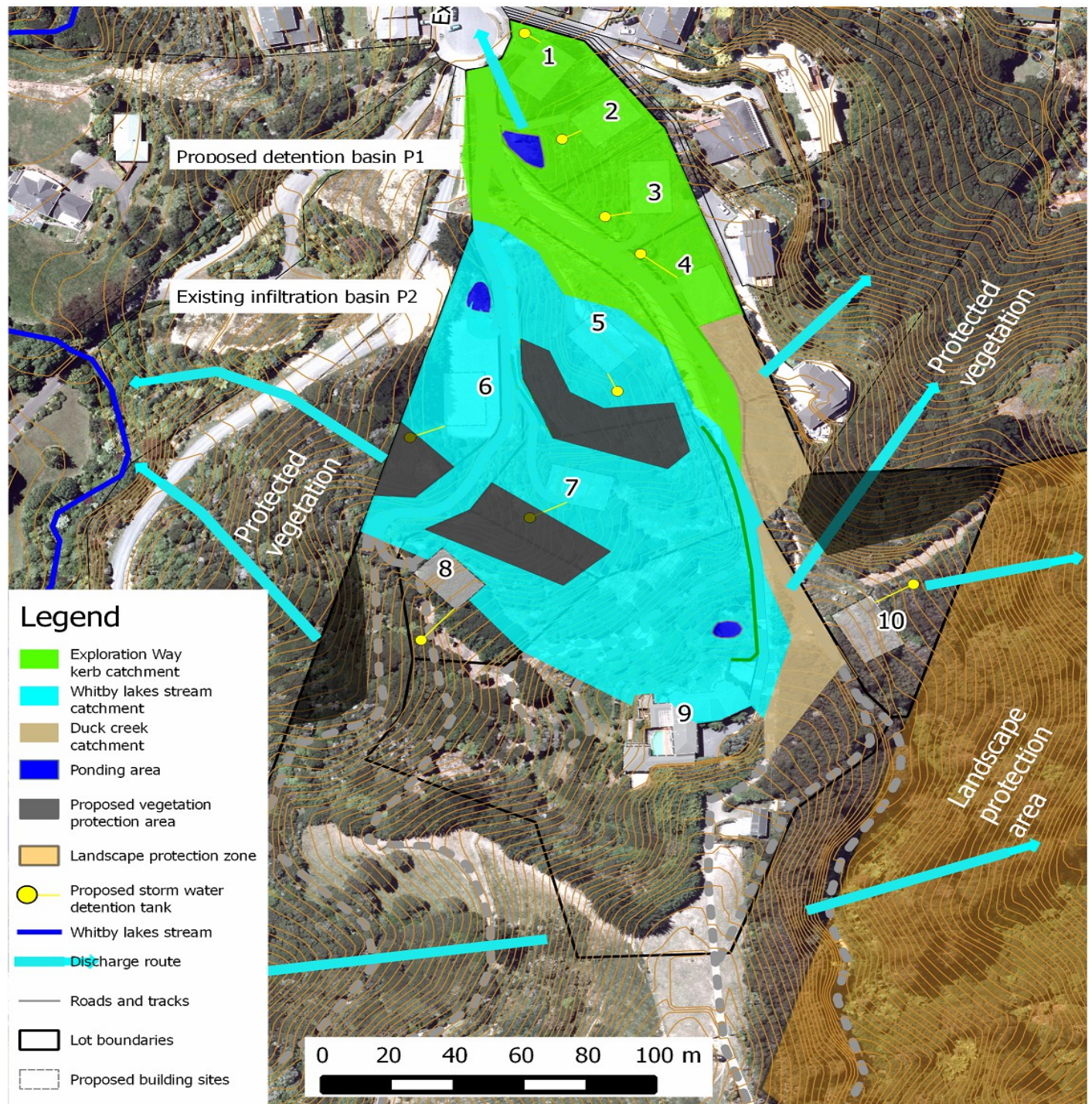


Storm water Catchment Analysis

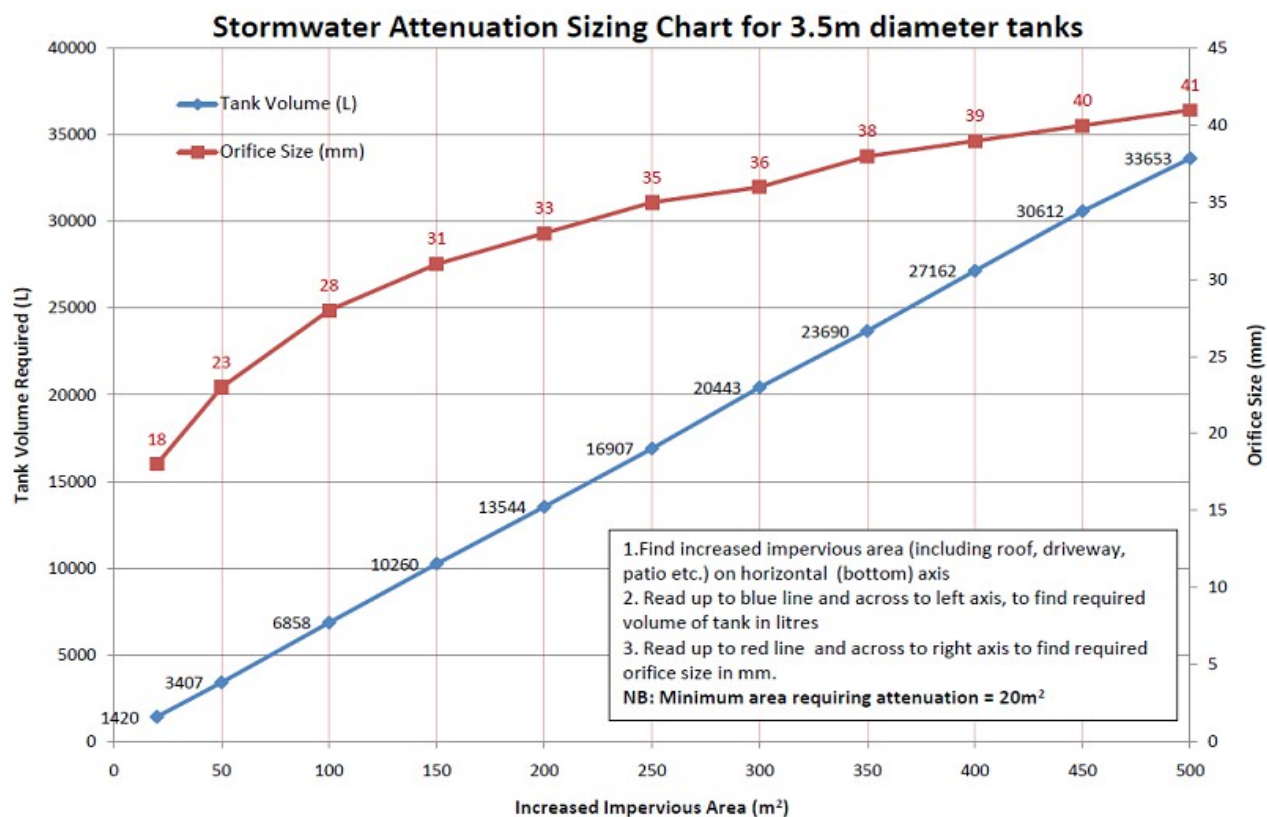


Analysis index

1. Storm water attenuation tank sizing method
2. Consent notices for storm water attenuation tanks
3. Summary of sub catchments
4. Hydrological Analysis for Exploration Way catchment
5. Hydrological Analysis for Whitby lakes stream catchment
6. Impact on neighbours

1 Storm water attenuation tank sizing method

All new lots are to use detention tanks to mitigate the effects of new impervious surfaces created by future building. It is proposed that the following chart be adopted from the Whangarei District Council as one acceptable solution to calculating detention tank sizes for this development.



(See <http://www.wdc.govt.nz/WaterandWaste/Stormwater/Stormwater-Attenuation/Pages/Default.aspx> for more detail)

With tropical storms, Whangarei have rainfall intensities that are typically 50% higher again than Porirua. This is demonstrated in the two charts below comparing Porirua and Whangarei rainfall intensities as provided by the NIWA HIRDS system (<http://hirds.niwa.co.nz>).

Results for Porirua

Intensity-Duration-Frequency results (produced on Wednesday 26th of February 2014)

Sitename: Porirua

Coordinate system: NZMG

Easting: 2664465

Northing: 6006278

Rainfall intensities (mm/h)

ARI (y)	aep	Duration									
		10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	39.0	27.3	22.2	15.6	10.5	5.6	3.8	2.5	1.5	1.1
2.00	0.500	42.6	29.7	24.0	16.8	11.3	6.0	4.0	2.7	1.6	1.2
5.00	0.200	54.0	37.8	30.6	21.4	14.2	7.5	5.0	3.3	1.9	1.4
10.00	0.100	63.0	44.1	35.8	25.0	16.6	8.7	5.8	3.8	2.2	1.6
20.00	0.050	73.2	51.3	41.6	29.2	19.3	10.0	6.6	4.4	2.6	1.9
30.00	0.033	80.4	56.1	45.6	31.8	21.0	10.9	7.2	4.7	2.8	2.0
40.00	0.025	85.2	59.7	48.4	33.9	22.3	11.5	7.6	5.0	2.9	2.1
50.00	0.020	89.4	62.7	50.8	35.5	23.4	12.0	7.9	5.2	3.0	2.2
60.00	0.017	93.0	65.1	52.8	36.9	24.2	12.5	8.2	5.4	3.1	2.3
80.00	0.012	99.0	69.3	56.2	39.2	25.8	13.2	8.7	5.7	3.3	2.4
100.00	0.010	103.8	72.6	58.8	41.2	26.9	13.8	9.0	5.9	3.5	2.5

Results for Whangarei

Intensity-Duration-Frequency results (produced on Wednesday 26th of February 2014)

Sitename: Whangarei

Coordinate system: NZMG

Easting: 2630430

Northing: 6607543

Rainfall intensities (mm/h)

ARI (y)	aep	Duration									
		10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	60.0	42.6	34.8	24.7	17.1	9.6	6.6	4.6	2.8	2.1
2.00	0.500	64.8	45.9	37.6	26.7	18.5	10.3	7.1	4.9	3.0	2.3
5.00	0.200	81.6	58.2	47.6	33.8	23.3	13.0	9.0	6.2	3.8	2.9
10.00	0.100	95.4	67.8	55.6	39.4	27.2	15.1	10.4	7.2	4.4	3.3
20.00	0.050	111.0	78.9	64.4	45.8	31.6	17.5	12.0	8.3	5.1	3.8
30.00	0.033	120.6	85.8	70.2	49.9	34.4	19.0	13.1	9.0	5.5	4.2
40.00	0.025	128.4	91.2	74.6	53.0	36.5	20.2	13.9	9.5	5.9	4.4
50.00	0.020	134.4	95.4	78.2	55.5	38.2	21.1	14.5	10.0	6.1	4.6
60.00	0.017	139.8	99.3	81.2	57.7	39.6	21.9	15.0	10.3	6.4	4.8
80.00	0.012	148.2	105.3	86.2	61.2	42.1	23.2	16.0	11.0	6.8	5.1
100.00	0.010	155.4	110.4	90.4	64.2	44.0	24.3	16.7	11.5	7.1	5.3

So although well over designed for Porirua the above chart provides a quick indicator of a solution to mitigating storm water concentration on new impervious surfaces.

2 Consent notices for storm water attenuation tanks

Using the tank sizing method chart in the previous section one can see that for an increase in impervious surface of 250m² for a new dwelling/hard stand footprint then a 3.5m diameter tank with approximately 17,000 litres of storage and 35mm diameter outlet would in theory mitigate the increased impervious area (even in Whangarei :-). Such a tank can be bought for under \$3000.

It is proposed that each site in the development provide such detention tank (or appropriate alternative) mitigation for any new impervious surfaces. As the sites are big and most have extensive bush coverage, there are ample suitable locations to tuck an above ground tank away out of sight and surrounded by bush. Lot owners may opt for more expensive underground tanks or methods but good above ground tank locations have been selected and indicated in the previous diagram. It is anticipated that council will want to ensure future development has appropriate storm water mitigation via consent notice. This being the case the developer would like to allow purchasers a simple solution for calculation of appropriate tank size.

It is therefore proposed that a consent notice be placed on titles for lots 1 – 10 to the effect that approved storm water attenuation will be required for any new impervious surfaces and that the chart on the previous page provides one acceptable means of calculating the sizing of this attenuation.

As suggested in the consent application lots 8, 9 and 10 may be able to get away with flow dissipater/soakage systems but as for any alternative these would need acceptable to council.

As the **development sits at the top of several watersheds** the natural storm water drains via several different discharge points as indicated on the overview diagram on the previous page. The different catchment analysis methods are summarised below.

Lot 10 dwelling is at the top of a large protected area of bush (Landscape protection zone) draining through several hundred meters of natural filter before reaching Duck creek. Any new impervious surfaces are proposed to be fully mitigated with detention tanks as discussed above. *No further storm water analysis for this dwelling is included here.*

Lot 9 (existing) dwelling and areas further south are not proposed to have new impervious surfaces or be greatly impacted by the development. This balance land naturally drains partly to the Whitby lakes stream and partly to the Duck creek through protected bush areas. *No further storm water analysis of these areas is included here.*

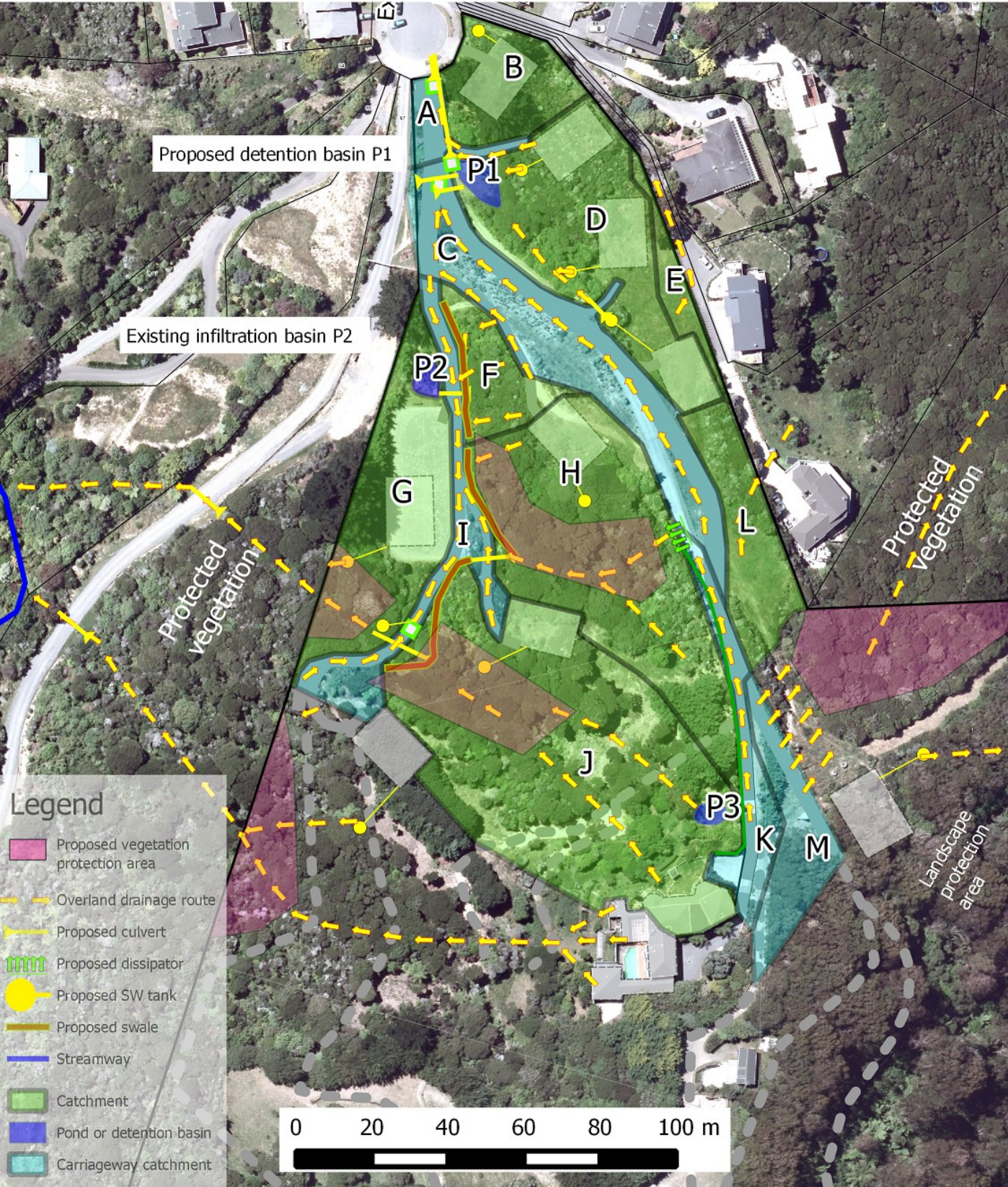
Lot 8 dwelling has an overland flow path through an area proposed for vegetation protection then an area already covenanted for vegetation protection and then to the Whitby lakes stream. Any new impervious surfaces are proposed to be fully mitigated with detention tanks as discussed above. *No further storm water analysis is included here.*

Drains to Duck Creek: A small area of the watershed affected by the development drains to Duck creek as shown in the previous diagram. There will be a slight and deliberate redirection of some of this flow back to its natural overland paths so as to ensure not to exasperate and hopefully reduce the current storm water issues suffered by 59 Exploration Way. The end point of this flow will still be Duck Creek. See later for further analysis of this area.

Drains to Whitby Lakes stream: The area shown in light blue on the previous diagram drains to the Whitby lakes stream. Mostly this exits the development land through a single dry gully into an area with existing vegetation protection. This gully leads to an existing 300mm diameter culvert under the neighbor's driveway before continuing down to the stream. New impervious surfaces are to be mitigated with detention tanks etc before water is returned to its natural overland flow route to the gully. See later rational method analysis of this area.

Drains to Exploration Way: The area shown in green on the previous page drains to the Exploration Way kerb. This is the most problematic drainage but with the introduction of storm water attenuation tanks for dwellings and a new storm water detention basin the rational method calculations provided later indicate a reduction in peak flows to the kerb can be easily achieved. See later rational method analysis of this area.

3 Summary of sub catchments



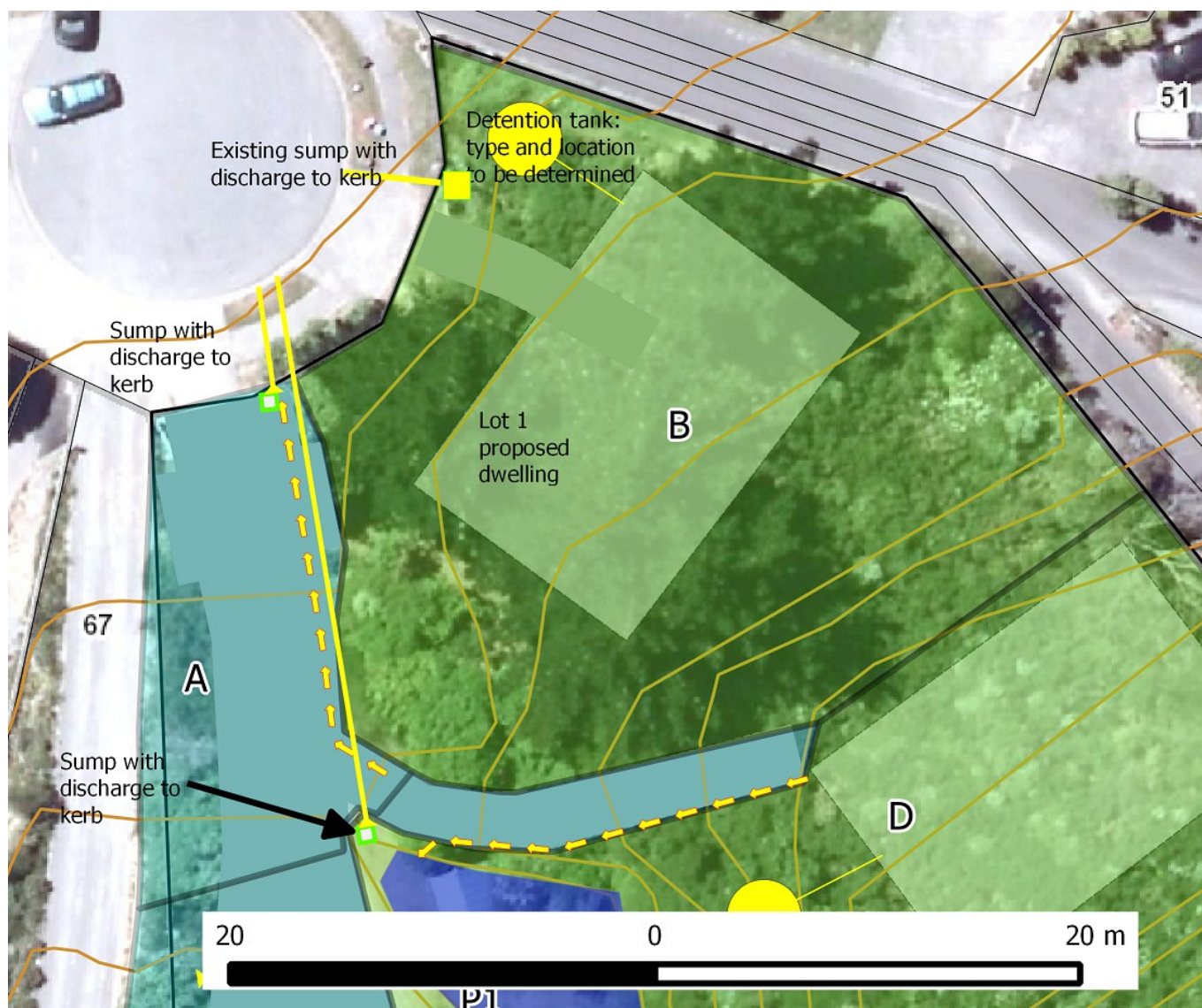
The following table and diagrams summarise the catchment areas highlighted above.

Summary of storm water sub catchments and possible mitigation measures

ID	Catchment description	Total Area (m2)	Post dev impervious area (m2) *	Proposed detention (m3) *	Impervious surfaces water route
Drains to Exploration Way kerb					
A	Entrance	237	141	0	Direct to kerb via crossing.
B	Lot 1 dwelling	902	250	17	To detention tank then discharge to kerb via existing pipe
C	Lot 2 3 4 5 carriageway	2076	1030	50	ROW channel, to new detention basin, then restricted outflow to kerb via standard discharge pipe(s) (relocate existing pipe)
D	Lot 2 3 4 dwellings	2353	750	51	Individual detention tanks then overland (one culvert for lot 3 driveway) to detention basin, then restricted outflow to kerb via standard discharge pipe (relocate existing)
E	Opposite 57 Exploration Way	276	0	0	No impervious surfaces. Continue current drainage route down neighboring ROW kerb to Exploration Way.
		5844	2171	118	
Drains to Whitby lakes stream					
F	Lot 6 detention basin	632	0	20	Overland flow to new ROW then to existing natural detention basin. Detention basin infiltrates to ground.
G	Lot 6 dwelling	1880	250	17	To detention tank then return the flow to natural overland route.
H	Lot 5 dwelling	3332	250	17	To detention tank then return flow to natural overland route down dry gully then via culverts under driveway and ROW to final gully route as for current flow to Whitby lakes stream.
I	Lot 6 7 8 carriageway	949	473	33	ROW to retain water directly on its surface up to 100mm deep (0 longitudinal grade past horse arena) , with central channel outflow (1:100 grade) and restricted release back to overland flow path.
J	Lot 7 dwelling	5272	475	17	To detention tank then return flow to current overland route.
K	Lot 9 carriageway (existing)	721	450	0	ROW channel to attenuation discharge point to overland flow route
		12786	1898	104	
Drains to Duck creek					
L	Uphill of 59 Exploration Way	938	0	0	No impervious surfaces. Natural flow regime maintained. This largely runs under the 59 Exploration Way driveway.
M	Lot 10 carriageway	822	182	0	Use porous paving and cross flow design solution so this wont actually be a new impervious surface. Reinstate natural overland drainage route through 130m of protected vegetation.
		1760	182	0	

*The Post Development Impervious Area for a new dwelling is estimated here at 250m2 per dwelling.

*The detention tank sizing needed for dwellings etc is estimated as previously described.

Catchments A, B: Entrance to right of way and Lot 1 dwelling**Catchment A: Entrance**

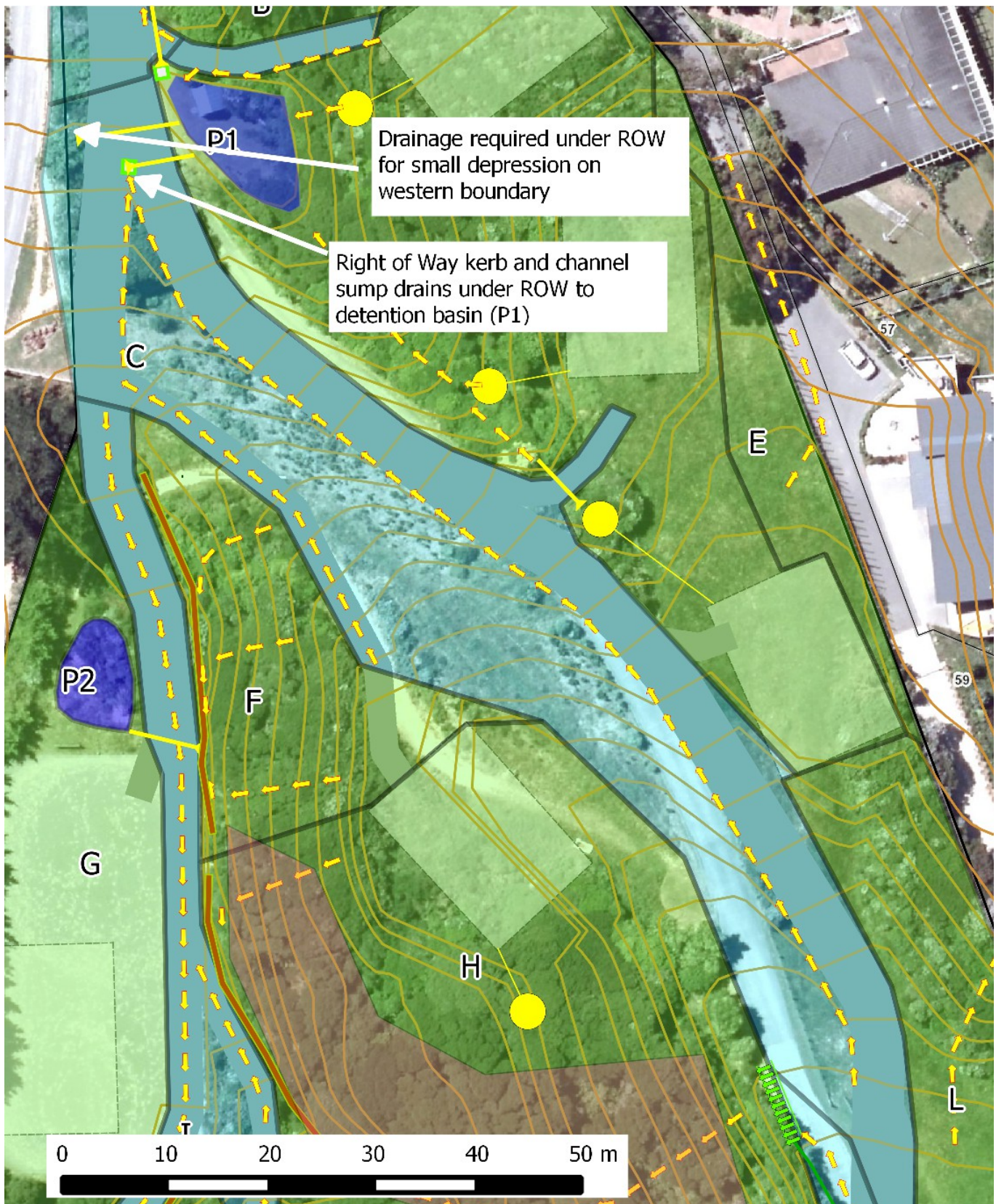
Catchment A is the main entrance to the development. The crossing/discharge location is at the highest point on the Exploration Way kerb so water flows both directions and thus down both sides of Exploration Way. This catchment is approximately 240m² including a small component on the western neighbours property. Approximately 140m² (being 22m of 6m wide ROW plus some driveway) of this area will be sealed under the proposal and will discharge to the kerb via a sump and standard pipe. No storm water detention is anticipated for this area. The storm water from further up the development that would normally discharge across this area will be diverted to a new detention pond (P1) as described later.

Currently this catchment has only 77m² of sealed surface (22m of 3.5m wide ROW).

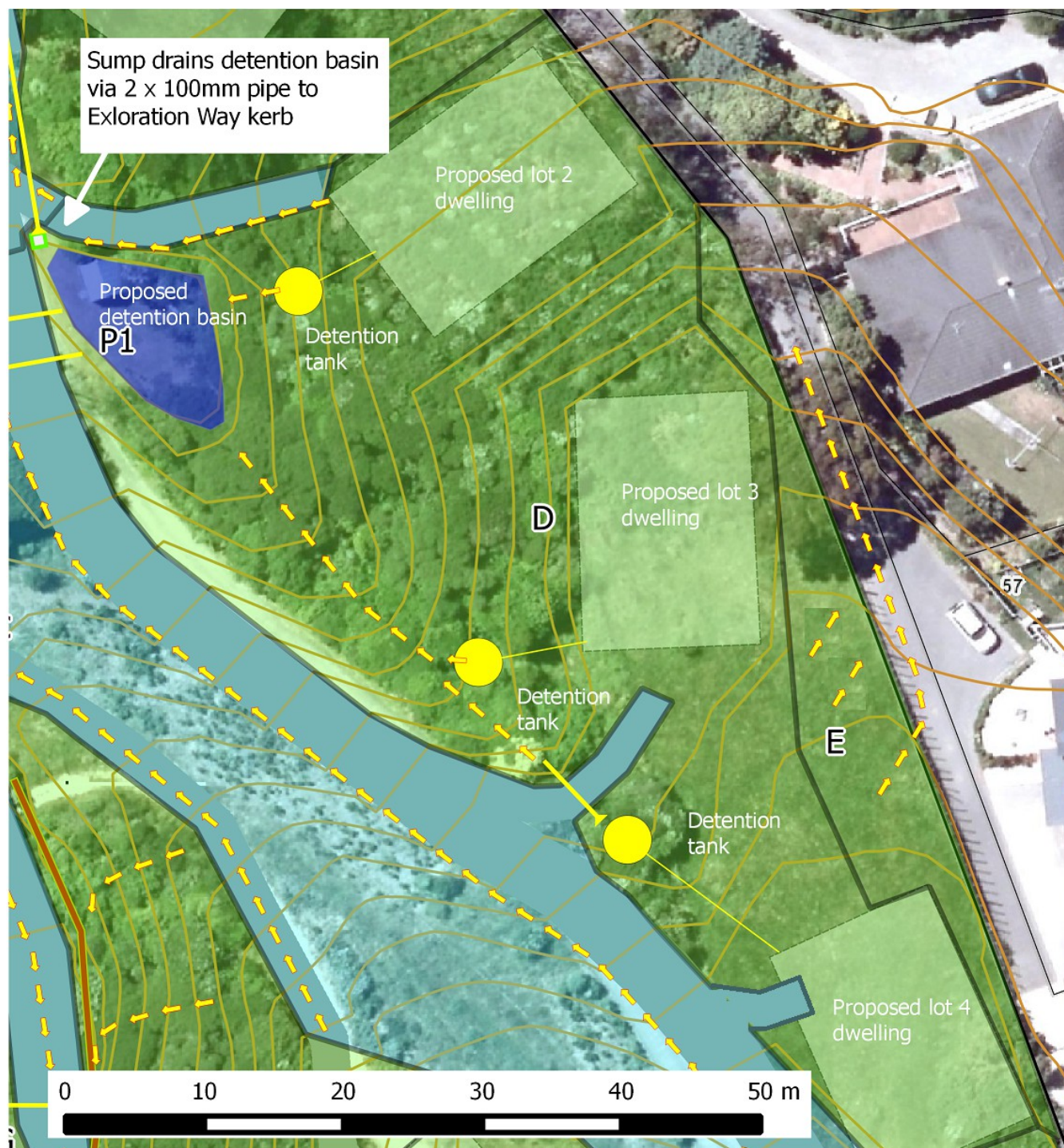
Catchment B: Lot 1 dwelling

Catchment B is the only lot in the development with direct frontage to Exploration Way. Currently this frontage has a sump that drains through twin 100mm pipes to the kerb. The twin pipes will no longer be required as the uphill water that currently flows to this road frontage will be diverted to the ponding area leaving only catchment B discharging directly to the road frontage. It is anticipated that the twin pipes in place will be left in place even though the loading requirement for them has gone.

If required by council appropriate detention tanks can be installed to compensate for new impervious surfaces on lot 1 which would further reduce the current storm water loads on the existing sump, pipes and crossing.



Catchment C has a total area of 2076m² and includes the 164m of 5m wide carriageway plus a total of around 60m length of 3.5m wide driveways up to dwellings 2,3,4 and 5. This means 1030m² of impervious surface as opposed to the 427m² of driveway that currently exists in this catchment. It is proposed that catchment C drain to the a new detention basin (P1).



Catchment D: Lots 2, 3 and 4 dwellings

Catchment D is proposed to contain the dwellings for lots 2, 3 and 4 and each of these lots will individually mitigate any new impervious surfaces with appropriate detention tanks. Good locations are available on lots 2 and 3 to hide large above ground tanks in the retained native trees. The lot 4 tank location shown would not be as well hidden and a future owner may consider underground storage. The tanks shown above are 3.5m diameter and each would typically have a 40mm diameter or smaller outfall. A culvert will be required under the driveway to the lot 3 dwelling. All drainage for this catchment will be to the new detention basin as shown (pump house to be removed).

Catchment E: Opposite 57 Exploration Way

This small area drains to the neighbour's right of way then to the Exploration Way kerb. A small reduction in this flow will probably occur as a result of new buildings diverting flows to detention tanks to the west.

4 Hydrological Analysis for Exploration Way Discharge

Catchment areas A, B, C, D and E will have pre and post development discharge to the Exploration Way road end. This analysis follows the recommendations in the Regional Standard for Water (<http://www.pcc.govt.nz/Publications/Regional-Standard-for-Water-Services>) and draws on data provided by NIWA's High Intensity Rainfall Design System HIRDS (<http://hirds.niwa.co.nz>). The estimation of surface water run off follows the rational method set out in "Verification Method E1/VM1" from the "Acceptable Solutions and Verification Methods For New Zealand Building Code Clause E1 Surface Water" (<http://www.dbh.govt.nz/userfiles/file/publications/building/compliance-documents#E1>).

The following parameters and assumptions have been used.

- Coefficients C for area moderation based on surface type
 - Bush 0.45 Heavy clay soil bush cover (including slope correction +0.1)
 - Grass 0.5 Heavy clay soil grass cover (including slope correction +0.1)
 - Impervious 0.9 Concrete ROW, hardstand or slightly absorbent roofing (including slope correction +0.05)
- Time of concentration: 10min
- Porirua rainfall intensities at key Annual Exceedance Probabilities (AEP):
 - Primary protection: AEP = 10% for 10min duration intensity = 63mm/hr
 - Secondary protection: AEP = 1% for 10min duration intensity = 103mm/hr
- PCC require provision for climate change: 16% increase in rainfall intensities
- PCC require provision for rainfall zone: 30% increase in rainfall intensities
- Design rainfall intensities with provision for climate change and zone
 - Primary protection: 95mm/hr
 - Secondary protection: 155mm/hr

The following pages provide calculations based on estimated areas for catchments. While the areas of roading are well established in the proposal, future areas of buildings, hard stands and cultivated vegetable gardens are necessarily broad brush. For each site a dwelling / hardstand area of 250m² has been assumed. This potentially under estimates the impervious surfaces. On the other hand the intention is that all new built surfaces appropriately plan mitigation of concentration at the building permit stage. Also it is equally likely that the areas of grass have been over estimated and mitigating bush and gardens with higher absorption are likely to be planted by new owners.

Pre-development catchments A, B, C, D and E				
Catchment	Bush	Grass	Impervious	Total
A Entrance current driveway	110	50	77	237
B Lot 1	902	0	0	902
C Current driveway	0	1646	430	2076
D Lots 2, 3, 4	1713	640	0	2353
E Opposite 57 Exploration Way	0	267	0	267
Area	2725	2603	507	5835
C	0.45	0.5	0.9	
Moderated run off area: C*Area	1226	1302	456	2984
Estimated run off at AEP 10%: 95mm/hr	0.079 m3/s			
Estimated run off at AEP 1%: 155mm/hr	0.128 m3/s			

Post-development catchments A, B, E with no mitigation				
Catchment	Bush	Grass	Impervious	Total
A Entrance upgraded to 6m wide	47	50	140	237
B Build 250m2 dwelling footprint	200	452	250	902
E Unchanged	0	267	0	267
Area	247	769	390	1406
C	0.45	0.5	0.9	
Moderated run off area: C*Area	111	385	351	847
Estimated run off at AEP 10%: 95mm/hr	0.022	m3/s		
Estimated run off at AEP 1%: 155mm/hr	0.036	m3/s		

Post-development catchments C and D with no mitigation				
Catchment	Bush	Grass	Impervious	Total
C Driveway upgrade to 5 wide ROW w/driveways	0	1046	1030	2076
D Add 3 x 250m2 dwelling footprints	600	1003	750	2353
Area	600	2049	1780	4429
C	0.45	0.5	0.9	
Moderated run off area: C*Area	270	1025	1602	2897
Estimated run off at AEP 10%: 95mm/hr	0.076 m3/s			
Estimated run off at AEP 1%: 155mm/hr	0.125 m3/s			

Increase in flow resulting from development with AEP 10% inundation			
	No mitigation (m3/s)	Mitigation (m3/s)	
Post-development catchments A, B, E	0.022	0.022	
Plus Post-development catchments C and D	0.076	0.030	*Limit max outflow of pond
Less Pre-development	0.079	0.079	
Increase (m3/s)	0.020	-0.026	

The figures above show that for a 10 year inundation event that calculated outflows to kerb are:

- currently 79 l/s
- developed but without mitigation 99 l/s
- developed but with proposed mitigation 52 l/s

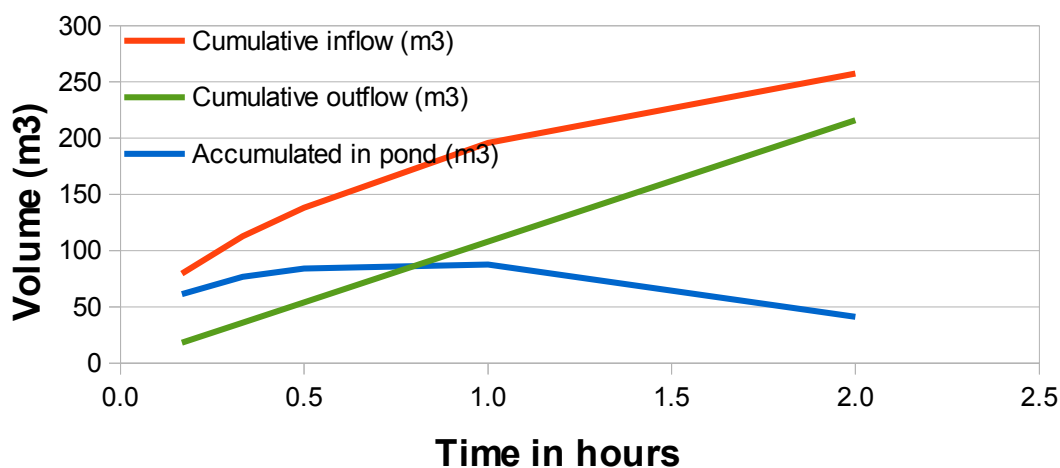
The proposed mitigation is an estimated total storage of 51 m3 (17m3 of storage per each of the three 250m2 anticipated dwellings as previously discussed) for new dwellings on in catchment D plus a new detention basin (P1) with a storage capacity potential of over 100 m3. It is proposed to limit the maximum discharge from the detention basin to approximately 30 l/s (the approximate capacity for two 100mm diameter pipes running from the detention basin location to the kerb).

If the development takes place with the proposed detention tanks and ponding solution one would expect a 26 l/s reduction in the peak loading on the Exploration Way kerb during a 10 year inundation event. (note that rounding effects above mean that the presented data do not sum exactly)

Detention basin volume calculation						
Moderated catchment area (C and D)						2897
With detention basin outflow rate limited to: (l/s)						30
Time	Hours	HIRDS inflow depth (mm)	PCC adjusted inflow depth (mm)	Cumulative inflow (m3)	Cumulative outflow (m3)	Accumulated in pond (m3)
10min	0.17	18.2	27	80	18	61
20min	0.33	25.8	39	113	36	77
30min	0.50	31.6	48	138	54	84
60min	1	44.8	68	196	108	88
2hrs	2	58.9	89	257	216	41
6hrs	6	91	137	398	648	0
12hrs	12	119.7	181	523	1296	0
24hrs	24	157.5	238	688	2592	0
48hrs	48	187.2	282	818	5184	0
72hrs	72	207.1	312	905	7776	0

Detained volume

Catchment area: 2897m²
Outflow rate: 30 l/s



The calculation above for a 10 year flood shows that if the outflow from the detention basin (P1) is limited to 30 l/s (twin 100mm pipes to kerb), a peak detained volume of 88 m³ may accumulate (blue line above). A similar calculation with outflow only limited to 15 l/s (a single 100mm pipe to kerb) indicates 149 m³ of water would temporarily accumulate.

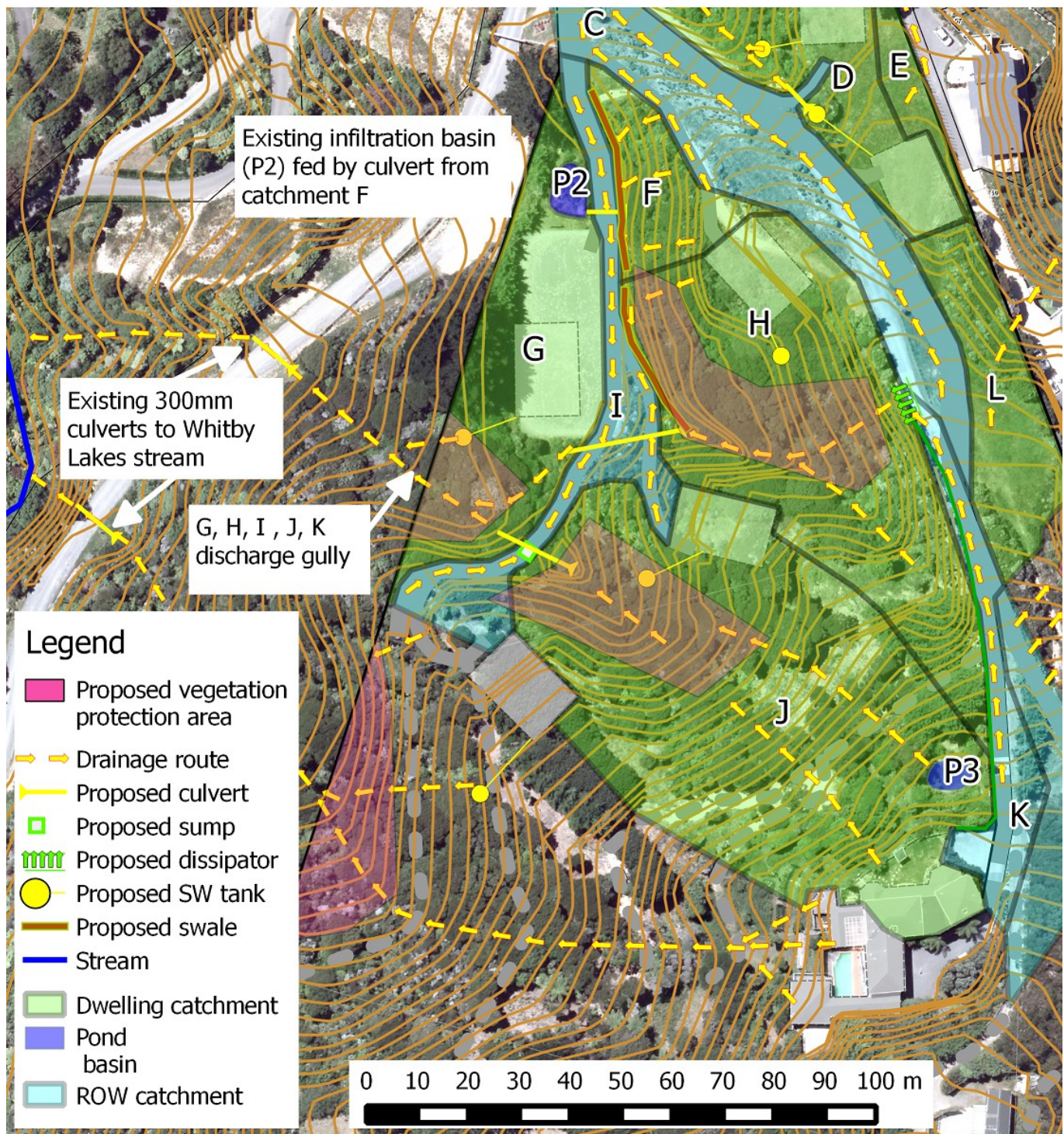
The calculation uses HIRDS inundation data for Porirua (with Annual Exceedance Probability 10%) and increases this inflow by applying the PCC zone (+30%) and climate change (+16%) multipliers. The inflow area used is area C and D as moderated according to the rational method and calculated on the previous page (shown as “Post-development catchments C and D with no mitigation”). The discharge is assumed constant based on a one meter head through pipes although in reality the head will increase as the pond fills.

If the detention basin has an area of 100m² (could easily fit up to 150m² at the location) then storing 88m³ of water would only fill it to 0.88m depth in a 10 year storm event and it would be empty again in less than 3 hours judging by the graph above.

The upstream dwelling detention tanks proposed (est 3 X 17 = 51m³ total) would relieve a considerable part of the load calculated for the detention basin so it is unlikely that the any where near 88m³ of storage would be required at the basin. Final details of the detention basin design are to be discussed with and meet with PCC and geotechnical engineering approval.

5 Hydrological Analysis for Whitby lakes stream discharge

Catchments G, H, I, J and K flow to the Whitby lakes stream



Features:

Run off from catchment F will be intercepted by a channel uphill of the right of way and conducted under the new right of way to its pre-development infiltration basin (P2).

Run off from catchment G (includes proposed lot 6 dwelling) will continue to discharge to its pre-development overland flow paths.

Run off from catchments H and J (includes proposed lot 5 and 7 dwellings with proposed detention tanks) will be conducted to the discharge gully shown with culverts under the new right of way which follow approximately the pre-development overland flow paths and result in discharge to the same gully as for pre-

Run off from catchment I (containing the mostly level proposed right of way across the existing horse arena) will flow to the discharge gully as shown. The northern part of this carriageway segment will divert some run off (about 180m² worth) away from its pre-development destination ground infiltration. This will be a small new load on the discharge gully after appropriate attenuation. This diverted flow will continue on to the Whitby Lakes stream as before.

Run off from catchment K (containing the existing upper section of 68 Exploration Way driveway) will continue (with a small increase in catchment area) to discharge into the upper reaches of catchment H, then down to the Whitby lakes stream.

It is proposed that all elements of new impervious surface (including carriageways) are separately and locally mitigated in this catchment. All new dwellings should have appropriately sized detention tanks installed. The new carriageway will have appropriate detention (on its surface or otherwise within the easement area) to mitigate all concentration effects.

Rational method calculation of change in discharge

The calculations for the theoretical increase in run off if no mitigation is employed are given below.

Pre-development				
Catchment	Bush	Grass	Impervious	Total
F North lot 5 that drains to existing infiltration basin	582	50	0	632
G Contains lot 6	1280	600	0	1880
H Contains lot 5	3350	0	0	3350
I Contains ROW for lots 6, 7 and 8	837	200	0	1037
J Contains lot 7 and part of existing lot 9 dwelling	4792	400	225	5192
K Contains upper section of existing driveway for 68 Exploration Way	271	450	450	721
Area	11112	1700	675	12812
C	0.45	0.5	0.9	
Moderated run off area: C*Area	5000	850	608	6458
Estimated run off at AEP 10%: 95mm/hr	0.170 m3/s			
Estimated run off at AEP 1%: 155mm/hr	0.278 m3/s			

Post-development				
Catchment	Bush	Grass	Impervious	Total
F Unchanged	582	50	0	632
G Dwelling added	1030	600	250	1880
H Dwelling added	3100	0	250	3350
I Right of way added	364	200	473	1037
J Dwelling added	4792	400	475	5192
K Unchanged	271	450	450	721
Area	10139	1700	1898	12812
C	0.45	0.5	0.9	
Moderated run off area: C*Area	4563	850	1708	7121
Estimated run off at AEP 10%: 95mm/hr	0.188 m3/s			
Estimated run off at AEP 1%: 155mm/hr	0.307 m3/s			

Increase in flow resulting from development with AEP 10% inundation

No mitigation	
Post-development AEP 10%	0.188
Less Pre-development AEP 10%	0.170
Increase (m3/s)	0.017

Note: In Catchment G the horse arena has been nominally treated as surface type "Bush".

The 17 l/s increase in peak (AEP 10%) run off to the discharge gully is expected to be fully mitigated with approximately 50m³ of dwelling detention tanks plus 30m³ of carriageway detention capability.

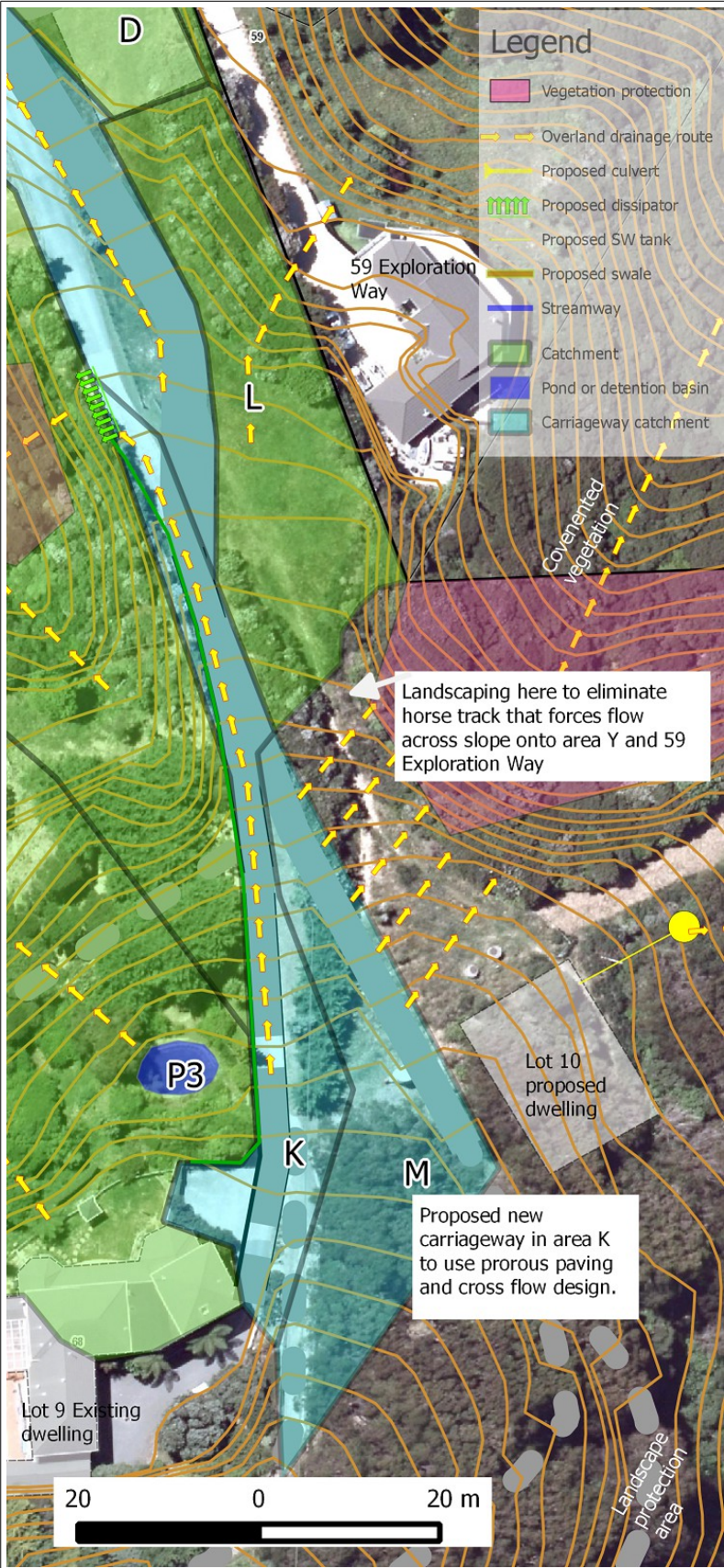
6 Impact on Neighbours

The storm water analysis herein shows that with a 10% annual exceedance probability event, the proposed development should result in storm water flows that largely replicate the pre-development hydrological regime:

- The peak flow of storm water to Exploration Way will however be reduced (which is regarded as a good thing!).
- The peak flow of storm water to Whitby lakes stream should be similar to the present.
- The peak flow of storm water to Duck creek should be similar to the present.
- A (very) small amount of run off that used to flow to Exploration Way kerb via the (eastern) neighbour's right of way will now flow via the new detention basin (P1) (which is regarded as a good thing).
- No immediate neighbours will be negatively affected.
- One immediate neighbour may be significantly positively affected as described below.

59 Exploration Way and actions to ensure no negative impact from the development.

The neighbour at 59 Exploration Way has informed the developer that they are very concerned with storm water run off and currently have issues. It is not clear if there may be some underground spring or other cause but it is proposed that a small change be made to the hydrological regime above this property to try to improve their situation. Rather than try to replicate the immediate pre-development environment it is proposed to take the opportunity to make the changes as described on the following page. It is hoped that these changes will be helpful and they will at the least ensure that there will be no negative effect from the development on 59 Exploration Way.



Catchment M

It is proposed that the new carriageway sited within this small catchment area use porous paving and provide for cross flow of water from the small area uphill of the carriageway. It is intended to direct this cross flow with minor landscaping so that the horse trail which has been diverting water across area L no longer exists. The result will be that catchment M run off will be returned to its natural route over more than 100m of protected vegetation rather than end up passing under the 59 Exploration Way driveway as presently.

Catchment L

This is the catchment immediately above 59 Exploration Way and water appears to flow largely under the 59 Exploration Driveway then down to Duck Creek. The development will reduce the water flowing down this route. No new impervious surfaces are planned in this area.

Catchment K

Although currently water from catchment K appears to flow to the west, due to the lack of camber on the current driveway it is suspected that in extreme storm events that some water flows more in a straight line from K to L (shown on the diagram to the left). IF so, this may be contributing to the storm water issues at 59 Exploration Way. As a result the developer intends to take the opportunity for remedial action to improve the camber/gutter to better ensure the storm water diversion from catchment K to the west.