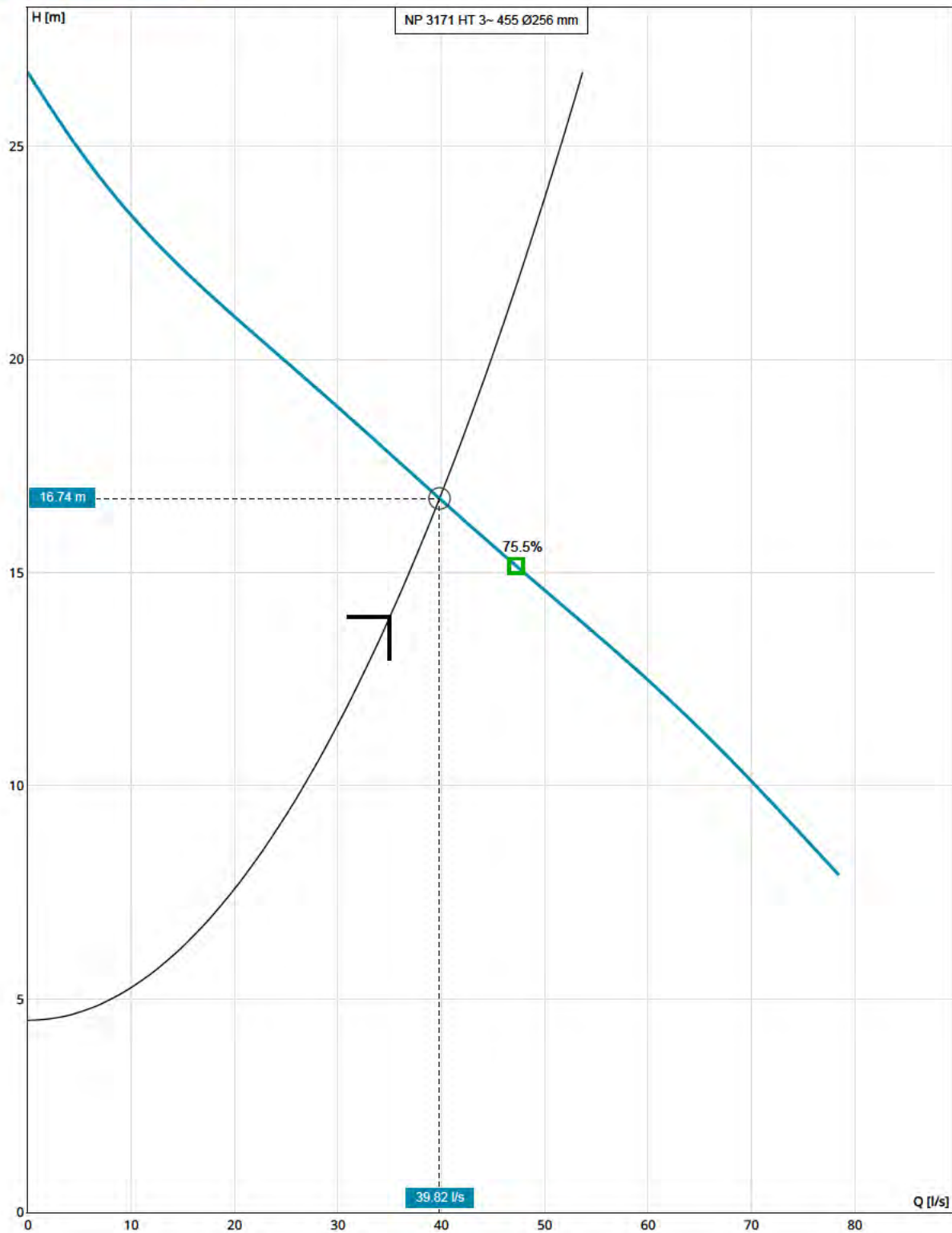
Fluid and Operating Conditions

Fluid Type	Density
Water	1,000 kg/m ³
Fluid Temperature	Dynamic Viscosity
4 °C	0.002 Pa·s
Specific Gravity	Fluid Vapor Pressure
1	8.14 mbar
	Atmospheric Pressure
	1,013.53 mbar
	Elevation
	0 m
	Ambient Temperature
	20 °C
	NPSH Available
	10.27 m
	Submergence
	0 m

Design Curve

Rated Speed	BEP Flow
50 Hz	47.23 l/s
Max Flow	BEP Head
78.46 l/s	15.16 m
H@QMin	Max P2
26.73 m	10.79 kW
H@QMax	Specific Energy
7.91 m	0.07 kWh/m ³
BEP	
75.53 %	

NP 3171 HT 3~ 455 | Duty Analysis

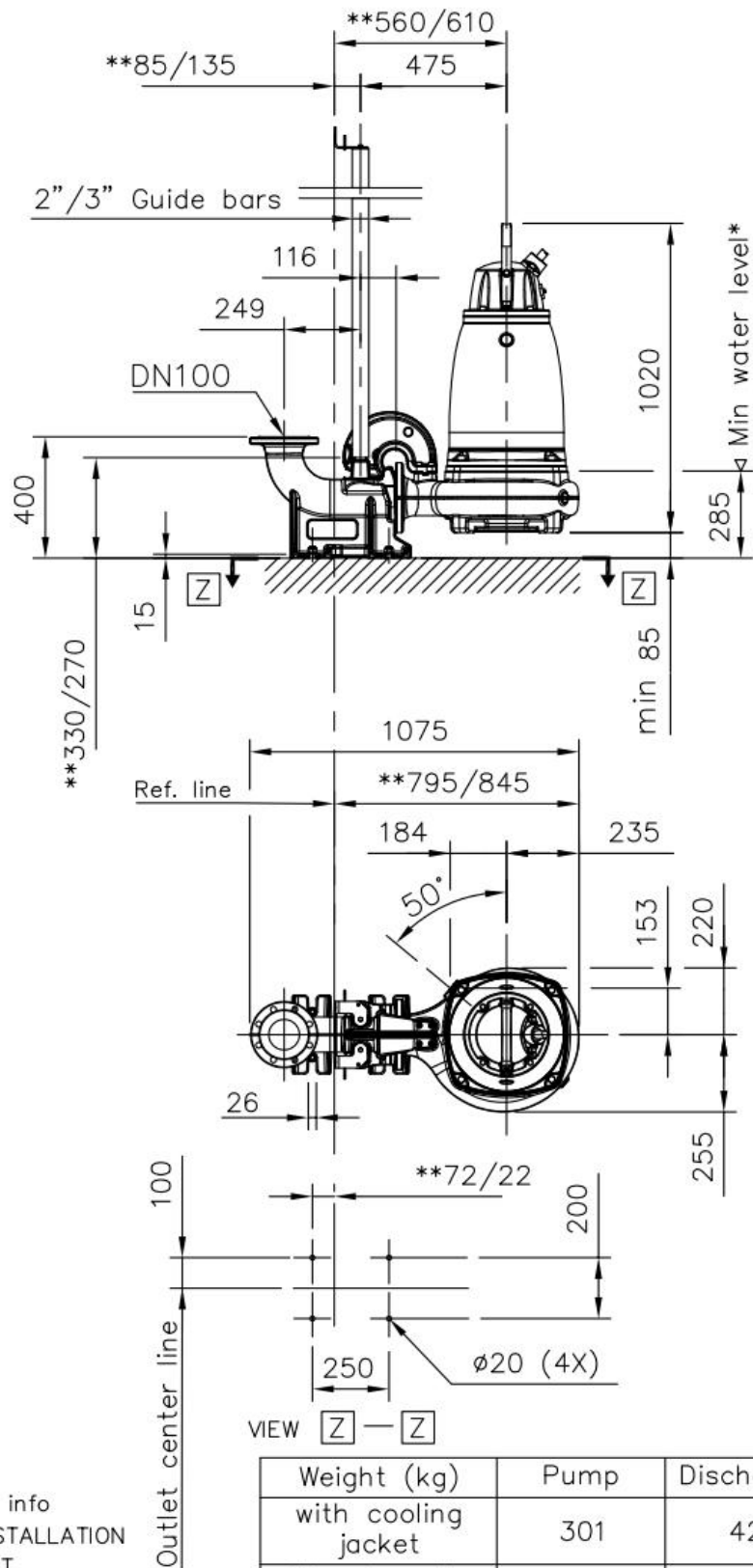


Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Name	Q (1x) [l/s]	H (1x) [m]	P2 (1x) [kW]	Q [l/s]	H [m]	P2 [kW]	η_p [%]	SE [kWh/m ³]	NPSHr [m]
DP @ 1x	39.82	16.74	8.75	39.82	16.74	8.75	74.71	0.07	3.69

NP 3171 HT 3~ 455 | Dimensional Data & Drawing



* Consult the IOM for more info
2" GUIDE BARS FOR NEW INSTALLATION
3" GUIDE BARS FOR RETROFIT
** DIMENSION FOR 2"/3" GUIDE BARS

Weight (kg)	Pump	Discharge
with cooling jacket	301	42
without cooling jacket	272	42

	NP,FP	3171	HT		Discharge outlet DN 100	Scale	Date
	091,095,181,185,350,390,660,670				Pump outlet DN 100	1: 20	250715
					Pump inlet	Drawing number	Revision
					Suction inlet	6599600	16

NP 3171 HT 3~ 455 | Headloss Calculation



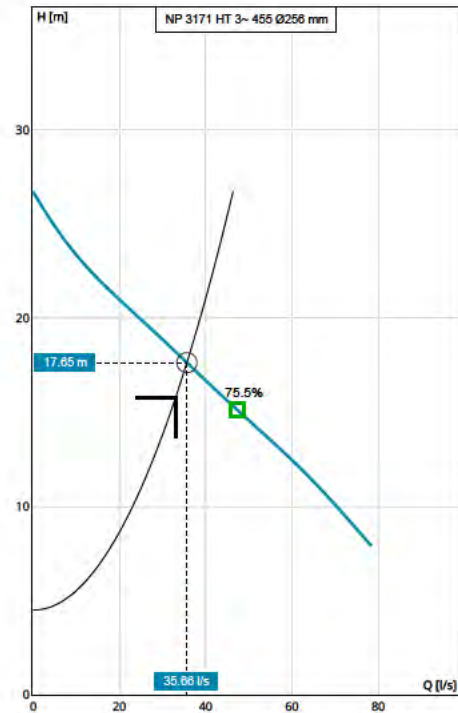
Fluid Type	Water	Total Flow	35 l/s	Kinematic Viscosity	0.000002 m ² /s
Static Head	4.5 m	Operating Pumps	1	System Type	Single Pump
Layout	Wet Installed Submersible Pumps	Calculation Model	Colebrook-White		

Type	Pipe Inner Diameter [mm]	Length / K Factor	Quantity	Velocity [m/s]	Pipe Roughness [mm]	Headloss [m]
Individual Discharge Piping / SS Wetwell / Stainless steel / PN 10 / DN 150 (159x4.0 mm) / New Pipes						
Pipe Length	151 mm	15 m	1	1.84 m/s	0.5 mm	0.53 m
90 Elbow	151 mm	0.3	1	1.84 m/s		0.06 m
Tee Line →  →	151 mm	0.1	1	1.84 m/s		0.02 m
Check Valve	151 mm	0.9	1	1.84 m/s		0.18 m
Gate Valve	151 mm	0.2	1	1.84 m/s		0.04 m
Total Head						0.83 m
Individual Discharge Piping / Rising main / PE100 (HDPE) PE 4710 / SDR 11 (PN 16) / DN 200 (250x22.7 mm) / New Pipes						
Pipe Length	204.6 mm	1,185 m	1	1 m/s	0.5 mm	8.63 m
Total Head						8.63 m
Friction Loss Head						9.46 m
Static Head						4.5 m
Total Head						13.96 m

NP 3171 HT 3~ 455 | Configuration Summary



Flygt's self-cleaning non-clog N-pumps feature innovative designs and functions that deliver high sustained efficiency and the most reliable operation. This makes them the most reliable choice available for a broad range of wastewater applications for tough applications such as unscreened sewage, wastewater and sludge up to an 8 percent solids concentration. Impeller material available in Hardened cast Iron, Hard Iron and Stainless Steel to fit any wastewater application.



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

GENERAL

Explosion Proof	Impeller Diameter
No	256 mm
Max. Pumped Media Temp.	
40 °C	

MATERIAL AND COATING

Impeller Material
Hard-Iron
Volute Material
Grey Cast Iron

MOTOR

Rated Voltage	Motor Efficiency Class
400 V	Standard
Coupling	Rated Power
Y	15 kW

INSTALLATION

Installation Type
P - Semi-Permanent, Wet

NP 3171 HT 3~ 455 | Product Details

Description

N 3171

The Flygt N-series are equipped with the Flygt invented N-technology with its innovative self-cleaning impeller. Solid objects entering the pump will pass through the impeller between the impeller vanes. If an object gets caught on the leading edge of one of the vanes, it will slide along the backswept shape towards the perimeter of the inlet where it will be guided by a relief groove through the pump housing. This ensures a high sustained total efficiency over time. Due to the mechanical self-cleaning design, a sludge concentration of solids up to 8% can easily be pumped. The pump can easily be installed in either permanently or temporary submerged, or horizontally or vertically dry installations.

Flexible and Modular Design

The modular hydraulic design enables customization of the hydraulics to meet the requirements of many applications.

- o Replaceable wear ring in two materials, gray iron or Hard Iron, for different operation conditions
- o Hardened gray iron impeller for typical wastewater applications
- o Hard-Iron impeller for heavy duty wastewater applications containing abrasive and corrosive content
- o Chopper ring intended for tough wastewater applications where cutting is required due to long fibres and solid concentrations up to 10-12%
- o Stainless steel impeller for special applications that require duplex stainless steel

Robust and Reliable

- o Short shaft overhang reduces shaft deflection and increases seal and bearing life
- o Class H Motor designed for submersible use. Heat is concentrated to the stator core for improved cooling properties.
- o The Plug-in seal with Active Seal system eliminates the risk associated with incorrect installation and careless handling. All in one unit. Available in Tungsten carbide (WCCR) or Silicone carbide (SiC) depending on pumped media.
- o Motor cable SUBCAB® specially developed for submersible use
- o Offers flexible cooling systems, e.g. closed-loop cooling system, media cooled or external cooling that allows full motor potential in dry installations.
- o Premium brand bearings, greased for life, ensures a minimum of 50 000 hours of duty
- o Leakage sensor and motor temperature sensor as standard

The N 3171 is available with the following options:

- o ATEX, FM, CSA-approvals
- o Premium efficiency motors
- o Hard Iron hydraulic design
- o Stainless Steel hydraulic design
- o Vibration-sensor, extended motor temperature sensors, additional leakage-sensor, current-sensor and pump memory
- o Compatible with SmartRun® Wastewater pump controller
- o Compatible with MAS 801 monitoring system

Product Features

- o State-of-the-art wastewater pump with N-technology
- o Sustained high efficiency pumping with energy savings up to 25%
- o Flexible and modular design
- o Robust and reliable

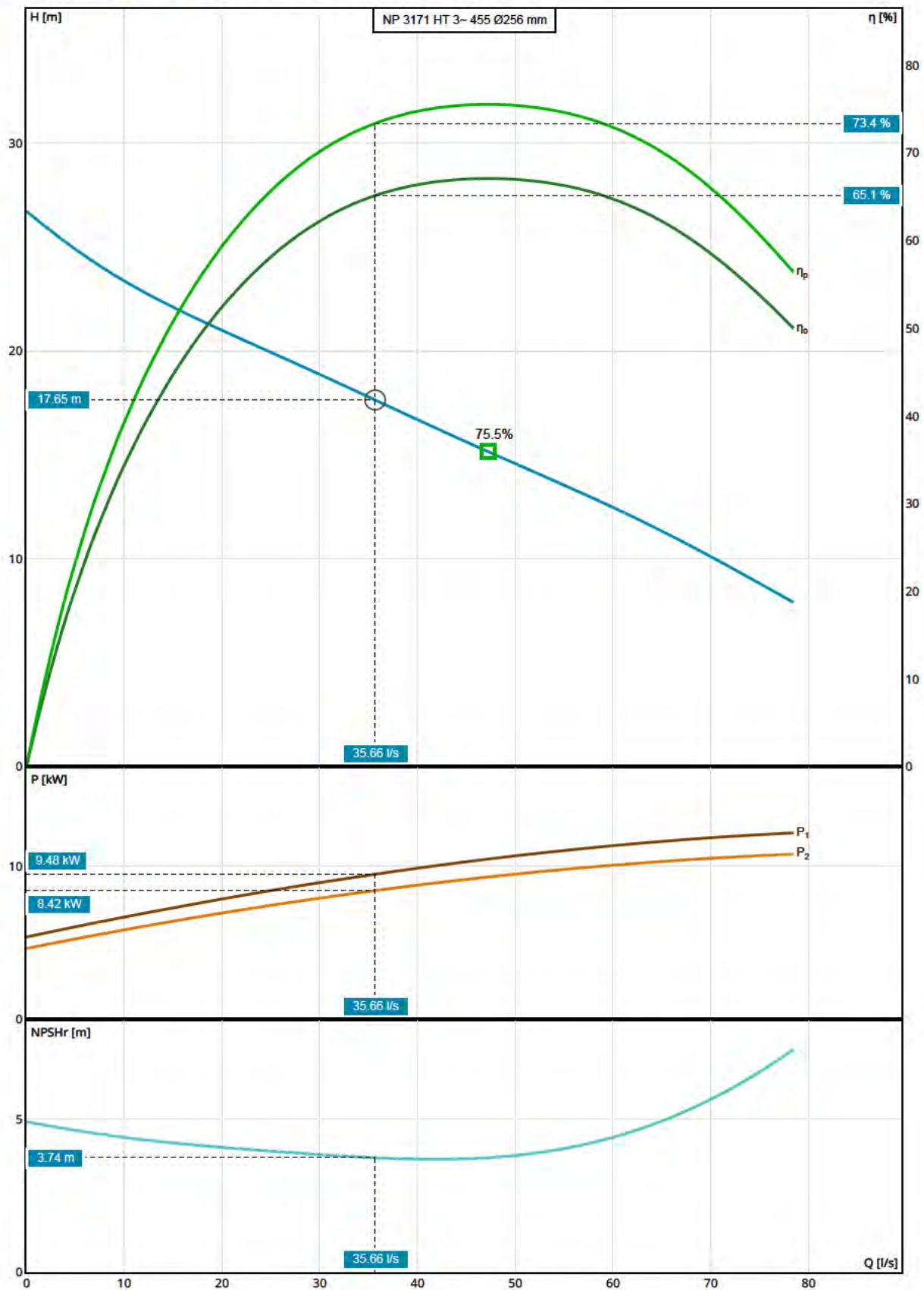
Construction Materials

Impeller Material	Volute Material	Stator Cover Material
Hard-Iron	Grey Cast Iron	-

Motor

Rated Power	Number Of Phases	Start Current Ratio	Motor Issue
15 kW	3	6.34	12
Motor Denomination	Rated Motor Speed	Insulation Class	Locked Rotor Code
25-14-4AA	1,460 RPM	H	H
Motor Efficiency Class	Rated Voltage	Approval	Max starts per hour
Standard	400 V	STD	30
Version Code	Rated Current	Total moment of inertia	Power Factor 100%
185	30 A	0.14 kgm ²	0.83
Frequency	Start Current	Type of duty	Power Factor 75%
50 Hz	189 A	S1	0.78
Max P2 (1x)	Starting Current, Direct Starting	Stator Variant	Power Factor 50%
10.79 kW	189 A	2	0.66
Number Of Poles	Starting Current, Star Delta	Motor Module	Efficiency 100%
4	63 A	131	87.2 %
			Efficiency 75%
			88.1 %
			Efficiency 50%
			87.5 %

NP 3171 HT 3~ 455 | Hydraulic Data & Performance Curve



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Selection

Series	Curve Code
N 3000	455
Name	Impeller Diameter
NP 3171 HT 3~ 455	256 mm
Frequency	Inlet Diameter
50 Hz	150 mm
Total Flow	Outlet Diameter
33 l/s	100 mm
Total Head	Number Of Vanes
15.76 m	2
Pump Flow	
33 l/s	
Pump Head	
15.76 m	
System Type	
Single Pump	
Operating Pumps	
1	
Standby Pumps	
No Standby Pump	

Design Point

Flow	Shaft power (P2)
35.66 l/s	8.42 kW
Head	NPSHR
17.65 m	3.74 m
Overall Efficiency (η_o)	Speed
65.13 %	1,480 RPM
Pump Efficiency (η_p)	Static Head
73.36 %	4.5 m
Input Power (P1)	Flow To BEP Ratio
9.48 kW	75.52 %

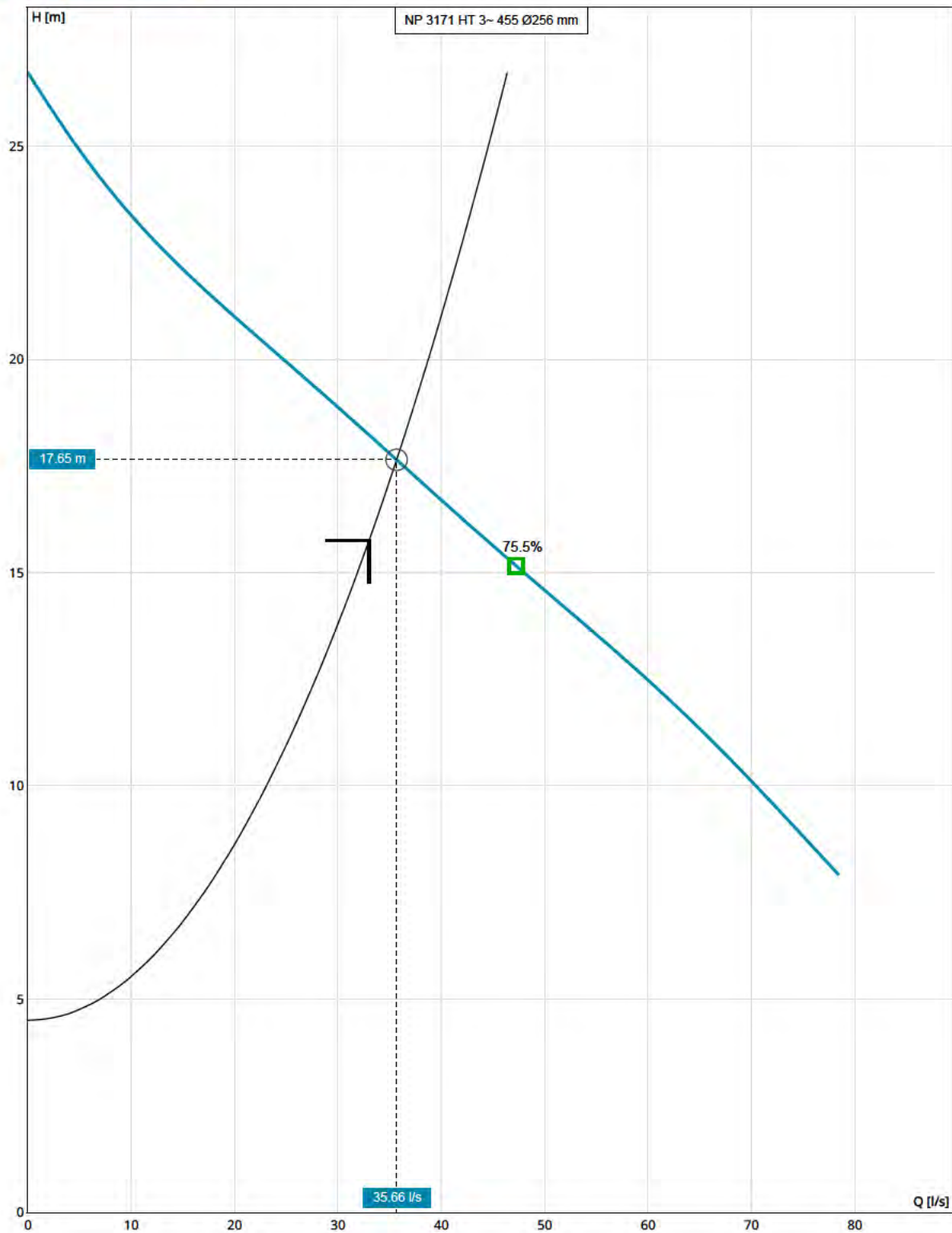
Fluid and Operating Conditions

Fluid Type	Density
Water	1,000 kg/m ³
Fluid Temperature	Dynamic Viscosity
4 °C	0.002 Pa·s
Specific Gravity	Fluid Vapor Pressure
1	8.14 mbar
	Atmospheric Pressure
	1,013.53 mbar
	Elevation
	0 m
	Ambient Temperature
	20 °C
	NPSH Available
	10.27 m
	Submergence
	0 m

Design Curve

Rated Speed	BEP Flow
50 Hz	47.23 l/s
Max Flow	BEP Head
78.46 l/s	15.16 m
H@QMin	Max P2
26.73 m	10.79 kW
H@QMax	Specific Energy
7.91 m	0.07 kWh/m ³
BEP	
75.53 %	

NP 3171 HT 3~ 455 | Duty Analysis

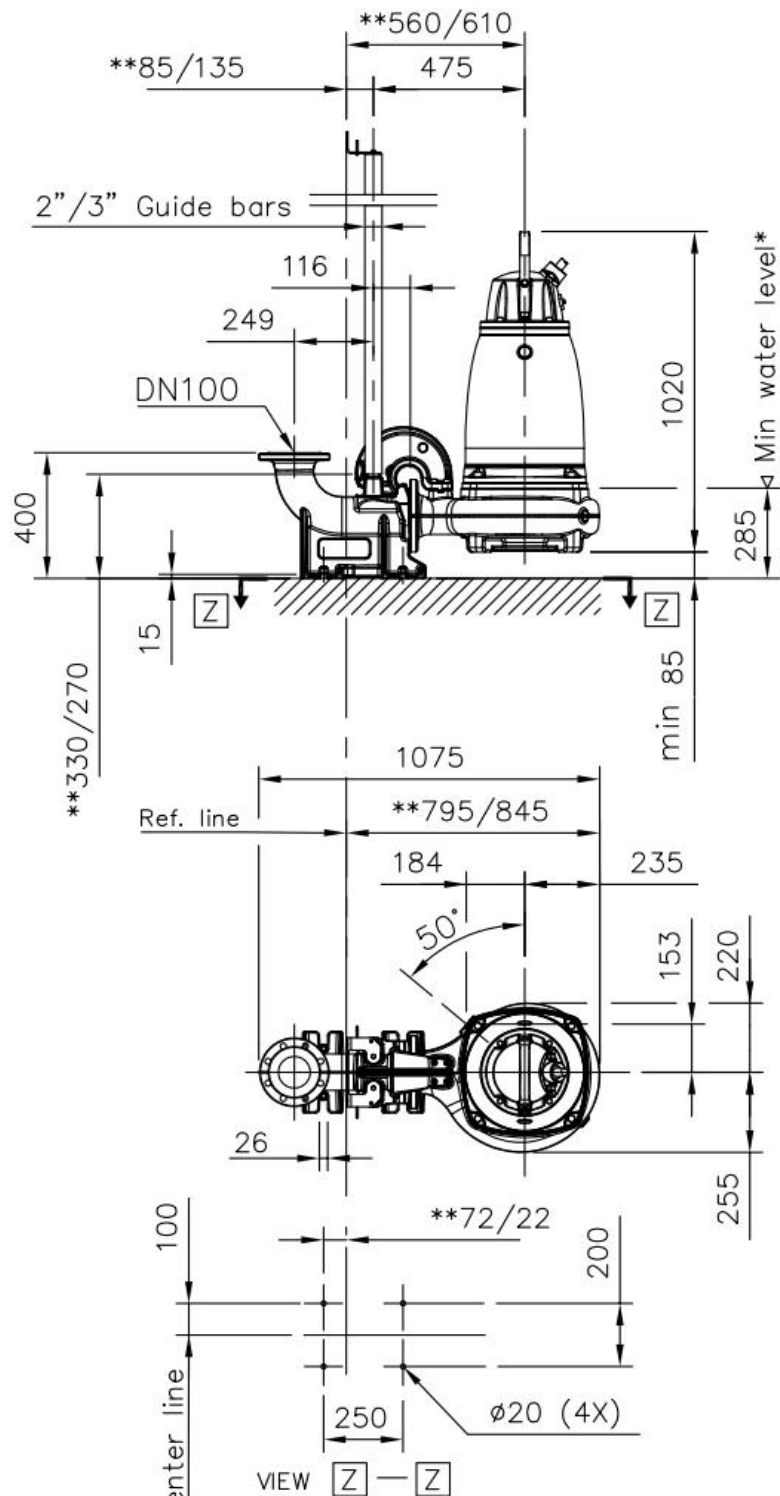


Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Name	Q (1x) [l/s]	H (1x) [m]	P2 (1x) [kW]	Q [l/s]	H [m]	P2 [kW]	η_p [%]	SE [kWh/m ³]	NPSHr [m]
DP @ 1x	35.66	17.65	8.42	35.66	17.65	8.42	73.36	0.07	3.74

NP 3171 HT 3~ 455 | Dimensional Data & Drawing



* Consult the IOM for more info
2" GUIDE BARS FOR NEW INSTALLATION
3" GUIDE BARS FOR RETROFIT
** DIMENSION FOR 2"/3" GUIDE BARS

Weight (kg)	Pump	Discharge
with cooling jacket	301	42
without cooling jacket	272	42

	NP,FP	3171	HT		Discharge outlet DN 100	Scale	Date
	091,095,181,185,350,390,660,670				Pump outlet DN 100	1:20	250715
					Pump inlet	Drawing number	Revision
					Suction inlet	6599600	16

NP 3171 HT 3~ 455 | Headloss Calculation



Fluid Type	Total Flow	Kinematic Viscosity
Water	33 l/s	0.000002 m ² /s
Static Head	Operating Pumps	System Type
4.5 m	1	Single Pump
Layout	Calculation Model	
Wet Installed Submersible Pumps	Colebrook-White	

Type	Pipe Inner Diameter [mm]	Length / K Factor	Quantity	Velocity [m/s]	Pipe Roughness [mm]	Headloss [m]
Individual Discharge Piping / SS Wetwell / Stainless steel / PN 10 / DN 150 (159x4.0 mm) / New Pipes						
Pipe Length	151 mm	15 m	1	1.84 m/s	1.5 mm	0.66 m
90 Elbow	151 mm	0.3	1	1.84 m/s		0.05 m
Tee Line →  →	151 mm	0.1	1	1.84 m/s		0.02 m
Check Valve	151 mm	0.9	1	1.84 m/s		0.16 m
Gate Valve	151 mm	0.2	1	1.84 m/s		0.03 m
Total Head						0.92 m
Individual Discharge Piping / Rising main / PE100 (HDPE) PE 4710 / SDR 11 (PN 16) / DN 200 (250x22.7 mm) / New Pipes						
Pipe Length	204.6 mm	1,185 m	1	1 m/s	1.5 mm	10.34 m
Total Head						10.34 m
Friction Loss Head						11.26 m
Static Head						4.5 m
Total Head						15.76 m

MCBERNS

INNOVATIVE SOLUTIONS

WELL WASHERS



Why choose a McBerns Well Washer?

- Eliminates fat & grease build up on infrastructure & Walls
- No power required
- Operates with mains pressure water
- Uses less than 100 lts water per/day
- Cleaner level sensor probes
- Reduces overflows caused by fogs
- Reduces odour
- Reduces confined space entries
- Reduces infrastructure corrosion
- Reduces maintenance
- Improved safety at pump stations
- Reduces customer complaints
- Healthier environment
- Optional pre-programmed with 5 cleaning cycle durations

McBerns Well Washers

The Well Washer has been in the Australasian marketplace for 25 years and is still the preferred method in keeping pump stations fat free. The AutoWellWasher™ will reduce maintenance in wet wells and tanks that accumulate fats, oils and greases (FOGs). Our design uses town water or recycled treated effluent at mains pressure to keep pump stations clean.

It can be installed using existing telemetry or with our pre-programmed timing device that activates towards the end of the pump out cycle.

Installing a wellwasher will eliminate large fatty build-up in pump stations, this then reduces blockages in pumps

and downstream sewers. The level sensors remain clean so the pumps work more efficiently, reducing the risk of overflows due to FOG build-up. It has also been shown to significantly reduce sulphide corrosion on concrete walls, pumps and other internal infrastructure components. There are fewer confined space entries required, only when essential maintenance tasks are needed.

The Well Washer is wholly designed and manufactured in Australia and has Australian, United States & International Patents.

'The total water usage for a single washer is as little as 100 litres per day.'

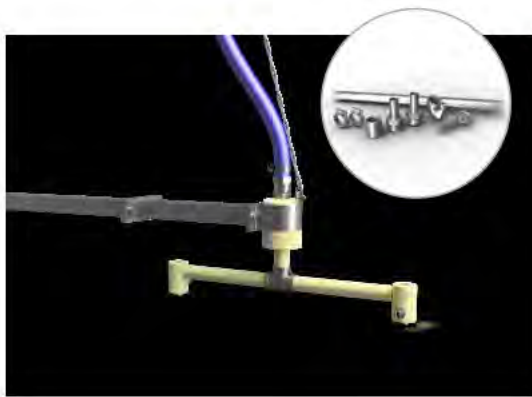
The principle behind the design is simple:
The Well Washer cleans the fat and grease away before it solidifies.





Well Washer Kit Guide Rail Mount

Part Number:	WWKITGRMOUNT
Description:	Kit includes washer, brackets and install hose & fittings
Application:	Eliminates fat & grease build up on infrastructure and walls
Material / Finish:	Austen, 316 S/S
Dimensions:	Taking the infrastructure into account we can design to specific requirements
Weight:	6 kg
General Specifications:	40/60 PSI, 30 l/min, 5-6m (Diameter)



Well Washer Kit Wall Mount

Part Number:	WWKITWALLMOUNT
Description:	Kit includes washer, brackets and install hose & fittings
Application:	Eliminates fat & grease build up on infrastructure and walls
Material / Finish:	Austen, 316 S/S
Dimensions:	600mm to 900mm Diameter
Weight:	6 kg
General Specifications:	40/60 PSI, 30 l/min, 5-6m (Diameter)



Optional Solenoid Valve

Part Number:	WWSOLENROID
Description:	Optional Solenoid Valves for water supply
Application:	Once energised allows water to flow to wellwasher
Material / Finish:	Glass reinforced nylon
Dimensions:	600mm to 900mm Diameter
Weight:	500 g
General Specifications:	Continuous operation 100% ED c/w LED connector plug IP65



Optional Pre-Programmed Allen-Bradley Micro810 Smart Relay

Part Number:	WWTIMER
Description:	Pre programmed with 5 cleaning cycle durations
Application:	Water Conservation, Minimise manual control
Material / Finish:	PVC
Dimensions:	600mm to 900mm Diameter
Weight:	500 g
General Specifications:	Less than 100 L daily



MCBERNS

INNOVATIVE SOLUTIONS

ODOUR MANAGEMENT
SAFETY ACCESS COVERS
DESIGN & FABRICATION
DATA ANALYTICS

MCBERNS PTY LTD
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Kunda Park, Qld, 4556
Phone: +61 7 5445 1646
Fax: +61 7 5445 1743
Email: mail@mcberns.com

Noel Southern: 0411 745 458
Paul O'Kane: 0459 396 157
Stuart Darby: 0413 436 683

www.mcberns.com



Aquate Commercial Pump Station

Technical Guide WW 10

Aquate Pump Stations are ideal for civil infrastructure applications where sewage or stormwater needs to be discharged into a reticulation network or wastewater treatment plant.



06.22 | WASTEWATER | WWW.AQUATE.COMMERCIALPUMPSTATIONS

Applications

From residential subdivisions, schools, factories and commercial developments to stormwater networks, our complete range of pump stations is the solution for any sewer, stormwater or trade waste application.

Approvals/Standards

Concrete components designed and manufactured to AS/NZS 4058:2007
Precast Concrete Pipes

AS/NZS 1546:1 2008 – tank certification

AS/NZS3000 – electrical controller

AS/NZS 3500.2:2021 Sanitary plumbing and drainage

Built under ISO9001:2008 QA System

We are the supply partner of choice for New Zealand's civil construction industry, specialising in water and infrastructure based solutions.

Aquate Pump Stations are ideal for civil infrastructure applications where conventional gravity systems are impractical or not cost effective.

Introduction

Hynds offers a wide range of high performance and durable Aquate packaged pump stations. These systems include chambers, pumps, level controls, control equipment, piping and valves etc. Aquate Pump stations are manufactured in Hynds Precast Factories and available in either concrete or polyethylene.

Our dedicated design team at Aquate provide a complete design and specification for consulting engineers and contractors. No matter what challenges your project presents, Aquate's expert engineers will work with you step by step to custom design the perfect pump station solution. Safety in design, environmental risk mitigation and ease of maintenance for servicing is always front of mind.

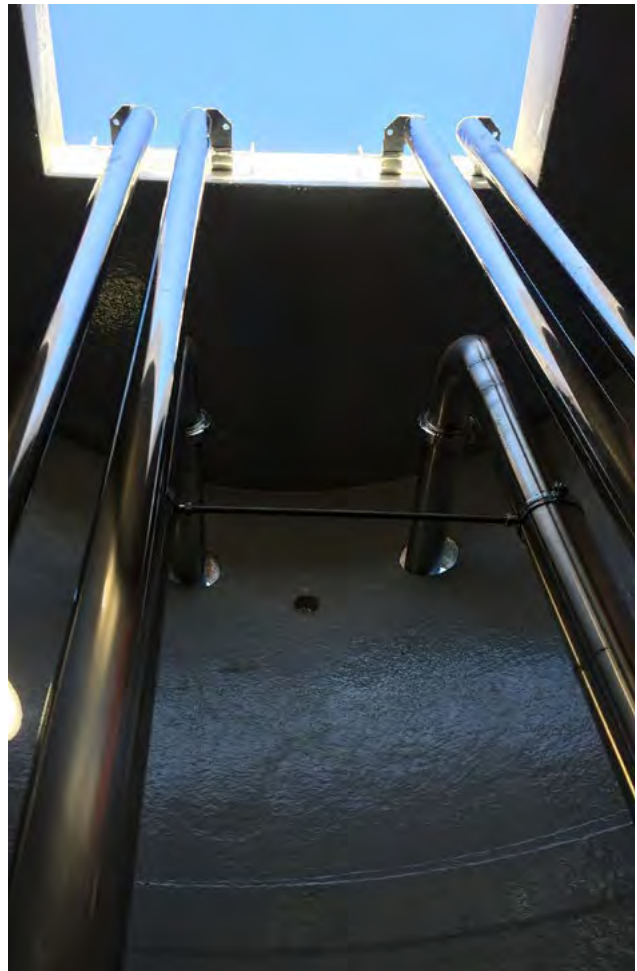
Hynds' dedicated Project Manager oversees the entire pump station project, including supply, on site installation, commissioning and quality assurance. Together with Aquate's world standard design service, the whole process from design through to installation is seamless.

Residential Aquate Pump Systems are also available for domestic applications.

See our website for more information: www.hynds.co.nz/product/aquate-residential-pump-station/

Features & Benefits

1. Flexible design: Aquate Pump Stations are designed to provide the required on-site storage and optimal pump performance.
2. Easy installation: The systems are prefabricated in the factory providing easy installation on site.
3. High quality pumps: Brands include Flygt, Grundfos, Domo and Zenit. Pumps are designed to meet the site specific requirements.



Technical data

Aquate Model No.	AQ1200	AQ1500	AQ1800	AQ2050	AQ2500	AQ3000
Internal diameter (mm)	1200	1500	1800	2020	2550	3000
Max chamber depth (m)	4.8	4.8	6.0	6.0	8.0	10.0
Min. riser sections (mm)	300	300	300	300	300	300
Valve chamber diameter (m)	1.2	1.2	1.5	1.5	1.8	1.8
Min volume wet-well (L)	2000	3500	5000	7000	10000	17000
Volume per additional metre depth (L)	1130	1760	2550	3100	5100	7050
Maximum pipework size (mm)	100	150	200	250	300	300

Control Panel

Hynds Aquate Pump Stations come complete with an electrical controller. This can be located on the pump chamber or installed at a nearby building. Features include:

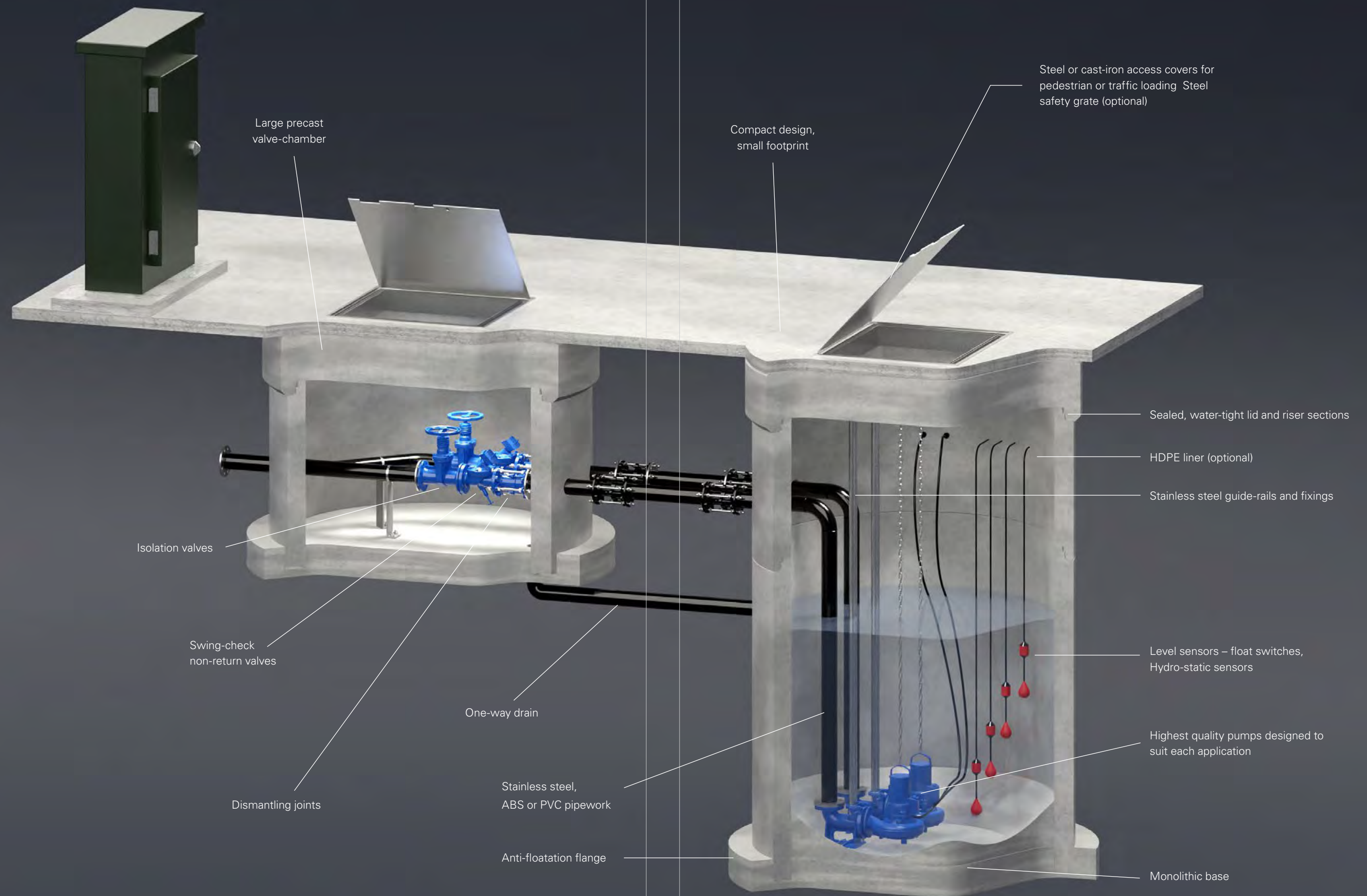
- Single or three phase option
- Simplex or duplex pump operation
- Lockable IP 65 rated enclosure
- Visual and audible pump failure alarm system
- High level alarm
- Over pressure protection
- Pump motor protection against variable electricity supply
- Performance data recorded



Options

- Web Based monitoring
- Float switches, hydrostatic transducers or ultrasonic level sensors
- Steel cabinets
- Hour run and start count
- Integration into a SCADA System
- Mag Flow Metres
- Alarm telemetry (SMS alarms), radio transmission, or outputs to BMS





Options cont...

- Flow Meters to monitor usage
- Auto well-washer for automatic station cleaning
- Odour filters
- Internal linings to prevent corrosion
- Lifting arm socket to simplify maintenance procedures
- Storage tank for emergency storage

Back up and support

Hynds has service agents throughout New Zealand. In the unlikely event of an alarm activation there is typically sufficient storage in the tank for 24 hours of normal operation. In the event of an alarm, either Hynds or the Local Council's Utility Services Team can provide onsite service.

Design Assistance

A dedicated Aquate Design Team will assist engineers design the ultimate pump station for their project.

The following information will need to be considered to complete the full design:

- Expected daily wastewater volumes
- Emergency storage requirements
- Private or Council owned
- Static lift of rising main
- Length of rising main
- Special requirements for the controller (see options available)
- Depth of inlet pipes
- Pedestrian or traffic loading

Based on the information provided, Aquate will supply a design and specification including :

- Size of wet-well required
- Emergency storage tank if required
- Pump model and design
- Rising main sizing
- GA drawings of the pump station and valve chamber

Contact

Contact our Project Manager to discuss your project

E: [REDACTED]

M: [REDACTED]

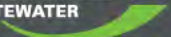




Branches Nationwide *Support Office & Technical Services* 0800 93 7473

Disclaimer: While every effort has been made to ensure that the information in this document is correct and accurate, users of Hynds product or information within this document must make their own assessment of suitability for their particular application. Product dimensions are nominal only, and should be verified if critical to a particular installation. No warranty is either expressed, implied, or statutory made by Hynds unless expressly stated in any sale and purchase agreement entered into between Hynds and the user.

hyndswastewater.co.nz
0800 425 433

HYNDS
WASTEWATER 



Scan for more information

Hynds Retention Tank with Mul-T-Level™ Outlet

Technical Guide D5.15

Hynds strong and reliable retention tanks are available in Ring Joint Pipe Internal Base or Flange Base manhole types.



03.15 | DRAINAGE | D5.15 HYNDS RETENTION TANK

Applications

Stormwater retention & detention
Sewer storage

Product Attributes

Versatile Mul-T-Level™ outlet
Highly durable
Simple installation
Various design layouts and large capacity options available
Water tight
Proven history

Approvals/Standards

AS/NZS 4058:2007 Precast concrete pipes (pressure and non-pressure)

Quality

ISO 9001:2008 Quality Management

The go to organisation for civil and rural water product solutions

HYNDS

Hynds strong and reliable retention tanks are available in Ring Joint Pipe, Internal Base or Flange Base Manhole types.

Design Specifications and Applications

RJ Retention Tank

- Generally used when the location permits the installation of a long narrow tank.
- Comprised of Hyspec reinforced concrete rubber ring joint pipes.
- Usually includes a spigot-plugged pipe, standard intermediate pipes and a collar-plugged pipe.
- The spigot and collar plugs are factory cast to ensure water tightness and integrity.
- A manhole offtake is factory fitted to one or more pipes to provide easy access for maintenance.

IB or FB Retention Tank

- Generally used in compact site conditions where relatively small volumes is required.
- Comprised of Hynds internal base or flange base manhole risers and a precast concrete lid.

Mul-T-Level™ outlet

- Enables the tank to be used for both detention and retention.
- Both the RJ and IB/FB retention tanks have a standard 100 or 150mm diameter PVC slip coupler and Mul-T-Level™ outlet cast-in or fitted during manufacturing.
- The required retention/detention volume is set by an orifice hole (of specified diameter) being drilled on the Mul-T-Level™ outlet at a pre-determined height.

General Specifications

- Manufactured from Hyspec spun concrete pipes, using the centrifugal spinning process.
- When the tank is installed in an aggressive environment, such as tidal areas, sewerage or mild acid solutions, the use of a special grade concrete is recommended. Contact Hynds Technical Team for more information.
- Retention tanks are available in various class types to suit specific site conditions, loading and applications.
- The diameter and length of the retention tank is dependent on:
 - Storage volume required
 - Site configuration and access equipment available
- Inspection and maintenance access is provided by a fitted inspection chamber or manhole riser starter.
- PVC slip couplers are fitted to end plugs to provide inlet and outlet connections to the retention tank.
- Non-standard couplers or starter types can be cast-in on request.
- Orifice holes are drilled at levels to suit the design requirements.
- Standard lids are available for access risers in the RJ type tanks.
- A light or heavy duty cast iron cover and frame will fit directly onto the 600mm diameter access riser.
- The 1050 mm diameter access riser requires a 1050 mm diameter manhole lid, which can be fitted with the cast iron manhole frame and cover.
- The IB or FB tanks require a lid, which can be fitted with a cast iron frame and cover to suit the riser diameter.
 - Note: Lid thickness is dependent on loads and application
 - Refer to Table 1 for RJ tank capacities and Tables 2 and 3 for IB/FB tank capacities.

TABLE 1 RJ type retention tank

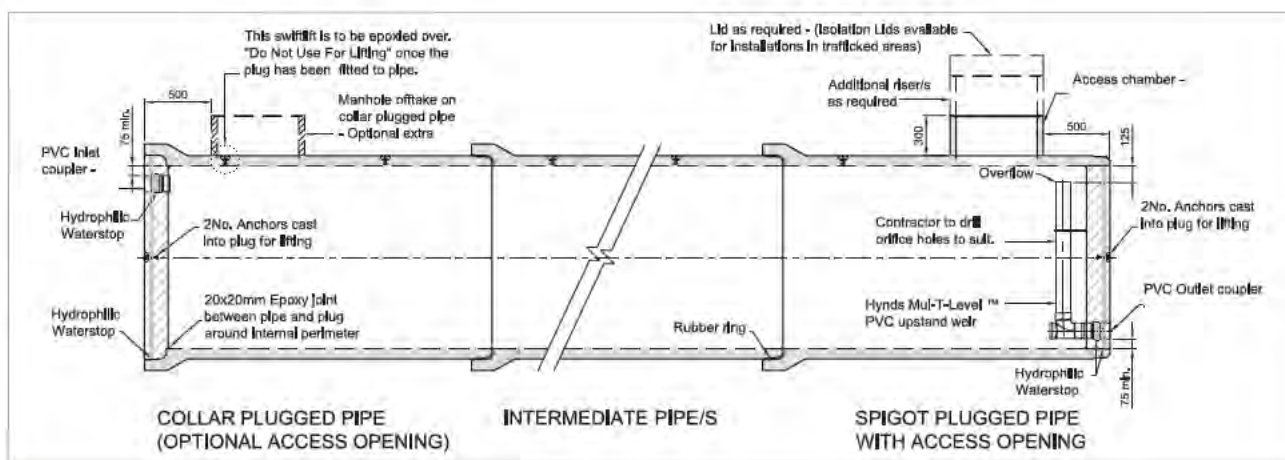
Nom Pipe Diameter and Joint Type	Pipe Effective Length (m)	Nom Vol per Pipe Length (m³)	Nom Vol per Pipe Length (Litres)	Suggested Offtake Dia (mm)	Lifting plugged pipe anchor req.	Handling intermediate pipe anchor req.
675RJ	2.440	0.72	720	600	A1	A2
750RJ	2.440	0.92	920	600	A1	A2
825RJ	2.436	1.14	1140	600	A1	A2
900RJ	2.448	1.38	1380	600	A1	A2
975RJ	2.440	1.67	1670	600	B1	B2
1050RJ	2.440	1.94	1940	600	B1	B2
1200RJ	2.440	2.58	2580	600	B1	B2
1350RJ	2.454	3.31	3310	600/1050	B1	B2
1600RJ	2.440	4.51	4510	1050	C1	B2*
1800RJ	2.438	6.13	6130	1050	C1	C2
1950SRJ	2.440	7.05	7050	1050	C1	C2
2100SRJ	2.397	8.02	8020	1050	C1	C2
2300SRJ	2.735	11.01	11010	1050	C1	C2
2550SRJ	2.470	12.18	12180	1050	C1	C2

Key

- **A1** 1 Tonne
2 no. in plug
1 no. in pipe
- **A2** 1 Tonne
2 no. in pipe
- **B1** 2.5 Tonne
2 no. in plug
1 no. in pipe
- **B2** 2.5 Tonne
2 no. in pipe
- **C1** 5 Tonne
2 no. in plug
1 no. in pipe
- **C2** 5 Tonne
1 no. in pipe

Notes:

- All dimensions refer to Class 2 (X) pipes
- Outlet 75 mm minimum above bottom invert of pipe
- Overflow 125mm below top
- *1600 Ø retention tanks require both B2 & C1 type lifting clutches for offloading and installation
- See Fig 6 for 3 point lift on typical plugged end pipe

**FIG. 1** General layout of typical RJ type retention tank with Mul-T-Level™ outlet

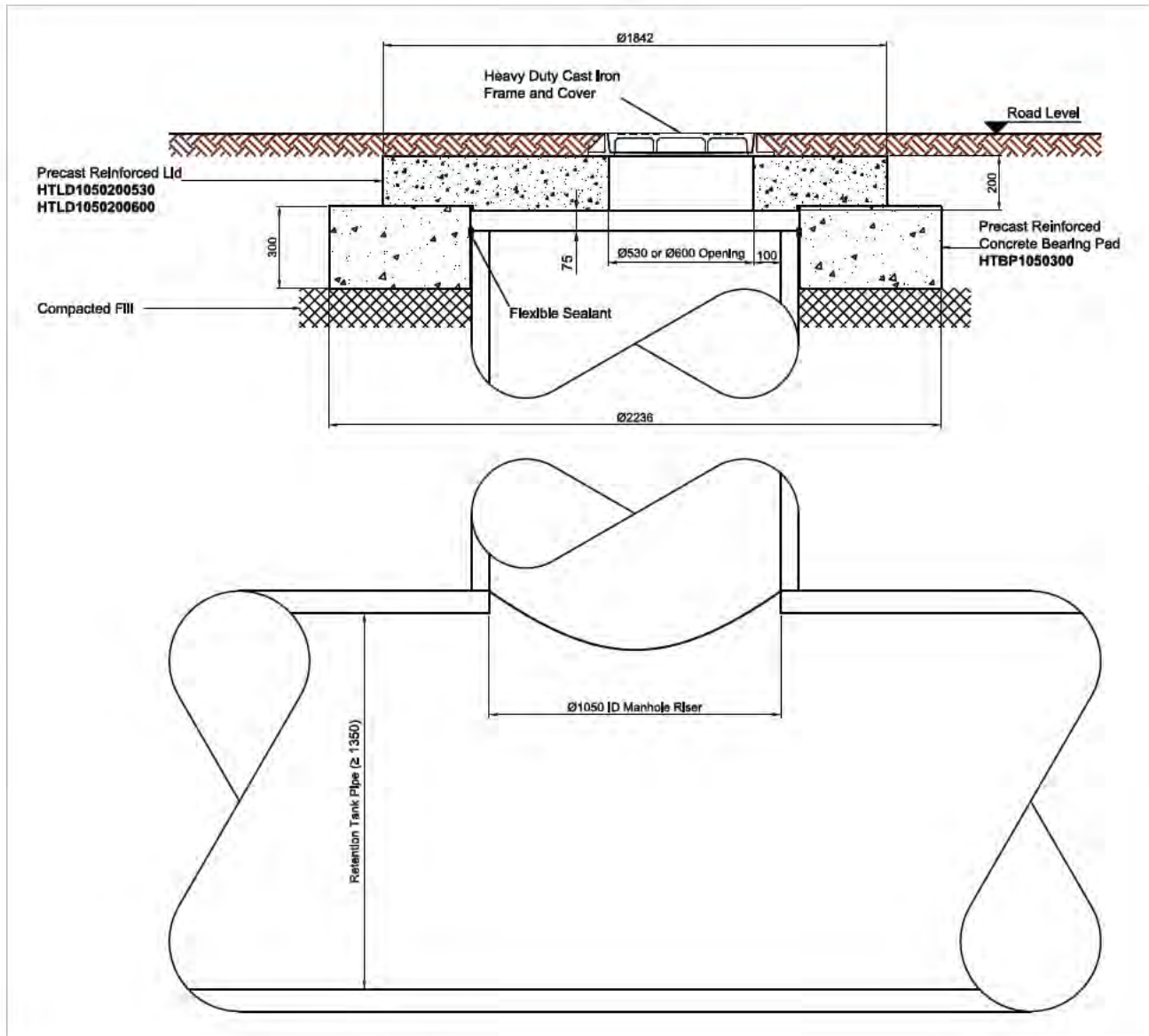


FIG. 2 Recommended detail for roadway installation

COLLAR PLUGGED PIPE (OPTIONAL ACCESS OPENING)

INTERMEDIATE PIPE/S

SPIGOT PLUGGED PIPE WITH ACCESS OPENING

PIPE Ø

Mn. Recommended Ø 675mm

PIPE CLASS

TOTAL No. OF PIPES (Incl. ends)

COVER TO INVERT

PVC INLET FITTING Ø

Pipe Ø	Standard Fitting Ø	Ø Required
Ø675 to 1200mm	Ø100mm	
Ø1350 to 3000mm	Ø150mm	

PVC OUTLET FITTING Ø

Ø Pipe	Standard Fitting Ø	Ø Required
Ø675 to 1200mm	Ø100mm	
Ø1350 to 3000mm	Ø150mm	

ACCESS CHAMBER - OUTLET SIDE Ø

Ø Pipe	Standard Offtake Ø	Ø Required
Ø675 to 1200mm	Ø600mm	
Ø1350 to 3000mm	Ø1050mm	
Ø1350 to 3000mm	Specify	

ACCESS CHAMBER - OPTIONAL INLET SIDE Ø

Ø Pipe	Standard Offtake Ø	Ø Required
Ø675 to 1200mm	Ø600mm	
Ø1350 to 3000mm	Ø1050mm	
Ø1350 to 3000mm	Specify	

JOB DETAILS

QUOTE No.

CO No.

I AUTHORISE HYNDS PIPE SYSTEMS LTD TO PROCEED WITH THE MANUFACTURING OF THIS PIPE SPECIAL AS DETAILED ABOVE. I ACKNOWLEDGE THAT ANY SPECIALS, ONCE MANUFACTURED, ARE DEEMED TO BE MY (CONTRACTOR'S) PROPERTY & ARE NON REFUNDABLE. STORAGE & HANDLING FEES WILL BE INCURRED FOR PRODUCTS THAT ARE NOT DELIVERED/COLLECTED WITHIN 1 MONTH OF THE DATE AGREED AT THE TIME OF ORDER. PRODUCT NOT DELIVERED/COLLECTED WITHIN 3 MONTHS OF THE DATE AGREED WILL BE DESTROYED AT MY EXPENSE.

NAME > SIGNATURE >

DATE >

FIG. 3 RJ Retention Tank Order Form

Internal base type

TABLE 2 Internal base retention tank

Riser Height (mm)	450	600	900	1200	1500	1800	2100	2400
O/A Height Incl 150mm Thick Lid	580	730	1030	1330	1630	1930	2230	2530
O/A Height Incl 200mm Thick Lid	630	780	1080	1380	1680	1980	2280	2580
Effective Depth (mm)	225	375	675	975	1275	1575	1875	2175
Nominal Diameter	A = Riser OD (m)	B = Riser ID (m)	IB Capacity (m ³)					
1050	1.194	1.066	0.20	0.33	0.60	0.87	1.14	1.41
1200	1.347	1.207	0.26	0.43	0.77	1.12	1.46	1.80
1400	1.524	1.372	0.33	0.55	1.00	1.44	1.88	2.33
1500	1.677	1.523	0.41	0.68	1.23	1.78	2.32	2.87
1650	1.842	1.676	0.50	0.83	1.49	2.15	2.81	3.47
1800	2.007	1.829	0.59	0.99	1.77	2.56	3.35	4.14
2050	2.236	2.036	0.73	1.22	2.20	3.17	4.15	5.13

Effective Depth (mm)	-	-	625	925	1225	-	-	2125
Nominal Diameter	A = Riser OD (m)	B = Riser ID (m)	IB Capacity (m ³)					
2300	2.58	2.30	-	-	-	3.84	-	-
2550	2.85	2.55	-	-	3.19	-	6.26	-

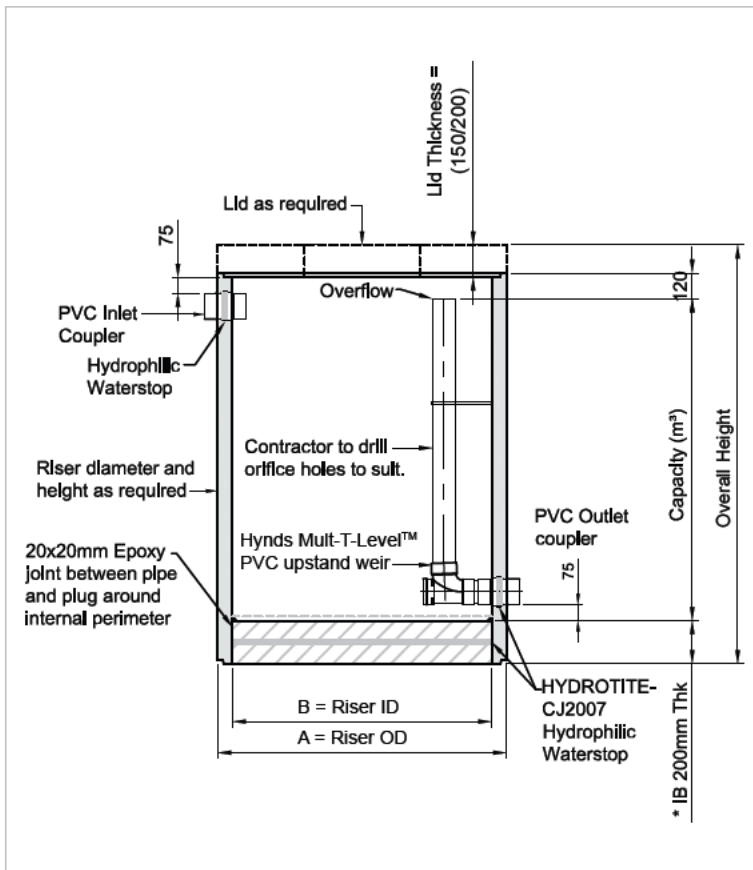


FIG. 4 Internal base

Flange base type

TABLE 3 Flange base retention tank

Riser Height (mm)			450	600	900	1200	1500	1800	2100	2400
O/A Height Incl 150mm Thick Lid			530	680	980	1280	1580	1880	2180	2480
O/A Height Incl 200mm Thick Lid			580	730	1030	1330	1630	1930	2230	2530
Effective Depth (mm)			225	375	675	975	1275	1575	1875	2175
Nominal Diameter	A = Riser OD (m)	B = Riser ID (m)	FB Capacity (m ³)							
1050	1.194	1.066	0.20	0.33	0.60	0.87	1.14	1.41	1.67	1.94
1200	1.347	1.207	0.26	0.43	0.77	1.12	1.46	1.80	2.15	2.49
1400	1.524	1.372	0.33	0.55	1.00	1.44	1.88	2.33	2.77	3.22
1500	1.677	1.523	0.41	0.68	1.23	1.78	2.32	2.87	3.42	3.96
1650	1.842	1.676	0.50	0.83	1.49	2.15	2.81	3.47	4.14	4.80
1800	2.007	1.829	0.59	0.99	1.77	2.56	3.35	4.14	4.93	5.71
2050	2.236	2.036	0.73	1.22	2.20	3.17	4.15	5.13	6.10	7.08

Effective Depth (mm)			-	-	625	925	1225	-	-	2125
Nominal Diameter	A = Riser OD (m)	B = Riser ID (m)	FB Capacity (m ³)							
2300	2.58	2.30	-	-	-	3.84	-	-	-	8.83
2550	2.85	2.55	-	-	3.19	-	6.26	-	-	10.85

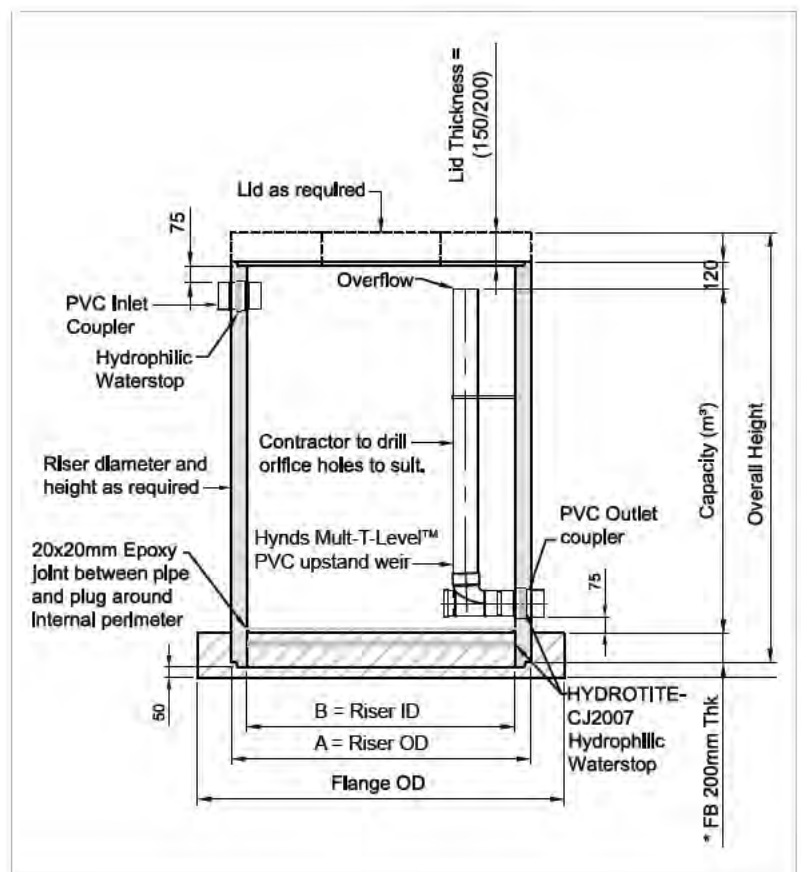


FIG. 5 Flange base

Installation

Mul-T-Level™ outlet

- Installation is simple and normally carried out by a drain layer using the same equipment and procedures as for the installation of concrete pipelines, or manholes.

RJ Retention Tank

- Similar installation to reinforced concrete rubber ring jointed pipes (including bedding requirements) and are dependent on site conditions and loading.
- Once the pipe sections have been installed and backfilled, the additional access risers are epoxied to the starter risers and brought up to the finished levels.
- The installation is then completed by fitting the required lids.
- The contractor must then drill the orifice holes at the required design levels.

Note: Refer to Figure 1 for a general layout of a typical RJ type tank.

RJ Retention Tank – Roadway Installation

- To minimise the effects of traffic, isolation of the manhole lid from the access riser is recommended.
- The depth of the modified flange base and riser must be kept to a minimum to enable maximum distribution of load above the tank.
- Refer to Figure 6 for 3 point lift of typical plugged end pipe.

IB or FB Retention Tank

- Similar installation to concrete manholes.
- Foundations should be prepared with compacted hardfill to prevent excessive settlement.
- Once the IB or FB tank is backfilled, the installation is completed by fitting the relevant concrete lid with the appropriate cast iron frame.



FIG. 6 Point lift of typical plugged end pipe

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Disclaimer: While every effort has been made to ensure that the information in this document is correct and accurate, users of Hynds product or information within this document must make their own assessment of suitability for their particular application. Product dimensions are nominal only, and should be verified if critical to a particular installation. No warranty is either expressed, implied, or statutory made by Hynds unless expressly stated in any sale and purchase agreement entered into between Hynds and the user.

Hyliner AKS HDPE Lining

Technical Guide D1.12

HyLiner AKS HDPE is used as corrosion protection lining in precast and cast in-situ concrete elements or structures to increase durability and reduce the risk of abrasion.



04.20 | DRAINAGE | D1.12 HYLINER AKS HDPE LINING

Applications

Corrosion protection lining for precast concrete pipes in sewer pipelines

Corrosion protection lining for in-situ concrete structures in wastewater treatment plants

Abrasion protection lining in high abrasion environments

Broad range of application in both precast and cast in-situ concrete

Product Attributes

Available in white (sewer applications) and black (where high UV resistance is required)

12 mm long anchors are integrally formed with the sheet

Factory QA tested and welding of joints is 100% quality tested onsite

Quality

ISO 9001:2008 Quality Management Standard

We are the supply partner of choice for New Zealand's civil construction industry, specialising in water and infrastructure based solutions.

HYNDS
PIPE SYSTEMS

HyLiner AKS HDPE is used as corrosion protection lining in precast and cast in-situ concrete elements or structures to increase durability and reduce the risk of abrasion.

Lining systems are able to bridge discontinuities in pipe or structure walls unlike other coating systems that rely on the integrity of the surface and quality of the surface preparation and the installer's expertise for functionality.

HyLiner AKS HDPE is a thermoplastic lining used to reduce the risk of sulphide attack or corrosion in sewage applications.

The high density polyethylene (*HDPE*) lining suits both precast and in-situ applications. Firmly anchored to the concrete surface of the pipe or structure, the lining requires only welding of joints to form a durable, chemically resistant concrete protection membrane with high abrasion resistance.

Installation

Installation procedures vary depending on the product:

Spun concrete pipe

The liner is inserted into the pipe prior to the completion of manufacture, with the pipe spinning process completed with the liner installed. This ensures that all the anchor knobs are well embedded in the spun concrete prior to the concrete curing and hardening.

Wet cast concrete pipe

The liner is securely attached to the inner mould before placement of reinforcement and casting of the pipe. The pipe once cast is cured in the normal manner using heat to accelerate the hardening process.

Precast concrete

This follows a similar process to the wet cast concrete pipe whereby the liner is attached to the mould prior to casting of the element.

In-situ concrete

This follows the same process as for precast concrete whereby the liner is attached to the formwork prior to casting of the concrete.

Installation Detail

In the case of concrete pipes, the liner need only be applied to the pipe's internal surface above low flow level during normal operating conditions as shown in fig 3.

Where 360° cover is required, the liner is fitted with an overlap at the invert (50 mm min) as shown in fig 4 & 5. This joint is not usually welded as it allows any accumulation of moisture from external hydrostatic pressure to dissipate from behind the liner.

Where the fluid contents are themselves aggressive, such as trade waste discharges, a longitudinal weld can be provided to seal the pipe invert.



FIG. 1 Where 360° cover is required, the liner is fitted with an overlap at the invert (50 mm min)

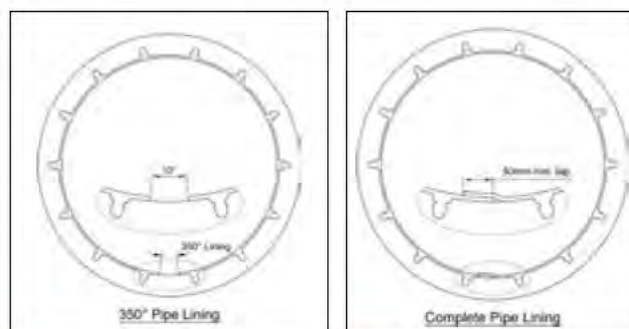


FIG. 3 Most concrete pipes only require the liner applied to the pipe's internal surface above low flow level during normal operating conditions.

FIG. 2 Invert overlap in a 1050Ø pipe.

Joining

A continuous lining system is created through the use of extrusion welding carried out by trained, qualified operators. Generally overlapped welds are recommended.

Various details for welded joints for precast concrete pipes and components are shown in Figures 4 to 6. Other details for site installation and fixing of brackets are shown in Figures 7 to 12.

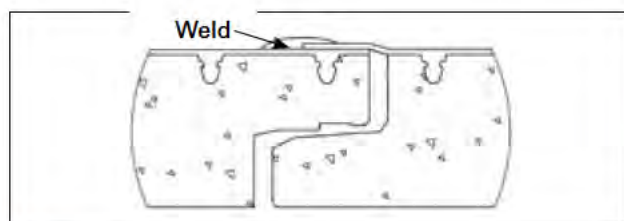


FIG. 4 HyLiner lined SRJ pipe (Lapped Joint)

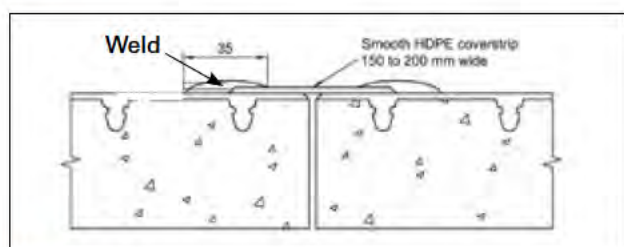


FIG. 5 Cover strip with 2 overlap welds

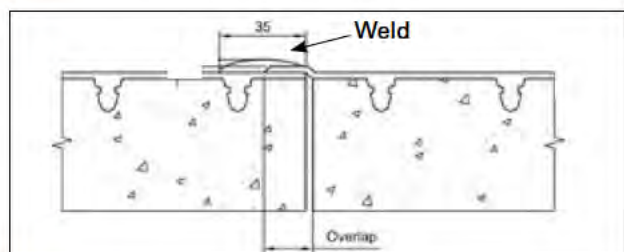


FIG. 6 Single overlap weld

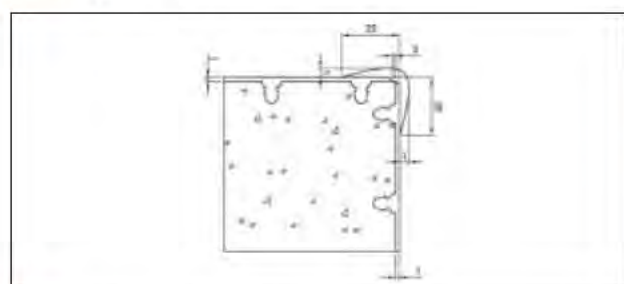


FIG. 7 Outside Corner Weld

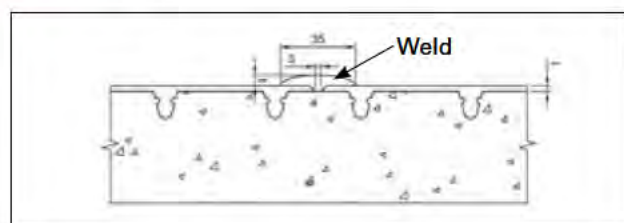


FIG. 8 Flat Extrusion Butt Weld

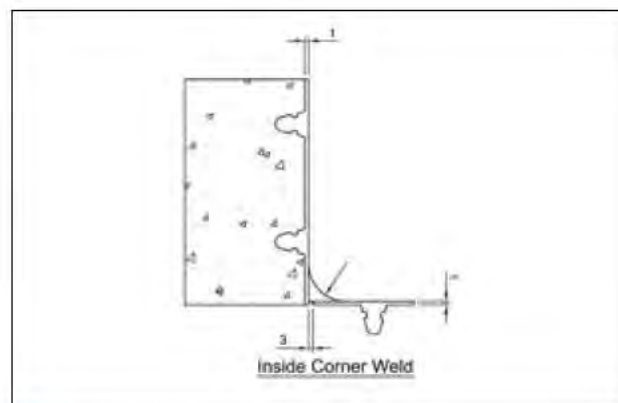


FIG. 9 Inside Corner Weld

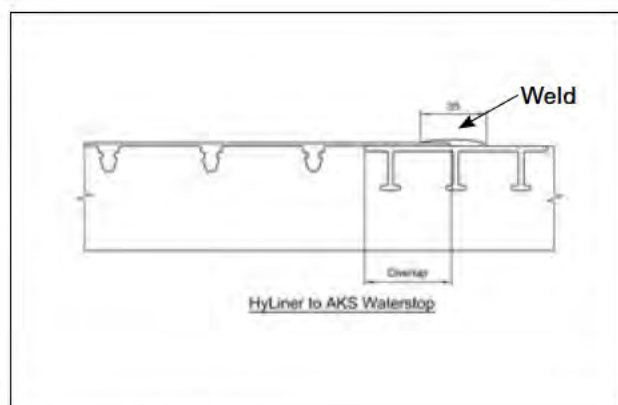


FIG. 10 HyLiner to AKS Waterstop

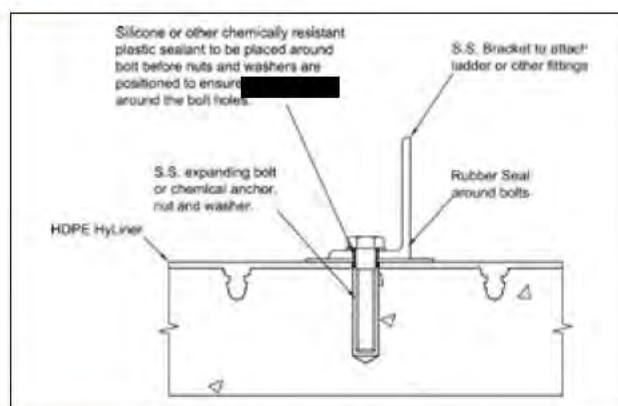


FIG. 11 Sealing of Brackets and Fittings to HyLiner Lined Structures

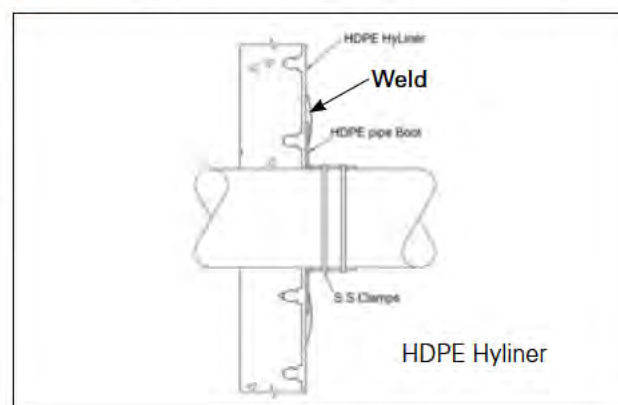


FIG. 12 Pipe Penetration Detail

Quality Control

In-plant quality control for the manufacture of the liner includes waviness, surface finish, knob shape and alignment, crimp height and depth of knobs, sheet thickness, density and tensile values.

Quality checks after casting into precast concrete pipes and components include effective anchor embedment, liner positioning on the product and spark testing for pin holes or damage.

All joints and the liner are spark tested after jointing is completed on site. This ensures the quality of the joints and identifies any damage in the liner as a result of handling and installation.

Abrasion resistance

HyLiner AKS HDPE has a good abrasion resistance when compared to other materials. A typical abrasion test value for HDPE liners is 0.3mm after 400 000 cycles (*Kirschmer, O., "Problems of Abrasion in Pipes", Steinzeugin Formationen, 1966, No 1, pp3-13*).

Wear rates are very slow even under continuous flow of abrasive slurry. Most drainage applications would have intermittent exposure to abrasion.

Suitable Structures for Lining

HyLiner AKS HDPE is suitable for installation in spun and wet cast concrete pipes from 1050–3000 mm diameter. HyLiner AKS HDPE is also suitable for lining a range of other concrete structures:

- Manhole risers and lids
- Rectangular or square precast concrete chambers and lids
- Precast concrete channels and lids
- Precast concrete pumpstations
- Insitu concrete structures such as tanks and chambers



FIG. 13 2300 Diameter Manhole Riser



FIG. 14 Liner being installed for a manhole lid

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BluSeal AKS

HDPE CONCRETE PROTECTION MEMBRANE



BluSeal Anchor Knob Sheet (AKS) is supplied and installed as a fully sealed and welded robust chemically resistant concrete protection lining.

BluSeal AKS is a synthetic membrane of HDPE sheet with integral anchors which are cast into concrete to form a flexible and durable corrosion protection lining. BluSeal AKS is used to protect concrete surfaces in chemically aggressive environments in sewerage tunnels, treatment works, pump stations, manholes and chemical retention bunds. It comes in a range of colours and thicknesses and can be applied to new and existing structures for protection or enhancement.

Application Advantages

- Fully welded homogenous lining
- Complete before 28-day concrete cure
- Factory assured thickness and absence of pinholes
- Retro-fitted lining is moisture compatible with assured bond

Lifecycle Advantages

- 100 year design life
- Membrane drainage eliminates negative pressure
- Chemical and impact resistant
- High anchor pull-out resistance
- Potable Water use to AS/NZS 4020:200
- Low coefficient of friction in lined conduits

About the Product

BluSeal AKS is supplied and installed as a fully sealed and welded, chemically resistant concrete protection system. The system includes propriety details for sealing around penetrations and against non-HDPE surfaces. Skilled applicators can fabricate the product into various shapes to suit irregular concrete formwork. All seams and joins are extrusion welded and then tested by spark or vacuum box testing. BluSeal AKS is designed and installed by approved applicators to international standards which are outlined in a manufacturer's installation manual. The elasticity of the membrane allows free drainage and relief of any hydrostatic pressure build-up in underground structures. The membrane can be cast into new structures or retrofitted by cement grouting onto the prepared surface of existing structures. AKS lined structures have an outstanding track record in aggressive environments, demonstrating a design life in excess of 100 years for the most demanding applications.

Application solutions

- Segmental sewer tunnels
- Inlet works and bioreactor tanks in WWTP
- Pump stations and manholes
- Tunnel waterproofing
- Chemical retention bunds
- Piles and foundation lining in aggressive ground conditions
- Sewer pipelines
- Slide pads on pipe plinths
- Concrete protection for industrial applications

Project Specification Clause

HDPE CORROSION PROTECTION LINING - The HDPE CPL membrane used for this project shall be supplied and installed as a fully sealed and welded robust continuous membrane system. It shall be a factory produced product that has independent testing to validate the performance outlined in the technical data table on the following pages. BluSeal AKS supplied by Bluey Technologies or equivalent shall be acceptable.

Project Examples

Sewerage treatment plants, sewer pump stations, sewer manholes, trunk sewer mains, chemical processing plant bunds and trenches, gas pipelines (pipe plinths).





BluSeal AKS

HDPE CONCRETE PROTECTION MEMBRANE

Application Specification

PREPARATION

- 1.1 BluSeal AKS must be installed onto formwork under the direction of an approved, specialised applicator who will plan layout configurations of sheets and weld seam locations. The applicator may also prefabricate some corner or seam sections and pipe penetration pieces offsite.
- 1.2 At joins in sheets the edge knobs are removed from one edge and the sheet is overlapped by 50mm to prevent egress of concrete fines and to provide a sound foundation for welding the seams.
- 1.3 Formwork shall be cleaned and free of defects. Form release oils are not necessary where BluSeal AKS is applied. Formwork should be designed to avoid leaking.
- 1.4 The sheets must be tensioned over the form within the yield elongation limit, prior to securing to the forms.
- 1.5 BluSeal Formtak can be used to assist in holding the sheet against timber formwork. Securing against the formwork is by nailing or stapling through the sheets at edges where extrusion welds will cover later or into edges that will be redundant and trimmed after the pour.
- 1.6 On circular forms, the sheets are wrapped and tensioned around and secured at the overlap by wires around the knobs and/or temporary speed welding along the seam.
- 1.7 In precast concrete applications the moulds may be designed to secure the membrane at the edges.
- 1.8 When BluSeal AKS is applied to an existing structure all corroded concrete and contaminants must be removed, leaving a surface profile greater or equal to CSP4 in accordance with ACI guidelines.
- 1.9 Treat or replace exposed reinforcement in accordance with ACI guidelines.
- 1.10 Refer to Bluey Technical Notes for recommendations regarding proving grout bond strength and design criteria.

APPLICATION

- 2.1 Always pour concrete or grout at a cooler ambient temperature than the temperature when the sheets were applied to the formwork. This will ensure the membrane is taut on the forms.
- 2.2 Anticipated maximum concrete temperature or accelerated curing temperature should not exceed 60 degrees Centigrade. Contact Bluey to discuss exceptions.
- 2.3 When grouting the sheets onto an existing structure, only grouts approved by Bluey such as BluCem HS200 shall be used, and mixing and placement shall be strictly in accordance with Bluey instructions. Fast set grouts, such as BluCem HE80, are recommended to be used for retrofitting the membrane in short time frames where assets must be returned to service quickly.
- 2.4 When grouting the membrane to floors, plan pours at times of the day where temperature changes before initial set of the grout are minimal. Avoid these pours in direct sunlight.
- 2.5 Concrete mix design, mixing, placement and compaction of concrete should follow standard civil construction practice to minimise voids and ensure full encapsulation of the anchors on the membrane.
- 2.6 Extrusion welding and weld testing at seams will be undertaken by approved applicators and in accordance with installation guidelines provided by the manufacturer and generally in accordance with DVS 2227. This includes proper preparation of the sheet surfaces to be welded and daily destructive seam peel tests sampled from trial welds. Welding technicians shall have formal industry training in extrusion welding techniques.
- 2.7 Non-destructive testing of completed welds will be either by vacuum box or spark testing.
- 2.8 Repairs and patching will be completed by extrusion welding over small defects or applying a minimum 200mm diameter patch over larger defects, with a minimum 80mm edge distance to the defect.
- 2.9 Destructive pull testing of anchors should be avoided.
- 2.10 Encapsulation of anchors can be easily checked by tapping across the surface of the membrane to detect any hollow sounds that indicate voids under the membrane. If voids are detected, they can be filled by injection of BluCem HS200 high flow grout through the lining. Repair by extrusion welding over the injection hole.



BlueSeal AKS

HDPE CONCRETE PROTECTION MEMBRANE

Product Data

Please refer to Important Notice on following page

Length of Knobs (nominal)	12mm
Knobs per m ²	1230
Pull-off Resistance	>700N per knob or 850kPa (short term loading)
Membrane Thickness	2.0mm to 10mm*
Roll Widths	Up to 3.2m
Colours	Black for UV exposed applications and light colours (such as white) for underground or covered structures.

TESTED CHARACTERISTIC	STANDARD	RESULT			
Density	ASTM D 505/D 792	≥ 940kg/m ³			
Carbon Black Content**	ASTM D 1603	2.0 - 3.0%			
Carbon Black Dispersion**	ASTM D 5596	Category 1 or Category 2			
ESCR (NCTL)	ASTM D 5397	>300 hours			
OIT	D 3895	>100 minutes			
Coefficient of Linear Expansion	ASTM E 831	1.1 - 1.4E-4cm/cm/deg C			
Tensile Properties (Sheet Material)	ASTM D 6693-04	Yield Stress 15MPa	Break Stress 27MPa	Yield Elongation 12%	Break Elongation 700%
Shore Hardness	DIN 53505	>50 Shore D			
Tear Resistance	ASTM D 1004	120N/mm			
Puncture Resistance	ASTM D 4833	300N/mm			
Dimensional Stability	ASTM D 1204	<2.0% change			
Water Absorption	ASTM D 570	<0.09%			
Flammability	UL94***	V0			

* Average minimum thickness to ASTM D 5199. Minimum thickness membrane made to order

** Black AKS only

*** Plastics flammability standard released by Underwriters Laboratories of the USA



BluSeal AKS

HDPE CONCRETE PROTECTION MEMBRANE

Contact Bluey

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ProcessMaster electromagnetic flowmeter

The perfect fit for the oil and gas industry



ABB has responded to the oil and gas industry's need for a rugged, reliable electromagnetic flowmeter

Measurement made easy

ProcessMaster flowmeters – perfect for the oil and gas industry

Expertise in measurement technology

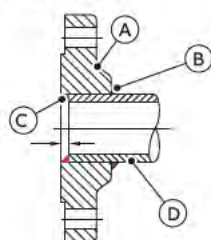
ABB's high pressure electromagnetic flowmeters are reliable, accurate and easily maintained. Customers worldwide have benefited from our application-oriented know-how and comprehensive service.

To learn more about our extensive portfolio, visit www.abb.com/measurement.

Designed specifically for oil and gas

We have added a two-tier, high-pressure version to our comprehensive range of electro-magnetic ProcessMaster flowmeters. It is available with either weld neck or slip-on flanges with RTJ and raised face connections.

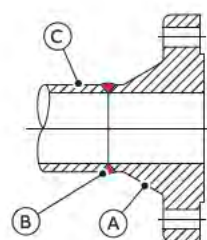
There are differences between X-Ray and dye penetrant test. For weld neck design we offer both dye penetrant and X-Ray tests; for slip-on design we offer only dye penetrant test.



(A) Slip-on flange (B) Fillet weld (outside) (C) Fillet weld (inside) (D) Pipe

Applications

- Slurries such as drilling mud
- Mixtures of fluids such as oil/water plus sand or produced water plus sand
- Injection fluids including sand and chemical additives for lubrication and corrosion prevention
- Sludge or sludge-like wastewater from produced water treatment
- Operating conditions such as high pressure or entrained gas in the fluid
- Harsh environmental conditions such as heat, moisture or vibration and explosive or corrosive atmospheres



(A) Weld neck flange (B) Butt weld (C) Pipe

Robust design for long life

The ProcessMaster flow sensor is designed for reliability in the demanding operating conditions found in oil and gas industry applications.

- Long lasting sensor lining materials withstand abrasion and corrosion, resulting in longer sensor service life and minimal maintenance requirements
- No additional pressure drop caused by protrusions into the pipe
- Optional self-cleaning measuring electrodes prevent issues caused by build-up of deposits
- Double sealed measuring electrodes minimize the risk of leakage and enhance reliability
- Optional all-316 stainless steel construction for corrosive offshore atmosphere
- Optional fully-welded sensor made from 316 material
- Protection of internal sensor components against moisture and vibration with potted Ex sensor

Range of certificates and test reports

- 3.1 material certificates and/or PMI certificates
- Certificates for non-destructive testing, X-Ray and/or dye penetration test
- Welder qualifications and procedures
- Hydrostatic pressure testing

Specification

Accuracy	Standard: 0.4 % of rate Enhanced: 0.2 % of rate
Nominal size range	DN 25 to 400 (1 to 18 in)
Nominal pressure	ASME CL 600 to 2500
Lining	Hard rubber, ETFE
Electrodes	Stainless steel, Hastelloy C
Process connection	Steel, stainless steel
IP rating	IP67, IP68
Fluid temperature	-25 to 130 °C (-13 to 266 °F)
Power supply	100 to 230 V AC, 24 V AC/DC
I/Os	Current, pulse status output
Communication *	HART protocol, PROFIBUS PA, FOUNDATION Fieldbus
Sensor housing material	Stainless steel 316
Transmitter housing material	Stainless steel
Wetted parts material	Option for NACE
Ex approvals	ATEX/IEC Zone 1.2, FM/cFM Cl1 Div.1, Cl1 Div.2
Marine approval	DNV
Verification	ScanMaster

* Acknowledgements

HART is a registered trademark of FieldComm Group, Austin, Texas, USA.

PROFIBUS is a registered trademark of PROFIBUS and PROFINET International (PI).



FEP630 high pressure magnetic flowmeter



FEP610 high pressure magnetic flowmeter

BLACKBOX

Technical Specifications:

Blackbox 130 is a compact low-cost intelligent controller that allows users to locally program the unit and give a readout of level. Economical and simple to program and operate, users benefit from extremely accurate and reliable digital echo processing with access to the dB and dBR range of transducers, measuring from 125 mm (4.9 in) right through to 40 m (131.2 ft).



PHYSICAL: MOUNTING OPTION SPECIFIC

Mounting Option:	Standard Wall Mount:	Large Wall Mount:
Controller Body Dimensions:	130 mm x 150 mm x 63.5 mm (5.1 in x 5.9 in x 2.5 in)	130 mm x 180 mm x 85 mm (5.1 in x 7.09 in x 3.3 in)
Weight:	Nominal 0.7 kg (1.4 lb)	Nominal 0.8 kg (1.7 lb)
Enclosure Material/Description:		ABS Base with polycarbonate lid, flammability rating UL 94 HB
Cable Entry Detail:	Underside fitted with 3 x M20, nylon cable glands suitable for 6 mm to 12 mm (0.2 in to 0.5 in) cable	Underside fitted with 3 x M20, nylon cable glands suitable for 6 mm to 12 mm (0.2 in to 0.5 in) cable
Transducer Cable Extensions:	2-core screened (2 conductor 20 AWG screened)	
Nominal Separation:	1,000 m (3,280 ft), for greater separation distances please contact us	

ENVIRONMENTAL

IP Rating:	IP66/67
Max. & Min. Temperature (Electronics):	-20 °C to +55 °C (-4 °F to +131 °F)
Flammable Atmosphere Approval:	All Blackbox units must be mounted in a safe area. Compatible with approved dB Transducers
CE Approval:	See EU Declaration of Conformity in the manual
UL Approval:	UL Listed. UL Listed to Canadian Safety Standards. Certificate Number E257330.

PERFORMANCE

Accuracy/Repeatability:	0.25% of the measured range or 6 mm (0.2 in), <i>whichever is greater</i>
Resolution:	dBMAH3 0.3 mm (0.01 in), dB3 0.5 mm (0.02 in), dB6 and dB10 1 mm (0.04 in), dB15 1.5 mm (0.06 in), dB25 2.5 mm (0.1 in), and dB40 5 mm (0.2 in).
Min. & Max. Range:	Dependent on Transducer. Nominally 125 mm to 40 m (4.9 in to 130 ft)
Echo Processing:	DATM (Digital Adaptive Tracking of Echo Movement)
Rate Response:	Fully Adjustable

OUTPUTS

Analog Output:	Isolated output of 4-20mA or 0-20mA into 1 kΩ (user programmable and adjustable) 0.1% resolution
Digital Output:	RS232 for programming and data extraction
Volt Free Contacts, Number, & Rating:	2 form "C" (SPDT) rated at 2 A at 240 V AC
Display:	2 x 12 alpha numeric

PROGRAMMING

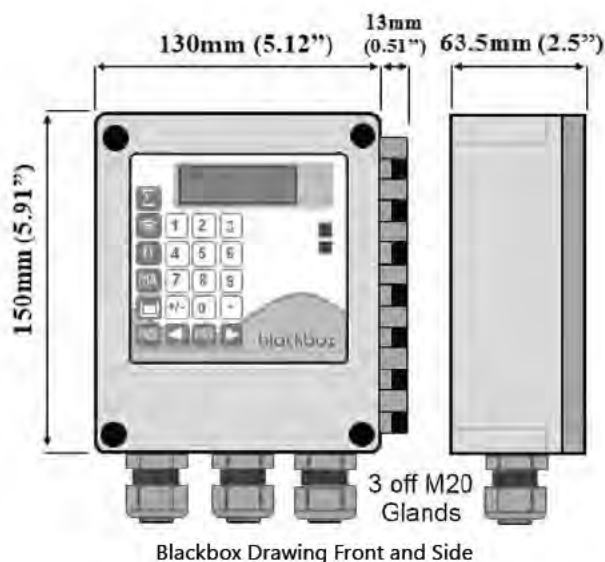
On-board Programming:	Via RS232 using supplied software
PC Programming:	Via RS232 using supplied software
Programming Security:	Via Passcode (user selectable and adjustable)
Programmed Data Integrity:	Via non-volatile RAM
Remote Programming:	Via RS232 using optional handheld calibrator

SUPPLY

Power Supply:	115 V AC +5% / -10% 50/60 Hz, 230 V AC +5% / -10% 50/60 Hz, 10-28 V DC, 10 W maximum power (typically 5 W)
Fuses:	50mA at 230 V AC, 100mA at 115 V AC

REMOTE COMMUNICATIONS

Power Supply:	Power supplied via Blackbox RS232 interface
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Rev 4.0

dB ULTRASONIC TRANSDUCERS

Technical Specifications:

The dB Transducer Series is a range of non-contacting ultrasonic transducers for level, volume, and flow measurement. Available in a variety of models and compatible with all Pulsar controllers so that you have a specific solution to suit your application requirements.



PHYSICAL: TRANSDUCER SPECIFIC

Model:	Dimensions:	Dia Face:	Weight:	Measurement Range:	Frequency:	Beam Angle:
dB3	78 (D) mm x 115 (H) mm (3.1 in x 4.5 in)	19 mm (0.7 in)	1.1 kg (2.4 lb)	125 mm to 3 m (4.9 in to 9.8 ft)	125kHz	<10°
dB6	86 (D) mm x 106 (H) mm (3.4 in x 4.2 in)	30 mm (1.2 in)	1.1 kg (2.4 lb)	300 mm to 6 m (11.8 in to 19.7 ft)	75kHz	<10°
dB56	86 (D) mm x 106 (H) mm (3.4 in x 4.2 in)	45 mm (1.8 in)	1.1 kg (2.4 lb)	200 mm to 6 m (7.9 in to 19.7 ft)	50kHz	<10°
dB10	86 (D) mm x 106 (H) mm (3.4 in x 4.2 in)	45 mm (1.8 in)	1.1 kg (2.4 lb)	300 mm to 10 m (11.8 in to 32.8 ft)	50kHz	<10°
dB15	86 (D) mm x 122 (H) mm (3.4 in x 4.8 in)	60 mm (2.4 in)	1.2 kg (2.6 lb)	500 mm to 15 m (19.7 in to 49.2 ft)	41kHz	<8°
dB25	105 (D) mm x 142 (H) mm (4.1 in x 5.6 in)	78 mm (3.1 in)	1.4 kg (3.1 lb)	600 mm to 25 m (23.6 in to 82 ft)	30kHz	<6°
dB40	205 (D) mm x 223 (H) mm (8.1 in x 8.8 in)	160 mm (6.3 in)	6 kg (13.2 lb)	1.2 m to 40 m (3.9 ft to 131.2 ft)	20kHz	<5°

PHYSICAL: ALL TRANSDUCERS

Sensor Body Material:	Valox 357 U and syntactic foam face
Cable Lengths:	Standard = 5 m, 10 m, 20 m, or 30 m (16.4 ft, 32.8 ft, 65.6 ft, or 98.4 ft). Optional: up to 150 m (492 ft) maximum (increments of 10 m (32.8 ft) only)
Maximum Separation:	500 m (1,640 ft)
Mounting Connection:	BSP or 1" NPT

ENVIRONMENTAL

Enclosure Protection:	IP68 / NEMA 6P
Max. And Min. Temperature (Electronics):	Standard: -40° C to +90° C (-40° F to +194° F) Hazardous area versions: -40° C to +75° C (-40° F to +167° F)

APPROVALS

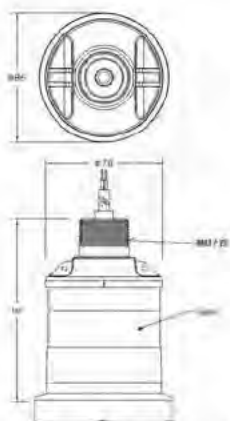
CE Approval:	2014/30/EU to EMC & 2014/34/EU ATEX Directives. Standards applied: EN 60079-0:2012+A11:2013/ EN 60079-11:2012 / EN 60079-18:2009 / EN 60079-26:2007 / EN 61326-1:2013
ATEX Approval:	Standard ATEX EEx m II T6 or optional EEx ia IIC T6. FM/FMC approval.

TRANSDUCER OPTIONS

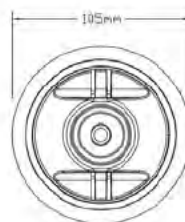
Model:	dB3	dBs6	dB6	dB10	dB15	dB25	dB40
PVDF		✓	✓	✓			
Front Threaded / PVDF	✓	✓	✓	✓			
Submergence Shield	✓	✓	✓	✓	✓	✓	
Flanged DIN/ANSI		✓	✓	✓	✓		
Foam Face		✓		✓	✓	✓	✓
Sanitary Flange		✓	✓	✓			
Intrinsically Safe of All the Above	✓	✓	✓	✓	✓	✓	✓

PERFORMANCE

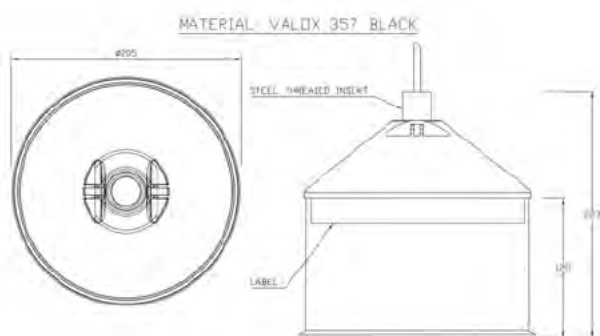
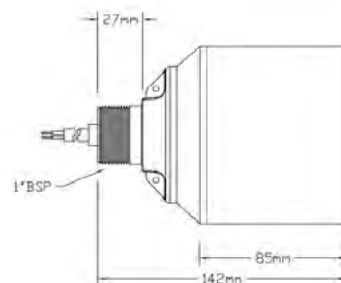
Accuracy:	0.25% or 6 mm (0.2 in) whichever is greater
Resolution:	0.01% or 2 mm (0.08 in) whichever is greater
Temp. Compensation:	Automatic, internal temperature sensor, ± 0.5 °C/°F



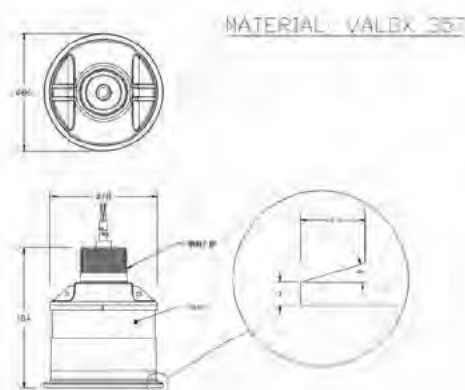
dB15 Transducer Drawing



dB25 Transducer Drawing



dB40 Transducer Drawing



dB6 & dB10 Transducer Drawing



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Rev 7.0

Technical Specification

891480 17.0



ENM 10

Level switch

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1 Product Description

1.1 Product design

Usage

ENM-10 is a level regulator for level control applications. The level regulator starts and stops a pump or activates an alarm device when the liquid level reaches the regulator.

Materials

Denomination	Standard version	Ex version
Regulator casing	Polypropylene	Polypropylene with black conductive casing
Bend relief	EPDM rubber	NBR-PVC rubber
Cable sheath	PVC	NBR-PVC rubber

The plastic components are welded and screwed together.

1.2 Technical data

Application limits

Feature	Value
Liquid temperature	Minimum 0°C (32°F) Maximum 60°C (140°F)
Liquid density	Minimum 0.65 g/cm ³ Maximum 1.5 g/cm ³

Electrical specifications

Feature	Value
Degree of protection	IP68, 20 m (65 ft), 2 bars
Interrupting capacity of micro switch	AC, resistive load, 250 V 10 A AC, inductive load, 250 V 3 A $\cos \phi = 0.5$ DC, 30 V 5 A
Interrupting capacity of gold-plated micro switch	AC, resistive load, 250 V 10 A AC, inductive load, 250 V 3 A $\cos \phi = 0.5$ DC, 24 V 10 mA

Voltage limits are subject to local regulations.

Density ranges

Density g/cm ³	Regulator length mm (in.)	Diameter mm (in.)
0.65 – 0.80	194 (7 10/16)	100 (4)
0.80 – 0.95	177 (7)	100 (4)
0.95 – 1.10	162 (6 3/8)	100 (4)
1.05 – 1.20	142 (5 9/16)	100 (4)
1.20 – 1.30	133 (5 1/4)	100 (4)
1.30 – 1.40	130 (5 2/16)	100 (4)

Density g/cm ³	Regulator length mm (in.)	Diameter mm (in.)
1.40 - 1.50	126 (5)	100 (4)

Weight

A regulator with standard density and 20 m cable weighs approximately 2 kg (4.5 lb).

1.3 Cables

Lengths

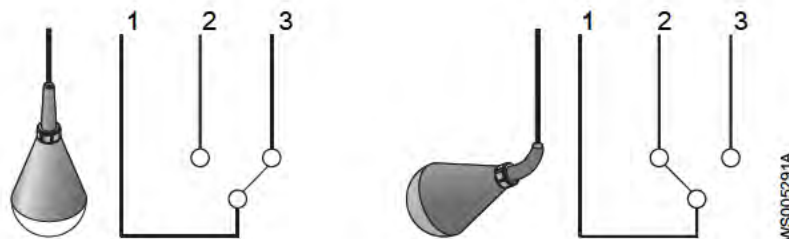
For liquids with specific density between 0.95 and 1.10 g/cm³, the following cables are available:

Version	Lengths m (ft)
Standard	• 6 m (20 ft) • 13 m (42 ft) • 20 m (65 ft) • 30 m (100 ft) • 50 m (167 ft)
Ex	• 6 m (20 ft) • 13 m (42 ft) • 20 m (65 ft) • 30 m (98 ft) • 50 m (164 ft)

Diameter

The cable diameter for all product variants is 6.7 mm (0.26 in), +/- 0.2 mm (0.00787 in).

Color codes



Cable	1	2	3
Color	Grey	Black	Brown

1.4 Approvals and standards

Standard approvals

LVD approval according to EN61058
 CSA approval: Certificate Number 1330172
 Cl. I Zone 0, Gr. IIC
 CL.I Div.1 Gr A, B, C and D
 Cl.II Gr. E, F, and G

Ex approvals

IECEX ia IIC T4 Ga: -20°C ≤ Ta ≤ 60°C
 IECEX NEMKO 09.0008
 ATEX II 1G Ex ia IIC T4 Ga

NEMKO 10 ATEX 1082

Applied standards for ATEX and IEC

- EN 60079-0:2012 / IEC 60079-0:2011
- EN 60079-11:2012 / IEC 60079-11:2011

Intrinsically safe circuits are required for the automatic control system. Use a Zener barrier, for example, part number 84 01 07.

The electrical connections must comply with the Ex regulations of the national submitter.



2 References

2.1 Chemical resistance tables

The tables show the degree of resistance the level regulator has to different chemicals at two different temperatures. The density of the liquid determines the buoyancy of the regulator.

Acids

Acid	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Acetic acid 50%	1	2	0	0
Acetic acid 75%	2	2	0	0
Benzoic acid	2	2	0	0
Boric acid 5%	0	–	0	0
Butyric acid	2	2	2	2
Chromic acid 10%	0	2	2	2
Citric acid	0	1	0	0
Hydrobromic acid 5%	1	2	0	0
Hydrochloric acid 10%	0	1	0	1
Hydrochloric acid 37%	1	2	0	2
Hydrocyanic acid 10%	0	0	1	2
Hydrofluoric acid 5%	0	2	0	1
Hypochloric acid	1	2	2	2
Maleic acid	2	2	2	2
Nitric acid 5%	1	1	1	1
Nitric acid 65%	2	2	2	2
Oleic acid	1	2	2	2
Oxalic acid 50%	1	1	1	2
Phosphoric acid 25%	0	0	1	2
Phosphoric acid 85%	0	0	1	2
Sulphuric acid 10%	1	2	1	2
Sulphuric acid 78%	2	2	2	2
Tannic acid	0	0	0	0
Tartaric acid	1	1	1	1

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Alkalis

Alkali	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Ammonium hydroxide	0	–	0	0
Calcium hydroxide	0	0	0	0

Alkali	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Potassium hydroxide	1	2	0	0
Sodium hydroxide	1	2	0	0

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Salts

Salt	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Aluminum chloride	0	0	0	0
Calcium sulphate	0	0	0	0
Calcium chloride	0	0	0	0
Calcium nitrate	0	0	0	0
Copper chloride	0	0	0	0
Copper sulphate	0	0	0	0
Ferric chloride	0	0	0	0
Ferrous sulphate	0	0	0	0
Magnesium chloride	0	0	0	0
Potassium sulphate	0	0	0	0
Potassium nitrate	0	0	0	0
Potassium carbonate	1	1	1	1
Potassium bicarbonate	0	0	0	0
Sodium sulphate	0	0	0	0
Sodium chloride	0	0	0	0
Sodium nitrate	0	0	0	0
Sodium bicarbonate	0	0	0	0
Sodium carbonate	0	0	0	0
Tin chloride	1	1	1	1
Zinc sulphate	0	0	0	0
Zinc chloride	0	0	0	0

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Oils

Oil	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Castor oil	1	1	1	1
Coconut oil	0	–	0	2
Corn oil	2	2	2	2
Diesel oil	2	2	2	2
Linseed oil	2	2	2	2
Mineral oils	2	2	2	2
Olive oil	1	1	1	1
Silicone oils	0	0	0	0

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Solvents and miscellaneous

Chemical	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Acetone	2	2	2	2
Aniline	2	2	1	2
Benzene	2	2	2	2
Butyl alcohol	2	2	0	1
Carbon tetrachloride	2	2	2	2
Chlorobenzene	2	2	2	2
Chloroform	2	2	2	2
Ethyl alcohol	2	2	0	1
Ethyl ether	2	2	2	2
Ethyl acetate	2	2	2	2
Ethylene dichloride	2	2	2	2
Ethylene chloride	2	2	2	2
Formaldehyde 37%	1	2	0	0
Gasoline	2	2	2	2
Kerosene	2	2	2	2
Methyl alcohol	2	2	0	0
Methyl ethyl ketone	2	2	2	2
Methylene chloride	2	2	2	2
Nitrobenzene	2	2	2	2
Phenol	2	2	2	2
Toluene	2	2	2	2
Trichlorethylene	2	2	2	2
Turpentine	2	2	2	2
Xylene	2	2	2	2

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Gases

Gas	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Carbon dioxide	0	0	0	0
Carbon monoxide	0	0	0	0
Chlorine - wet	2	2	2	2
Hydrogen sulfide	0	0	1	1
Sulphur dioxide - wet	1	1	2	2

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

2.2 Product range

Version	For density (g/cm ³)	Color of level switch	Length of cable (m)	Type of cable ¹	Approvals	For market
582 88 00	0.65–0.80	Blue	20	1	CE	International
582 88 01	0.80–0.95	Blue	20	1	CE	International
582 88 02	0.95–1.10	Blue	6	1	CE	International
582 88 03	0.95–1.10	Blue	13	1	CE	International
582 88 04	0.95–1.10	Blue	20	1	CE	International
582 88 05	1.05–1.20	Blue	20	1	CE	International
582 88 06	1.20–1.30	Blue	20	1	CE	International
582 88 07	1.30–1.40	Blue	20	1	CE	International
582 88 08	1.40–1.50	Blue	20	1	CE	International
582 88 09	0.65–0.80	Gray	20	3	CSA/CE	Canada
582 88 10	0.80–0.95	Gray	20	3	CSA/CE	Canada
582 88 11	0.95–1.10	Gray	6	3	CSA/CE	Canada
582 88 12	0.95–1.10	Gray	13	3	CSA/CE	Canada
582 88 13	0.95–1.10	Gray	20	3	CSA/CE	Canada
582 88 14	1.05–1.20	Gray	20	3	CSA/CE	Canada
582 88 15	1.20–1.30	Gray	20	3	CSA/CE	Canada
582 88 16	1.30–1.40	Gray	20	3	CSA/CE	Canada
582 88 17	1.40–1.50	Gray	20	3	CSA/CE	Canada
582 88 18	0.65–0.80	Gray	20	1	CSA/CE	Canada
582 88 19	0.80–0.95	Gray	20	1	CSA/CE	Canada
582 88 20	0.95–1.10	Gray	6	1	CSA/CE	Canada
582 88 21	0.95–1.10	Gray	13	1	CSA/CE	Canada
582 88 22	0.95–1.10	Gray	20	1	CSA/CE	Canada
582 88 23	1.05–1.20	Gray	20	1	CSA/CE	Canada
582 88 24	1.20–1.30	Gray	20	1	CSA/CE	Canada
582 88 25	1.30–1.40	Gray	20	1	CSA/CE	Canada
582 88 26	1.40–1.50	Gray	20	1	CSA/CE	Canada
582 88 36	0.95–1.10	Gray	30	3	CSA/CE	Canada
582 88 37	0.95–1.10	Gray	50	3	CSA/CE	Canada
582 88 38	0.95–1.10	Gray	100	3	CSA/CE	Canada
582 88 39	0.95–1.10	Gray	150	3	CSA/CE	Canada
582 88 51	0.95–1.10	Red	65	2	CE	International
582 88 52	0.95–1.10	Red	6	2	CE	International
582 88 53	0.95–1.10	Red	13	2	CE	International
582 88 54	0.95–1.10	Red	20	2	CE	International
582 88 57	0.95–1.10	Red	20	2	CE	Canada
582 88 70	0.65–0.80	Blue	20	3	CE	International
582 88 71	0.80–0.95	Blue	20	3	CE	International
582 88 72	0.95–1.10	Blue	6	3	CE	International
582 88 73	0.95–1.10	Blue	13	3	CE	International

¹ See *Type of cables* on page 9.

Version	For density (g/cm ³)	Color of level switch	Length of cable (m)	Type of cable ¹	Approvals	For market
582 88 74	0.95–1.10	Blue	20	3	CE	International
582 88 75	1.05–1.20	Blue	20	3	CE	International
582 88 76	1.20–1.30	Blue	20	3	CE	International
582 88 77	1.30–1.40	Blue	20	3	CE	International
582 88 78	1.40–1.50	Blue	20	3	CE	International
582 88 79	0.95–1.10	Blue	65	1	CE	International
582 88 80	0.95–1.10	Blue	30	1	CE	International
582 88 81	0.95–1.10	Blue	50	1	CE	International
582 88 82	0.95–1.10	Gray	30	1	CSA/CE	Canada
582 88 83	0.95–1.10	Gray	50	1	CSA/CE	Canada
582 88 86	0.95–1.10	Red	30	2	CE	International
582 88 87	0.95–1.10	Red	50	2	CE	International
582 88 90	0.95–1.10	Blue	30	3	CE	International
582 88 91	0.95–1.10	Blue	50	3	CE	International
582 88 92	0.95–1.10	Red	6	2	CE	Japan
582 88 93	0.95–1.10	Red	13	2	CE	Japan
582 88 94	0.95–1.10	Red	20	2	CE	Japan
582 88 95	0.95–1.10	Blue	6	1	CE	Japan
582 88 96	0.95–1.10	Blue	13	1	CE	Japan
582 88 98	0.95–1.10	Blue	50	1	CE	Japan
594 79 10	0.95–1.10	Blue	70	3	CE	International
594 79 13	0.95–1.10	Blue	100	3	CE	International
594 79 18	0.95–1.10	Blue	150	3	CE	International
594 79 19 ²	0.95–1.10	Blue	20	3	CE	International
594 79 20 ²	0.95–1.10	Gray	20	3	CSA/CE	International
594 79 21 ²	0.95–1.10	Transparent	6	3	CE	For demonstration only.
594 79 40 ²	0.95–1.10	Black	6	3	ATEX/IECEX ³	International
594 79 41 ²	0.95–1.10	Black	13	3	ATEX/IECEX ³	International
594 79 42 ²	0.95–1.10	Black	20	3	ATEX/IECEX ³	International
594 79 49 ²	0.95–1.10	Black	30	3	ATEX/IECEX ³	International
594 79 50 ²	0.95–1.10	Black	50	3	ATEX/IECEX ³	International

Type of cables

Type of cable	Jacket	Color coding of wires
1	Blue polyvinyl chloride (PVC)	Grey/Brown/Black
2	Red PVC	Grey/Brown/Black
3	Black nitrile rubber (NBR)/PVC	Grey/Brown/Black

¹ See *Type of cables* on page 9.

² Designed for low current, slow movements and oil. Includes micro switch with gold plated contacts.

³ Zener barrier 84 01 07 required.

Xylem |'zīləm|

- 1) The tissue in plants that brings water upward from the roots;
- 2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com



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and more information

The original instruction is in English. All non-English
instructions are translations of the original instruction.

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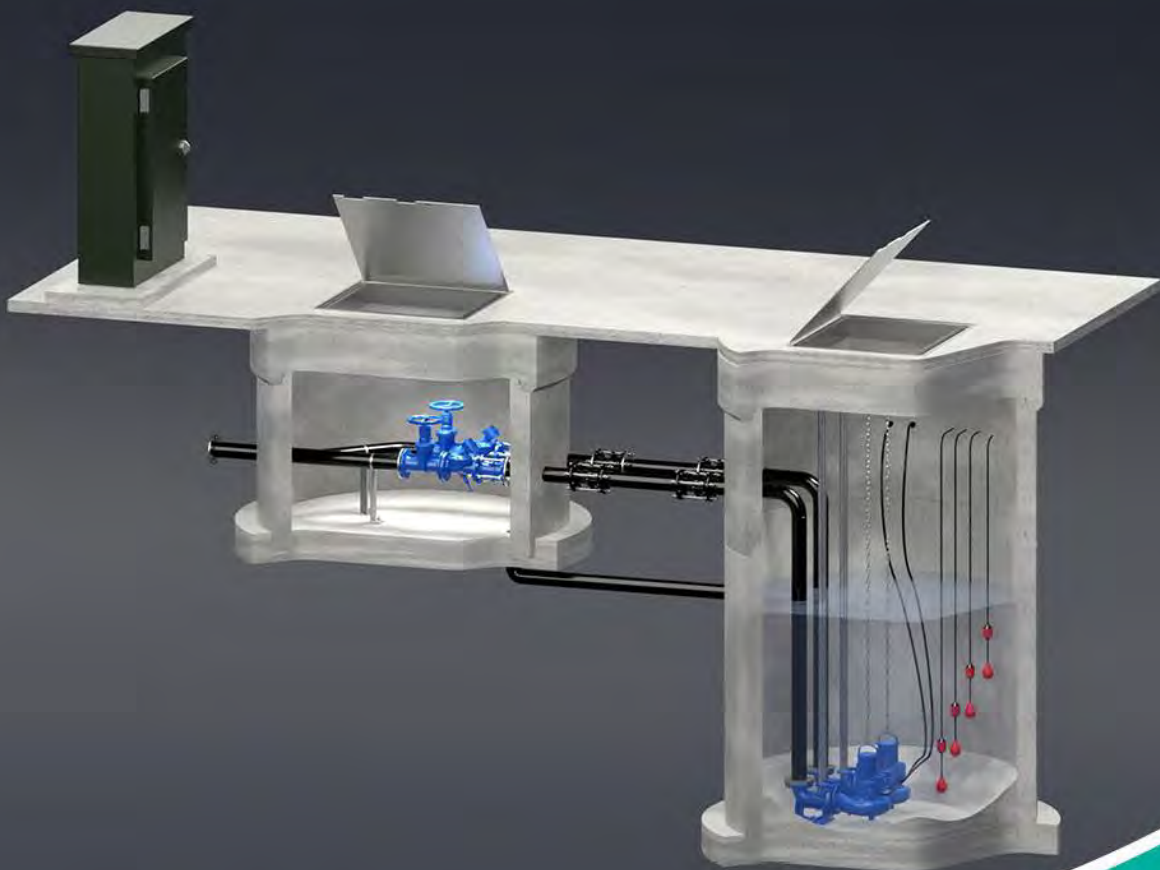
PUMP STATION

WWPS B, SOUTHERN LINKS 1, INDUSTRIAL 1, HAMILTON

TECHNICAL SPECIFICATIONS

MAVEN WAIKATO LIMITED

21 May 2026



Peter Carroll – Aquate Director

BE Civil, MBA, CPEng, FEngNZ

www.aquate.co.nz

Foreward

This installation manual is a guide only. All relevant Health and Safety laws and codes of construction must be adhered to and take precedence over any information in this manual. Installers must practice good professional practice and are required to understand all National and Local regulations in respect to the installation of drainage materials.

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APPENDICES

12

1 Technical Specifications

Tank Volume: 14.2 m³

Effective volume: 11.6 m³

Storage tank vol: 30.96 m³

Tank material: Concrete

Lining : HDPE lining in wetwell and storage tank

Manufacturing Std: AS/NZS 4058:2007 and NZS 3101

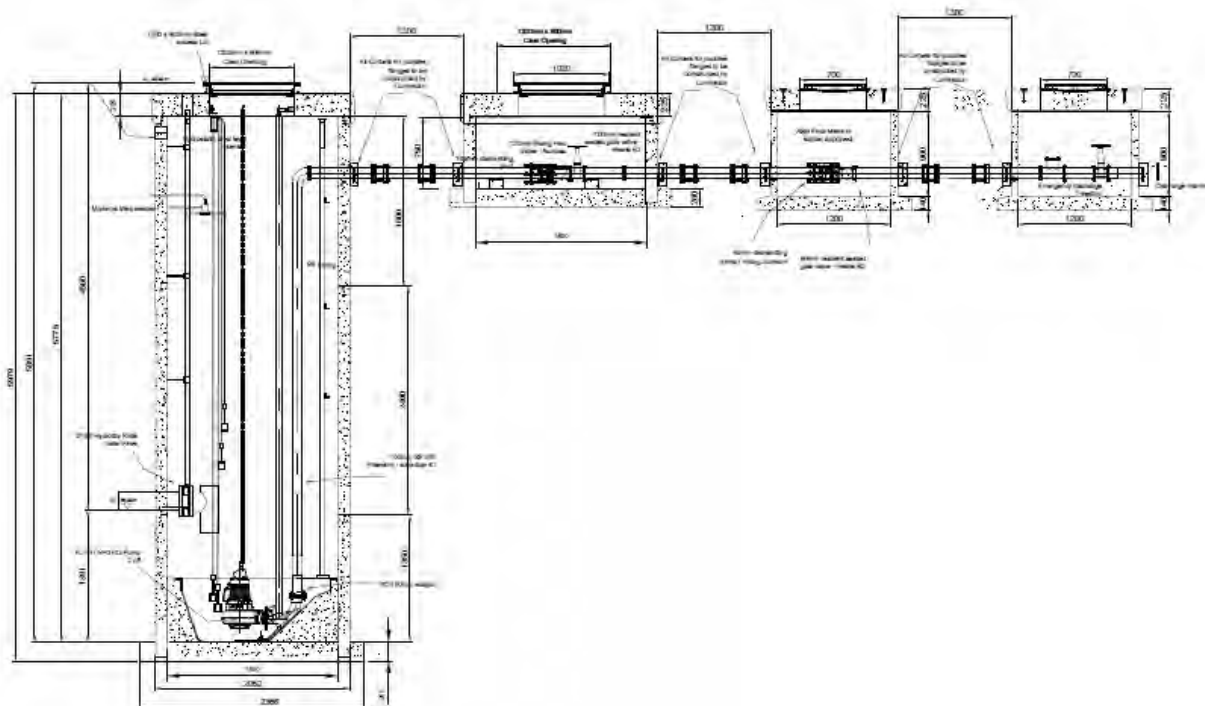
Loading: The standard lid is suitable for pedestrian loading only.

Inlet Connections: the inlet pipe to be installed on site and sealed by the drainage contractor.

Outlet connection: A flanged stainless steel is installed for connection to the outlet pressure pipe

Venting: External venting required (see section 1.6 for venting details if required)

Dimensions: see drawing below



1.1 Pumps/Pump Performance

See full specifications in the Appendices

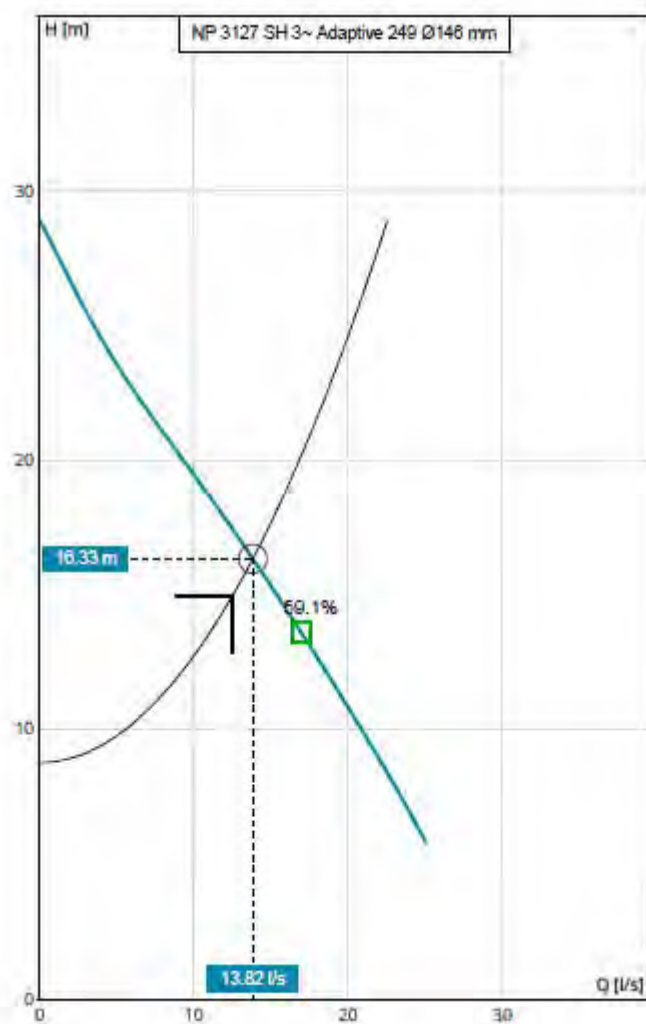
Manufacturer: Xylem Pumps

Type: Flygt NP3127 SH3 249

Connection: 415 V, 50 Hz

Power: 7.4 kW

Phases: Three



1.2 Design Information

1.2.1 Storage Calculations

The total Average Dry Weather flow has been calculated from the expected flow rate with the following assumption:

Average dry weather flow = 177 dwellings = 105.8 m³/day

Total emergency storage required is 9 hours = 39.7 m³

Total emergency storage in wet-well and emergency storage tank is 42.56 m³ so 9.65 hours storage has been provided.

1.2.2 Pump Design

The system above has been designed based on the information provided below.

Rising main length : 502m

Static Lift : – 8.75 m

Rising main – PE100 (HDPE) PE 4710 / SDR 11 (PN 16) / DN 150 (160x14.6 mm)

Rising main – OD – 160mm, ID – 130.8 mm

Option 1 K = 1.5

Flygt NP3127 - Flow rate = 12.71 l/s with a total head loss of 17.27 m (single pump).

Pumps to operate in a duty / assist / standby function

Velocity in PE pipe = 0.95 m/s



Option 2 $K = 0.5$

Flygt NP3127 - Flow rate = 13.8 l/s with a total head loss of 16.33 m (single pump).

Pumps to operate in a duty / assist / standby function

Velocity in PE pipe = 1.03 m/s



1.2.3 Pump Operational Levels

The operational levels will be set as follows (dimensions taken from floor of wet-well) :

Set point		Description	Control function
Value	Unit		
300mm	5.2 %	Low Level Alarm	Stops both pumps/ alarms
350 mm	6.1%	Duty/ Standby Pump OFF	Stops Duty and Standby pump
800 mm	13.9%	Duty Pump ON	Starts duty pump
900 mm	15.6 %	Assist Pump ON	Assist Pump ON
1200 mm	20.8%	Hi Level Alarm	Hi Level alarm activated

250 mm		Stop Both Pumps - Float Switch	Stop Both Pumps
900 mm		Start Duty Pump – Float Switch	Start Duty Pump
1000 mm		Start Assist Pump – Float Switch	Start Assist Pump
1500 mm		Critical High Alarm – Float Switch	Critical High Alarm

1.2.4 Pump Stop/Start Calculations

Expected daily flow:	105800	litres
Infiltration (l/day)	0	litres
SWI (l/day)	0	litres
Peaking factor :	3	
ADDWF	1.22	l/s
PDDWF	3.06	l/s
PWWF	6.59	l/s
Pump Station diameter	1.8	m
Pump station depth (total)	5.55	m
Pump station depth (effective)	4.55	m
Volume (effective)	11.57	m ³
Pump Stop Level	0.4	m
Pump Start Level	1	m
Volume to pump:	1526	litres
Discharge rate:	13.8	l/s
Time to empty: (PDDWF)	2.4	minutes
Time to empty: (PWWF)	3.5	minutes
Time to fill (PDDWF)	8.3	minutes
Time to fill (PWWF)	3.9	minutes
No starts/ hour (PDDWF)	5.6	
No starts/ hour (PWWF)	8.1	
No starts per pump (PDDWF)	2.8	
No starts per pump (PWWF)	4.1	
Max Start/Hour permissible	15	Okay

1.3 Pipework, Valves and Fittings

Discharge connection:	100 mm diameter flange coupler
Inlet and outlets:	the inlet pipe to be installed on site and sealed by the drainage contractor. The outlet pipe is pre-installed in the factory.
Discharge pipework:	Includes a non-return valve, dismantling joint and an isolation valve.
Lifting chains:	a stainless steel chain is connected from the pump to the underside of the chamber for ease of pump removal if required.
Materials:	All pipework will be 100mm 316 Stainless steel Schedule 40 and will be manufactured to the relevant AUS/ NZ Standards
Guide rails:	Stainless steel

1.4 Access lids

Steel access lids (1200 x 900mm) will be supplied as per the RITS design

1.5 Magflow metre

An ABB ProcessMaster DN100 is included installed in a 1500mm diameter manhole

1.6 Level Sensors

1 off – ABB Black Box Hydrostatic level sensor

4 off – Flygt ENM10 float switches for Low level, duty pump operation, standby pump operation, and High-level alarm

1.7 Electrical & Controls

This controller is designed on the latest 2023 HCC drawings which are quite different to their previous standards. Any comparison to a competing proposal should ensure that the same standards have been used in the pricing.

This allows for the design, including production of electrical drawings, build and factory acceptance testing (FAT) of the pump station controller.

The design will include::

- 1 x Allen Bradley Micro800 PLC and IO modules as per their standard design.
- 1 x programming of Allen Bradley PLC.
- 1 x Trio Radio unit for communicating to HCC's SCADA system.
- 1 x battery backup for communication and PLC 24VDC circuits.
- 1 x supply of aerial for radio communication to base station.
- 2 x DOL starting configuration with overload and short circuit protection as per HCC standards, for each pump.
- 2 x current transducers and amp meters.
- 2 x capacitors for power factor correction.

- 1 x phase failure relay with output to PLC.
- 1 x surge divertor with output to PLC.
- 1 x level indicator input.
- 1 x flow indicator input.
- 22mm dia push buttons and selector switches for pump circuitry and control.
- Cabinet door switches and internal lights.
- Anticondensation heaters for cabinet.
- 2 x isolation switches for the pumps.
- 1 x Cubic internal panel. Note this differs to the HCC drawing but is of an equal or better quality to the Bremca 250 series panel.
- 1 x generator connection with interlocked mains/generator breakers.
- RCD protected service plugs mounted within cabinet.
- 1 x painted aluminium pillar box approximately 1.95 x 1.525 x 0.5m (l x h x d) with multiple door access, and internal panels.
- 1 x full CAD drawings.

We have not allowed for any of the following:

- Supply of any boosting to the radio signal if the standard Trio radio unit and standard aerial is insufficient.
- Supply of any site metering although space left in cabinet for a smart meter.
- Any civil works including construction of plinth for controller to mount to.
- Any on site installation including running of cable to and from controller, or mounting revenue meter (if required), or installing any on site lighting, installing the aerial or aerial base. It is suggested the site electricians are engaged to do this where required.

1.8 Odour Control System

This has been excluded as per RITS standards. See section 5.3.7.16 RITS.

1.9 Protective lining

The wet-well including the underside of the lid will be lined with Blue-seal HDPE lining for sulphuric acid resistance (see Appendices)

1.10 Well-washer

A McBerns well washer has been specified by RITS – see appendices for details

A sprinkler system using BETE nozzles has been included in the storage tanks to RITS design

1.11 RPZ Cabinet

A steel cabinet to RITS design has been included along with an RPZ standpipe and two off solenoid valves for the well washer and sprinkler system

1.12 Inlet valve

A 225mm diameter knife-gate valve will be installed on the inlet pipe in to the wetwell. This includes a spindle to the underside of the lid

2 Construction

The pump station has been design using reinforced precast concrete components. The system will be fabricated off site and delivered to site ready for installation. The tank will have a 14,200 litre capacity and a total depth of 5.75 m.

The pump stations will be delivered to site in a kit-set format and will need to be installed in the ground by the drainage contractor.

The construction and commissioning of the Aquate pump station will then be completed by a trained Hynds Environmental Construction Technician.

3 Safety in Design

This pump station has been designed to minimise any risk to operators and service personnel.

Access into the pump station should not be required for ongoing maintenance as almost all servicing work can be completed from ground level. The main components can be accessed as follows:

- Pumps – these can be removed from the pump station by lifting them up out of the wet-well and inspecting above ground. Note : the pumps weight 105 kg each.
- Floats – can be lifted from the connection points in the access hole in the lid.
- Non-return valves/Isolation valves –can be access from ground level without the need to enter the chamber
- Venting will be required and will need to be installed on site. The access lids are air-tight.

Risk register

The risk register is a live document which requires continuous monitoring updating. This will need to be completed by the maintenance company for the pump station. The items below are a guide only. The safety and design and Hazops workshops have encompassed risks for normal operation of the vacuum wastewater pump station. Specific risks for the maintenance process are outlined below.

Risk matrix

			Consequence / potential severity				
			Minimal Non-injury or First Aid injury (FAI)	Minor Medical treatment injury	Moderate Medical treatment injury, with lost time (LTI)	Major Injury requiring hospital-/notifiable event	Catastrophic Fatality or multiple fatalities
Likelihood	Very high	Almost certain: Commonly occurs	3: Medium	4: High	4: High	5: Very high	5: Very high
	High	Likely: Could easily happen	2: Low	3: Medium	4: High	4: High	5: Very high
	Medium	Possible: Could happen or has been known to happen	2: Low	2: Low	3: Medium	4: High	4: High
	Low	Unlikely: Hasn't happened yet but could happen	1: Very Low	2: Low	3: Medium	3: Medium	4: High

	Very low	Rare: Very unlikely but could happen in exceptional circumstances	1: Very Low	2: Low	2: Low	3: Medium	4: High
	Hazards (<i>one per line</i>)			Hazard controls – what do we need to do to make it safe?			
What are we doing? (<i>step by step</i>)	What could cause harm?	Existing risk level (<i>use risk matrix</i>)	Eliminate/ Controls			Residual risk level	
Wet-well inspection	The wet-well is classified as a confined space, an inspection is required prior to wet commissioning.	3	Elimination: The vessel will be isolated from the system at all exit points and inspected from the access hole in the lid . Isolate/Engineering Controls/PPE: Entry will only be required if debris is identified and cannot be removed by any other means. Entry to the vessel should follow confined space protocols, including ensuring all persons involved have the required training, admin and PPE controls.			1 1	
Sewage Pump Testing	The wet well will be filled up for wet testing. This is a potential drowning hazard.	3	Elimination Barriers around the access hatch to be erected so no one can enter the wet-well. Engineering Controls/PPE: All essential persons to wear appropriate protection. Sewage pump shall only operate when required for wet testing..			1 1	
Removing lids for access	Traffic moving through area Back strain	3 2	Isolate/Engineering Controls/PPE: Place cones around service area so vehicles cannot enter site Engineering Controls/PPE – use appropriate lifting equipment if lifting pumps / lids on site				
Removing pumps	This is a falling hazard	4	Elimination Barriers around the access hatch to be erected so no one can enter the wet-well.				
Electrical checks	Electrical shock	3	Engineering Controls/PPE: Only fully certified electricians to complete electrical work				

4 Warrantees

Aquate guarantees the performance and quality of its pump stations provided:

- The product is only used for the intended purposes as stated in the quote
- The control panel and pump station is correctly installed and commissioned by a suitable installer
- The fault is due to a defect in design, materials or workmanship
- The fault is reported to an Aquate agent or representative during the guarantee period
- No pump station components have been replaced by alternative products
- This guarantee does not cover faults resulting from misuse of the system, blockages or breakdowns caused by the introduction of inappropriate materials into the system, incorrect electrical installation of the control unit, deficient maintenance or normal wear and tear.

Aquate assumes no liability for bodily harm, property damage or economic losses as a result of its pump stations.

4.1 Pumps

The pumps come with a 12 month year warranty against faulty components and/or workmanship. If prohibited substances are introduced to the system causing the pump to block and burn out, the warranty is null and void.

Flygt undertakes to remedy faults in products sold by Flygt provided that:

- The fault is due to defects in design, materials or workmanship;
- The fault is reported to a Flygt representative during the guarantee period;
- The product is used only under conditions described in the care and maintenance instructions and in applications for which it is intended;
- The monitoring equipment incorporated in the product is correctly connected;
- All service and repair work is done by a workshop authorized by Flygt or the original manufacturer;
- Genuine manufacturer's parts are used
- Storage should be in accordance with the care and maintenance manual.
- The equipment is operated and maintained in accordance with the Operation and Care and Maintenance Manual.

Failure to comply with these requirements will render warranty void unless, due to the nature of the warranty claim, such voiding of warranty is prevented by law, regulation, act and/or ordinance.

Hence, the guarantee does not cover faults caused by deficient maintenance, abuse, incorrectly executed repair work or normal wear and tear.

5 Maintenance schedule

A certain amount of system maintenance is required on an ongoing basis to ensure that the system is working correctly. This is the responsibility of the owner

5.1 Six monthly

The following procedures should be completed every six months:

- The pumping station should be inspected to check the build-up of grease and fat particularly on the float switches and pumps. They may need to be withdrawn for cleaning.
- Visually inspect the pump station walls and hose down if necessary
- Ensure the pump station access lid is securely fastened and bolted down.
- Lift the pumps and inspect for any damage or blockages around the impellers
- Lift the floats and test the alarm system/pump operation
- Consult with the electrical control supplier for additional checks

5.2 Annually

The following procedures should be completed at least once every 12 months:

- The pumping station should be inspected to check the build-up of grease and fat particularly on the float switches and pumps. They may need to be withdrawn for cleaning.
- Visually inspect the pump station walls and hose down if necessary

- Lift the floats and test the alarm system/pump operation
- Press the mute button (audio alarms only) to check the audio alarm turns off.
- Visually check the pump station for any structural damage to the tank and pipework
- Ensure the pump station access lid is securely fastened and bolted down.
- Lift the pumps and inspect for any damage or blockages around the impellers
- Have the pump station sucked out to remove any debris/stones if necessary

5.3 Maintenance requirements

The pump maintenance and repair operations must be carried out by workers authorised by the manufacturer; Failure to comply with these instructions will result in forfeiture of the warranty and jeopardise the unit's safety.

Before any cleaning and/ or maintenance operations are carried out on the electric pump, the power supply must be switched off.

To disconnect the submersible electric pump from the electricity mains, first disconnect the phase conductors, then the yellow –green earth wires.

Use the special handle to remove the submersible electric pump from the tank.

ATTENTION: Before carrying out any operations, check the pump temperature. Only work on the pump when it is at room temperature.

Clean the electric pump thoroughly, using a jet of water or specific products to clean all its parts. When disposing of the waste material, follow the antipollution rules in force.

Replace any broken or worn parts with original spare parts only.

Given the likelihood that work on the electric pump will be carried out in confined spaces such as vats, wells, cesspools, tanks or cisterns, do not underestimate the risks caused by potentially poisonous exhalations.

APPENDICES

General Arrangement Drawing – Plan

General Arrangement Drawing – Section

General Arrangement Drawing – Plan with tank

General Arrangement Drawing – Section with tank

Flygt NP3127 SH3 249 Specifications k 1.5

Flygt NP3127 SH3 249 Specifications k 0.5

McBerns well washing brochure

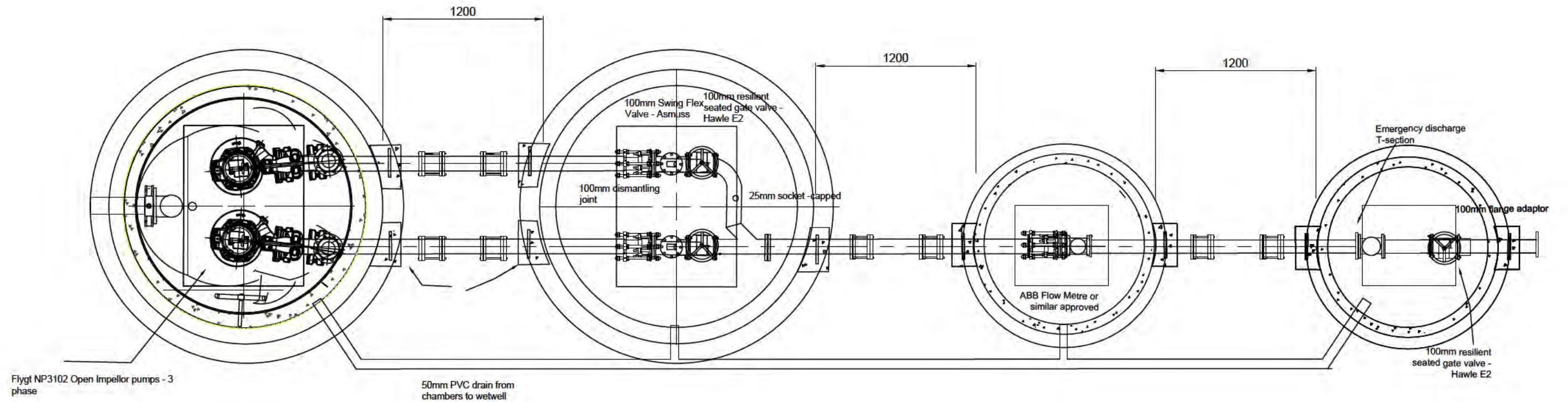
BlueSeal-AKS data sheet

Hyliner HDPE liner – data sheet

ABB Magflow Meter Specifications

ABB Blackbox level sensor specifications

Flygt ENM10 float switch specifications



NOTES:

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REVISIONS

REV #	REVISION DESCRIPTION	DATE	DRAWN
A	Preliminary design	21/5/26	PC

PO Box 58142, Botany, Auckland, 2316
Tel: 09-274 0316
Fax: 09-272 7485
email: hwwsupport@hynds.co.nz

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ISO 9001 CERTIFIED MANAGEMENT SYSTEM



PROJECT:

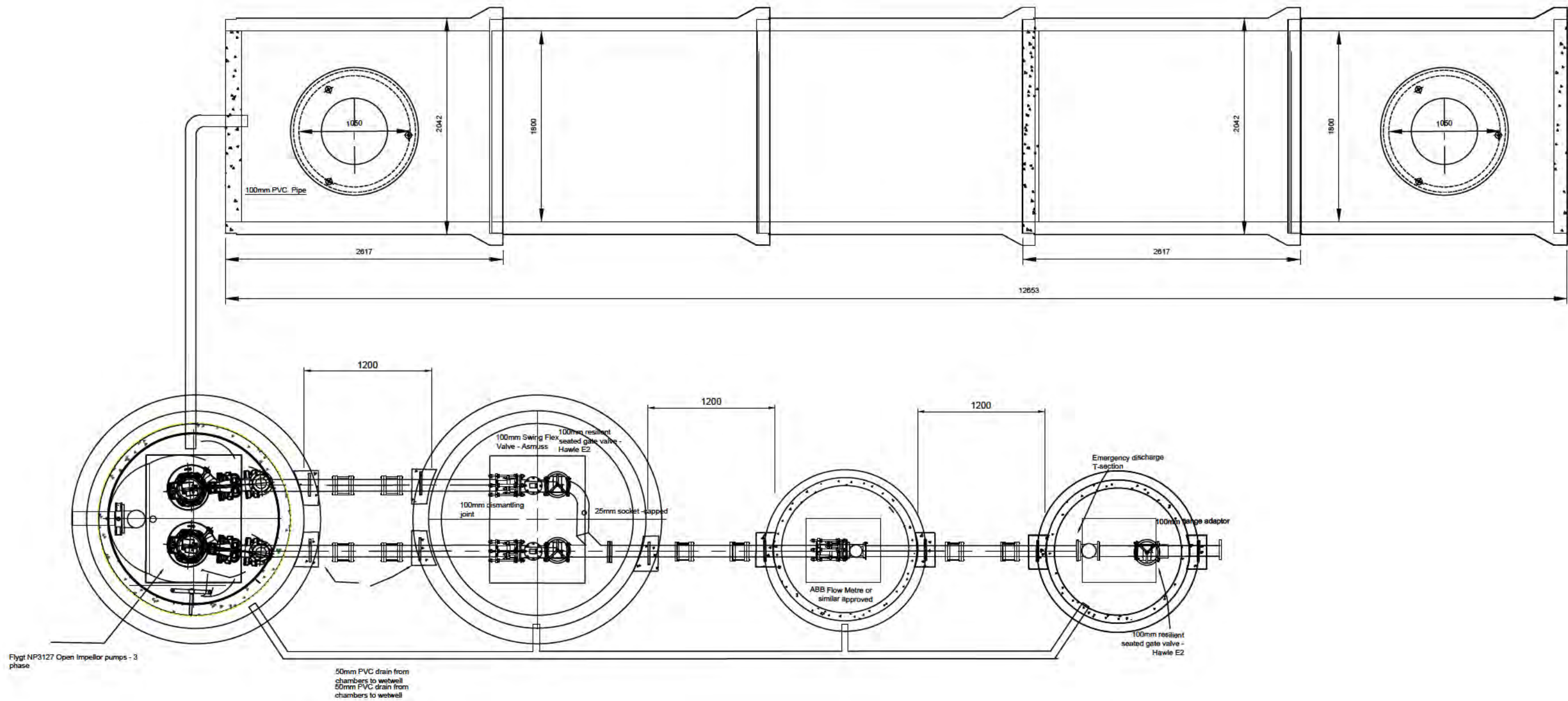
Southern Links Industrial 1
Hamilton
Wastewater Pump Station WWPS-B

DRAWING TITLE:

Plan View

REFERENCE/QUOTE NUMBER:

REFERENCE/QUOTE NUMBER:	AQ2286A	
DRAWN: PC	DESIGN: PC	CHECKED: JB
SIGNATURE:	SIGNATURE:	SIGNATURE:
SCALE: As Shown	Note: Do not scale drawing if in doubt ASK!!!	DATE: 21/5/26
PAPER SIZE: A3		
DRAWING NUMBER: AQ2286A 1	SHEET NUMBER: of 4	REVISION NUMBER: A



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ISO 9001 CERTIFIED MANAGEMENT SYSTEM



PROJECT:

Southern Links Industrial 1
Hamilton
Wastewater Pump Station WWPS-B

DRAWING TITLE:

Plan View with tank

REFERENCE/QUOTE NUMBER:

AQ2286A

DRAWN: PC
SIGNATURE:

DESIGN: PC
SIGNATURE:

CHECKED: JB
SIGNATURE:

SCALE: As Shown
PAPER SIZE: A3

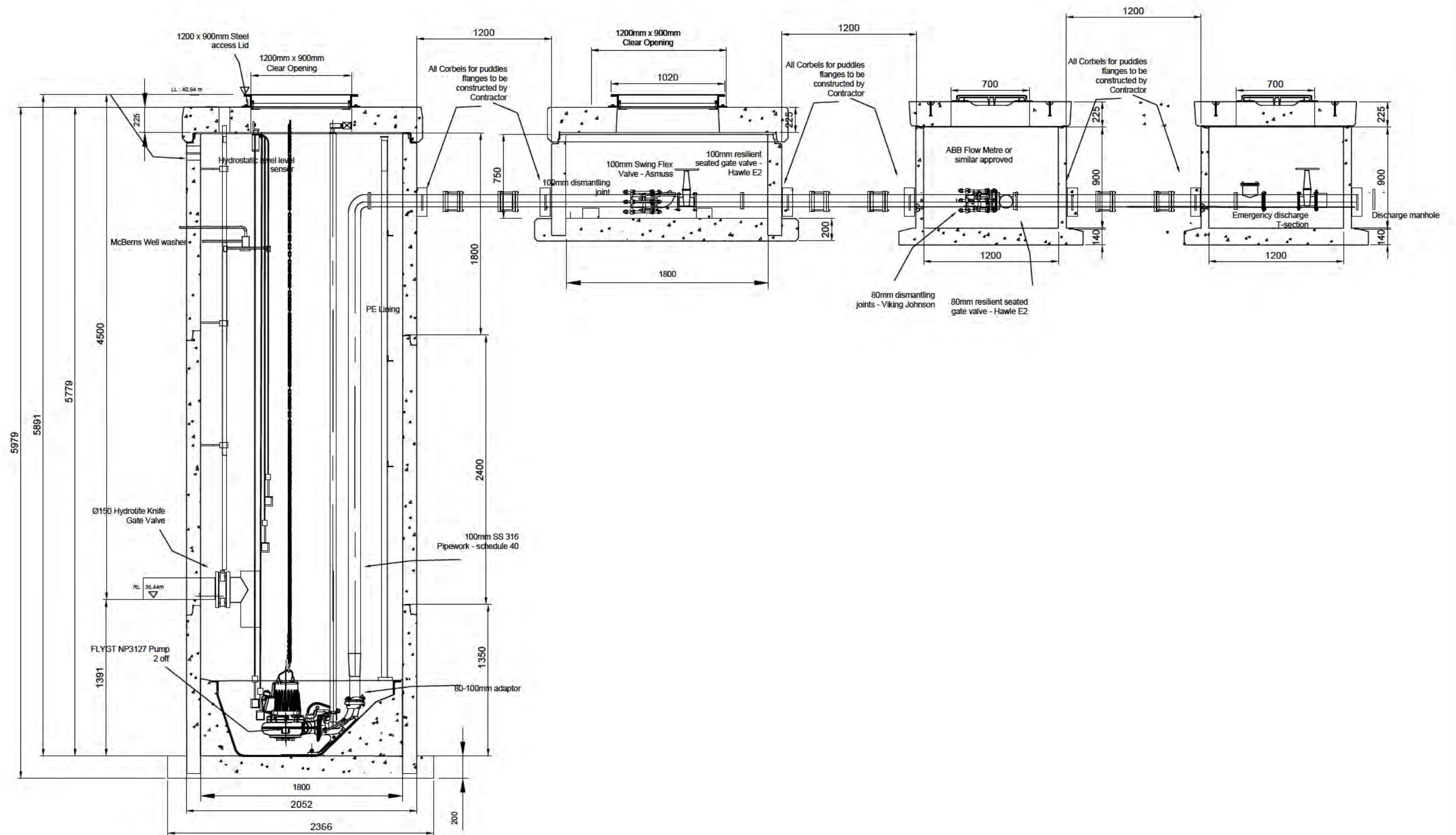
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21/5/26

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AQ2286A 2

SHEET NUMBER:
of 4

REVISION NUMBER:
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ISO 9001 CERTIFIED MANAGEMENT SYSTEM



PROJECT:

Southern Links Industrial 1
Hamilton
Wastewater Pump Station WWPS-B

DRAWING TITLE:

Section View

REFERENCE/QUOTE NUMBER:

AQ2286A

DRAWN: PC
SIGNATURE:

DESIGN: PC
SIGNATURE:

CHECKED: JB
SIGNATURE:

SCALE: As Shown
PAPER SIZE: A3

Note:
Do not scale drawing if in doubt ASK!!!
DATE:
21/5/26

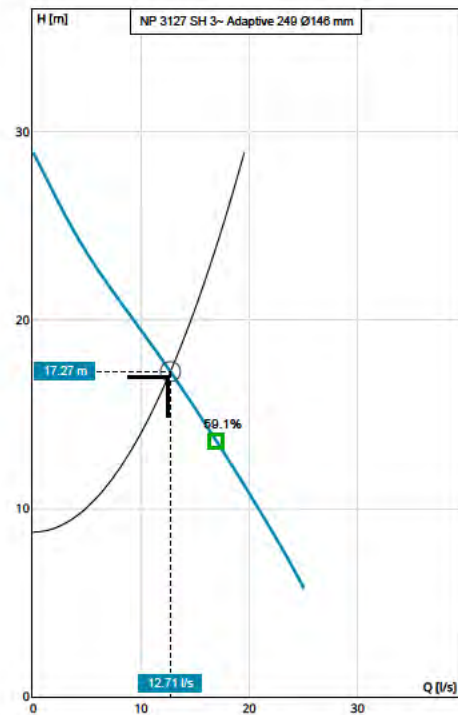
DRAWING NUMBER:
AQ2286A 3

SHEET NUMBER:
of 4
REVISION NUMBER:
A

NP 3127 SH 3~ Adaptive 249 | Configuration Summary



Flygt's self-cleaning non-clog N-pumps feature innovative designs and functions that deliver high sustained efficiency and the most reliable operation. This makes them the most reliable choice available for a broad range of wastewater applications for tough applications such as unscreened sewage, wastewater and sludge up to an 8 percent solids concentration. Impeller material available in Hardened cast Iron, Hard Iron and Stainless Steel to fit any wastewater application.



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

GENERAL

Explosion Proof	Impeller Diameter
No	146 mm
Max. Pumped Media Temp.	
40 °C	

MATERIAL AND COATING

Impeller Material	Stator Cover Material
Hard-Iron	Grey Cast Iron
Volute Material	
Grey Cast Iron	

MOTOR

Rated Voltage	Motor Efficiency Class
400 V	Standard
Coupling	Rated Power
D	7.4 kW

INSTALLATION

Installation Type
P - Semi-Permanent, Wet

NP 3127 SH 3~ Adaptive 249 | Product Details

Description

N 3127

Wastewater N-Technology Pump With Adaptive N® Impeller

Flygt N-pumps take on the toughest applications and get the job done. Every component is designed and manufactured to deliver sustained high efficiency. Thanks to patented N-technology with its innovative self-cleaning impeller, Flygt N-pumps deliver the highest total efficiency. They lower your energy bill and reduce unplanned maintenance costs. That adds up to total peace of mind – and big savings over the long term. Most solid objects entering the pump will pass through the impeller between the impeller vanes. If an object gets caught on the leading edge of one of the vanes, it will slide along the backswept shape towards the perimeter of the inlet. Due to the mechanical self-cleaning design, a sludge concentration up to 8% can easily be pumped.

Flexible and Modular Design

- o This self-cleaning pump features innovative functions that make it the best choice for a broad range of applications. The modular hydraulic design enables you to tailor the hydraulics to meet the requirements of virtually any application.
- o Replaceable wear ring in two materials, gray iron or Hard-Iron, for different operation conditions
- o Hardened gray iron impeller for typical wastewater applications
- o Hard-Iron impeller for abrasive and corrosive applications
- o Stainless steel impeller for special applications that require duplex stainless steel
- o Short shaft overhang reduces shaft deflection and increases seal and bearing life
- o Motor designed for submersible use. Heat is concentrated to the stator core for improved cooling properties
- o The double mechanical seal system consists of two sets of mechanical shaft seals that work independently to provide double security. Available in Tungsten carbide (WCCR) or Silicone carbide (SiC) depending on pumped media.
- o Griploc mechanical face seal system secures locking to the shaft, no rubber friction, no grub screws and no shaft damage
- o Motor cable SUBCAB ® specially developed for submersible use.

Product Features

- o Sustained high efficiency
- o Hardened cast iron, optional Duplex stainless steel and Hard-Iron impellers
- o State-of-the-art wastewater pump with enhanced Adaptive N® hydraulic
- o Sustained high efficiency with energy savings up to 25%
- o Flexible and modular design
- o Robust and reliable

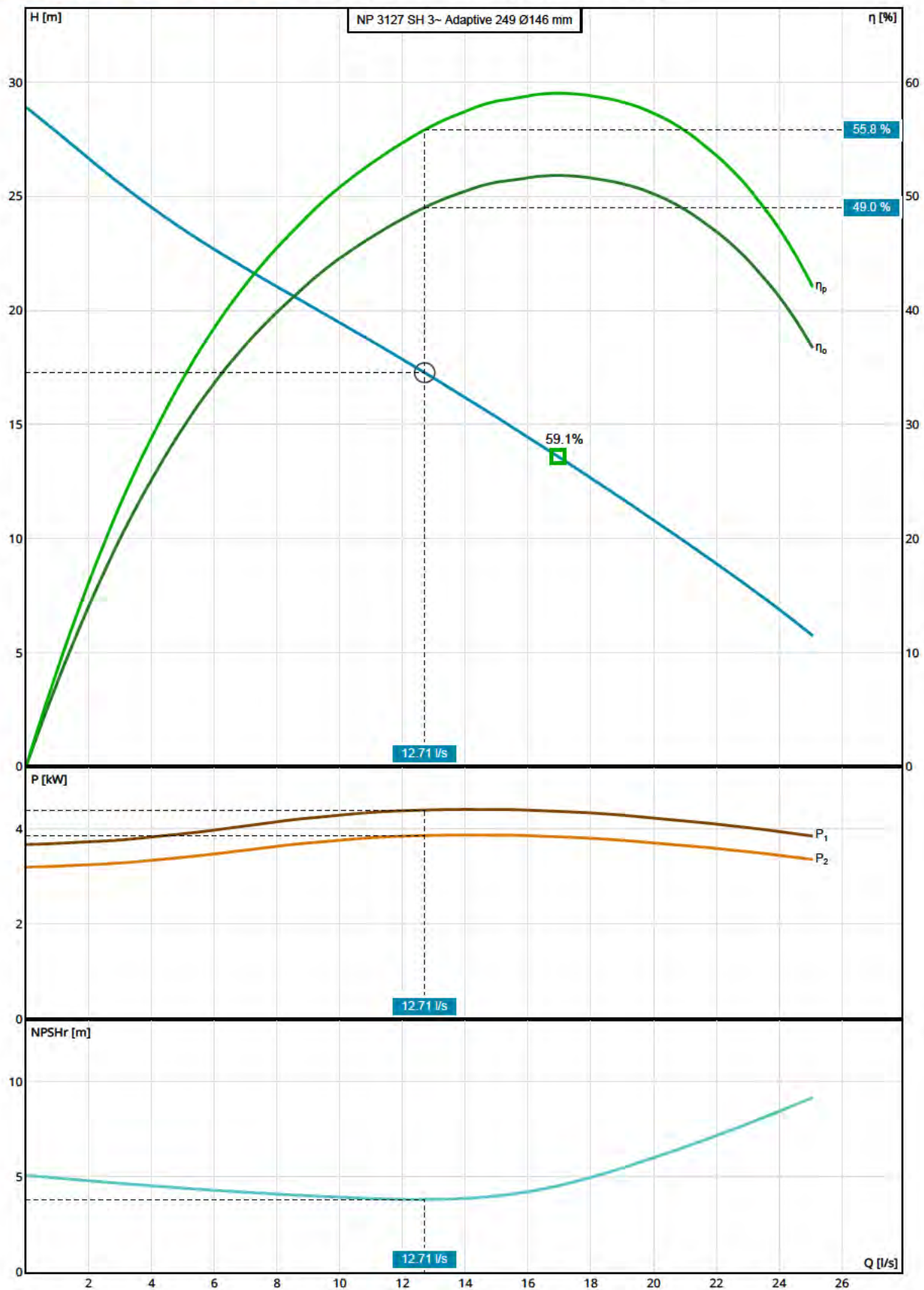
Construction Materials

Impeller Material	Volute Material	Stator Cover Material
Hard-Iron	Grey Cast Iron	Grey Cast Iron

Motor

Rated Power	Number Of Phases	Start Current Ratio	Motor Issue
7.4 kW	3	8.28	12
Motor Denomination	Rated Motor Speed	Insulation Class	Locked Rotor Code
21-11-2AL	2,900 RPM	H	J
Motor Efficiency Class	Rated Voltage	Approval	Max starts per hour
Standard	400 V	STD	30
Version Code	Rated Current	Total moment of inertia	Power Factor 100%
060	14 A	0.02 kgm ²	0.89
Frequency	Start Current	Type of duty	Power Factor 75%
50 Hz	114 A	S1	0.86
Max P2 (1x)	Starting Current, Direct Starting	Stator Variant	Power Factor 50%
3.87 kW	114 A	2	0.78
Number Of Poles	Starting Current, Star Delta	Motor Module	Efficiency 100%
2	38 A	164	87.3 %
			Efficiency 75%
			88.2 %
			Efficiency 50%
			87.7 %

NP 3127 SH 3~ Adaptive 249 | Hydraulic Data & Performance Curve



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Selection

Series	Curve Code
N 3000	249
Name	Impeller Diameter
NP 3127 SH 3~ Adaptive 249	146 mm
Frequency	Inlet Diameter
50 Hz	100 mm
Total Flow	Outlet Diameter
12.5 l/s	80 mm
Total Head	Number Of Vanes
17 m	2
Pump Flow	
12.5 l/s	
Pump Head	
17 m	
System Type	
Single Pump	
Operating Pumps	
1	
Standby Pumps	
No Standby Pump	

Design Point

Flow	Shaft power (P2)
12.71 l/s	3.86 kW
Head	NPSHR
17.27 m	3.82 m
Overall Efficiency (η_o)	Speed
49.03 %	2,951 RPM
Pump Efficiency (η_p)	Static Head
55.84 %	8.75 m
Input Power (P1)	Flow To BEP Ratio
4.39 kW	74.93 %

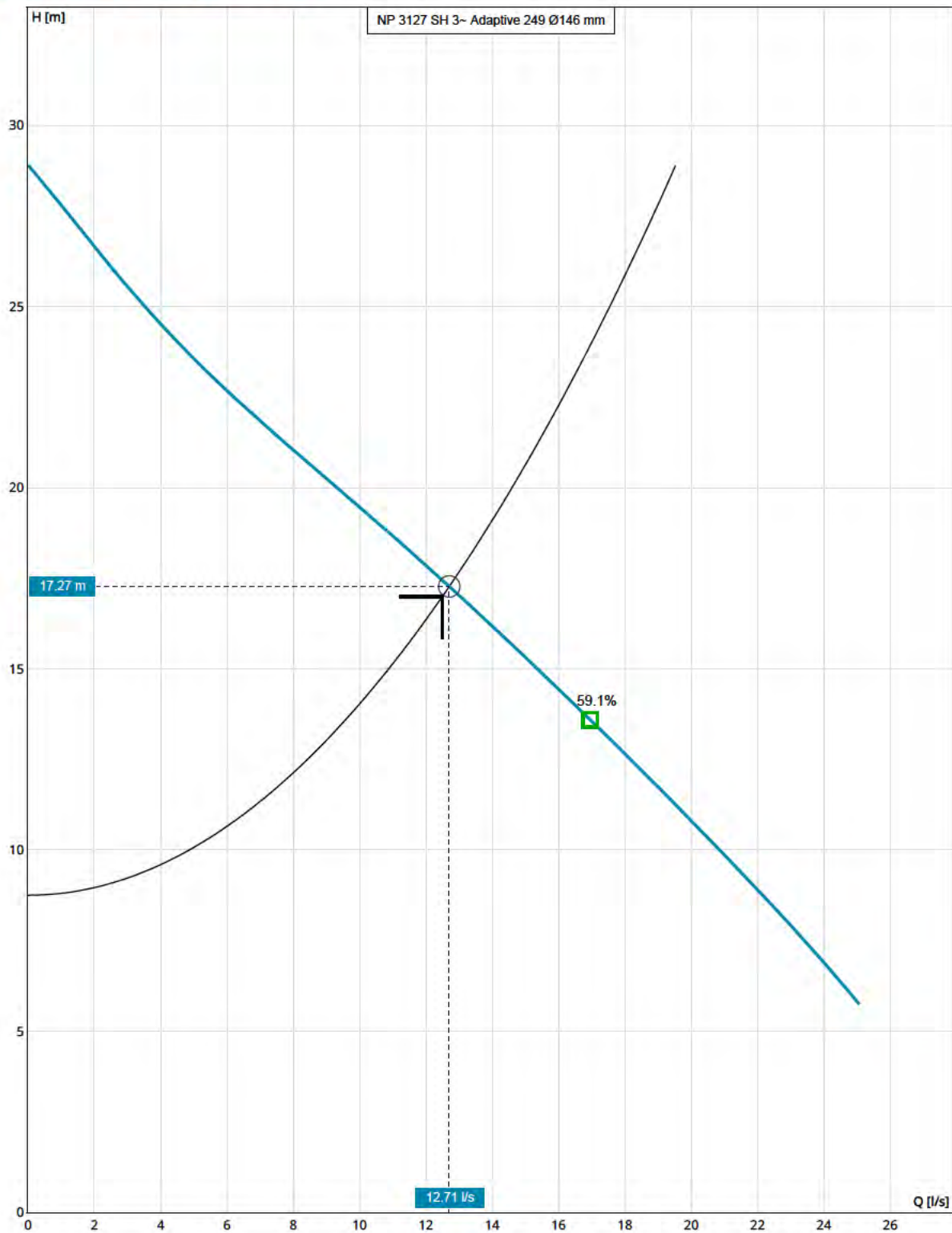
Fluid and Operating Conditions

Fluid Type	Density
Water	1,000 kg/m ³
Fluid Temperature	Dynamic Viscosity
4 °C	0.002 Pa·s
Specific Gravity	Fluid Vapor Pressure
1	8.14 mbar
	Atmospheric Pressure
	1,013.53 mbar
	Elevation
	0 m
	Ambient Temperature
	20 °C
	NPSH Available
	10.27 m
	Submergence
	0 m

Design Curve

Rated Speed	BEP Flow
50 Hz	16.96 l/s
Max Flow	BEP Head
25.07 l/s	13.6 m
H@QMin	Max P2
28.9 m	3.87 kW
H@QMax	Specific Energy
5.74 m	0.1 kWh/m ³
BEP	
59.06 %	

NP 3127 SH 3~ Adaptive 249 | Duty Analysis

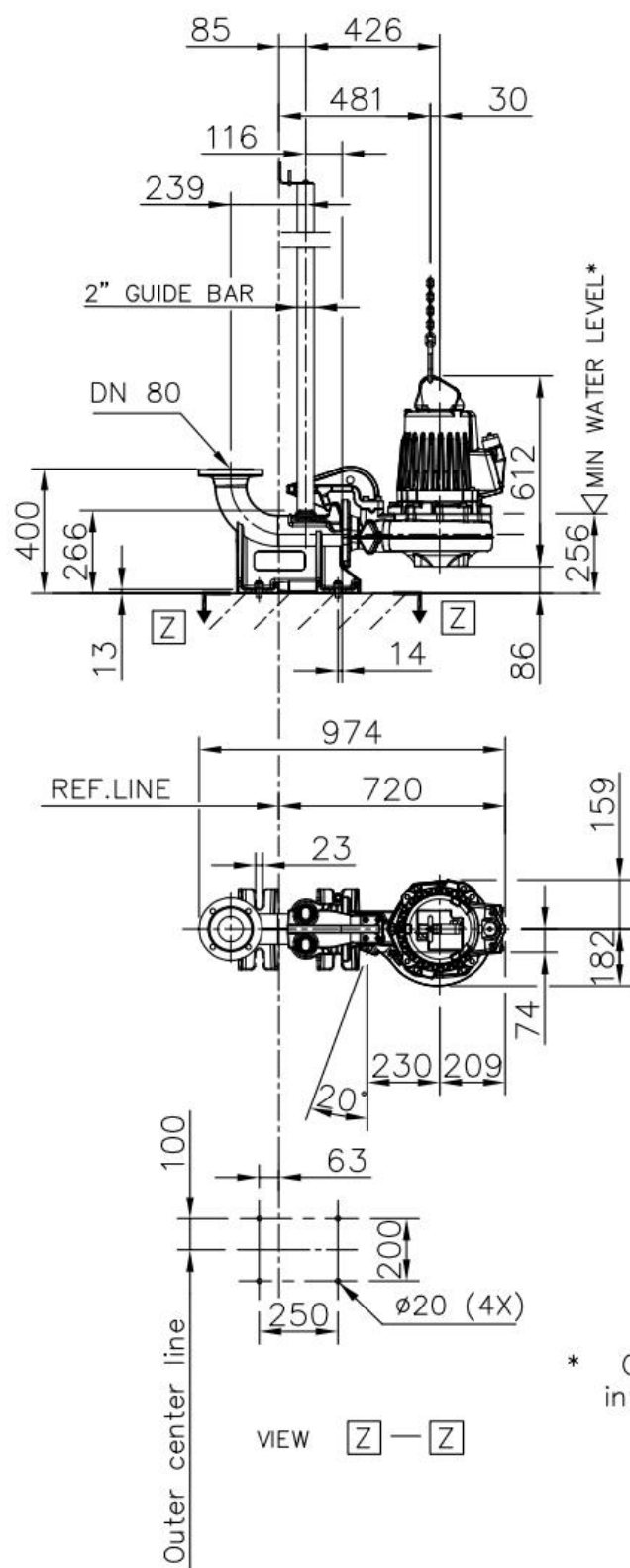


Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Name	Q (1x) [l/s]	H (1x) [m]	P2 (1x) [kW]	Q [l/s]	H [m]	P2 [kW]	η_p [%]	SE [kWh/m ³]	NPSHr [m]
DP @ 1x	12.71	17.27	3.86	12.71	17.27	3.86	55.84	0.1	3.82

NP 3127 SH 3~ Adaptive 249 | Dimensional Data & Drawing



* Consult the IOM for more info

Weight (kg)	
Pump	Disch
147	35

	FP,NP	3127	SH		Discharge outlet DN 80	Scale	Date
	060,070,161,191,350,390,901,911,920,930				Pump outlet DN 80	1:20	250408
					Pump inlet	Drawing number	Revision
					Suction inlet	7319700	8

NP 3127 SH 3~ Adaptive 249 | Headloss Calculation



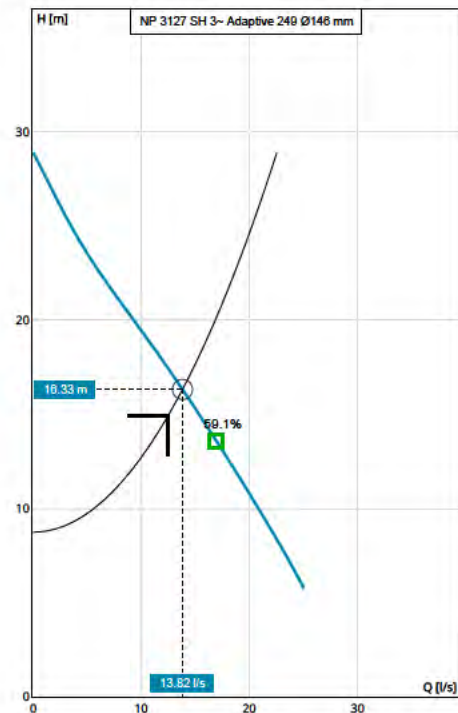
Fluid Type	Total Flow	Kinematic Viscosity
Water	12.5 l/s	0.000002 m ² /s
Static Head	Operating Pumps	System Type
8.75 m	1	Single Pump
Layout	Calculation Model	
Wet Installed Submersible Pumps	Colebrook-White	

Type	Pipe Inner Diameter [mm]	Length / K Factor	Quantity	Velocity [m/s]	Pipe Roughness [mm]	Headloss [m]
Individual Discharge Piping / Wetwell SS / Stainless steel / PN 10 / DN 100 (104x2.0 mm) / New Pipes						
Pipe Length	100 mm	12 m	1	1.59 m/s	1.5 mm	0.68 m
90 Elbow	100 mm	0.3	1	1.59 m/s		0.04 m
Tee Line →  →	100 mm	0.1	1	1.59 m/s		0.01 m
Check Valve	100 mm	5	1	1.59 m/s		0.65 m
Gate Valve	100 mm	0.2	1	1.59 m/s		0.03 m
Total Head						1.41 m
Individual Discharge Piping / Rising main / PE100 (HDPE) PE 4710 / SDR 11 (PN 16) / DN 150 (160x14.6 mm) / New Pipes						
Pipe Length	130.8 mm	502 m	1	0.93 m/s	1.5 mm	6.84 m
Total Head						6.84 m
Friction Loss Head						8.25 m
Static Head						8.75 m
Total Head						17 m

NP 3127 SH 3~ Adaptive 249 | Configuration Summary



Flygt's self-cleaning non-clog N-pumps feature innovative designs and functions that deliver high sustained efficiency and the most reliable operation. This makes them the most reliable choice available for a broad range of wastewater applications for tough applications such as unscreened sewage, wastewater and sludge up to an 8 percent solids concentration. Impeller material available in Hardened cast Iron, Hard Iron and Stainless Steel to fit any wastewater application.



Curve: ISO 9906

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GENERAL

Explosion Proof	Impeller Diameter
No	146 mm
Max. Pumped Media Temp.	
40 °C	

MATERIAL AND COATING

Impeller Material	Stator Cover Material
Hard-Iron	Grey Cast Iron
Volute Material	
Grey Cast Iron	

MOTOR

Rated Voltage	Motor Efficiency Class
400 V	Standard
Coupling	Rated Power
D	7.4 kW

INSTALLATION

Installation Type
P - Semi-Permanent, Wet

NP 3127 SH 3~ Adaptive 249 | Product Details

Description

N 3127

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- o Motor cable SUBCAB ® specially developed for submersible use.

Product Features

- o Sustained high efficiency
- o Hardened cast iron, optional Duplex stainless steel and Hard-Iron impellers
- o State-of-the-art wastewater pump with enhanced Adaptive N® hydraulic
- o Sustained high efficiency with energy savings up to 25%
- o Flexible and modular design
- o Robust and reliable

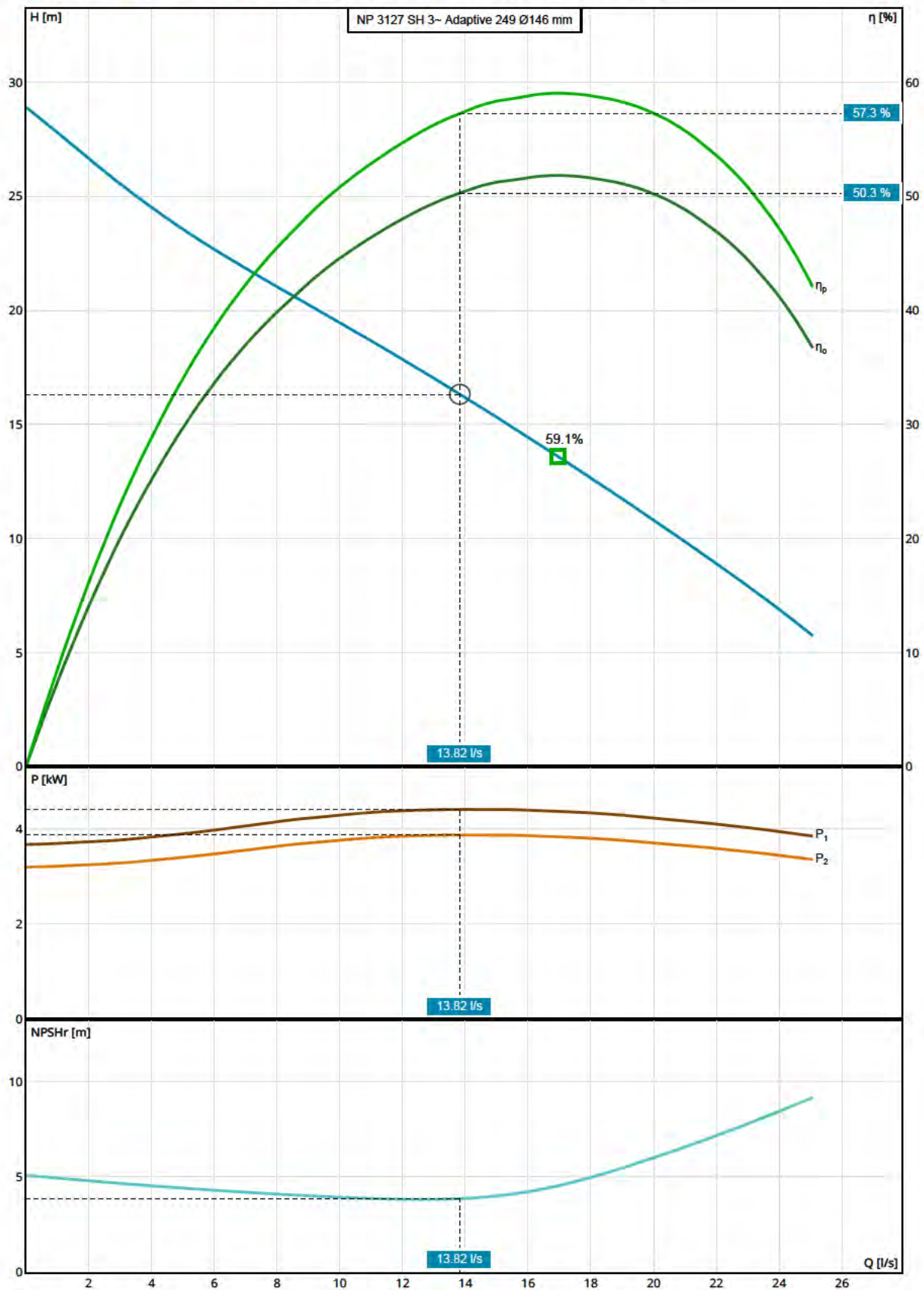
Construction Materials

Impeller Material	Volute Material	Stator Cover Material
Hard-Iron	Grey Cast Iron	Grey Cast Iron

Motor

Rated Power	Number Of Phases	Start Current Ratio	Motor Issue
7.4 kW	3	8.28	12
Motor Denomination	Rated Motor Speed	Insulation Class	Locked Rotor Code
21-11-2AL	2,900 RPM	H	J
Motor Efficiency Class	Rated Voltage	Approval	Max starts per hour
Standard	400 V	STD	30
Version Code	Rated Current	Total moment of inertia	Power Factor 100%
060	14 A	0.02 kgm ²	0.89
Frequency	Start Current	Type of duty	Power Factor 75%
50 Hz	114 A	S1	0.86
Max P2 (1x)	Starting Current, Direct Starting	Stator Variant	Power Factor 50%
3.87 kW	114 A	2	0.78
Number Of Poles	Starting Current, Star Delta	Motor Module	Efficiency 100%
2	38 A	164	87.3 %
			Efficiency 75%
			88.2 %
			Efficiency 50%
			87.7 %

NP 3127 SH 3~ Adaptive 249 | Hydraulic Data & Performance Curve



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Selection

Series	Curve Code
N 3000	249
Name	Impeller Diameter
NP 3127 SH 3~ Adaptive 249	146 mm
Frequency	Inlet Diameter
50 Hz	100 mm
Total Flow	Outlet Diameter
12.5 l/s	80 mm
Total Head	Number Of Vanes
14.94 m	2
Pump Flow	
12.5 l/s	
Pump Head	
14.94 m	
System Type	
Single Pump	
Operating Pumps	
1	
Standby Pumps	
No Standby Pump	

Design Point

Flow	Shaft power (P2)
13.82 l/s	3.87 kW
Head	NPSHR
16.33 m	3.86 m
Overall Efficiency (η_o)	Speed
50.29 %	2,951 RPM
Pump Efficiency (η_p)	Static Head
57.26 %	8.75 m
Input Power (P1)	Flow To BEP Ratio
4.4 kW	81.53 %

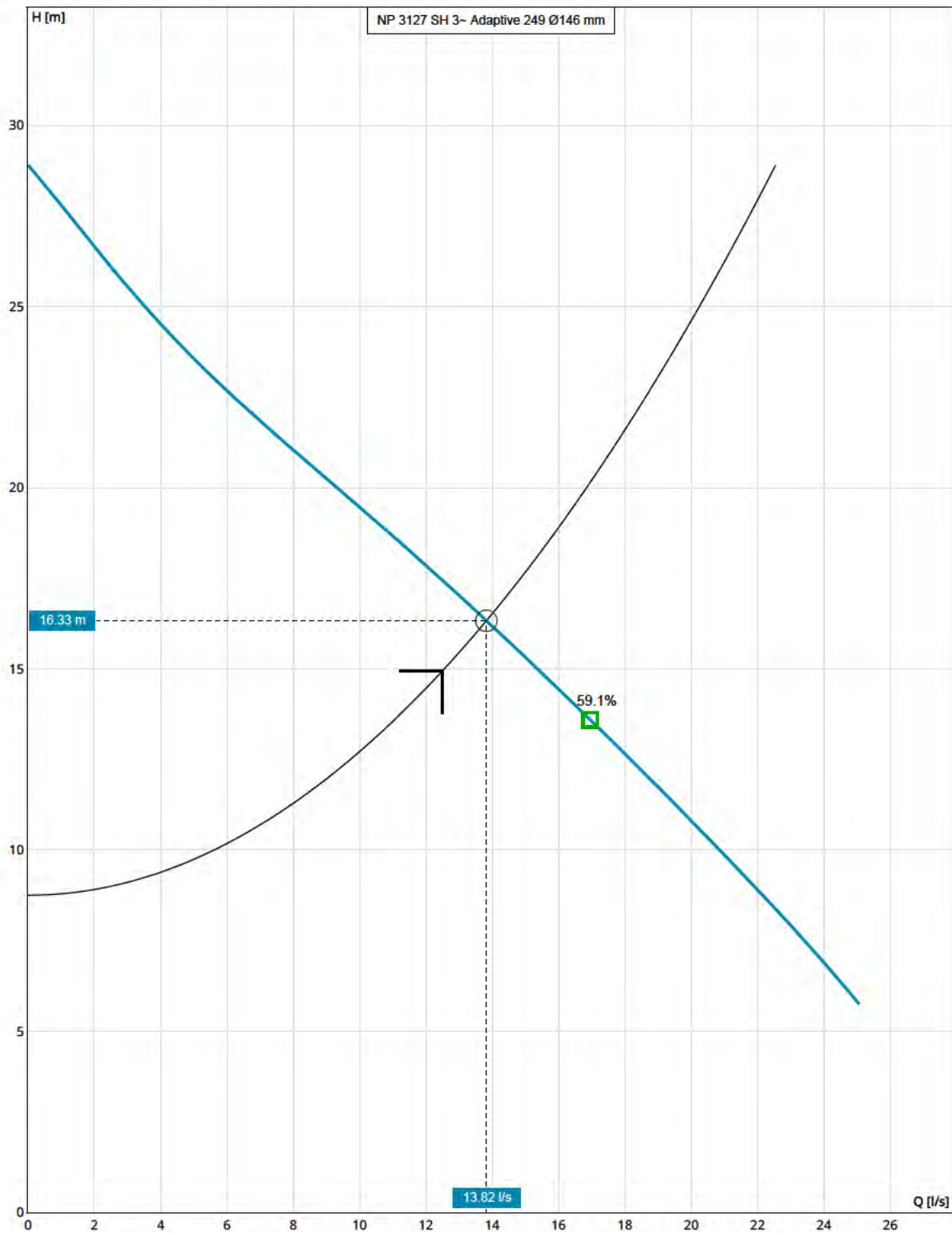
Fluid and Operating Conditions

Fluid Type	Density
Water	1,000 kg/m ³
Fluid Temperature	Dynamic Viscosity
4 °C	0.002 Pa·s
Specific Gravity	Fluid Vapor Pressure
1	8.14 mbar
	Atmospheric Pressure
	1,013.53 mbar
	Elevation
	0 m
	Ambient Temperature
	20 °C
	NPSH Available
	10.27 m
	Submergence
	0 m

Design Curve

Rated Speed	BEP Flow
50 Hz	16.96 l/s
Max Flow	BEP Head
25.07 l/s	13.6 m
H@QMin	Max P2
28.9 m	3.87 kW
H@QMax	Specific Energy
5.74 m	0.09 kWh/m ³
BEP	
59.06 %	

NP 3127 SH 3~ Adaptive 249 | Duty Analysis

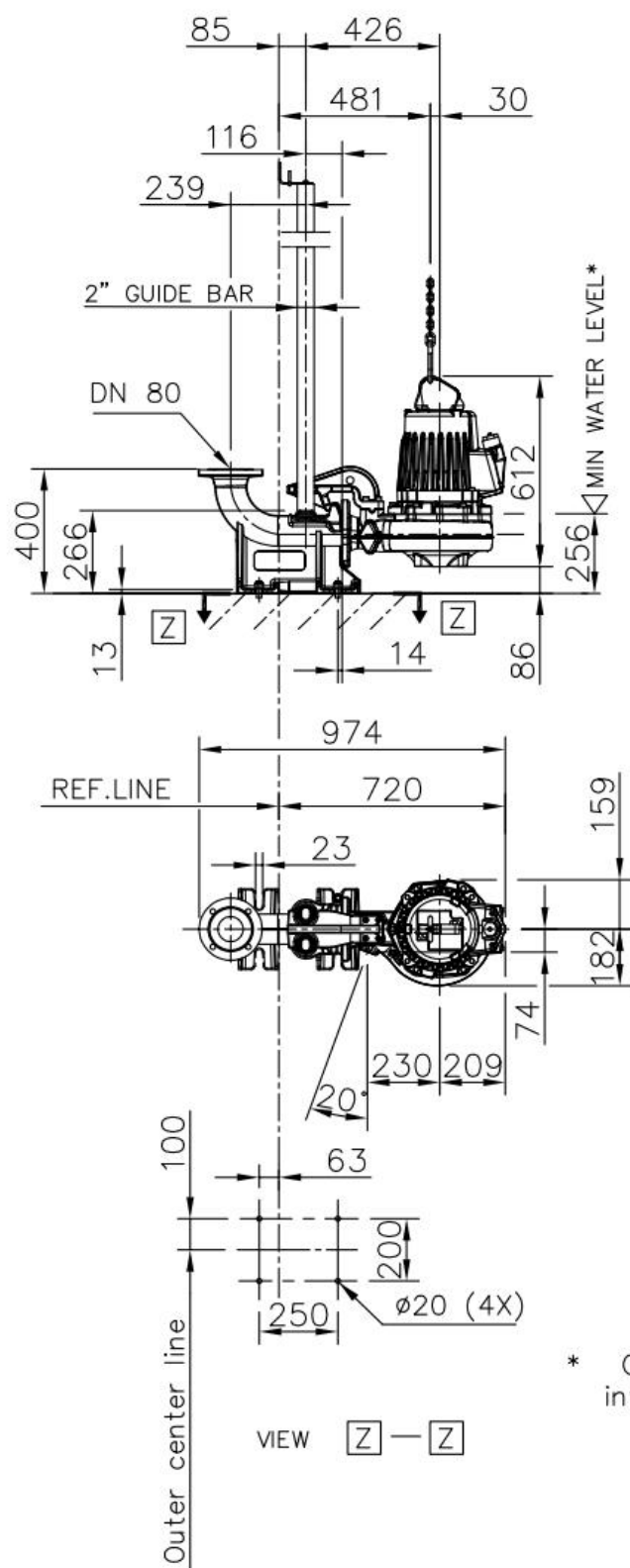


Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances. Please consult your local Flygt representative for additional performance guarantees.

Name	Q (1x) [l/s]	H (1x) [m]	P2 (1x) [kW]	Q [l/s]	H [m]	P2 [kW]	η_p [%]	SE [kWh/m ³]	NPSHr [m]
DP @ 1x	13.82	16.33	3.87	13.82	16.33	3.87	57.26	0.09	3.86

NP 3127 SH 3~ Adaptive 249 | Dimensional Data & Drawing



* Consult the IOM for more info

Weight (kg)	
Pump	Disch
147	35

	FP,NP	3127	SH		Discharge outlet DN 80	Scale	Date
	060,070,161,191,350,390,901,911,920,930				Pump outlet DN 80	1:20	250408
					Pump inlet	Drawing number	Revision
					Suction inlet	7319700	8

NP 3127 SH 3~ Adaptive 249 | Headloss Calculation



Fluid Type	Total Flow	Kinematic Viscosity
Water	12.5 l/s	0.000002 m ² /s
Static Head	Operating Pumps	System Type
8.75 m	1	Single Pump
Layout	Calculation Model	
Wet Installed Submersible Pumps	Colebrook-White	

Type	Pipe Inner Diameter [mm]	Length / K Factor	Quantity	Velocity [m/s]	Pipe Roughness [mm]	Headloss [m]
Individual Discharge Piping / Wetwell SS / Stainless steel / PN 10 / DN 100 (104x2.0 mm) / New Pipes						
Pipe Length	100 mm	12 m	1	1.59 m/s	0.5 mm	0.49 m
90 Elbow	100 mm	0.3	1	1.59 m/s		0.04 m
Tee Line →  →	100 mm	0.1	1	1.59 m/s		0.01 m
Check Valve	100 mm	5	1	1.59 m/s		0.65 m
Gate Valve	100 mm	0.2	1	1.59 m/s		0.03 m
Total Head						1.21 m
Individual Discharge Piping / Rising main / PE100 (HDPE) PE 4710 / SDR 11 (PN 16) / DN 150 (160x14.6 mm) / New Pipes						
Pipe Length	130.8 mm	502 m	1	0.93 m/s	0.5 mm	4.99 m
Total Head						4.99 m
Friction Loss Head						6.19 m
Static Head						8.75 m
Total Head						14.94 m

MCBERNS

INNOVATIVE SOLUTIONS

WELL WASHERS



Why choose a McBerns Well Washer?

- Eliminates fat & grease build up on infrastructure & Walls
- No power required
- Operates with mains pressure water
- Uses less than 100 lts water per/day
- Cleaner level sensor probes
- Reduces overflows caused by fogs
- Reduces odour
- Reduces confined space entries
- Reduces infrastructure corrosion
- Reduces maintenance
- Improved safety at pump stations
- Reduces customer complaints
- Healthier environment
- Optional pre-programmed with 5 cleaning cycle durations

McBerns Well Washers

The Well Washer has been in the Australasian marketplace for 25 years and is still the preferred method in keeping pump stations fat free. The AutoWellWasher™ will reduce maintenance in wet wells and tanks that accumulate fats, oils and greases (FOGs). Our design uses town water or recycled treated effluent at mains pressure to keep pump stations clean.

It can be installed using existing telemetry or with our pre-programmed timing device that activates towards the end of the pump out cycle.

Installing a wellwasher will eliminate large fatty build-up in pump stations, this then reduces blockages in pumps

and downstream sewers. The level sensors remain clean so the pumps work more efficiently, reducing the risk of overflows due to FOG build-up. It has also been shown to significantly reduce sulphide corrosion on concrete walls, pumps and other internal infrastructure components. There are fewer confined space entries required, only when essential maintenance tasks are needed.

The Well Washer is wholly designed and manufactured in Australia and has Australian, United States & International Patents.

'The total water usage for a single washer is as little as 100 litres per day.'

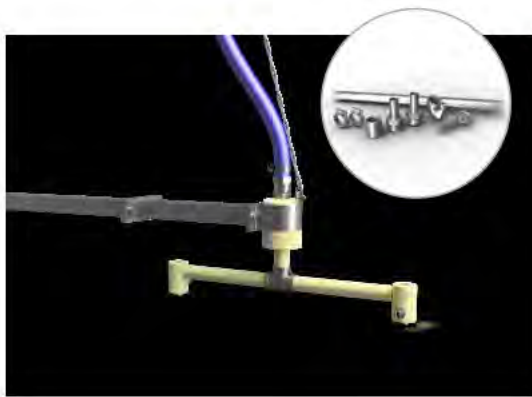
The principle behind the design is simple:
The Well Washer cleans the fat and grease away before it solidifies.





Well Washer Kit Guide Rail Mount

Part Number:	WWKITGRMOUNT
Description:	Kit includes washer, brackets and install hose & fittings
Application:	Eliminates fat & grease build up on infrastructure and walls
Material / Finish:	Austen, 316 S/S
Dimensions:	Taking the infrastructure into account we can design to specific requirements
Weight:	6 kg
General Specifications:	40/60 PSI, 30 l/min, 5-6m (Diameter)



Well Washer Kit Wall Mount

Part Number:	WWKITWALLMOUNT
Description:	Kit includes washer, brackets and install hose & fittings
Application:	Eliminates fat & grease build up on infrastructure and walls
Material / Finish:	Austen, 316 S/S
Dimensions:	600mm to 900mm Diameter
Weight:	6 kg
General Specifications:	40/60 PSI, 30 l/min, 5-6m (Diameter)



Optional Solenoid Valve

Part Number:	WWSOLENOID
Description:	Optional Solenoid Valves for water supply
Application:	Once energised allows water to flow to wellwasher
Material / Finish:	Glass reinforced nylon
Dimensions:	600mm to 900mm Diameter
Weight:	500 g
General Specifications:	Continuous operation 100% ED c/w LED connector plug IP65



Optional Pre-Programmed Allen-Bradley Micro810 Smart Relay

Part Number:	WWTIMER
Description:	Pre programmed with 5 cleaning cycle durations
Application:	Water Conservation, Minimise manual control
Material / Finish:	PVC
Dimensions:	600mm to 900mm Diameter
Weight:	500 g
General Specifications:	Less than 100 L daily



MCBERNS

INNOVATIVE SOLUTIONS

ODOUR MANAGEMENT
SAFETY ACCESS COVERS
DESIGN & FABRICATION
DATA ANALYTICS

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Phone: +61 7 5445 1646
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Email: mail@mcberns.com

Noel Southern: 0411 745 458
Paul O'Kane: 0459 396 157
Stuart Darby: 0413 436 683

www.mcberns.com



Aquate Commercial Pump Station

Technical Guide WW 10

Aquate Pump Stations are ideal for civil infrastructure applications where sewage or stormwater needs to be discharged into a reticulation network or wastewater treatment plant.



06.22 | WASTEWATER | WWW.AQUATE.COMMERCIALPUMPSTATIONS

Applications

From residential subdivisions, schools, factories and commercial developments to stormwater networks, our complete range of pump stations is the solution for any sewer, stormwater or trade waste application.

Approvals/Standards

Concrete components designed and manufactured to AS/NZS 4058:2007
Precast Concrete Pipes

AS/NZS 1546:1 2008 – tank certification

AS/NZS3000 – electrical controller

AS/NZS 3500.2:2021 Sanitary plumbing and drainage

Built under ISO9001:2008 QA System

We are the supply partner of choice for New Zealand's civil construction industry, specialising in water and infrastructure based solutions.

Aquate Pump Stations are ideal for civil infrastructure applications where conventional gravity systems are impractical or not cost effective.

Introduction

Hynds offers a wide range of high performance and durable Aquate packaged pump stations. These systems include chambers, pumps, level controls, control equipment, piping and valves etc. Aquate Pump stations are manufactured in Hynds Precast Factories and available in either concrete or polyethylene.

Our dedicated design team at Aquate provide a complete design and specification for consulting engineers and contractors. No matter what challenges your project presents, Aquate's expert engineers will work with you step by step to custom design the perfect pump station solution. Safety in design, environmental risk mitigation and ease of maintenance for servicing is always front of mind.

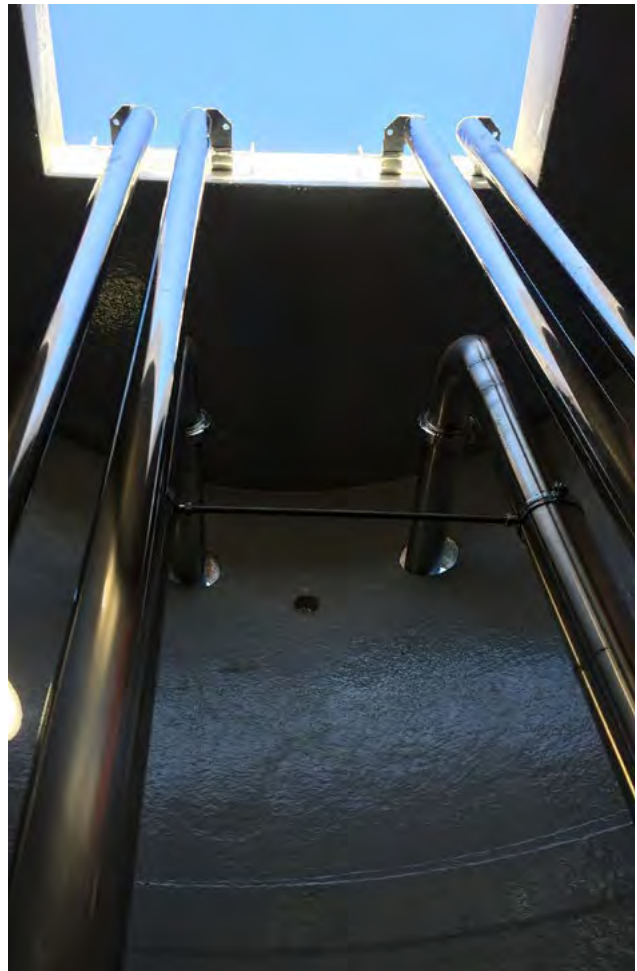
Hynds' dedicated Project Manager oversees the entire pump station project, including supply, on site installation, commissioning and quality assurance. Together with Aquate's world standard design service, the whole process from design through to installation is seamless.

Residential Aquate Pump Systems are also available for domestic applications.

See our website for more information: www.hynds.co.nz/product/aquate-residential-pump-station/

Features & Benefits

1. Flexible design: Aquate Pump Stations are designed to provide the required on-site storage and optimal pump performance.
2. Easy installation: The systems are prefabricated in the factory providing easy installation on site.
3. High quality pumps: Brands include Flygt, Grundfos, Domo and Zenit. Pumps are designed to meet the site specific requirements.



Technical data

Aquate Model No.	AQ1200	AQ1500	AQ1800	AQ2050	AQ2500	AQ3000
Internal diameter (mm)	1200	1500	1800	2020	2550	3000
Max chamber depth (m)	4.8	4.8	6.0	6.0	8.0	10.0
Min. riser sections (mm)	300	300	300	300	300	300
Valve chamber diameter (m)	1.2	1.2	1.5	1.5	1.8	1.8
Min volume wet-well (L)	2000	3500	5000	7000	10000	17000
Volume per additional metre depth (L)	1130	1760	2550	3100	5100	7050
Maximum pipework size (mm)	100	150	200	250	300	300

Control Panel

Hynds Aquate Pump Stations come complete with an electrical controller. This can be located on the pump chamber or installed at a nearby building. Features include:

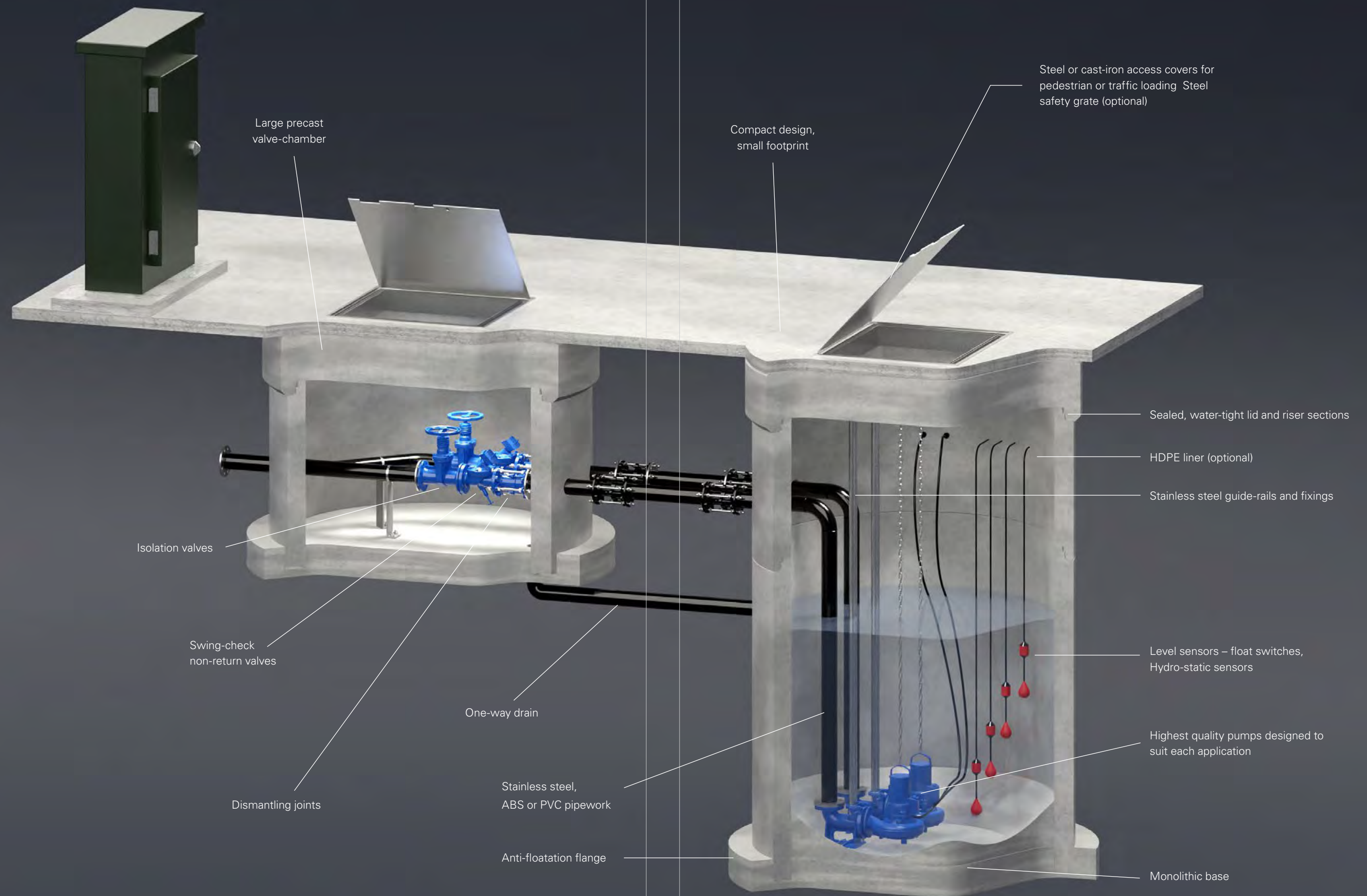
- Single or three phase option
- Simplex or duplex pump operation
- Lockable IP 65 rated enclosure
- Visual and audible pump failure alarm system
- High level alarm
- Over pressure protection
- Pump motor protection against variable electricity supply
- Performance data recorded



Options

- Web Based monitoring
- Float switches, hydrostatic transducers or ultrasonic level sensors
- Steel cabinets
- Hour run and start count
- Integration into a SCADA System
- Mag Flow Metres
- Alarm telemetry (SMS alarms), radio transmission, or outputs to BMS





Options cont...

- Flow Meters to monitor usage
- Auto well-washer for automatic station cleaning
- Odour filters
- Internal linings to prevent corrosion
- Lifting arm socket to simplify maintenance procedures
- Storage tank for emergency storage

Back up and support

Hynds has service agents throughout New Zealand. In the unlikely event of an alarm activation there is typically sufficient storage in the tank for 24 hours of normal operation. In the event of an alarm, either Hynds or the Local Council's Utility Services Team can provide onsite service.

Design Assistance

A dedicated Aquate Design Team will assist engineers design the ultimate pump station for their project.

The following information will need to be considered to complete the full design:

- Expected daily wastewater volumes
- Emergency storage requirements
- Private or Council owned
- Static lift of rising main
- Length of rising main
- Special requirements for the controller (see options available)
- Depth of inlet pipes
- Pedestrian or traffic loading

Based on the information provided, Aquate will supply a design and specification including :

- Size of wet-well required
- Emergency storage tank if required
- Pump model and design
- Rising main sizing
- GA drawings of the pump station and valve chamber

Contact

Contact our Project Manager to discuss your project

E: John.Bradford@hynds.co.nz

M: 027 538 9724

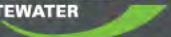




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0800 425 433

HYNDS
WASTEWATER 



Scan for more information

Hynds Retention Tank with Mul-T-Level™ Outlet

Technical Guide D5.15

Hynds strong and reliable retention tanks are available in Ring Joint Pipe Internal Base or Flange Base manhole types.



03.15 | DRAINAGE | D5.15 HYNDS RETENTION TANK

Applications

Stormwater retention & detention

Sewer storage

Product Attributes

Versatile Mul-T-Level™ outlet

Highly durable

Simple installation

Various design layouts and large capacity options available

Water tight

Proven history

Approvals/Standards

AS/NZS 4058:2007 Precast concrete pipes (pressure and non-pressure)

Quality

ISO 9001:2008 Quality Management

The go to organisation for civil and rural water product solutions

HYNDS

Hynds strong and reliable retention tanks are available in Ring Joint Pipe, Internal Base or Flange Base Manhole types.

Design Specifications and Applications

RJ Retention Tank

- Generally used when the location permits the installation of a long narrow tank.
- Comprised of Hyspec reinforced concrete rubber ring joint pipes.
- Usually includes a spigot-plugged pipe, standard intermediate pipes and a collar-plugged pipe.
- The spigot and collar plugs are factory cast to ensure water tightness and integrity.
- A manhole offtake is factory fitted to one or more pipes to provide easy access for maintenance.

IB or FB Retention Tank

- Generally used in compact site conditions where relatively small volumes is required.
- Comprised of Hynds internal base or flange base manhole risers and a precast concrete lid.

Mul-T-Level™ outlet

- Enables the tank to be used for both detention and retention.
- Both the RJ and IB/FB retention tanks have a standard 100 or 150mm diameter PVC slip coupler and Mul-T-Level™ outlet cast-in or fitted during manufacturing.
- The required retention/detention volume is set by an orifice hole (of specified diameter) being drilled on the Mul-T-Level™ outlet at a pre-determined height.

General Specifications

- Manufactured from Hyspec spun concrete pipes, using the centrifugal spinning process.
- When the tank is installed in an aggressive environment, such as tidal areas, sewerage or mild acid solutions, the use of a special grade concrete is recommended. Contact Hynds Technical Team for more information.
- Retention tanks are available in various class types to suit specific site conditions, loading and applications.
- The diameter and length of the retention tank is dependent on:
 - Storage volume required
 - Site configuration and access equipment available
- Inspection and maintenance access is provided by a fitted inspection chamber or manhole riser starter.
- PVC slip couplers are fitted to end plugs to provide inlet and outlet connections to the retention tank.
- Non-standard couplers or starter types can be cast-in on request.
- Orifice holes are drilled at levels to suit the design requirements.
- Standard lids are available for access risers in the RJ type tanks.
- A light or heavy duty cast iron cover and frame will fit directly onto the 600mm diameter access riser.
- The 1050 mm diameter access riser requires a 1050 mm diameter manhole lid, which can be fitted with the cast iron manhole frame and cover.
- The IB or FB tanks require a lid, which can be fitted with a cast iron frame and cover to suit the riser diameter.
 - Note: Lid thickness is dependent on loads and application
 - Refer to Table 1 for RJ tank capacities and Tables 2 and 3 for IB/FB tank capacities.

TABLE 1 RJ type retention tank

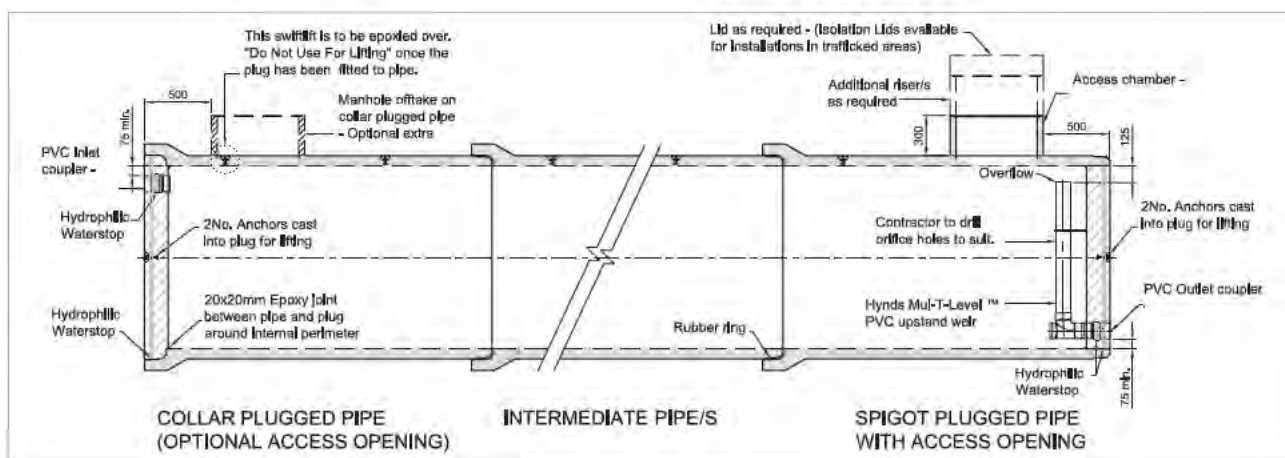
Nom Pipe Diameter and Joint Type	Pipe Effective Length (m)	Nom Vol per Pipe Length (m³)	Nom Vol per Pipe Length (Litres)	Suggested Offtake Dia (mm)	Lifting plugged pipe anchor req.	Handling intermediate pipe anchor req.
675RJ	2.440	0.72	720	600	A1	A2
750RJ	2.440	0.92	920	600	A1	A2
825RJ	2.436	1.14	1140	600	A1	A2
900RJ	2.448	1.38	1380	600	A1	A2
975RJ	2.440	1.67	1670	600	B1	B2
1050RJ	2.440	1.94	1940	600	B1	B2
1200RJ	2.440	2.58	2580	600	B1	B2
1350RJ	2.454	3.31	3310	600/1050	B1	B2
1600RJ	2.440	4.51	4510	1050	C1	B2*
1800RJ	2.438	6.13	6130	1050	C1	C2
1950SRJ	2.440	7.05	7050	1050	C1	C2
2100SRJ	2.397	8.02	8020	1050	C1	C2
2300SRJ	2.735	11.01	11010	1050	C1	C2
2550SRJ	2.470	12.18	12180	1050	C1	C2

Key

- **A1** 1 Tonne
2 no. in plug
1 no. in pipe
- **A2** 1 Tonne
2 no. in pipe
- **B1** 2.5 Tonne
2 no. in plug
1 no. in pipe
- **B2** 2.5 Tonne
2 no. in pipe
- **C1** 5 Tonne
2 no. in plug
1 no. in pipe
- **C2** 5 Tonne
1 no. in pipe

Notes:

- All dimensions refer to Class 2 (X) pipes
- Outlet 75 mm minimum above bottom invert of pipe
- Overflow 125mm below top
- *1600 Ø retention tanks require both B2 & C1 type lifting clutches for offloading and installation
- See Fig 6 for 3 point lift on typical plugged end pipe

**FIG. 1** General layout of typical RJ type retention tank with Mul-T-Level™ outlet

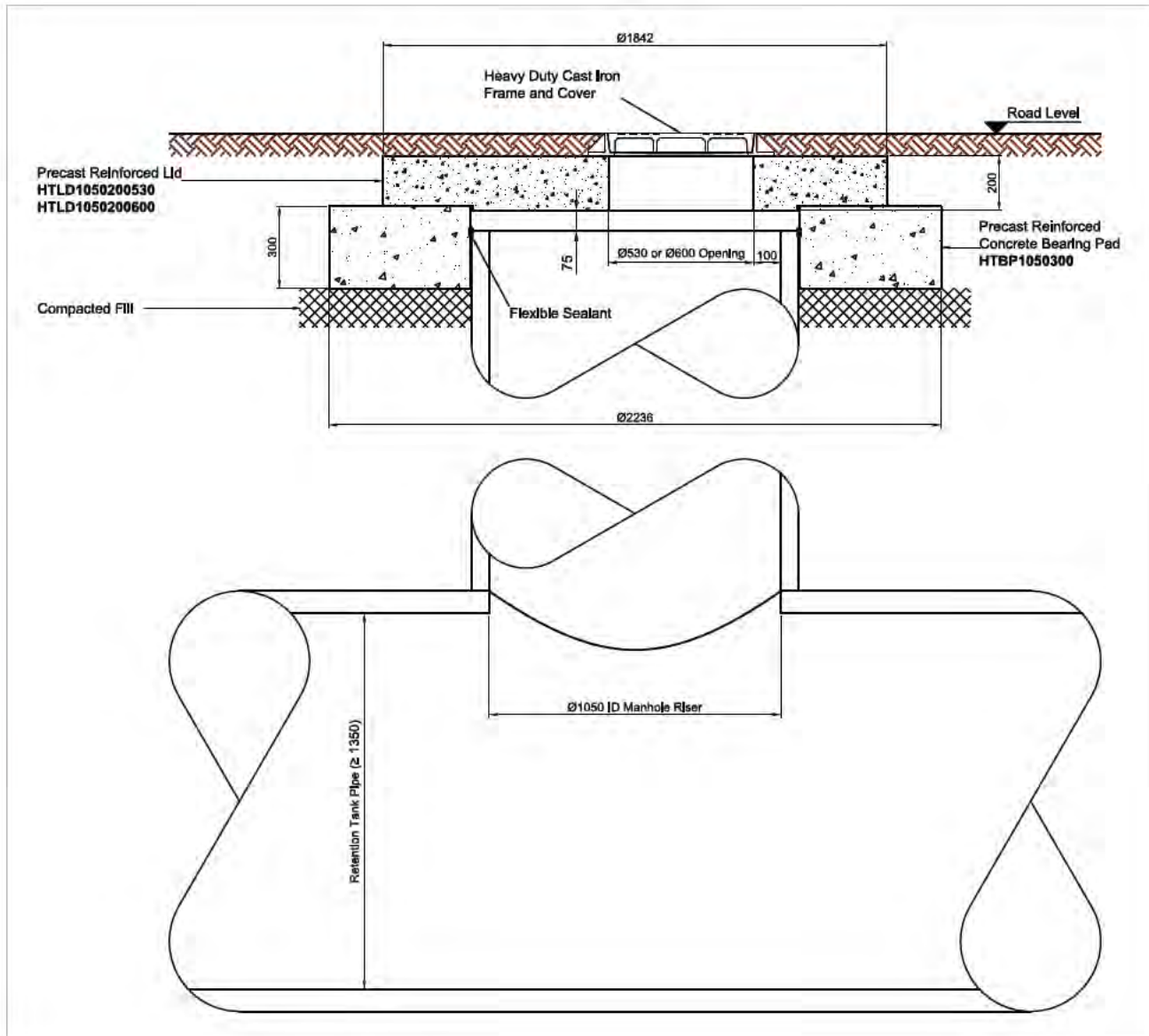


FIG. 2 Recommended detail for roadway installation

COLLAR PLUGGED PIPE (OPTIONAL ACCESS OPENING)

INTERMEDIATE PIPE/S

SPIGOT PLUGGED PIPE WITH ACCESS OPENING

PIPE Ø

Mh. Recommended Ø 675mm

PIPE CLASS

TOTAL No. OF PIPES (Incl. ends)

COVER TO INVERT

PVC INLET FITTING Ø

Pipe Ø	Standard Fitting Ø	Ø Required
Ø675 to 1200mm	Ø100mm	
Ø1350 to 3000mm	Ø150mm	

PVC OUTLET FITTING Ø

Ø Pipe	Standard Fitting Ø	Ø Required
Ø675 to 1200mm	Ø100mm	
Ø1350 to 3000mm	Ø150mm	

ACCESS CHAMBER - OUTLET SIDE Ø

Ø Pipe	Standard Offtake Ø	Ø Required
Ø675 to 1200mm	Ø600mm	
Ø1350 to 3000mm	Ø1050mm	
Ø1350 to 3000mm	Specify	

ACCESS CHAMBER - OPTIONAL INLET SIDE Ø

Ø Pipe	Standard Offtake Ø	Ø Required
Ø675 to 1200mm	Ø600mm	
Ø1350 to 3000mm	Ø1050mm	
Ø1350 to 3000mm	Specify	

JOB DETAILS

QUOTE No.

CO No.

I AUTHORISE HYNDS PIPE SYSTEMS LTD TO PROCEED WITH THE MANUFACTURING OF THIS PIPE SPECIAL AS DETAILED ABOVE. I ACKNOWLEDGE THAT ANY SPECIALS, ONCE MANUFACTURED, ARE DEEMED TO BE MY (CONTRACTOR'S) PROPERTY & ARE NON REFUNDABLE. STORAGE & HANDLING FEES WILL BE INCURRED FOR PRODUCTS THAT ARE NOT DELIVERED/COLLECTED WITHIN 1 MONTH OF THE DATE AGREED AT THE TIME OF ORDER. PRODUCT NOT DELIVERED/COLLECTED WITHIN 3 MONTHS OF THE DATE AGREED WILL BE DESTROYED AT MY EXPENSE.

NAME > SIGNATURE >

DATE >

FIG. 3 RJ Retention Tank Order Form

Internal base type

TABLE 2 Internal base retention tank

Riser Height (mm)	450	600	900	1200	1500	1800	2100	2400
O/A Height Incl 150mm Thick Lid	580	730	1030	1330	1630	1930	2230	2530
O/A Height Incl 200mm Thick Lid	630	780	1080	1380	1680	1980	2280	2580
Effective Depth (mm)	225	375	675	975	1275	1575	1875	2175
Nominal Diameter	A = Riser OD (m)	B = Riser ID (m)	IB Capacity (m ³)					
1050	1.194	1.066	0.20	0.33	0.60	0.87	1.14	1.41
1200	1.347	1.207	0.26	0.43	0.77	1.12	1.46	1.80
1400	1.524	1.372	0.33	0.55	1.00	1.44	1.88	2.33
1500	1.677	1.523	0.41	0.68	1.23	1.78	2.32	2.87
1650	1.842	1.676	0.50	0.83	1.49	2.15	2.81	3.47
1800	2.007	1.829	0.59	0.99	1.77	2.56	3.35	4.14
2050	2.236	2.036	0.73	1.22	2.20	3.17	4.15	5.13

Effective Depth (mm)	-	-	625	925	1225	-	-	2125
Nominal Diameter	A = Riser OD (m)	B = Riser ID (m)	IB Capacity (m ³)					
2300	2.58	2.30	-	-	-	3.84	-	-
2550	2.85	2.55	-	-	3.19	-	6.26	-

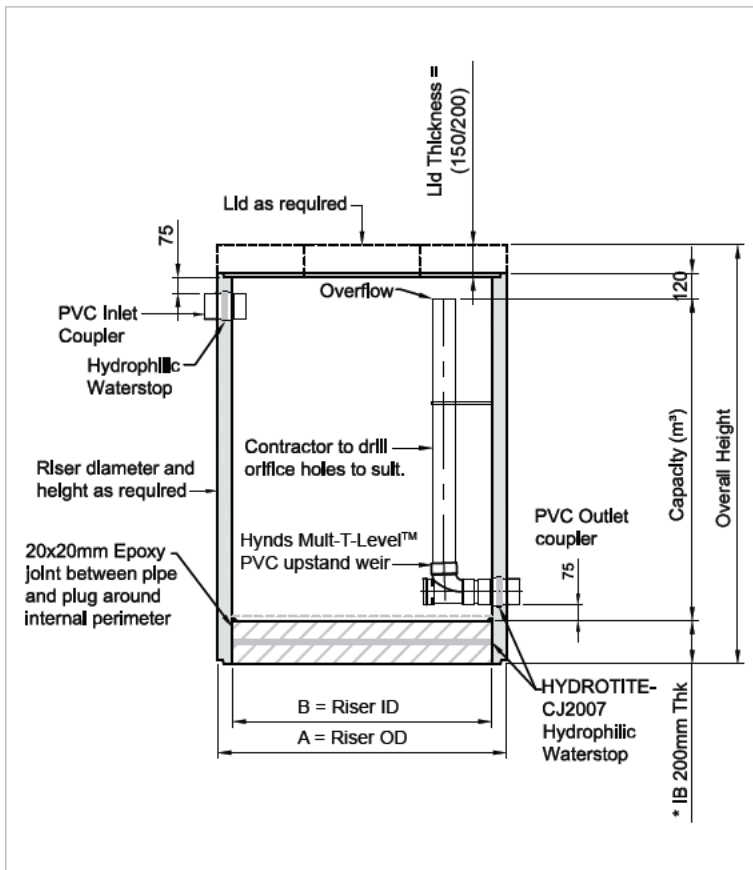


FIG. 4 Internal base

Flange base type

TABLE 3 Flange base retention tank

Riser Height (mm)			450	600	900	1200	1500	1800	2100	2400
O/A Height Incl 150mm Thick Lid			530	680	980	1280	1580	1880	2180	2480
O/A Height Incl 200mm Thick Lid			580	730	1030	1330	1630	1930	2230	2530
Effective Depth (mm)			225	375	675	975	1275	1575	1875	2175
Nominal Diameter	A = Riser OD (m)	B = Riser ID (m)	FB Capacity (m ³)							
1050	1.194	1.066	0.20	0.33	0.60	0.87	1.14	1.41	1.67	1.94
1200	1.347	1.207	0.26	0.43	0.77	1.12	1.46	1.80	2.15	2.49
1400	1.524	1.372	0.33	0.55	1.00	1.44	1.88	2.33	2.77	3.22
1500	1.677	1.523	0.41	0.68	1.23	1.78	2.32	2.87	3.42	3.96
1650	1.842	1.676	0.50	0.83	1.49	2.15	2.81	3.47	4.14	4.80
1800	2.007	1.829	0.59	0.99	1.77	2.56	3.35	4.14	4.93	5.71
2050	2.236	2.036	0.73	1.22	2.20	3.17	4.15	5.13	6.10	7.08

Effective Depth (mm)			-	-	625	925	1225	-	-	2125
Nominal Diameter	A = Riser OD (m)	B = Riser ID (m)	FB Capacity (m ³)							
2300	2.58	2.30	-	-	-	3.84	-	-	-	8.83
2550	2.85	2.55	-	-	3.19	-	6.26	-	-	10.85

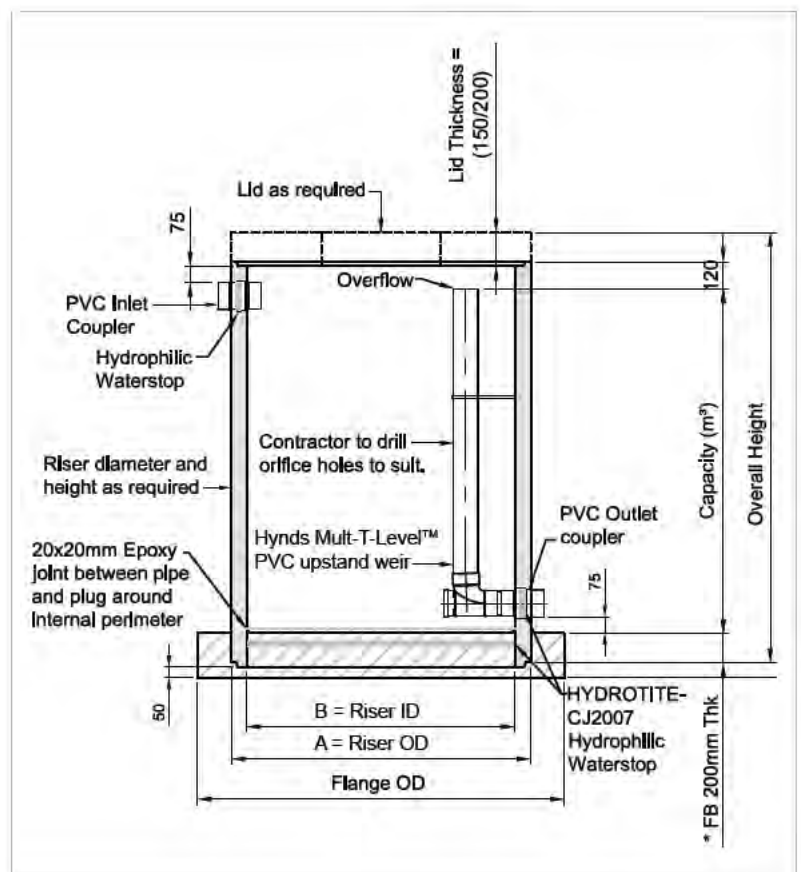


FIG. 5 Flange base

Installation

Mul-T-Level™ outlet

- Installation is simple and normally carried out by a drain layer using the same equipment and procedures as for the installation of concrete pipelines, or manholes.

RJ Retention Tank

- Similar installation to reinforced concrete rubber ring jointed pipes (including bedding requirements) and are dependent on site conditions and loading.
- Once the pipe sections have been installed and backfilled, the additional access risers are epoxied to the starter risers and brought up to the finished levels.
- The installation is then completed by fitting the required lids.
- The contractor must then drill the orifice holes at the required design levels.

Note: Refer to Figure 1 for a general layout of a typical RJ type tank.

RJ Retention Tank – Roadway Installation

- To minimise the effects of traffic, isolation of the manhole lid from the access riser is recommended.
- The depth of the modified flange base and riser must be kept to a minimum to enable maximum distribution of load above the tank.
- Refer to Figure 6 for 3 point lift of typical plugged end pipe.

IB or FB Retention Tank

- Similar installation to concrete manholes.
- Foundations should be prepared with compacted hardfill to prevent excessive settlement.
- Once the IB or FB tank is backfilled, the installation is completed by fitting the relevant concrete lid with the appropriate cast iron frame.



FIG. 6 Point lift of typical plugged end pipe

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Hyliner AKS HDPE Lining

Technical Guide D1.12

HyLiner AKS HDPE is used as corrosion protection lining in precast and cast in-situ concrete elements or structures to increase durability and reduce the risk of abrasion.



04.20 | DRAINAGE | D1.12 HYLINER AKS HDPE LINING

Applications

Corrosion protection lining for precast concrete pipes in sewer pipelines

Corrosion protection lining for in-situ concrete structures in wastewater treatment plants

Abrasion protection lining in high abrasion environments

Broad range of application in both precast and cast in-situ concrete

Product Attributes

Available in white (sewer applications) and black (where high UV resistance is required)

12 mm long anchors are integrally formed with the sheet

Factory QA tested and welding of joints is 100% quality tested onsite

Quality

ISO 9001:2008 Quality Management Standard

We are the supply partner of choice for New Zealand's civil construction industry, specialising in water and infrastructure based solutions.

HYNDS
PIPE SYSTEMS

HyLiner AKS HDPE is used as corrosion protection lining in precast and cast in-situ concrete elements or structures to increase durability and reduce the risk of abrasion.

Lining systems are able to bridge discontinuities in pipe or structure walls unlike other coating systems that rely on the integrity of the surface and quality of the surface preparation and the installer's expertise for functionality.

HyLiner AKS HDPE is a thermoplastic lining used to reduce the risk of sulphide attack or corrosion in sewage applications.

The high density polyethylene (*HDPE*) lining suits both precast and in-situ applications. Firmly anchored to the concrete surface of the pipe or structure, the lining requires only welding of joints to form a durable, chemically resistant concrete protection membrane with high abrasion resistance.

Installation

Installation procedures vary depending on the product:

Spun concrete pipe

The liner is inserted into the pipe prior to the completion of manufacture, with the pipe spinning process completed with the liner installed. This ensures that all the anchor knobs are well embedded in the spun concrete prior to the concrete curing and hardening.

Wet cast concrete pipe

The liner is securely attached to the inner mould before placement of reinforcement and casting of the pipe. The pipe once cast is cured in the normal manner using heat to accelerate the hardening process.

Precast concrete

This follows a similar process to the wet cast concrete pipe whereby the liner is attached to the mould prior to casting of the element.

In-situ concrete

This follows the same process as for precast concrete whereby the liner is attached to the formwork prior to casting of the concrete.

Installation Detail

In the case of concrete pipes, the liner need only be applied to the pipe's internal surface above low flow level during normal operating conditions as shown in fig 3.

Where 360° cover is required, the liner is fitted with an overlap at the invert (50 mm min) as shown in fig 4 & 5. This joint is not usually welded as it allows any accumulation of moisture from external hydrostatic pressure to dissipate from behind the liner.

Where the fluid contents are themselves aggressive, such as trade waste discharges, a longitudinal weld can be provided to seal the pipe invert.



FIG. 1 Where 360° cover is required, the liner is fitted with an overlap at the invert (50 mm min)

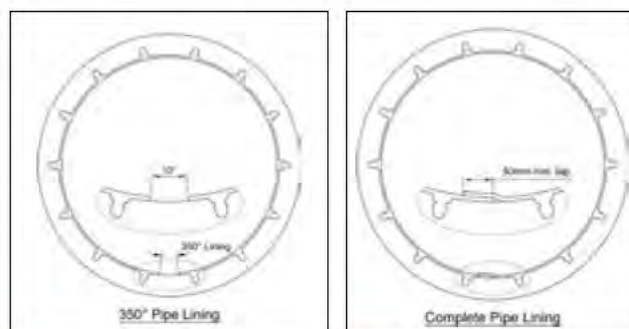


FIG. 3 Most concrete pipes only require the liner applied to the pipe's internal surface above low flow level during normal operating conditions.

FIG. 2 Invert overlap in a 1050Ø pipe.

Joining

A continuous lining system is created through the use of extrusion welding carried out by trained, qualified operators. Generally overlapped welds are recommended.

Various details for welded joints for precast concrete pipes and components are shown in Figures 4 to 6. Other details for site installation and fixing of brackets are shown in Figures 7 to 12.

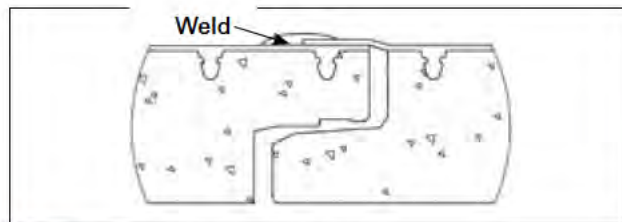


FIG. 4 HyLiner lined SRJ pipe (Lapped Joint)

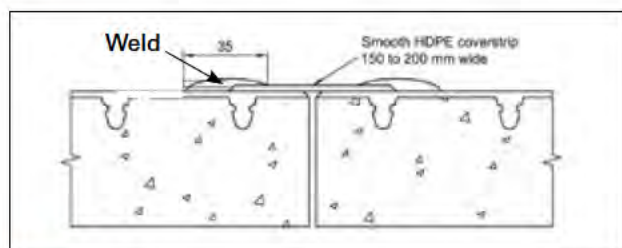


FIG. 5 Cover strip with 2 overlap welds

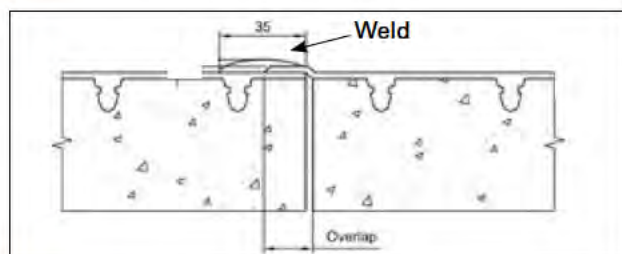


FIG. 6 Single overlap weld

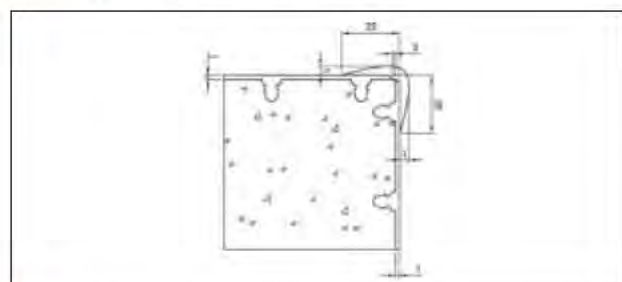


FIG. 7 Outside Corner Weld

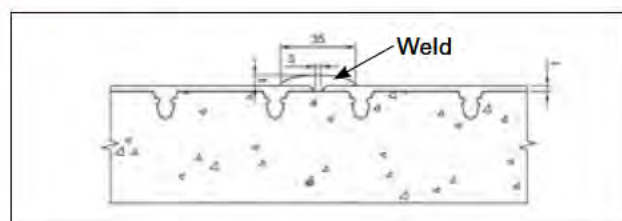


FIG. 8 Flat Extrusion Butt Weld

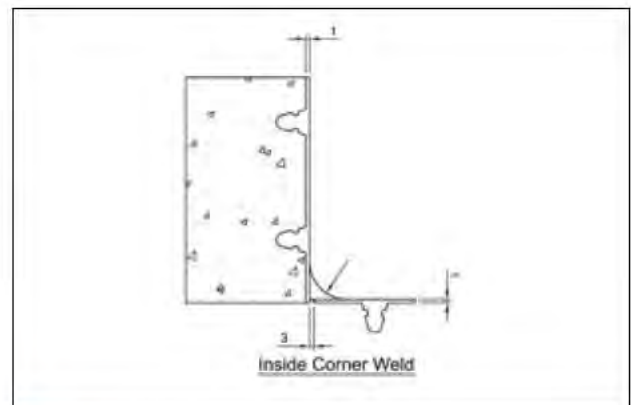


FIG. 9 Inside Corner Weld

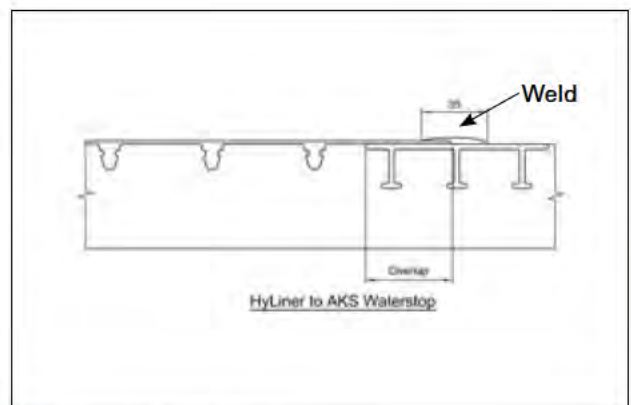


FIG. 10 HyLiner to AKS Waterstop

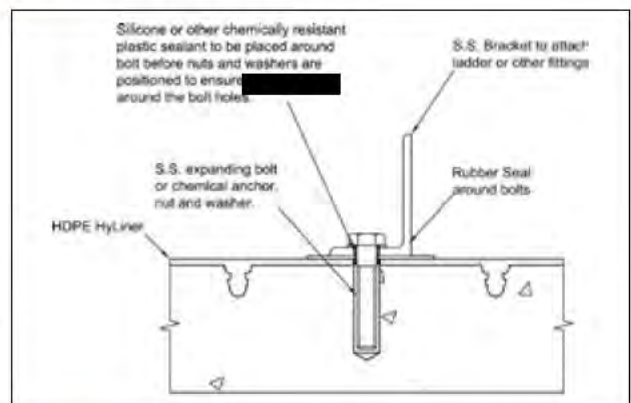


FIG. 11 Sealing of Brackets and Fittings to HyLiner Lined Structures

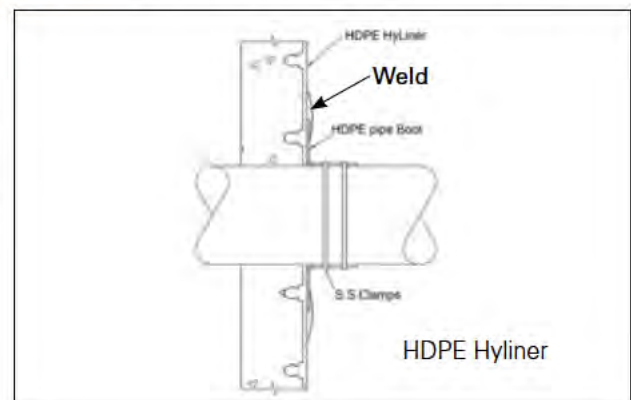


FIG. 12 Pipe Penetration Detail

Quality Control

In-plant quality control for the manufacture of the liner includes waviness, surface finish, knob shape and alignment, crimp height and depth of knobs, sheet thickness, density and tensile values.

Quality checks after casting into precast concrete pipes and components include effective anchor embedment, liner positioning on the product and spark testing for pin holes or damage.

All joints and the liner are spark tested after jointing is completed on site. This ensures the quality of the joints and identifies any damage in the liner as a result of handling and installation.

Abrasion resistance

HyLiner AKS HDPE has a good abrasion resistance when compared to other materials. A typical abrasion test value for HDPE liners is 0.3mm after 400 000 cycles (*Kirschmer, O., "Problems of Abrasion in Pipes", Steinzeugin Formationen, 1966, No 1, pp3-13*).

Wear rates are very slow even under continuous flow of abrasive slurry. Most drainage applications would have intermittent exposure to abrasion.

Suitable Structures for Lining

HyLiner AKS HDPE is suitable for installation in spun and wet cast concrete pipes from 1050–3000 mm diameter. HyLiner AKS HDPE is also suitable for lining a range of other concrete structures:

- Manhole risers and lids
- Rectangular or square precast concrete chambers and lids
- Precast concrete channels and lids
- Precast concrete pumpstations
- Insitu concrete structures such as tanks and chambers



FIG. 13 2300 Diameter Manhole Riser



FIG. 14 Liner being installed for a manhole lid

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BluSeal AKS

HDPE CONCRETE PROTECTION MEMBRANE



BluSeal Anchor Knob Sheet (AKS) is supplied and installed as a fully sealed and welded robust chemically resistant concrete protection lining.

BluSeal AKS is a synthetic membrane of HDPE sheet with integral anchors which are cast into concrete to form a flexible and durable corrosion protection lining. BluSeal AKS is used to protect concrete surfaces in chemically aggressive environments in sewerage tunnels, treatment works, pump stations, manholes and chemical retention bunds. It comes in a range of colours and thicknesses and can be applied to new and existing structures for protection or enhancement.

Application Advantages

- Fully welded homogenous lining
- Complete before 28-day concrete cure
- Factory assured thickness and absence of pinholes
- Retro-fitted lining is moisture compatible with assured bond

Lifecycle Advantages

- 100 year design life
- Membrane drainage eliminates negative pressure
- Chemical and impact resistant
- High anchor pull-out resistance
- Potable Water use to AS/NZS 4020:200
- Low coefficient of friction in lined conduits

About the Product

BluSeal AKS is supplied and installed as a fully sealed and welded, chemically resistant concrete protection system. The system includes propriety details for sealing around penetrations and against non-HDPE surfaces. Skilled applicators can fabricate the product into various shapes to suit irregular concrete formwork. All seams and joins are extrusion welded and then tested by spark or vacuum box testing. BluSeal AKS is designed and installed by approved applicators to international standards which are outlined in a manufacturer's installation manual. The elasticity of the membrane allows free drainage and relief of any hydrostatic pressure build-up in underground structures. The membrane can be cast into new structures or retrofitted by cement grouting onto the prepared surface of existing structures. AKS lined structures have an outstanding track record in aggressive environments, demonstrating a design life in excess of 100 years for the most demanding applications.

Application solutions

- Segmental sewer tunnels
- Inlet works and bioreactor tanks in WWTP
- Pump stations and manholes
- Tunnel waterproofing
- Chemical retention bunds
- Piles and foundation lining in aggressive ground conditions
- Sewer pipelines
- Slide pads on pipe plinths
- Concrete protection for industrial applications

Project Specification Clause

HDPE CORROSION PROTECTION LINING - The HDPE CPL membrane used for this project shall be supplied and installed as a fully sealed and welded robust continuous membrane system. It shall be a factory produced product that has independent testing to validate the performance outlined in the technical data table on the following pages. BluSeal AKS supplied by Bluey Technologies or equivalent shall be acceptable.

Project Examples

Sewerage treatment plants, sewer pump stations, sewer manholes, trunk sewer mains, chemical processing plant bunds and trenches, gas pipelines (pipe plinths).





BluSeal AKS

HDPE CONCRETE PROTECTION MEMBRANE

Application Specification

PREPARATION

- 1.1 BluSeal AKS must be installed onto formwork under the direction of an approved, specialised applicator who will plan layout configurations of sheets and weld seam locations. The applicator may also prefabricate some corner or seam sections and pipe penetration pieces offsite.
- 1.2 At joins in sheets the edge knobs are removed from one edge and the sheet is overlapped by 50mm to prevent egress of concrete fines and to provide a sound foundation for welding the seams.
- 1.3 Formwork shall be cleaned and free of defects. Form release oils are not necessary where BluSeal AKS is applied. Formwork should be designed to avoid leaking.
- 1.4 The sheets must be tensioned over the form within the yield elongation limit, prior to securing to the forms.
- 1.5 BluSeal Formtak can be used to assist in holding the sheet against timber formwork. Securing against the formwork is by nailing or stapling through the sheets at edges where extrusion welds will cover later or into edges that will be redundant and trimmed after the pour.
- 1.6 On circular forms, the sheets are wrapped and tensioned around and secured at the overlap by wires around the knobs and/or temporary speed welding along the seam.
- 1.7 In precast concrete applications the moulds may be designed to secure the membrane at the edges.
- 1.8 When BluSeal AKS is applied to an existing structure all corroded concrete and contaminants must be removed, leaving a surface profile greater or equal to CSP4 in accordance with ACI guidelines.
- 1.9 Treat or replace exposed reinforcement in accordance with ACI guidelines.
- 1.10 Refer to Bluey Technical Notes for recommendations regarding proving grout bond strength and design criteria.

APPLICATION

- 2.1 Always pour concrete or grout at a cooler ambient temperature than the temperature when the sheets were applied to the formwork. This will ensure the membrane is taut on the forms.
- 2.2 Anticipated maximum concrete temperature or accelerated curing temperature should not exceed 60 degrees Centigrade. Contact Bluey to discuss exceptions.
- 2.3 When grouting the sheets onto an existing structure, only grouts approved by Bluey such as BluCem HS200 shall be used, and mixing and placement shall be strictly in accordance with Bluey instructions. Fast set grouts, such as BluCem HE80, are recommended to be used for retrofitting the membrane in short time frames where assets must be returned to service quickly.
- 2.4 When grouting the membrane to floors, plan pours at times of the day where temperature changes before initial set of the grout are minimal. Avoid these pours in direct sunlight.
- 2.5 Concrete mix design, mixing, placement and compaction of concrete should follow standard civil construction practice to minimise voids and ensure full encapsulation of the anchors on the membrane.
- 2.6 Extrusion welding and weld testing at seams will be undertaken by approved applicators and in accordance with installation guidelines provided by the manufacturer and generally in accordance with DVS 2227. This includes proper preparation of the sheet surfaces to be welded and daily destructive seam peel tests sampled from trial welds. Welding technicians shall have formal industry training in extrusion welding techniques.
- 2.7 Non-destructive testing of completed welds will be either by vacuum box or spark testing.
- 2.8 Repairs and patching will be completed by extrusion welding over small defects or applying a minimum 200mm diameter patch over larger defects, with a minimum 80mm edge distance to the defect.
- 2.9 Destructive pull testing of anchors should be avoided.
- 2.10 Encapsulation of anchors can be easily checked by tapping across the surface of the membrane to detect any hollow sounds that indicate voids under the membrane. If voids are detected, they can be filled by injection of BluCem HS200 high flow grout through the lining. Repair by extrusion welding over the injection hole.



BlueSeal AKS

HDPE CONCRETE PROTECTION MEMBRANE

Product Data

Please refer to Important Notice on following page

Length of Knobs (nominal)	12mm
Knobs per m ²	1230
Pull-off Resistance	>700N per knob or 850kPa (short term loading)
Membrane Thickness	2.0mm to 10mm*
Roll Widths	Up to 3.2m
Colours	Black for UV exposed applications and light colours (such as white) for underground or covered structures.

TESTED CHARACTERISTIC	STANDARD	RESULT			
Density	ASTM D 505/D 792	≥ 940kg/m ³			
Carbon Black Content**	ASTM D 1603	2.0 - 3.0%			
Carbon Black Dispersion**	ASTM D 5596	Category 1 or Category 2			
ESCR (NCTL)	ASTM D 5397	>300 hours			
OIT	D 3895	>100 minutes			
Coefficient of Linear Expansion	ASTM E 831	1.1 - 1.4E-4cm/cm/deg C			
Tensile Properties (Sheet Material)	ASTM D 6693-04	Yield Stress 15MPa	Break Stress 27MPa	Yield Elongation 12%	Break Elongation 700%
Shore Hardness	DIN 53505	>50 Shore D			
Tear Resistance	ASTM D 1004	120N/mm			
Puncture Resistance	ASTM D 4833	300N/mm			
Dimensional Stability	ASTM D 1204	<2.0% change			
Water Absorption	ASTM D 570	<0.09%			
Flammability	UL94***	V0			

* Average minimum thickness to ASTM D 5199. Minimum thickness membrane made to order

** Black AKS only

*** Plastics flammability standard released by Underwriters Laboratories of the USA



BluSeal AKS

HDPE CONCRETE PROTECTION MEMBRANE

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IMPORTANT NOTICE

This Technical Data Sheet is provided for general information and instruction only. The properties and characteristics set out herein represent typical testing results under laboratory conditions. Results of actual product characteristics may vary slightly. Site-specific and project-specific conditions may affect product performance, including without limitation: surfaces, environmental conditions, contact conditions, storage conditions, storage timeframes, weather, and climatic or seasonal conditions. Not all product parameters are batch tested as part of the manufacturing quality control process, and performance may vary between batches.

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ProcessMaster electromagnetic flowmeter

The perfect fit for the oil and gas industry



ABB has responded to the oil and gas industry's need for a rugged, reliable electromagnetic flowmeter

Measurement made easy

ProcessMaster flowmeters – perfect for the oil and gas industry

Expertise in measurement technology

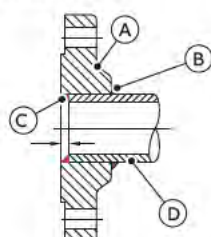
ABB's high pressure electromagnetic flowmeters are reliable, accurate and easily maintained. Customers worldwide have benefited from our application-oriented know-how and comprehensive service.

To learn more about our extensive portfolio, visit www.abb.com/measurement.

Designed specifically for oil and gas

We have added a two-tier, high-pressure version to our comprehensive range of electro-magnetic ProcessMaster flowmeters. It is available with either weld neck or slip-on flanges with RTJ and raised face connections.

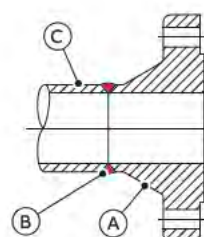
There are differences between X-Ray and dye penetrant test. For weld neck design we offer both dye penetrant and X-Ray tests; for slip-on design we offer only dye penetrant test.



(A) Slip-on flange (B) Fillet weld (outside) (C) Fillet weld (inside) (D) Pipe

Applications

- Slurries such as drilling mud
- Mixtures of fluids such as oil/water plus sand or produced water plus sand
- Injection fluids including sand and chemical additives for lubrication and corrosion prevention
- Sludge or sludge-like wastewater from produced water treatment
- Operating conditions such as high pressure or entrained gas in the fluid
- Harsh environmental conditions such as heat, moisture or vibration and explosive or corrosive atmospheres



(A) Weld neck flange (B) Butt weld (C) Pipe

Robust design for long life

The ProcessMaster flow sensor is designed for reliability in the demanding operating conditions found in oil and gas industry applications.

- Long lasting sensor lining materials withstand abrasion and corrosion, resulting in longer sensor service life and minimal maintenance requirements
- No additional pressure drop caused by protrusions into the pipe
- Optional self-cleaning measuring electrodes prevent issues caused by build-up of deposits
- Double sealed measuring electrodes minimize the risk of leakage and enhance reliability
- Optional all-316 stainless steel construction for corrosive offshore atmosphere
- Optional fully-welded sensor made from 316 material
- Protection of internal sensor components against moisture and vibration with potted Ex sensor

Range of certificates and test reports

- 3.1 material certificates and/or PMI certificates
- Certificates for non-destructive testing, X-Ray and/or dye penetration test
- Welder qualifications and procedures
- Hydrostatic pressure testing

Specification

Accuracy	Standard: 0.4 % of rate Enhanced: 0.2 % of rate
Nominal size range	DN 25 to 400 (1 to 18 in)
Nominal pressure	ASME CL 600 to 2500
Lining	Hard rubber, ETFE
Electrodes	Stainless steel, Hastelloy C
Process connection	Steel, stainless steel
IP rating	IP67, IP68
Fluid temperature	-25 to 130 °C (-13 to 266 °F)
Power supply	100 to 230 V AC, 24 V AC/DC
I/Os	Current, pulse status output
Communication *	HART protocol, PROFIBUS PA, FOUNDATION Fieldbus
Sensor housing material	Stainless steel 316
Transmitter housing material	Stainless steel
Wetted parts material	Option for NACE
Ex approvals	ATEX/IEC Zone 1.2, FM/cFM Cl1 Div.1, Cl1 Div.2
Marine approval	DNV
Verification	ScanMaster

* Acknowledgements

HART is a registered trademark of FieldComm Group, Austin, Texas, USA.

PROFIBUS is a registered trademark of PROFIBUS and PROFINET International (PI).



FEP630 high pressure magnetic flowmeter



FEP610 high pressure magnetic flowmeter

BLACKBOX

Technical Specifications:

Blackbox 130 is a compact low-cost intelligent controller that allows users to locally program the unit and give a readout of level. Economical and simple to program and operate, users benefit from extremely accurate and reliable digital echo processing with access to the dB and dBR range of transducers, measuring from 125 mm (4.9 in) right through to 40 m (131.2 ft).



PHYSICAL: MOUNTING OPTION SPECIFIC

Mounting Option:	Standard Wall Mount:	Large Wall Mount:
Controller Body Dimensions:	130 mm x 150 mm x 63.5 mm (5.1 in x 5.9 in x 2.5 in)	130 mm x 180 mm x 85 mm (5.1 in x 7.09 in x 3.3 in)
Weight:	Nominal 0.7 kg (1.4 lb)	Nominal 0.8 kg (1.7 lb)
Enclosure Material/Description:		ABS Base with polycarbonate lid, flammability rating UL 94 HB
Cable Entry Detail:	Underside fitted with 3 x M20, nylon cable glands suitable for 6 mm to 12 mm (0.2 in to 0.5 in) cable	Underside fitted with 3 x M20, nylon cable glands suitable for 6 mm to 12 mm (0.2 in to 0.5 in) cable
Transducer Cable Extensions:	2-core screened (2 conductor 20 AWG screened)	
Nominal Separation:	1,000 m (3,280 ft), for greater separation distances please contact us	

ENVIRONMENTAL

IP Rating:	IP66/67
Max. & Min. Temperature (Electronics):	-20 °C to +55 °C (-4 °F to +131 °F)
Flammable Atmosphere Approval:	All Blackbox units must be mounted in a safe area. Compatible with approved dB Transducers
CE Approval:	See EU Declaration of Conformity in the manual
UL Approval:	UL Listed. UL Listed to Canadian Safety Standards. Certificate Number E257330.

PERFORMANCE

Accuracy/Repeatability:	0.25% of the measured range or 6 mm (0.2 in), <i>whichever is greater</i>
Resolution:	dBMAH3 0.3 mm (0.01 in), dB3 0.5 mm (0.02 in), dB6 and dB10 1 mm (0.04 in), dB15 1.5 mm (0.06 in), dB25 2.5 mm (0.1 in), and dB40 5 mm (0.2 in).
Min. & Max. Range:	Dependent on Transducer. Nominally 125 mm to 40 m (4.9 in to 130 ft)
Echo Processing:	DATM (Digital Adaptive Tracking of Echo Movement)
Rate Response:	Fully Adjustable

OUTPUTS

Analog Output:	Isolated output of 4-20mA or 0-20mA into 1 kΩ (user programmable and adjustable) 0.1% resolution
Digital Output:	RS232 for programming and data extraction
Volt Free Contacts, Number, & Rating:	2 form "C" (SPDT) rated at 2 A at 240 V AC
Display:	2 x 12 alpha numeric

PROGRAMMING

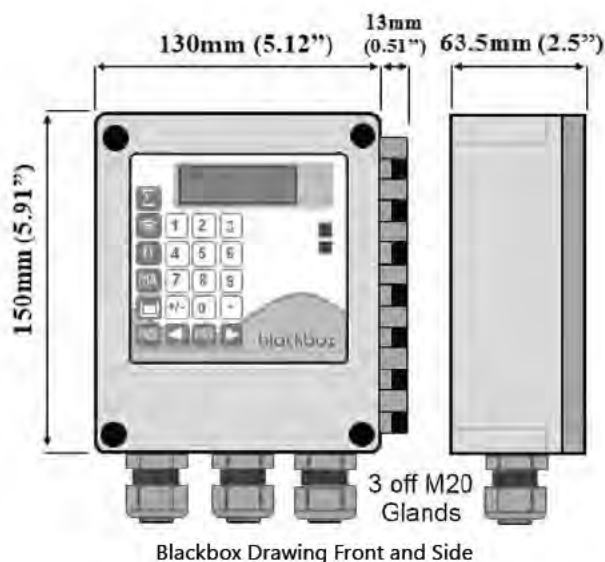
On-board Programming:	Via RS232 using supplied software
PC Programming:	Via RS232 using supplied software
Programming Security:	Via Passcode (user selectable and adjustable)
Programmed Data Integrity:	Via non-volatile RAM
Remote Programming:	Via RS232 using optional handheld calibrator

SUPPLY

Power Supply:	115 V AC +5% / -10% 50/60 Hz, 230 V AC +5% / -10% 50/60 Hz, 10-28 V DC, 10 W maximum power (typically 5 W)
Fuses:	50mA at 230 V AC, 100mA at 115 V AC

REMOTE COMMUNICATIONS

Power Supply:	Power supplied via Blackbox RS232 interface
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Rev 4.0

dB ULTRASONIC TRANSDUCERS

Technical Specifications:

The dB Transducer Series is a range of non-contacting ultrasonic transducers for level, volume, and flow measurement. Available in a variety of models and compatible with all Pulsar controllers so that you have a specific solution to suit your application requirements.



PHYSICAL: TRANSDUCER SPECIFIC

Model:	Dimensions:	Dia Face:	Weight:	Measurement Range:	Frequency:	Beam Angle:
dB3	78 (D) mm x 115 (H) mm (3.1 in x 4.5 in)	19 mm (0.7 in)	1.1 kg (2.4 lb)	125 mm to 3 m (4.9 in to 9.8 ft)	125kHz	<10°
dB6	86 (D) mm x 106 (H) mm (3.4 in x 4.2 in)	30 mm (1.2 in)	1.1 kg (2.4 lb)	300 mm to 6 m (11.8 in to 19.7 ft)	75kHz	<10°
dB56	86 (D) mm x 106 (H) mm (3.4 in x 4.2 in)	45 mm (1.8 in)	1.1 kg (2.4 lb)	200 mm to 6 m (7.9 in to 19.7 ft)	50kHz	<10°
dB10	86 (D) mm x 106 (H) mm (3.4 in x 4.2 in)	45 mm (1.8 in)	1.1 kg (2.4 lb)	300 mm to 10 m (11.8 in to 32.8 ft)	50kHz	<10°
dB15	86 (D) mm x 122 (H) mm (3.4 in x 4.8 in)	60 mm (2.4 in)	1.2 kg (2.6 lb)	500 mm to 15 m (19.7 in to 49.2 ft)	41kHz	<8°
dB25	105 (D) mm x 142 (H) mm (4.1 in x 5.6 in)	78 mm (3.1 in)	1.4 kg (3.1 lb)	600 mm to 25 m (23.6 in to 82 ft)	30kHz	<6°
dB40	205 (D) mm x 223 (H) mm (8.1 in x 8.8 in)	160 mm (6.3 in)	6 kg (13.2 lb)	1.2 m to 40 m (3.9 ft to 131.2 ft)	20kHz	<5°

PHYSICAL: ALL TRANSDUCERS

Sensor Body Material:	Valox 357 U and syntactic foam face
Cable Lengths:	Standard = 5 m, 10 m, 20 m, or 30 m (16.4 ft, 32.8 ft, 65.6 ft, or 98.4 ft). Optional: up to 150 m (492 ft) maximum (increments of 10 m (32.8 ft) only)
Maximum Separation:	500 m (1,640 ft)
Mounting Connection:	BSP or 1" NPT

ENVIRONMENTAL

Enclosure Protection:	IP68 / NEMA 6P
Max. And Min. Temperature (Electronics):	Standard: -40° C to +90° C (-40° F to +194° F) Hazardous area versions: -40° C to +75° C (-40° F to +167° F)

APPROVALS

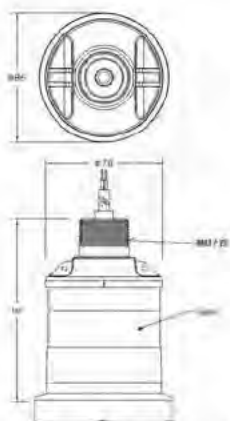
CE Approval:	2014/30/EU to EMC & 2014/34/EU ATEX Directives. Standards applied: EN 60079-0:2012+A11:2013/ EN 60079-11:2012 / EN 60079-18:2009 / EN 60079-26:2007 / EN 61326-1:2013
ATEX Approval:	Standard ATEX EEx m II T6 or optional EEx ia IIC T6. FM/FMC approval.

TRANSDUCER OPTIONS

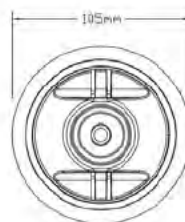
Model:	dB3	dBs6	dB6	dB10	dB15	dB25	dB40
PVDF		✓	✓	✓			
Front Threaded / PVDF	✓	✓	✓	✓			
Submergence Shield	✓	✓	✓	✓	✓	✓	
Flanged DIN/ANSI		✓	✓	✓	✓		
Foam Face		✓		✓	✓	✓	✓
Sanitary Flange		✓	✓	✓			
Intrinsically Safe of All the Above	✓	✓	✓	✓	✓	✓	✓

PERFORMANCE

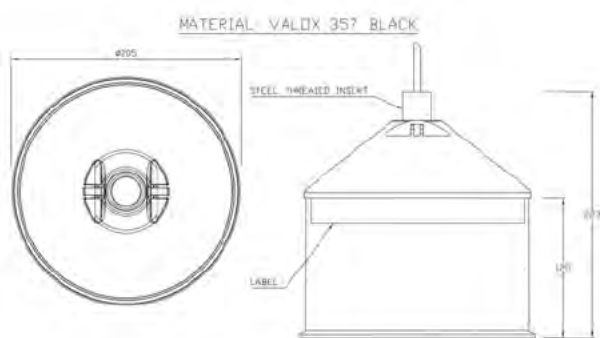
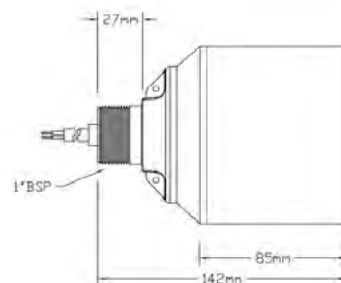
Accuracy:	0.25% or 6 mm (0.2 in) whichever is greater
Resolution:	0.01% or 2 mm (0.08 in) whichever is greater
Temp. Compensation:	Automatic, internal temperature sensor, ± 0.5 °C/°F



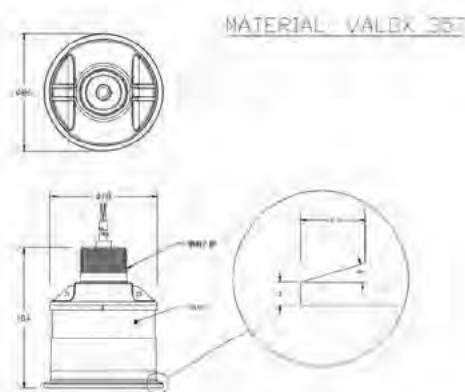
dB15 Transducer Drawing



dB25 Transducer Drawing



dB40 Transducer Drawing



dB6 & dB10 Transducer Drawing



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Rev 7.0

Technical Specification

891480 17.0



ENM 10

Level switch

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1.3	Cables.....	3
1.4	Approvals and standards.....	3
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1 Product Description

1.1 Product design

Usage

ENM-10 is a level regulator for level control applications. The level regulator starts and stops a pump or activates an alarm device when the liquid level reaches the regulator.

Materials

Denomination	Standard version	Ex version
Regulator casing	Polypropylene	Polypropylene with black conductive casing
Bend relief	EPDM rubber	NBR-PVC rubber
Cable sheath	PVC	NBR-PVC rubber

The plastic components are welded and screwed together.

1.2 Technical data

Application limits

Feature	Value
Liquid temperature	Minimum 0°C (32°F) Maximum 60°C (140°F)
Liquid density	Minimum 0.65 g/cm ³ Maximum 1.5 g/cm ³

Electrical specifications

Feature	Value
Degree of protection	IP68, 20 m (65 ft), 2 bars
Interrupting capacity of micro switch	AC, resistive load, 250 V 10 A AC, inductive load, 250 V 3 A $\cos \phi = 0.5$ DC, 30 V 5 A
Interrupting capacity of gold-plated micro switch	AC, resistive load, 250 V 10 A AC, inductive load, 250 V 3 A $\cos \phi = 0.5$ DC, 24 V 10 mA

Voltage limits are subject to local regulations.

Density ranges

Density g/cm ³	Regulator length mm (in.)	Diameter mm (in.)
0.65 – 0.80	194 (7 10/16)	100 (4)
0.80 – 0.95	177 (7)	100 (4)
0.95 – 1.10	162 (6 3/8)	100 (4)
1.05 – 1.20	142 (5 9/16)	100 (4)
1.20 – 1.30	133 (5 1/4)	100 (4)
1.30 – 1.40	130 (5 2/16)	100 (4)

Density g/cm ³	Regulator length mm (in.)	Diameter mm (in.)
1.40 - 1.50	126 (5)	100 (4)

Weight

A regulator with standard density and 20 m cable weighs approximately 2 kg (4.5 lb).

1.3 Cables

Lengths

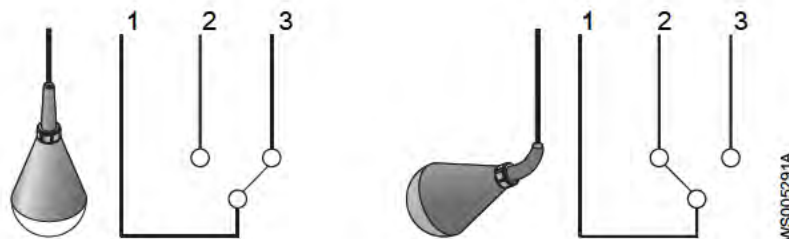
For liquids with specific density between 0.95 and 1.10 g/cm³, the following cables are available:

Version	Lengths m (ft)
Standard	• 6 m (20 ft) • 13 m (42 ft) • 20 m (65 ft) • 30 m (100 ft) • 50 m (167 ft)
Ex	• 6 m (20 ft) • 13 m (42 ft) • 20 m (65 ft) • 30 m (98 ft) • 50 m (164 ft)

Diameter

The cable diameter for all product variants is 6.7 mm (0.26 in), +/- 0.2 mm (0.00787 in).

Color codes



Cable	1	2	3
Color	Grey	Black	Brown

1.4 Approvals and standards

Standard approvals

LVD approval according to EN61058
 CSA approval: Certificate Number 1330172
 Cl. I Zone 0, Gr. IIC
 CL.I Div.1 Gr A, B, C and D
 Cl.II Gr. E, F, and G

Ex approvals

IECEX ia IIC T4 Ga: -20°C ≤ Ta ≤ 60°C
 IECEX NEMKO 09.0008
 ATEX II 1G Ex ia IIC T4 Ga

NEMKO 10 ATEX 1082

Applied standards for ATEX and IEC

- EN 60079-0:2012 / IEC 60079-0:2011
- EN 60079-11:2012 / IEC 60079-11:2011

Intrinsically safe circuits are required for the automatic control system. Use a Zener barrier, for example, part number 84 01 07.

The electrical connections must comply with the Ex regulations of the national submitter.



2 References

2.1 Chemical resistance tables

The tables show the degree of resistance the level regulator has to different chemicals at two different temperatures. The density of the liquid determines the buoyancy of the regulator.

Acids

Acid	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Acetic acid 50%	1	2	0	0
Acetic acid 75%	2	2	0	0
Benzoic acid	2	2	0	0
Boric acid 5%	0	–	0	0
Butyric acid	2	2	2	2
Chromic acid 10%	0	2	2	2
Citric acid	0	1	0	0
Hydrobromic acid 5%	1	2	0	0
Hydrochloric acid 10%	0	1	0	1
Hydrochloric acid 37%	1	2	0	2
Hydrocyanic acid 10%	0	0	1	2
Hydrofluoric acid 5%	0	2	0	1
Hypochloric acid	1	2	2	2
Maleic acid	2	2	2	2
Nitric acid 5%	1	1	1	1
Nitric acid 65%	2	2	2	2
Oleic acid	1	2	2	2
Oxalic acid 50%	1	1	1	2
Phosphoric acid 25%	0	0	1	2
Phosphoric acid 85%	0	0	1	2
Sulphuric acid 10%	1	2	1	2
Sulphuric acid 78%	2	2	2	2
Tannic acid	0	0	0	0
Tartaric acid	1	1	1	1

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Alkalis

Alkali	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Ammonium hydroxide	0	–	0	0
Calcium hydroxide	0	0	0	0

Alkali	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Potassium hydroxide	1	2	0	0
Sodium hydroxide	1	2	0	0

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Salts

Salt	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Aluminum chloride	0	0	0	0
Calcium sulphate	0	0	0	0
Calcium chloride	0	0	0	0
Calcium nitrate	0	0	0	0
Copper chloride	0	0	0	0
Copper sulphate	0	0	0	0
Ferric chloride	0	0	0	0
Ferrous sulphate	0	0	0	0
Magnesium chloride	0	0	0	0
Potassium sulphate	0	0	0	0
Potassium nitrate	0	0	0	0
Potassium carbonate	1	1	1	1
Potassium bicarbonate	0	0	0	0
Sodium sulphate	0	0	0	0
Sodium chloride	0	0	0	0
Sodium nitrate	0	0	0	0
Sodium bicarbonate	0	0	0	0
Sodium carbonate	0	0	0	0
Tin chloride	1	1	1	1
Zinc sulphate	0	0	0	0
Zinc chloride	0	0	0	0

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Oils

Oil	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Castor oil	1	1	1	1
Coconut oil	0	–	0	2
Corn oil	2	2	2	2
Diesel oil	2	2	2	2
Linseed oil	2	2	2	2
Mineral oils	2	2	2	2
Olive oil	1	1	1	1
Silicone oils	0	0	0	0

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Solvents and miscellaneous

Chemical	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Acetone	2	2	2	2
Aniline	2	2	1	2
Benzene	2	2	2	2
Butyl alcohol	2	2	0	1
Carbon tetrachloride	2	2	2	2
Chlorobenzene	2	2	2	2
Chloroform	2	2	2	2
Ethyl alcohol	2	2	0	1
Ethyl ether	2	2	2	2
Ethyl acetate	2	2	2	2
Ethylene dichloride	2	2	2	2
Ethylene chloride	2	2	2	2
Formaldehyde 37%	1	2	0	0
Gasoline	2	2	2	2
Kerosene	2	2	2	2
Methyl alcohol	2	2	0	0
Methyl ethyl ketone	2	2	2	2
Methylene chloride	2	2	2	2
Nitrobenzene	2	2	2	2
Phenol	2	2	2	2
Toluene	2	2	2	2
Trichlorethylene	2	2	2	2
Turpentine	2	2	2	2
Xylene	2	2	2	2

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

Gases

Gas	PVC cable		NBR/PVC cable	
	20°C (68°F)	60°C (140°F)	20°C (68°F)	60°C (140°F)
Carbon dioxide	0	0	0	0
Carbon monoxide	0	0	0	0
Chlorine - wet	2	2	2	2
Hydrogen sulfide	0	0	1	1
Sulphur dioxide - wet	1	1	2	2

0 = No effect. 1 = Minor to moderate effect. 2 = Severe effect. – = No available information.

2.2 Product range

Version	For density (g/cm ³)	Color of level switch	Length of cable (m)	Type of cable ¹	Approvals	For market
582 88 00	0.65–0.80	Blue	20	1	CE	International
582 88 01	0.80–0.95	Blue	20	1	CE	International
582 88 02	0.95–1.10	Blue	6	1	CE	International
582 88 03	0.95–1.10	Blue	13	1	CE	International
582 88 04	0.95–1.10	Blue	20	1	CE	International
582 88 05	1.05–1.20	Blue	20	1	CE	International
582 88 06	1.20–1.30	Blue	20	1	CE	International
582 88 07	1.30–1.40	Blue	20	1	CE	International
582 88 08	1.40–1.50	Blue	20	1	CE	International
582 88 09	0.65–0.80	Gray	20	3	CSA/CE	Canada
582 88 10	0.80–0.95	Gray	20	3	CSA/CE	Canada
582 88 11	0.95–1.10	Gray	6	3	CSA/CE	Canada
582 88 12	0.95–1.10	Gray	13	3	CSA/CE	Canada
582 88 13	0.95–1.10	Gray	20	3	CSA/CE	Canada
582 88 14	1.05–1.20	Gray	20	3	CSA/CE	Canada
582 88 15	1.20–1.30	Gray	20	3	CSA/CE	Canada
582 88 16	1.30–1.40	Gray	20	3	CSA/CE	Canada
582 88 17	1.40–1.50	Gray	20	3	CSA/CE	Canada
582 88 18	0.65–0.80	Gray	20	1	CSA/CE	Canada
582 88 19	0.80–0.95	Gray	20	1	CSA/CE	Canada
582 88 20	0.95–1.10	Gray	6	1	CSA/CE	Canada
582 88 21	0.95–1.10	Gray	13	1	CSA/CE	Canada
582 88 22	0.95–1.10	Gray	20	1	CSA/CE	Canada
582 88 23	1.05–1.20	Gray	20	1	CSA/CE	Canada
582 88 24	1.20–1.30	Gray	20	1	CSA/CE	Canada
582 88 25	1.30–1.40	Gray	20	1	CSA/CE	Canada
582 88 26	1.40–1.50	Gray	20	1	CSA/CE	Canada
582 88 36	0.95–1.10	Gray	30	3	CSA/CE	Canada
582 88 37	0.95–1.10	Gray	50	3	CSA/CE	Canada
582 88 38	0.95–1.10	Gray	100	3	CSA/CE	Canada
582 88 39	0.95–1.10	Gray	150	3	CSA/CE	Canada
582 88 51	0.95–1.10	Red	65	2	CE	International
582 88 52	0.95–1.10	Red	6	2	CE	International
582 88 53	0.95–1.10	Red	13	2	CE	International
582 88 54	0.95–1.10	Red	20	2	CE	International
582 88 57	0.95–1.10	Red	20	2	CE	Canada
582 88 70	0.65–0.80	Blue	20	3	CE	International
582 88 71	0.80–0.95	Blue	20	3	CE	International
582 88 72	0.95–1.10	Blue	6	3	CE	International
582 88 73	0.95–1.10	Blue	13	3	CE	International

¹ See *Type of cables* on page 9.

Version	For density (g/cm ³)	Color of level switch	Length of cable (m)	Type of cable ¹	Approvals	For market
582 88 74	0.95–1.10	Blue	20	3	CE	International
582 88 75	1.05–1.20	Blue	20	3	CE	International
582 88 76	1.20–1.30	Blue	20	3	CE	International
582 88 77	1.30–1.40	Blue	20	3	CE	International
582 88 78	1.40–1.50	Blue	20	3	CE	International
582 88 79	0.95–1.10	Blue	65	1	CE	International
582 88 80	0.95–1.10	Blue	30	1	CE	International
582 88 81	0.95–1.10	Blue	50	1	CE	International
582 88 82	0.95–1.10	Gray	30	1	CSA/CE	Canada
582 88 83	0.95–1.10	Gray	50	1	CSA/CE	Canada
582 88 86	0.95–1.10	Red	30	2	CE	International
582 88 87	0.95–1.10	Red	50	2	CE	International
582 88 90	0.95–1.10	Blue	30	3	CE	International
582 88 91	0.95–1.10	Blue	50	3	CE	International
582 88 92	0.95–1.10	Red	6	2	CE	Japan
582 88 93	0.95–1.10	Red	13	2	CE	Japan
582 88 94	0.95–1.10	Red	20	2	CE	Japan
582 88 95	0.95–1.10	Blue	6	1	CE	Japan
582 88 96	0.95–1.10	Blue	13	1	CE	Japan
582 88 98	0.95–1.10	Blue	50	1	CE	Japan
594 79 10	0.95–1.10	Blue	70	3	CE	International
594 79 13	0.95–1.10	Blue	100	3	CE	International
594 79 18	0.95–1.10	Blue	150	3	CE	International
594 79 19 ²	0.95–1.10	Blue	20	3	CE	International
594 79 20 ²	0.95–1.10	Gray	20	3	CSA/CE	International
594 79 21 ²	0.95–1.10	Transparent	6	3	CE	For demonstration only.
594 79 40 ²	0.95–1.10	Black	6	3	ATEX/IECEX ³	International
594 79 41 ²	0.95–1.10	Black	13	3	ATEX/IECEX ³	International
594 79 42 ²	0.95–1.10	Black	20	3	ATEX/IECEX ³	International
594 79 49 ²	0.95–1.10	Black	30	3	ATEX/IECEX ³	International
594 79 50 ²	0.95–1.10	Black	50	3	ATEX/IECEX ³	International

Type of cables

Type of cable	Jacket	Color coding of wires
1	Blue polyvinyl chloride (PVC)	Grey/Brown/Black
2	Red PVC	Grey/Brown/Black
3	Black nitrile rubber (NBR)/PVC	Grey/Brown/Black

¹ See *Type of cables* on page 9.

² Designed for low current, slow movements and oil. Includes micro switch with gold plated contacts.

³ Zener barrier 84 01 07 required.

Xylem |'zīləm|

- 1) The tissue in plants that brings water upward from the roots;
- 2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

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