January 9th, 2025

Updated: February 7th, 2025

SERVICING BRIEF

MEADOW PARK REZONING – 9153 TWINBERRY DRIVE LAND LEASED MODULAR HOME COMMUNITY

Client: Westcan Property Ltd.

L&M Project No.: 1546-10

Rezoning No.: RZ100832

L&M Engineering Limited

1210 Fourth Avenue, Prince George, BC V2L 3J4

Phone: (250) 562-1977

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1.0 INTRODUCTION

On behalf of Westcan Property Ltd., L&M Engineering is pleased to submit a Servicing Brief in support of the rezoning application (RZ100832) for the property located at 9153 Twinberry Drive. The developer is proposing to rezone a portion of the property to facilitate the construction of a Land Leased Modular Home Community. The subject property is currently split zoned RS2: Single Residential, RM1: Multiple Residential, RM3: Multiple Residential, AG: Greenbelt, AF: Agriculture and Forestry, and W: Water. In order to facilitate the development of a Land Leased Modular Home Community, 10.7 ha of the property is being rezoned to RM9: Manufactured Home Park. The remainder of the property will remain zoned RS2, AG, AF and W.

Exhibit 1: Proposed Zoning

This servicing brief has been prepared to summarize the existing utilities in the surrounding area and demonstrate how the property can be serviced with municipal water, sanitary, and storm sewer servicing.

2.0 BACKGROUND DATA AND REPORTS

L&M Engineering has reviewed the following reports regarding the subject developments:

- City of Prince George – 2017 Sanitary Sewer Services Master Plan prepared by AECOM;
- City of Prince George – 2014 Water Service Network Plan prepared by Opus Dayton Knight;
- City of Prince George – Development Services Department: Design Guidelines; and
- PG Map

3.0 SITE TOPOGRAPHY

The site is partially treed, with open spaces and brush throughout. The property is relatively flat with a slight grade toward the existing onsite wetland.

4.0 DESIGN POPULATION

Under the proposed RM9 zone, the allowable density is 22 dwelling units per hectare. The developer is volunteering a Section 219 Covenant to limit the density of the proposed rezoning area to 15 dwelling units per hectare. Therefore, the proposed rezoning area (10.7 ha) could yield a maximum of **160 modular home units**.

Additionally, the land area located immediately south of the proposed rezoning area is currently zoned RS2: Single Residential. Based on a conceptual layout of this RS2 area, approximately **47 single-family** lots could be constructed. Since the RS2 area is already zoned and could be developed without further rezoning, it was included in the design population.

The design population for the subject was calculated as follows:

- Approximate number of dwellings: 207 (modular homes + single family homes)
- Using a factor of 3.0 people/dwelling (Hart-Nechako Sector – CoPG Design Guidelines – Table 2.10.1) yields a maximum population of **621** people.

5.0 WATER DISTRIBUTION SYSTEM

5.1 Existing System

L&M conducted a review of the existing municipal watermain infrastructure in the vicinity of the subject property. 200mmø water mains exist on both Meadow Rim Way and Twinberry Drive. There is also a 200mmø water service that exists in the northwest corner of the site, off of Meadow Rim Way.

5.2 Domestic Water Demands

The domestic water demand has been calculated utilizing rates published in the City of Prince George Draft Design Guidelines. Table 1 outlines the calculation of the domestic water demand.

Table 1 – Estimated Water Demand				
Location	**ADD (L/s)**	**MDD (L/s)**	**PHD (L/s)**	**Node Elevation**
Node 1	2.64	8.18	11.22	732.00

5.3 Fire Protection Demands

In addition to the domestic water demand, an allowance for fire protection must be made. The City of Prince George Draft Design Guidelines recommends minimum fire protection design flows based on land use. The recommended Modular Home design fire flow is 85 L/s.

The document titled Water Supply for Public Fire Protection, produced by the Fire Underwriters Survey (FUS) is the de-facto standard in Canada for establishing fire protection requirements in municipal water works system design. This document presents a fire flow estimate that accounts for factors such as building construction, total floor area, material combustibility, automatic sprinkling, building separation, and occupancy. Preliminary FUS calculations were completed, using approximate exposure distances and building dimensions. Based on the calculation, the development would only require 67 L/s of available fire flow. The FUS calculations are included in Appendix B.

5.4 Water Modelling Results

L&M submitted design parameters to the City of Prince George for water modelling. The City's Water Model was analyzed under Avergage Day Demand (ADD), Maximum Day Demand (MDD) and Peak Hour Demand (PHD) conditions. Maximum Day conditions represent the highest recorded daily demand on the water system and Peak Hour conditions represent the highest demand on the system during the course of a day.

Based on the water modelling results, it was determined that the existing municipal water infrastructure cannot provide the development with the required 67L/s of fire flow. Therefore, multiple water modelling scenarios were completed to determine which offsite watermain upgrades would provide the site with sufficient fire flows. Based on the City modelling, it was determined that two offsite watermain upgrades are required to achieve a minimum fire flow of 67 L/s. The first upgrade project includes installing a 300mmø watermain along the Chief Lake Frontage Road that connects the Highway 97 main to the existing 450mmø on Chief Lake Road. Refer to Exhibit 2. It has been expressed that this project is already being planned by the City of Prince George and is expected to be installed in the near future, although the exact timelines have not been determined.

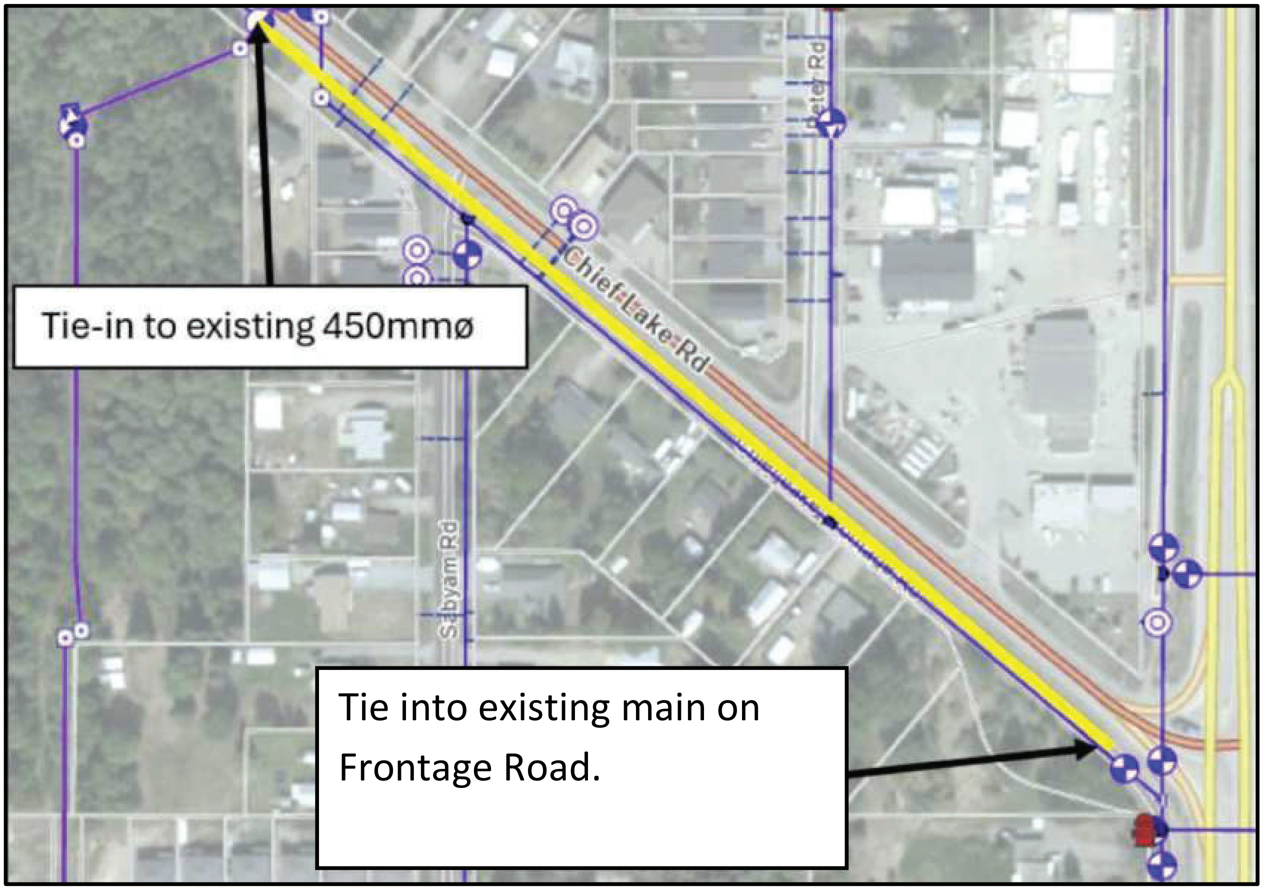

Exhibit 2: City Watermain Upgrade Project – Chief Lake Frontage Road

The second upgrade project includes installing approximately 1km of 200mmø water main from the east end of Knight Crescent to existing 200mmø main that extends south of Twinberry Drive. This upgrade project between Knight Crescent and Twinberry Drive would be the developer’s responsibility. Refer to Exhibit 3.

Exhibit 3: Proposed Watermain Upgrade Project – Knight Cres to Twinberry Drive

Once these projects are completed the modelling results indicate that the development can achieve an available fire flow of 76.85 L/s under MDD conditions. The residual pressures during ADD and PHD conditions are 98.98 psi and 92.25 psi, respectively.

The developer is volunteering a Section 219 Covenant to ensure that any building that is constructed on the property meets the available fire flow achieved at the property. Currently any building constructed on the property would need to meet the FUS requirement of 58.11 L/s. Once the upgrades mentioned above have been implemented any building constructed on the property would need to meet the FUS requirement of 76.85L/s.

5.5 Proposed Water Servicing

The proposed plan for the subject development is to utilize the existing 200mmø water service that extends into the property, off the end of Meadow Rim Way. Additionally, the two upgrade projects listed above will need to be installed to achieve the required fire flows.

6.0 SANITARY COLLECTION SYSTEM

6.1 Existing System

The existing sanitary network in the vicinity of the subject property consists of gravity mains on Meadow Rim Way and Twinberry Drive. These mains flow south to the end of Twinberry Drive and into sanitary lift station PW126. From there the sewage is pumped through a forcemain to the gravity sewer network on Highway 97 (at the Chief Lake Road intersection) which drains down the Hart Highway to sanitary lift station PW117. The sewage is then pumped across the John Hart Bridge into another gravity sewer network which flows to the Prince George Wastewater Treatment Center.

The sanitary main on Meadow Rim Way is stubbed into the subject property and terminates at the City manhole (Asset ID: 13) located on the subject property.

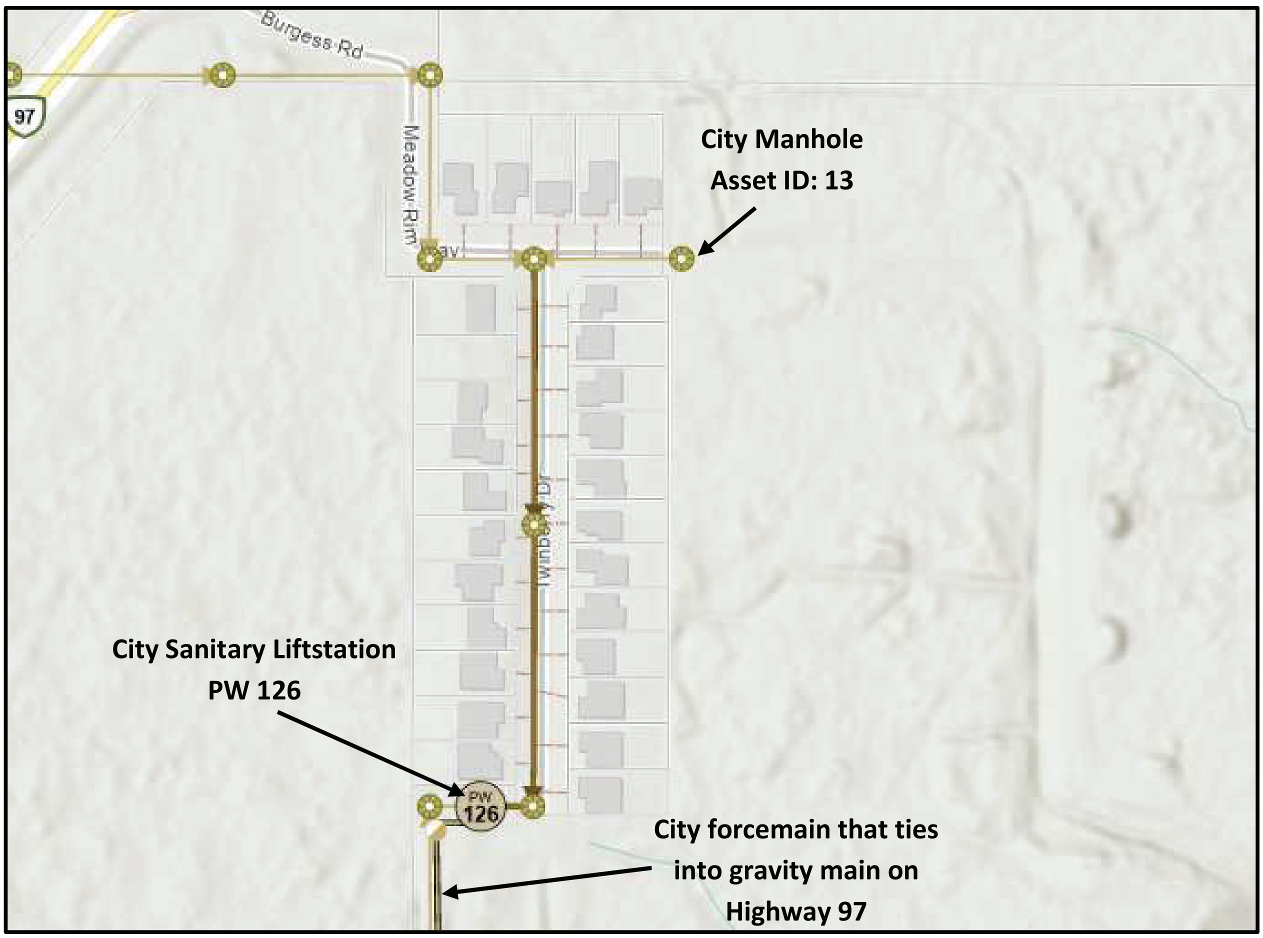

Exhibit 4: Existing Sanitary Infrastructure (Image obtained from PGMap)

6.2 Sanitary Design Flows

The City of Prince George Design Guidelines (Section 4.2) outline the procedure required to determine the sanitary sewer design flows. The estimated sanitary sewer flow calculation for the proposed RM9 area and the existing RS2 are summarized in Table 2.

Table 2: Estimated Sewage Design Flow			
Variable	**Result**		**Notes**
Population	621	people	Refer to Section 4.1
Domestic Avg Daily per Capita	380	l/d	Refer to Section 4.2.2.6 CoPG Design Guidelines
Total Avg. Daily Flow	235,980	l/d	= Population * Avg. Flow per Capita
Peak Factor	3.92		Harman Equation
Total Peak Design Flow (Qs)	925,042	l/d	=Total Avg. Daily Design Flow * Peak Factor
Total Peak Design Flow (Qs)	10.7	l/s	=Total Avg. Daily Design Flow * Peak Factor
Infiltration and Inflow			
Development Area	15.28	ha	
Infiltration Rate	11,200	l/ha/d	Refer to section 4.2.2.4 (11,200 L/ha)
Infiltration (Qi)	171,136	l/d	= Development Area x Infiltration Rate
Infiltration (Qi)	2.0	l/s	= Development Area x Infiltration Rate
Total Design Flow (Qs + Qi)	1,096,178	l/d	(Qs + Qi)
Total Design Flow (Qs + Qi)	**12.7**	l/s	(Qs + Qi)

6.3 Existing Capacity

L&M Engineering reviewed the *City of Prince George 2017 Sanitary Sewer Services Master Plan (prepared by AECOM)* and PGMap for information related to the capacity of the existing sanitary system.

The 2017 Sanitary Master Plan used the following criteria to determine if pipe upgrades are required:

- Local sewers (PWWF<40 L/s) running more than 70% full (Qpeak/Qfull > 0.7) were recommended for upgrade.
- Trunk sewers (PWWF>=40 L/s) running more than 83.5% full (Qpeak/Qfull > 0.835) were recommended for upgrade. This is equivalent to approximately 70% of the full pipe depth.

The 2017 Sanitary Master Plan indicates that all of the pipes between the subject property and PW126 (sanitary liftstation) have the available capacity to accommodate the 12.7 L/s generated by the subject development. The 2017 Sanitary Master Plan also indicates that all of the pipes between PW126 and PW117 (located adjacent to the John Hart Bridge) have the capacity to accommodate the additional 12.7 L/s, with the exception of one pipe section identified as *AssetID 8206*. AssetID is located approximately 500m south of the Highway 97 and Austin Road intersection. The 2017 Sanitary Master Plan has identified *AssetID 8206* and 5 other surrounding pipes to be a long-term recommended upgrade project (O-23).

Additionally, PW126 is listed as being over capacity under the existing flow conditions. The 2017 Sanitary Master Plan has included the replacement of PW126 as a short-term recommended upgrade project (E-6). It is our understanding that the City is proposing to replace the existing lift station and relocate it from its current location. The City has indicated that a Request for Proposal for the design of the lift station replacement/relocation will be posted in the near future.

Since the current lift station is listed as being over capacity, the developer is volunteering a Section 219 Covenant to ensure that the lift station (PW126) is upgraded to accommodate the flows from the development prior to the construction of any new dwellings.

6.4 Proposed Sanitary Servicing

The proposed RM9 zone could be serviced using the existing 200mmø sanitary main that is stubbed into the northwest corner of the proposed zoning area. Due to the topography of the site, it is likely that a second sanitary service will be required along the south end of the site. If a second service is required, then additional sanitary main will also be required to direct the flows to PW126.

7.0 STORM WATER SYSTEM

7.1 Existing System

The existing storm infrastructure in the vicinity of the subject site consists of a storm main that extends through the proposed RM9 area and into the Meadow Park natural wetland. The portion of main that bisects the subject property is not located within a municipal statutory right-of-way. It is recommended that a statutory right-of-way be established around the existing storm infrastructure located on 9153 Twinberry Drive (highlighted in Exhibit 5). This main is currently servicing the residential developments on Meadow Rim Way and Twinberry Drive. Since municipal storm currently drains to the wetland located on private property, it is recommended that a statutory right-of-way be established around the wetland area or that the wetland area be designated to the City of Prince George.

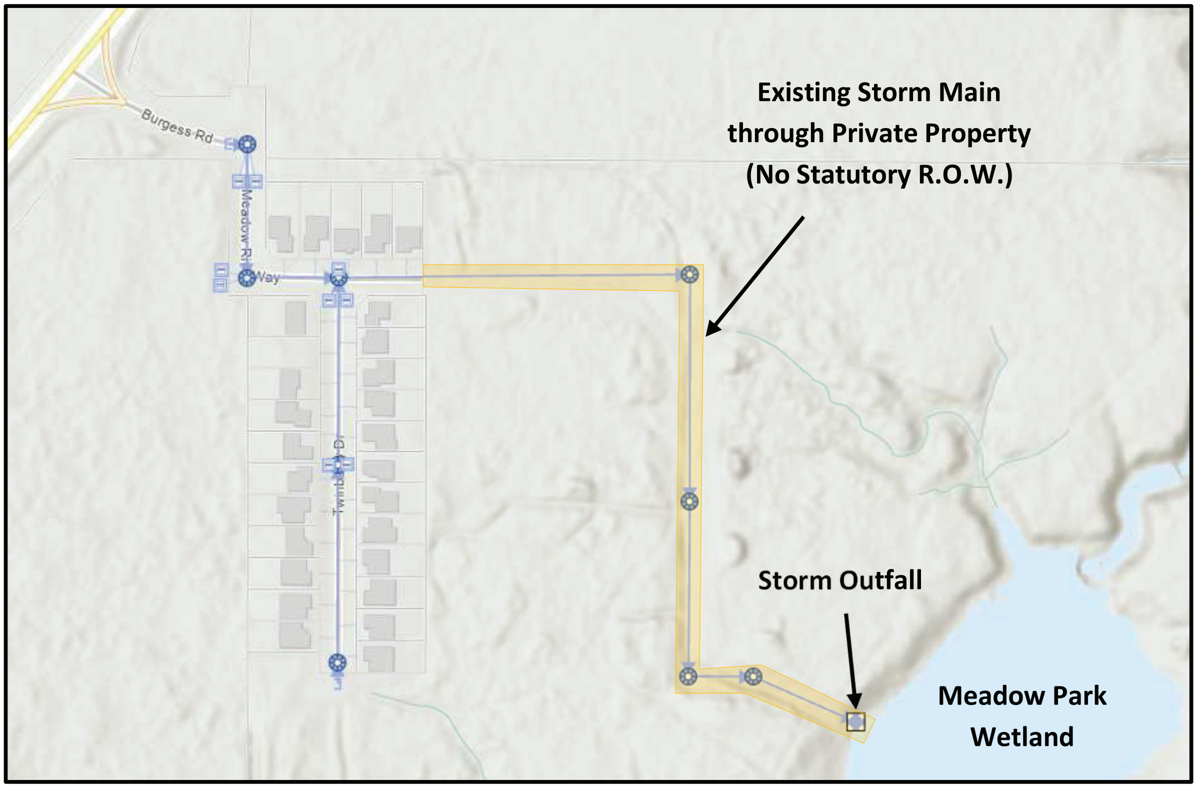

Exhibit 5: Existing Storm Infrastructure (Image obtained from PGMap)

The majority of the Meadow Park natural wetland area is located to the southeast of the proposed rezoning area. A narrow section of the wetland, ranging between 5m and 15m wide, extends up to the north property line where the wetland discharges into a larger ravine. Based on the PGMAP orthographic imagery, it appears that a natural drainage outlet exists on the north end of the wetland that connects to the larger ravine, allowing the wetlands top water elevation to self regulate. The wetland area has an approximate freeboard level of 3.0m.

The downstream ravine has a relatively flat grade and is part of the McMillan Creek watershed. The ravine flows from the subject property to the east until it reaches Old Summit Lake Road. From there the water flows south along the west side of Old Summit Lake Road and then south along the west side of Northwood Pulpmill Road.

7.2 McMillan Creek Watershed Drainage Plan

DWB Consulting Services Limited prepared a McMillan Creek Watershed Drainage Plan (WDP) in 2017 to outline concerns within the watershed and provide recommendations to alleviate concerns and guide new development projects. The majority of the concerns listed in the report are related to deficient existing infrastructure, mainly failing or blocked road crossings. The report also identifies areas of erosion concern within the watershed; however, none of the areas listed are within the subject development's downstream drainage channels.

The short-term improvements identified in the report include installing 4 clear span bridges, in locations (HofferKamp Road, Aberdeen Road, McMillan Drive, and Northwood Road) with deficient existing crossing structures, executing a culvert maintenance plan and following best management practices (BMP's) for existing and new infrastructure. The BMPs identified in the report include snow management, riparian protection, beaver management, minor storm water systems, and infiltration systems.

During the design and construction of the proposed development, these BMP's should be implemented when possible. These include but are not limited to:

- Provide a leave strip buffer between the development and the riparian areas;
- Stock pile snow a minimum of 30m from the natural wetland;
- Design storm collection infrastructure to include sumps to reduce sedimentation mobilization;
- Prepare an Erosion and Sediment Control Plan for all construction activities;

We recommend that above BMP's be implemented in accordance with the 2017 McMillan Creek WDP prepared by DWB Consulting Services Limited.

7.3 Storm Modelling

L&M used HydroCAD 10.0 software to approximate the increase in wetland water elevation during a 10-year design period storm event. Below is a summary of the following key HydroCAD model input parameters used to model the wetland.

Runoff Curve Numbers (CN)
In order to develop an accurate model, each sub-catchment area must be characterized by land use and corresponding impervious and pervious area identified as a runoff curve number (CN). These values dictate how much of the rainfall is absorbed back into the ground vs. captured and conveyed by storm infrastructure.

Pre-Development: CN = 77 Woods, Poor, HSG C
Post Development: CN = 90 1/8 acres lots, 65% imp, HSG C

Times of Concentration

The individual inlet times of concentrations for the post development conditions in the developed areas were determined based on slopes and flow lengths with travel times calculated based on estimated storm sewer lengths, grades, and velocities.

Pre-Development: Tc = 23.3 minutes
Post Development: Tc = 10.0 minutes

Rainfall Intensity

Rainfall intensity duration frequency information for the 10-year return period was based on the Rainfall IDF Curves from the Prince George Airport Data from 1960 to 2023. This data was provided by the City of Prince George.

10-Year, 24Hr Rainfall Depth = 44mm

Based on the HydroCAD modelling results, the proposed development will increase the wetland water elevation by approximately 7cm during a 24hr, 10-year storm event. The water will then discharge through the natural drainage outlet on the north end of the wetland and the normal water level will be restored. During a 10-year storm event the wetland area will still provide approximately 3.0m of freeboard.

7.4 Proposed Storm Servicing

The proposed plan to accommodate the storm runoff generated by the development is to direct all of the storm water toward the Meadow Park natural wetland. This could be accomplished by directing all of the development's runoff to the existing pipe network which currently discharges into the wetland via a storm headwall. Depending on the detailed design lot grading for the property, it may not be feasible to have all of the storm water drain toward the existing pipe network. If that is the case, then additional headwall outlets could be installed into the wetland at different locations.

8.0 SUMMARY

In summary, the site located 9153 Twinberry Drive, in Prince George, BC appears situated such that it can be adequately serviced with nearby municipal sanitary, storm, and water infrastructure. It is our understanding that the City already has plans to upgrade sanitary lift station PW126 as it is currently over capacity. Once the lift station is upgraded, all of the sanitary infrastructure in the area will be sufficient to service the subject development. The storm water generated by the site can be directed to the Meadow Rim natural wetland area. In order to achieve adequate fire flows for the development, two offsite upgrade projects are required. One project includes upgrading the water network along the Chief Lake Frontage Road and the second project includes looping the existing water network from Knight Cresent to Twinberry Drive.

9.0 CLOSURE

This Servicing Brief has been prepared for the City of Prince George and Westcan Property Ltd. as the intended users. Any use which a third party makes of this report or any reliance on or decisions to be made based on it are the responsibility of such third parties. L&M Engineering Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this study. The information and data contained within this document represent L&M Engineering Limited's professional judgement in accordance with the knowledge and information available to L&M Engineering Limited at the time of the report preparation. No other warranty, expressed or implied, is made.

Sincerely,

L&M ENGINEERING LTD

Prepared by:

PERMIT TO PRACTICE
NO 1002375
2025-02-07

Tanner Fjellstrom, P. Eng
Associate

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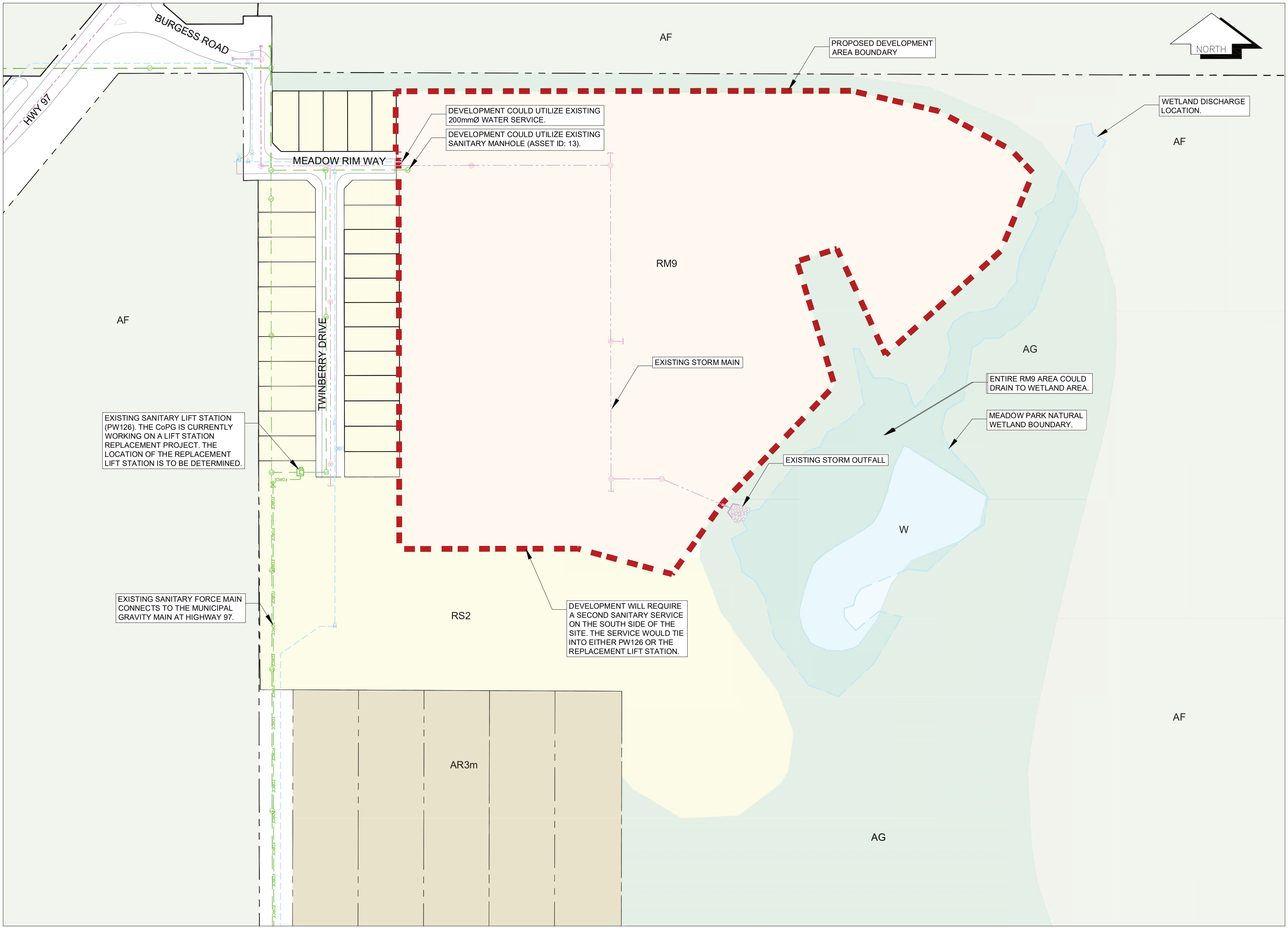
APPENDIX A

SERVICING DRAWINGS



LEGEND

EX. LEGAL LINE
EX. LEGAL R.O.W. & EASEMENT
EX. SANITARY & MANHOLE
EX. SANITARY FORCE MAIN
EX. STORM & MANHOLE
EX. WATER & VALVE

PROPOSED RM9
RS2
AR3
AF
AG
WATER

NO.	DATE (D/M/Y)	REVISION	BY

ISSUED FOR CONSTRUCTION

L&M ENGINEERING LIMITED

CITY OF PRINCE GEORGE
Development Services

CONSULTANTS PROJECT No.:	1546-10
DRAWN:	NLW
CHECKED:	TF
ENGINEER:	TF
DATE:	26/11/2024
SCALES:	FULL 1:1,250
SCALES:	HALF 1:2,500

WESTCAN PROPERTY LTD.
MEADOW PARK SUBDIVISION

SERVICING PLAN

DRAWING No.
C001

0 37.5 75 Meters

APPENDIX B

WATER MODELLING & FUS CALCULATION

CITY OF PRINCE GEORGE
Infrastructure and Public Works

1100 Patricia Boulevard, Prince George, BC V2L 3V9
Telephone (250) 561-7511 Fax (250) 612-5603

MEMO

To: **Tanner Fjellstrom**
L&M Engineering Ltd.
tanner@tlmengineering.bc.ca

From: **Mohammad Bayat**
250-561-7784
mohammad.bayat@princegeorge.ca

Date: **January 7th, 2025**

Subject: **WM000205 Water Modelling for 9153 Twinberry Dr, PID: 015-142-370**
Total number of pages (including this sheet): 9 Original WILL NOT follow by mail.

Tanner Fjellstrom,

Water modelling has been carried out for 9153 Twinberry Dr, PID: 015-142-370 under the conditions provided by yourself via the attached email sent January 6th, 2025. As requested, the scenarios have been evaluated at the locations indicated on the map in your email. Scenarios 1 & 2 have already been assessed under WM000204 and Scenarios 3 & 4 are modelled under WM000205.

The results of the modelling are outlined in Table 1. Although adding 200mm main from knight to south end of Twinberry increased the design fire flow, both Scenarios 3 and 4 still **do not meet** City guidelines, which require at least 85 L/s with a minimum residual pressure of 20 psi for mobile home parks.

If you plan to provide FUS calculations, please note that Upgrade #2 has not been completed, and the timeline for its completion has not been specified yet. Therefore, including the 200mm loop from Knight to the south end of Twinberry, in the current condition, will be considered Scenario 3 until Upgrade #2 is completed.

Additionally, as these values are theoretical, there might be a level difference between them and the actual available fire flow, which requires a field flow test, especially in cases where the required and calculated fire flows are close. However, a flow test is not possible at this time of the year and can be completed in Spring 2025.

Table 1: Modelling Scenarios for 9153 Twinberry Dr

Asset ID	Modelling Node #	Static Pressure During ADD	Static Pressure During PHD	Design Fire Flow During MDD
Scenario1 - Node 1	11319	98.57 psi	88.43 psi	58.11 L/s
Scenario2 - Node 1	11319	98.87 psi	91.17 psi	66.28 L/s
Scenario3 - Node 1	11319	97.25 psi	88.06 psi	62.05 L/s
Scenario4 - Node 1	11319	98.98 psi	92.25 psi	76.85 L/s

* Values are provided at the main

Keep in mind that the hydrant curves and values are provided at the proposed main and any losses within the service connections must be considered by the designer.

Modelling has been carried out using the most recent version of the City's water model, analyzed under Average Day Demands (ADD), Maximum Day Demands (MDD), and Peak Hour Demands (PHD). Average Day represents the expected average demand over the entire year. Maximum Day represents the average demand during the expected highest demand day of the year. Peak Hour represents the expected highest single-hour average demand with a 3-year return period. Fire Flows given are Design Fire Flows, representing the highest flow that can be drawn from a hydrant under Maximum Day Demand, without reducing pressure at any point in the network below 20 PSI.

Regards,

Mohammad Bayat

Prepared by
Mohammad Bayat, EIT
Engineering Technologist

Reviewed by
Al Clark, P.Eng.
City Engineer

CC: Jon LaFontaine, Utilities Manager
Mandy Jones, Manager Development Services

Bayat, Mohammad

From: Tanner Fjellstrom <tanner@lmengineering.bc.ca>
Sent: Monday, January 6, 2025 8:46 AM
To: devserv
Cc: Morrison, Donald; Bayat, Mohammad
Subject: RE: Water Modelling Request - 9153 Twinberry Drive
Attachments: 1546-10 Water Modelling Request (2025.01.06).pdf; WM000204 - 9153 TWINBERRY DR.pdf

Hi Donald,

I would like to request that we add two modelling scenarios to the WM100204 for Twinberry. On the attached PDF is a 200mmø onsite water extension to loop the network from Knight Crescent to the main at the south end of Twinberry Drive. By adding this loop, the water getting to site will be able to bypass approximately 470m of 150mmø pipe along Wapiti and reduce the head loss through this section. We would like to have this loop modelled with and without City Upgrade #2 (listed below). Below is summary of the scenarios we would like modelled:

Scenario 1 – Include City Upgrade #1 (Listed Below) – Modelling was completed in original WM000204

1. Pressure during ADD scenario
2. Pressure during PHD scenario
3. Available Fire Flow during MDD scenario (Hydrant Curve at Node 1)

Scenario 2 – Include City Upgrade #1 and City Upgrade # 2 (Listed Below) - Modelling was completed in original WM000204

1. Pressure during ADD scenario
2. Pressure during PHD scenario
3. Available Fire Flow during MDD scenario (Hydrant Curve at Node 1)

Scenario 3 – Include 200mmø loop from Knight to South End of Twinberry (Attached) and City Upgrade #1 – New Request

1. Pressure during ADD scenario
2. Pressure during PHD scenario
3. Available Fire Flow during MDD scenario (Hydrant Curve at Node 1)

Scenario 4 – Include 200mmø loop from Knight to South End of Twinberry (Attached), City Upgrade #1, and City Upgrade #2 - New Request

1. Pressure during ADD scenario
2. Pressure during PHD scenario
3. Available Fire Flow during MDD scenario (Hydrant Curve at Node 1)

Please let me know if you have any questions.

Sincerely,

Tanner Fjellstrom
Associate, P.Eng
L&M Engineering Limited
P: (250) 562-1977 (ext 124)

C: (250) 613-9213

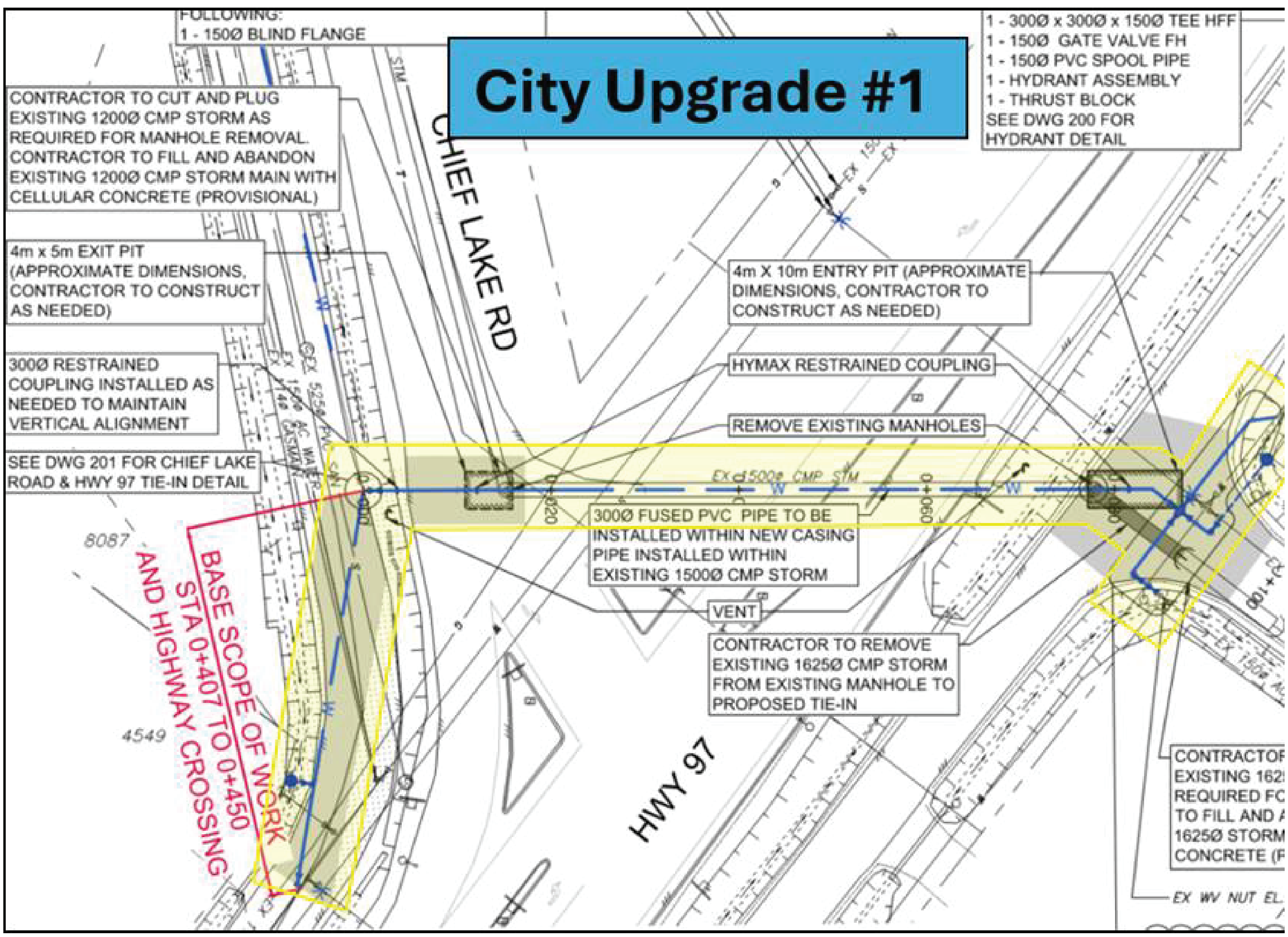
From: Tanner Fjellstrom
Sent: December 6, 2024 8:52 AM
To: devserv@princegeorge.ca
Cc: Morrison, Donald ; Jason Boyes ; James Wankel
Subject: Water Modelling Request - 9153 Twinberry Drive

To whom this may concern,

L&M would like to request water modelling for the property located at 9153 Twinberry Drive, PID: 015-142-370. The property is currently undergoing a rezoning process to rezone 10.7ha of land to RM9 for the purposes of a Modular Home Community development. Attached is a marked-up PDF outlining the requested water modelling node.

It is L&M's understanding that a recent watermain upgrade project took place at the intersection of Highway 97 & Chief Lake Road (City Upgrade # 1 listed below). We would like all water modelling scenarios to include these works that have been completed (The upgrade project is not shown on PG Map).

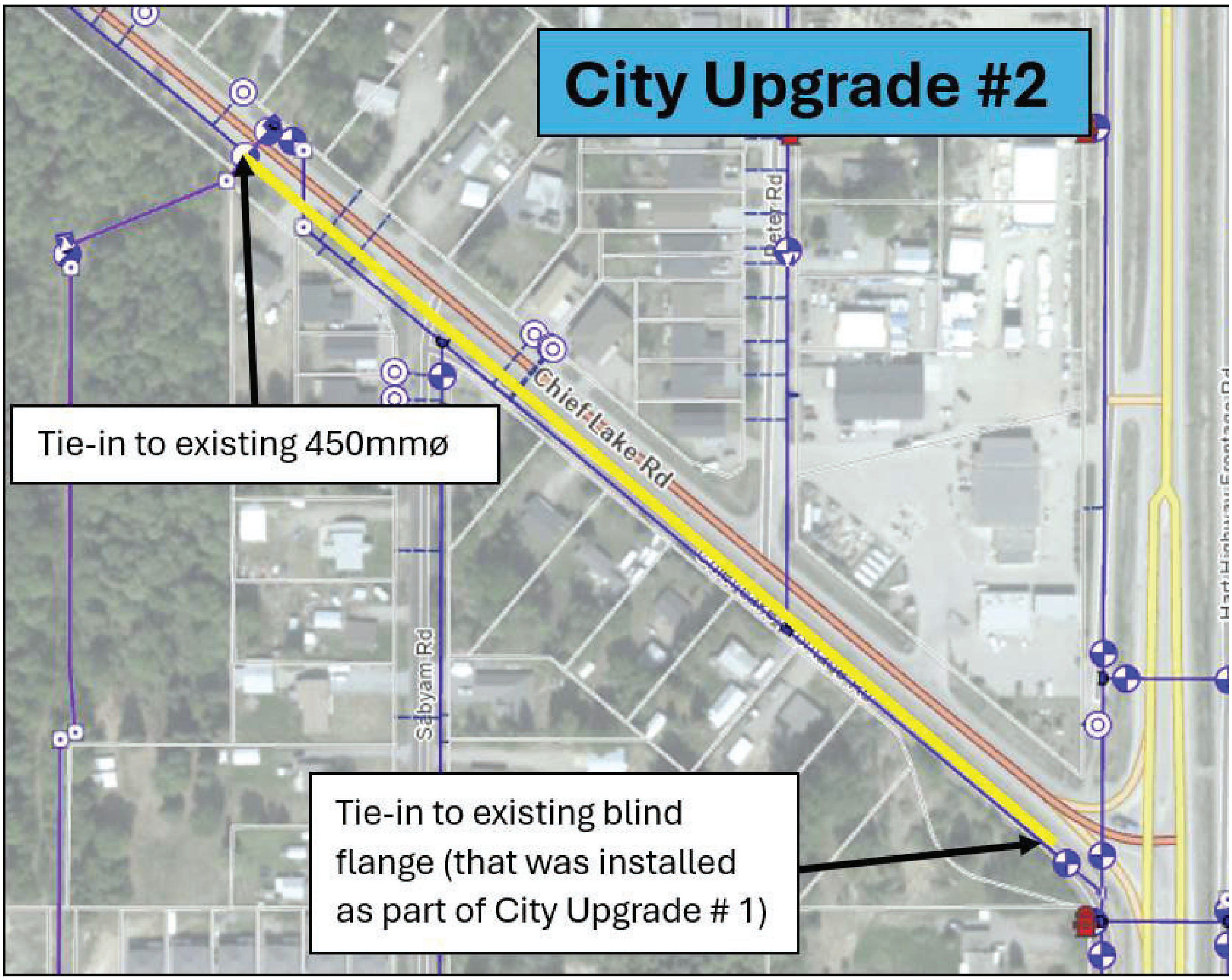
<u>**City Upgrade #1**</u>
Already Completed – At the intersection of Highway 97 & Chief Lake Road (Drawing Set Attached) – Installed a 300mmø watermain from the Chief Lake Frontage Road, across Highway 97, to Chestnut Drive. Also installed 43m of 300mmø watermain from the end of the Highway 97 road crossing and tied into the existing main on the Chief Lake Road Frontage Road. Based on recent conversations with the City, it is L&M's understanding that all of the works highlight in yellow (below) were completed.



It is also our understanding that an additional project is being planned by the City is the same area (City Upgrade # 2 listed below). This project would include connecting City Upgrade # 1 to the 450mm main on Chief Lake Road. We would like Water Modelling Scenario 2 to include this upgrade.

<u>**City Upgrade #2**</u>

To be Completed – Along Chief Lake Frontage Road – Install a 300mmø watermain from the Chief Lake Frontage Road blind flange (at station 0+407 in attached drawing set) to the existing 450mmø watermain on Chief Lake Road. It is L&M's understanding that the City has plans to construct Upgrade #2 in the next few years.



<u>**Summary of Water Modelling Scenarios**</u>

Scenario 1 – Include City Upgrade #1 (Listed Below)

1. Pressure during ADD scenario
2. Pressure during PHD scenario
3. Available Fire Flow during MDD scenario (Hydrant Curve at Node 1)

Scenario 2 – Include City Upgrade #1 and City Upgrade # 2 (Listed Below)

1. Pressure during ADD scenario

2. Pressure during PHD scenario
3. Available Fire Flow during MDD scenario (Hydrant Curve at Node 1)

Table 1: Estimated Water Demand					
ADD (l/c/d)	475	CoPG Design Guidelines Section 3.1.3			
MDD Factor	3.1	CoPG Design Guidelines Section 3.1.4 Table 3.1.1			
PHD Factor	4.25	CoPG Design Guidelines Section 3.1.4 Table 3.1.1			
Location	**Population**	**ADD (L/s)**	**MDD (L/s)**	**PHD (L/s)**	**Node Elevation (m)**
Scenario 1					
Node 1	480	2.64	8.18	11.22	732.00

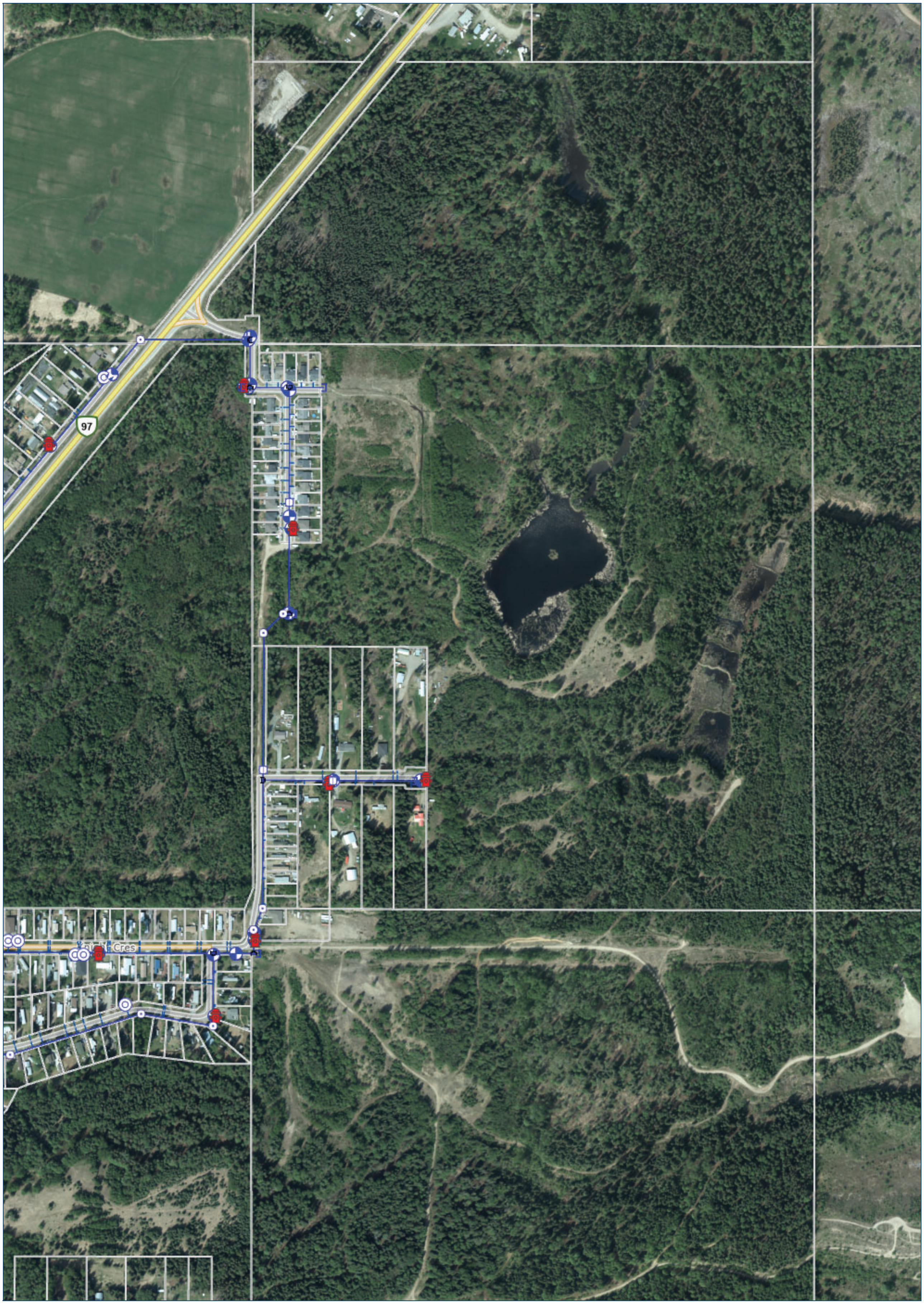
FUS Requirements
Based on preliminary FUS calculations, the Modular Home Community will require between 60 – 67 L/s of fire flow. If these flows are not achieved in Scenario 1 or 2, then additional modelling will be requested.

If you have any questions or concerns, please feel free to contact me.

Sincerely,

Tanner Fjellstrom
Associate, P.Eng
L&M Engineering Limited
P: (250) 562-1977 (ext 124)
C: (250) 613-9213

Map Title



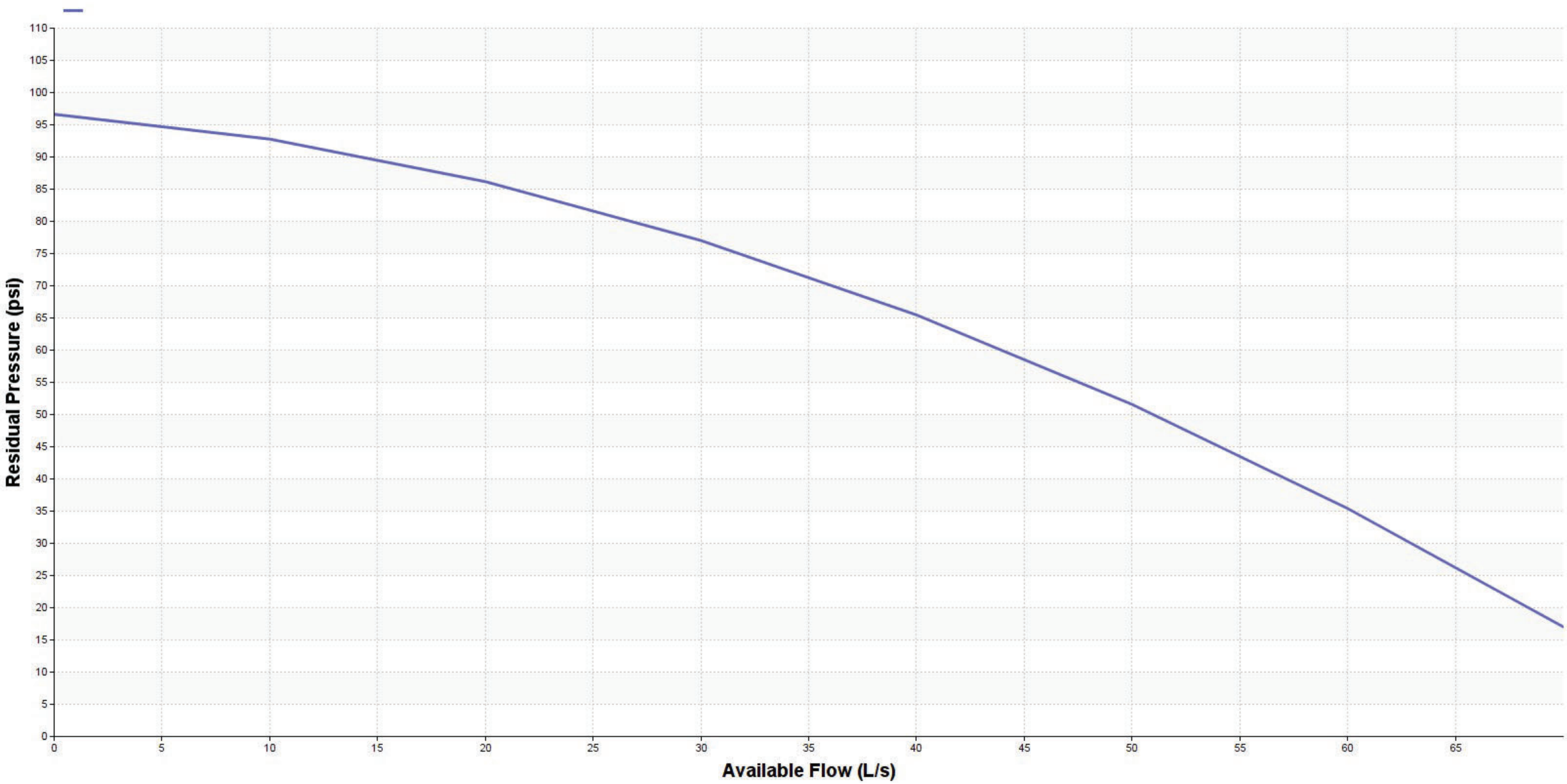
CITY OF
PRINCE GEORGE

Notes:

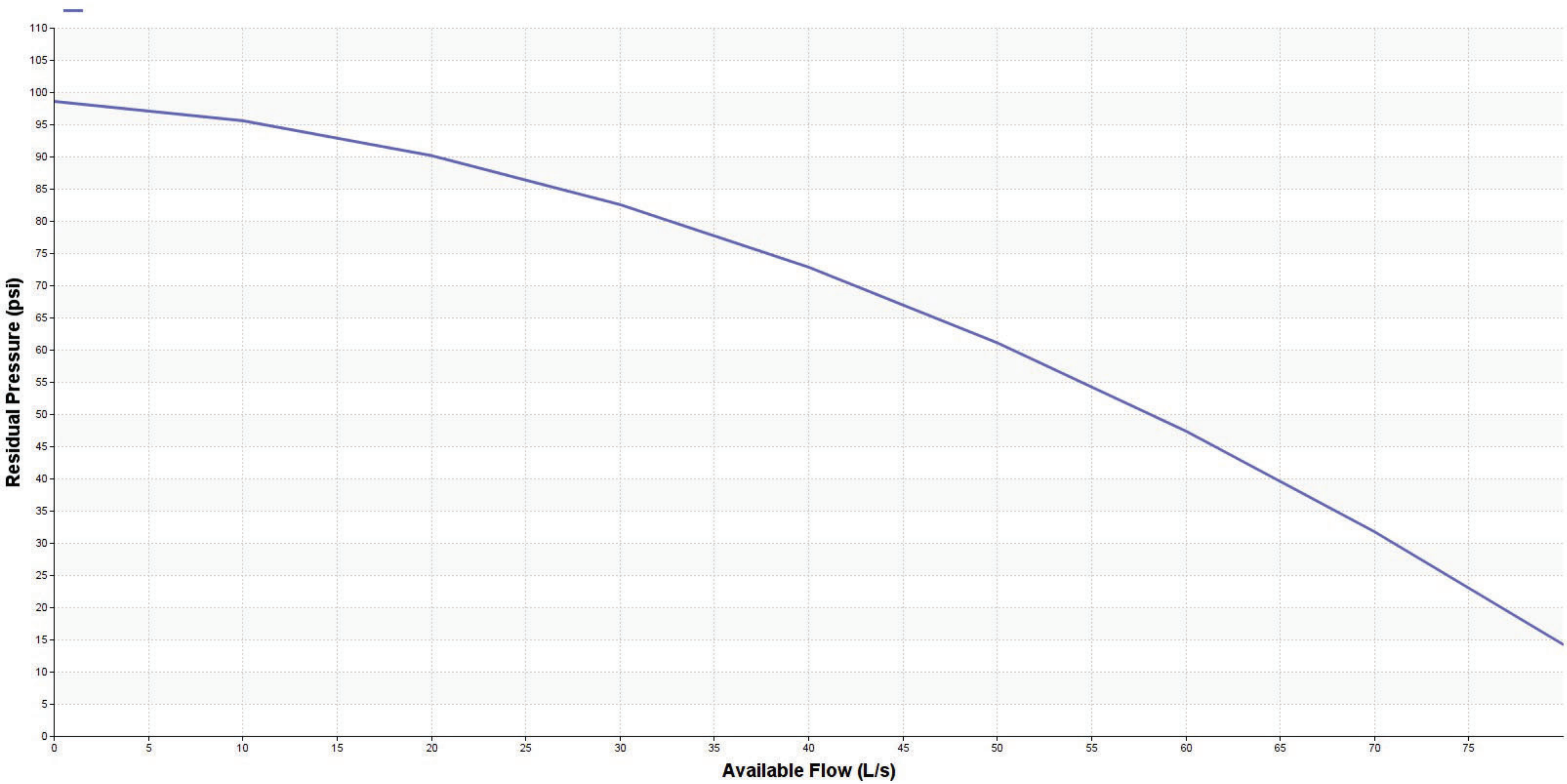
Printed: January 6, 2025 8:22

0 50 100
m

Hydrant Curve for Node 1 - Scenario 3



Hydrant Curve for Node 1 - Scenario 4



FIRE UNDERWRITERS SURVEY
FIRE FLOW ESTIMATE

City: City

Date:
Engineer:
Job No: 1546-10

Project: Meadow Park - RM9

Address: 9153 Twinberry Drive

Fire Area Considered

Types of Construction: Wood Frame
C: 1.5

Ground floor area (ft^2): 1750 **No. of Stories:** 1
(m^2): 163
Total floor area (m^2)(if needed): 163
Fire flow from table (=220*C*$A^{0.5}$): 4208 L/m (a)
Occupancy: Non-Combustible **Add or Subtract** -25 % -1051.9
Sub Total 3156 L/m (b)
Automatic sprinklers: None Subtract 0 % x b = 0
Sub Total 3156 L/m

Exposures :	**Exposure Distance (m)**				
1. Front	20-30	Add	0	%	Based on LxH ratio
2. Left	8		16	%	Based on LxH ratio
3. Rear	12		10	%	Based on LxH ratio
4. Right	8		16	%	Based on LxH ratio
		Total	42	%	
		Use	42	% x b =	1325 L/m

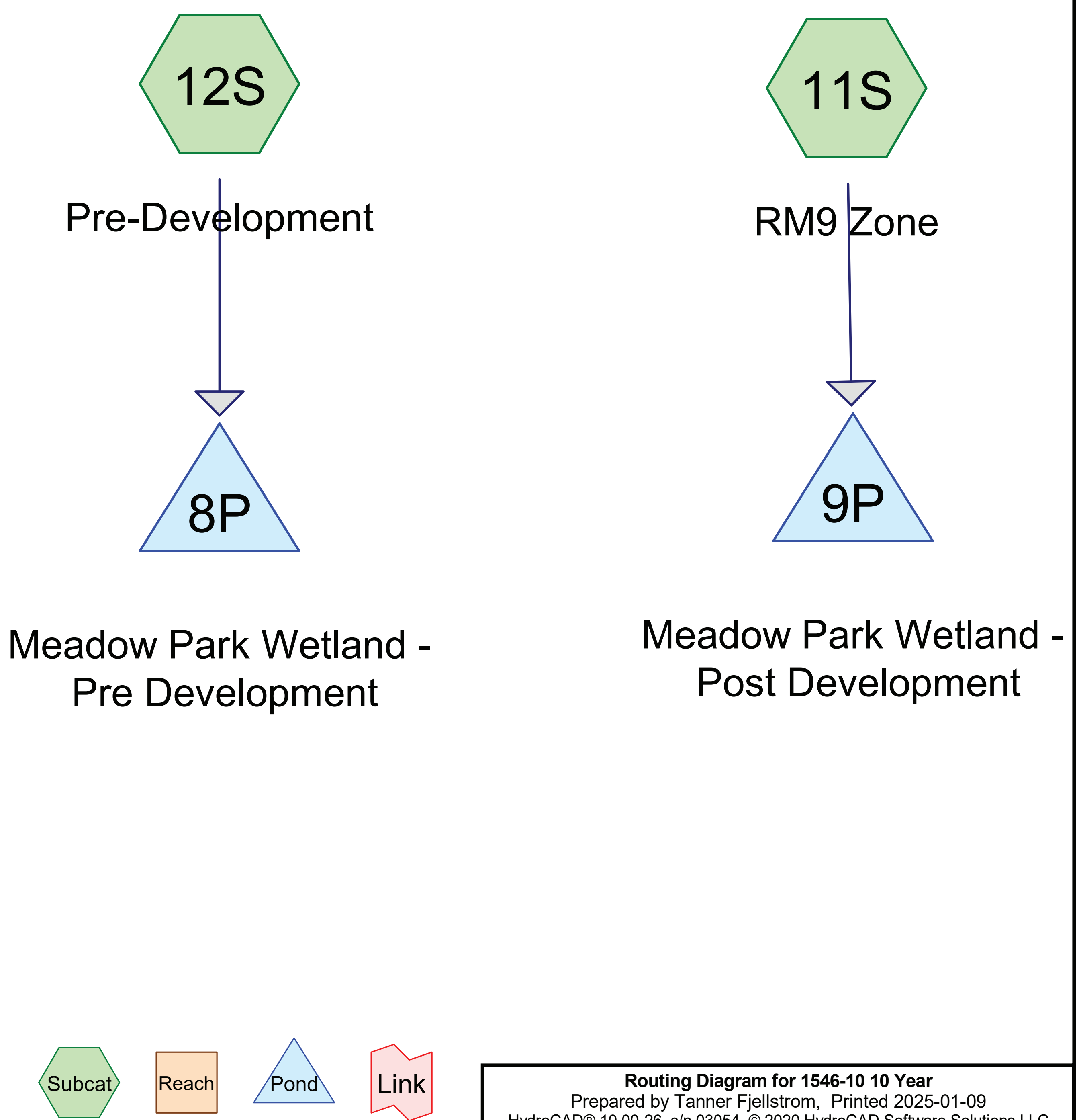
Total 4481 L/m
Fire Flow Required(Rounded to the nearest 1000 L/m) 4000 L/m

67 L/s

Notes and/or calculations:

APPENDIX C

STORM MODELLING



Routing Diagram for 1546-10 10 Year
Prepared by Tanner Fjellstrom, Printed 2025-01-09

Area Listing (all nodes)

Area (hectares)	CN	Description (subcatchment-numbers)
10.7000	90	1/8 acre lots, 65% imp, HSG C (11S)
10.7000	77	Woods, Poor, HSG C (12S)
21.4000	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (hectares)	Soil Group	Subcatchment Numbers
0.0000	HSG A	
0.0000	HSG B	
21.4000	HSG C	11S, 12S
0.0000	HSG D	
0.0000	Other	
21.4000		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (hectares)	HSG-B (hectares)	HSG-C (hectares)	HSG-D (hectares)	Other (hectares)	Total (hectares)	Ground Cover	Subcatchment Numbers
0.0000	0.0000	10.7000	0.0000	0.0000	10.7000	1/8 acre lots, 65% imp	11S
0.0000	0.0000	10.7000	0.0000	0.0000	10.7000	Woods, Poor	12S
0.0000	**0.0000**	**21.4000**	**0.0000**	**0.0000**	**21.4000**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 11S: RM9 Zone Runoff Area=107,000.0 m² 65.00% Impervious Runoff Depth>21 mm
Tc=10.0 min CN=90 Runoff=0.8204 m³/s 2.196 Ml

Subcatchment 12S: Pre-Development Runoff Area=10.7000 ha 0.00% Impervious Runoff Depth>7 mm
Flow Length=300.0 m Slope=0.0200 m/m Tc=23.3 min CN=77 Runoff=0.1012 m³/s 0.748 Ml

Pond 8P: Meadow Park Wetland - Pre Peak Elev=0.035 m Storage=715.4 m³ Inflow=0.1012 m³/s 0.748 Ml
Outflow=0.0013 m³/s 0.032 Ml

Pond 9P: Meadow Park Wetland - Peak Elev=0.094 m Storage=1,919.5 m³ Inflow=0.8204 m³/s 2.196 Ml
Outflow=0.0083 m³/s 0.276 Ml

Total Runoff Area = 21.4000 ha Runoff Volume = 2.944 Ml Average Runoff Depth = 14 mm
67.50% Pervious = 14.4450 ha 32.50% Impervious = 6.9550 ha

Summary for Subcatchment 11S: RM9 Zone

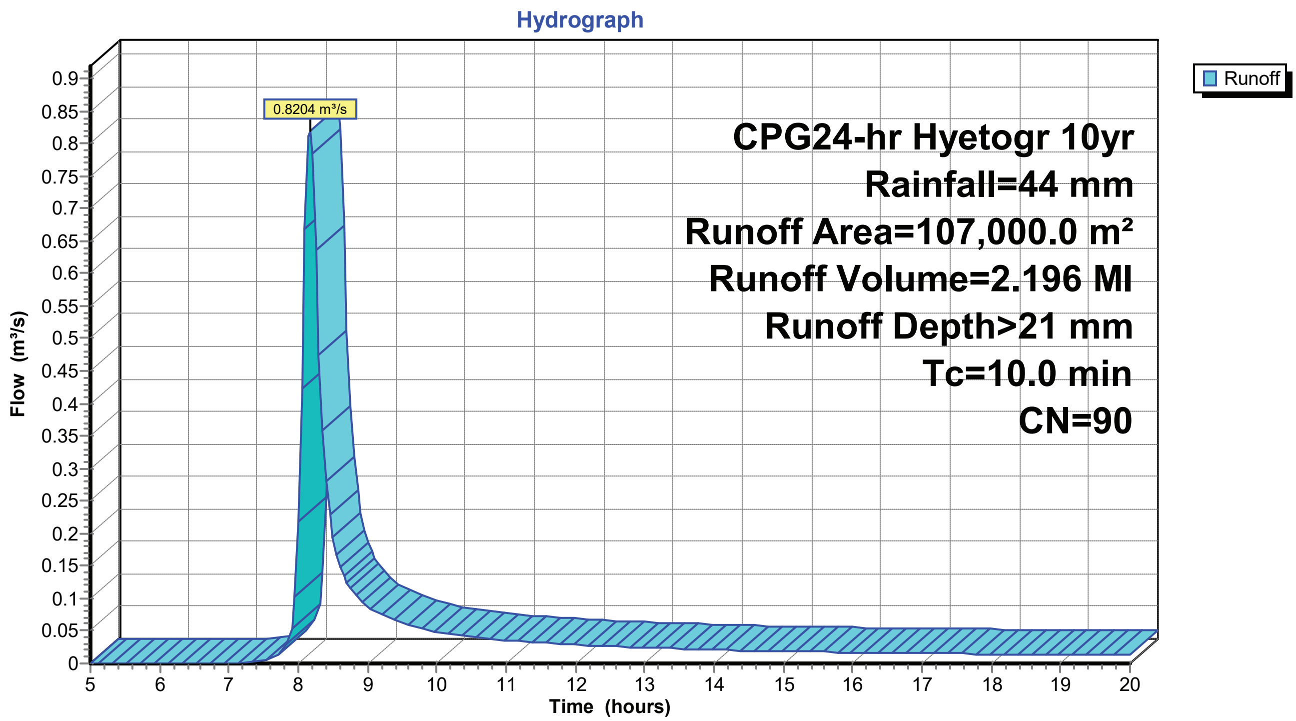
Runoff = 0.8204 m³/s @ 8.17 hrs, Volume= 2.196 Ml, Depth> 21 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
CPG24-hr Hyetogr 10yr Rainfall=44 mm

Area (m²)	CN	Description
107,000.0	90	1/8 acre lots, 65% imp, HSG C
37,450.0		35.00% Pervious Area
69,550.0		65.00% Impervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
10.0					**Direct Entry,**

Subcatchment 11S: RM9 Zone



Summary for Subcatchment 12S: Pre-Development

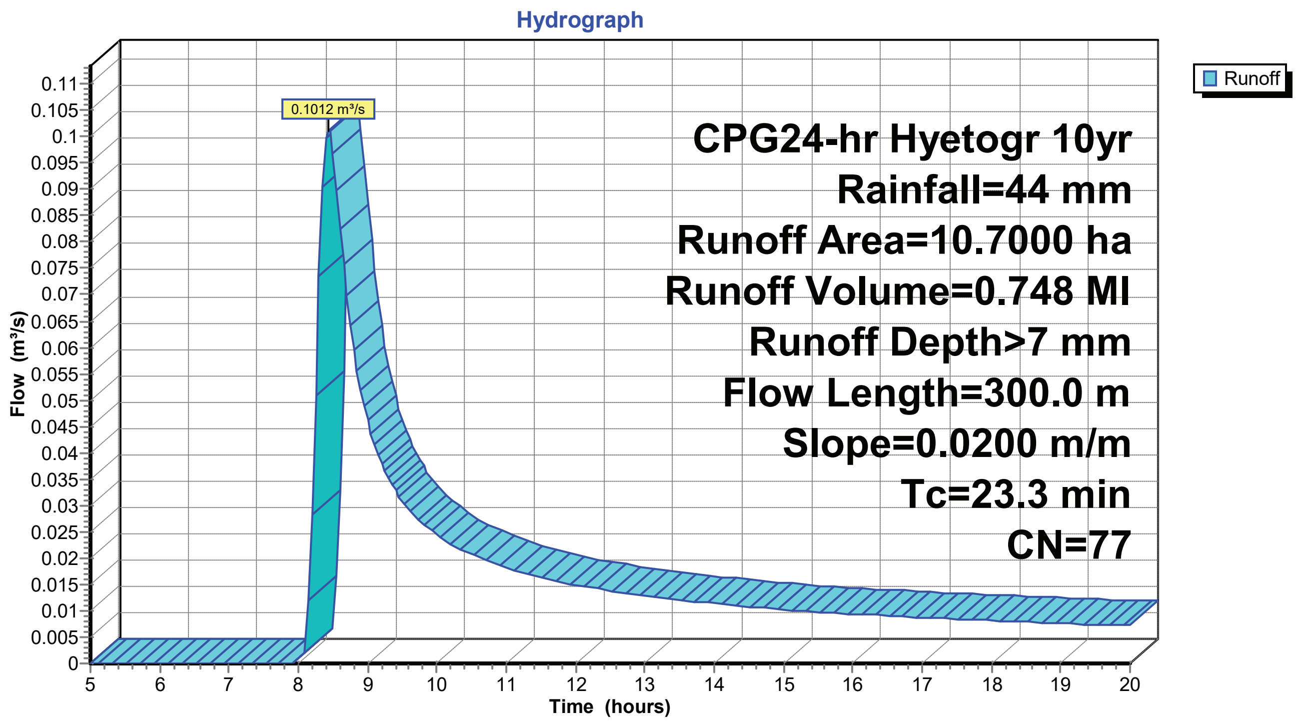
Runoff = 0.1012 m³/s @ 8.44 hrs, Volume= 0.748 Ml, Depth> 7 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
CPG24-hr Hyetogr 10yr Rainfall=44 mm

Area (ha)	CN	Description
10.7000	77	Woods, Poor, HSG C
10.7000		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m³/s)	Description
23.3	300.0	0.0200	0.21		**Shallow Concentrated Flow,** Woodland Kv= 1.52 m/s

Subcatchment 12S: Pre-Development



Summary for Pond 8P: Meadow Park Wetland - Pre Development

Inflow Area =	10.7000 ha,	0.00% Impervious, Inflow Depth >	7 mm
Inflow =	0.1012 m³/s @	8.44 hrs, Volume=	0.748 Ml
Outflow =	0.0013 m³/s @	20.00 hrs, Volume=	0.032 Ml, Atten= 99%, Lag= 693.8 min
Primary =	0.0013 m³/s @	20.00 hrs, Volume=	0.032 Ml

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 0.035 m @ 20.00 hrs Surf.Area= 20,456.0 m² Storage= 715.4 m³

Plug-Flow detention time= 451.9 min calculated for 0.032 Ml (4% of inflow)
Center-of-Mass det. time= 240.2 min (947.4 - 707.2)

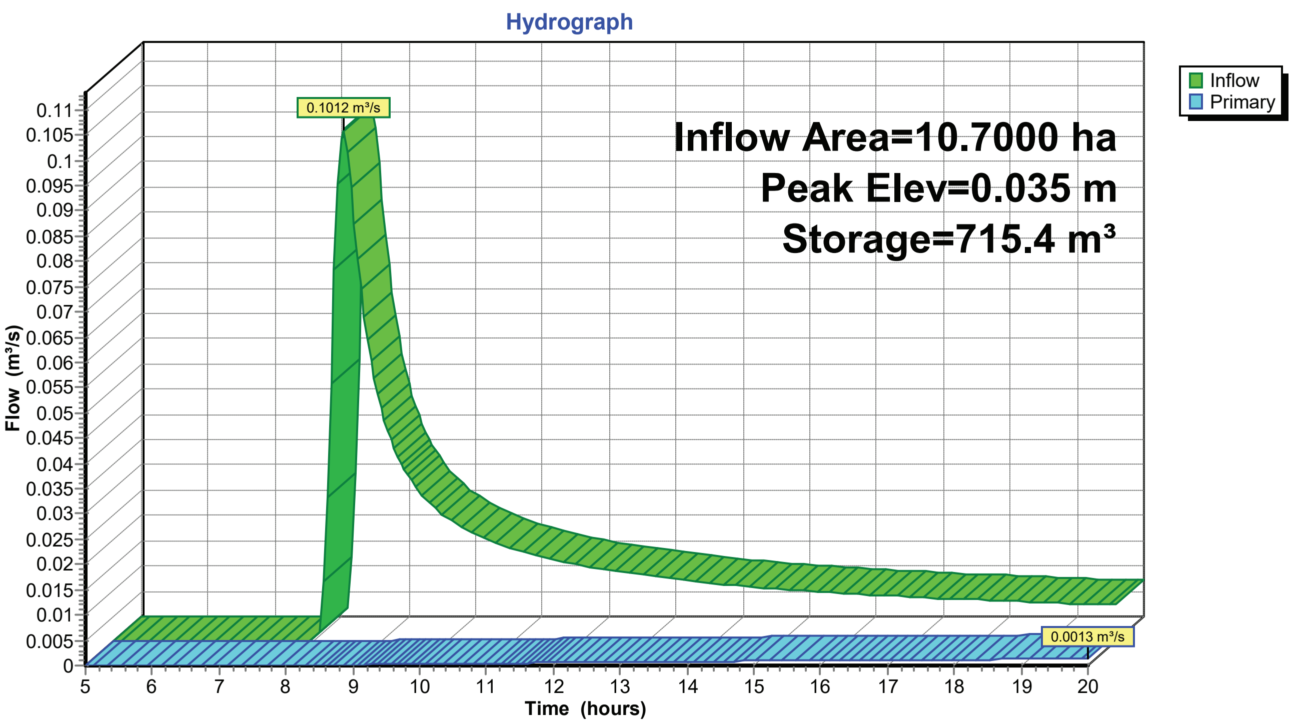
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	20,456.0 m³	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)
0.000	20,456.0	0.0	0.0
1.000	20,456.0	20,456.0	20,456.0

Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**200 mm Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.0013 m³/s @ 20.00 hrs HW=0.035 m (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.0013 m³/s @ 0.35 m/s)

Pond 8P: Meadow Park Wetland - Pre Development



Summary for Pond 9P: Meadow Park Wetland - Post Development

Inflow Area = 10.7000 ha, 65.00% Impervious, Inflow Depth > 21 mm
Inflow = 0.8204 m³/s @ 8.17 hrs, Volume= 2.196 Ml
Outflow = 0.0083 m³/s @ 20.00 hrs, Volume= 0.276 Ml, Atten= 99%, Lag= 710.0 min
Primary = 0.0083 m³/s @ 20.00 hrs, Volume= 0.276 Ml

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 0.094 m @ 20.00 hrs Surf.Area= 20,456.0 m² Storage= 1,919.5 m³

Plug-Flow detention time= 415.5 min calculated for 0.276 Ml (13% of inflow)
Center-of-Mass det. time= 269.6 min (896.7 - 627.1)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	20,456.0 m³	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (meters)	Surf.Area (sq-meters)	Inc.Store (cubic-meters)	Cum.Store (cubic-meters)
0.000	20,456.0	0.0	0.0
1.000	20,456.0	20,456.0	20,456.0

Device	Routing	Invert	Outlet Devices
#1	Primary	0.000 m	**200 mm Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.0083 m³/s @ 20.00 hrs HW=0.094 m (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.0083 m³/s @ 0.58 m/s)

Pond 9P: Meadow Park Wetland - Post Development