Site Suitability for Onsite Stormwater Disposal Report

Ref: 29909
Revision A – October 2021

Prepared for:

Boulcott Farms Heritage Golf Club

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Ref: Rawat/29909 15 October 2021

PRELIMINARY INVESTIGATIONS RELATING TO POSSIBLE DEVELOPMENT OF LAND AT BOULCOTT FARM HERITAGE GOLF CLUB

Following the engagement of our services for further investigating and reporting on stormwater disposal at the above site, we have carried out three further percolation tests on site. We detail our findings and report below.

1. PREAMBLE

The Boulcott Heritage Golf Club are considering undertaking a plan change and converting some of their land from general recreation to residential. This land will then be sold for development by others.

A preliminary investigation was undertaken in August 2020 looking at disposal options for the proposed land to be developed. Three excavations were dug, spread across the site, to establish if free draining material, required for consideration of on-site disposal, was available. Free drainage material was found at each of the excavations – or varying grade and at varying depths. Preliminary soakage tests were also undertaken at the time and documented with findings in the September 2020 Site Suitability for Onsite Stormwater Disposal Report produced by Cuttriss.

These preliminary investigations and findings established that on-site disposal could be utilised across the site, but testing was limited by restricted testing water resulting in results based only on the soakage at the base of the excavation and not the sides. Further testing has been undertaken as an addendum to the established soakage rates attainable given soakage available across the full extent of the excavation/ future soak pits – sides and base.

2. DOCUMENTS

Refer to the test record sheets, photos and calculations in the appendices. Soakage rates have been interpolated from the results of the soakage tests undertaken.

3. LOCATION

The Boulcott Farms Heritage Golf Club main entrance is accessed from the northern end of Military Road.

The area being considered for development is currently lawn and fairway located in the south-eastern corner of the golf course. The site being considered for development is bordered by existing residential development (St James Avenue) along one boundary and large trees along the other.

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4. TOPOGRAPHY

The topography of the site generally consists of fairly flat to rolling grassed land.

As noted in the 2020 report, observations on site (following and during rainfall) and information from the golf club groundskeepers indicate that there is generally no ponding of stormwater within the site.

Stormwater control for the fairway and lawns areas is currently achieved by shaping and simple shallow soak pit arrangements.

5. TESTING

The additional investigations comprised three new percolation tests being undertaken, in the areas indicated in Image 1 below and in Appendix A. These tests were taken to have a further understanding of suitability for the possible future development to utilise on-site soakage as its primary method of stormwater control.

Image 1 – Approximate test pit locations

The test pits were dug by the golf club groundskeepers at various sizes. The test pits were to depths between 1.4m to 2.0m deep depending at what depth free draining material was observed.

A total of 10,000 litres of water was emptied into each excavation. Water was discharged into the test holes as quickly as possible by pressure pumping. *Under the 2020 testing only 1,000 litres of water were used at each at the testing location.*

The testing methodology noted in Section 7* and adopted is commonly utilised and approved by the Wellington Water Land Development team.

6. FACTOR OF SAFETY

Although not a requirement of the compliance document for the New Zealand Building Code (E1 Surface Water) it is recommended that the design soakage rates have an appropriate factor of safety applied to the raw soakage rates recorded.

A factor of safety of 0.5 is commonly applied to Upper Hutt City Council and Hutt City calculations, as being an acceptable factor of safety for soak pit designs in the Hutt Valley.

7. SOAKAGE RESULTS

The results from the testing undertaken are summarised in Table 1 below, with full calculations included in Appendix A.

Test Pit #	*Dimensions*	*Depth*	*Material found*	*Max water level during filling*	*Raw Soakage Rate*	*Design Soakage Rate (inc. 0.5 safety factor)*
1	2.3m L x 1.0m W	1.90m	Topsoil with fine gravels and rocks/stones	1.71m	1,383 mm/hr	692 mm/hr
2	2.2m L x 1.0m W	1.57m	Topsoil with fine gravels and rocks/stones	1.51m	2,925 mm/hr	1,462 mm/hr
3	2.2m L x 1.0m W	1.38m	Topsoil with fine gravels and rocks/stones	0.51m	11,411 mm/hr	5,705 mm/hr

Table 1 – Soakage testing results

**The methodology we commonly utilise for calculating the soakage rates, starts measuring soakage once the excavation has been filled / part filled. We are then able to record the rate the volume of water soaks into the ground through both the base of the excavation and the sides. In cases of high soakage rates, most of the water only absorbs into the base of the excavations.*

The earlier 2020 investigations and testing concluded a probable soakage rate of 1,050 mm/hr. This rate had been interpolated based on the testing undertaken at that time being only of the base. Calculations were undertaken based primarily on filling time. It was noted that it was expected that higher soakage rates would likely be established if a larger quantity of water was used in the testing.

These further tests undertaken, with a much larger quantity of testing water, have resulted in establishing that higher soakage rates are available within the site at the testing locations.

This additional testing and calculations undertaken have further confirmed that typical low impact urban designs (e.g. soak pits or soak trenches) are suitable for this site.

8. EXAMPLE SOAK PIT DESIGN

As with the previous (2020) investigations and report, at this stage there has only been some preliminary work around possible development layout and lot sizing. Depending on the type of development approved and undertaken, it is expected that Lot sizes could range from 160m² to 410m².

Further high-level calculations have been undertaken, utilising the most recently established soakage rate, looking at three lot size scenarios and resulting soak pit designs. These calculations have been undertaken to confirm that a soak pit design, based on the limited lot design we currently have available, would be able to fit within a possible lot layout, while meeting Wellington Water Soak Pit Clearances from Structures requirements

The results are summarised in Table 2 below, with full calculations included in Appendix B. These calculations have been undertaken using the lowest permeability rate established under the most recent testing for the site – 1,383 mm/hr (raw soakage rate).

Lot Size	Impermeable Area m^2	Soak Pit Dimensions (m) - w x l x d
410 m²	164 m² roof + 100 m² drive/courtyard	1.70 x 3.00 x 1.46
200 m²	100 m² roof + 60 m² drive/courtyard	1.50 x 2.00 x 1.49
160 m²	78 m² roof + 35 m² drive/courtyard	1.20 x 2.0 x 1.02

Table 2 – Indicative soak pit sizes

9. LOCATION OF FUTURE SOAKPITS

The proposed future soakpit locations will need to meet the Wellington Water (WWL) Soak Pit Clearances from Structures requirements –

- Proximity to existing and proposed boundaries - min 1.5m required- RSWS*
- Proximity to proposed dwellings - min 2m required – RSWS*
- Proximity to proposed public wastewater network - min 1m required – RSWS*

**Regional Standard for Water Services, Table 4.7 – Clearance Distances Between Soak Pits and Structures.*

Looking at the 160m² scenario considered in example soak pit design, there should be room to fit the proposed soak pit designed and achieve the required clearances from boundaries and buildings as indicated below in Image 2.

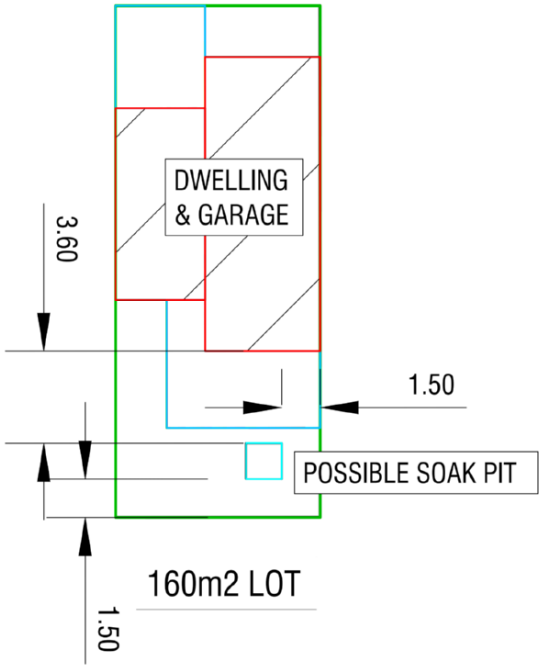

Image 2 – Indicative 160m² lot layout

While the larger lot sizes investigated require larger soakage pits, there larger overall size of these lots indicates that soakage could be utilised meeting required clearances.

10. CONCLUSION

This additional testing has been undertaken as an addendum to the original testing to further confirm the suitability of on-site stormwater disposal and to provide results of soakage rates observed during the testing process, utilising larger quantities of testing water.

The testing confirmed that typical low impact urban designs (e.g. soak pits) would be suitable for this site.

Further detailed testing would need to be undertaken as part of the land development investigation, design and construction works. Testing and calculations will need to consider lot and dwelling placement and size etc. These inspections should be carried out by a suitably qualified engineer.

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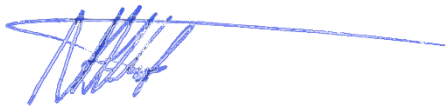

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APPENDIX A

Soakage Test Results and Photos

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Job No. 29909 **Boulcott Farm**

Test Pit One

Test carried out Thursday 30th September 2021

Weather: Fine

Size of Pit excavation

Width	1.0	m	
Length	2.3	m	
Depth	1.9	m	Test hole with topsoil & fine gravels
Volume	**4.37**	m3	

Water supply

Tank Size & Water	10,000	l
Filling rate supplied by tanker being pumped into hole	1111.1	l/min

Above: View of excavated pit at test location 1

Above: View of excavated pit at test location 1 with material removed from ground shown

Above: View of soakage testing at test location 1

Above: View of excavated pit at test location 1 at completion

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CLIENT BOULCOTT FARM HERITAGE GOLF CLUB
JOB NO. 29909
DATE 30/09/2021
SHEET 1 OF 9 SHEETS

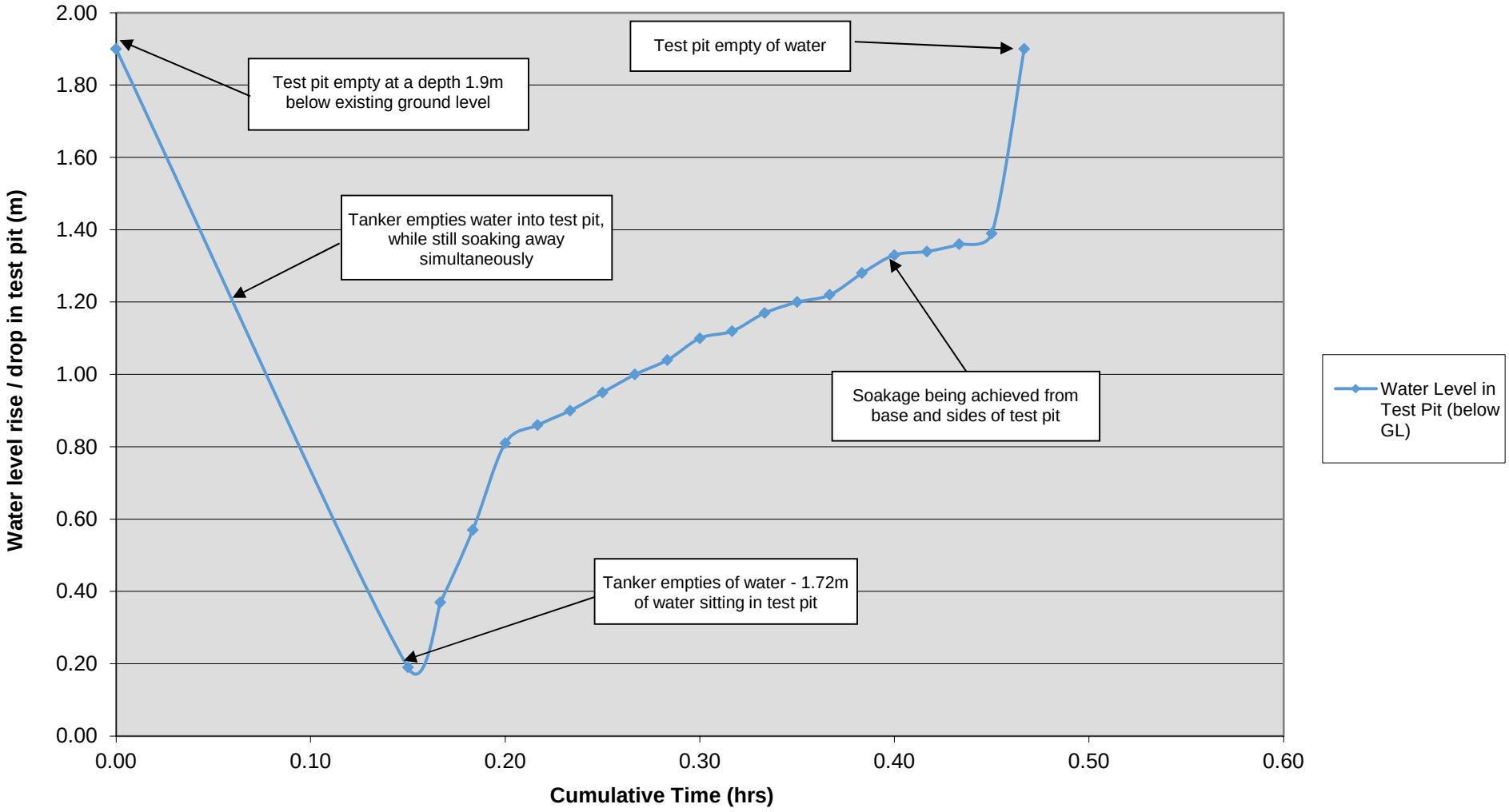
LOT DP
SITE ADD 33 MILITARY ROAD
LOCALITY LOWER HUTT
FIELDWORK DR

LOCATION 1
DEPTH OF EXCAVATED TEST PIT 1.90m
BASE AREA OF PIT 1.0m (wide) x 2.3m (long)

Time	Time Difference	Cumulative Time	Water Level in Test Pit (below GL)	Cumulative Fall in Test Pit	Time	Time Difference	Cumulative Time	Water Level in Test Pit (below GL)	Cumulative Fall in Test Pit
[hh:mm:ss]	[min]	[hrs]	[m]	[m]	[hh:mm:ss]	[min]	[hrs]	[mm]	[mm]
8:56:00	0	0.00	1.90						
9:05:00	9	0.15	0.19						
9:06:00	1	0.17	0.37						
9:07:00	1	0.18	0.57						
9:08:00	1	0.20	0.81						
9:09:00	1	0.22	0.86						
9:10:00	1	0.23	0.90						
9:11:00	1	0.25	0.95						
9:12:00	1	0.27	1.00						
9:13:00	1	0.28	1.04						
9:14:00	1	0.30	1.10						
9:15:00	1	0.32	1.12						
9:16:00	1	0.33	1.17						
9:17:00	1	0.35	1.20						
9:18:00	1	0.37	1.22						
9:19:00	1	0.38	1.28						
9:20:00	1	0.40	1.33						
9:21:00	1	0.42	1.34						
9:22:00	1	0.43	1.36						
9:23:00	1	0.45	1.39						
9:24:00	1	0.47	1.90						

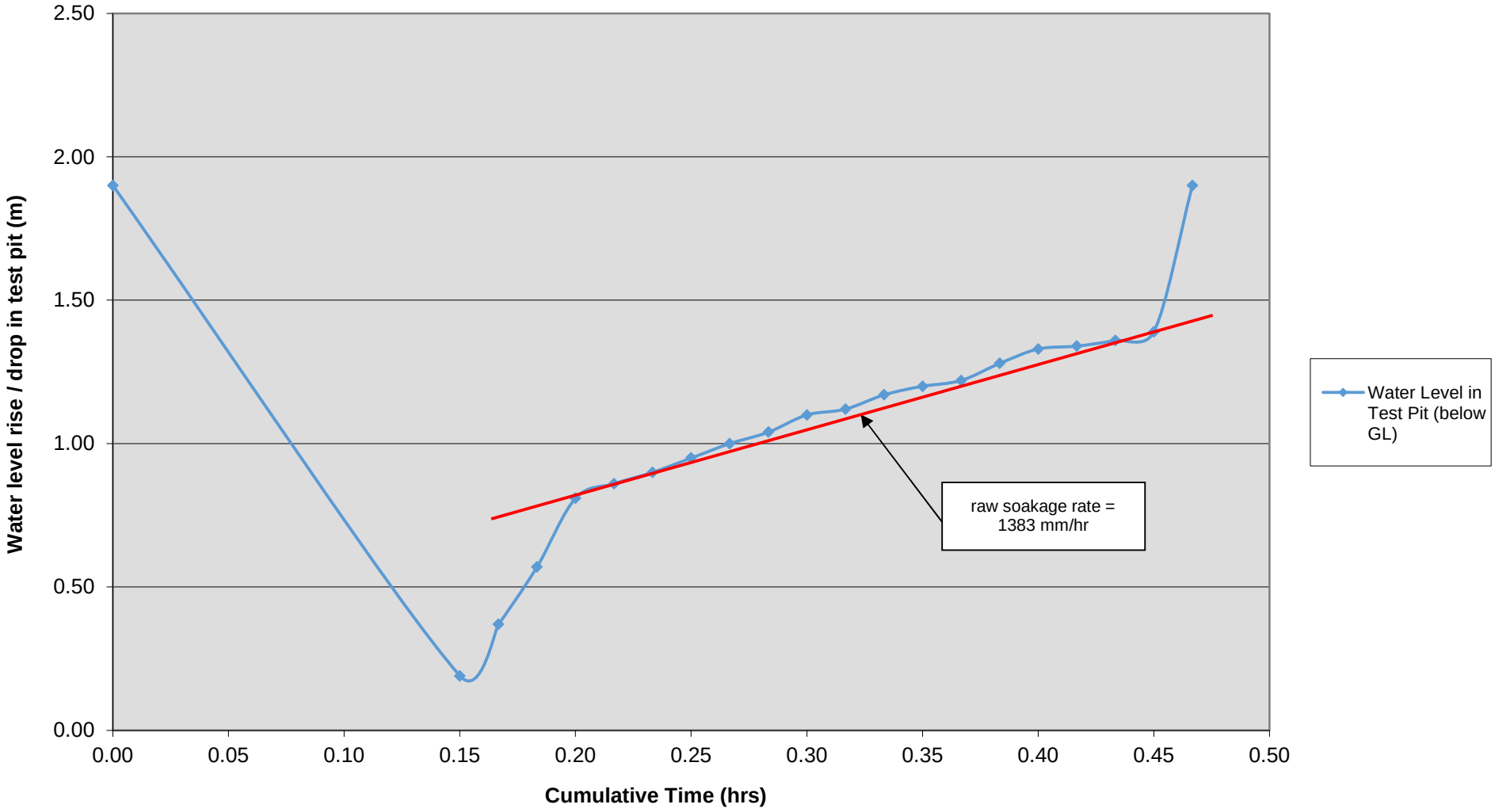
Plot of water level (m) vs time (hrs) - Location 1 - 30 September 2021

(0.0m = existing ground level)



Plot of water level (m) vs time (hrs) - Location 1 - 30 September 2021

(0.0m = existing ground level)



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Test Pit Two

Test carried out Thursday 30th September 2021

Weather: Fine

Size of Pit excavation

Width	1.0	m	
Length	2.2	m	
Depth	1.57	m	Test hole with topsoil, rocks & fine gravels
Volume	**3.45**	m3	

Water supply

Tank Size & Water	10,000	l
Filling rate supplied by tanker being pumped into hole	1428.6	l/min

Above: View of excavated pit at test location 2

Above: View of excavated pit at test location 2 with material removed from ground shown

Above: View of soakage testing at test location 2

Above: View of excavated pit at test location 2 at completion

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JOB NO. 29909
DATE 30/09/2021
SHEET 4 OF 9 SHEETS

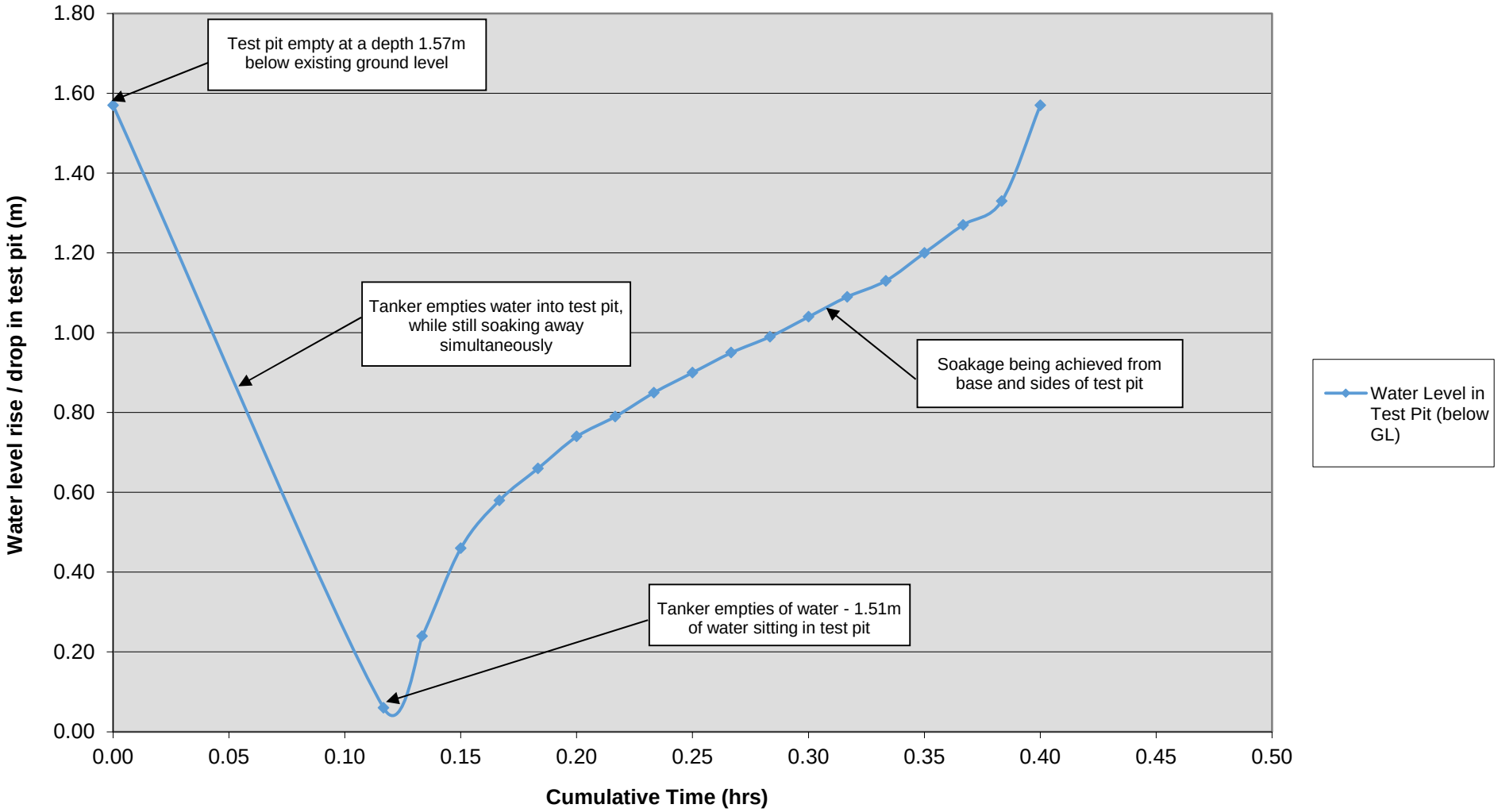
LOT DP
SITE ADD 33 MILITARY ROAD
LOCALITY LOWER HUTT
FIELDWORK DR

LOCATION 2
DEPTH OF EXCAVATED TEST PIT 1.57m
BASE AREA OF PIT 1.0m (wide) x 2.2m (long)

Time	Time Difference	Cumulative Time	Water Level in Test Pit (below GL)	Cumulative Fall in Test Pit	Time	Time Difference	Cumulative Time	Water Level in Test Pit (below GL)	Cumulative Fall in Test Pit
[hh:mm:ss]	[min]	[hrs]	[m]	[m]	[hh:mm:ss]	[min]	[hrs]	[mm]	[mm]
10:25:00	0	0.00	1.57						
10:32:00	7	0.12	0.06						
10:33:00	1	0.13	0.24						
10:34:00	1	0.15	0.46						
10:35:00	1	0.17	0.58						
10:36:00	1	0.18	0.66						
10:37:00	1	0.20	0.74						
10:38:00	1	0.22	0.79						
10:39:00	1	0.23	0.85						
10:40:00	1	0.25	0.90						
10:41:00	1	0.27	0.95						
10:42:00	1	0.28	0.99						
10:43:00	1	0.30	1.04						
10:44:00	1	0.32	1.09						
10:45:00	1	0.33	1.13						
10:46:00	1	0.35	1.20						
10:47:00	1	0.37	1.27						
10:48:00	1	0.38	1.33						
10:49:00	1	0.40	1.57						

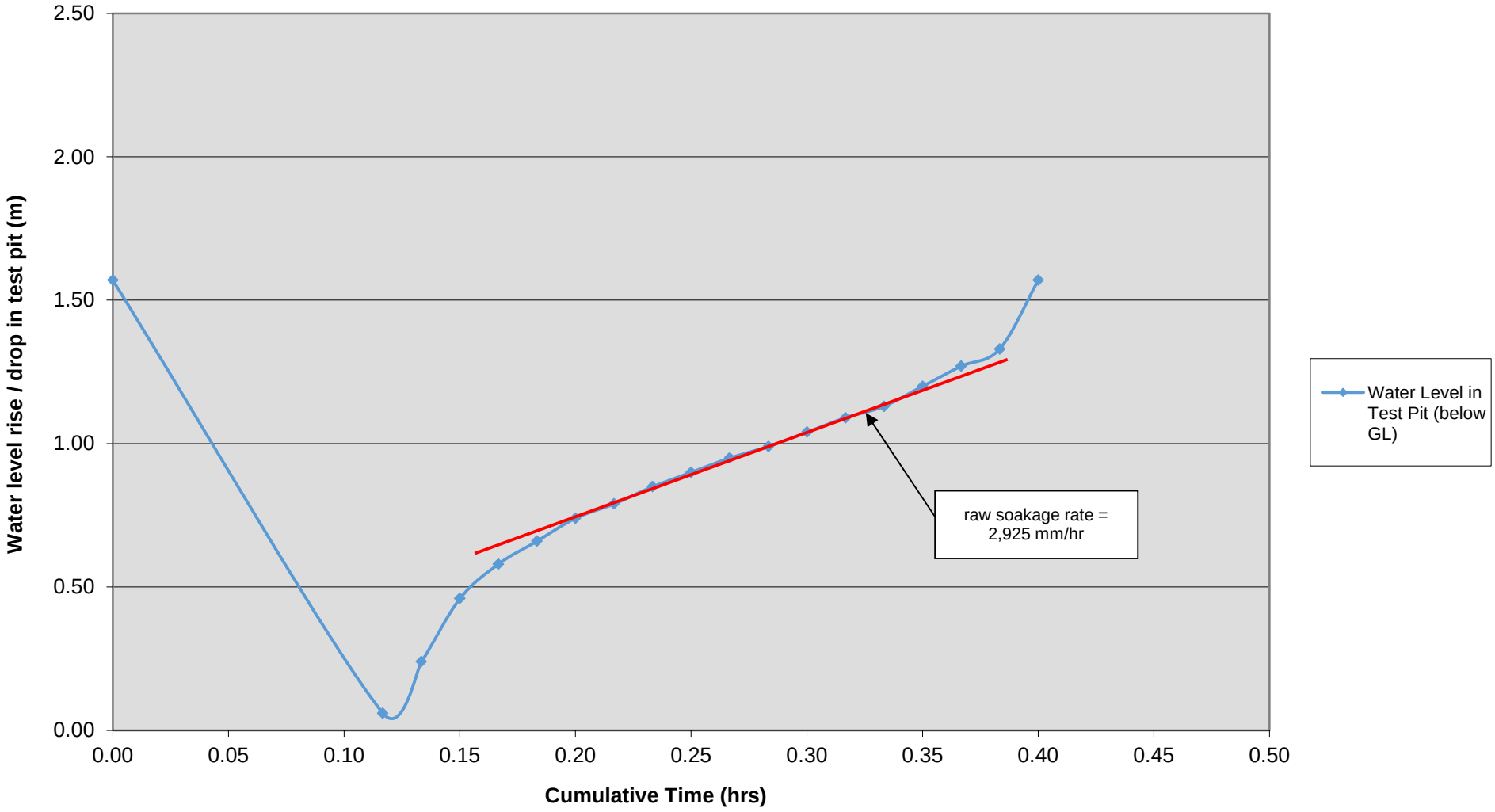
Plot of water level (m) vs time (hrs) - Location 2 - 30 September 2021

(0.0m = existing ground level)



Plot of water level (m) vs time (hrs) - Location 2 - 30 September 2021

(0.0m = existing ground level)



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Test Pit Three

Test carried out Thursday 30th September 2021

Weather: Fine

Size of Pit excavation

Width	1.0	m	
Length	2.2	m	
Depth	1.4	m	Test hole with topsoil, rocks & fine gravels
Volume	**3.08**	m3	

Water supply

Tank Size & Water	10,000	l
FIlling rate supplied by tanker being pumped into hole	1000.0	l/min

Above: View of excavated pit at test location 3

Above: View of excavated pit at test location 3 with material removed from ground shown

Above: View of soakage testing at test location 3

Above: View of excavated pit at test location 3 at completion

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CLIENT BOULCOTT FARM HERITAGE GOLF CLUB
JOB NO. 29909
DATE 30/09/2021
SHEET 7 OF 9 SHEETS

LOT DP
SITE ADD 33 MILITARY ROAD
LOCALITY LOWERH hUTT
FIELDWORK DR

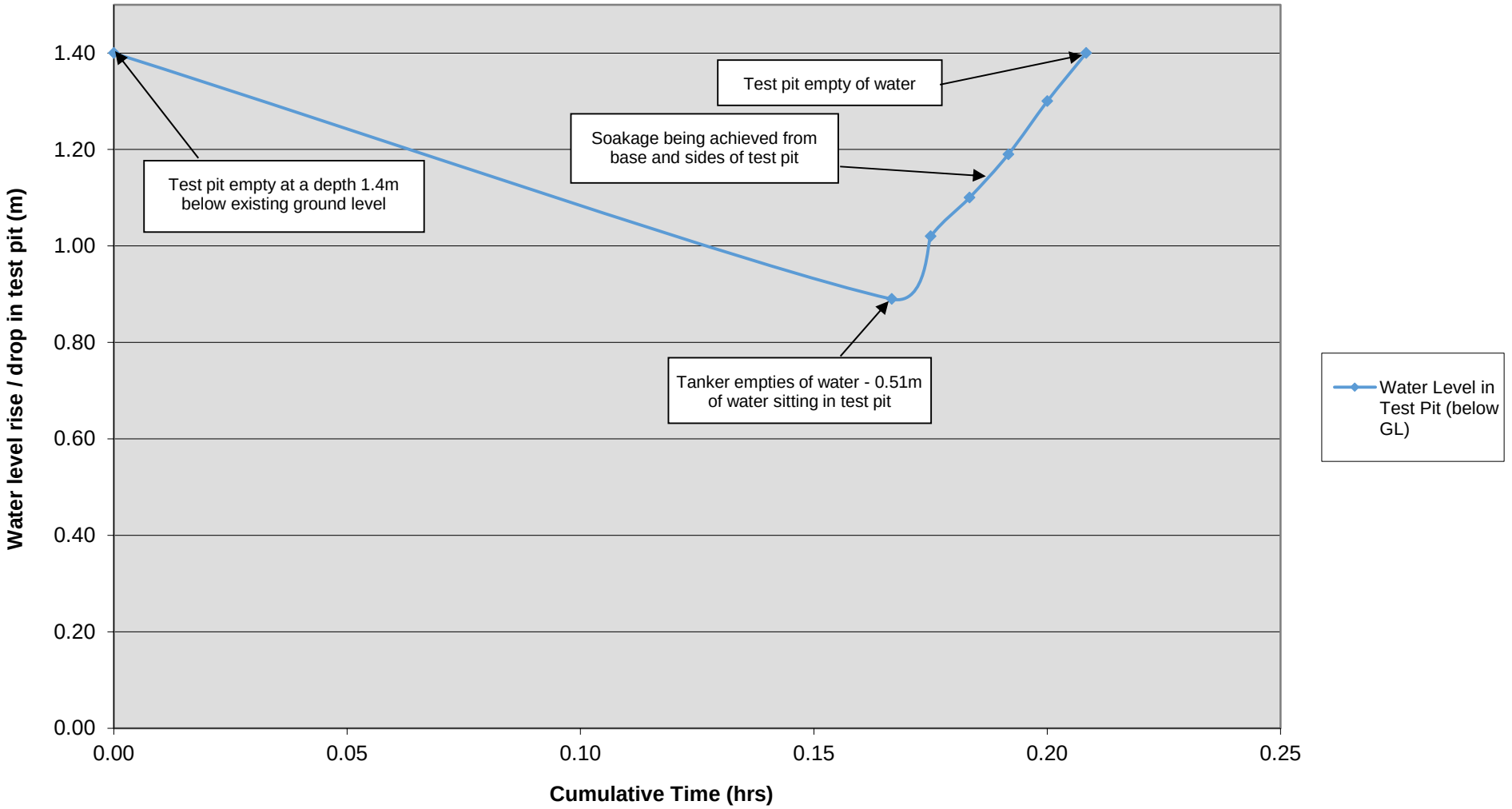
LOCATION 3
DEPTH OF EXCAVATED TEST PIT 1.4m

BASE AREA OF PIT 1.0m (wide) x 2.2m (long)

Time	Time Difference	Cumulative Time	Water Level in Test Pit (below GL)	Cumulative Fall in Test Pit	Time	Time Difference	Cumulative Time	Water Level in Test Pit (below GL)	Cumulative Fall in Test Pit
[hh:mm:ss]	[min]	[hrs]	[m]	[m]	[hh:mm:ss]	[min]	[hrs]	[mm]	[mm]
9:45:00	0	0.00	1.40						
9:55:00	10	0.17	0.89						
9:55:30	0.5	0.18	1.02						
9:56:00	0.5	0.18	1.10						
9:56:30	0.5	0.19	1.19						
9:57:00	0.5	0.20	1.30						
9:57:50	0.5	0.21	1.40						

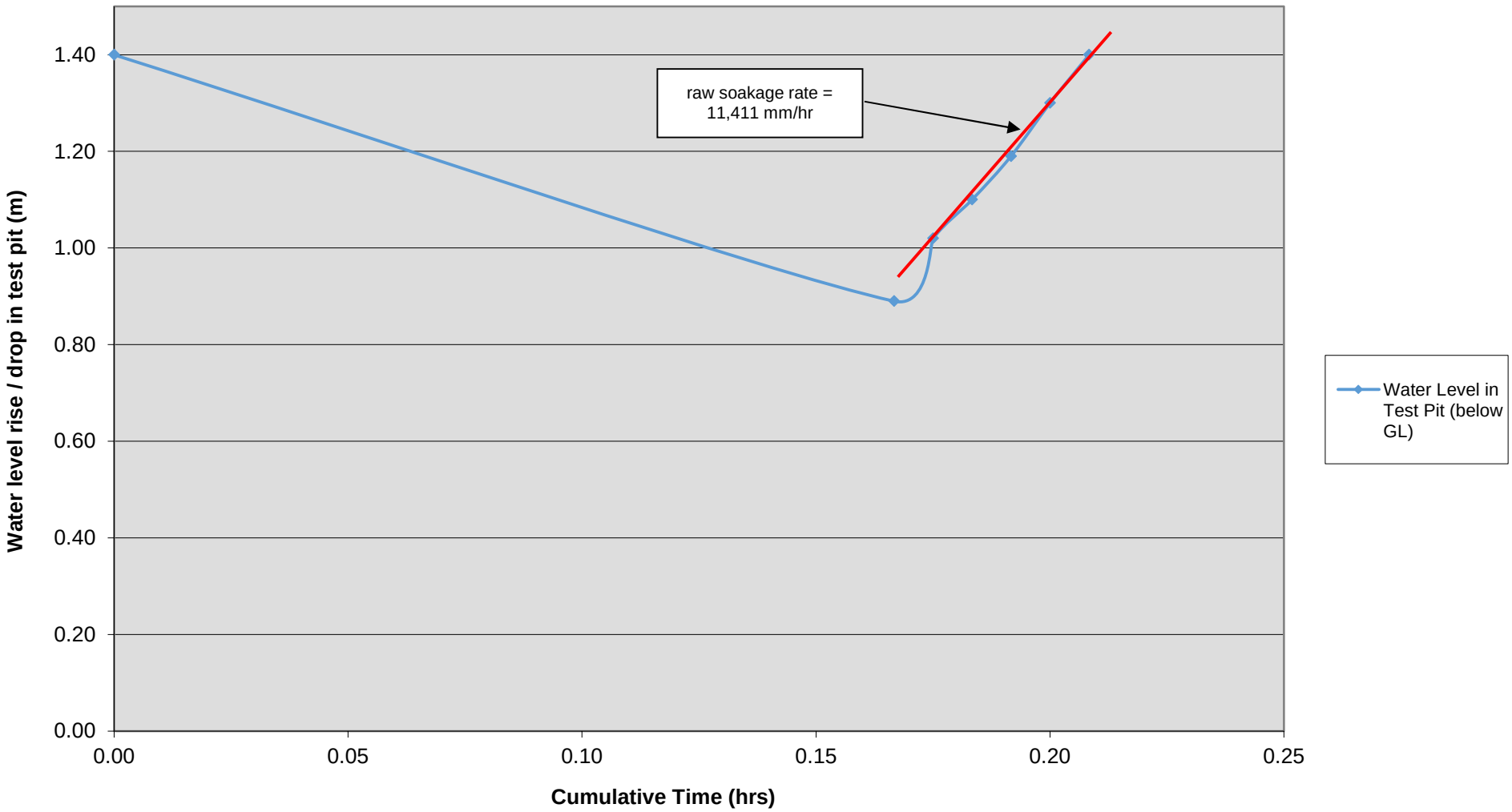
Plot of water level (m) vs time (hrs) - Location 3 - 30 September 2021

(0.0m = existing ground level)



Plot of water level (m) vs time (hrs) - Location 3 - 30 September 2021

(0.0m = existing ground level)



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APPENDIX B

Soak Pit Design Calculations

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INDICATIVE SOAKPIT DESIGN FOR STORMWATER RUNOFF DISPOSAL

DESIGN TO E1/VM1 (NZ BUILDING CODE) FOR STORMWATER INTO SOAKPIT AT

Estimated Dimensions of Soakpit - 410m2 Lot with 40% site coverage dwelling

W =	1.70	m	L = 3.00 m
A_{sp} =	5.1	m^2	(area of base of soakpit)
C =	0.95		(run-off coefficient (from Table 1))
I =	25.524	mm/hr	(4%, 1 hour storm event - inc. 20% Climate Change)

Estimated Catchment Area

$A_{Dwelling}$=	164.0	m^2	(impervious area of roof)
$A_{Driveway}$	100.0	m^2	(impervious area of courtyard)
A_{total}=	264.0	m^2	
soakage		m3/hr	
test pit		m2	
S_r =	692	mm/hr	*(Including Safety Factor of 0.5)*
R_c = 10 x C x I x A =	6.40	m^3	(total rainfall)
$V_{soak} = A_{sp} \times S_r /1000$ =	3.53	m^3	(base soakage)
$V_{stor} = R_c - V_{soak}$ =	**2.87**	m^3	(design storage)

Dimensions of Chambers

Ø =	600	mm	D = 1.35 m (depth of chamber 3x 0.6 risers)
A_{chamb} =	0.28	m^2	(footprint of chamber)
V_{chamb} =	0.38	m^3	(storage of chamber)
V_{hole} =	6.55	m^3	(rubble volume of required hole - based on void ratio of 0.38)
$D_{hole} = V_{hole}/(A_{sp} - A_{chamb})$ =	1.36	m	(required hole depth)

Indicative Soakpit Dimensions

W =	**1.70**	**m**
L =	**3.00**	**m**
D (min) =	**1.46**	**m**

(assumes 100mm surface reinstatement)

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INDICATIVE SOAKPIT DESIGN FOR STORMWATER RUNOFF DISPOSAL

DESIGN TO E1/VM1 (NZ BUILDING CODE) FOR STORMWATER INTO SOAKPIT AT

Estimated Dimensions of Soakpit - 200m2 Lot

W =	1.50	m	L = 2.00	m
A_{sp} =	3.0	m^2	(area of base of soakpit)	
C =	0.95		(run-off coefficient (from Table 1))	
I =	25.524	mm/hr	(4%, 1 hour storm event - inc. 20% Climate Change)	

Estimated Catchment Area

$A_{Dwelling}$=	100.0	m^2	(impervious area of roof)
$A_{Driveway}$	60.0	m^2	(impervious area of courtyard)
A_{total}=	160.0	m^2	
soakage		m3/hr	
test pit		m2	
S_r =	692	mm/hr	*(Including Safety Factor of 0.5)*
R_c = 10 x C x I x A =	3.88	m^3	(total rainfall)
$V_{soak} = A_{sp} \times S_r / 1000$ =	2.08	m^3	(base soakage)
$V_{stor} = R_c - V_{soak}$ =	**1.80**	m^3	(design storage)

Dimensions of Chambers

Ø =	600	mm	D = 1.32	m (depth of chamber 3x 0.6 risers)
A_{chamb} =	0.28	m^2	(footprint of chamber)	
V_{chamb} =	0.37	m^3	(storage of chamber)	
V_{hole} =	3.76	m^3	(rubble volume of required hole - based on void ratio of 0.38)	
$D_{hole} = V_{hole}/(A_{sp} - A_{chamb})$ =	1.39	m	(required hole depth)	

Indicative Soakpit Dimensions

W =	**1.50**	**m**	
L =	**2.00**	**m**	
D (min) =	**1.49**	**m**	(assumes 100mm surface reinstatement)

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INDICATIVE SOAKPIT DESIGN FOR STORMWATER RUNOFF DISPOSAL

DESIGN TO E1/VM1 (NZ BUILDING CODE) FOR STORMWATER INTO SOAKPIT AT

Estimated Dimensions of Soakpit - 160m2 Lot

W =	1.20	m	L = 2.00 m
A_{sp} =	2.4	m^2	(area of base of soakpit)
C =	0.95		(run-off coefficient (from Table 1))
I =	25.524	mm/hr	(4%, 1 hour storm event - inc. 20% Climate Change) NB: 1 hour storm not necessarily worst case

Estimated Catchment Area

$A_{Dwelling}$=	78.0	m^2	(impervious area of roof)
$A_{Driveway}$	35.0	m^2	(impervious area of courtyard)
A_{total}=	113.0	m^2	
soakage		m3/hr	
test pit		m2	
S_r =	692	mm/hr	*(Including Safety Factor of 0.5)*
R_c = 10 x C x I x A =	2.74	m^3	(total rainfall)
$V_{soak} = A_{sp} \times S_r /1000$ =	1.66	m^3	(base soakage)
$V_{stor} = R_c - V_{soak}$ =	**1.08**	m^3	(design storage)

Dimensions of Chambers

Ø =	600	mm	D = 1.20 m (depth of chamber 3x 0.6 risers)
A_{chamb} =	0.28	m^2	(footprint of chamber)
V_{chamb} =	0.34	m^3	(storage of chamber)
V_{hole} =	1.95	m^3	(rubble volume of required hole - based on void ratio of 0.38)
$D_{hole} = V_{hole}/(A_{sp} - A_{chamb})$ =	0.92	m	(required hole depth)

Indicative Soakpit Dimensions

W =	**1.20**	**m**	
L =	**2.00**	**m**	
D (min) =	**1.02**	**m**	(assumes 100mm surface reinstatement)