THE MUNICIPALITY OF THE VILLAGE OF LIONS BAY

INFRASTRUCTURE COMMITTEE MEETING
OF THE VILLAGE OF LIONS BAY
HELD ON THURSDAY, SEPTEMBER 16, 2019 at 7:00 PM
COUNCIL CHAMBERS, 400 CENTRE ROAD, LIONS BAY

AGENDA

1. Call to Order

2. Appointment of Recorder

3. Approval of the Agenda

4. Public Questions & Comments

5. Approval of Minutes

A. Infrastructure Committee Meeting – July 4, 2019 (Page 3)
THAT the Infrastructure Committee Meeting Minutes of July 4, 2019 be approved as presented.

6. Business Arising from the Minutes

7. Unfinished Business

A. Oceanview Drainage Report (Draft report from ISL) (Page 7)
B. Harvey Tank Update (Verbal)
C. Kelvin Grove WWTP Update (Verbal)
D. ICIP Update (Verbal)

8. New Business

A. EV Charging Station – Council request of March 19, 2019 (Norm)
"THAT Council direct the Infrastructure Committee to pursue DC fast charging station "terms of reference" including ownership, maintenance, reliability and user payment format."

9. Public Questions & Comments

10. Adjournment

MEETING OF THE INFRASTRUCTURE COMMITTEE
OF THE VILLAGE OF LIONS BAY
HELD ON THURSDAY, JULY 4, 2019 at 7:00 PM
COUNCIL CHAMBERS, 400 CENTRE ROAD, LIONS BAY

MINUTES

In Attendance:

Committee:	Mayor Ron McLaughlin Councillor Fred Bain (Chair) Councillor Neville Abbott Anthony Greville Jim Mutrie Brian Ulrich Karl Buhr
Staff:	CAO Peter DeJong (Recorder) Public Works Manager Nai Jaffer
Delegations:	0
Public:	1

1. Call to Order
Chair Bain called the meeting to order at 7:00 p.m.

2. Appointment of Recorder
CAO DeJong was appointed recorder for the meeting.

3. Approval of Agenda
The following were added for updates under Item 7, Unfinished Business:
a. Kelvin Grove WWTP
b. Harvey Tank Project
c. Oceanview Drainage

4. Public Questions & Comments
None

5. Approval of Minutes
None

6. Business Arising from Minutes

None

7. Unfinished Business

A. Update re. Kelvin Grove WWTP (N. Jaffer)

An RFP for engineering services aimed at shepherding a "like for like" replacement of the existing Rotating Batch Contactor (RBC) plant under our current permit parameters through the Ministry of Environment was issued in late June. If MOE says we cannot do this and must comply with the new regulations, then we will issue a new RFP to take into account such requirements and the best options to achieve the goals and objectives of the Municipality. It is expected that the IC would play an important role is such a process.

If MOE allows us to proceed on a "like for like" basis, we expect there could be a 50-100% increase in capacity as far as how many dwellings could be connected to the system, primarily as a result of improved RBC technology. A brief discussion ensued regarding volumes of effluent. A question was asked about expected costs but it was noted that cost estimates could not be discussed in open meeting.

B. Update re. Harvey Tank (N. Jaffer)

The old Harvey Tank has been demolished and the contractor is prepping the foundation for the base ring. The bypass valves were 40 years old and leaking so they had to be replaced before doing the foundation. The PRV is prepped and ready to go. It was suggested that viewing of the site wait until the foundation is prepped and the base ring arrives. Kudos for the contractor, Industra, were expressed re. keeping the noise levels down and for "drivers like ninjas."

C. Update re. Oceanview Drainage Study (N. Jaffer)

ISL have completed the surveying and topo modelling, but still need to prepare plans and draft a report. They will evaluate the options of reimplementing the easement drainage to Rundle Ck or sticking with Oceanview Rd. That report will come back to the IC for review and a recommendation to Council.

A question was asked as to how they will take into account intermittent flows and N. Jaffer responded that they cannot – it will need to be a percentage. Another question was asked as to whether the design would include infiltration basins, etc.

Action: N. Jaffer to circulate the Scope of Work from the RFP.

8. New Business

A. Infrastructure Committee Terms of Reference (TOR)

Non-Council members of the committee expressed their general distaste for the new Terms of Reference and their sense that their services were no longer appreciated by Council or staff. Various statements were made by committee members in this respect.

It was noted by Mayor McLaughlin that the grant funding process has stalled so there are no new projects at the moment. N. Jaffer noted that the IMP provides a project road map and the drainage will certainly be something for the IC to work on.

Councillor Bain stated that Council still needs the wisdom of the IC and that the IC needs to be involved early in a project process, but not to supplant the role of staff or Council; others concurred.

Mayor McLaughlin stated that projects are on the runway and that it may be necessary to find some smaller projects to spend taxpayer infrastructure dollars pending any further grant funding. He indicated that a response would be provided to an email sent by one of the committee members asking about various items.

Councillor Bain stated that communication needs to be improved. A discussion took place regarding meeting dates and it was agreed to schedule meetings for the 3rd Monday, subject to cancellation or re-scheduling depending on agenda content or lack thereof.

9. Public Questions & Comments

None

10. Adjournment

The meeting was adjourned at 8:35 pm.

Memorandum

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To:	**Village of Lions Bay**	Date:	**September 6, 2019**
Attention:	**Nai Jaffer, Public Works Manager**	Project No.:	**32282**
Cc:			
Reference:	**Oceanview Road Open Channel Hydraulic Assessment - Draft**		
From:	**Ghazal Shirazian, E.I.T., Project Engineer** **Andrew Baird, P.Eng., Senior Project Engineer**		

1.0 Background

ISL Engineering and Land Services (ISL) was retained by the Village of Lions Bay to provide engineering services for the hydraulic assessment of the open drainage channel beginning at 270 Oceanview Road.

The existing storm drainage on the upper portion of Oceanview Road prior to 2005 discharged to Rundle Creek through an existing CSP culvert that ran between lots 260 and 270 Oceanview Road. In 2005 this culvert failed and was subsequently filled with concrete and the drainage re-routed to an existing ditch on the east side of Oceanview Road. The Village has received multiple complaints related to excess flow along this ditch.

The open channel begins at an existing 450mm concrete culvert located south of 270 Oceanview Road that inlets on the south side of Oceanview Rd. and outlets on the North Side of Oceanview Road the remaining ditch consists of 7 driveway culverts and an open channel as well as a 60.0m long above ground corrugated HDPE storm main that was installed in 2011 to mitigate infiltration issues. The infiltration issues were reviewed by Golder Associates in 2008 and in 2011 the Village installed the HDPE pipe to reduce the infiltration, this HDPE pipe is still in place at the time of this memorandum. Ultimately, the storm sewer outfalls to Harvey Creek at Crosscreek Road through an underground corrugated Steel pipe. Refer to Figure 1.1 Site Location. Also, Figure C (attached) showing the Photo Index Map.

ISL's scope for the assessment included:

- Review background information
- Site review and field measurements
- Confirm the design flows
- Hydraulic assessment of the open channel and driveway culverts
- Discuss options to improve the existing drainage course down Oceanview Road to Harvey Creek and the old drainage course between 260 and 270 Oceanview Road to Rundle Creek.

This memorandum summarizes ISL's findings and recommendations with respect to the above scope of work.

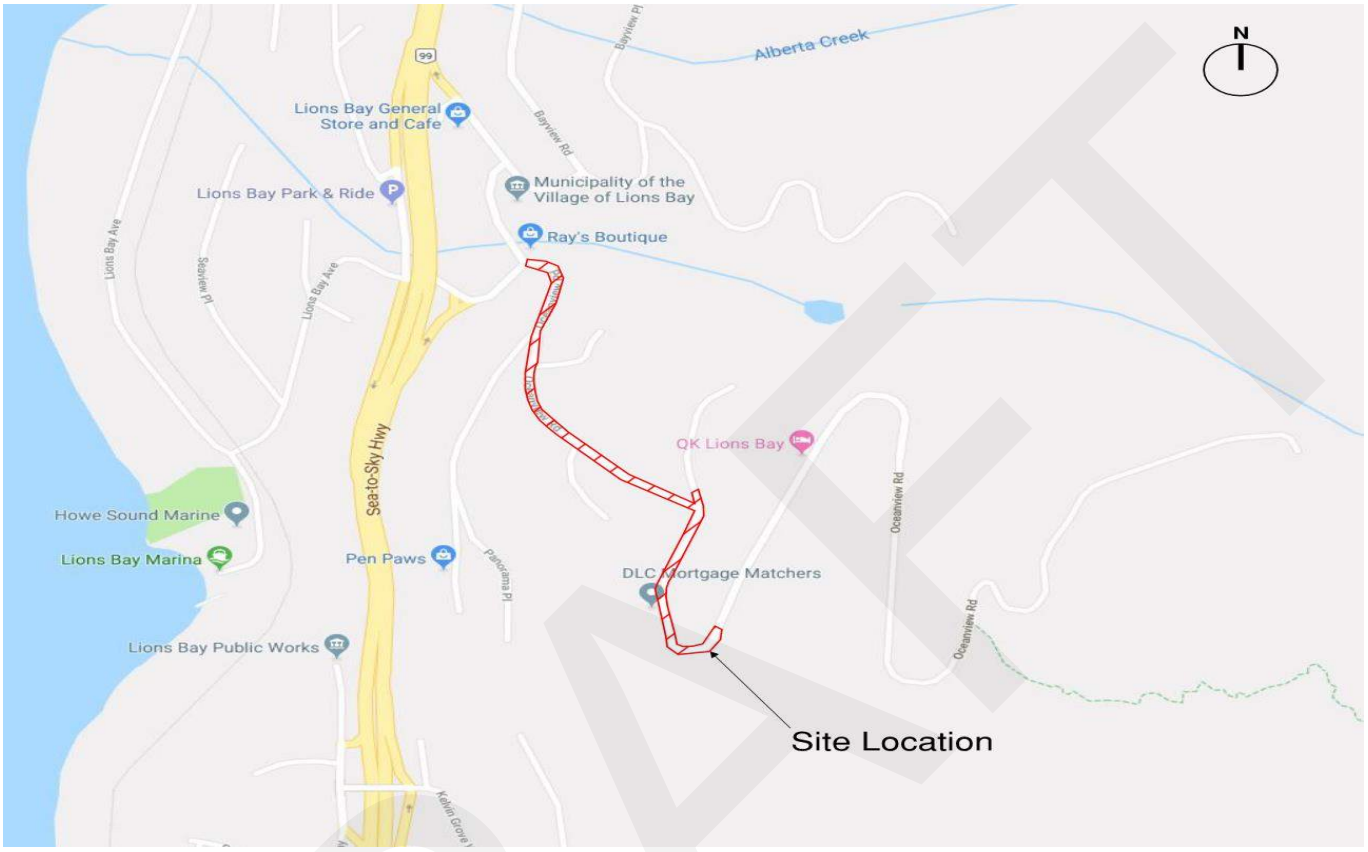


Figure 1.1 – Site Location

2.0 Open Channel Assessment

2.1 Desktop and Site Observations

Following the request by the Village of Lions Bay to review the open channel on Oceanview Road, Ghazal Shirazian, EIT from ISL performed a site visit on April 26, 2019. Observations from site visit are attached. ISL considered the south (upstream) property boundary of 270 Oceanview Road to be STA 1+000 and the outlet at Harvey Creek STA 1+615 the end of the study area. The open channel from STA 1+000 to STA 1+615 had steep gradients which are varied for each section of the channel. Table 1 (attached) summarizes the channel characteristics, culvert data, and the overall condition of each section.

After STA. 1+200, the water in the channel was observed to decrease in volume, the bottom of the channel is wet for approximately 15.0m downstream of the 450mm Corrugated Steel culvert at STA. 1+238 downstream of this location no water was observed. In general, the culverts were observed to be in poor condition and require replacement or further detailed investigation. The ditch channel was overgrown with vegetation in many areas and it was observed that the flow decreased lower down the channel likely due to infiltration that has been observed previously.

2.2 Peak Flow Assessment

The catchment area for the channel in this study area is approximately 30ha consisting of 1.6ha of paved roadway and 28.4ha of natural forested area with an average gradient of 56%. The extent of the catchment area is shown in Figure A (attached). The Village of Lions Bay Infrastructure Master Plan Report done by AECOM, dated July 28, 2016 (IMP), suggested to use the higher value for a specific storm event between Squamish IDF Curve and West Vancouver Municipal Hall IDF Curve. A synthetic hyetograph was developed using the highest numbers obtained from the IDF Curves mentioned above and an SCS Type IA rainfall distribution was used in this analysis. The peak flows for 10-year, 25-year, and 100-year for the duration of 1hr, 2hr, 6hr, 12hr, and 24hr calculated using XPSWMM are shown in Table 2.1.

Table 2.1 – Oceanview Road Open Channel – Peak Flows Obtained XPSWMM

Return Period/Duration (yrs/hrs)	Rainfall Depth (mm)	Total Runoff Depth (mm)	Total Runoff Volume (m^3)	Q_{Peak} (m^3/s)
10/1	19.3	1.29	386.3	0.21
10/2	29.2	4.96	1489.2	0.32
10/6	58.8	23.27	6979.8	1.02
10/12	100.8	57.29	17185.9	1.94
10/24	**180.0**	**129.66**	**38898.9**	**2.70**
25/1	22.8	2.37	710.7	0.34
25/2	33.6	7.12	2136.8	0.45
25/6	71.4	32.85	9855.1	1.57
25/12	117.6	72.07	21621.7	2.51
25/24	**216.0**	**163.95**	**49184.0**	**3.44**
100/1	27.5	4.21	1261.8	0.55
100/2	38.6	9.87	2962.2	0.67
100/6	87.6	46.04	13810.9	2.34
100/12	147.6	99.36	29809.2	3.55
100/24	**285.6**	**231.30**	**69389.4**	**4.86**

The results obtained from XPSWMM are 10-year peak flow of **2.70 m^3/s**, 25-year peak flow of **3.44 m^3/s**, and 100-year peak flow of **4.86 m^3/s**.

2.3 Hydraulic Capacity Assessment

ISL used the 10-year Peak Flow to assess the channel capacity since Village of Lions Bay IMP suggested the minor systems must safely convey the 10-year Peak Flow.

Table 2.2 shows the capacity of the channel at different sections based on field measurements. The capacity assessment utilized a freeboard of 0m.

Table 2.2 – Oceanview Road Open Channel – Flow Capacity

Station	Capacity (m^3/s)	Meet 10yr Storm (Y/N)	Meet 25yr Storm (Y/N)	Meet 100yr Storm (Y/N)
1+015	2.58	N	N	N
1+037	4.85	Y	Y	N
1+082	3.28	Y	N	N
1+098	0.54	N	N	N
1+112	1.27	N	N	N
1+196	2.61	N	N	N
1+223	0.20	N	N	N
1+274	2.62	N	N	N
1+282	3.63	Y	Y	N
1+337	2.22	N	N	N
1+375	0.64	N	N	N
1+429	1.79	N	N	N

As it is shown in Table 2.2, some sections of the channel have inadequate capacity to convey the 10-year and 25-year peak flows and the entire channel doesn't have enough capacity to convey the 100-yr peak flow.

The capacity of culverts are shown in Table 2.3.

Table 2.3 – Oceanview Road Culvert – Flow Capacity

Station	Capacity (m^3/s)	Meet 10yr Storm (Y/N)	Meet 25yr Storm (Y/N)	Meet 100yr Storm (Y/N)
1+000	1.07	N	N	N
1+090	0.78	N	N	N
1+106	0.59	N	N	N
1+127	0.98	N	N	N
1+200	0.87	N	N	N
1+262	0.91	N	N	N
1+276	0.98	N	N	N
1+324	1.46	N	N	N
1+362	1.46	N	N	N
1+394	0.96	N	N	N
1+465	1.31	N	N	N

Table 2.3 shows that the existing culverts have inadequate capacity to convey the 10-year peak flow.

3.0 Upgrade Recommendation

Some sections of the open channel and all the culverts were found to be under capacity based on the 10-year design event. In addition, the culverts are in poor condition and should to be replaced. The following two options were evaluated to increase the capacity of channel and culverts. Figure B attached shows the two options.

- Option 1 - Modify the channel cross section and upsize the culverts
- Option 2 – Divert the flow through a new culvert between Lot 260 and Lot 270

The analysis of results of these options are presented below.

3.1 Option 1 – Modify the Channel Cross Section and Upsize the Culverts

3.1.1 Hydraulic Capacity Assessment

Option 1 would involve upgrading the channel to an impervious ditch liner system such as SmartDitch and upsizing the culverts as shown in Table 3.3 to improve the entire channel's capacity. The impervious ditch liner would solve the existing infiltration issue as well as reduce maintenance and increase the ditch capacity. Prior to each culvert, an inlet structure needs to be installed to improve the hydraulics of the flow. In addition, the existing 525mm HDPE to be replaced with the impervious ditch liner. Table 3.1 shows the Smart Ditch cross section parameters.

Table 3.1 – Oceanview Road Open Channel – Flow Capacity

Channel Depth (m)	Side Slopes (H:V)	Base Width (m)	Bed Slope (%)	n Value
0.762	1:0.926	0.387	Varies	0.0222

The channel capacity varies for each section due to the different channel bed slopes. Table 3.2 shows the capacity of each section with freeboard of 0.3m.

Table 3.2 – Oceanview Road Open Channel – Option 1 Flow Capacity

Station	Bed Slope (%)	Capacity (m^3/s)	Meet 10yr Storm (Y/N)
1+015	21.5	6.30	Y
1+037	9.8	4.47	Y
1+082	10.0	3.71	Y
1+098	6.3	3.43	Y
1+112	8.5	3.71	Y
1+136 (Replaced HDPE)	6.1	3.36	Y
1+223	9.2	4.28	Y
1+274	20.5	6.14	Y
1+282	16.9	5.57	Y
1+337	14.8	5.22	Y

Station	Bed Slope (%)	Capacity (m^3/s)	Meet 10yr Storm (Y/N)
1+375	15.3	5.30	Y
1+429	15.4	5.32	Y

Table 3.3 shows the proposed culvert parameters and capacities.

Table 3.3 – Oceanview Road Culvert – Option 1 Flow Capacity

Station/ Lot No.	Dia. (mm)	Material	L (m)	S (%)	Capacity (m^3/s)	Meet 10yr Storm (Y/N)
1+000	675	Conc.	15	10.1	3.15	Y
1+090	750	Conc.	8	8.75	3.06	Y
1+106 Lot 265	750	Conc.	6	5.0	2.94	Y
1+127 Lot 215	900	Conc.	9	1.7	2.76	Y
1+200 (Highview Place)	750	Conc.	23	10.9	4.33	Y
1+262 Lot 145	675	Conc.	12	11.8	3.39	Y
1+276 Lot 135	675	Conc.	6	13.7	3.67	Y
1+324 Lot 115 -125	675	Conc.	14	13.3	2.85	Y
1+362 Lot 107	675	Conc.	13	13.3	3.61	Y
1+394 Lot 105	675	Conc.	5	13.2	3.59	Y
1+465	675	Conc.	150	10.7	3.25	Y

The culvert sizes shown in Table 3.3 are theoretical based on the existing culvert parameters (slope, length, etc.). Should this option be chosen, the sizes, slopes, and lengths of culverts will be reviewed and revised in detailed design. It is best practice to not decrease the size of the storm sewers and culverts downstream from the preceding structure.

3.1.2 Costs

Table 3.4 shows the cost breakdown for Option 1.

Table 3.4 – Cost Estimate – Option 1

Item	Quantity	Unit	Unit Price	Total Price
Driveway Culverts				
675mm Concrete	50	Linear Meter	$950	$47,500
750mm Concrete	6	Linear Meter	$975	$5,850
900mm Concrete	9	Linear Meter	$1,100	$9,900
Roadway Crossing Culverts				
675mm Concrete – Sta. 1+000 to Sta. 1+015 and Sta. 1+465 to Sta. 1+615	165	Linear Meter	$950	$156,750
750mm Concrete - Sta. 1+090 to Sta. 1+098 and Sta. 1+200 to Sta. 1+223	31	Linear Meter	$975	$30,225
Inlet Structure	10	Each	$12,000	$120,000
SmartDitch	354	Linear Meter	$350	$123,900
General; Ditch Cleaning, Mobilization, etc	1	Lump Sum	$10,000	$10,000
Subtotal				$504,125
Contingency		20%		$100,825
Total				**$604,950**

3.2 Option 2 – Divert the Flow through a New Culvert between Lot 260 and Lot 270

3.2.1 Hydraulic Capacity Assessment

In this option, the 10-year peak flow would be re-routed to Rundle Creek through a proposed 675mm concrete pipe located between Lot 260 and Lot 270 as it is shown in Figure B (attached). The existing 450mm culvert crossing Oceanview Drive would be removed and the open channel system would remain in place to facilitate the road drainage. Table 3.5 shows the proposed pipes parameters and capacities.

Table 3.5 – Oceanview Road Pipe – Option 2 Flow Capacity

From/To	Dia. (mm)	Material	L (m)	S (%)	Capacity (m^3/s)	Meet 10yr Storm (Y/N)
HW01 to MH01	675	Conc.	30	8.1	2.82	Y
MH01 to Out	675	Conc.	45	9.6	3.08	Y

This option however does not address the existing concerns related to infiltration of the existing ditch on Oceanview Drive. Likely ditch improvements would still be required should option 2 be chosen. These improvements would include the installation of an impermeable ditch liner such as SmartDitch and improvements to the existing deteriorated culverts.

3.2.2 Challenges and Costs

Option 2 would likely require Geotechnical assessment required to stabilize the excavation required between 260 and 270 Oceanview drive. The 3.0m Right-Of-Way between the lots is limited and already contains an existing abandoned storm pipe and 2 existing live watermains. Construction Considerations as to the replacement of the watermains or protection would also be required during detailed design. The existing open channel infiltration issue and poor condition of driveway culverts should also be considered.

Table 3.6 shows the cost breakdown for Option 2.

Table 3.6 – High Level Cost Estimate – Option 2

Item	Quantity	Unit	Unit Price	Total Price
675mm Concrete Pipe	75	Linear Meter	$950	$71,250
Inlet/Outlet Structure	2	Each	$12,000	$24,000
1200mm diameter Manhole	1	Each	$8,000	$8,000
Removal of existing abandoned CSP Pipe (assumed 60m)	1	Lump Sum	$12,000	$12,000
Legal Survey of ROW between 260 and 270	1	Lump Sum	$5,000	$5,000
*General; Geotechnical Consideration for trench wall stabilization between 260 and 270 Oceanview Dr	1	Lump Sum	$100,000	$100,000
Pre-Condition Survey 260 and 270 Oceanview Dr.	1	Lump Sum	$5,000	$5,000
Subtotal				$225,250
Contingency		20%		$45,050
Total				**$270,300**

**A significant grade differential between the 260 and 270 Oceanview Dr. and existing retaining wall would require a geotechnical investigation to review and advise on construction practices. The construction cost could differ depending on the findings of a geotechnical investigation. In addition to this review legal survey would also be required to verify the right-of-way extents. A pre-condition survey of both 260 and 270 may be warranted to verify pre-construction condition of the homes and confirm that no damage occurred during construction.*

4.0 Conclusion & Closing Remarks

The existing open channel system starting at 450mm concrete culvert at 270 Oceanview Drive has inadequate hydraulic capacity to convey the 10-year design flow. The driveway culverts along the system are corrugated steel pipes which are in a poor condition.

ISL has reviewed two options to deal with the channel hydraulic capacity. The first option is to upgrade the open channel sections to an impervious system such as SmartDitch and upsize the culverts to increase their capacity to handle the flows. The second option is to divert the flow through a proposed 675mm concrete pipe between Lot 260 and Lot 270 to Rundle Creek. This option would still require upgrades to open channel to deal with the infiltration issue. The replacement of existing culverts is recommended as well due to their poor condition. The advantages, disadvantages, and the costs for each option are summarized in Table 4.1.

Table 4.1 – Option Comparison

Option No.	Advantages	Disadvantages	Total Cost
1	• Improvements to existing deteriorated culverts • Solves existing ditch infiltration issue	• Removal of pre 2005 drainage course • Larger construction impact to residents	$604,950
2	• Less impact to residents (Smaller Construction footprint) • Reinstates original drainage path (Pre-2005)	• Does not solve existing ditch infiltration issue • Does not improve the condition of driveway culverts • Limited access to the 3.0m R.O.W. between Lot 260 and Lot 270 • Challenging construction through Reinstating the existing retaining wall between Lot 260 and Lot 270 • Challenging construction adjacent to existing live watermains	$270,300 (Excluding improvements to the open channel and driveway culverts on Oceanview Rd.)

We trust you find this memorandum in accordance with your request. Should you require clarification or further information, please contact ISL at your convenience.

Sincerely,

Andrew Baird, P.Eng.
Senior Project Engineer

Ghazal Shirazian, E.I.T.
Project Engineer

Attachments:
1. Table 1 – Existing Condition of Open Channel and Culverts
2. Figure A – Catchment Plan
3. Figure B – Stormwater Management Options
4. Figure C – Photo Index Map
5. Site Photos

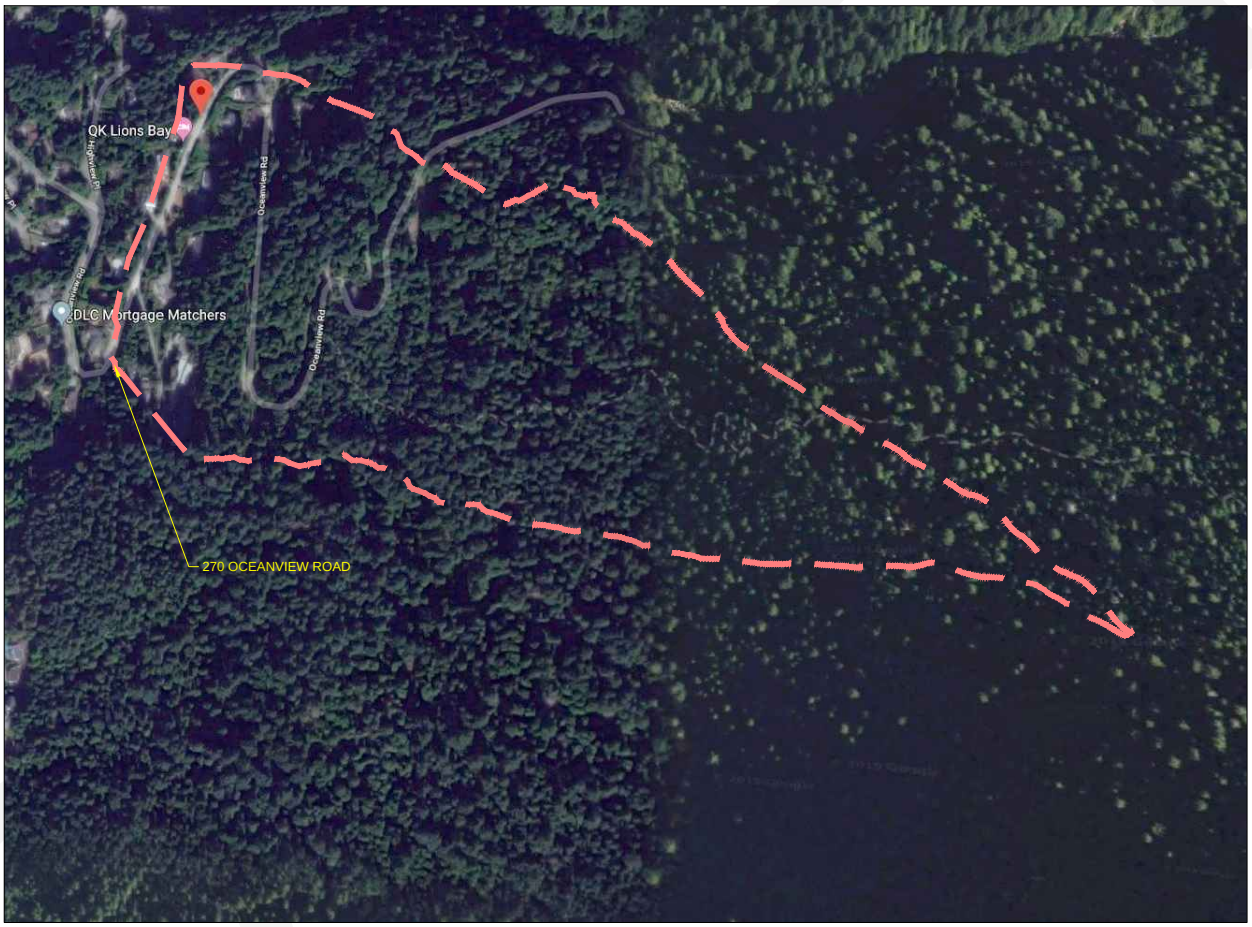
Table 1 – Existing Condition of Open Channel and Culverts

Sta.	Culvert				Channel Cross section					Comments
	Dia. (mm)	Material	L (m)	S (%)	D (m)	W (m)	Side Slope (H:V)	S (%)	n	
1+000	450	Concrete	15.0	10.1	-	-	-	-	-	Good condition, concrete headwall inlet
1+015	-	-	-	-	0.45	0.9	1:0.8	21.5	0.05	Boulders observed in channel for approx. the first 5m, cobbles and gravel banks including some vegetation thereafter
1+037	-	-	-	-	0.7	0.3	1:0.5	9.8	0.04	Channel consisted of cobbles and gravel banks including some vegetation and trees
1+082	-	-	-	-	0.7	0.4	1:0.8	7.5	0.035	Channel consisted of cobbles and gravel banks including some vegetation and trees
1+090	450	Corrugated Steel	8.0	8.75	-	-	-	-	-	Poor condition, corroded bottom and deformed, debris covered inlet, and outlet not visible due to vegetation cover
1+098	-	-	-	-	0.55	0.5	Rect.	6.3	0.04	Channel consisted of large cobbles and vegetation, banks contained large rocks in some sections and overgrown vegetation causing flow restriction

Sta.	Culvert				Channel Cross section					Comments
	Dia. (mm)	Material	L (m)	S (%)	D (m)	W (m)	Side Slope (H:V)	S (%)	n	
1+106	450	Corrugated Steel	6.0	5.0	-	-	-	-	-	Poor Condition, corroded bottom, inlet was obstructed by large rocks and vegetation, and outlet not visible due to vegetation cover
1+112	-	-	-	-	0.45	0.4	1:0.5	7.4	0.035	Channel consisted of cobbles and overgrown vegetation, over hanging branches observed obstructing the channel
1+127	525	Corrugated HPDE	69.0	5.1	-	-	-	-	-	Inlet not visible due to overhanging branches, installed in 2011 to mitigate infiltration issues
1+196	-	-	-	-	0.9	0.3	1:0.25	11.5	0.05	Channel consisted of cobbles and gravel banks including vegetation growth
1+200	450	Corrugated Steel	23.0	10.9	-	-	-	-	-	Poor Condition, corroded bottom, three vertical grates at the inlet with trapped leaves and sticks, outlet not visible due to vegetation cover
1+223	-	-	-	-	0.3	0.4	Rect.	9.2	0.035	Channel consisted of cobbles, gravel and thick vegetation in some areas, banks contained vegetation, wet

Sta.	Culvert				Channel Cross section					Comments
	Dia. (mm)	Material	L (m)	S (%)	D (m)	W (m)	Side Slope (H:V)	S (%)	n	
										channel, but no presence of flowing water
1+262	450	Corrugated Steel	12.0	11.8	-	-	-	-	-	Poor Condition, corroded bottom, obstructed inlet with small rocks, leaves, and sticks, outlet not visible due to vegetation cover, no presence of water
1+274	-	-	-	-	0.5	0.4	1:0.5	20.5	0.05	Channel consisted of cobbles and vegetation
1+276	450	Corrugated Steel	6.0	13.7	-	-	-	-	-	Poor Condition, corroded bottom, inlet and outlet not visible due to vegetation cover
1+282	-	-	-	-	0.6	0.4	1:0.5	16.9	0.05	Channel consisted of cobbles and gravel, banks including vegetation.
1+324	525	Corrugated Steel	14.0	13.3	-	-	-	-	-	Poor Condition, corroded bottom, misplaced four vertical grates, outlet not visible due to vegetation cover, no presence of water
1+337	-	-	-	-	0.5	0.4	1:0.5	14.8	0.05	Channel consisted of cobbles and vegetation, no presence of water
1+362	525	Corrugated Steel	13.0	13.3	-	-	-	-	-	Poor Condition, corroded bottom, imbedded in the ground at outlet, small rocks, leaves, and sticks at the outlet, no presence of water

Sta.	Culvert				Channel Cross section					Comments
	Dia. (mm)	Material	L (m)	S (%)	D (m)	W (m)	Side Slope (H:V)	S (%)	n	
1+375	-	-	-	-	0.3	0.4	1:0.8	15.3	0.05	Channel consisted of cobbles and vegetation, no presence of water
1+394	450	Corrugated Steel	5.0	13.2	-	-	-	-	-	Poor Condition, corroded bottom, outlet not visible due to vegetation cover, no presence of water
1+429	-	-	-	-	0.5	0.5	1:0.8	15.4	0.05	Channel consisted of cobbles and vegetation, no presence of water
1+465	525	Corrugated Steel	150	10.7						Inlet in poor Condition, corroded bottom, no presence of water
1+615	Outlet to Harvey Creek									



LEGEND

CATCHMENT BOUNDARY

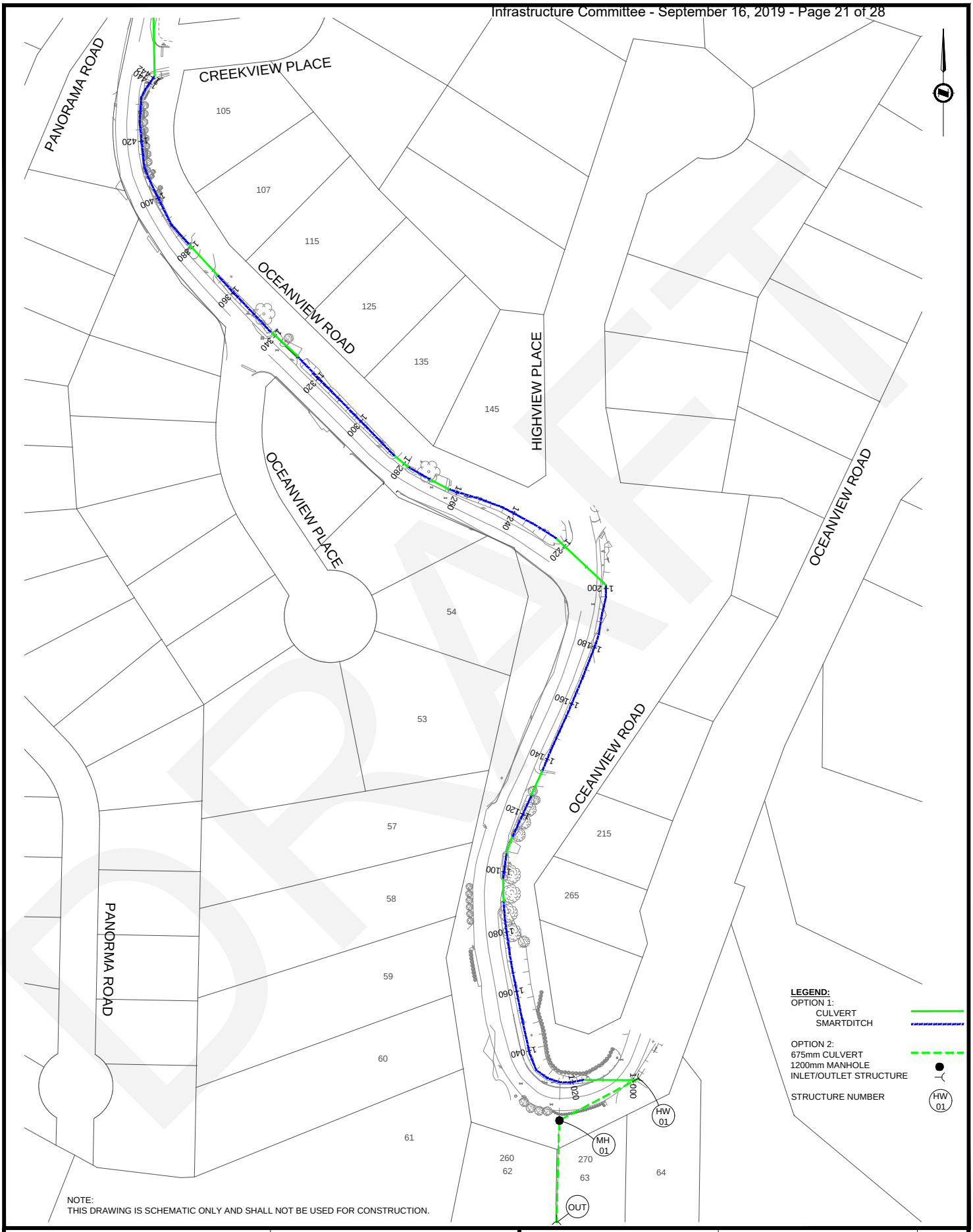
NOTE:
THIS DRAWING IS SCHEMATIC ONLY AND SHALL NOT BE USED FOR CONSTRUCTION.

CATCHMENT PLAN

OCEANVIEW ROAD
VILLAGE OF LIONS BAY

ISL
#503, 4190 Lougheed Hwy, Burnaby, B.C. V5C 6A8
T: (604)629-2696 F: (604)629-2698

SCALE	NTS	DATE	19-09-04	DWG. NO. 1 OF 1
DRAWN BY	EJS	DESIGN BY	GSH	
CHECKED	ATB	APPROVED BY	ATB	
PROJECT NUMBER	32282	DRAWING NUMBER	FIGURE A	REV.



NOTE:
THIS DRAWING IS SCHEMATIC ONLY AND SHALL NOT BE USED FOR CONSTRUCTION.

STORMWATER MANAGEMENT OPTIONS

OCEANVIEW ROAD
VILLAGE OF LIONS BAY

ISL
#503, 4190 Lougheed Hwy, Burnaby, B.C. V5C 6A8
T: (604)629-2696 F: (604)629-2698

SCALE	NTS	DATE	19-08-22	DWG. NO.
DRAWN BY	GSH	DESIGN BY	GSH	1 OF 1
CHECKED	ATB	APPROVED BY	ATB	
PROJECT NUMBER	32282	DRAWING NUMBER	FIGURE B	REV.

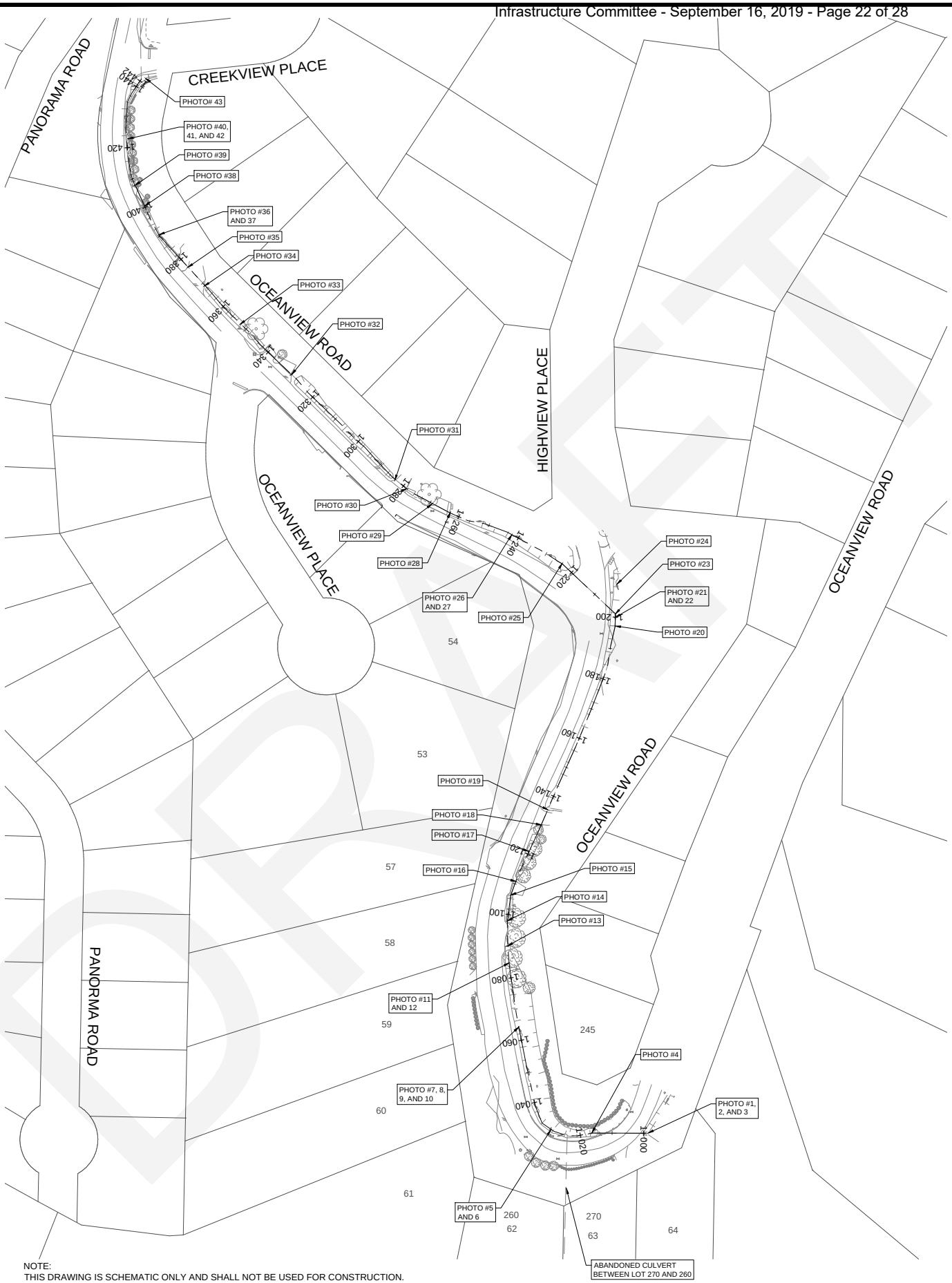


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PHOTO INDEX MAP

OCEANVIEW ROAD
VILLAGE OF LIONS BAY

ISL
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SCALE	NTS	DATE	19-08-22	DWG. NO.
DRAWN BY	GSH	DESIGN BY	GSH	1 OF 1
CHECKED	ATB	APPROVED BY	ATB	
PROJECT NUMBER	32282	DRAWING NUMBER	FIGURE C	REV.


Photo #1


Photo #2


Photo #3


Photo #4


Photo #5


Photo #6


Photo #7


Photo #8


Photo #9


Photo #10


Photo #11


Photo #12


Photo #13


Photo #14


Photo #15


Photo #16


Photo #17


Photo #18


Photo #19


Photo #20


Photo #21


Photo #22


Photo #23


Photo #24


Photo #25


Photo #26


Photo #27

Photo #28

Photo #29

Photo #30

Photo #31

Photo #32

Photo #33

Photo #34

Photo #35

Photo #36


Photo #37


Photo #38


Photo #39

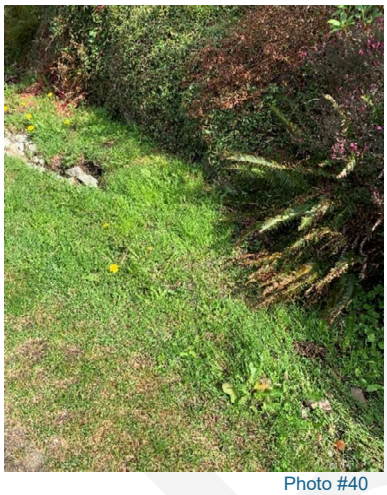
Photo #40


Photo #41


Photo #42


Photo #43


Outlet to Harvey Creek


Outlet to Harvey Creek