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Tasman District
s 9(2)(a)

15 February 2023 Ref: 1017

Mark Lile
Landmark Lile Limited
PO Box 343
Nelson 7040

Dear Mark

Proposed Subdivision – Ryeland Avenue, Wakefield, Tasman District
Transportation Impact Report

Following on from your instructions, development reviews and site visits, I have completed my analysis of the proposed residential subdivision in Ryeland Avenue, Wakefield. The subdivision consists of 80 new lots for residential purposes along with associated roads and accesses.

The analysis of the site and traffic related matters has included site visits, analysis of the local road environment, assessment of the planning framework and an assessment of effects is provided below. This Transportation Impact Assessment ("TIA") forms part of the Resource Consent application for the development outlined above. The TIA sets out and describes:

- The existing transport environment in the vicinity of the site
- The development proposal
- Assessment of the development against the provisions of the Tasman Resource Management Plan, and
- An assessment of the proposed network effects including trip generation, access arrangements and parking.

The assessment provided below provides an analysis of the matters as set out above.

1. Site Location and Road Network

The site is located on the south-eastern end of Ryeland Avenue in Wakefield. Ryeland Avenue is connected to Pitfure Road to the northwest of the subdivision site.

Figure 1 shows the location of the site within the adjacent road network.

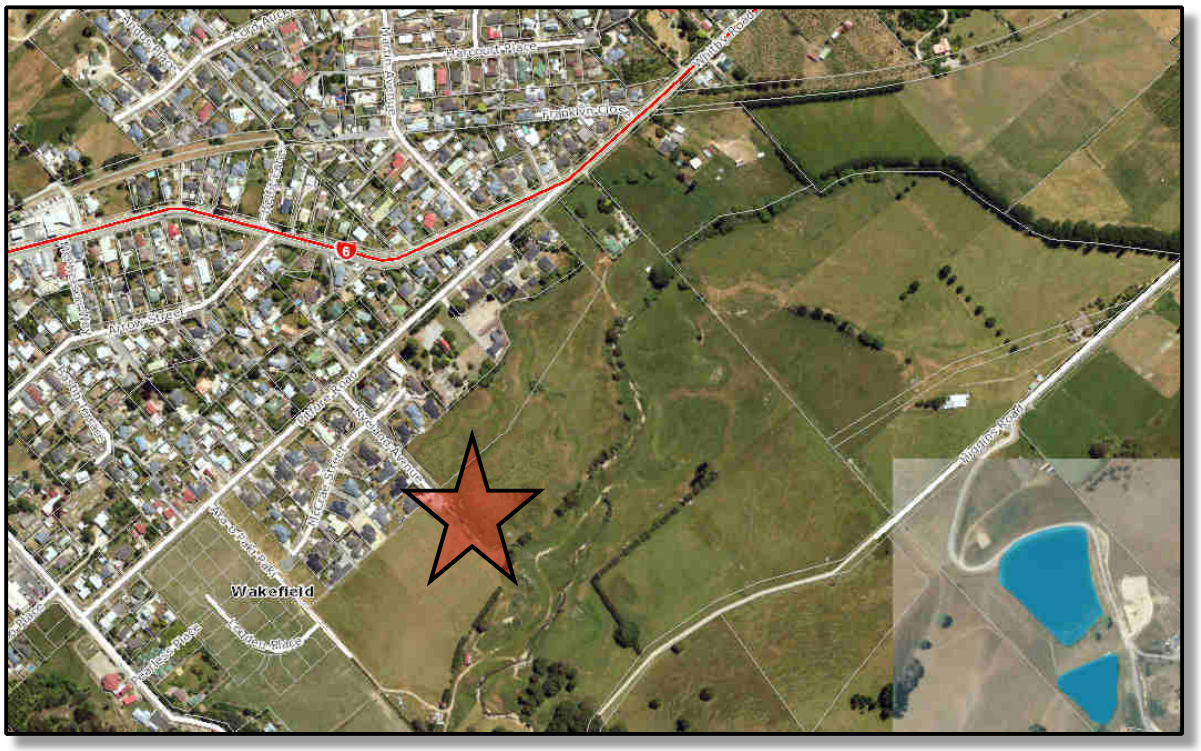

Figure 1: Site Location (Source: Top of the South Maps)

As shown the site is vacant pasture with residential homes located on the western side of the development and farm land to the east. The Wakefield Village is located close by to the west and is around a 900 metre walk from the subdivision.

The subdivision site will have its main access from Ryeland Avenue with a connecting road being constructed to the south linking to Ara o Paki Paki. Both these roads connect to Pitfure Road which has connections to the wider road network via State Highway 6 to the north and Edward Street to the south.

Ryeland Avenue and Ara o Paki Paki are local roads in the Tasman Resource Management Plan (TRMP).

The current speed limit in the area is 50km/h which is consistent with the urban area.

Various services are located nearby including Wakefield Village, the local primary school and recreational reserves.

The proposed subdivision is a continuation/extension of the existing adjacent residential area.

2. Crash History

A detailed search of the Waka Kotahi crash database was carried out for the five-year period from 2018 to 2022/23. It should be noted that 2022 and 2023 may not have all reports coded into the crash database. It can take up to three months for reports to be entered into the Waka Kotahi system.

The search area included crashes within 50 metres of the Ryeland Avenue and Ara o Paki Paki intersections with Pitfure Road.

There have been no reported crashes within the search area. Extending the area out to 300 metres of the two intersections shows there has been one non-injury crash reported.

This crash occurred on Pitfure Road outside number 59. The crash occurred on 19 March 2018 where a northbound vehicle collided with a parked car. The driver drove off after the crash without providing any details.

3. Proposed Development

The proposed subdivision will see the development of xx lots. The development will be a continuation of the existing adjacent development with the geometric layout being the same as already approved by Council.

Figure 2 shows the proposed development for the site. (Note: the plan has been reorientated from North). Larger scale plans are available in the application documents.

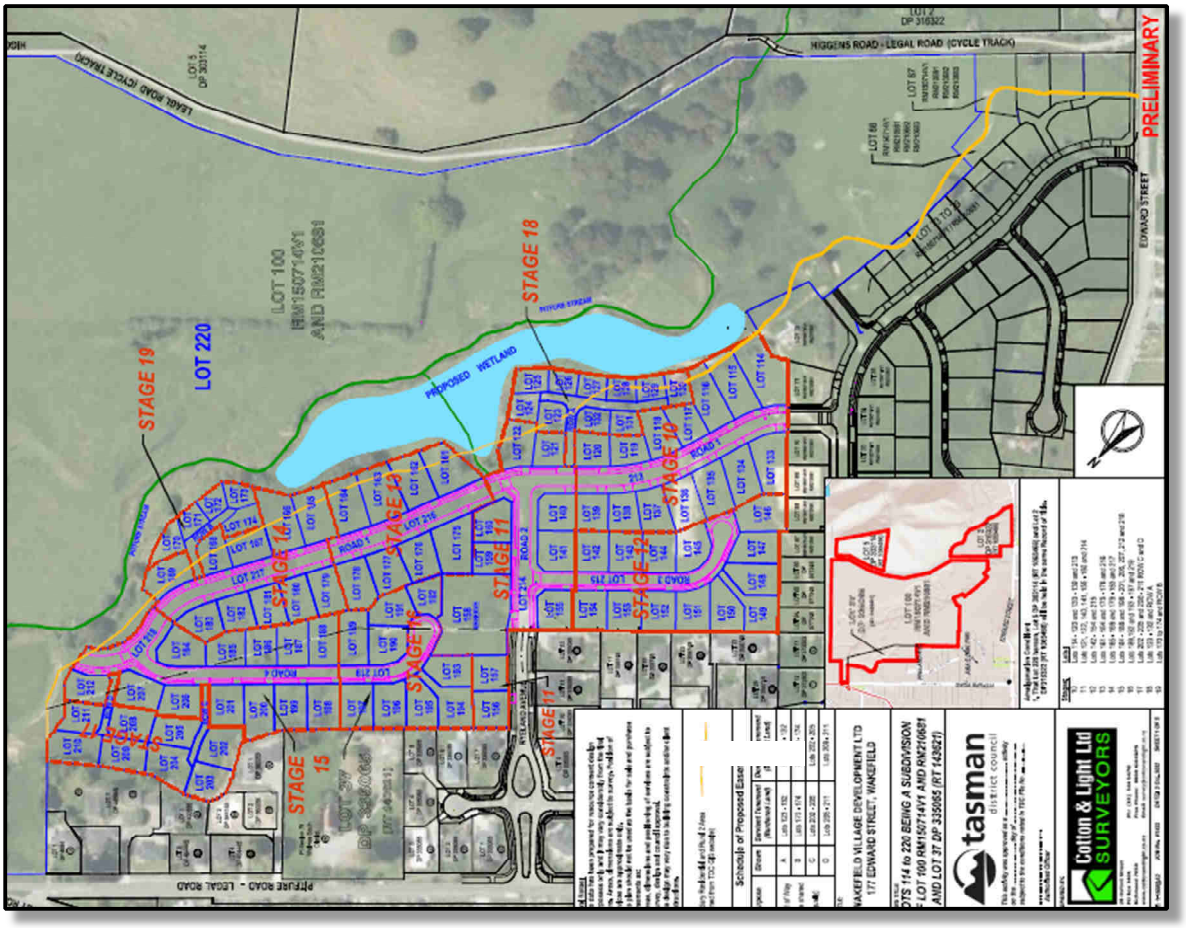

Figure 2: Proposed Subdivision (Source: Cotton and Light)

As shown the subdivision consists of a number of different stages with two new cul de sacs, a new road extending Ryeland Avenue and a main spine road linking back to Ara o Paki Paki.

As noted above the road design will be a continuation of the existing road network in the area with the main spine road having a carriageway width of eight metres and a footpath of 1.4 metres. The new cul de sacs will have a kerb-to-kerb width of seven metres with a 1.4 metre wide footpath along one side of the road.

It is proposed to install standard kerb and channel and form the vehicle accesses to each lot.

4. Planning Framework

The development is located within the Residential Zone as listed within the Tasman Resource Management Plan. As such, the development parking, loading and access is considered against Chapter 16, Section 16.2 Transport.

Section 16.2 provides the rules and standards for the access, parking and traffic requirements for developments. The TRMP also references the Nelson Tasman Land Development Manual for engineering standards applicable under the TRMP.

Section 16.3 provides rules and standards around subdivisions with an assessment provided below.

It should be noted that recent central government has provided direction to Councils to remove parking requirements from their respective District Plans. This was done by way of a National Policy Statement for Urban Design (NPS UD). Tasman District Council have removed the parking requirements in line with the government direction.

Table 1 below provides a statement of compliance against the relevant requirements set out in Section 16.2.

RULE	REQUIREMENT	DISCUSSION	COMPLIANCE
16.2.2.1	**Permitted Activities (Land Use – Vehicle Access Considerations)** Any land use is a permitted activity that may be undertaken without a resource consent, if it complies with the following conditions:		
16.2.2.1 - Access and Vehicle Crossings			
(a)	*The site of the activity is provided with an access and crossing, laid out and constructed in accordance with the matters listed in Figure 16.2A.* *Note that Figure 16.2A now refers to the NTLDM 2019.*	Figure 16A refers to the NTLDM 2019 and the following: General 4.10.2.1 (a) – (e), 4.10.2.3 and 4.10.2.4 – 4.10.2.8 Higher speed environments 4.10.2.2 Grade and gradient design 4.10.3.2 – 4.10.3.4 Spacing 4.10.2.3 and 4.10.7 Tracking and turning 4.10.6 Sight distances 4.10.4	**Refer the NTLDM Table (Table 2)**
(b)	*Visibility from the access and crossing complies with 4.10.4.1 and 4.10.4.2 of the Nelson Tasman Land Development Manual 2019.*	Site specific assessment.	**Refer the NTLDM Table (Table 2)**
(c)	*The design of the access and crossing complies with Figure 4-10 of the Nelson Tasman Land Development Manual 2019.*	There are footpaths along one side of the road. The splay of 2.0 m by 1.5 metres can be met by the new lots where required.	**Can comply**
(j)	***On-site Turning*** *On-site manoeuvring space is provided on any site.*	The lots are for single dwellings and not onto a classified road so no on site turning required.	**Complies**

16.2.2.2 - Provision for Parking and Loading			
(b)	***Frontage to Unformed Legal Roads*** *Vehicular access to the site of any activity is by formed legal road, or by an existing right-of-way or other legally enduring instrument over another property.*	All access will be from a legal road or private road.	**Complies**
16.2.2.3 - Provision for Parking and Loading			
(b)	*The activity does not use parking spaces on another site, except where the title of the site of the activity and the title of the site on which the parking for that activity is provided, are amalgamated or otherwise encumbered so that one site cannot be disposed of independently of the other.*	Parking is provided within the new lots and does not use another site. It should be noted that there is no car parking requirement as required by the NPS on the site.	**Complies**
Size of Parking Spaces			
(e)	*Any required parking space and associated manoeuvring area (other than for residential activities) is designed to accommodate a 90 percentile design motor car in accordance Schedule 16.2A.*	All parking spaces and associated manoeuvring are expected to meet the TRMP requirements or the alternative parking standard AS/NZS 2890.1.	**Complies** Accepted Practice
(f)	*Any residential car park is 5 metres x 3 metres, but where two car parks are side-by side, the combined area may be 5 metres x 5 metres.*	As noted above all spaces will meet TRMP or AS/NZS 2890.1. It is noted that this rule contradicts the requirements of Schedule 16.2.	**Complies**
Surface of Parking Areas			
(m)	*The surface of any parking area in the Residential zone is formed and sealed, and spaces marked on the ground.*	All car park areas will be formed with a sealed surface. Spaces are not typically marked on individual lots.	**Complies**

Table 1: Tasman Resource Management Plan Standards Compliance Table

As shown, there are no non-compliances with the development and this section of the TRMP. It should be noted that the TRMP refers to the NTLDM which is assessed below, and any non-compliances are identified.

Table 2 below provides a statement of compliance against the relevant requirements referenced in the TRMP Section 16.2, that are set out in the NTLDM. The TRMP specifically references the following sections of the NTLDM.

- Sections 4.10.2.1 (a) to (e)
- Section 4.10.2.3
- Sections 4.10.3.2 to 4.10.3.4
- Section 4.10.4
- Section 4.10.6
- Section 4.10.7

These sections are set out in the table below, along with discussion and compliance.

Private Access - Section 4.10.2			
Section 4.10.2.1	*Private access must meet the requirements contained within a) through to e):*		
	a) Be designed in accordance with the minimum specifications in Table 4-13.	The individual site accesses have been specifically designed to meet the requirements of the NTLDM.	**Will Comply**
	b) Only serve up to six units.	The development has two right of ways which serve less than six lots.	**Complies**
	c) Give access to the lower ranked road in the hierarchy if the site has frontage to more than one road.	The roads within the development are all local roads.	**Complies**
	d) Not create a shorter through-route alternative for vehicle, cyclists or pedestrians than the adjoining road network	There are no connecting routes through the private access.	**Complies**
	e) intersects with the carriageway at an angle of 75 to 105 degrees on unclassified roads	All accesses will join the public road at 90 degrees.	**Complies**
Section 4.10.2.3	*Not more than one crossing is provided per site.*	There is only one vehicle crossing per site.	**Complies**
Section 4.10.3.2	*The maximum gradient of an access ramp for the first 6m from the property boundary line will be 1-in-20 (5%).*	The gradients for the accesses will meet these requirements.	**Complies**
Section 4.10.3.3	*On roads where the footpath is located against or close to the kerb and where the target speed environment is 40km/h or lower, vehicle*	The road will have kerb and channel and the footpath is separated by a grass berm from the road edge. The target speed is less than 40 km/h.	**Complies** Road layout approved as part of

	crossings will be designed with a mountable kerb.	It is proposed to have standard kerb and channel as per the already approved layout.	adjacent subdivision.
4.10.4	*The minimum sight distance that must be available from any vehicle access point along the frontage road is shown in Table 4-14.*	All vehicle access will meet this requirement.	**Complies**
4.10.6	*Section 4.10.6.2* *Tracking paths and turning circles on private land will be provided in accordance with AS/NZS 2890.1 "off-street carparking" 2004.*	All vehicle tracking is in accordance with AS/NZS 2890.1.	**Complies**
	Section 4.10.6.3 *Vehicle access points must be located so that no part of the access, nor tracking path crosses any part of another site except where there is a right of way or other similar legal easement over those parts of the other site see Figure 4-12.*	None of the accesses cross over adjacent properties.	**Complies**
4.10.7	*No part of a vehicle crossing shall be closer to a road intersection than the distances permitted in Table 4-15.*	All accesses will have the required separation distances.	**Complies**

Table 2: NTLDM 2020 TRMP Reference Compliance Table

As shown the development can meet all of the referenced requirements from the TRMP to the NTLDM.

Table 3 sets out the various rules from Section 16.3 that relate to subdivisions.

RULE	REQUIREMENT		COMPLIANCE
16.3.6.1	**Rural 2 Zones**		
(f)	*Transport* *The subdivision complies with the transport conditions in Schedule 16.3B.*		**See Below**

Table 3: Compliance Table for Section 16.3 of the TRMP

As set out in the table above, the rules direct the assessment to Schedule 16.3B of the TRMP.

For the purpose of the analysis of the requirements of Section 18.8 the roads for the subdivision are considered to be "Local Roads."

Table 4 sets out the requirements of Section 18.8 of the TRMP.

RULE	REQUIREMENT		COMPLIANCE
18.8.3.1	**Road Construction**		
(b) *The activity meets the standards set out in the following sections of the Nelson Tasman Land Development Manual 2019:* For the purpose of this assessment the NTLDM 2020 has been used.			
(i) Section 4.6.1.1: road design cross section	*A local road requires the following parameters.*		
	▪ *A 5.5 metre wide sealed moving lane.*	The road to be vested will be constructed with a width of eight metres.	**Complies**
	▪ *1 carpark/2 dwellings or 2 x 2.0*	Parking is available on the road.	**Complies**
	▪ *Min 0.3m, Max 6.0m.*	Berms are provided that vary in width. All berms are more than 0.3 metres in width.	**Complies**
	▪ *2 x 1.5 metre wide footpaths*	It is proposed to provide one 1.4 metre wide footpath which is consistent with the already approved adjacent subdivisions.	**Complies** Consistent with adjacent subdivision.
	▪ *2 x 1.6 service berms*	Service berms are available with varying widths. Generally, these are around 1.1 to 1.4 metres.	**Complies** Consistent with adjacent subdivision.
	▪ *A legal road reserve width of 19 metres*	It is proposed to have a 17.6 metre wide road reserve for Roads 1 and 2. Roads 3 and 4 have a legal width of 12 metres. Road 3 has 15 lots and could be classed as a residential lane.	**Does not comply.** Roads 1, 2 and 4 do not have 19 metres legal width.
(ii) Section 4.9.2: Sight Distances	*This section refers to Safe Intersection Sight Distances (SISD).*	The new intersections are able to meet the minimum SISD requirements. All new intersections provide more than 73 metres which meet the SISD requirement for a 40 km/h target speed.	**Can comply**

(iii) Section 4.8.5: road alignment safe stopping distances	*This section sets out the Safe Stopping Distance (SSD) requirements for new intersections.*	All intersections easily meet the minimum requirement of 40 metres at 40 km/h. The Safe stopping distances are more than 80 metres.	**Complies**
(iv)Section 4.6.4.2: cul de sac turning circles	*The minimum radius of the turning circle of a vested cul-de-sac will be 7.0m in a residential area, as per SD417 'Cul-de-sac Turning Circles'*	There is a turning head provided at the end of the cul de sac which has a radius of at least seven metres.	**Complies**

Table 4: Compliance Table for Section 18.8 of the TRMP

As shown in the table above, the road layout can meet the requirements set out in Rule 18.8. except for the width of the legal road reserve.

The next section of this report considers the areas of non-compliance, along with other transportation matters that require further consideration. The next section also provides an assessment of effects.

As shown, the development does not meet all of the requirements of the NTLDM. It is proposed to reduce the legal road width for the application to align it with the legal road widths used in the adjacent subdivisions.

5. Assessment of Effects

This section of the report considers the proposed development, analyses the transportation matters and provides an assessment on the impacts of the development on the adjacent road network. The main areas that require careful consideration relate to the road to be vested, the site access and parking. Note that larger scale plans are contained within the application documents.

5.1. New Roads

The design of the new roads is consistent with the adjacent roads that lead into the development.

The formation width exceeds the minimum requirements of the NTLDM which will comfortably allow vehicles to be parked on the road and traffic moving along the road to pass.

The legal width of Roads 1, 2 and 4 (assuming Road 3 is treated like a residential lane) do not meet the NTLDM requirements. The road cross section is able to meet the operational needs of the development and the reduced width has no effect on safety efficiency or servicing. The reduced legal road width allows for better land utilisation.

There will be 1.4 metre wide footpaths along one side of the roadway with crossing points provided at intersections. This does not meet the NTLDM requirements of a 1.5

metre wide footpath on each side of the roadway. The 100mm difference will have no effect on the usability of the footpath.

The road design is able to meet the needs of the users and any effects are considered to be less than minor.

5.2. New Intersections

There will be three new intersections and one road connecting to an existing intersection. The cul de sac intersections will be controlled with give way signs, along with the connection to Ara o Paki Paki.

The intersection of Road 1 and Road 2 will require careful design to provide clarity of the priority route. The design of this intersection is best dealt with at the engineering design stage. Options include squaring up the intersection and/or reducing the road width of Road 1 between Road 2 and Ara o Paki Paki. Reducing the road width along this section of road could have positive effects on the use of this road.

The other intersections are consistent with good design and are able to operate safely and efficiently with any effects being less than minor.

5.3. Site Accesses

Each new lot will be provided with a vehicle crossing that will be constructed to the requirements of the NTLDM. All vehicle crossings will be a minimum of three metres wide and a maximum of six metres wide.

Sight lines and location of the vehicle access will allow the users of the driveway to enter and exit the property safely and efficiently.

6. Road Safety

An assessment of the safety of the new roads, intersections and accessways has been undertaken. It is noted that the assessment has been carried out independent of the road designers.

Generally, the subdivision layout provides safe design for all road users. There is good forward visibility, and the vehicle crossings are provided with appropriate sight lines. There is a footpath along one side of the new roads with crossing points provided at the intersection. Kerb buildouts have been provided at the new intersections with the intersection of Road 1 and Ara o Paki Paki having a raised threshold.

It is expected as part of the detailed design and construction that street trees will be considered and planted. This will assist in reducing the speeds along the new roads.

The intersection of Road 1 and Road 2 and potentially Road 1, south of Road2 will need specific design. This will ensure the intersection is safe and appropriate guidance to users of the intersection is provided.

No landscaping plans have been prepared at this point. Any street trees near the new intersections will need to be located so they do not obstruct the required sight lines. This can be managed through the Engineering Plan Approval stage.

It is suggested that the design includes kerb buildouts and trees to restrict the road width in the vicinity of Lot 179 to break up the length of this straight and provide a traffic calming measure to reduce the operating speeds.

7. Conclusion

The proposed subdivision will provide xx new lots for new homes in Wakefield.

The proposed design is a continuation of the existing subdivisions on adjacent land and provides a consistent approach to the overall residential area. The design provides the needs of the intended users which will be safe and efficient.

The area of non-compliance in regard to the legal road widths has no effects on the operational needs of the roadway.

Overall, there are no adverse effects arising from the development, with any effects being less than minor and will be indiscernible to other road users.

We are happy to provide any further clarification if required.

Regards

Gary Clark
Director
NZCE (Civil), REA, MIPENZ, CPEng

PO Box 828, NELSON

8 Mar 2023

Wakefield Village Development Ltd
c/- Landmark Lile
51 Halifax St,
Nelson

Geotechnical Assessment Report

Wakefield Village Development
Stages 10 – 19

177 Edward Street, Wakefield

Introduction
Wakefield Village Development Ltd is proposing to develop an 8-hectare block of land on the east side of Wakefield into a residential subdivision. The works are located on the land immediately north of the previous subdivision development by Wakefield Village Development Ltd subdivision. The proposed development is to comprise 94 new residential lots and associated roading and services infrastructure.

Swanney Geotechnical and Civil Engineering have been engaged to investigate the site and prepare a geotechnical assessment report for submission in support of the resource consent application. The subdivision design has been prepared by Cotton and Light Ltd.

Figure 1 Site Location

Site Description
The site is located on the east side of Wakefield. The gently undulating site is bounded by the existing Wakefield residential area to the west, the earlier stages of the Wakefield Village Development Ltd residential subdivision to the south, and the terrace-edge bank leading down to the current Pitfure Stream floodplain to the north and east. The site is currently in pasture.

The site is relatively flat, with a minor fall to the northeast of approximately 1:100. The undulations across the area are associated with north-trending relict meandering watercourses across the site. These watercourses are ephemeral. An open drain extends from Ryeland Avenue across the site to discharge residential stormwater flows to the stream.

The bank leading down to Pitfure Stream on the east of the site is typically 3 – 4m high with gradients ranging from ~1:1 to 1:4. Some uncertified earth fill has been placed on the outside of the bank east of lots 119 – 128. The extent of this has been confirmed via test pitting across this area.

The contours across the site are shown on the appended site investigation plan.

Proposed Development
It is proposed to develop 8 hectares of the property into 94 new residential lots. The new roading will be linked into Ara o Pak Paki at the south end Ryeland Avenue on the west side with two internal dead-end streets. All new lots will be serviced with sewer and stormwater connections. Stormwater flows are to be discharged to the Pitfure Stream via the new stormwater reticulation system.

The subdivision earthworks will comprise levelling areas where required to meet the design ground levels. This will involve cut-to-fill earthworks to infill low lying areas. Cuts and fills will typically be less than 1m, locally greater than this in the invert of drainage pathways and perimeter fills.

The proposed layout and extent of earthworks is shown on the appended Cotton and Light Ltd plans ‘Wakefield Village Development Ltd – 177 Wakefield Street, Wakefield – Stage 10 – 19 Enlargement Diagram’ and ‘Stage 10 – 19 Prelim Cut and Fill Plan’ dated 28 Feb 2023.

Site Investigation
Prior to Swanney Geotech becoming involved with the project, Tasman Consulting Engineers Ltd carried out test pits across the south end of the subdivision. The logs from these test pits have been included in the current investigation. The Swanney site investigation comprised excavation of six test pits across the northern end of the site and 12 CPT tests in 2022/23. The CPT tests were carried out by CW Drilling Ltd using a Pagani TG 63-150 rig. The location of the testing is shown on the appended site investigation plan.

Geology/Ground Conditions
The geology of the area is described in the GNS publication 'Geology of the Nelson Area – 1:250,000' 1998. The Holocene terrace underlying the site is the lowest aggradation surface above the Wai-iti River, approximately 5m above the younger alluvial floodplain on which the majority of Wakefield township is located. It is mapped as Q2a – Clay-bound gravel and minor fan deposits forming lowest aggradation surfaces above major rivers. There are no mapped faults crossing the site. The closest active fault shown on the GNS active faults database is the Waimea Fault 3km to the southeast.

The underlying soils comprise interlayered alluvial silts sands and gravels, with the shallow soils mottled grey/orangey brown and deeper soils distinctive blue/grey. The top 2m -3m of soils was generally stiff/dense, underlain by a layer of soft blue/grey fine sand/silt over more dense gravels. The layer of weaker ground was 1m + thick and at 2-3m depth. Groundwater level is around 2-3m below ground level, increasing in depth closer to the edge of the terrace to the east.

The test pit logs are appended.

Liquefaction Investigation and Analysis
The presence of young weak saturated silts and sands underlying the site indicate potential for liquefaction of the soils to occur following an earthquake event. The site investigation has included 12 CPT tests across the site to allow the extent of the potential liquefaction effects to be assessed.

The CPT testing comprised five tests along the east terrace edge of the site and seven through the body of the site. Tests CPT 12, 13 and 14 at the north end of the site needed to be punched with a solid cone to penetrate the top 2-3m of dense gravels before the CPT test could proceed. The test locations are shown on the appended site investigation plan.

The liquefaction potential at the site has been assessed via analysis of the CPT data following the recommendations from the MBIE/NZGS Nov 2021 publications Earthquake Geotechnical Engineering Practise - Module 1 Overview of the Guidelines and Module 3 Identification, Assessment and Mitigation of Liquefaction Hazards (Method 1 procedure).

Data from 12 CPT tests has been analysed with the Geologismiki CLiq software and using the Idris and Boulanger (2014) method. Peak ground accelerations and earthquake magnitudes for Serviceability Limit State event (SLS, 1:25yr event) and Ultimate Limit State event (ULS, 1:500yr) from Module 1 Table A1 have been used (Nelson – SLS: $a_{max.}$ = 0.10g M = 6.1, ULS: $a_{max.}$ = 0.41g M = 6.1). The 1:100 yr event ($a_{max.}$ = 0.41g M = 6.1) has also been run.

The output from the analysis is appended.

Test	Depth to refusal (m)	Vertical settlement (mm)			Liquefaction Severity Number LSN		
		SLS (1:25yr)	1:100yr	ULS (1:500yr)	SLS	1:100yr	ULS
7	8.6	<5	30	60	<1	6	15
8	8.7	<5	30	85	<1	7	25
9	7.9	5	85	100	1	20	27
10	8.2	<5	10	40	<1	2	10
11	11.2	<5	10	25	<1	4	3
12	8.3	<5	<10	40	<1	1	8
13	9.4	<5	<10	10	<1	<1	1
14	8.5	<5	<10	15	<1	<1	3
15	9.4	<5	10	30	<1	2	6
16	13.5	<5	10	35	<1	1	3
17	13.5	<5	25	70	<1	4	17
18	7.9	<5	25	30	<1	2	6

Table 1 Liquefaction analysis results

Notes:

1. Input earthquake parameters for Nelson from Table A1, Earthquake Geotechnical Engineering Practise - Module 1.
   SLS: $\alpha_{max}(g) = 0.10$, M = 6.1
   1:100yr event: $\alpha_{max}(g) = 0.20$, M = 6.1
   ULS: $\alpha_{max}(g) = 0.41$, M = 6.1
2. Cumulative vertical settlements rounded to 5mm.
3. Groundwater depth for analysis has been taken as 0.5m above measured groundwater levels at time of investigation.

LSN Range	Expected ground surface damage
0-10	Little to no expression of liquefaction, minor effects
10-20	Minor expression of liquefaction, some sand boils
20-30	Moderate expression of liquefaction, with some sand boils and structural damage
30-40	Moderate to severe expression of liquefaction, settlement can cause structural damage
40-50	Major expression of liquefaction, undulations and damage to ground surface, severe total and differential settlements of structures
>50	Severe damage, extensive evidence of liquefaction as surface, severe total and differential settlements affecting structures, damage to services.

* Table based on Table 13.1 from T&T report 'Liquefaction Vulnerability Study'

Figure 1 Liquefaction Severity Number expected ground surface damage

Liquefaction Hazard Assessment

The Liquefaction Severity Number (LSN) is an analysis method developed following the 2010/11 Christchurch earthquakes which provides an indication of the vulnerability of the land to liquefaction-induced damage.

The analysis indicates a low risk of liquefaction occurring following a 1:25 year EQ event at any of the test locations across the site.

Following a 1:100-year event the test sites would expect 'little to no expression of liquefaction' at the surface except for CPT9 which would expect 'minor to moderate expression'.

Following an ultimate limit state event (1:500-year event) 8 of the 12 test locations (CPT 10 – 16 & 18) would expect 'little to no expression of liquefaction'. This covers the northern 2/3's and the southeast and the site. The southwest of the site has an increased risk, with test locations CPT7 & 17 expecting 'minor expression of liquefaction' and test locations CPT 8 & 9 expecting 'moderate expression of liquefaction.

The assessment of the liquefaction vulnerability of the site has been carried out in terms of the MBIE/EQC/MOE 2017 publication 'Planning and Engineering Guidance for Potentially Liquefaction-prone Land'. The expected ground damage against the analysed performance of the ground has been assessed in terms of Table 4.4 of the publication. Based on the analysis, the liquefaction vulnerability category for the area of test sites CPT 7, 8, 9 & 17 is *Medium Liquefaction Vulnerability*. Based on the proposed layout, this will include lots 133 – 155. The remainder of the site is categorised as *Low Liquefaction Vulnerability*.

Following triggering of liquefaction within the soils there is potential for lateral spreading to occur in some situations where there is a free face present. With the layering of the potentially liquefiable soils following the general land slope to the north and the extent of potential liquefaction reducing towards the bank on the east side of the site, the risk of lateral spreading towards the bank is considered low.

Discussion/Recommendations

The ground conditions across the site typically comprise a stiff/dense top 2m -3m of soils underlain by weaker layered saturated soils, with competent gravels below. Groundwater level is around 2-3m below ground level, increasing in depth closer to the edge of the terrace to the east. The proposed bulk earthworks are expected to be within the stiff/dense soils and above the water table. It is intended that the earthworks be a cut-to-fill operation. As much of the shallow soils have a high silt content, these will be sensitive to moisture content when being used in compacted fills and conditioning of fill may be required prior to placement/compaction.

The proposed development extends up to the bank on the east side of the site. This is the outside of the upper alluvial terrace, leading down to the current Pitfure Stream floodplain. The bank gradient varies from ~1:1 to 1:4. The ground along the face of the bank is typically tight predominantly gravel soils. Minor shallow slippage on the face of the bank could occur. The risk to new buildings from potential instability can be simply addressed by requiring setback distances for any future buildings from the edge of the bank. Some uncertified earth fill has been identified on the outside of the bank east of lots 119 – 128. The extent of this has been confirmed via test pitting across this area and the proposed lots do not extend onto this area of fill.

The investigation has found parts of the site could potentially be affected by liquefaction following an earthquake event. An assessment of the liquefaction vulnerability of the site has identified the area comprising lots 133 – 155 as *Medium Liquefaction Vulnerability*. Specific foundation design for buildings on these lots will be required to address the risk. Due to the limited extent of potential deformation, ground remedial works are not considered warranted. The remainder of the site is categorised as *Low Liquefaction Vulnerability*. We anticipate these sites will be suitable for foundation design in accordance with NZS3604:2011 Timber Framed Buildings.

The depth to the basement rock underlying the alluvial gravels has not been confirmed as part of this investigation. The site subsoil class in terms of Structural Design Actions standard NZS1170.5 should be taken as Class D (deep or soft soil site).

In conclusion, it is our opinion that the area is suitable for the proposed residential development.

If you have any queries on the above, please contact me on 021 882011

Jeff Swanney
CPEng, CMEngNZ

Swanney Geotechnical and Civil Engineering
PO Box 992,
Nelson

Appended:

Cotton and Light Ltd plans	'Wakefield Village Development Ltd – 177 Wakefield Street, Wakefield – Stage 10 – 19 Enlargement Diagram' and 'Stage 10 – 19 Prelim Cut and Fill Plan' dated 28 Feb 2023.

Swanney Geotechnical and Civil Engineering plan 'Site Investigation Plan' dated Mar 2023

CPT analysis output

Test pit logs

STORMWATER ASSESSMENT

FOR THE

COMPREHENSIVE SUBDIVISION OVER

177 EDWARD STREET
WAKEFIELD

February 2023

Prepared by: S King-Turner
Andrew Melvin King-Turner Ltd
Consulting Engineers
PO Box 7036
Nelson 7042
s 9(2)(a)

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Stormwater Assessment
Comprehensive Subdivision
177 Edward Street, Wakefield

1. Introduction

This report considers the stormwater design relating to Stages 10 to 18 of the subdivision. Stages 1-2 has been completed and Stages 3-9 (located to the south east of the completed stages) are covered by an earlier report

2. Existing Drainage

The recently completed stages discharge to Pitfure Stream at the south east end of Ara o Paki Paki. This discharge includes runoff from Edward St and Pitfure St. The existing area covered by Stages 10-18 is farmland and generally falls towards Pitfure Stream. There is a narrow strip of land along the north west boundary which currently drains to a ditch adjacent the north west boundary. This ditch currently discharges via an open channel through 120 & 132 Whitby Road before discharging to Pitfure Stream. The channel through 132 Whitby Rd also collects water from Franklyn Close and Arrow Street. This open channel is prone to flooding so by diverting the water from the subdivision away from this channel should help reduce the flooding potential. There is also a significant open channel flowing through the subdivision off the end of Ryeland Avenue. The intention is to pipe this flow under Road 10 to Pitfure Stream and use the road as a secondary flood path.

3. Stormwater Design Methodology

The original stormwater design methodology was for all the stormwater from stages 1-9 to discharge to a stormwater detention pond located at the end of Road 1 (Ara o Paki Paki) adjacent Pitfure Stream. The pond was designed to have sufficient capacity that it compensated for the future development area, being stages 10-18, so they could discharge directing into Pitfure Stream without detention. In February 2021 an amendment to Resource Consent RM150717 was granted which replaced the detention pond if favour of stormwater treatment and detention wetlands to be constructed along the west bank of Pitfure Stream.

Design is to be carried out in accordance with NTLDM Chapter 5 where possible. Due to the poor drainage and relatively high water table direct infiltration to groundwater is not a viable option, therefore surface disposal is the only viable option.

Based on NTLDM, secondary flood path design is based on Q_{100} – 6hr duration RCP8.5 2090. This exceeds the resource consent requirement to meet the Tasman District Council Engineering Standards 2013, which did not account for global warming.

4. Objective

As stated in the NTLDM the performance outcomes for the design and construction of stormwater systems are as follows:

a) A management solution that is based on a holistic catchment-based assessment, including consideration of topography, soil and slope, vegetation, built development, existing drainage patterns, freshwater resources, stormwater network infrastructure, natural values and natural hazards;
b) An integrated design approach to stormwater management, which accommodates stormwater functions including access for maintenance and operations, as well as amenity, recreation and ecological values;
c) A network that manages stormwater flows to a standard that minimises people and property from harm or damage and nuisance effects, especially from risk to safety, health and well-being;
d) A management approach that aims to improve water quality;
e) Devices and design solutions that are robust, durable and easily maintained;
f) A whole-of-life operations, maintenance and replacement or renewal programme that is clearly described, costed, and can be afforded;
g) A stormwater system design that takes into account the foreseeable demands of future development;
h) A resilient network infrastructure that performs well against the risk of geotechnical, seismic, flood hazards and coastal hazards (erosion and inundation);
i) A design that maintains or improves values associated with freshwater resources, including riparian management and in-stream habitat values;
j) Stormwater assets that have high amenity value, and shared use of open-space areas where practicable and agreed to by Reserves and Facilities Manager;
k) A network that maintains a high visual amenity that enhances the value of adjoining property and neighbourhood values as a whole.

All performance outcomes are also subject to the applicable Resource Management Plan objectives and policies and appropriate bylaws, which take precedence over the requirements of the Nelson Tasman Land Development Manual (NTLDM).

5. Design Runoff Calculations

Design calculations need to show a 10% Annual Exceedance Probability (AEP) event, including allowance for climate change, can be accommodated by the primary stormwater system, i.e. the piped network. They also need to show that the stormwater runoff generated during a 1% AEP event can be dealt with in a way that does not cause damage or nuisance to people or property.

6. Stormwater Design Strategy

As noted above the initial stormwater design strategy was to discharge stages 1-9 into a detention pond which was designed to compensate for the entire subdivision allowing stages 10 to 18 to discharge directly into Pitfure Stream while not increasing the post development flow.

The resource consent (RM150717) was amended in February 2021 to replace the detention pond if favour of stormwater treatment and detention wetlands to be constructed along the west bank of Pitfure Stream.

Due to site constraints it has not been possible to fit the wetlands within the proposed area and maintain the required batter slopes as set out in the Wetlands Practice Note for Nelson and Tasman Councils. The terraced nature of the site would require significant retaining walls and create a number of other issues around ground stability due to the wetlands.

The catchment for Pitfure Stream to a point at the northern end of the proposed subdivision is around 1200 ha. Of this 1200ha, residential property accounts for only around 10%, including the currently proposed adjacent subdivisions. The proposed Pitfure Road subdivision is only about 1.5% of the total catchment so has little impact on the peak flow of Pitfure Stream. The further you go downstream the smaller the percentage of the catchment the subdivision becomes.

The time of concentration for the subdivision, including the water flowing down Edward Street, is 23 minutes, which is when the peak discharge from the subdivision will occur. The peak flow for the catchment is at around 90 minutes so well after that of the subdivision. Based on Tonkin & Taylor flow modelling for Pitfure Stream the effect of the stormwater runoff from the subdivision is shown in appendix 3 for a 6hr duration event. At low rainfall depths the majority of the rainfall within the catchment is dealt with by infiltration, hence the increased offset of peak flows at short return period events. There is also a bigger percentage difference between predevelopment and post development flows at low rainfall depths as more of the catchment rainfall is infiltrated but the actual increase is only 0.1m^3/s for the Q_2_6hr event. For the Q_{100}_6hr event there is a 2% increase in flow which is less than the likely accuracy of the model and rainfall hyetograph. Given the detention pond was designed for extended detention this moved the peaks closer together making the peak flow greater. The removal of the detention pond should therefore have a beneficial effect on the peak flow in Pitfure Stream.

The wetlands where to provide a dual benefit of improved water quality and some detention, and although the loss of the detention element is not considered significant, improving water quality is still a desirable outcome. Stormwater runoff from the main roading network should be treated to reduce contamination of the water discharging to the stream. The NTLDM does not require treatment for roads serving less than 5000 vehicles per day so this is not required within the subdivision, however some treatment will be incorporated where it is practical to do so.

7. Calculations

Calculations, where possible, have been done in accordance with NZ Building Code Verification Method E1/VM1.

Runoff Coefficient (C)

The runoff coefficient 'C' has been taken as prescribed in NZBC E1/VM1 Table 1. Roads C = 0.9, Residential sections C = 0.65, Rural catchment C = 0.35.

Time of Concentration (Tc)

Unlike Stages 1-9 that had catchment areas from outside the subdivision, i.e. Edward St and Pitfure Road, Stages 10-18 all have compact catchment areas so the minimum time of concentration given in NZBC E1 of 10minutes has been used for design of piped systems.

The time of concentration for the Pitfure Stream catchment has been taken from the computer modelling provided by the TDC which shows T_c = 150 minutes.

8. Rainfall Intensity

Rainfall intensity was taken from HIRDS website
For piped flow I_{10} 10 minute duration RCP8.5 2090, I = 109mm/hr
For secondary flood path I_{100} 10 minute duration RCP8.5 2090, I = 180mm/hr
For Pitfure Stream flows I_{100} 6hr RCP8.5 2090, I = 24.7mm/hr has been used

9. Flow Calculations

Summary of flow calculations for the current development are given in the following table,

Stage	Area Sections (m^2)	Area Roads (m^2)	CA (m^2)	Q_{10} (l/s)	Q_{100} (l/s)
10	9650	2650	8658	262	433
11	5180+2500*	3000	6942	210	347
12	8395	1740	7023	213	351
13	6180	2005	5822	176	291
14	6250	2120	5971	181	299
15	7555	2270	6954	211	348
16	5795	1225	4869	148	244
17	5110	495	3767	114	189
18	2925	455	2311	70	116
19	1810	370	1510	46	76
Total	61350	16330	53825	1631	2693

* Reserve area C = 0.35
Predevelopment flow Q_{10} = 0.35*109*(61350+16330)/10000*2.78 = 824l/s
Q_{100} = 0.35*180*(61350+16330)/10000*2.78 = 1360l/s

10. Secondary Flood Path

NTLDM requires the secondary flood path to be designed to take a Q_{100} event. This is to be provided by the roading network within the subdivision. The runoff will be directed to Pitfure Stream. Stages 1-9 secondary flood flows already discharge to the Stream.

11. Pitfure Stream Flood Flows and impact Assessment

We have looked at the Q_{100} flood flows in Pitfure Stream based on Q_{100} – 6hr duration RCP8.5 2090. This exceeds the resource consent requirement to meet the Tasman Engineering Standards 2013, which did not account for global warming.

The TDC have carried out flood modelling on Pitfure Stream which gave a Q_{100}-6hr maximum flow of 14.2m^3/s at the northern boundary of the subdivision. The flooding map shows no flooding immediately downstream of this location so flow at this point is not outlet controlled. Rainfall was calculated using a Chicago hyetograph method, based on HIRD rainfall data. For a 6hr duration event the maximum rainfall went from 47.4mm/hr to 61.2mm/hr. For a 6hr event the initial soakage within the catchment will be approaching its minimum value so the increase in rainfall will proportionally increase the peak flow in Pitfure Stream, giving a peak flow of 18.3m^3/s. Comparing this with the flow interpolated from the Wai-iti River flow at Livingston Rd, Wai-iti River catchment at Livingston Road is 285km^2 compared to Pitfure Strem catchment of 12km^2, Q_{50} 451m^3/s x 12/285 = 19m^3/s, adjusting for Q_{100} 105/91.1x19 = 21.9m^3/s with further adjustment for climate change 180/133*21.9 = 29.6m^3/s. Although the flows

are significantly different, they are similar magnitude and the catchment characteristics are different. A Q_{100} 6hr flow of 20m^3/s has been used for assessment of flood levels in Pitfure Stream. Based on this flow the existing stream channel can cope with the Q_{100} event without overflowing. Minimum ground levels along the west bank of Pitfure Stream have been calculated and proposed building platform levels exceed these so no flooding issue.

12. Climate Change

Rainfall intensity has been taken from HIRDS data based on RCP8.5 projections for 2090 so no further adjustment for climate change is required.

13. Conclusions

Stormwater flow calculations for Stages 10-18 of the residential development have shown Pitfure Stream does not pose a flooding hazard. Secondary flood flows can be directed to Pitfure Stream via the roading network. Discharge of the surface runoff from the development directly into Pitfure Stream does not significantly impact the peak flow in Pitfure Stream due to the offset in time of concentration.

We trust this stormwater assessment meets your current requirements. We would be pleased to discuss further with you any issues raised in this report.

Evaluation by:	
Structural Engineer	Steven King-Turner
CPEng Number	142318
Date	3-03-2023

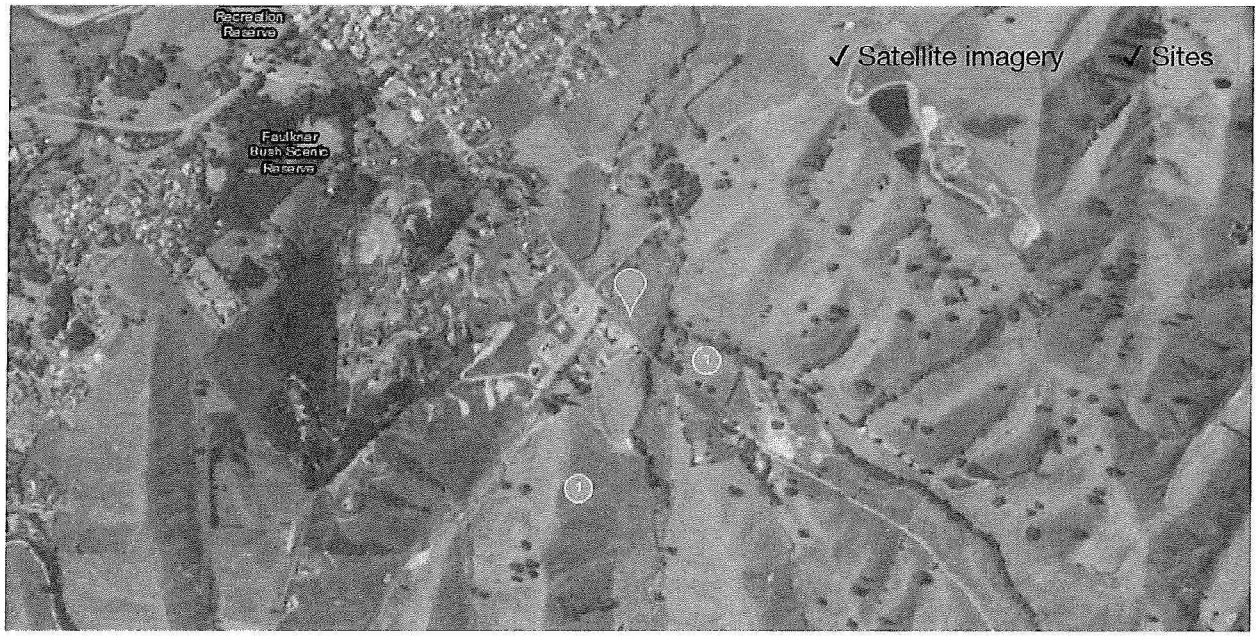
APPENDIX 1

HIRDS V4 data

High Intensity Rainfall Design System V4 (/)

Location

Address search	177 Edward Street Wakefield



Site Information

To generate a set of results, either click on an existing data point, or a new location and enter a site name, then press the Generate Report button.

Latitude	-41.4130309
Longitude	173.0515557
Site Name	177 Edward Street Wakefield
Site Id	

Output Table Format

- Depth - Duration - Frequency
- Intensity - Duration - Frequency

Generate Report

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	12(
50	0.020	20	14	11	6.9	5.0	2.3	1.6	0.61	0.37	0.29	0.21	0.1
60	0.017	21	15	13	7.5	5.5	2.5	1.7	0.66	0.40	0.31	0.22	0.2
80	0.012	24	18	14	8.5	6.2	2.8	1.9	0.73	0.45	0.35	0.25	0.2
100	0.010	27	20	16	9.3	6.9	3.0	2.1	0.80	0.49	0.38	0.27	0.2
250	0.004	39	29	24	14	10	4.2	2.9	1.1	0.69	0.52	0.38	0.3

High Intensity Rainfall Design System V4 (/)

Location

Address search 113 Edward Street, Wakefield

Site Information

To generate a set of results, either click on an existing data point, or a new location and enter a site name, then press the Generate Report button.

Latitude	-41.4093389
Longitude	173.047214
Site Name	113 Edward Street, Wakefield
Site Id	

Output Table Format

- ○ Depth - Duration - Frequency
- ◉ Intensity - Duration - Frequency

Generate Report

Results

Spreadsheet Download

Site Details	Historical Data	RCP2.6 Scenario	RCP4.5 Scenario	RCP6.0 Scenario	RCP8.5 Scenario

Rainfall intensities (mm/hr) :: RCP8.5 for the period 2031-2050

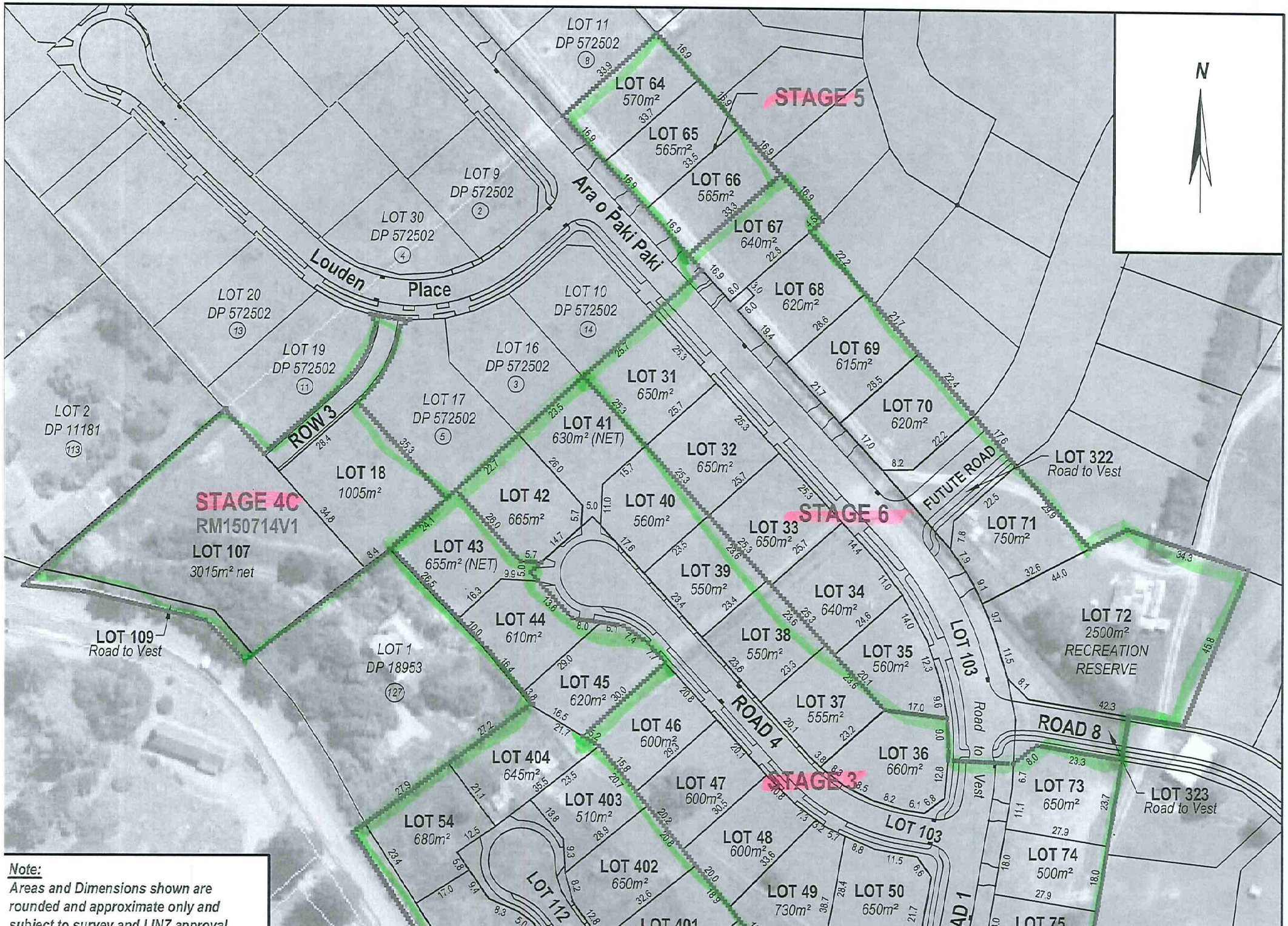
ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	50.2	36.5	30.0	21.3	14.7	7.80	5.06	3.21	1.97	1.47	1.18	0.994
2	0.500	55.8	40.5	33.3	23.5	16.3	8.60	5.58	3.52	2.17	1.61	1.29	1.09
5	0.200	75.5	54.5	44.7	31.4	21.6	11.4	7.33	4.60	2.82	2.09	1.68	1.41
10	0.100	90.8	65.3	53.5	37.5	25.7	13.4	8.64	5.41	3.30	2.44	1.96	1.64
20	0.050	107	76.7	62.7	43.8	30.0	15.6	9.99	6.23	3.79	2.80	2.24	1.88
30	0.033	117	83.7	68.3	47.7	32.5	16.9	10.8	6.73	4.09	3.01	2.41	2.02
40	0.025	124	88.8	72.4	50.5	34.4	17.8	11.4	7.09	4.30	3.17	2.53	2.12
50	0.020	130	92.8	75.7	52.7	35.9	18.6	11.8	7.36	4.46	3.29	2.63	2.20
60	0.017	135	96.2	78.4	54.5	37.1	19.2	12.2	7.59	4.60	3.39	2.70	2.26
80	0.012	142	102	82.7	57.5	39.1	20.1	12.8	7.95	4.81	3.54	2.82	2.36
100	0.010	149	106	86.1	59.8	40.6	20.9	13.3	8.24	4.98	3.66	2.92	2.44
250	0.004	174	123	100	69.3	46.9	24.0	15.2	9.38	5.65	4.14	3.30	2.76

Rainfall intensities (mm/hr) :: RCP8.5 for the period 2081-2100

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	59.6	43.3	35.7	25.2	17.3	8.97	5.71	3.57	2.16	1.59	1.27	1.07
2	0.500	66.5	48.2	39.7	28.0	19.3	9.95	6.34	3.93	2.38	1.75	1.40	1.18
5	0.200	90.6	65.4	53.6	37.7	25.8	13.3	8.41	5.19	3.13	2.30	1.83	1.53
10	0.100	109	78.6	64.4	45.1	30.8	15.7	9.95	6.12	3.68	2.70	2.15	1.80
20	0.050	129	92.5	75.6	52.9	35.9	18.3	11.5	7.06	4.24	3.10	2.47	2.06
30	0.033	141	101	82.6	57.6	39.1	19.9	12.5	7.63	4.57	3.34	2.66	2.21
40	0.025	150	107	87.5	61.0	41.3	21.0	13.2	8.05	4.81	3.52	2.79	2.33
50	0.020	157	112	91.6	63.8	43.2	21.9	13.7	8.36	5.00	3.65	2.90	2.41
60	0.017	163	116	94.8	66.0	44.6	22.6	14.2	8.64	5.15	3.77	2.99	2.48
80	0.012	173	123	100	69.6	47.0	23.8	14.9	9.04	5.40	3.94	3.12	2.60
100	0.010	180	128	104	72.4	48.9	24.7	15.4	9.38	5.59	4.07	3.23	2.69
250	0.004	211	149	121	83.9	56.4	28.3	17.7	10.7	6.34	4.61	3.65	3.03

Appendix 2

Catchment Plans



Note:

Areas and Dimensions shown are rounded and approximate only and subject to survey and LINZ approval


132
PT LOT 1 DP 3897
LOT 3 DP 14980
SECTION 1 SO 14837
LOT 4 DP 14980
WHITBY ROAD - LEGAL ROAD (SH 6)
PITFURE ROAD - LEGAL ROAD
HIGGINS ROAD
LEAGL ROAD (CYCLE TRACK)
LOT 1 DP 2916
LOT 1 DP 4684
LOT 1 DP 449848
LOT 3 DP 464445
LOT 1 SE 490586
LOT 4 DP 464445
LOT 3 DP 544153
LOT 2 DP 560050
LOT 1 DP 560050
Pt Section 78 Waimea South District
LOT 37 DP 335065 (RT 143621)
LOT 3 DP 335065
LOT 4 DP 335065
LOT 5 DP 335065
LOT 2 DP 335065
LOT 6 DP 335065
LOT 1 DP 335065
LOT 7 DP 335065
LOT 5 DP 303114
LOT 100 RM150714V1 AND RM210681
LOT 220
STAGE 19
STAGE 17
STAGE 15
STAGE 14
STAGE 16
STAGE 13
STAGE 11
LOT 210
LOT 211
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LOT 156
LOT 157
LOT 158 RESERVE
LOT 159
LOT 160
LOT 218
LOT 219
LOT 217
LOT 216
ROW D
ROW C
ROW B
ROAD 12
ROAD 9
PITFURE STREAM
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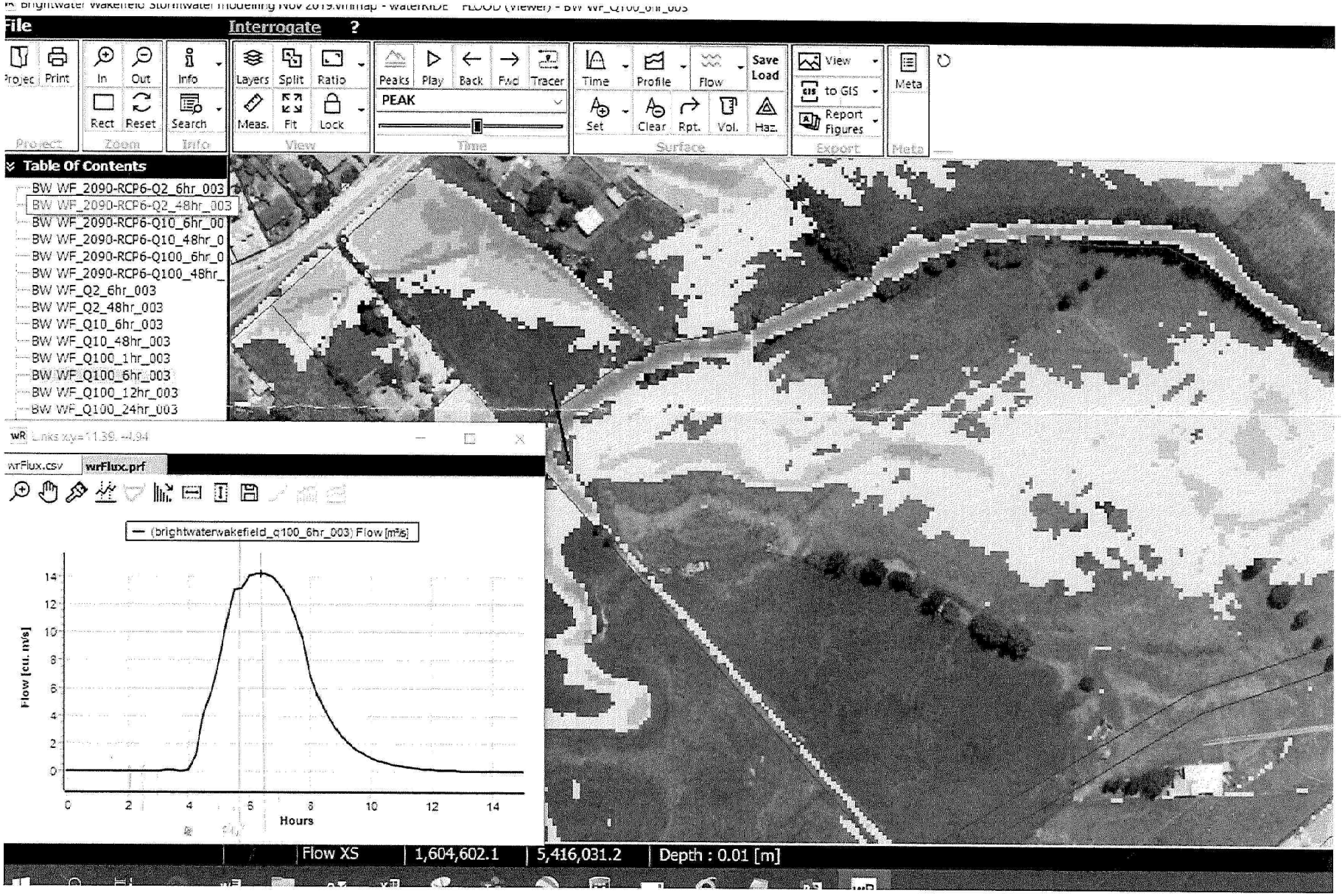
LOT 122

Appendix 3

Computer Modelling for Pitfure Stream Flow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Interrogate
?
Project
Print
In
Out
Rect
Reset
Info
Search
Zoom
Layers
Split
Ratio
Meas.
Fit
Lock
View
Peaks
Play
Back
Fwd
Tracer
PEAK
Time
Time
Profile
Flow
Save Load
Set
Clear
Rpt.
Vol.
Haz.
Surface
View
to GIS
Report Figures
Export
Meta
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BW WF_2090-RCP6-Q2_6hr_003
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BW WF_2090-RCP6-Q10_6hr_00
BW WF_2090-RCP6-Q10_48hr_0
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BW WF_Q100_24hr_003
wrFlux.csv
wrFlux.prf
(brightwaterwakefield_q100_6hr_003) Flow [m³/s]
Flow [cu. m/s]
Hours
0
2
4
6
8
10
12
14
Flow XS
1,604,602.1
5,416,031.2
Depth : 0.01 [m]

TDC model for Q_{100} - 6hr has $Q = 14.2 m^3/s$ shows no flooding immediately downstream so no backing up of flow.

Adjust flow for Q_{100} - 6hr RCP8.5 2090 using linear interpolation

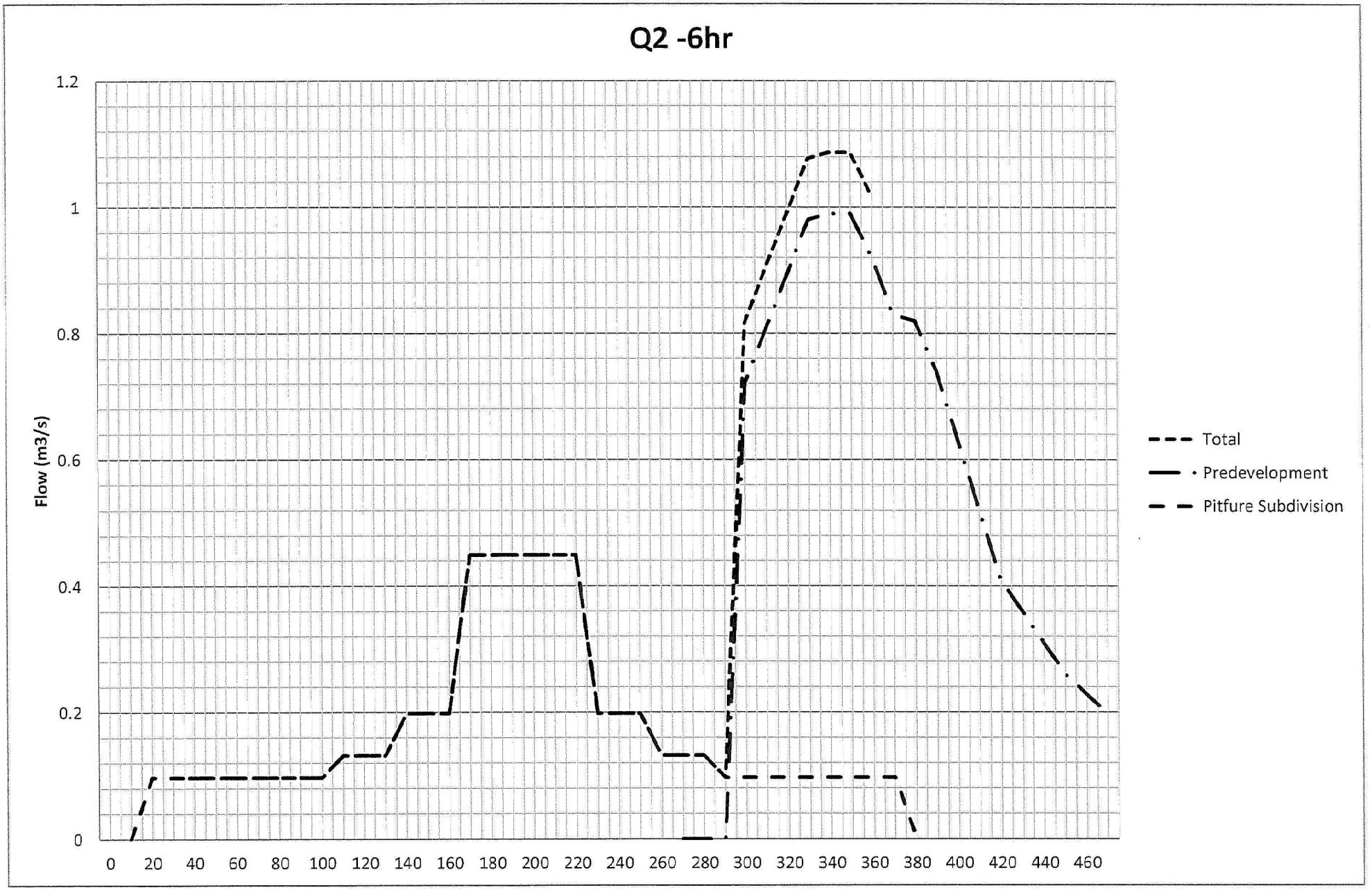
Depth of rainfall Q_{100} - 6hr = 114mm

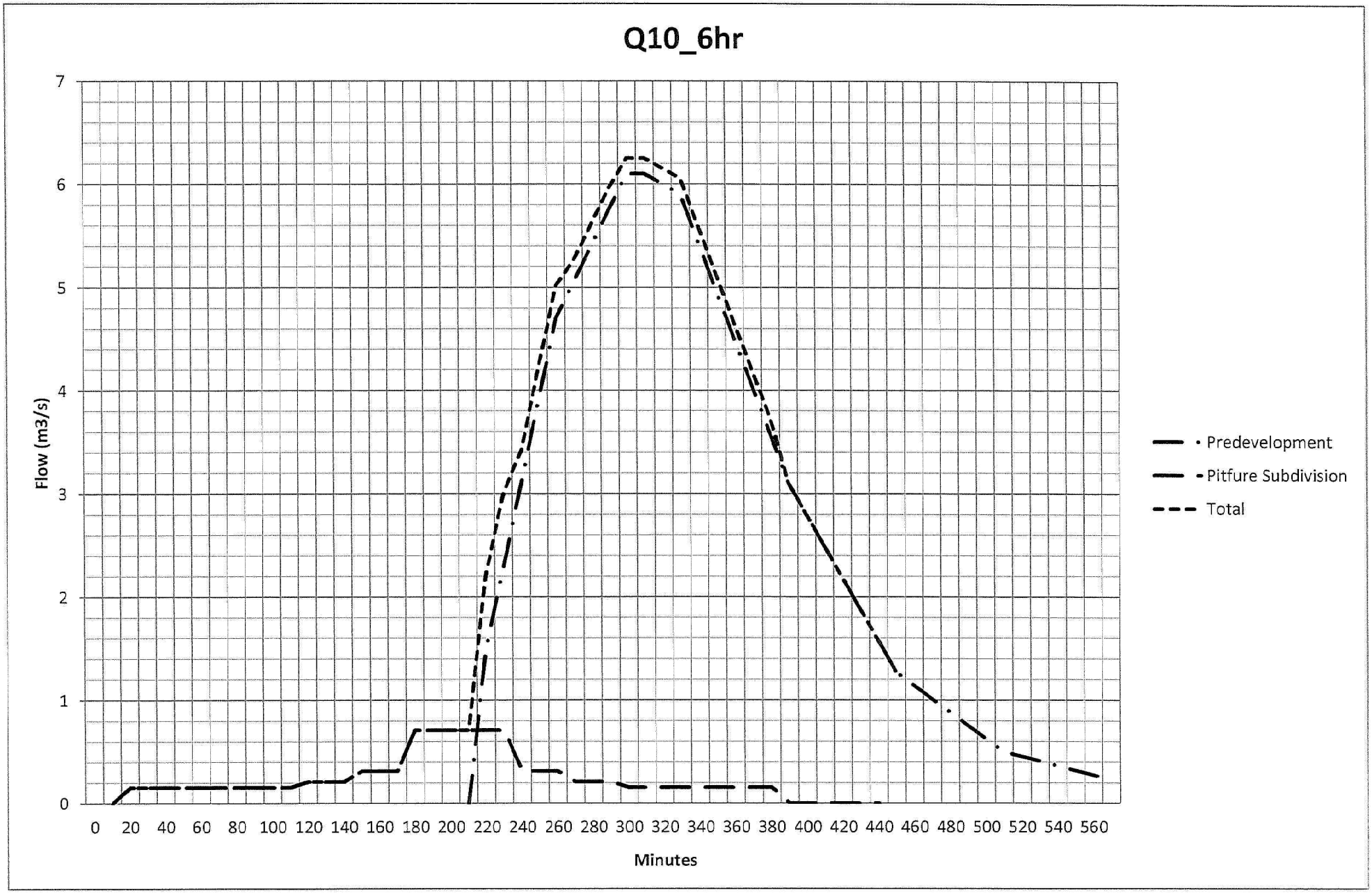
" Q_{100} - 6hr RCP8.5 2090 = 148mm

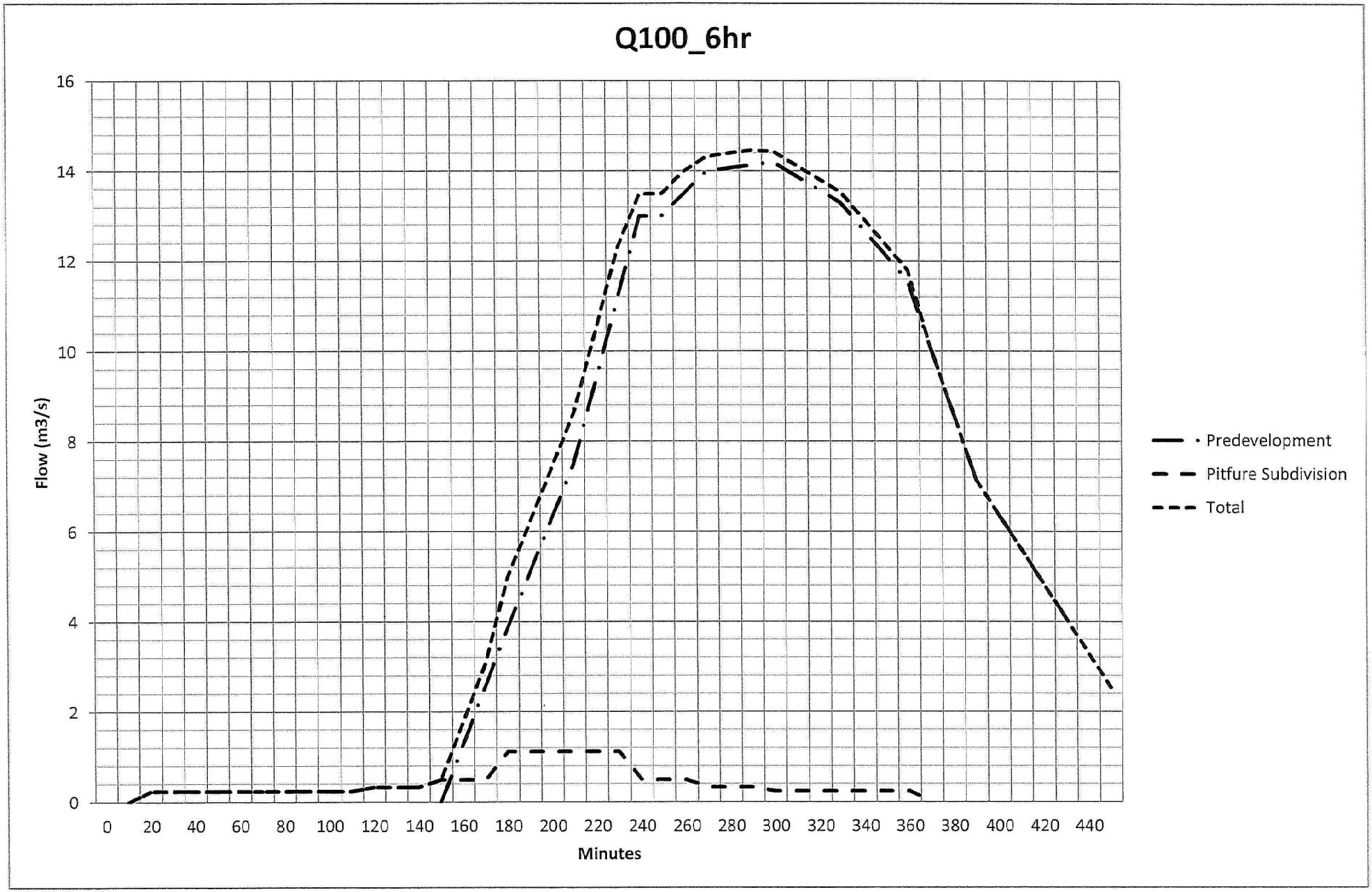
Hydeograph max 10min rainfall 7.9mm => 47.4mm/hr

10.2mm => 61.2mm/hr

$61.2/47.4 \times 14.2 = 18.3 m^3/s$.

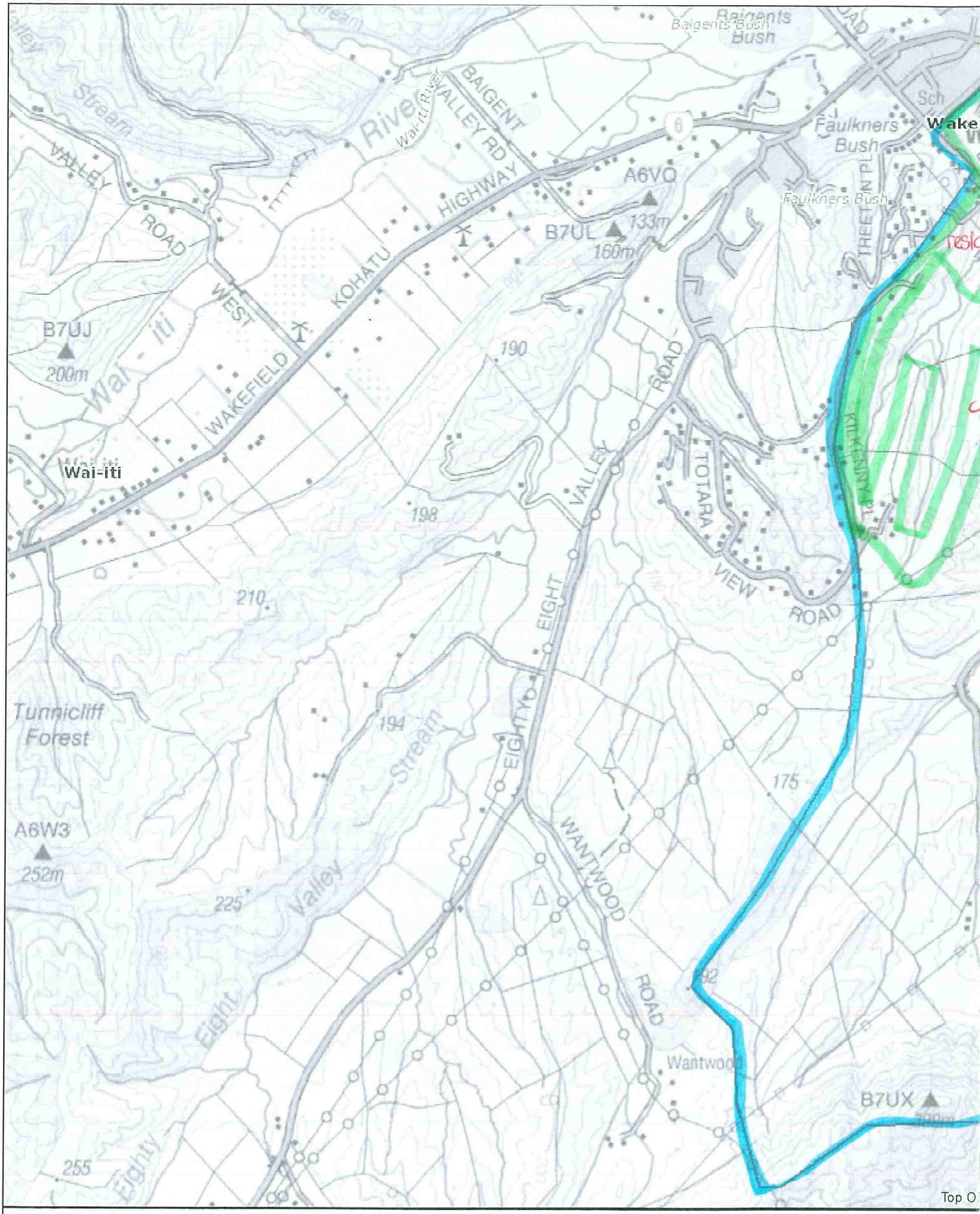

Q2 -6hr
Flow (m3/s)
1.2
1
0.8
0.6
0.4
0.2
0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460
Total
Predevelopment
Pitfure Subdivision


Q10_6hr
Flow (m3/s)
0
1
2
3
4
5
6
7
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560
Minutes
Predevelopment
Pitfure Subdivision
Total


Q100_6hr
Flow (m3/s)
0
2
4
6
8
10
12
14
16
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
Minutes
Predevelopment
Pitfure Subdivision
Total

Appendix 4

Q100 Flow to Pitfure Stream



Top of the South Maps

Legend

Place Names

Road Labels

River Labels

Stream Labels

Nelson City Council
te kaunihera o whakatū

tasman district council

Wakefield Village

Open Channel flow

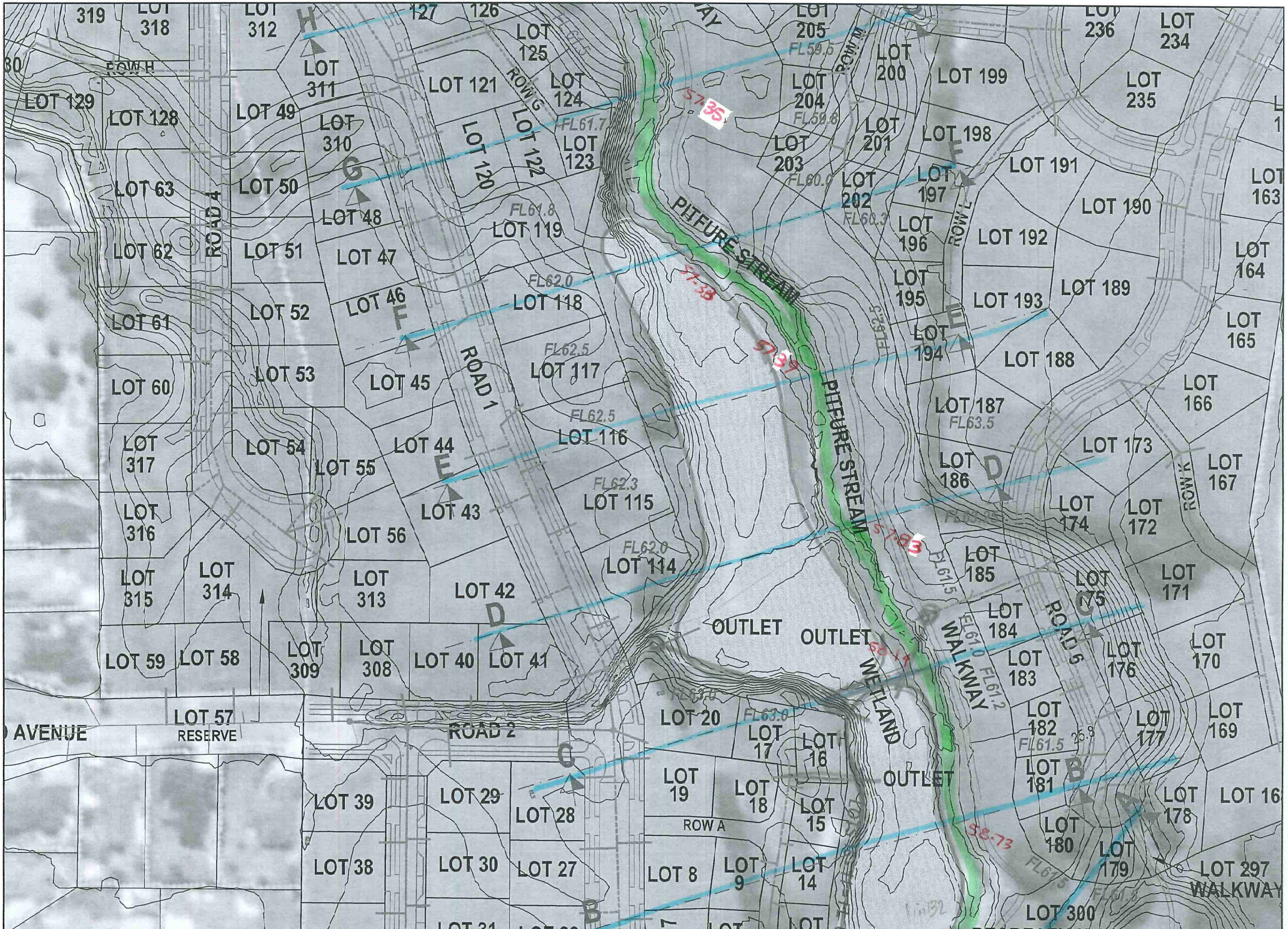
Pitfure Stream

n =	0.045	
S =	0.006667	typical flatter to north end

$Q = A.R^{2/3}.S^{1/2}.n^{-1}$ R = A/P

Section

AA	A =	11.41	BB	A =	12.26	CC	A =	11.66
	P =	11.47		P =	14.56		P =	12.14
	R =	0.994769		R =	0.842033		R =	0.960461
	S =	0.006667		S =	0.006667		S =	0.006667
	v =	1.808104		v =	1.617936		v =	1.766289
	Q =	20.63046		Q =	19.83589		Q =	20.59493
DD	A =	10.77	EE	A =	12.4	FF	A =	14.64
	P =	9.85		P =	14.14		P =	20.52
	R =	1.093401		R =	0.876945		R =	0.71345
	S =	0.00625		S =	0.006667		S =	0.006667
	v =	1.864578		v =	1.662353		v =	1.44872
	Q =	20.0815		Q =	20.61318		Q =	21.20925
GG	A =	10.98	HH	A =	14.74	II	A =	13.8
	P =	10.41		P =	14.28		P =	10.92
	R =	1.054755		R =	1.032213		R =	1.263736
	S =	0.006667		S =	0.003704		S =	0.003333
	v =	1.88008		v =	1.381291		v =	1.499677
	Q =	20.64328		Q =	20.36023		Q =	20.69555
Control	A =	30.2	Control	A =	9.035			
	P =	29.49		P =	10.48			
	R =	1.024076		R =	0.862118			
	S =	0.006452		S =	0.00625			
	v =	1.813467		v =	1.591373			
	Q =	54.76672		Q =	14.37806			


LOT 319
LOT 318
LOT 312
LOT 127
LOT 126
LOT 125
LOT 311
LOT 121
LOT 124
LOT 129
LOT 128
LOT 49
LOT 310
LOT 120
LOT 122
LOT 123
LOT 63
LOT 50
LOT 48
LOT 119
LOT 62
LOT 51
LOT 47
LOT 52
LOT 46
LOT 118
LOT 61
LOT 53
LOT 45
LOT 117
LOT 60
LOT 54
LOT 44
LOT 116
LOT 317
LOT 55
LOT 43
LOT 115
LOT 316
LOT 56
LOT 114
LOT 315
LOT 314
LOT 313
LOT 42
LOT 59
LOT 58
LOT 309
LOT 308
LOT 40
LOT 41
LOT 57
RESERVE
LOT 20
LOT 17
LOT 16
LOT 39
LOT 29
LOT 28
LOT 19
LOT 18
LOT 15
LOT 38
LOT 30
LOT 27
LOT 8
LOT 9
LOT 14
LOT 205
LOT 200
LOT 199
LOT 204
LOT 201
LOT 198
LOT 203
LOT 202
LOT 197
LOT 191
LOT 196
LOT 192
LOT 195
LOT 193
LOT 194
LOT 188
LOT 187
LOT 186
LOT 173
LOT 185
LOT 174
LOT 172
LOT 184
LOT 175
LOT 171
LOT 183
LOT 176
LOT 170
LOT 182
LOT 177
LOT 169
LOT 181
LOT 178
LOT 16
LOT 180
LOT 179
LOT 297
LOT 300
LOT 236
LOT 234
LOT 235
LOT 190
LOT 163
LOT 164
LOT 189
LOT 165
LOT 166
LOT 167
ROAD 1
ROAD 2
ROAD 4
ROAD 6
PITFURE STREAM
WETLAND
WALKWAY
OUTLET
ROW A
ROW G
ROW H
ROW J
ROW K
AVENUE
FL62.0
FL62.5
FL62.3
FL63.0
FL61.7
FL61.8
FL59.6
FL59.8
FL60.0
FL60.3
FL63.5
FL61.5
FL61.0
FL61.2
FL61.5
S7.35
S7.33
S7.37
S7.63
S8.11
S8.73

Cotton & Light Ltd
SURVEYORS
28 Oxford Street
PO Box 3406
Richmond 7050
www.cottonandlight.co.nz
Ph: (03) 544 5470
Free Phone: 0800 GO4GPS
Email: survey@cottonandlight.co.nz

KEY:
INDICATIVE STORMWATER LAYOUT

DRAFT

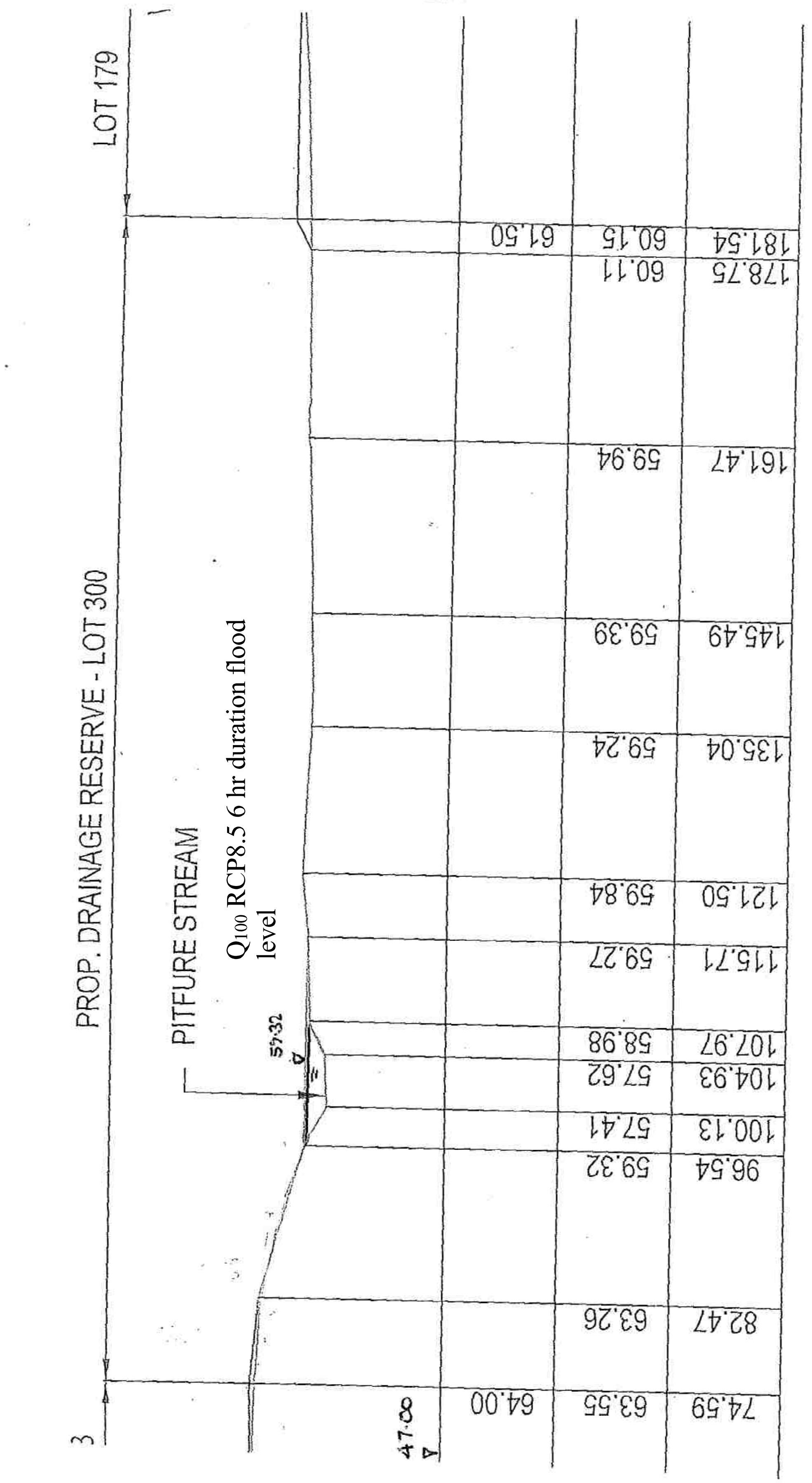
SCALE 1:1000 @A2

Date: 11 April 2022

Sheet 3 of 9

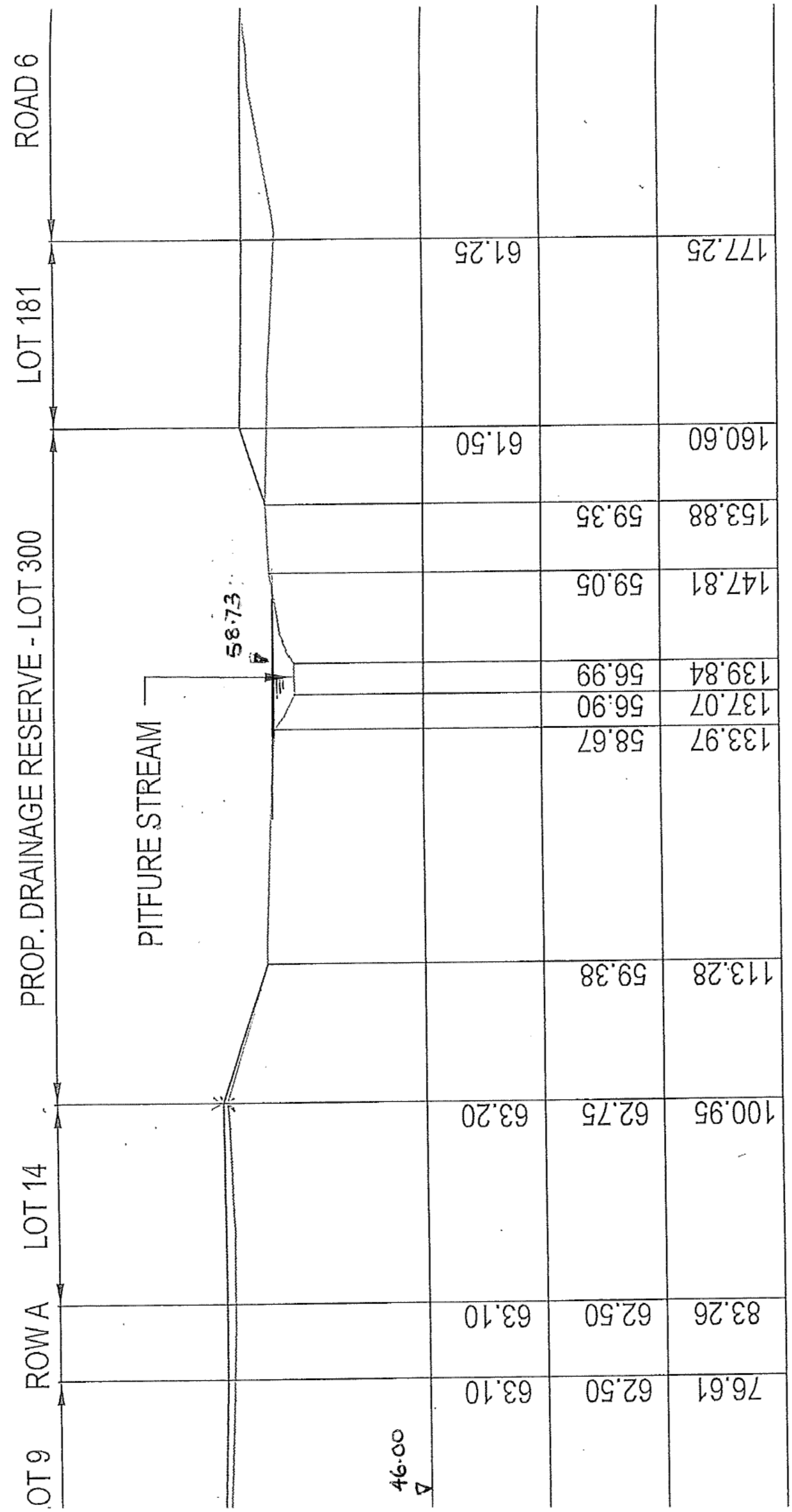
JOB TITLE:
WAKEFIEL
177 ED

DRAWING TITLE:
INDICATIVE S
OF LOTS 107 & 108 RM15
LOT 2 DP 316322 AN

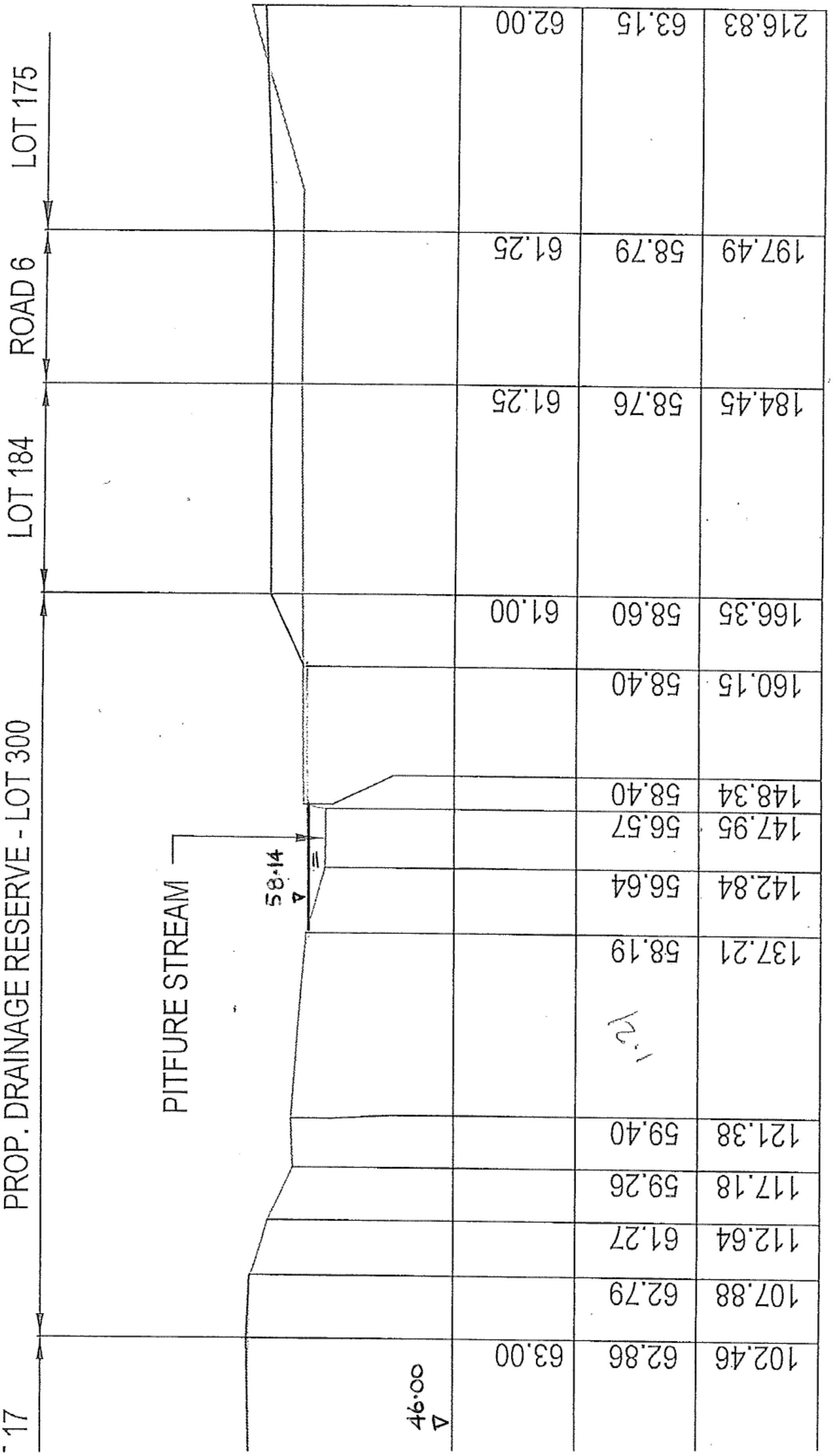


LOT 179
PROP. DRAINAGE RESERVE - LOT 300
PITFURE STREAM
Q_{100} RCP8.5 6 hr duration flood level
57.32
47.80
64.00
63.55
74.59
63.26
82.47
59.32
96.54
57.41
100.13
57.62
104.93
58.98
107.97
59.27
115.71
59.84
121.50
59.24
135.04
59.39
145.49
59.94
161.47
60.11
178.75
61.50
60.15
181.54

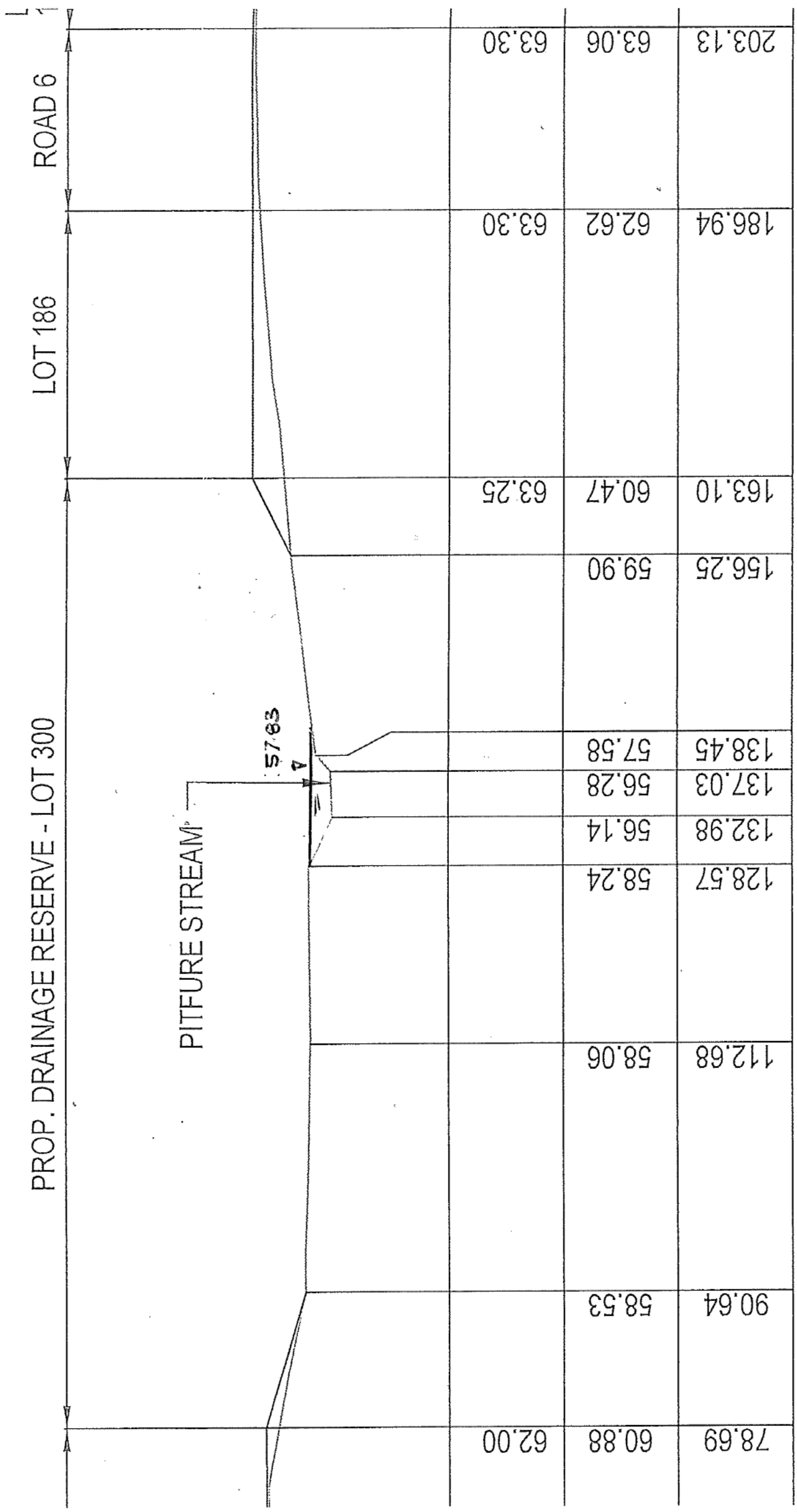
SECTION AA


ROAD 6
LOT 181
PROP. DRAINAGE RESERVE - LOT 300
PITFURE STREAM
LOT 14
ROW A
OT 9
58·73
46·00
61.25
177.25
61.50
160.60
59.35
153.88
59.05
147.81
56.99
139.84
56.90
137.07
58.67
133.97
59.38
113.28
63.20
62.75
100.95
63.10
62.50
83.26
63.10
62.50
76.61

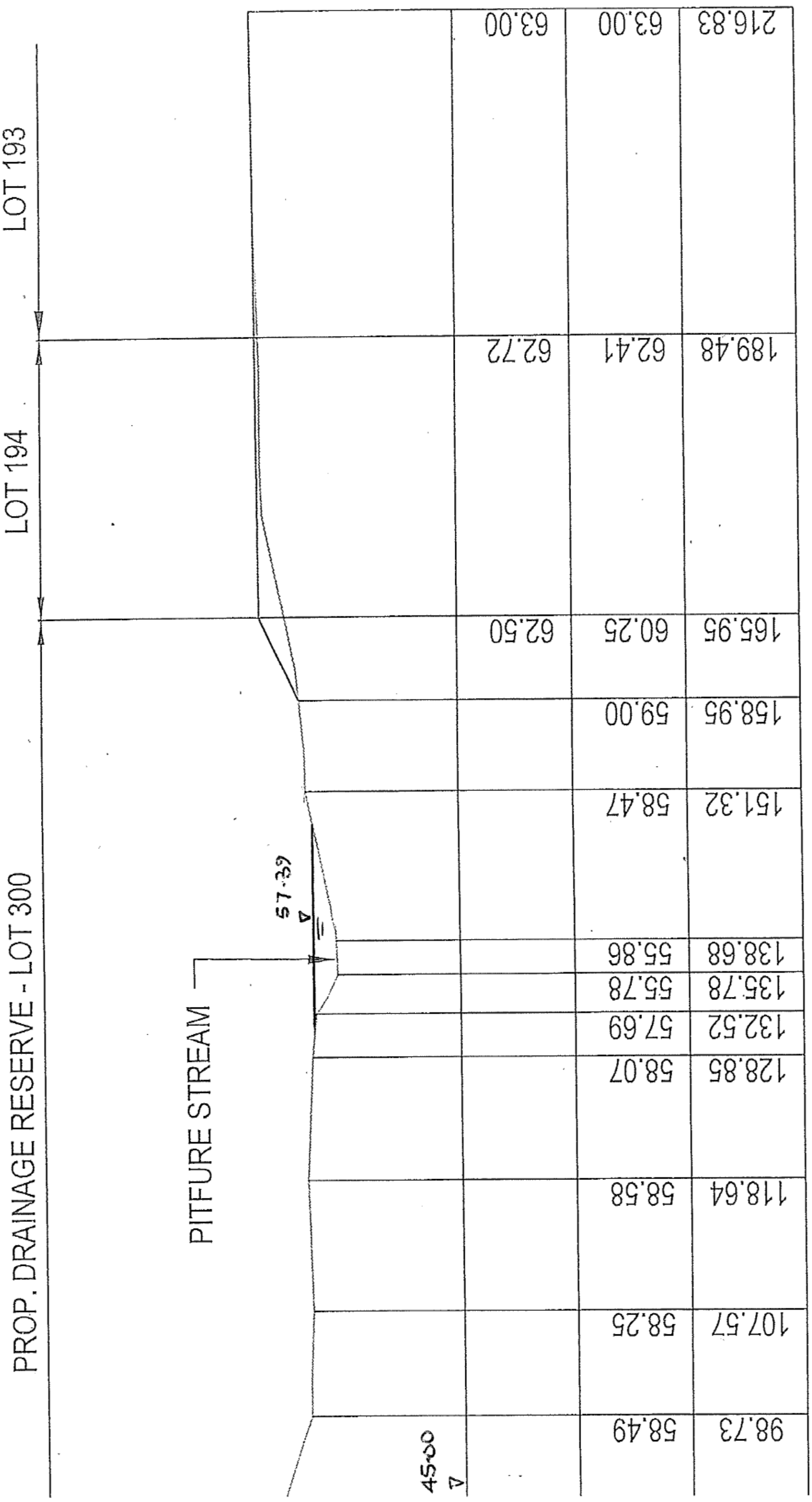
SECTION BB


LOT 175
ROAD 6
LOT 184
PROP. DRAINAGE RESERVE - LOT 300
PITFURE STREAM
17
58.14
46.00
216.83
63.15
62.00
197.49
58.79
61.25
184.45
58.76
61.25
166.35
58.60
61.00
160.15
58.40
148.34
58.40
147.95
56.57
142.84
56.64
137.21
58.19
121.38
59.40
117.18
59.26
112.64
61.27
107.88
62.79
102.46
62.86
63.00

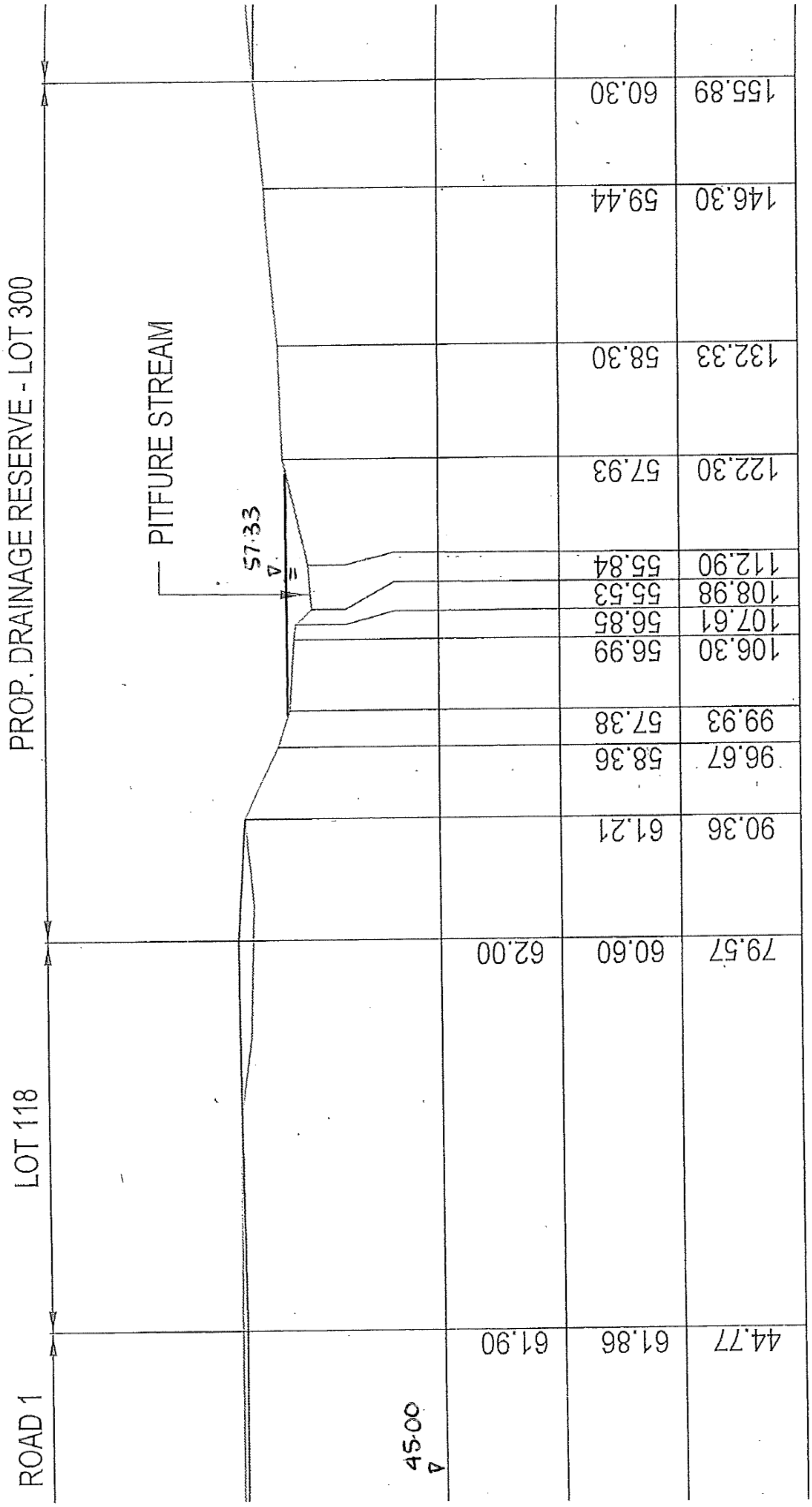
SECTION CC


ROAD 6
LOT 186
PROP. DRAINAGE RESERVE - LOT 300
PITFURE STREAM
57.83
63.30
63.06
203.13
63.30
62.62
186.94
63.25
60.47
163.10
59.90
156.25
57.58
138.45
56.28
137.03
56.14
132.98
58.24
128.57
58.06
112.68
58.53
90.64
62.00
60.88
78.69

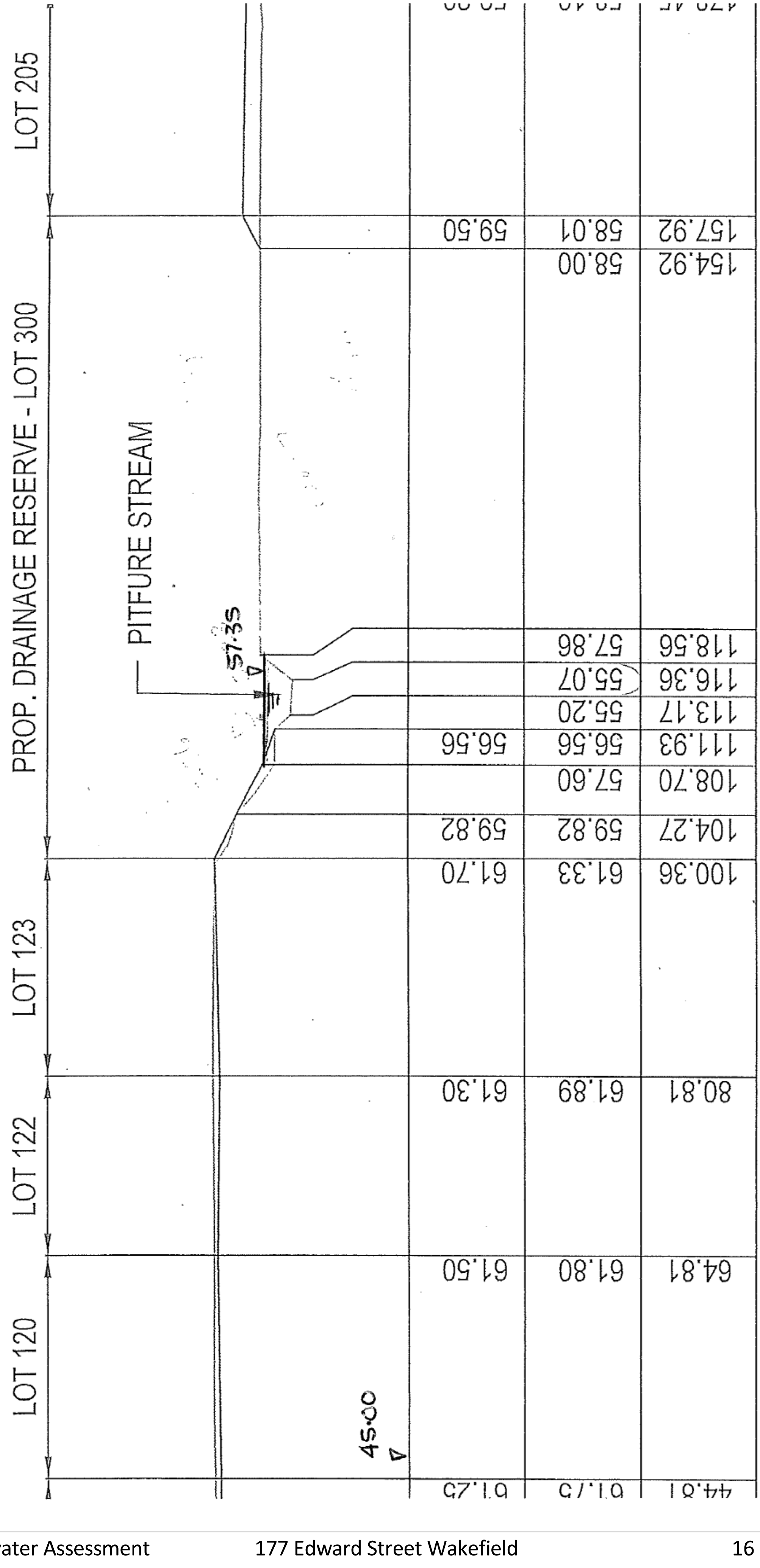
SECTION DD


LOT 193
LOT 194
PROP. DRAINAGE RESERVE - LOT 300
PITFURE STREAM
57.39
45.00
63.00
63.00
216.83
62.72
62.41
189.48
62.50
60.25
165.95
59.00
158.95
58.47
151.32
55.86
138.68
55.78
135.78
57.69
132.52
58.07
128.85
58.58
118.64
58.25
107.57
58.49
98.73

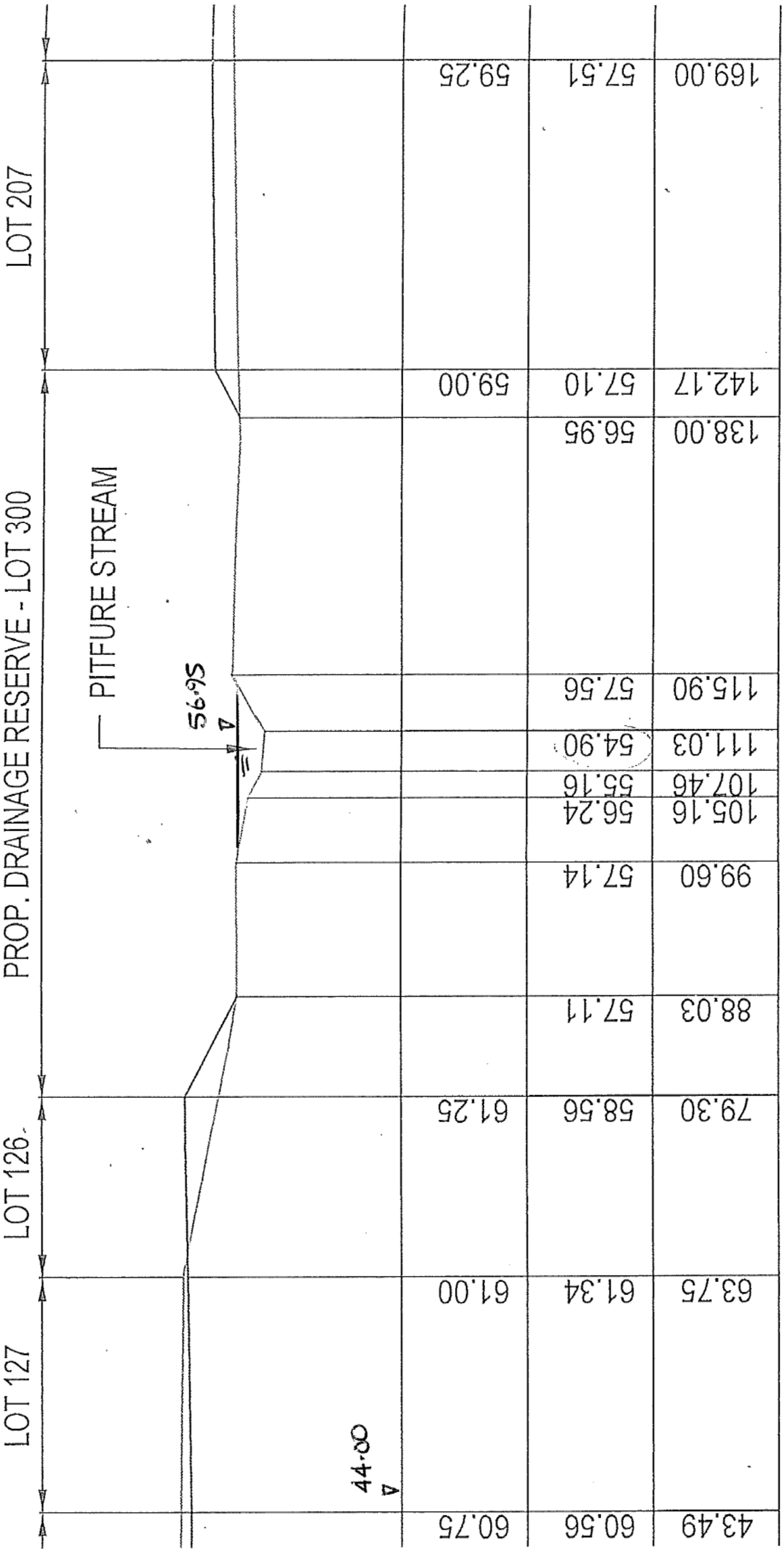
SECTION EE


ROAD 1
LOT 118
PROP. DRAINAGE RESERVE - LOT 300
PITFURE STREAM
57.33
45.00
61.90
61.86
44.77
62.00
60.60
79.57
61.21
90.36
58.36
96.67
57.38
99.93
56.99
106.30
56.85
107.61
55.53
108.98
55.84
112.90
57.93
122.30
58.30
132.33
59.44
146.30
60.30
155.89

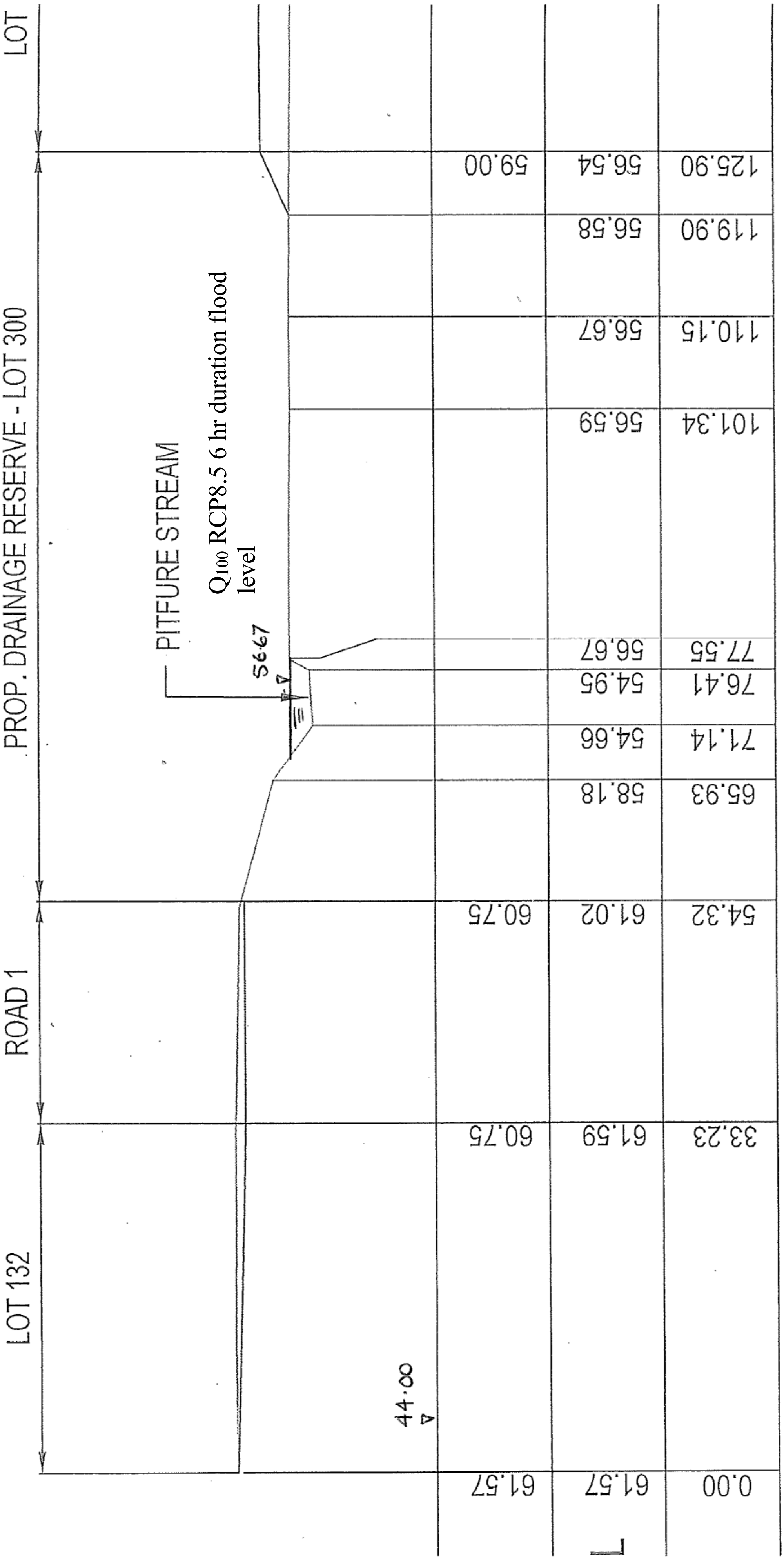
SECTION FF


LOT 205
PROP. DRAINAGE RESERVE - LOT 300
PITFURE STREAM
57.35
LOT 123
LOT 122
LOT 120
45.00
59.50
58.01
157.92
58.00
154.92
57.86
118.56
55.07
116.36
55.20
113.17
56.56
56.56
111.93
57.60
108.70
59.82
59.82
104.27
61.70
61.33
100.36
61.30
61.89
80.81
61.50
61.80
64.81

SECTION GG


LOT 207
PROP. DRAINAGE RESERVE - LOT 300
PITFURE STREAM
LOT 126
LOT 127
56.95
44.00
59.25
57.51
169.00
59.00
57.10
142.17
56.95
138.00
57.56
115.90
54.90
111.03
55.16
107.46
56.24
105.16
57.14
99.60
57.11
88.03
61.25
58.56
79.30
61.00
61.34
63.75
60.75
60.56
43.49

SECTION HH


LOT
PROP. DRAINAGE RESERVE - LOT 300
ROAD 1
LOT 132
PITFURE STREAM
Q100 RCP8.5 6 hr duration flood level
56.67
44.00
59.00
56.54
125.90
56.58
119.90
56.67
110.15
56.59
101.34
56.67
77.55
54.95
76.41
54.66
71.14
58.18
65.93
60.75
61.02
54.32
60.75
61.59
33.23
61.57
61.57
0.00

SECTION II