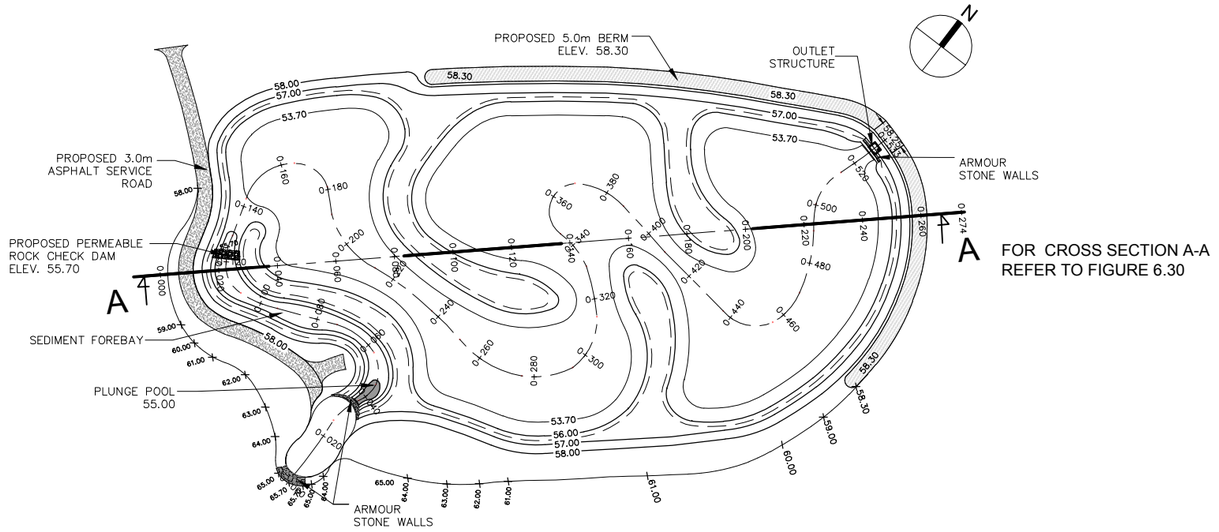
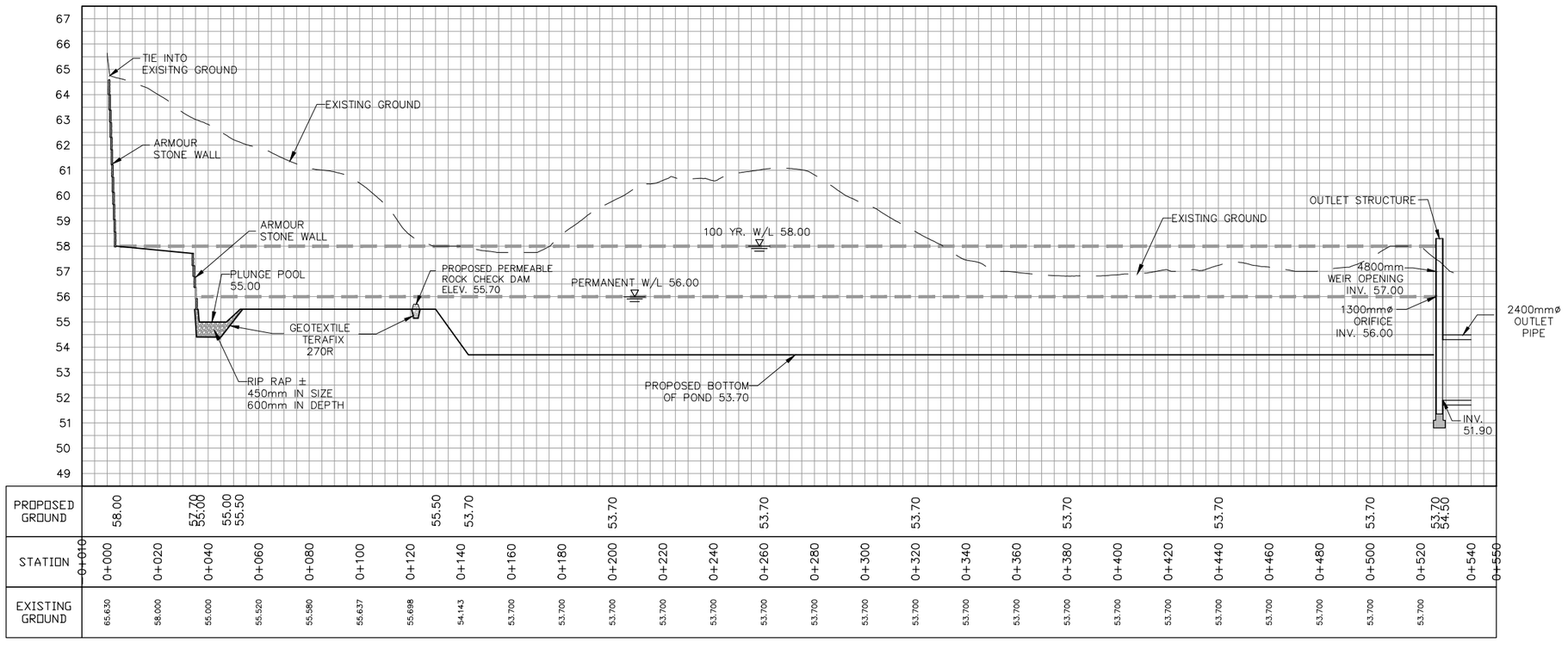


EASTERN POND VIEW

SCALE: 1:2000



EASTERN POND PROFILE

SCALE: VERT. 1:2000, HORIZ. 1:200

Project Title

FORMER CFB ROCKCLIFFE
MASTER SERVICING STUDY

Drawing Title

EASTERN SWM FACILITY
PROFILE

Sheet No.

FIGURE 6.27

Scale

AS SHOWN

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Table 6.17 Performance of Eastern SWM Facility (XPSWMM output files presented on the CD in Appendix E)

STORM EVENT	EXTENDED STORAGE* (HA-M)	DISCHARGE (CMS)
Permanent Storage	3.59	0
25 mm 4 hour Chicago	1.81	0.97
2 year 24 hour SCS Type II	2.64	2.87
5 year 24 hour SCS Type II	3.22	5.09
100 year 24 hour SCS Type II	4.56	12.21
100 year 24 hour SCS Type II + 20%	5.23	15.49
100 year 3 hour Chicago	4.27	10.19
100 year 3 hour Chicago + 20%	4.84	13.24
July 1, 1979	5.36	16.18
August 1988	4.84	13.24
August 1996	3.99	8.67

**It should be noted that extended storage excludes permanent storage*

6.5.4.5.2 Western SWM Facility

The conceptual Western SWM Facility is located at the northwestern corner of the development, abutting Hemlock Road. As indicated on **Figure 6.13**, the proposed 1500 mm diameter trunk storm sewer to service the western portion of the study area extends west along Hemlock Road, terminating on the north side of the Western SWM Facility. To the south, a 525 mm diameter storm sewer will be installed to service Area PH2G, terminating on the south side of the SWM facility. The Western SWM Facility is proposed to be designed as a wet pond (refer to **Section 6.4.2**), with an outlet discharging to the existing Aviation Parkway culvert. Flows in excess of the culvert capacity will be routed eastward through a channel and pipe conduit, designed to bypass the Eastern facility and outlet directly to the Ottawa River as discussed in **Section 6.5.4.4**. A detailed design/ study of the proposed SWM facilities will be undertaken to support the subdivision approval.

Runoff will flow from the two inlets to sediment forebays, from which flow is conveyed to the main cell of the facility. Downstream of the southern sediment forebay, the Southwest Channel will tie into the main cell of the facility. Similar to the Eastern SWM Facility, the proposed design creates a series of smaller open water surfaces, considered less desirable to birds, possibly augmented with floating islands to further discourage waterfowl. The presence of birds is a concern of the nearby Rockcliffe Airport. The use of floating islands also has the added ability to be reconfigured in the future to further assist in this matter.

A conceptual plan, profile and typical cross section of the facility are presented on **Figure 6.29, 6.30,** and **6.31** respectively**.** The bottom of the facility is at 68.70 m and the permanent water level is 2.3 m higher (elevation 71 m) resulting in a permanent volume of 1.90 ha-m. The performance of the Western SWM Facility is summarized in **Table 6.18**.

Water quality was simulated with the help of 25 mm Chicago storm event. During this storm event, water quality storage of 0.44 ha-m is utilized resulting in a depth of 0.40 m. The outflow from the facility during the 25 mm event is 0.14 cms. The outflow hydrograph from the facility is presented in **Appendix E**. The results indicate that the water quality storm event is released in greater than 24 hours, satisfying the MOE regulatory requirements.

During the 100 year 24 hour SCS Type II event, considered the design storm for the pond, a 2.06 ha-m extended storage is utilized resulting in an elevation of 72.60 m (1.60 m depth). The outflow from the facility is 0.57 cms. In a case where the outlet structure becomes fully blocked and the SWM facility continues to receive inflow, runoff from the western SWM facility will overtop Hemlock Road at an elevation of 70.00 m as shown in **Figure 6.29**. An emergency overflow route from the facility into Hemlock Road is provided via a berm located west of the

0 50 100

J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 6\Figure 6.29 WesternSWM Facility Plan View.dwg Layout Name: Figure6.29-8x11

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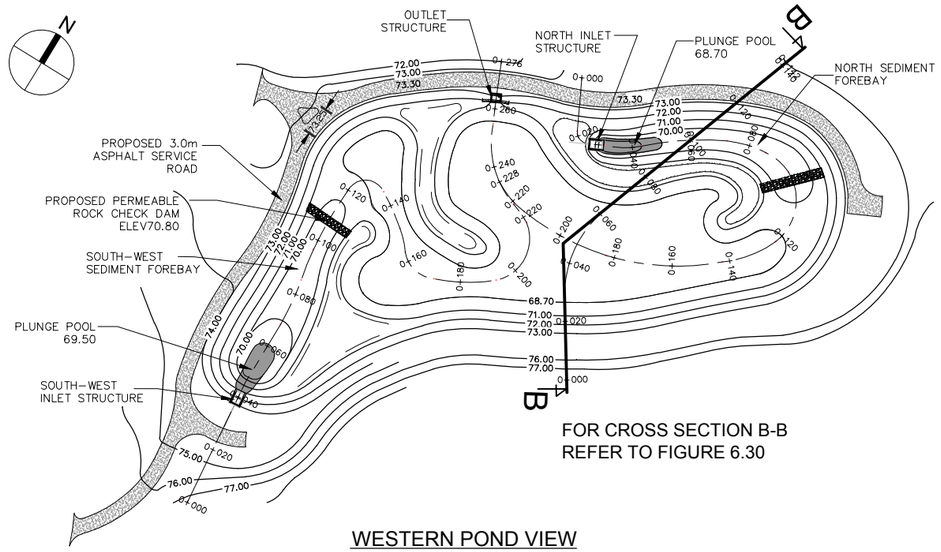
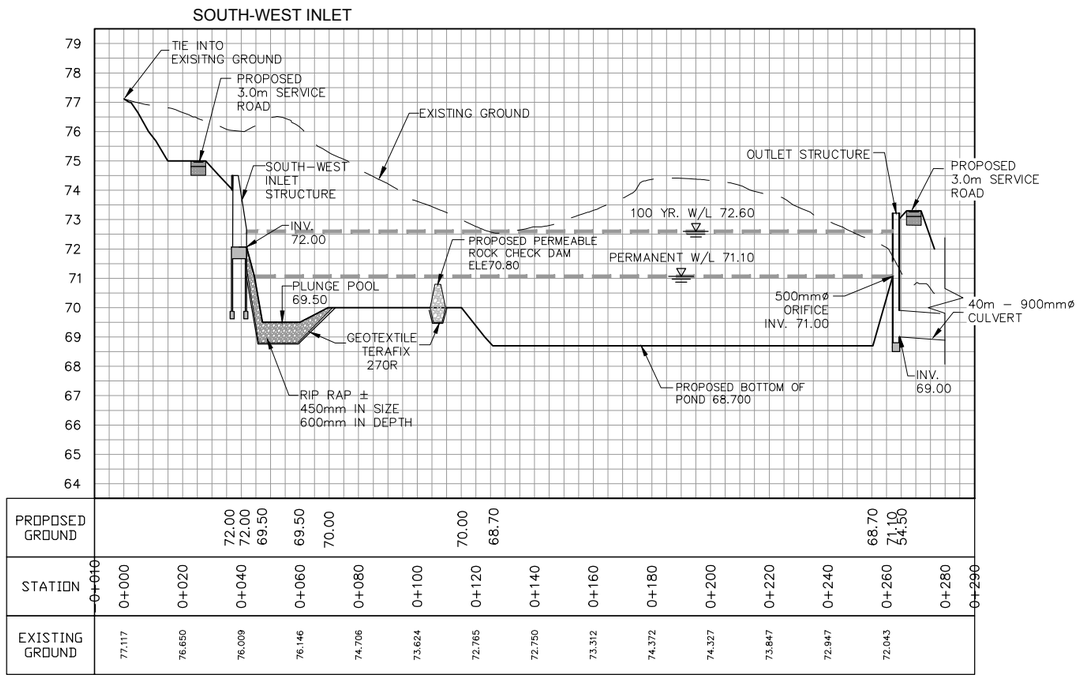
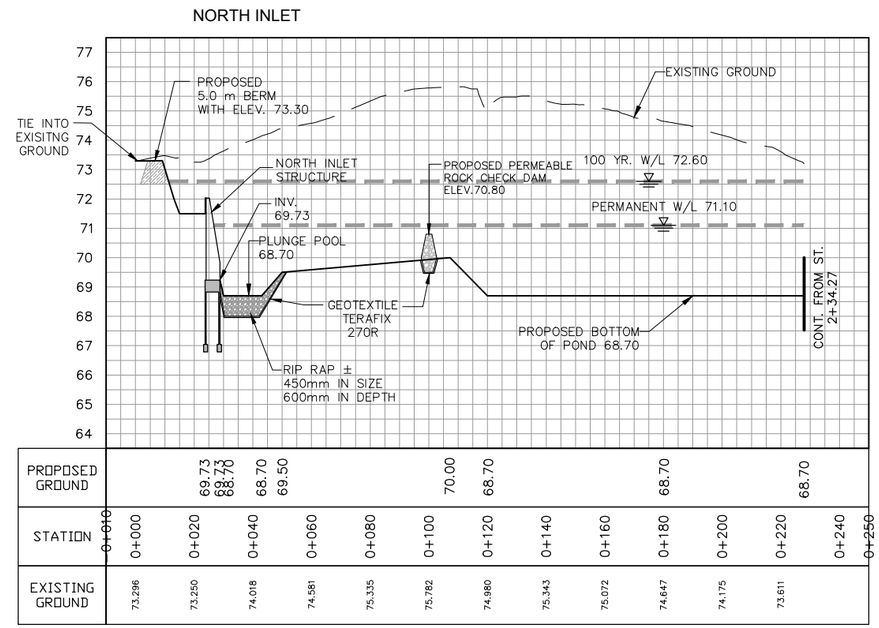
Project Title	Drawing Title	Sheet No.
FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	WESTERN SWM FACILITY PLAN VIEW	FIGURE 6.29



WESTERN POND VIEW
SCALE: 1:2000





WESTERN POND PROFILE
SCALE: VERT. 1:2000, HORIZ. 1:200

FIGURE 6.30

FORMER CFB ROCKCLIFFE
MASTER SERVICING STUDY

WESTERN SWM FACILITY
PROFILES

Scale AS SHOWN

Project Title

Drawing Title

Sheet No.

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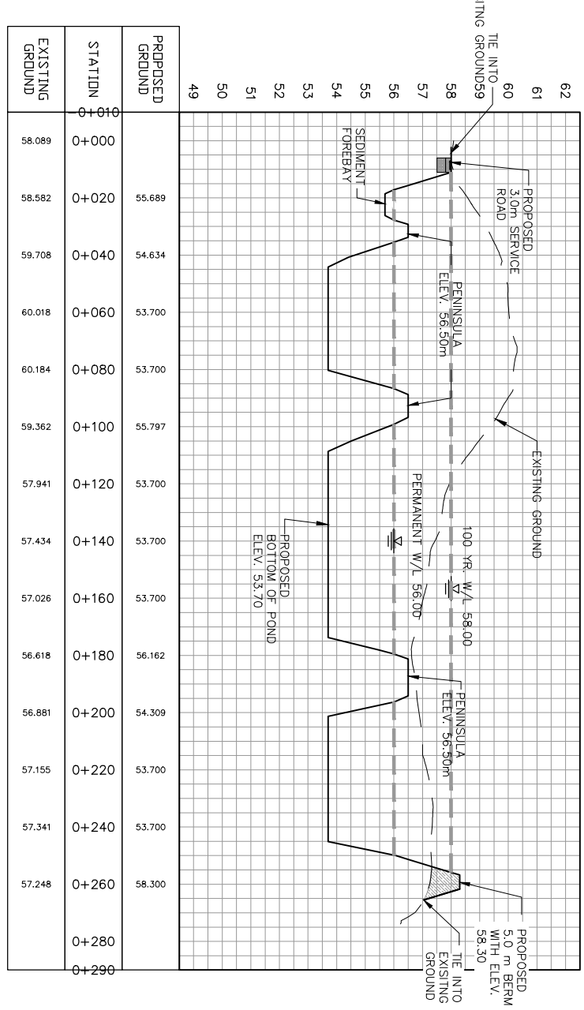
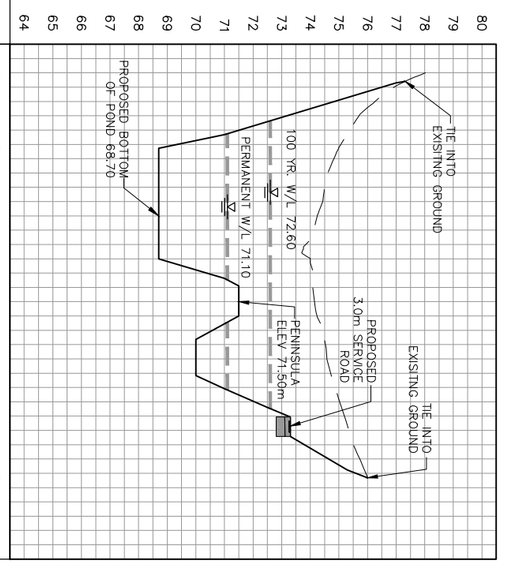


EXISTING GROUND	STATION	PROPOSED GROUND
	0+010	
58.089	0+000	
58.582	0+020	55.689
59.708	0+040	54.634
60.018	0+060	53.700
60.184	0+080	53.700
59.362	0+100	55.797
57.941	0+120	53.700
57.434	0+140	53.700
57.026	0+160	53.700
56.618	0+180	56.162
56.881	0+200	54.309
57.155	0+220	53.700
57.341	0+240	53.700
57.248	0+260	58.300
	0+280	
	0+290	

EASTERN POND CROSS SECTION A-A

SCALE: VERT. 1:2000, HORIZ. 1:200



EXISTING GROUND	STATION	PROPOSED GROUND
	0+010	
78.021	0+000	77.32
75.372	0+020	68.70
74.501	0+040	
73.840	0+060	68.70
74.147	0+080	71.50
74.581	0+100	71.50
75.191	0+120	68.70
75.939	0+140	68.70
	0+160	73.30
	0+170	73.30
		76.00

WESTERN POND CROSS SECTION B-B

SCALE: VERT. 1:2000, HORIZ. 1:200

Sheet No.	Drawing Title	Project Title	Scale
FIGURE 6.31	EASTERN AND WESTERN POND CROSS SECTIONS	FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	AS SHOWN

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facility (**Figure 6.29**). The berm has been graded conceptually 0.05 m below the rest of the berm, at elevation 72.25 m, for approximately 10 m section of berm as shown in **Figure 6.29**.

Total flow from Area PH2I and Area EXTW (refer to **Figures 6.13 and 6.14**) and outflow from the Western SWM Facility are tributary to the Aviation Parkway culvert. The areas could generate almost 2.56 cms during the 100 year 24 hour SCS Type II event (the more critical storm event). This value is significantly less than the existing conditions flow from the site to the Aviation Parkway culvert (estimated at 11.13 cms, refer to **Section 6.5.2**).

The outlet structure is proposed to be a 500 mm diameter orifice with an invert of 71.00 m (refer to **Figure 6.30**). From the outlet structure, outflow from the facility will be conveyed to the Hemlock Road culvert, where it will flow overland towards the existing Aviation Parkway culvert. The existing Hemlock Road culvert has significant debris build up limiting its capacity; therefore it is proposed to be upgraded. The upgraded culvert is proposed to be a 900 mm diameter pipe with 0.75 % longitudinal slope. The proposed culvert invert is at 69.00 m to facilitate gravity drawdown of the SWM facility. Downstream of the Hemlock culvert, flow will be conveyed to the Western Creek via the existing Aviation Parkway culvert during frequent storm events. During infrequent storm events, flow in excess of the Aviation Parkway culvert capacity will be conveyed east via the proposed channel-pipe configuration discussed in **Section 6.5.4.4.**

Bankfull flow conditions for the Western Creek were simulated with the 25 mm storm event. Statistically, the 25 mm precipitation corresponds to a storm event with approximately the 1:5 return period. The estimated bankfull flows in the downstream Western Creek could range between 0.70 cms and 1.4 cms (DST, September 2013). From a fluvial geomorphology perspective, outflow through the Aviation Parkway culvert during the 25 mm storm event is 0.30 cms, a rate that corresponds to less than bankfull estimates.

Table 6.18 Performance of Western SWM Facility (XPSWMM output files presented on the CD in Appendix E)

STORM EVENT	EXTENDED STORAGE* (HA-M)	DISCHARGE (CMS)
Permanent Storage	1.91	0
25 mm 4 hour Chicago	0.44	0.14
2 year 24 hour SCS Type II	0.77	0.28
5 year 24 hour SCS Type II	1.07	0.37
100 year 24 hour SCS Type II	2.06	0.57
100 year 24 hour SCS Type II + 20%	2.55	0.64
100 year 3 hour Chicago	1.82	0.53
100 year 3 hour Chicago + 20%	2.33	0.64
July 1, 1979	2.35	0.62
August 1988	1.96	0.56
August 1996	1.76	0.52

**It should be noted that extended storage excludes permanent storage*

6.6 Hydraulic Model

6.6.1 Hydraulic Evaluation

The hydraulic evaluation was completed to confirm the hydraulic grade line (HGL) along the trunk storm sewers through the development. The XPSWMM analysis was used to support the conceptual design of the Burma Road SWM Facility and the two end-of-pipe SWM facilities. This includes the design of the two culvert crossings along the Burma Road (refer to **Section 6.5.4.2.1**), the design of the Hemlock Road culvert (refer to **Section 6.5.4.5.2**), the functioning of

the flow split at the Aviation Parkway, and the channel-pipe configuration discussed in **Section 6.5.4.4.** Details about boundary conditions are discussed in **Section 6.6.1.1**.

Minor system hydrographs generated by SWMHYMO have been imported to XPSWMM. Stage-area curves of the SWM facilities have been entered into the model. Minor system losses were accounted for in accordance with Appendix 6-B of the City of Ottawa Sewer Design Guidelines (November 2004).

Simulations were performed for various storm events to confirm the HGL through the development, the results of which are presented in **Section 6.6.2**. The XPSWMM model schematics are provided on **Figures 6.30** and **6.33** (enclosed in **Appendix E**). Model files are also provided in **Appendix E.**

6.6.1.1 Boundary Conditions at the Eastern and Western Outlets

Based on the topography, there is no effect from the Ottawa River flood levels on the stormwater management facility. The fixed water level assumed at the boundary condition was based on normal river water level indicated on the topographical mapping.

The boundary condition for the dynamic evaluation of the Western SWM facility was based on the results of the western outlet from XPSWMM evaluation, and the maximum possible water level in the Western Creek downstream of the Aviation culvert. For each storm event modeled, the tailwater boundary condition was created based on the western outlet Outflow vs Time rating curve and the backwater elevation of 60.50 m. This elevation is based on the surveyed road elevation at the culvert crossing just downstream of the Aviation culvert on the Western Creek (refer to **Figure 6.14**). Details regarding the development of the tailwater boundary conditions are presented in **Appendix E**.

6.6.2 Hydraulic Grade Line Analysis

Hydraulic grade line elevations throughout the development for the 100 year 3 hour Chicago storm are summarized in the following **Table 6.19**. The underside of footing elevations (USF) were assumed to be 2.40 m below future road grades where are referenced to **Figure 6.15** Macro Grading Plan. The clearance to the proposed road grade is also indicated. The results indicate that during the 100 year 3 hour Chicago storm event, the trunk storm sewers operate under free flow conditions. Also all the proposed USF's are more than 0.30 m above the predicted sewer HGL and therefore meet the City of Ottawa Freeboard criteria.

Hydraulic grade line results for other storm events including the 100 year 3 hour Chicago + 20% increase in intensity, 100 year 24 hour SCS Type II, July 1 1979, August 1988 and August 1996 storms are presented in **Appendix E**.

Table 6.19 Hydraulic Grade Line

XPSWMM NODE ID	MH NO.	PROPOSED ROAD ELEVATION (M)	USF (M)	100 YEAR 3 HOUR CHICAGO (XPSWMM FILE 32952-100CH.XP)	
				HGL (M)	USF – HGL (M)
Eastern SWM Facility					
ESTSWM	N/A	N/A	N/A	57.89	N/A
MH 226	226	82.51	80.11	71.22	8.89
S225	225	82.51	80.11	75.13	4.98
MH (194)	194	82.86	80.46	75.61	4.85
MH222	222	84.40	82.00	79.86	2.14
S221	221	86.00	83.60	80.47	3.13
MH220	220	87.00	84.60	80.84	3.76

XPSWMM NODE ID	MH NO.	PROPOSED ROAD ELEVATION (M)	USF (M)	100 YEAR 3 HOUR CHICAGO (XPSWMM FILE 32952-100CH.XP)	
				HGL (M)	USF – HGL (M)
S216	216	88.00	85.60	81.52	4.08
MH (161)	161	88.40	86.00	83.75	2.25
S211	211	89.00	86.60	83.86	2.74
MH (159)	159	88.62	86.22	83.97	2.25
MH155	155	88.40	86.00	84.31	1.69
MH(150)	150	87.75	85.35	84.70	0.65
S150	150	88.00	85.60	84.97	0.63
MH (134)	134	88.11	85.71	85.30	0.41
S140	140	88.40	86.00	85.42	0.58
MH135	135	89.20	86.80	85.56	1.24
MH130	130	90.40	88	86.06	1.94
MH119	119	89.65	87.25	86.49	0.76
S115	115	90.00	87.60	86.75	0.85
EXTBRM	128	92.75	N/A	90.38	N/A
MH230	230	85.80	83.40	81.67	1.73
MH (289)	289	85.97	83.57	81.78	1.79
S175	175	85.80	83.40	81.83	1.57
MH (193)	193	78.57	N/A	75.92	N/A
MH (192)	192	81.23	N/A	76.24	N/A
MH (191)	191	82.81	N/A	78.33	N/A
MH (190)	190	81.81	N/A	80.44	N/A
MH (386)	386	84.95	N/A	80.66	N/A
MH205	205	90.70	88.30	80.75	7.55
MH (188)	188	90.37	87.97	83.28	4.69
MH326	326	90.30	87.90	83.59	4.31
MH (186)	186	90.10	87.70	83.88	3.82
MH (185)	185	90.00	87.60	84.02	3.58
S323	323	90.00	87.60	84.12	3.48
MH (183)	183	89.08	86.68	84.15	2.53
MH (182)	182	88.45	86.05	84.17	1.88
S320	320	88.00	85.60	84.19	1.41
S330	330	86.00	N/A	85.48	N/A
MH331	331	83.50	N/A	79.99	N/A
MH332	332	82.00	N/A	79.50	N/A
Western SWM Facility					
SWMW	N/A	77.00	N/A	72.44	N/A
S360	360	79.50	77.10	75.04	2.06
MH272	272	72.50	N/A	72.72	N/A
MH271	271	74.50	N/A	72.44	N/A
MH(228)	228	76.29	N/A	72.47	N/A
MH (227)	227	77.93	N/A	72.55	N/A
S250	250	79.50	77.10	74.35	2.75
MH(270)	270	79.50	77.10	75.63	1.47
MH251	251	81.20	78.80	75.86	2.94
MH252	252	82.20	79.80	76.42	3.38
MH(266)	266	82.40	80.00	76.49	3.51
MH(243)	243	82.40	80.00	76.65	3.35
S258	258	82.40	80.00	76.77	3.23

6.7 Macro Grading

A proposed grading and drainage plan is included on **Figure 6.15**, which is enclosed in **Appendix E**. The proposed road grades consider the geotechnical grade raise limitations as well as provide a conveyance corridor for major storm routing. As noted in **Sections 6.4.1** and **6.5.4**, for storms less frequent than the 5 year event, runoff in excess of the minor system capture will be routed via street segments and rear yards and outlet to one of the following features: the retrofitted Burma Road SWM Facility; one of three dry ponds; the southwest channel; or one of the end-of-pipe SWM facilities. The development will be constructed to ensure the safe conveyance of runoff during the 100 year event.

Once the macro grading was determined, a preliminary storm and sanitary sewer design was completed. The two sewer profiles were then adjusted to ensure there were no conflicts at intersections. **Figure 6.16**, which is enclosed in **Appendix E**, provides an analysis of potential sewer crossings and identifies a positive clearance at all sewer crossing locations.

6.8 Phase 1 Requirements

As stated earlier, the development of the former CFB Rockcliffe site will happen in a phased sequence spread over a number of years. The project is proposed to be constructed in three phases as shown in **Figure 1.6**. Additionally, Phase 1 will be divided into two: Phase 1A and Phase 1B. Phase 1A will include Codd's Road to the City Centre area and the lower density residential areas immediately west of Codd's road. The Phase 1A development limits are shown on **Figure 5.4** which is included in **Appendix D**.

Although the Phase 1A development will include only Codd's Road and areas west, it is recommended that Phase 1A also include construction of an east-west link between Codd's and Burma Roads as well as Burma Road to Montreal Road.

Besides being good engineering and planning practice, construction of the latter two streets is necessary because these will provide corridors for redundant infrastructure which are required to meet City guidelines. Main Street and Burma Road will provide two vehicular access points to Phase 1A and also accommodate a looped watermain network and utility system. The City requires a looped watermain network for a development as large as Phase 1A and some of the major utility providers have also indicated they require looped systems for operational redundancy. Codd's Road and Burma Road will provide the opportunity for these requirements. The recommended storm sewer system for Phase 1A is indicated on **Figure 5.4** which is included in **Appendix E**.

Although Phase 1A will include construction of both Main Street and Burma Road, no developments adjacent to those streets are planned until Phase 1B is completed. Most of the sewers constructed in these two streets will remain "dry." Any groundwater or surface infiltration in the east-west link street sewer will naturally empty into the Codd's Road sewer at node 150. However, the storm sewer in Burma Road which is located north of node 108 is proposed to outlet to node 108 and then westward towards node 114. Since the latter sewer system is not proposed as part of Phase 1A, some interim drainage measures are necessary. It is therefore proposed to construct a temporary drainage pipe outletting to the Burma Road SWM facility to ensure a drainage outlet for the Burma Road minor storm system located north of node 108 until such time that Phase 1B is completed. At that time, the temporary drainage measures can be removed.

Stormwater flows from the Burma Road SWM Facility are presently routed through the subject site in a pair of 1050 mm diameter storm sewers. One of those routes westward and outlets near Hemlock Road, where flows are carried under the Airport Parkway and eventually to the Ottawa River. The second storm sewer routes northeast and outlets over the north escarpment.

The Burma Road SWM Facility will continue to operate as-is until it is reconstructed as part of Phase 1B. Therefore, flows from the two existing 1050 mm diameter storm sewers will be intercepted by the Phase 1A storm sewer in the east-west link street as indicated in **Figure 6.34** which is located in **Appendix E**. It should be noted that any interim increase in drainage area and/or runoff to the Burma facility (i.e., before the pond is retrofitted) will be assessed at the time of detailed design to confirm that sufficient freeboard will be maintained for existing basements.

Figure 6.34 also indicates the required local minor storm sewers needed to properly service Phase 1A. All stormwater runoff from this phase will be routed to the new Eastern SWM Facility, which will need to be constructed as part of Phase 1A. Also, the western cell of the proposed Park Dry Pond will need to be constructed as part of Phase 1A in order to accept major storm runoff from Codd's Road.

6.9 Cost Estimates

Cost estimates for the proposed SWM facilities and storm sewers are summarized in **Table 6.20 – Table 6.22**. The total cost is estimated at $15,443,189.40.

Table 6.20 Cost Estimate – Eastern SWM Facility

ITEM	COST ($)
Excavation - 80,000 m^3	1,600,000.00
Inlet Structure - Lump Sum	100,000.00
Outlet Structure - Lump Sum	75,000.00
2400mm Storm Pipe - 600 m	1,692,000.00
Connection from Aviation Parkway Culvert - 800 m	800,000.00
Maintenance Access Lane - 600 m^2	40,000.00
Topsoil & Seed - 10,000 m^2	40,000.00
Aquatic Planting - Lump Sum	100,000.00
Site Landscaping - Lump Sum	200,000.00
Waterfall & Plunge Pool - Lump Sum	300,000.00
Contingency (25%)	1,236,750.00
TOTAL	6,183,750.00

Table 6.21 Cost Estimate – Western SWM Facility

ITEM	COST ($)
Excavation - 40,000 m^3	800,000.00
Rock Excavation - 15,000 m^3	750,000.00
Inlet Structure (2)	100,000.00
Outlet Structure - Lump Sum	75,000.00
Hemlock Road Culvert - Lump Sum	200,000.00
Maintenance Access Lane - 1350 m^2	80,000.00
Topsoil & Seed - 8,500 m^2	35,000.00
Aquatic Planting - Lump Sum	50,000.00
Site Landscaping - Lump Sum	100,000.00
Clean Out Existing Creek & Culvert	50,000.00
Contingency (25%)	560,000.00
TOTAL	2,800,000.00

Table 6.22 Cost Estimate – Storm Sewer

ITEM	COST ($)
2100 mm Storm Sewer - 70 m @ $1,508.96	105,627.20
2700 mm Storm Sewer - 480 m @ $4,225.07	2,028,033.60
3000 mm Storm Sewer - 775 m @ $5,545.87	4,298,049.25
3600 mm x 3000 mm Storm Sewer - 5 m @ $5,545.87	27,729.35
TOTAL	6,459,439.40

The cost estimates for the two SWM facilities are based on preliminary quantities and unit prices based on past projects. Estimates for proposed storm sewers include only sewers 1800 mm diameter and larger as per the City of Ottawa Development Charge By-Law. The unit rate for the trunk storm sewers are the 2014 rates provided by the City. Due to the presence of rock on the site the contingency unit prices were used. The City of Ottawa does not include cost sharing rates for sewers larger than 3000 mm diameter. The estimate for the proposed 3600 mm x 3000 mm sewer is based on the unit price for a 3000 mm diameter pipe.

6.10 Conclusions

It has been concluded that the existing storm sewer system within former CFB Rockcliffe has reached its useful life and the site's redevelopment should include the construction of a new separated storm sewer system including a dual drainage network and end-of-pipe SWM facilities. The proposed storm sewer system is designed to convey runoff from the majority of the study area as well as several external areas, including the NRC Campus, Thorncliffe, Foxview, and Fairhaven communities, the Montfort Hospital, and the potential future museum site.

The City of Ottawa and CLC have agreed to pursue phased stormwater management demonstration projects for former CFB Rockcliffe using LID Best Management Practices (BMPs). Traditional servicing and LID alternatives were reviewed in parallel as two independent studies. This was done recognizing that LID alternatives would be identified for implementation on a trial basis, phase by phase. To maintain this flexibility, the LID alternatives were evaluated independently. Aquafor Beech was retained by CLC to prepare the 'Stormwater Management Existing Conditions & LID Pilot Project Scoping' (May 2015). The report includes detailed environmental review in the form of stormwater management existing conditions as part of the LID evaluation. The report should be read in parallel with this MSS document.

Runoff from the site is currently conveyed to two creeks, the Eastern Creek and Western Creek, via two existing culvert crossings of the Aviation and Rockcliffe Parkways. The Eastern (Rockcliffe Parkway) culvert can theoretically convey 3.5 cms with no overflow and the Western (Aviation Parkway) culvert can convey 1.35 cms with no overflow at an approximate elevation of 62.00 m.

Construction of the Eastern SWM Facility, adjacent to the Rockcliffe Parkway, will include installation of a new storm sewer conveying outflow from the pond directly to the Ottawa River. Due to the direction connection to river, it is not required the Eastern SWM Facility provide water quantity control. Construction of the Western SWM Facility, located in the northwest corner of the development, will include enhancement in the form of debris removal from the Aviation Parkway culvert; removal of silt build up in the creek at the outlet of the Aviation Parkway culvert; and removal of the blockage in a culvert within the RCMP campus.

Both SWM facilities are to provide an Enhanced Level of Protection, corresponding to 80% TSS removal. Since no fish were found in either creek during the aquatic habitat assessment (DST, August 2013) it is concluded that temperature mitigation measures are not required for the outflows from the SWM facilities.

The existing conditions water balance is evaluated in **Section 6.3.3.5**. It should be noted that the water budget will be finalized, including of relevant infiltration techniques and the percentage of the development area tributary to the infiltration features, as part of the parallel study being completed by Aquafor Beech.

The conceptual stormwater management system incorporates standard urban drainage design and stormwater management features, including a dual drainage concept and two end-of-pipe stormwater management facilities.

The dual drainage design accommodates both minor (pipe) and major (surface) stormwater runoff by featuring a combination of on-site detention (surface ponding) and direct conveyance with no ponding. The dual drainage system was evaluated using the SWMHYMO hydrological model.

The minor system storm sewers are sized based on the rational method, applying standards of both the City of Ottawa and MOE. Where possible, roads are designed to accommodate on-site storage. Inlet control devices (ICDs) will be utilized to control the surcharge in the minor system during infrequent storm events and maximize use of available on-site storage. ICDs will be sized at the detailed design stage.

The recommended minor storm sewer plan is presented on **Figure 6.7** and profiles are presented on **Figure 6.8** (both enclosed in **Appendix E**). The associated storm sewer design spreadsheets are also enclosed in **Appendix E**, along with the corresponding drainage area plan (**Figure 6.9**). All minor storm sewer sizes will be reviewed and confirmed at the time of detailed design.

Minor and major flow from the majority of the study area will be conveyed to the two end-of-pipe facilities for treatment, prior to being released to the Ottawa River.

As noted above, the infiltration techniques and the percentage of the development area tributary to the infiltration features will be determined during subsequent stages of design. The stormwater management concept has been developed as standard SWM facilities, assuming all development area, with the exception of Special Design Area and small area west of the Western SWM Facility (Area PH3A and Area PH2I respectively, refer to **Figures 6.13** and **6.14**), is tributary to the end-of-pipe facilities.

A SWMHYMO model has been developed to represent former CFB Rockcliffe, as well as the external drainage areas, under both existing and post-development conditions.

The results indicate that both Rockcliffe and Aviation Parkway culverts will theoretically overflow under existing conditions.

In terms of post-development conditions, the SWMHYMO simulation was used to evaluate major flow routing on street segments; and performance of the park dry pond, eastern dry pond, and the central dry pond. The XPSWMM simulation was used to evaluate the retrofitted Burma Road pond, and performance of the two end-of-pipe SWM facilities. It is proposed to outlet the Eastern SWM Facility to the Ottawa River via a new storm sewer. It is proposed to outlet the Western SWM Facility to the Ottawa River via the Western Creek.

With respect to major flow routing on street segments, maximum overland flow on streets was reviewed at critical downstream locations and at all locations, the depth of ponding is less than the City of Ottawa guideline of 0.3 m. Further, the depth by velocity does not exceed the City guideline of 0.6 m^2/s.

As part of the redevelopment of former CFB Rockcliffe, the Burma Road SWM Facility will be retrofitted to increase its available storage, which will aid in reducing storm sewer sizes in the study area. Similarly, three major system dry ponds are proposed across the site. The details of the performance of the Burma Road SWM Facility and three dry ponds are summarized in

Section 6.5.4.2. The potential infiltration component of these ponds will be evaluated as part of the parallel LID work; as part of the MSS, however, the storage volume designated for all the ponds is for major system storage only. The functional design for the major system storage provides flexibility in terms of the potential future use for LID techniques.

A channel is proposed around the south and west of the study area to convey major flow from a portion of the study area as well as total flow from Fairhaven and the Montfort Hospital Woods, major flow from a portion of the Montfort Hospital site, and the outflow from the Montfort Hospital SWM Facility. The channel releases to the Western SWM Facility. The channel design will be further refined as part of Aquafor Beech's proposed work plan for the LID pilot project.

A swale is proposed along the eastern and southern edge of block 56 to capture and convey NRC surface runoff and direct it to the improved Burma Pond during Phase 2 construction. The existing ditch will be modified if and as needed to accommodate the NRC runoff.

The two end-of-pipe SWM facilities were simulated in XPSWMM to confirm design and performance. As previously noted, at this stage of design is it assumed that all development areas, with the exception of Special Design Area and PH2I, are tributary to one of the two end-of-pipe SWM facilities.

The Eastern SWM Facility, designed as a wet pond, is comprised of 3.59 ha-m of permanent storage and 1.81 ha-m of water quality extended storage, exceeding the MOE requirements. The facility features a stilling basin, a wet cell, and the outlet structure to a new storm sewer to the Ottawa River. At the upstream end of the facility, the stilling basin will provide energy dissipation for the proposed waterfall inlet. Runoff will then flow into the sediment forebay, prior to the downstream wet cell. The performance of the SWM facility during various storm events is summarized in **Table 6.17**.

Total flow from Area EXTE2 and major flow from Area PH3A (the Special Design Area) are tributary to the Eastern Creek. The areas generate 2.89 cms during the 100 year 3 hour Chicago event (the more critical storm event). This value corresponds to less than the maximum capacity calculated for the existing culvert.

The bankfull flow conditions were simulated with the 25 mm storm event. Statistically, the 25 mm precipitation corresponds to a storm event approximating the 1:5 year return period. The estimated bankfull flows in the Eastern Creek could range between 0.50 cms and 2.5 cms (DST, September 2013). From a fluvial geomorphology perspective the flow generated by the above-noted drainage areas during the 25 mm storm event is 0.56 cms, which is at the lower end of the bankfull estimates.

It is proposed to provide baseflow augmentation to the Eastern Creek from the Eastern SWM Facility by means of a small diameter pipe. Based on a volumetric calculation, 51,081 cu-m/year is to be conveyed from the pond to the creek. This is to be confirmed at the detailed design stage, supported by continuous modeling.

The Western SWM Facility, designed as a wet pond, is comprised of 1.90 ha-m of permanent storage and 0.44 ha-m of water quality extended storage, exceeding MOE requirements. The 1500 mm diameter trunk storm sewer servicing the western portion of the study area extends west along Hemlock Road, terminating on the north side of the Western SWM Facility. To the south, a 525 mm diameter storm sewer will be installed to service Area PH2G, terminating on the south side of the SWM facility. The Southwest Channel ties into the main cell of the facility. The Western SWM Facility is designed as a wet pond (refer to **Section 6.4.2**), with an outlet discharging to the existing Aviation Parkway culvert. During the 100 year 24 hour SCS Type II event, considered the design storm for the pond, the outflow from the facility is 1.25 cms, which is significantly less than the existing conditions flow from the site to the Aviation Parkway culvert. The performance of the SWM Facility during various storm events is summarized in **Table 6.18**.

The bankfull flow conditions were simulated with the 25 mm storm event. Statistically, the 25 mm precipitation corresponds to a storm event with approximately the 1:5 return period. The estimated bankfull flows in the downstream Western Creek could range between 0.70 cms and 1.4 cms (DST, September 2013). From a fluvial geomorphology perspective, outflow through the Aviation Parkway culvert during the 25 mm storm event is 0.30 cms, a rate that corresponds to less than bankfull estimates.

The hydraulic evaluation was completed to confirm the hydraulic grade line of the trunk storm sewers through the development. Minor system hydrographs generated by SWMHYMO have also been imported to XPSWMM. During the 100 year 3 hour Chicago storm event, which is considered the design storm, the trunk storm sewers operate under free flow conditions.

The proposed grading and drainage plan is included on **Figure 6.15**, which is enclosed in **Appendix E**. The proposed road grades consider the geotechnical grade raise limitations as well as provide a conveyance corridor for major storm routing. For storms less frequent than the 5 year event, runoff in excess of the minor system capture will be routed via street segments and rear yards and outlet to one of the following features: the retrofitted Burma Road SWM Facility; one of three dry ponds; the southwest channel; or directly to one of the end-of-pipe SWM facilities. The development will be constructed to ensure the safe conveyance of runoff during the 100 year event. **Figure 6.16**, which is enclosed in **Appendix** E, provides an overview of potential sewer crossings and identifies a positive clearance at all sewer crossing locations.

The Phase 1 requirements are discussed in **Section 6.8**.

7 Shallow Utilities

Select utility companies were circulated a copy of the study area, along with a general description of the intended land use. The purpose of the circulation was to:

- Establish the limits of existing utility infrastructure near the site;
- Alert the utilities that the MSS is underway, and plan for future development;
- Identify if there are any known constraints to extend utility service.

An information meeting was had with representatives of the various stakeholder utility companies on February 7, 2014. A copy of the meeting notes are enclosed in **Appendix F**. The existing utility infrastructure is presented on **Figure 2.19**.

7.1 Hydro One

Hydro One does not service this territory. It does however maintain a 13 Kv service to the adjacent NRC development. That service also includes a sub-station located on the NRC property.

7.2 Hydro Ottawa

Hydro Ottawa indicates that there are three potential sources of power available to service the proposed development. These include extensions from either: the Moulton sub-station; the Overbrook sub-station or the Hydro One NRC sub-station. Hydro Ottawa confirmed that both the Moulton sub-station and Hydro One sources would be radial, or un-looped sources. The Overbrook source would provide a more redundant and reliable service for the property.

7.3 Enbridge Gas

Enbridge reports that it maintains a gas main which serves existing customers on Codd's Road immediately to the south of the site. An extension of that main will provide the required gas service to the subject site. Gas is also available from Montreal Road. There are no known constraints for gas service.

7.4 Communications

Bell Canada reports it has fibre-optic cable along Montreal Road. Bell is ready to extend its infrastructure north along Cobb's Road, and would likely do so in conjunction with Hydro Ottawa pole upgrades.

Rogers Ottawa advises they have the necessary infrastructure to service this community; they have no design constraints to service the subject site.

7.5 Proposed Utility Plan

Details of the initial utility design are premature at this stage of the development. As with other infrastructure, the various higher level utilities encourage redundancy and looping in an attempt to provide a reliable service. Once Hydro Ottawa decides on the best supply source and completes some external improvements, all utilities will be available from Montreal Road and extension of both Codd's Road and Burma Road. Because Phase 1A will include construction of both Codd's Road and Burma Road, it is likely that the various shallow utility designs will take advantage of the multiple supply locations along those streets. It is therefore anticipated that the development of Phase 1A, including Burma Road and Main Street/Hemlock Road, will include

shallow utilities. This information was developed in consultation with the respective utility companies. Hydro Ottawa has an existing 4 Kva circuit which is constructed on the former CFB Rockcliffe and serves the RCAF Pump Station. Development of the subject site will need to include a continued service to the pump station. The higher level utilities have available capacity to service the former CFB Rockcliffe site. All that remains is to extend existing supply to the subject site.

8 Project Listing

This MSS is structured to satisfy the requirements of Phases 1 and 2 of the Municipal Class EA process as outlined in **Section 1.5** and illustrated on **Figure 3.1** for projects as defined in the Municipal Class Environmental Assessment document. This process includes integration with the Planning Act as provided for in Section 2.9 of the Municipal Class EA document.

8.1 Projects

The municipal infrastructure projects associated with the refined municipal servicing plan are:

- Water Distribution Projects
    - Trunk watermains in existing roadways or utility corridors (Schedule A)
    - Trunk watermains in future roadways and utility corridors (Schedule B)
- Wastewater Collection Projects
    - Trunk sanitary sewers in existing roadways or utility corridors (Schedule A)
    - Trunk sanitary sewers in future roadways and utility corridors (Schedule B)
- Stormwater Collection and Treatment
    - Trunk storm sewers in existing roadways or utility corridors (Schedule A)
    - Trunk storm sewers in future roadways and utility corridors (Schedule B)
    - New stormwater retention/detention ponds and appurtenances including outfall (Schedule B)
        - Eastern Stormwater Management Pond and associated sewers and outlet
        - Western Stormwater Management Pond and associated sewers and outlet
        - Park Dry Pond
        - Eastern Dry Pond
        - Central Dry Pond
    - Enlarge stormwater retention pond (Schedule B)
        - Enlarge Burma Road SWM Facility

It should be noted that all the projects listed above are required specifically for the redevelopment of former CFB Rockcliffe and will therefore only be constructed as part of that development process. Given that the listed projects are all site specific, and that the City of Ottawa is not in the practice of constructing site specific infrastructure for developers in advance of the developers' need, it is most probable that the above projects will become a condition of approval as a draft plan condition under the Planning Act prior to the construction of the project. If this is the process followed, all the listed projects automatically become Schedule A projects as defined by definitions 10 and 17 page 1-10 of the Municipal Class EA document, and can proceed directly to final design and construction as Schedule A projects without any further EA requirements.

8.2 Review Process

In addition to the public and agency input to the overall planning of the preferred servicing alternatives described in **Section 3** of this document, review agencies and the public will have the opportunity to review the Class EA documentation prepared for the CFB Rockcliffe project, and have the ability to appeal to the Ontario Municipal Board (OMB). The assessment and review process is being harmonized with the Planning Act because the development application process is occurring simultaneously. Notification of the conditions of planning approvals and the Class EA documents will be advertised through a Notice of Completion and there will be an opportunity to appeal to the OMB.

Under the Planning Act, appeals to the OMB may be made to any of the Official Plan and zoning by-law amendments or to the approval of subdivisions. The deadlines for the appeals to each application are found in the Planning Act. For Draft Plans of Subdivision and Zoning By-law amendments, appeals are to be filed within 20 days after written notice of decisions are provided. In addition, the OMB may dismiss an appeal if the person does not submit either written or oral submissions before the approval authority has granted approval. Once approved, however, the Class EA documents and the preferred municipal infrastructure projects will not be subject to additional EA approval requirements with the submission of subsequent site plans or plans of subdivisions. Once the application is approved under the Planning Act, the requirements of the Class EA are met and projects identified in the Class Environmental Assessments for former CFB Rockcliffe are approved and can proceed to construction and no additional notification under the EA Act is necessary. This allows the integration of both planning processes while ensuring the intent and requirements of both Acts are met.

The implementation of the required supporting infrastructure over time, to facilitate development of the CFB Rockcliffe Lands, will take place as Conditions of Approval. The approvals will be conducted under the Planning Act, and other acts as identified in **Section 9**.

9 Approval Requirements

The former CFB Rockcliffe CDP process satisfies the Municipal Class EA process under the integrated EA and Planning Act provision. In addition to this process and the City of Ottawa subdivision/site plan approval process, the following agency approvals will be required for implementation of the proposed development plan including, but not necessarily limited to:

- Ontario Water Resources Act

  All sanitary sewer, storm sewer and stormwater management projects will require a Environmental Compliance Approval from the Ministry of the Environment.

- Conservation Authorities Act

  All works associated with the enhancement of the outlets to the Ottawa River will require approval by the Rideau Valley Conservation Authority under Section 28 of the Conservation Authorities Act.

- Fisheries Act

  Proponent is to complete the DFO Self Assessment for Projects Near Water. If it is determined through the self assessment that the project has the potential to cause serious adverse harm to fish or fish habitat, contact DFO to request a formal DFO review.

10 Implementation and Phasing

This MSS develops a servicing strategy for the preferred concept plan developed in the CDP. The servicing strategy has built flexibility into the design of the municipal services to allow for changes in land use to be accommodated as build out occurs in several phases over several years. The configuration of the trunk watermains, trunk sanitary sewers and trunk storm sewers has also been arranged to build flexibility into the potential phasing options to accommodate changing market demands for building product type and quantity required to build out. A preliminary phasing plan is presented in **Figure 1.6**. In recognition of the probability that the preferred concept plan may not be entirely built out as currently planned due to unforeseen circumstances, the following process is set out to deal with changes which occur after approval of the Environmental Assessment, but prior to construction.

The change process distinguishes between minor and major changes. A major design change would require completion of an amendment to this EA, while a minor change would not. For either kind of change, it is the responsibility of the proponent to ensure that all possible concerns of the public and affected agencies are addressed.

10.1 Minor Changes

Minor design changes may be defined as those which do not appreciably change the expected net impacts associated with the project. For example, a design change in a utility location within a road right-of-way or the size of a pipe would be considered minor. Changes in utility alignment between road allowances, which do not affect other landowners, would also be considered as minor. All appropriate stakeholders will be provided details of the modification. The majority of such changes could likely be dealt with during the detailed design phase and would remain the responsibility of the proponent to ensure that all relevant issues are taken into account.

10.2 Major Changes

Major changes may be defined as those which change the intent of the EA or appreciably change the expected net impacts associated with the project. An example of a major change would result from a proposed shift in a preferred design alignment or configuration which would warrant changes in mitigation as described in the EA and affect other landowners. If the proposed modification is major, the recommendations and conclusions in this report would require updating. An addendum to the EA would be required to document the change, identify the associated impacts and mitigation measures and allow related concerns to be addressed and reviewed by the appropriate stakeholders.

The preferred servicing solution developed in this MSS presents a high level trunk servicing solution to illustrate the feasibility of servicing the concept plan and guide the final design process, but does not attempt to provide detailed design on a street by street basis. This more detailed level of design will be completed as part of the plan of subdivision or Site Plan Application process when site specific details such as individual lotting, building configurations, and final geotechnical information will be available. This more rigorous level of analysis will undoubtedly result in adjustments to the design presented in this MSS. These adjustments are to be expected as the design evolves in detail and can be dealt with as described above.

10.3 Phasing

Phasing of development of the CFB Rockcliffe site is determined by several key servicing factors which dictate the logical progression of development. Two principal services with limited initial phasing flexibility are the supply of water and vehicular access. In order to provide the necessary

access and redundancy both these services require the extension of Codd's Road and Burma Road connections.

An initial development phase will also require a sanitary outlet and stormwater outlet. The former CFB Rockcliffe site is fortunate to have three existing sanitary outlets in the form of three connection points to a main sanitary collector sewer, one of which is centrally located slightly west of Codd's Road and is known as the Codd's Road Shaft. This central sanitary outlet will provide an efficient and cost effective wastewater outlet for an initial phase of development which recognizes the water and vehicular access constraints. In order to provide a stormwater outlet for the initial phase of development defined by the water and vehicular requirements, it will be necessary to construct the Eastern SWM Facility and associated outlet, including the trunk storm sewer connecting to this pond.

An integral part of the phasing strategy for a staged build out of the CFB Rockcliffe site will be recognition of the sanitary and storm sewers within the proposed development area which must remain in service to outlet the Montfort Hospital, the NRC Campus, and the Thorncliffe development. **Figures 5.4** and **6.34** identify these sewers and potential points of interception with new servicing as part of the construction of Phase 1A and 1. **Figure 1.6** illustrates the initial phasing plan for the entire development area and **Figures 4.9**, **5.4**, and **6.34** illustrate the municipal services required to support Phase 1A and ultimately Phase 1 as currently proposed.

11 Conclusion

11.1 General

This report provides a planning-level functional design to service the former CFB Rockcliffe site. A servicing design is included to facilitate future detail design work. The servicing solutions presented herein are not intended to be absolute but rather provide specific guidelines for site infrastructure development while recognizing some flexibility is potentially possible over the life of the total development.

Some watermain off-site infrastructure may require upgrades to bring the pressure zone, which includes the former CFB Rockcliffe site, to the City's desired level of service. The City's 2013 Master Water Plan Update (MWP) recognizes this situation and accordingly recommends another watermain feed along Montreal Road to the Brittany Drive Water Pump Station and capacity improvements to both that station and the Montreal Road Water Pump Station.

Although Hydro Ottawa has existing services adjacent to the site, it most likely will have to extend external plant to the site from either the Moulton sub-station or the Overbrook sub-station to meet the service requirements of the former CFB Rockcliffe site.

This report has been completed in accordance with the Municipal Class Environmental Assessment process. Principal findings and recommendations of the Master Servicing Study are summarized below.

11.2 Water Distribution

- The existing external water plant along Montreal Road and Brittany Drive has sufficient capacity to service the pressure zone, but does not currently meet the City's guidelines for reliability redundancy and accepted level of service.
- External watermain improvements are needed to meet long term level of service guidelines for the pressure zone including the former CFB Rockcliffe site.
- The 2013 Water Master Plan has identified the following external improvements to service the pressure zone and the proposed development.
    - P-01 Brittany Drive PS – add 22 ML/d capacity – 2013
    - C-03 Brittany Drive PS – 400 mm diameter Montreal Road watermain – between St. Laurent Boulevard and Brittany Drive – 2013
- Replace all existing site watermains
- Two new 400 mm diameter watermains extended from Montreal Road into the site along Codd's Road and Burma Road will provide water to the subject site.
- Portions of the site, especially west of Codd's Road and in Block 44, will experience pressures above 80 psi and pressure reduction with the use of individual pressure reducing valves (PRVs) is recommended in those areas.
- For the construction of Phase 1A, a piping loop through Main Street with connections to the existing Montreal Road watermain from Codd's Road and Burma Road recommended to provide sufficient water supply and fire flow.

  The proposed piping through the Special Design Area in this development is conceptual as no defined road layout or rights of way have been identified at this time. For the purposes of hydraulic modelling, the watermains shown to loop/go through these areas

are intended to demonstrate the need for water and looping through the area. The exact location and looping of these watermains will be determined upon detailed design.

In regards to the future museum, a review determined that although it is located on low-lying lands, it is not feasible to service this area through Zone 1E. The past CFB evaluation of this area ruled out the interconnection from Zone 1E, as it cannot provide pressure greater than 50 psi per the Level of Service requirements. Since pressures are not expected to exceed 100 psi in the proposed watermains that the museum service lines would connect to, it is recommended that the future museum be serviced by Zone MONT pressures with appropriate pressure reducing measures along the service to the museum.

- The site servicing can be completed by installing a series of small diameter watermains following the proposed road layout.

11.3 Wastewater Collection

- Most of the existing sanitary and combined sewers will be removed and replaced with new sanitary sewers, mostly in the new roadways.
- The wastewater outlet for the site is the existing Ottawa Interceptor Outfall Sewer (IOS). The IOS has three existing connection locations on or adjacent to the site.
- Two existing pullback sewers which are currently connected to the IOS will be used as wastewater outlets. It is proposed to re-use portions of both the Alvin Heights and Airbase Pullback Sewers as well as the RCAF Pullback Sewer.
- The existing connection to the Codd's Road shaft will be modified to accommodate the proposed wastewater plan.
- Existing wastewater flows from both the Montfort Hospital and Thorncliffe Village will be captured in the proposed site sewers and re-routed to the IOS.
- Wastewater capacity will also be provided for the potential urbanization of the external Fairview development, and wastewater flows from the potential future museum site can be routed directly to the Airbase Outlet Sewer.
- No wastewater capacity will be provided for the NRC Campus.
- While the new site development will be serviced with gravity sewers, the new sanitary infrastructure will provide an allowance of 29 l/s for the existing RCAF Pump Station.

11.4 Stormwater Management System

- The stormwater management system incorporates standard urban drainage design and stormwater management features, including a dual drainage concept, which accommodates minor and major flow, and two end-of-pipe stormwater management facilities.
- The dual drainage design and the end-of-pipe SWM facilities have been designed in accordance with City of Ottawa and MOE design guidelines.
- The Eastern SWM Facility provides water quality treatment of urban runoff, outletting to the Ottawa River via a new storm sewer. The Western SWM Facility provides water quality and quantity treatment of urban runoff, outletting to the Ottawa River via the Western Creek.
- The Burma Road SWM Facility will be retrofitted as part of the redevelopment, contributing to a reduction in storm sewer sizes in the development.

- Three dry ponds and one channel will be constructed for surface storage and routing. Each of these features will alleviate surface flow and reduce storm sewer sizes.

11.5 Utility Infrastructure

- Each utility company (Hydro Ottawa, Enbridge Gas, Bell Canada and Rogers Ottawa) has confirmed availability of capacity either adjacent to the site or can be extended to the site.
- The existing 4Kv power circuit between Lang's Road and the RCAF Pump Station must be maintained during site development.

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APPENDIX A

MSS TERMS OF REFERENCE

File: 32952-5.3.1

FINAL (MAY 24, 2013)
Rockcliffe CLC Community Design Plan
Site Servicing Report – Terms of Reference

Introduction:

Canada Lands Company (CLC) is renewing a planning and consultation process to redevelop the lands formally known as Canadian Forces Base (CFB) Rockcliffe in Ottawa. The 310 acres (125 hectares) of the Rockcliffe site are located on an escarpment in the heart of the city.

The general Rockcliffe area is bounded by:

- Rockcliffe Parkway to the north;
- National Research Council to the east;
- Montfort Hospital and various commercial and residential developments along Montreal Road to the south;
- Aviation Parkway to the west.

The project elements covered by this scope of work include evaluation of water and wastewater infrastructure, on-site stormwater drainage, and utility infrastructure for the development area. The intent is to complete this work in coordination with development of the land use plan through a parallel EA process with the Community Design Plan (CDP) planning process. Under this process, the inventory of existing conditions, evaluation of alternatives and the selection of the preferred solutions will be completed in concert with the development and evolution of the land use plan, and the Transportation Master Plan (TMP). All plans would be finalized at the same time, taking into account the two-way feedback between the various components. Current City of Ottawa Sewer and Water Design Guidelines will be followed when designing wastewater collection system and water distribution system including relevant geotechnical information related to sanitary and storm sewer and water construction in accordance with the City of Ottawa Geotechnical Investigation and Reporting Guidelines.

The scope of work is summarized on the following pages and will include input from all pertinent agencies, including the City of Ottawa, Rideau Valley Conservation (RVCA), Ministry of Natural Resources (MNR), and Ministry of the Environment (MOE). The scope of work is general in nature with the intent that work will be undertaken in a manner that will satisfy the requirements of Phases 1 and 2 of the EA process as well as City and agency requirements.

Objectives:

The process to be followed for each element of the study would be the EA planning process for Phase 1 & 2 including:

- Inventory of existing conditions, opportunities and constraints;
- Evaluation of alternatives;
- Selection of preferred alternative.

The process will include the necessary coordination with the Community Design Plan, Community Transportation Study, and pertinent Environmental and Geotechnical Studies, as well as the required public contact and documentation. In addition to satisfying the EA process requirements, the analysis will identify the impact of the proposed development on the environment, and both existing and planned infrastructure.

A comprehensive analysis of the planning alternatives will be completed and documented, in support of the preferred servicing alternative. A cost-benefit analysis will be prepared as part of the evaluation. Development of the preferred alternatives will include identification of specific projects or project modifications that will be required in support development, including the approval process, costs, phasing, and probable timelines. Any interim solutions will also be identified at this point. The study will be completed in accordance with the following key principles for successful environmental assessment planning:

- Consultation;
- Analysis of off-site impacts on existing infrastructure;
- Develop a reasonable servicing alternative for on-site services for each of the planning concepts;
    - Evaluation of stormwater management alternatives will be summarized in the servicing document.
    - Watermains, storm sewers, and sanitary sewer distribution system options that are within proposed road corridors are deemed to have no measurable variables with respect to the environment or social impact, and therefore, the most efficient network will generally be presented.
- Consider the impact on all aspects of the environment (social, fiscal, and natural);
- Systematic evaluation;
- Clear documentation;
- Traceable decision making.

Existing Conditions:

An inventory of existing conditions for the study area will be prepared including:

1. Land Ownership Plan with boundary information.
2. Air photo.
3. Topographical mapping.
4. A drawing with all existing water, wastewater, storm, and utility plant. The plan will include existing facilities, planned facilities, and modelling information on both the existing conditions and planned growth.
5. An inventory of existing natural environment conditions will be prepared including preparation of a Preliminary Geotechnical Report addressing soil parameters required to develop and assess stormwater management criteria, and soil conditions at all potential stormwater management facility locations. These findings will be used, as appropriate, to develop servicing solutions. The resulting information will be consolidated into a separate Existing Conditions Plan and Report that will identify specific constraints and opportunities in the study area. In turn, this will be used to develop a Land Use Plan, and to guide preparation of the alternative servicing solutions.

Wastewater:

Following is the proposed wastewater evaluation process: The capacity and condition of existing infrastructure will be identified through analysis and evaluation of information provided by the City. The connection point and method of connection to the City existing trunk network will be determined. This analysis will include liaising with City staff to investigate the need for additional future access points to the existing IOS tunnel and the need to provide for ultimate twinning of this sewer (including access locations and possible odour control requirements). Design alternatives will be investigated and analyzed, operational issues will be part of the evaluation, sewer sizes, evaluations, grades and catchment boundaries are to be shown on drawings. An Overall Servicing Plan will be prepared that shows the water, wastewater and stormwater infrastructure. The analysis and solutions will identify any pump station requirements, locations and elevations, overflows, HGL analysis and redundancy requirements. Servicing conflicts and water crossing requirements will be identified. Operational issues will be considered (i.e. initial low flow, corrosion, etc.).

Water:

The currently proposed infrastructure for the area may be found in the City's Water Master Plan Update, and in recent design studies related to the Montreal Road Pressure Zone.

It is proposed that low and high unit water demand rates will be utilized to determine the sensitivity of the staging/phasing plan to water demands.

The scope of work for water will consist of the following primary items:

- System level and subdivision level demand sets will be determined considering two development scenarios (base and aggressive). The City will provide unit demand rates for the determination of demands, including fire flows.

- The City will provide their recently updated water system hydraulic model and the Consultant will modify the City model to represent the development as lumped demands linked to existing system via expected connection points. The City will provide growth information outside Zone MTL that could impact infrastructure supplying this area.

- Evaluate hydraulics using "system level" demands considering various scenarios (projected development, zone configuration and supply point options) and reliability/redundancy needs. This will include base and aggressive development scenarios and alternative zone configurations. It is not expected that the demands within the CLC Lands will vary significantly from previous studies and analyses, and as such, significant changes to the distribution system supplying this area are not anticipated. Our work plan considers that this exercise will be limited to confirming existing and previously proposed infrastructure needs and that only minor changes may be needed. If demands vary significantly, additional effort beyond that estimated herein may be required.

- Review with the City if there is a need for elevated storage in the Zone MTL pressure zone (it is expected that an elevated tank will not be required).

- Assess alternatives, considering off-site impacts (suction feedermain and PS capacities). Life-cycle costs will be considered in the evaluation (e.g. consider power and O&M costs that the City will have to take on).

- Prepare a high level conceptual design of Montreal Road and Britanny Drive PS upgrades, and select preferred alternatives. The conceptual design will consist of recommendations for pump sizing and types (with phasing/staging of new pump units), overall power requirements, external supply & discharge piping and a layout of the building structure and property for both pump stations. Our level of effort is based on the assumption that significant changes to previously proposed works will not be required – this is predicated on water demands that are reasonably consistent with previous studies for this area.

- A formal presentation will be made to City staff to present development concept, servicing options, evaluation of alternatives and preferred alternatives.

- The preferred solutions will be modified as required to reflect City comments - updates will also be made if necessary based on revised development information.

- The report will include the following (plans/recommendations as applicable):

    - Plan of conceptual skeleton on-site network showing pipe sizing, connection points, zone delineation, PRVs, pump station, as applicable
    - Confirmation of previously proposed routing of any off-site watermains
    - Expected pressure range in each sub-zone

- Identification of any additional upgrades needed for the MTL zone pump stations, beyond current recommendations
- Phasing plan
- Operations under emergency conditions – short and long term conditions
- Costs for off-site works, identifying any "benefit to existing" contributions.

Storm Drainage:

The following is the proposed scope of work for stormwater servicing:

- Prepare a Servicing Plan of the internal storm sewer network with a solution for both the major and minor drainage systems.
- Analyse the 100-year storm sewer hydraulic grade line.
- Ensure conformance to the Grade Control Plan and any grade raise restrictions.
- Identify the major system storage requirements (surface ponding) and identify stormwater management design criteria specific to the Rockcliffe drainage area including water quality, water balance/runoff volume, flood control and erosion control criteria, all as required by the environmental and existing infrastructure constraints identified on and downstream of the site.
- Integrate the design with findings from Environmental studies for the area.
- Establish, in conjunction with wastewater and water services, a preferred minor system (storm sewer) sizing and configuration plan including profiles with HGL, original ground and proposed grade that is free of conflicts from other infrastructure components. Sizing will be performed using a combination of Rational Method spreadsheets and/or hydrologic/hydraulic modelling (SWMHYMO/XP-SWMM).
- Hydraulic grade line elevations are to be provided for the 5-year and 100-year storms along the recommended trunk sewer alignments.
- Peak flow and depth of flow along the major-system for the 100-year storm are to be provided for road sections identified as major corridors of the overland flow system to ensure compliance with Sewer Design Guidelines criteria.
- Establish a functional-level design for SWM facilities identifying the preferred sizing, configuration and operating levels, using the recommendations of the MOE, and City of Ottawa Design Guidelines. Sediment drying areas, access roads, as well as inlet and outlet structures will be presented on an individual figure with a cross section of the facility.
- Characterize and delineate the overall catchment area and constraint boundaries (detailed topography, environmental protection zones, flood plain, embankment areas, geotechnical constraints, aquatic habitat conditions, existing land uses, etc.).
- Identify and evaluate innovative lot level and conveyance measures which may potentially form part of the overall stormwater management concept for Rockcliffe on a pilot project basis. Prepare conceptual applications specific to the Rockcliffe site and liaise with City staff to identify specific applications to be applied on private and/or public property. Determine whether preferred innovative measures are to be applied on a phase by phase basis or on a community wide basis. Develop criteria to evaluate the performance of individual innovative measures. Develop a proposed monitoring program for each approved application.

Additional specific issues that will be addressed include:

1. Discussions with City staff will be required in regards to the design events and criteria to be used in determining the major-minor drainage. Dynamic modelling will be used to simulate and evaluate the preferred alternative.
2. The proposed surface elevations, HGL, pipe sizes, slopes and obvert/invert elevations will be presented on the Storm Drainage Area Plan.
3. Preferred SWM Facility locations will be identified, with consideration for using rural lands. (NCC Lands) including liaising with NCC to confirm any assumptions which include NCC Lands.
4. The Drainage and Wastewater Services Division will be circulated, with ongoing coordination to ensure their requirements are met and implemented.

Shallow Utilities:

- The final Servicing Report will include a summary of shallow utility requirements to support the preferred Concept Plan as identified through the CDP process. Meetings will be held with Hydro, Bell, Cablevision and Consumer Gas to identify existing major infrastructure, off-site upgrades (if required) to support the proposed development, preferred routing of major feeds within the CDP area, and potential phasing of these works in accordance with the proposed development phasing plan.

Process:

As noted above, the Site Servicing Report will be developed through a step-by-step process, in parallel with the Community Design Plan (CDP), and Community Transportation Study (CTS) through Phases 1 and 2 of the EA process. The process is iterative and incremental by its very nature as alternative solutions are developed, analyzed and discussed amongst the stakeholder groups.

Reporting alternatives and conclusions will be completed in stages. A consolidated report documenting the process, outlining the solutions, and classifying the various required projects will be the final product. The impact on planned and existing infrastructure will be identified. Any upgrades, whether new or incremental, will be determined. Alternative and selected solutions will be developed. The analysis and solutions will be developed in accordance with City of Ottawa criteria and practices. The resulting documentation will identify timing, costs and staging of major infrastructure works, including any interim solutions. The approval requirements and process for implementation will also be outlined.

Deliverables:

The deliverables for the project include:

A detailed Site Servicing Report prepared following the requirements of the Class EA process that details storm drainage, wastewater, and water infrastructure needs in support of the proposed development. This report will include but not be limited to:

1. Master Grade Plan(s), identifying fill constraint areas;
2. Major System Flow Routing Plan;
3. Trunk Storm Sewer Distribution Plan;
4. Trunk Sanitary Distribution Plan;
5. Trunk Water Distribution Plan;
6. Master Stormwater Management Plan, including conceptual SWM facility designs;
7. Digital copies of all models used for the analysis of the proposed infrastructure;
8. Geotechnical Report.

APPENDIX B

2013 IMP WASTEWATER COLLECTION SYSTEM ASSESSMENT:

2060 PUMP STATION RESULTS

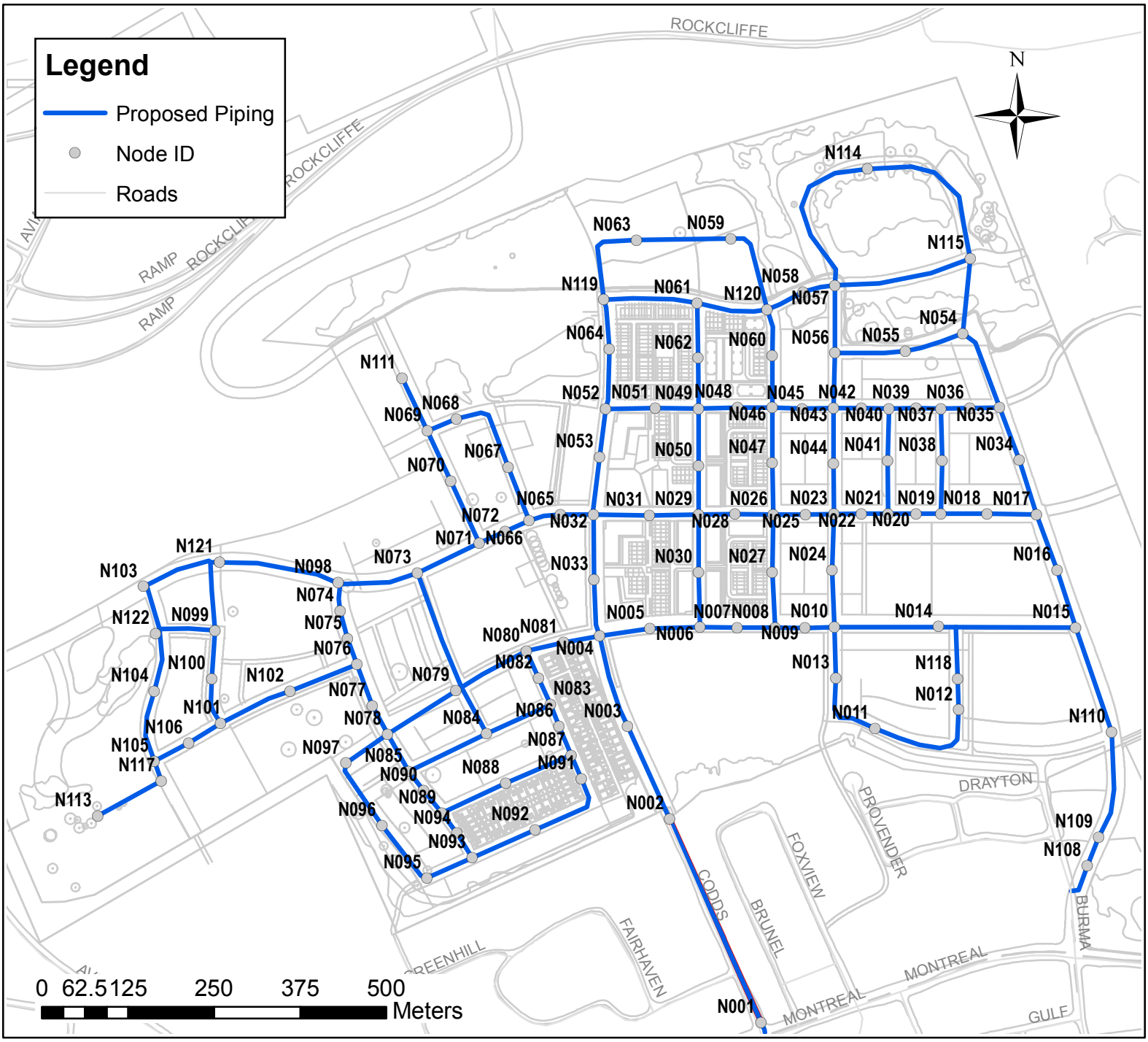
Table 6-2 - 2060 Pump Station Results

Pump Station Name	Future Firm Capacity[a]	Design Event		Hurricane Frances	
		Modeled Peak Flow	Residual Capacity	Modeled Peak Flow	Residual Capacity
	(L/sec)	(L/sec)	(L/sec)	(L/sec)	(L/sec)
Acres	5,200	4,218	982	4,668	532
Briarridge	175	116	59	135	40
Carp	91	90	1	105	(14)
Forest Valley	385	213	172	243	142
Hazeldean	1,225	688	537	732	493
Hemlock	300	249	51	328	(28)
Kanata West	1,253	1,125	128	1,224	29
Leitrim	**381**	**552**	(171)	**622**	(241)
Manotick	322	292	30	355	(33)
March	TBD	586	N/A	623	N/A
RCAF	29	2	27	2	27
RCMP	**12**	**23**	(11)	**33**	(21)
ROPEC Raw Sewage Pump Station	9,861	9,324	537	9,748	114
Signature Ridge	360	169	191	195	165
Stittsville	**108**	**249**	(141)	**272**	(164)
Tartan	216	81	135	111	105
Tenth	**424**	**541**	(117)	**616**	(192)
The following Pump Station have flow restrictions in place or are triggered during wet weather events.					
Crystal Beach[b]	280	434	(154)	541	(261)
Munster1	30	23	7	31	(1)
Richmond[c]	360	401	(41)	497	(137)
Rideau River[d]	1,493	1,081	412	1,278	215
Woodroffe[e]	540	639	(99)	825	(285)

[a] *Future firm capacities as provided by City*
[b] *Diversion from West Nepean to Acres Pump Station.*
[c] *Excess sent to lagoon.*
[d] *Siphon operation is to be triggered by peak DWF greater than 97L/s.*
[e] *Diversion from Woodroffe Collector/West Nepean to Lynwood Trunk.*
Red brackets identify locations without sufficient residual capacity

APPENDIX C

WATER DISTRIBUTION SYSTEM: HYDRAULIC MODELING RESULTS


Legend
Proposed Piping
Node ID
Roads
N
ROCKCLIFFE
RAMP
ROCKCLIFFE
RAMP
ROCKCLIFFE
N114
N115
N063
N059
N119
N061
N120
N058
N057
N054
N064
N062
N060
N056
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N012
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N084
N086
N003
N011
N110
N106
N105
N097
N085
N087
N117
N090
N088
N091
N109
N113
N089
N002
N096
N094
N092
N108
N093
N095
N001
DRAYTON
PROVENDER
FOXVIEW
CODDS
BRUNEL
FAIRHAVEN
MONTREAL
MONTREAL
BURMA
GULE
0 62.5 125 250 375 500
Meters

BSDY & MXDY Analysis with MRPS at Max. Discharge HGL = 147m

	BSDY		MXDY	
ID	Max Pressure (psi)	Min Pressure (psi)	Max Pressure (psi)	Min Pressure (psi)
N001	62.99	55.65	62.98	56.39
N002	72.31	64.97	72.31	65.71
N003	82.44	75.08	82.43	75.82
N004	84.74	77.37	84.74	78.11
N005	84.90	77.53	84.90	78.27
N006	83.19	75.82	83.19	76.56
N007	83.19	75.82	83.19	76.55
N008	82.60	75.23	82.60	75.96
N009	83.18	75.81	83.18	76.55
N010	81.92	74.55	81.92	75.29
N011	81.21	73.84	81.21	74.58
N012	81.21	73.85	81.21	74.58
N013	81.93	74.56	81.93	75.30
N014	79.65	72.29	79.65	73.03
N015	78.06	70.72	78.06	71.46
N016	76.52	69.17	76.52	69.91
N017	75.83	68.46	75.83	69.20
N018	75.66	68.29	75.66	69.03
N019	76.21	68.83	76.20	69.57
N020	77.39	70.01	77.39	70.75
N021	77.85	70.47	77.85	71.21
N022	78.92	71.55	78.92	72.28
N023	80.58	73.20	80.58	73.94
N024	82.20	74.82	82.20	75.56
N025	82.28	74.90	82.27	75.63
N026	83.14	75.76	83.14	76.50
N027	84.13	76.76	84.13	77.49
N028	83.52	76.14	83.51	76.87
N029	83.61	76.23	83.60	76.96
N030	84.36	76.98	84.36	77.72
N031	84.15	76.77	84.15	77.51
N032	84.17	76.79	84.17	77.53
N033	84.68	77.30	84.68	78.04
N034	75.97	68.60	75.97	69.34
N035	76.76	69.39	76.76	70.13
N036	76.81	69.43	76.81	70.17
N037	76.88	69.50	76.88	70.24
N038	76.47	69.09	76.47	69.83
N039	77.31	69.93	77.31	70.67
N040	77.85	70.47	77.85	71.21
N041	78.20	70.82	78.20	71.56
N042	78.09	70.71	78.09	71.45
N043	78.22	70.85	78.22	71.58
N044	80.52	73.14	80.52	73.88
N045	79.72	72.34	79.72	73.08
N046	82.48	75.10	82.48	75.84
N047	81.99	74.61	81.99	75.35
N048	81.87	74.49	81.87	75.23
N049	82.03	74.65	82.03	75.38

	BSDY		MXDY	
ID	Max Pressure (psi)	Min Pressure (psi)	Max Pressure (psi)	Min Pressure (psi)
N050	81.38	74.00	81.38	74.74
N051	82.10	74.72	82.10	75.46
N052	80.66	73.28	80.65	74.01
N053	82.81	75.43	82.81	76.17
N054	80.01	72.64	80.01	73.37
N055	80.13	72.75	80.13	73.49
N056	81.61	74.23	81.60	74.96
N057	86.86	79.48	86.86	80.22
N058	85.08	77.70	85.08	78.44
N059	79.59	72.20	79.58	72.94
N060	82.83	75.45	82.83	76.19
N061	82.35	74.97	82.35	75.71
N062	80.78	73.40	80.78	74.14
N063	83.74	76.36	83.74	77.09
N064	83.84	76.46	83.84	77.19
N065	84.08	76.70	84.08	77.43
N066	84.25	76.86	84.25	77.60
N067	82.50	75.11	82.50	75.84
N068	86.30	78.90	86.30	79.64
N069	87.43	80.03	87.43	80.77
N070	83.17	75.77	83.16	76.51
N071	85.87	78.48	85.87	79.21
N072	83.90	76.51	83.90	77.24
N073	88.35	80.95	88.34	81.69
N074	90.15	82.75	90.15	83.49
N075	90.42	83.02	90.41	83.75
N076	89.88	82.48	89.88	83.22
N077	88.07	80.67	88.07	81.41
N078	88.09	80.70	88.09	81.43
N079	87.27	79.88	87.27	80.62
N080	86.16	78.77	86.16	79.51
N081	85.50	78.12	85.50	78.85
N082	85.61	78.22	85.61	78.95
N083	85.62	78.23	85.62	78.96
N084	86.96	79.57	86.96	80.30
N085	87.75	80.36	87.75	81.09
N086	85.56	78.17	85.56	78.90
N087	84.50	77.11	84.50	77.84
N088	85.43	78.04	85.43	78.77
N089	87.17	79.77	87.16	80.51
N090	87.42	80.03	87.42	80.76
N091	83.85	76.46	83.85	77.20
N092	83.77	76.38	83.77	77.11
N093	84.43	77.04	84.43	77.77
N094	86.31	78.92	86.31	79.65
N095	85.50	78.11	85.50	78.84
N096	87.76	80.36	87.75	81.10
N097	89.45	82.06	89.45	82.79
N098	91.53	84.13	91.52	84.86
N099	92.14	84.74	92.14	85.48

	BSDY		MXDY	
ID	**Max Pressure (psi)**	**Min Pressure (psi)**	**Max Pressure (psi)**	**Min Pressure (psi)**
N100	93.54	86.13	93.53	86.87
N101	93.75	86.35	93.75	87.08
N102	91.26	83.86	91.26	84.60
N103	93.52	86.11	93.51	86.85
N104	94.12	86.72	94.12	87.45
N105	91.38	83.97	91.37	84.71
N106	92.95	85.55	92.95	86.28
N108	78.16	70.91	78.16	71.66
N109	78.38	71.12	78.38	71.86
N110	78.66	71.36	78.66	72.10
N111	90.82	83.42	90.81	84.16
N113	91.27	83.87	91.27	84.60
N114	91.80	84.42	91.80	85.16
N115	90.31	82.93	90.31	83.67
N117	92.50	85.10	92.50	85.83
N118	81.29	73.93	81.29	74.66
N119	87.69	80.31	87.69	81.04
N120	84.09	76.71	84.09	77.45
N121	87.97	80.57	87.97	81.30
N122	96.12	88.72	96.12	89.45

MXDY+FF Analysis with MRPS at Max. Discharge HGL = 147m

ID	Static Demand (Lpm)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (Lpm)	Residual Pressure (psi)	Available Flow at Hydrant (Lpm)	Available Flow Pressure (psi)
N001	0.11	62.9	147.0	13,000	43.4	18,901	20
N002	0.05	72.3	147.0	13,000	51.6	22,380	20
N003	0.05	82.4	147.0	13,000	61.5	27,531	20
N004	0.05	84.7	147.0	13,000	63.7	28,357	20
N005	0.07	84.9	147.0	13,000	62.5	26,183	20
N006	0.07	83.2	147.0	13,000	60.6	25,193	20
N007	0.20	83.2	147.0	13,000	60.3	24,752	20
N008	0.07	82.6	147.0	13,000	59.9	24,681	20
N009	0.07	83.2	147.0	13,000	60.2	24,639	20
N010	0.07	81.9	147.0	13,000	59.0	24,153	20
N011	0.07	81.2	147.0	13,000	37.8	15,457	20
N012	0.07	81.2	147.0	13,000	42.2	16,321	20
N013	0.07	81.9	147.0	13,000	48.7	17,808	20
N014	0.07	79.6	147.0	13,000	56.2	22,254	20
N015	0.07	78.0	147.0	13,000	57.5	25,934	20
N016	0.07	76.5	147.0	13,000	55.6	24,552	20
N017	0.07	75.8	147.0	13,000	54.7	23,871	20
N018	0.20	75.6	147.0	13,000	53.3	21,465	20
N019	0.07	76.2	147.0	13,000	53.8	21,778	20
N020	0.07	77.4	147.0	13,000	54.9	22,366	20
N021	0.07	77.8	147.0	13,000	55.5	22,997	20
N022	0.07	78.9	147.0	13,000	56.7	23,725	20
N023	0.07	80.6	147.0	13,000	58.9	25,322	20
N024	0.07	82.2	147.0	13,000	53.2	18,901	20
N025	0.20	82.3	147.0	13,000	60.2	25,469	20
N026	0.07	83.1	147.0	13,000	61.1	25,990	20
N027	0.07	84.1	147.0	13,000	55.0	19,254	20
N028	0.20	83.5	147.0	13,000	61.1	25,560	20
N029	0.07	83.6	147.0	13,000	61.5	25,999	20
N030	0.07	84.3	147.0	13,000	55.3	19,374	20
N031	0.07	84.1	147.0	13,000	61.7	25,819	20
N032	0.07	84.1	147.0	13,000	63.0	27,759	20
N033	0.07	84.7	147.0	13,000	63.5	27,933	20
N034	0.20	75.9	147.0	13,000	54.6	23,565	20
N035	0.20	76.7	147.0	13,000	55.4	23,969	20
N036	0.20	76.8	147.0	13,000	55.4	23,893	20
N037	0.20	76.9	147.0	13,000	55.5	23,927	20
N038	0.20	76.4	147.0	13,000	48.0	18,254	20
N039	0.20	77.3	147.0	13,000	55.9	24,141	20
N040	0.20	77.8	147.0	13,000	56.4	24,485	20
N041	0.20	78.2	147.0	13,000	49.7	18,497	20
N042	0.20	78.1	147.0	13,000	56.7	24,660	20

ID	Static Demand (Lpm)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (Lpm)	Residual Pressure (psi)	Available Flow at Hydrant (Lpm)	Available Flow Pressure (psi)
N043	0.20	78.2	147.0	13,000	56.9	24,887	20
N044	0.20	80.5	147.0	13,000	58.2	24,323	20
N045	0.20	79.7	147.0	13,000	58.3	25,466	20
N046	0.20	82.5	147.0	13,000	61.1	26,690	20
N047	0.20	82.0	147.0	13,000	53.4	19,004	20
N048	0.20	81.9	147.0	13,000	60.4	26,290	20
N049	0.20	82.0	147.0	13,000	60.5	26,368	20
N050	0.20	81.4	147.0	13,000	52.9	18,940	20
N051	0.20	82.1	147.0	13,000	60.6	26,315	20
N052	0.17	80.6	147.0	13,000	59.2	25,799	20
N053	0.17	82.8	147.0	13,000	61.4	26,838	20
N054	0.20	80.0	147.0	13,000	56.8	22,758	20
N055	0.20	80.1	147.0	13,000	49.1	18,127	20
N056	0.20	81.6	147.0	13,000	59.1	24,553	20
N057	0.20	86.8	147.0	13,000	64.2	26,500	20
N058	0.20	85.1	147.0	13,000	62.0	25,281	20
N059	0.20	79.6	147.0	13,000	39.9	15,951	20
N060	0.20	82.8	147.0	13,000	54.5	19,377	20
N061	0.20	82.3	147.0	13,000	58.8	23,498	20
N062	0.20	80.8	147.0	13,000	51.9	18,751	20
N063	0.20	83.7	147.0	13,000	43.5	16,420	20
N064	0.17	83.8	147.0	13,000	60.6	24,487	20
N065	0.17	84.1	147.0	13,000	61.4	25,452	20
N066	0.17	84.2	147.0	13,000	60.7	24,282	20
N067	0.17	82.5	147.0	13,000	44.8	16,782	20
N068	0.17	86.3	147.0	13,000	42.0	15,966	20
N069	0.17	87.4	147.0	13,000	43.6	16,196	20
N070	0.17	83.1	147.0	13,000	43.8	16,519	20
N071	0.17	85.8	147.0	13,000	61.5	24,009	20
N072	0.17	83.9	147.0	13,000	59.8	23,443	20
N073	0.17	88.3	147.0	13,000	63.7	24,562	20
N074	0.17	90.1	147.0	13,000	62.9	22,377	20
N075	0.17	90.4	147.0	13,000	47.0	16,638	20
N076	0.17	89.9	147.0	13,000	62.6	22,252	20
N077	0.17	88.0	147.0	13,000	61.8	22,691	20
N078	0.05	88.1	147.0	13,000	63.0	24,005	20
N079	0.05	87.3	147.0	13,000	63.0	24,596	20
N080	0.05	86.1	147.0	13,000	62.4	24,832	20
N081	0.05	85.5	147.0	13,000	62.8	25,988	20
N082	0.05	85.6	147.0	13,000	61.0	23,529	20
N083	0.05	85.6	147.0	13,000	60.8	23,337	20
N084	0.05	86.9	147.0	13,000	62.1	23,782	20
N085	0.05	87.7	147.0	13,000	62.6	23,773	20

ID	Static Demand (Lpm)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (Lpm)	Residual Pressure (psi)	Available Flow at Hydrant (Lpm)	Available Flow Pressure (psi)
N086	0.05	85.5	147.0	13,000	60.1	22,493	20
N087	0.05	84.5	147.0	13,000	58.6	21,510	20
N088	0.05	85.4	147.0	13,000	58.4	20,781	20
N089	0.05	87.1	147.0	13,000	61.2	22,644	20
N090	0.05	87.4	147.0	13,000	61.7	23,011	20
N091	0.05	83.8	147.0	13,000	57.1	20,558	20
N092	0.05	83.7	147.0	13,000	56.0	19,979	20
N093	0.05	84.4	147.0	13,000	57.4	20,587	20
N094	0.05	86.3	147.0	13,000	59.7	21,565	20
N095	0.05	85.5	147.0	13,000	56.1	19,524	20
N096	0.05	87.7	147.0	13,000	55.5	18,788	20
N097	0.05	89.4	147.0	13,000	54.7	18,408	20
N098	0.17	91.5	147.0	13,000	63.3	21,940	20
N099	0.17	92.1	147.0	13,000	61.0	20,212	20
N100	0.17	93.5	147.0	13,000	57.0	18,508	20
N101	0.17	93.7	147.0	13,000	63.1	20,742	20
N102	0.17	91.2	147.0	13,000	61.8	20,842	20
N103	0.17	93.5	147.0	13,000	60.4	19,560	20
N104	0.17	94.1	147.0	13,000	61.3	19,841	20
N105	0.17	91.4	147.0	13,000	58.9	19,420	20
N106	0.17	92.9	147.0	13,000	61.2	20,109	20
N108	0.20	78.2	147.0	13,000	59.3	29,049	20
N109	0.20	78.4	147.0	13,000	59.2	28,533	20
N110	0.07	78.6	147.0	13,000	58.6	27,151	20
N114	0.20	91.8	147.0	13,000	46.0	16,361	20
N115	0.20	90.3	147.0	13,000	66.3	25,961	20
N117	0.166	92.5	147.0	13,000	49.734	17,036	20
N118	0.071	81.3	147.0	13,000	47.898	17,670	20
N119	0.2	87.7	147.0	13,000	64.013	25,497	20
N120	0.2	84.1	147.0	13,000	61.101	24,993	20
N121	0.166	87.9	147.0	13,000	57.304	19,507	20
N122	0.166	96.1	147.0	13,000	63.748	20,446	20

BSDY & MXDY Analysis with MRPS at Max. Discharge HGL = 143m

	BSDY		MXDY	
ID	Max Pressure (psi)	Min Pressure (psi)	Max Pressure (psi)	Min Pressure (psi)
N001	57.36	55.65	57.36	56.39
N002	66.67	64.97	66.66	65.71
N003	76.79	75.08	76.78	75.82
N004	79.09	77.37	79.09	78.11
N005	79.25	77.53	79.25	78.27
N006	77.54	75.82	77.54	76.56
N007	77.54	75.82	77.54	76.55
N008	76.95	75.23	76.95	75.96
N009	77.53	75.81	77.53	76.55
N010	76.27	74.55	76.27	75.29
N011	75.56	73.84	75.56	74.58
N012	75.56	73.85	75.56	74.58
N013	76.28	74.56	76.28	75.30
N014	74.00	72.29	74.00	73.03
N015	72.41	70.72	72.41	71.46
N016	70.87	69.17	70.87	69.91
N017	70.18	68.46	70.18	69.20
N018	70.01	68.29	70.01	69.03
N019	70.56	68.83	70.55	69.57
N020	71.74	70.01	71.74	70.75
N021	72.20	70.47	72.20	71.21
N022	73.27	71.55	73.27	72.28
N023	74.93	73.20	74.93	73.94
N024	76.55	74.82	76.55	75.56
N025	76.63	74.90	76.62	75.63
N026	77.49	75.76	77.49	76.50
N027	78.48	76.76	78.48	77.49
N028	77.87	76.14	77.86	76.87
N029	77.96	76.23	77.95	76.96
N030	78.71	76.98	78.71	77.72
N031	78.50	76.77	78.50	77.51
N032	78.52	76.79	78.52	77.53
N033	79.03	77.30	79.03	78.04
N034	70.32	68.60	70.32	69.34
N035	71.11	69.39	71.11	70.13
N036	71.16	69.43	71.16	70.17
N037	71.23	69.50	71.23	70.24
N038	70.82	69.09	70.82	69.83
N039	71.66	69.93	71.66	70.67
N040	72.20	70.47	72.20	71.21
N041	72.55	70.82	72.55	71.56
N042	72.44	70.71	72.44	71.45
N043	72.57	70.85	72.57	71.58
N044	74.87	73.14	74.87	73.88
N045	74.07	72.34	74.07	73.08
N046	76.83	75.10	76.83	75.84
N047	76.34	74.61	76.34	75.35
N048	76.22	74.49	76.22	75.23
N049	76.38	74.65	76.38	75.38

	BSDY		MXDY	
ID	Max Pressure (psi)	Min Pressure (psi)	Max Pressure (psi)	Min Pressure (psi)
N050	75.73	74.00	75.73	74.74
N051	76.45	74.72	76.45	75.46
N052	75.01	73.28	75.00	74.01
N053	77.16	75.43	77.16	76.17
N054	74.36	72.64	74.36	73.37
N055	74.48	72.75	74.48	73.49
N056	75.96	74.23	75.95	74.96
N057	81.21	79.48	81.21	80.22
N058	79.43	77.70	79.43	78.44
N059	73.94	72.20	73.93	72.94
N060	77.18	75.45	77.18	76.19
N061	76.70	74.97	76.70	75.71
N062	75.13	73.40	75.13	74.14
N063	78.09	76.36	78.09	77.09
N064	78.19	76.46	78.19	77.19
N065	78.43	76.70	78.43	77.43
N066	78.60	76.86	78.60	77.60
N067	76.85	75.11	76.85	75.84
N068	80.65	78.90	80.65	79.64
N069	81.78	80.03	81.78	80.77
N070	77.52	75.77	77.51	76.51
N071	80.22	78.48	80.22	79.21
N072	78.25	76.51	78.25	77.24
N073	82.70	80.95	82.69	81.69
N074	84.50	82.75	84.50	83.49
N075	84.77	83.02	84.76	83.75
N076	84.23	82.48	84.23	83.22
N077	82.42	80.67	82.42	81.41
N078	82.44	80.70	82.44	81.43
N079	81.62	79.88	81.62	80.62
N080	80.51	78.77	80.51	79.51
N081	79.85	78.12	79.85	78.85
N082	79.96	78.22	79.96	78.95
N083	79.97	78.23	79.97	78.96
N084	81.31	79.57	81.31	80.30
N085	82.10	80.36	82.10	81.09
N086	79.91	78.17	79.91	78.90
N087	78.85	77.11	78.85	77.84
N088	79.78	78.04	79.78	78.77
N089	81.52	79.77	81.51	80.51
N090	81.77	80.03	81.77	80.76
N091	78.20	76.46	78.20	77.20
N092	78.12	76.38	78.12	77.11
N093	78.78	77.04	78.78	77.77
N094	80.66	78.92	80.66	79.65
N095	79.85	78.11	79.85	78.84
N096	82.11	80.36	82.10	81.10
N097	83.80	82.06	83.80	82.79
N098	85.88	84.13	85.87	84.86
N099	86.49	84.74	86.49	85.48

	BSDY		MXDY	
ID	**Max Pressure (psi)**	**Min Pressure (psi)**	**Max Pressure (psi)**	**Min Pressure (psi)**
N100	87.89	86.13	87.88	86.87
N101	88.10	86.35	88.10	87.08
N102	85.61	83.86	85.61	84.60
N103	87.87	86.11	87.86	86.85
N104	88.47	86.72	88.47	87.45
N105	85.73	83.97	85.72	84.71
N106	87.30	85.55	87.30	86.28
N108	72.51	70.91	72.51	71.66
N109	72.73	71.12	72.73	71.86
N110	73.01	71.36	73.01	72.10
N111	85.17	83.42	85.16	84.16
N113	85.62	83.87	85.62	84.60
N114	86.15	84.42	86.15	85.16
N115	84.66	82.93	84.66	83.67
N117	86.85	85.10	86.85	85.83
N118	75.64	73.93	75.64	74.66
N119	82.04	80.31	82.04	81.04
N120	78.44	76.71	78.44	77.45
N121	82.32	80.57	82.32	81.30
N122	90.47	88.72	90.47	89.45

MXDY+FF Analysis with MRPS at Max. Discharge HGL = 143m

ID	Static Demand (Lpm)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (Lpm)	Residual Pressure (psi)	Available Flow at Hydrant (Lpm)	Available Flow Pressure (psi)
N001	0.11	57.3	143.0	13,000	43.4	18,901	20
N002	0.05	66.6	143.0	13,000	51.6	22,380	20
N003	0.05	76.8	143.0	13,000	61.5	27,531	20
N004	0.05	79.1	143.0	13,000	63.7	28,357	20
N005	0.07	79.2	143.0	13,000	62.5	26,183	20
N006	0.07	77.5	143.0	13,000	60.6	25,193	20
N007	0.20	77.5	143.0	13,000	60.3	24,752	20
N008	0.07	76.9	143.0	13,000	59.9	24,681	20
N009	0.07	77.5	143.0	13,000	60.2	24,639	20
N010	0.07	76.3	143.0	13,000	59.0	24,153	20
N011	0.07	75.5	143.0	13,000	37.8	15,457	20
N012	0.07	75.5	143.0	13,000	42.2	16,321	20
N013	0.07	76.3	143.0	13,000	48.7	17,808	20
N014	0.07	74.0	143.0	13,000	56.2	22,254	20
N015	0.07	72.4	143.0	13,000	57.5	25,934	20
N016	0.07	70.9	143.0	13,000	55.6	24,552	20
N017	0.07	70.2	143.0	13,000	54.7	23,871	20
N018	0.20	70.0	143.0	13,000	53.3	21,465	20
N019	0.07	70.5	143.0	13,000	53.8	21,778	20
N020	0.07	71.7	143.0	13,000	54.9	22,366	20
N021	0.07	72.2	143.0	13,000	55.5	22,997	20
N022	0.07	73.3	143.0	13,000	56.7	23,725	20
N023	0.07	74.9	143.0	13,000	58.9	25,323	20
N024	0.07	76.5	143.0	13,000	53.2	18,901	20
N025	0.20	76.6	143.0	13,000	60.2	25,469	20
N026	0.07	77.5	143.0	13,000	61.1	25,990	20
N027	0.07	78.5	143.0	13,000	55.0	19,254	20
N028	0.20	77.8	143.0	13,000	61.1	25,560	20
N029	0.07	77.9	143.0	13,000	61.5	25,999	20
N030	0.07	78.7	143.0	13,000	55.3	19,374	20
N031	0.07	78.5	143.0	13,000	61.7	25,819	20
N032	0.07	78.5	143.0	13,000	63.0	27,759	20
N033	0.07	79.0	143.0	13,000	63.5	27,933	20
N034	0.20	70.3	143.0	13,000	54.6	23,565	20
N035	0.20	71.1	143.0	13,000	55.4	23,969	20
N036	0.20	71.1	143.0	13,000	55.4	23,893	20
N037	0.20	71.2	143.0	13,000	55.5	23,927	20
N038	0.20	70.8	143.0	13,000	48.0	18,254	20
N039	0.20	71.6	143.0	13,000	55.9	24,141	20
N040	0.20	72.2	143.0	13,000	56.4	24,485	20
N041	0.20	72.5	143.0	13,000	49.7	18,497	20
N042	0.20	72.4	143.0	13,000	56.7	24,660	20

ID	Static Demand (Lpm)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (Lpm)	Residual Pressure (psi)	Available Flow at Hydrant (Lpm)	Available Flow Pressure (psi)
N043	0.20	72.6	143.0	13,000	56.9	24,887	20
N044	0.20	74.9	143.0	13,000	58.2	24,323	20
N045	0.20	74.1	143.0	13,000	58.3	25,466	20
N046	0.20	76.8	143.0	13,000	61.1	26,690	20
N047	0.20	76.3	143.0	13,000	53.4	19,004	20
N048	0.20	76.2	143.0	13,000	60.4	26,290	20
N049	0.20	76.4	143.0	13,000	60.5	26,368	20
N050	0.20	75.7	143.0	13,000	52.9	18,940	20
N051	0.20	76.4	143.0	13,000	60.6	26,315	20
N052	0.17	75.0	143.0	13,000	59.2	25,799	20
N053	0.17	77.1	143.0	13,000	61.4	26,838	20
N054	0.20	74.3	143.0	13,000	56.8	22,758	20
N055	0.20	74.5	143.0	13,000	49.1	18,127	20
N056	0.20	75.9	143.0	13,000	59.1	24,553	20
N057	0.20	81.2	143.0	13,000	64.2	26,500	20
N058	0.20	79.4	143.0	13,000	62.0	25,281	20
N059	0.20	73.9	143.0	13,000	39.9	15,951	20
N060	0.20	77.2	143.0	13,000	54.5	19,377	20
N061	0.20	76.7	143.0	13,000	58.8	23,498	20
N062	0.20	75.1	143.0	13,000	51.9	18,751	20
N063	0.20	78.1	143.0	13,000	43.5	16,420	20
N064	0.17	78.2	143.0	13,000	60.6	24,487	20
N065	0.17	78.4	143.0	13,000	61.4	25,452	20
N066	0.17	78.6	143.0	13,000	60.7	24,282	20
N067	0.17	76.8	143.0	13,000	44.8	16,782	20
N068	0.17	80.6	143.0	13,000	42.0	15,966	20
N069	0.17	81.8	143.0	13,000	43.6	16,196	20
N070	0.17	77.5	143.0	13,000	43.8	16,519	20
N071	0.17	80.2	143.0	13,000	61.5	24,009	20
N072	0.17	78.2	143.0	13,000	59.8	23,443	20
N073	0.17	82.7	143.0	13,000	63.7	24,562	20
N074	0.17	84.5	143.0	13,000	62.9	22,377	20
N075	0.17	84.7	143.0	13,000	47.0	16,638	20
N076	0.17	84.2	143.0	13,000	62.6	22,252	20
N077	0.17	82.4	143.0	13,000	61.8	22,691	20
N078	0.05	82.4	143.0	13,000	63.0	24,005	20
N079	0.05	81.6	143.0	13,000	63.0	24,596	20
N080	0.05	80.5	143.0	13,000	62.4	24,832	20
N081	0.05	79.8	143.0	13,000	62.8	25,988	20
N082	0.05	79.9	143.0	13,000	61.0	23,529	20
N083	0.05	79.9	143.0	13,000	60.8	23,337	20
N084	0.05	81.3	143.0	13,000	62.1	23,782	20
N085	0.05	82.1	143.0	13,000	62.6	23,773	20

ID	Static Demand (Lpm)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (Lpm)	Residual Pressure (psi)	Available Flow at Hydrant (Lpm)	Available Flow Pressure (psi)
N086	0.05	79.9	143.0	13,000	60.1	22,493	20
N087	0.05	78.8	143.0	13,000	58.6	21,510	20
N088	0.05	79.8	143.0	13,000	58.4	20,781	20
N089	0.05	81.5	143.0	13,000	61.2	22,644	20
N090	0.05	81.7	143.0	13,000	61.7	23,011	20
N091	0.05	78.2	143.0	13,000	57.1	20,558	20
N092	0.05	78.1	143.0	13,000	56.0	19,979	20
N093	0.05	78.8	143.0	13,000	57.4	20,587	20
N094	0.05	80.6	143.0	13,000	59.7	21,566	20
N095	0.05	79.8	143.0	13,000	56.1	19,524	20
N096	0.05	82.1	143.0	13,000	55.5	18,788	20
N097	0.05	83.8	143.0	13,000	54.7	18,408	20
N098	0.17	85.9	143.0	13,000	63.3	21,940	20
N099	0.17	86.5	143.0	13,000	61.0	20,212	20
N100	0.17	87.9	143.0	13,000	57.0	18,508	20
N101	0.17	88.1	143.0	13,000	63.1	20,742	20
N102	0.17	85.6	143.0	13,000	61.8	20,842	20
N103	0.17	87.8	143.0	13,000	60.4	19,560	20
N104	0.17	88.4	143.0	13,000	61.3	19,841	20
N105	0.17	85.7	143.0	13,000	58.9	19,420	20
N106	0.17	87.3	143.0	13,000	61.2	20,109	20
N108	0.20	72.5	143.0	13,000	59.3	29,050	20
N109	0.20	72.7	143.0	13,000	59.2	28,535	20
N110	0.07	73.0	143.0	13,000	58.6	27,151	20
N114	0.2	86.1	143.0	13,000	46.028	16,361	20
N115	0.2	84.6	143.0	13,000	66.263	25,961	20
N117	0.166	86.8	143.0	13,000	49.734	17,036	20
N118	0.071	75.6	143.0	13,000	47.898	17,670	20
N119	0.2	82.0	143.0	13,000	64.013	25,497	20
N120	0.2	78.4	143.0	13,000	61.101	24,993	20
N121	0.166	82.3	143.0	13,000	57.304	19,507	20
N122	0.166	90.4	143.0	13,000	63.748	20,446	20

Phase 1A
MXDY+FF Analysis with MRPS at Max. Discharge HGL = 147m

ID	Static Demand (Lpm)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (Lpm)	Residual Pressure (psi)	Available Flow at Hydrant (Lpm)	Available Flow Pressure (psi)
N002	2.74	72.51	147	13,000	23.36	15,044	20
N003	2.74	82.64	147	13,000	32.79	21,220	20
N004	2.74	84.94	147	13,000	34.54	21,596	20
N005	0.00	85.10	147	13,000	33.62	20,340	20
N006	0.00	83.39	147	13,000	31.18	18,755	20
N007	0.00	83.39	147	13,000	30.82	18,384	20
N008	0.00	82.80	147	13,000	30.02	17,886	20
N009	0.00	83.38	147	13,000	30.54	18,078	20
N010	0.00	82.12	147	13,000	29.31	17,479	20
N014	0.00	79.86	147	13,000	27.88	16,946	20
N015	1.19	78.26	147	13,000	29.52	19,354	20
N032	0.00	84.37	147	13,000	32.52	19,743	20
N033	0.00	84.88	147	13,000	33.71	20,694	20
N065	0.00	84.28	147	13,000	31.21	18,561	20
N066	0.00	84.45	147	13,000	30.54	17,934	20
N071	0.00	86.07	147	13,000	31.24	17,916	20
N072	0.00	84.10	147	13,000	29.68	17,377	20
N073	0.00	88.55	147	13,000	33.30	18,586	20
N078	2.74	88.29	147	13,000	32.92	18,405	20
N079	2.74	87.48	147	13,000	33.37	19,056	20
N080	2.74	86.36	147	13,000	32.85	19,092	20
N081	2.74	85.70	147	13,000	33.42	19,929	20
N082	2.74	85.81	147	13,000	31.38	18,117	20
N083	2.74	85.82	147	13,000	31.17	17,955	20
N084	2.74	87.16	147	13,000	32.395	18,413	20
N085	2.74	87.95	147	13,000	32.657	18,332	20
N086	2.74	85.76	147	13,000	30.438	17,435	20
N087	2.74	84.70	147	13,000	28.956	16,687	20
N088	2.74	85.63	147	13,000	28.767	16,342	20
N089	2.74	87.37	147	13,000	31.571	17,750	20
N090	2.74	87.62	147	13,000	31.874	17,883	20
N091	2.74	84.06	147	13,000	27.486	15,853	20
N092	2.74	83.97	147	13,000	26.554	15,293	20
N093	2.74	84.63	147	13,000	28.309	16,267	20
N094	2.74	86.51	147	13,000	30.275	17,112	20
N095	2.74	85.70	147	13,000	28.264	16,018	20
N096	2.74	87.96	147	13,000	30.096	16,652	20
N097	2.74	89.65	147	13,000	32.629	17,789	20
N110	0.00	78.86	147	13,000	31.063	21,005	20

APPENDIX D

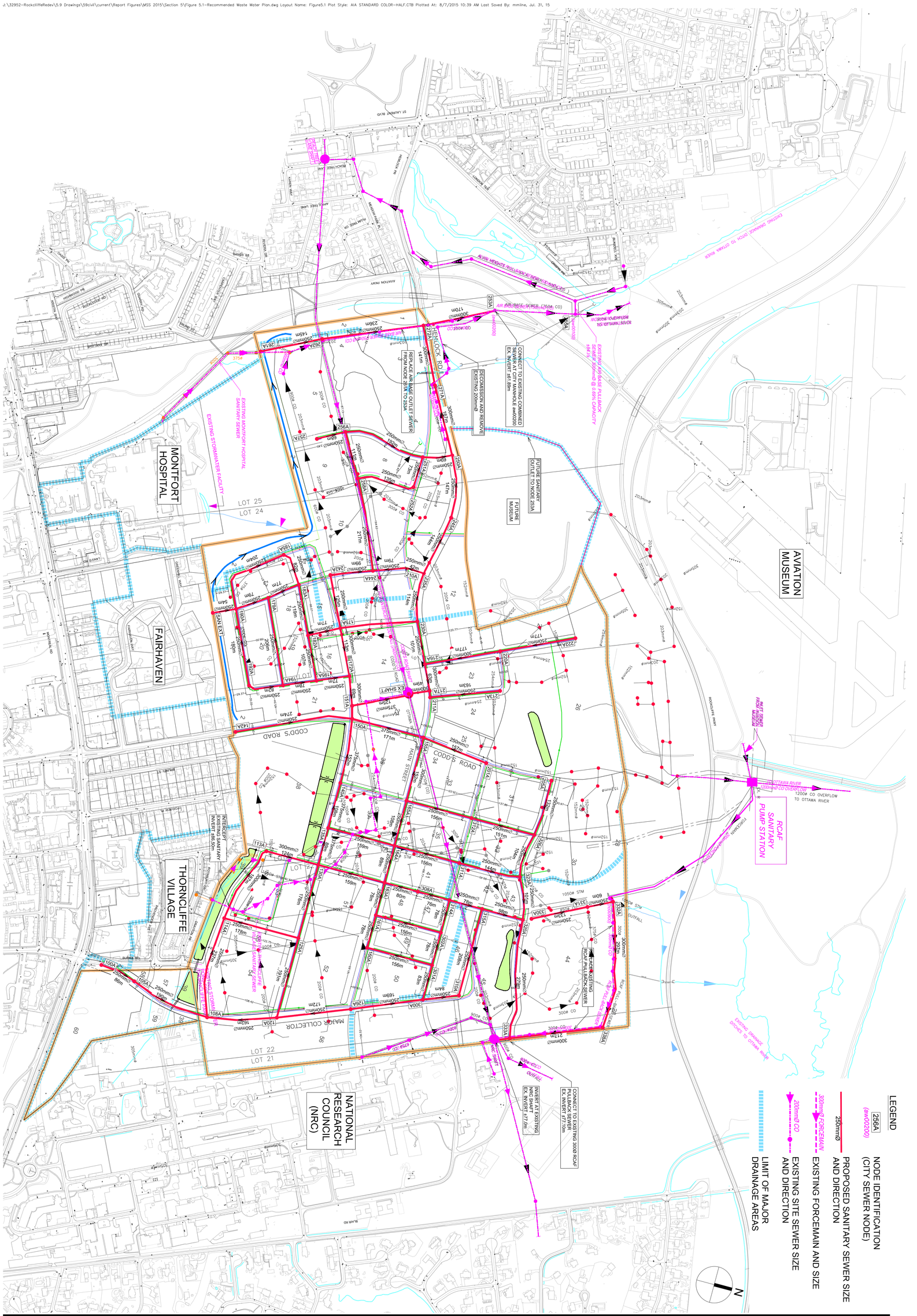
WASTEWATER COLLECTION SYSTEM: SUPPORTING INFORMATION

- Table 5.2 Land Use Distribution and Density Targets, Former CFB Rockcliffe Community Design Plan
- Figure 5.1 Recommended Wastewater Plan
- Sanitary Sewer Design Sheets
- Figure 5.2 Sanitary Drainage Area Plan
- Drawing No. 12381 S1 J. L. Richards & Associates Ltd
- Table 7.5.8.4. Ontario Building Code 2012
- Figure 5.4 Recommended Phase 1A Wastewater Plan
- January 13, 2015 Meeting Notes

Table 5.2: Land Use Distribution and Density

Land Use	Land Area (ha)	Minimum Density (units/ha)	Minimum Units	Target Employment (jobs)	Estimated Population
Low-Rise Residential	8.94		427		1,167
Blocks 11, 15-17, 19-21, 55	*6.53*	*32*	*209*	*n/a*	*619*
Blocks 53, 57	*2.41*	*91*	*219*	*n/a*	*548*
Low- To Mid-Rise Residential	19.88	105	2,087	n/a	3,964
Forest Special Design Area	3.13	91	285	n/a	461
Low- To Mid-Rise Mixed-Use	2.27	91	206	n/a	393
Mid-Rise Mixed-Use	7.68	143	1,100	n/a	1,430
High-Rise Mixed-Use	7.3	170	1,241	n/a	2,355
Employment	15.54	n/a	n/a	2,610	n/a
Westerly Node (Blocks 5, 8, 9)	*1.56*	*n/a*	*n/a*	*580*	*n/a*
High-Rise Employment (Block 56)	*6.08*	*n/a*	*n/a*	*1,600*	*n/a*
Schools (Blocks 14, 52, 54)	*7.31*	*n/a*	*n/a*	*75*	*n/a*
Mixed-Use Retail (Blocks 23-25, 31-33, 35-37, 60)	*0.59*	*n/a*	*n/a*	*355*	*n/a*
Parks and Parkettes (not including Important Tree Groupings)	19.73	n/a	n/a	n/a	n/a
Natural Areas	5.95	n/a	n/a	n/a	n/a
Important Tree Groupings	10.10	n/a	n/a	n/a	n/a
SWM Features	7.95	n/a	n/a	n/a	n/a
Road Network and Lanes	22.35	n/a	n/a	n/a	n/a
TOTAL	**130.82**		**5,346**	**2,610**	**9,764**

J:\32952-RockcliffeRedev\5.9 Drawings\59civil\current\Report Figures\MSS 2015\Section 5\Figure 5.1-Recommended Waste Water Plan.dwg Layout Name: Figure5.1 Plot Style: AIA STANDARD COLOR-HALF.CTB Plotted At: 8/7/2015 10:39 AM Last Saved By: mmline, Jul. 31, 15



Sheet No.	Drawing Title	Project Title	Scale
FIGURE 5.1	RECOMMENDED WASTEWATER PLAN	FORMER CFB ROCKCLIFFE MASTER SERVICING STUDY	0 100 200

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