



**CITY OF PRINCE GEORGE**

**Prince George Golf and Curling Club Lands  
Preliminary Servicing Assessment**

**Watermains, Sanitary Sewer and Stormwater Management**

**Submitted to**

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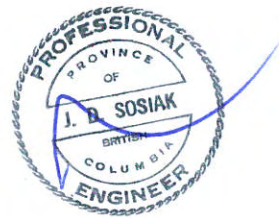
**Submitted by**

**McElhanney Consulting Services Ltd.**

1633 First Avenue  
Prince George BC V2L 2Y8

May 2010

Our File: 2341-02011-0



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**APPENDIX A            Site 360 Concept Plan**



## **1.0 INTRODUCTION**

### **1.1 Background and Authorization**

The Prince George Golf and Curling Club (PGGCC) lands encompass an area of approximately 63 hectares to the southwest of a major highway intersection within the city of Prince George. The lands are bounded on the north by Highway 97 and the existing Pine Centre Mall, on the west by Westwood Drive and on the east by Highway 16 and a number of existing/proposed commercial developments. Ferry Avenue forms the south boundary for the PGGCC lands and separates the site from the Pine Valley Golf Course to the south.

The golf course has been in place for several decades but the tree cover that was one of its more attractive features has been ravaged by a pine beetle infestation. As a consequence, the PGGCC intends to relocate to a new site northwest of the intersection of Foothills Boulevard and North Nechako Road. The existing golf course would then be available for alternative uses and the City of Prince George is in the process of developing a neighbourhood plan covering this land. The conceptual uses are shown on the “Future Land Use Plan”, dated March 09, 2010 that is included as Appendix A.

The City of Prince George has requested that McElhanney Consulting Services Ltd. (MCSL) conduct an assessment of the servicing requirements for the proposed development of the golf course property. The assignment includes the following:

- Review sanitary sewer system requirements for the proposed development.
- Review expected fire protection requirements and anticipated water demands.
- Review storm sewer requirements.
- Identify potential for development phasing.

Existing City water, sewer and storm mains surround the site and are available to service the demands of the proposed development as well as off-site uses.





## **2.0 CONNECTION POINTS AND DESIGN POPULATIONS**

### **2.1 Site Conditions and Service Area**

The golf course lands by their nature have very limited amounts of existing water, sanitary sewer and storm sewer mains in place. What little existing infrastructure is in place is likely undersized for the proposed development or is located in unsuitable locations. The site has been developed as a golf course and driving range and may contain some private utilities such as water lines used to service irrigation sprinklers. These pipes likely do not meet the minimum standards for municipal mains. Therefore, existing mains within the development area will, in most cases, be ignored for the purpose of the assessment and will be assumed to be either removed or abandoned when the development work takes place.

Based on the topographic information on the PGMap website, the site has a slight grade (less than 1%) from the north towards Ferry Avenue and is approximately 3 m higher than the Treasure Cove Casino site located east of the PGGCC lands. Gravity pipe installations for storm and sanitary servicing appear to be feasible but the limited ground slope available requires that minimum grades be used on proposed piping. Gravity pipes will tend to be relatively large diameter due to the shallow grades needed.

Existing services are present in Ferry Avenue, Recplace Drive and Recreation Place Road on the east side and along Westwood Drive to the west. Water, sanitary and storm sewer mains are also present on the east side of Highway 16 in the Treasure Cove Casino site. An existing 150 mm watermain crosses Highway 97 to connect to the Carney Hill reservoir (PW830) in Pressure Zone 1.

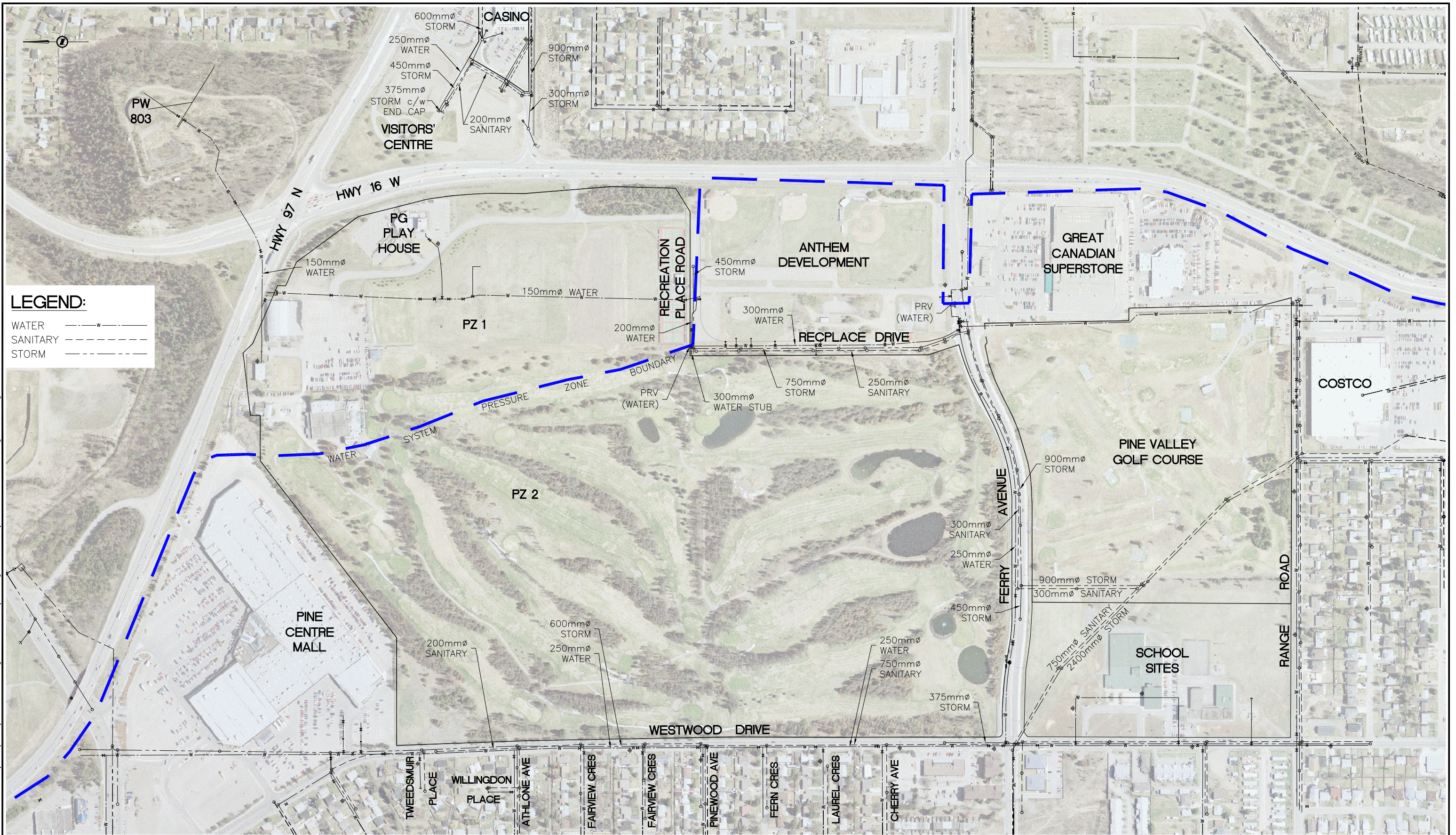
Ferry Avenue is at the south end of the PGGCC golf course and is an important road link at the site. Existing services in Ferry Avenue include a 250 mm watermain, a 300 mm sanitary sewer and a 900 mm storm sewer. The storm and sanitary sewers connect to major trunk sewers located south of the site in the Pine Valley Golf Course. Existing deep utilities are shown on Figure 1.

Existing services in Westwood Drive include 200 mm and 750 mm sanitary sewers and a 250 mm watermain. Storm sewers include a 375 mm storm sewer main near the intersection with Ferry Avenue and 600 mm and 750 mm storm sewers north of the intersection of Pinewood Street and Westwood Drive. Services in Recplace Drive include a 250 mm sanitary sewer, a 300 mm water main and a 750 mm storm sewer.

Existing services at the casino site include 250 mm watermains and 200 mm sanitary sewer mains. Storm sewers vary from 300 mm to 900 mm diameter depending on the location and discharge into subsurface recharge system designed to service the casino site only. The sanitary sewer mains have some limited potential to service the northeast corner of the PGGCC lands. The watermain is in Pressure Zone 1 of the City's water distribution system.



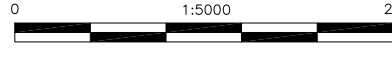
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City of Prince George  
**PGGCC Servicing**  
 EXISTING UTILITIES

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Figure 5

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The Future Land Use Plan indicates that the central portion of the site and a belt along Westwood Drive will be dedicated for park use which may allow some existing irrigation piping to be retained. Otherwise, existing irrigation piping located in proposed development areas will need to be removed or abandoned.

The north end of the site has varied existing uses including the PGGCC clubhouse, the Roll-a-Dome and the Prince George Playhouse, in addition to the golf course. The existing servicing includes an existing 150 mm watermain that crosses Highways 97 and 16 to feed existing mains that link to Recreation Place Road. A pressure reducing valve (PRV) station on the water distribution main in Recreation Place Road and a second PRV station beside Ferry Avenue define a boundary between Pressure Zone 1 and Pressure Zone 2 as shown on Figure 1.

## **2.2 Land Use**

The Future Land Use Plan in Appendix A includes a legend and summary table indicating the land area proposed for each type of development shown on the plan. The table itemizes other uses such as park space and rights-of-way for an overall site area of 78.25 hectares. The Pine Valley Golf Course is included in the area calculation but will remain in use as a golf course.

Variations in ultimate use are possible and the summary table also includes separate columns for potential 'Low Range' and 'High Range' estimates of areas for each potential land use. It should be noted that there is not sufficient area available to accommodate every land use to its full 'High Range' potential. These estimates consider each land use in isolation and if a particular land use does achieve its full 'High Range' estimated area, other land uses may need to have their areas reduced to compensate.

For the purposes of the servicing assessment, the 'low range' areas are used to calculate a 'low demand' scenario. For the circumstance of 'high range' areas, the assessment assumes that intensive uses such as the Regional Commercial area and Medium Density Residential areas receive higher area allotments and other uses are reduced accordingly to develop a 'high demand' scenario. No use receives an area allotment below its potential 'low range' requirement.

The proposed road layout as shown on the Future Land Use Plan results in a compact site with potential direct servicing connections to Recplace Drive, Ferry Avenue and Westwood Drive. Connections to existing servicing in the Treasure Cove Casino site and the 150 mm watermain crossing Highway 97 will require easements or rights-of-way through the proposed Regional Commercial area.



## 2.3 Design Populations

Equivalent populations related to the proposed land use are used in the calculation of the servicing requirements for the development concept. The relevant usages and corresponding equivalent population factors are:

Single Family Residential	75 persons/hectare
Medium Density Residential	150 persons/hectare
Light Industrial	90 persons/hectare
Highway Commercial/Shopping Centre	60 persons/hectare

The P.G.G.C.C. Neighbourhood Plan, Future Land Use Plan identifies several different land uses that for the purposes of the servicing assessment can fall into one of the categories noted above. Proposed commercial areas as well as the site of the Golf Course Clubhouse are assumed to have servicing requirements similar to Highway Commercial areas.

The proposed Regional Commercial area permits uses similar to Highway Commercial/Shopping Centre but also allows for hotel development. Servicing requirements could therefore be higher and the equivalent population factor of 90 persons/hectare is used for the assessment.

For the residential component, the Seniors Housing, Multiple Family and Townhouse sites are considered as medium density residential.

Table 1 following is a calculation of the equivalent design populations for the proposed site development as shown on the land use plan as well as the alternative 'low demand' and 'high demand' situations.

Land Use (persons/ha)	Area (ha)/Equivalent Population		
	Shown on Drawing	Low Demand	High Demand
Clubhouse (60)	4.7/280	3.0/180	3.0/180
Regional Commercial (90)	12.0/1080	12.0/1080	15.9/1430
Other Commercial (60)	15.1/900	9.3/560	9.3/560
Medium Density Residential (150)	12.8/1920	9.5/1420	18.7/2800
Single Family Residential (75)	3.7/280	3.1/240	3.1/240
<b>Total Population</b>	4460	3480	5210

**Table 1 – Equivalent Design Populations**



It should be noted that the Clubhouse, Other Commercial, and Single Family Residential land uses are shown as having the same areas under both the 'low demand' and 'high demand' scenarios. These figures appear anomalous but, under a 'high demand' scenario, heavy users such as the Regional Commercial and Medium Density Residential are assumed to require larger land areas and other relatively light user areas are reduced accordingly.

Equivalent populations are used for the calculation of demands for water servicing and sanitary sewer. Park Space and Roads/ROW are not included in the calculation of equivalent design population but will have an impact on stormwater management.



### 3.0 PROPOSED SANITARY SEWER SERVICING

#### 3.1 Design Flow Rates

For sanitary sewer service, the City's Design Guidelines specify the following criteria:

Average Daily per Capita Flow – 380 l/day

Peak Factor =  $1 + \{14 / (4 \times P^{0.5})\}$  where P is population in thousands

Infiltration allowance – 11,200 l/ha/day

Table 2 following itemizes the calculated design flow rates for the three development scenarios when these criteria are applied to the equivalent populations calculated in Table 1.

	Shown on Drawing	Low Demand	High Demand
Equivalent Population	4460	3480	5210
Average Day Sewage Generated (litres)	1,694,800	1,322,400	1,979,800
Average Day Flow Rate (l/s)	19.6	15.3	22.9
Peak Factor	2.7	2.9	2.5
Area (ha.)	48.4	36.9	50.0
Daily Infiltration (litres)	542,080	413,280	560,000
Infiltration Flow Rate (l/s)	6.3	4.8	6.5
Peak Flow Rate including Infiltration (l/s)	58.4	48.8	64.5

**Table 2 – Design Sanitary Sewage Flows**

The design flow rates in Table 2 measure the impact on the City's existing sanitary sewer system that could result when the site is developed.

Sanitary sewer mains and forcemains should have the capability of carrying peak sewage flow plus infiltration. Design gravity sewer main size requirements vary depending on factors such as pipe roughness and slope and, according to the Design Guidelines, pipes should maintain a minimum flow velocity of 0.61 m/s. Where sewage pump stations are used, flow velocities in forcemains should be no less than 0.6 m/s and should not exceed 3.1 m/s under ultimate flow conditions.



The City provided estimates of the available capacity in the existing sanitary sewers based on the information in the Sanitary Sewer Model. The estimates were in the form of 'existing' available capacity as well as available capacity considering full build-out in the various zones of the city. A particular section of sewer main can therefore have surplus capacity under existing conditions that would be available for new development but would be undersized if all the lands feeding it were fully developed as permitted under their zoning.

### **3.2 Sanitary Sewer Servicing**

The land use plan shows a conceptual road layout with proposed roadways connecting to Westwood Drive at the intersections with Laurel Crescent and Athlone Drive. A connection to Ferry Avenue is shown approximately midway between Westwood Drive and Recplace Drive. Recplace Drive is extended northward and is provided with two interior road connections. The conceptual road layout appears to complement the natural grade of the site making it amenable for the installation of gravity sewer mains. Elevation and grading should be confirmed by a detailed topographic survey as part of the design process.

At Athlone Drive, the existing sanitary sewer along Westwood Drive is 200 mm diameter and may have an available capacity in the order of 12 l/s under existing conditions and 6 l/s under zone conditions. The proposed sewer therefore should be 200 mm diameter as well and design flow should be limited to 12 l/s or less. The majority of the sewage flow from the northwest corner of the PGGCC lands would therefore need to be directed along the proposed 300 mm main by the Single Family development.

A 750 mm sanitary sewer trunk main enters Westwood Drive from Pinewood Avenue and continues south past Ferry Avenue. This trunk sewer services areas in the north and central portion of the City including the Hart Highlands and UNBC. The model information indicates that this trunk sewer is deficient in capacity if zoning demands are considered but has capacity available under existing conditions. Available capacity appears to be in the order of 70 l/s. As indicated in Table 2, design flow rates from the PGGCC lands could range from 48.8 l/s to 64.5 l/s. Monitoring of sewage flows in the existing sewer main is desirable to confirm the actual capacity available.

The intersection with Laurel Crescent provides an opportunity for a sanitary sewer connection to the existing 750 mm sanitary sewer trunk main in Westwood Drive. Gravity mains along the proposed road alignments in the Single Family development could allow approximately 75% of the sewage flows generated by the development to be discharged to this existing 750 mm trunk main. As shown on Figure 2, a 375 mm gravity sewer is required for the connection to the existing trunk sewer. Under a 'low demand' scenario, a 300 mm main might be sufficient but sizing would need to be confirmed during the design process.



Within the development, 300 mm diameter mains would be necessary to service the north and east portions of the site with 250 mm mains at the extremities of the pipe system. At the south end of the development, a 250 mm sanitary sewer could service a portion of the proposed Arterial Commercial area with a connection to the existing 300 mm sewer main in Ferry Avenue.

The proposed Regional Commercial area at the northeast corner of the PGGCC lands has a roadway connecting to Recplace Road. There is an existing 250 mm sewer main in the road that services the Anthem Commercial Development. The 250 mm main can be extended to service the Regional Commercial area but some of the downstream capacity will be taken up by the Anthem Development. Alternatively, all or part of the sewage flows from the Regional Commercial area could be diverted west as shown on Figure 2 to proposed mains discharging to the sewer trunk in Westwood Drive.

The north portion of the site, including the existing clubhouse could be serviced by new 250 mm and 300 mm gravity mains running south along the Single Family development. A connection to the existing 200 mm main at the casino site is also possible but would require crossing Highway 16. This connection could allow a limited amount of development to take place adjacent to Highway 16 in advance of other work in the Regional Commercial area.

### **3.3 Impact on Development Phasing**

There are several potential connection locations for sanitary sewer servicing around the perimeter of the site. Other than the need to proceed in a logical progression from the existing connection points, sanitary sewer servicing is not expected to be a major constraint in determining potential phasing of the development of the PGGCC lands.

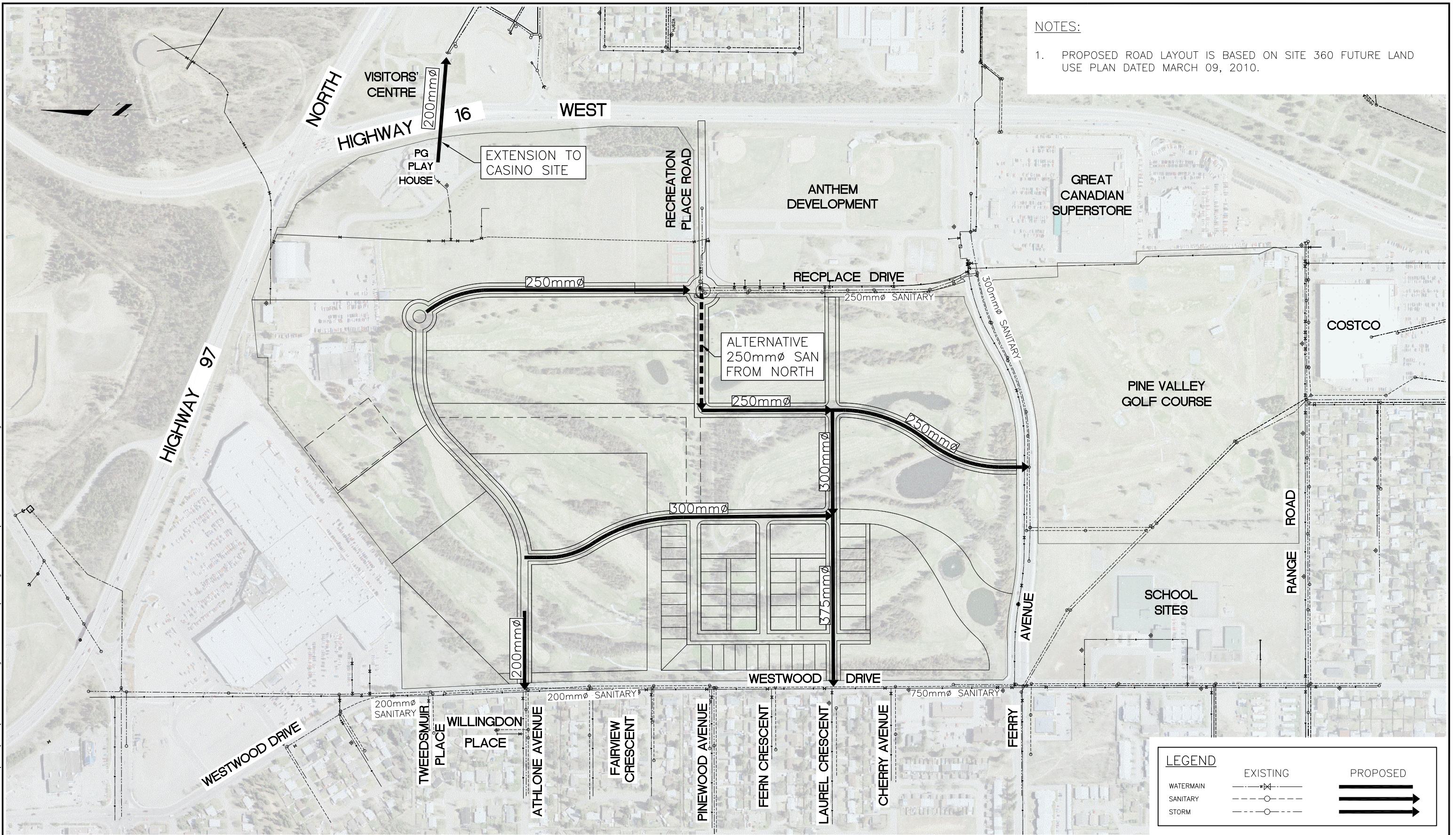
The existing 200 mm sewer main in the Treasure Cove Casino site provides an opportunity for a limited amount of development to take place along Highway 16 as a first phase.

### **3.4 Impacts on Offsite Sanitary Sewer**

The existing 750 mm trunk sewer has available capacity to service the PGGCC lands but the proposed development could be competing with other developments in the City for this capacity. Developments in the north portion of the City such as the Hart Highlands could take up capacity in the portion of the trunk sewer along Westwood Drive and the section leading to Vance Road. These other developments would have to be of a scale comparable to that of PGGCC to have an immediate effect. Development of the PGGCC lands will probably take place in phases and it is likely that the early phases will not have to compete directly with developments to the north for sewer capacity.



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**NOTES:**

1. PROPOSED ROAD LAYOUT IS BASED ON SITE 360 FUTURE LAND USE PLAN DATED MARCH 09, 2010.

LEGEND	
EXISTING	PROPOSED
WATERMAIN	
SANITARY	
STORM	

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 SANITARY SEWER SERVICING

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Figure 6





The proposed development of University Heights is more likely to be a constraint because sewage flows from this development will be entering the existing trunk sewer at Vance Road and competing directly with the PGGCC lands for the available capacity in this main. A conceptual drawing prepared by L&M Engineering indicates that the early phases of development on the east side of Tyner Boulevard could be contributing a sewage flow in the order of 75 l/s to the existing trunk sewer.

Considering that the existing available capacity is 70 l/s where the trunk sewer crosses Highway 16 at Vance Road, the first phase of development at PGGCC could be limited by the development at University Heights until the trunk sewer is upgraded. The City intends to twin the trunk sewer where it crosses the highway to improve the sewer capacity in this area.

L&M's conceptual drawings indicates that a future phase of the University Heights development may intercept sewage flows from UNBC that currently enter the trunk sewer upstream from the PGGCC lands. Sewage flows from UNBC would be diverted to the existing trunk sewer on Vance Road and available capacity in the trunk sewer along Westwood Drive would increase as a result. However, this diversion cannot take place until there has been extensive development of University Heights which may span several decades and is unlikely to be of any benefit to the development of the PGGCC lands.



## 4.0 PROPOSED WATERMAIN EXTENSIONS

### 4.1 Design Flow Rates

The Design Guidelines contain the following criteria for calculating water demands:

Average daily water (ADD) demand – 475 litres/capita/day

Maximum Daily Demand (MDD) factor – 2.5 (Pressure Zones 1 & 2)

Peak Hour Demand (PHD) factor – 4.25 (Pressure Zones 1 & 2)

Table 3 following itemizes the calculated design flow rates for the three development scenarios based on the equivalent populations calculated in Table 1.

	<b>Shown on Drawing</b>	<b>Low Demand</b>	<b>High Demand</b>
Equivalent Population	4460	3480	5210
Average Daily Demand (litres)	2,118,500	1,653,000	2,474,750
Average Day Flow Rate (l/s)	24.5	19.4	28.6
Maximum Day Flow Rate (l/s)	61.3	47.8	71.6
Peak Hour Flow Rate (l/s)	104.2	81.3	121.7

**Table 3 – Design Water Demands**

The design flow rates in Table 3 cover normal water usage and do not include fire protection requirements. The Design Guidelines specify minimum fire protection flows according to land use. The applicable minimum fire flow requirements for the uses proposed on the PGGCC lands are:

Single family residential	60 l/s
Apartments and townhouses	125 l/s
Commercial land use	150 l/s

The water distribution system serving the proposed development will be integrated with existing mains surrounding the site. It is therefore possible that the new mains will be conducting water for other areas outside of the site limits.



## **4.2 Pressure Zones and Offsite Upgrading**

The 2001 Water Service Infrastructure Master Plan recommended some improvements to the City's water distribution system that affect the proposed PGGCC redevelopment. One recommendation was that the area south and west of the intersection of Highway 97 and Highway 16 be moved from Pressure Zone 1 to Pressure Zone 2. This area included the Anthem development along Recplace Drive.

To accommodate the change in the pressure zone, the development of the Anthem property incorporated the two PRV chambers shown on Figure 1. The chamber locations place the Anthem development in Pressure Zone 2 and maintain interconnections with Pressure Zone 1. The PRV chamber on Recreation Place Road was designed as a temporary installation to facilitate a future adjustment to the pressure zone boundary. This chamber will need to be removed when the adjoining portions of the PGGCC lands are developed.

The Master Plan also recommended that a 300 mm watermain loop link Ferry Avenue with the 250 mm watermain in Westwood Drive in the vicinity of the Pine Centre Mall to improve fire protection capability. The development of the Anthem property included the installation of a 300 mm main in Recplace Drive as part of this loop. The loop would need to be continued when the north portion of the PGGCC lands is developed.

Another recommendation was that a 350 mm watermain be installed along Highway 97 to improve service to the BCR/Danson area of the City. This future main affects the interconnection between Pressure Zone 1 and Pressure Zone 2 because the Master Plan indicates that this main could be fed from either of these two zones. The City is considering a direct connection to PW803.

The existing 150 mm main connecting the two zones conflicts with the proposed Regional Commercial area. This main has limited capacity for assisting the proposed feed to BCR/Danson and may need to be replaced or supplemented with a larger pipe. A connection to the existing 250 mm watermain in the casino site will improve water flow to Pressure Zone 1 and the casino site.

## **4.3 Minimum Main Sizing**

The watermains in the proposed development need to be of sufficient size to deliver the required domestic and fire flows with as little loss in pressure as possible. Pipeline size is therefore governed by hydraulic conditions of head loss and velocity for the flow rate needed. The Design Guidelines recommend that the maximum velocity of flow in watermains not exceed 2 m/s under design flow conditions.



Flow rates in the watermains are dependent on the overall distribution system network and the usage conditions being considered. Under fire flows, conditions could vary significantly depending on where the fire is taking place.

The maximum velocity criteria can be used as a tool to determine what minimum watermain size could be necessary for the various portions of the development. Minimum sizes should also consider the diameters of the existing watermains to which the new mains will be connecting.

Table 4 following summarizes the resulting pipe sizes and flow velocities for the potential demand conditions. For calculation purposes it is assumed that there are two connections from the existing water system and that half of the required flow rate is carried from each of the connection points. Only water demands originating within the limits of the site are considered. These are simplistic assumptions and the proposed mains should therefore be checked on the City's water model during the design process.

	<b>Design Flow Rate* (l/s)</b>	<b>Pipe Diameter (mm)</b>	<b>Velocity* (m/s)</b>
<b>Peak Hour Flow</b> Low Demand and High Demand Scenario Conditions	81.3 to 121.7	200	1.29 – 1.94
<b>Regional Commercial Area</b> Max. Day plus 150 l/s Fire Flow	197.8 to 221.6	250 - 300	2.01 - 1.57
<b>Multi-Family Areas</b> Max. Day plus 125 l/s Fire Flow	172.8 to 196.6	250	1.76 - 2.00
<b>Single Family Residential</b> Max. Day plus 60 l/s Fire Flow	107.8 to 131.6	200	1.72 – 2.09

\* 50% of flow rate from each direction

**Table 4 – Design Flow Rate and Velocity Summary**

Reference to Table 4 indicates that the maximum day demand plus fire flow criteria results in higher flow rates than ultimate peak hour demand and therefore should be the governing factor in the selection of a minimum pipe size.

For the Regional Commercial area, a 250 mm main appears to be marginally undersized even under low demand conditions. Watermains serving this area therefore should be 300 mm diameter, consistent with the existing 300 mm main in Recplace Drive. The 300 mm main should extend to the connection with the existing 250 mm watermain in Westwood Drive. This installation would form part of the 300 mm loop recommended in the Water Service Infrastructure Master Plan.



For multiple family areas, 250 mm watermains appear to be acceptable even under high demand conditions. 200 mm watermains should be suitable for the single family residential area. The 200 mm watermain may be marginally undersized under a high demand scenario but additional looping could reduce flow rates and head losses in individual runs of pipe.

The new distribution system in the proposed development will incorporate some internal looping as well as multiple connections to the existing City water system that may allow some of the pipe sizes to be reduced from what is indicated in Table 4. Other hydraulic conditions, such as head loss both in the existing system and in the proposed extensions, will also affect the final selection of a pipe size. Pipe size requirements should be confirmed with the use of the City's water model and onsite hydrant flow tests during the design stage.

#### **4.4 Proposed Water Distribution**

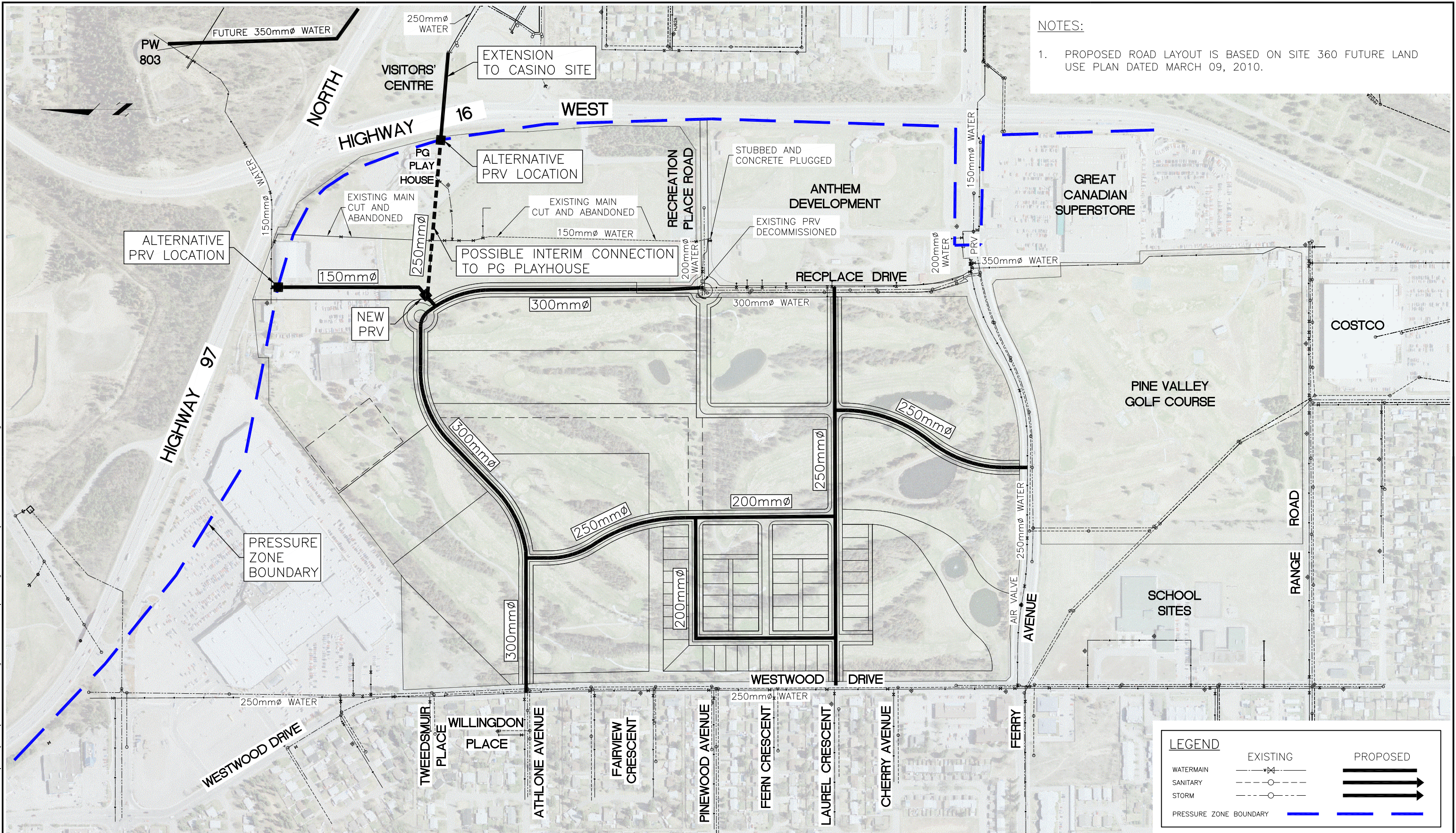
The proposed road layout shown on the Future Land Use Plan provides opportunities for multiple connections to existing 250 mm diameter watermains located in Westwood Drive, Ferry Avenue and the casino site as well as an existing 300 mm main in Recplace Drive. As shown on Figure 3, at full development there could be as many as seven connections to existing watermains including the 150 mm watermain in Pressure Zone 1. Figure 3 shows a possible watermain layout based on the minimum pipe sizes described in Table 4.

An existing 150 mm main forming a connection between Pressure Zone 1 and Pressure Zone 2 passes through the proposed Regional Commercial development and will conflict with proposed development works. Much of this main will need to be either removed or abandoned. This process would require that the main be cut and capped where it connects to the existing 200 mm main in Recreation Place Road. The existing PRV chamber on the watermain would be decommissioned. The 200 mm main and future connections to it would then operate as part of Pressure Zone 2.

To reinstate the connection to Pressure Zone 1, a new PRV station and a new 150 mm main can be located along the boundary of the proposed Regional Commercial area and the Clubhouse site. The PRV location shown on Figure 3 permits maintenance access from the proposed roadway and would allow a connection to be made to the existing 250 mm watermain in the casino site. This main could also serve as an interim connection to the PG Playhouse if this portion of the site is not immediately developed. Alternative locations for the PRV station are possible beside Highway 97 or Highway 16 and would eliminate the potential for future developments to make inadvertent connections to Pressure Zone 1.



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**NOTES:**  
 1. PROPOSED ROAD LAYOUT IS BASED ON SITE 360 FUTURE LAND USE PLAN DATED MARCH 09, 2010.

LEGEND		
EXISTING	PROPOSED	
WATERMAIN		
SANITARY		
STORM		
PRESSURE ZONE BOUNDARY		

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City of Prince George  
 PGGCC Servicing  
 WATER SERVICING

Client Project No. \_\_\_\_\_  
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 MCSL Project No. 2341-2011-0  
 Drawing No. \_\_\_\_\_  
 Sheet 3 of 4  
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Figure 7





#### **4.5 Phasing of Development**

The proposed development of the PGGCC lands covers a large area and will likely proceed as a series of phases. Fire protection will likely be the governing factor in the extension of watermains and the first phase of development ideally should be looped with at least two connections to the existing water distribution system.

As noted in the discussion of sanitary sewer servicing, extensions to existing mains in the Treasure Cove Casino site may permit a limited amount of initial development adjacent to Highway 16. An extension of the existing 250 mm watermain across Highway 16 with a connection to the existing 150 mm watermain could provide water service for this initial development as well as improving service to the casino site. Water servicing requirements would need to be verified once the nature of the development is known. Succeeding phases would incorporate this connection and complete the transition to Pressure Zone 2.





## **5.0 STORMWATER MANAGEMENT**

### **5.1 Existing Conditions**

The PGGCC lands drain into two watersheds. The smaller portion in the extreme northwest corner of the site by Pine Centre lies in the Hudson's Bay Slough watershed. The major portion of the PGGCC lands however lies in the Peden Hill/University Heights watershed that drains into Lansdowne Creek.

The existing storm sewer in Westwood Drive flows north and is in the Hudson's Bay Slough watershed for which a Watershed Drainage Plan has been prepared. Table C-1 in this Watershed Drainage Plan indicates that the existing runoff flows to the 750 mm storm sewer at the intersection of Athlone Avenue and Westwood Drive are at 110% of the pipe capacity.

The City will shortly be undertaking a stormwater management plan for the Peden Hill/University Heights watershed. Lansdowne Creek is a highly environmentally sensitive fish bearing stream that enters the Fraser River and senior government officials are expected to impose restrictions to maintain stormwater discharge volumes into the creek at current levels.

Existing storm sewers around the site have been in place for many years and were likely designed with the assumption that the PGGCC lands would remain in use as a golf course with extensive green areas. The existing golf course does not have any significant direct connections to the existing storm sewer and any stormwater making its way into the piping would have to travel overland to catch basins in the surrounding streets.

Proposed developments will increase impervious areas that will generate increased storm runoff on the site. The current City standard is that piped storm sewer systems be designed to accommodate a 1:10 year return period. The older existing pipe systems may have been designed on the basis of a 1:5 year return period or possibly a 1:2 year period. The combination of changed land use and more stringent design standards would likely result in a conventional piped storm sewer system overloading existing storm sewers around the site.

The site is relatively flat and the existing golf course has several ponds that likely are collection points for existing runoff on the site. The City's experience with other sites in the vicinity of the PGGCC lands indicates that existing underlying gravel soil in the area is highly permeable. It is likely that little runoff from the golf course ever reaches the existing storm sewers. Stormwater management techniques such as ground recharge may therefore be possible on the site but should be verified by geotechnical investigations. Alternatively or in conjunction with ground recharge, surface detention possibly incorporating the existing ponds on the site could be used.

Recharge or detention facilities would permit smaller diameter pipe to be used in proposed storm sewer piping and reduce impacts on the City's existing storm sewer system.



## 5.2 Management of Storm Drainage

Stormwater management will include the minor drainage system consisting of catch basins, drains, culverts, underground storm sewers and associated facilities that will deal with the selected design storm. Stormwater flows exceeding the capacity of the minor system will travel overland along the major drainage system which tends to be governed by the natural topography of the site or significant manmade features such as road embankments.

The majority of storm runoff from the PGGCC lands would travel south and eventually discharge to Lansdowne Creek. Considering the probable restrictions on increasing storm water volumes in the creek, the City's objective is that there be zero increase in runoff from the PGGCC lands under post-development conditions.

Experience on other sites in the vicinity of the PGGCC lands suggests that the site is amenable to stormwater recharge systems. Recharge systems have been installed by private developments such as the Treasure Cove Casino and the Anthem development. These installations allow a significant portion of the storm runoff to be disposed within the site limits. Recharge systems could include collection and infiltration systems installed under paved parking surfaces, subsurface discharge of building roof drains, the use of perforated pipe for storm sewer mains and catch basin leads and communal infiltration basins.

Surface systems such as rain gardens, bioswales and grassed drainage swales would also provide opportunities for ground recharge of surface runoff as well as improving the quality of the stormwater. Open air detention ponds or infiltration basins, possibly incorporating existing water hazards on the golf course, could also be used to manage storm runoff and should be considered early in the planning stages of any proposed development of the site.

These measures could permit significant reductions in the size of storm sewer piping in the development and would also form part of the major storm drainage system.

Overland flow in the major drainage system will take place whenever stormwater flows exceed the capacity of storm sewer piping and associated recharge or detention systems. Development should utilize strategies such as grading lots higher than adjoining streets and parking lots to avoid flooding of residences or high-value structures under 1:100 year storm flow conditions.

Some of the systems discussed above could be incorporated into the development work taking place on the proposed private lots. Other systems would be community based.



### 5.3 Storm Sewer

Paved streets will require catch basins with connections to underground storm sewer piping. A conceptual storm sewer layout with pipe sizes is shown on Figure 4. The conceptual layout assumes connections to existing gravity storm sewer mains. Adjustments to the routing and pipe sizes are possible if detention or recharge facilities are incorporated into the development. Preliminary pipe sizes have been determined by means of the Rational Method with the assumption that all stormwater flows in excess of predevelopment levels are dealt with by onsite measures as described above.

The storm sewer is assumed to connect to existing piping in Westwood Drive, Recplace Drive and Ferry Avenue. Alternative discharge locations to an onsite detention or infiltration facility may be feasible and should be assessed as part of the overall watershed drainage plan covering this area.

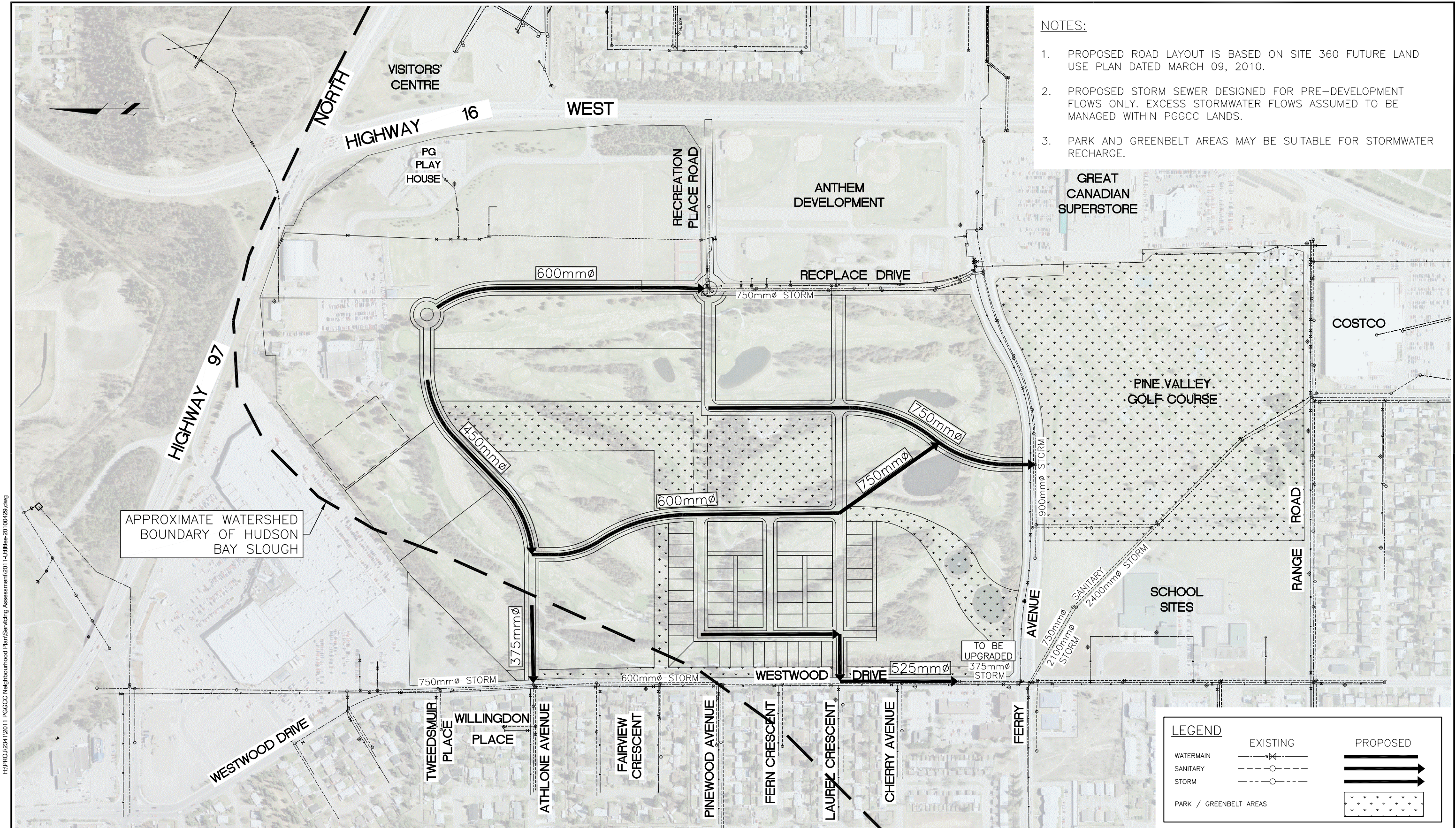
Major connection points for the storm sewer are located in Ferry Avenue and Recplace Drive. The existing storm sewer in Ferry Avenue is an existing 900 mm storm sewer that ultimately connects to the 2400 mm diameter trunk main located in the Pine Valley Golf Course. The proposed storm sewer connection is a 750 mm diameter pipe with 600 mm diameter branch piping that drains the central portion of the proposed development. A portion of this pipe will require a separate right-of-way or easement through the proposed Arterial Commercial area on the north side of Ferry Avenue. On the east side of the site, 750 mm and 600 mm storm sewers drain the Regional Commercial area and discharge to an existing 750 mm storm sewer in Recplace Drive.

A possible storm sewer connection to Westwood Drive is a 375 mm diameter pipe connecting to the existing 750 mm main in Westwood Drive at the northwest corner of the site. The existing main may be undersized and its capacity and the impact of the proposed connection should be verified during the design process. In the worst case, the connection could trigger a costly upgrading of the existing storm sewer along Westwood Drive. This upgrading would need to conform to current standards, including the use of a 1:10 year return period, and may require that existing 750 mm and 900 mm storm sewers be upgraded along Westwood Drive and through the Pine Centre parking lot to the existing 1800 mm storm sewer trunk located in Massey Drive.

Alternative onsite management of stormwater by detention or infiltration should be considered for the northwest corner of the site or, if topography permits, storm sewer piping should be connected to the proposed 600 mm main located to the east.

The proposed Single Family and Townhouse areas beside Westwood Drive appear to be serviceable by 375 mm and 450 mm storm sewers. However, the existing 375 mm storm sewer at the south end of Westwood Drive would need to be replaced with a larger pipe. Alternatively, the proposed storm sewer could be extended parallel to Westwood Drive and tie directly into the existing trunk main at the intersection with Ferry Avenue.





- NOTES:**
1. PROPOSED ROAD LAYOUT IS BASED ON SITE 360 FUTURE LAND USE PLAN DATED MARCH 09, 2010.
  2. PROPOSED STORM SEWER DESIGNED FOR PRE-DEVELOPMENT FLOWS ONLY. EXCESS STORMWATER FLOWS ASSUMED TO BE MANAGED WITHIN PGGCC LANDS.
  3. PARK AND GREENBELT AREAS MAY BE SUITABLE FOR STORMWATER RECHARGE.

APPROXIMATE WATERSHED BOUNDARY OF HUDSON BAY SLOUGH

**LEGEND**

	EXISTING	PROPOSED
WATERMAIN		
SANITARY		
STORM		
PARK / GREENBELT AREAS		

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City of Prince George  
 PGGCC Servicing  
 STORM SEWER SERVICING

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Figure 8

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The calculated pipe sizes are consistent with existing storm sewer sizes but still represent a significant increase of runoff flows to the existing system, even with predevelopment flows being assumed. The following factors should be noted:

- The Rational Method calculation tends to yield conservative results, especially on larger sites.
- The calculation assumes a 1:10 year return period whereas existing piping was probably designed for a 1:5 year return.

The pipe sizes noted are probably a worst case.

#### **5.4 Phasing**

As is the case with sanitary sewers, development phasing should incorporate a logical progression of gravity pipelines from the existing connection points. In the case of stormwater management, communal recharge or detention facilities utilizing park or greenbelt areas would provide additional flexibility in the location of proposed development phases. Stormwater management is not expected to be a significant constraint on the phasing of the development.

Extensions to the existing watermain and sanitary sewer main in the Treasure Cove Casino site may permit an initial small scale development in the northeast portion of the Regional Commercial area beside Highway 16. Though storm sewers and a recharge facility are present in the casino site, their design capacity is limited to the casino site only and the existing system cannot accept any stormwater from the PGGCC lands. A dedicated interim (or permanent) detention or recharge facility located on the PGGCC lands should be used to service this initial development.



## **6.0 CONCLUSIONS AND RECOMMENDATIONS**

### **6.1 Conclusions**

1. The existing ground has a slight grade from the north end of the site towards Ferry Avenue making the site amenable to gravity storm and sanitary servicing.
2. Tie in locations for the development to existing City water, sanitary and storm sewer mains are available in Westwood Drive, Recplace Drive, Ferry Avenue and the casino site.
3. The development is at the boundary of water Pressure Zone 1 and Pressure Zone 2.
4. Extensions to existing watermains and sanitary sewer mains in the casino site could allow a limited amount of development adjacent to Highway 16 as a first phase. The casino site cannot accept stormwater and this development would require detention or recharge facilities to be located within the PGGCC lands.
5. Phasing will be governed by the locations of connection points for gravity mains.
6. Early phases of development may be competing with the University Heights development for sanitary sewer capacity in the existing trunk sewer on Vance Road.
7. Later phases of the PGGCC development may be competing with developments in the north end of the city for sanitary sewer capacity in the trunk sewer along Westwood Drive.
8. Development of the PGGCC lands will be affected by recommendations in the Water System Infrastructure Master Plan.
9. The existing golf course may be contributing little or no runoff to existing storm sewers because of site conditions such as level topography and permeable soil.
10. Existing storm sewers in Westwood Drive and Ferry Avenue/Recplace Drive are undersized for runoff generated by the proposed development.
11. The existing soil at the site appears to be suitable for ground recharge of stormwater runoff.

### **6.2 Sanitary Sewer Servicing Recommendations**

- Confirm elevations and grades with a topographic survey.
- Sanitary sewer connections should be made to existing sewer mains in Westwood Drive, Ferry Avenue and Recplace Drive.
- At each phase of development, available sanitary sewer capacity should be checked to verify that it has not been taken up by developments in other parts of the city.
- The existing sanitary sewer trunk on Vance Road and Highway 16 should be upgraded when warranted by proposed development of the PGGCC lands and other developments such as University Heights.
- Sewage flow monitoring and a check of the City's sewer system model should be used to verify that sewage flows generated by the proposed development will not overload existing sewer mains downstream from the development.



### **6.3 Water Servicing Recommendations**

- The first phase of development should incorporate two connections to the existing water distribution system to provide looping for fire protection.
- Watermain installations for the Regional Commercial Area should incorporate a 300 mm loop main and a relocation of the pressure zone boundary as recommended in the Water System Infrastructure Master Plan.
- The existing 250 mm diameter watermain located in the Treasure Cove Casino site should be extended across Highway 16 to provide a new connection between Pressure Zone 1 and Pressure Zone 2.
- Watermain sizes and connection points should be verified with hydrant flow tests and a check of the City's water model.

### **6.4 Storm Sewer Servicing Recommendations**

- Confirm elevations and grades with a topographic survey.
- A geotechnical investigation should take place to verify the extent to which the site is suitable for ground recharge of stormwater runoff.
- Storm sewer piping should accommodate pre-development flows only. Stormwater flows in excess of pre-development flows should be directed to onsite systems.
- Parks, roadway boulevards and greenbelts should be utilized for recharge or detention of runoff wherever possible.
- Onsite management of stormwater runoff should be used to the fullest extent possible.



## 7.0 CLOSURE

This report includes an assessment of a possible servicing requirements for the proposed redevelopment of the Prince George Golf and Curling Club lands.

This Assessment Report has been prepared by McElhanney Consulting Services Ltd. for the benefit of the City of Prince George. The information and data contained herein represent MCSL's best professional judgement in light of the knowledge and information available to MCSL at the time of preparation. Except as required by law, this report and the information and data contained herein are to be treated as confidential and may be used and relied upon only by the client, its officers and employees.

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McElhanney Consulting Services Ltd.

Jim Sosiak PEng  
Project Engineer



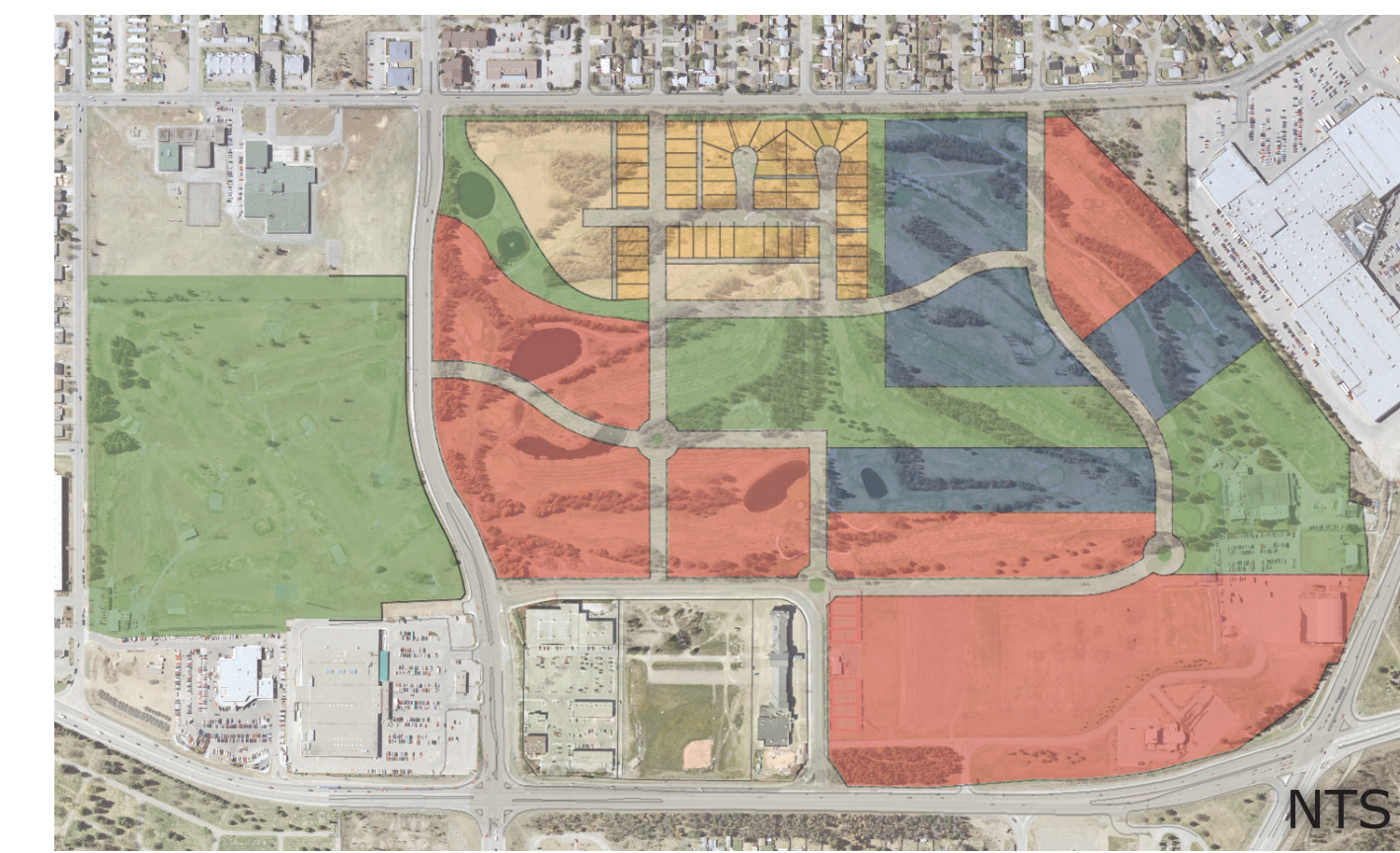
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APPENDIX A  
Concept Plan





**LEGEND**

	As Shown	Low Range	High Range
<b>Public/Recreation</b>			
Pine Valley Golf Course	<b>38.3 Ac. (15.5 Ha.)</b>	<b>38.3 Ac. (15.5 Ha.)</b>	<b>38.3 Ac. (15.5 Ha.)</b>
Clubhouse	<b>11.5 Ac. (4.7 Ha.)</b>	<b>7.5 Ac. (3 Ha.)</b>	<b>11.5 Ac. (4.7 Ha.)</b>
Park Space	<b>20.1 Ac. (8.1 Ha.)</b>	<b>15.0 Ac. (6 Ha.)</b>	<b>20.1 Ac. (8.1 Ha.)</b>
<b>Subtotal</b>	<b>69.9 Ac. (29.3 Ha.)</b>	<b>60.8 Ac. (24.6 Ha.)</b>	<b>69.9 Ac. (28.3 Ha.)</b>
<b>Commercial</b>			
Regional Commercial	<b>29.8 Ac. (12.0 Ha.)</b>	<b>29.8 Ac. (12.0 Ha.)</b>	<b>32.0 Ac. (12.9 Ha.)</b>
Arterial Commercial	<b>18.0 Ac. (7.3 Ha.)</b>	<b>18.0 Ac. (7.3 Ha.)</b>	<b>37.0 Ac. (14.9 Ha.)</b>
Pine Centre Mall Expansion Commercial	<b>6.4 Ac. (2.6 Ha.)</b>	<b>5.0 Ac. (2.0 Ha.)</b>	<b>10.0 Ac. (4.0 Ha.)</b>
Neighbourhood Commercial/Mixed Use	<b>12.8 Ac. (5.2 Ha.)</b>	<b>0.0 Ac. (0.0 Ha.)</b>	<b>12.8 Ac. (5.2 Ha.)</b>
<b>Subtotal</b>	<b>67.0 Ac. (27.1 Ha.)</b>	<b>52.8 Ac. (21.4 Ha.)</b>	<b>91.8 Ac. (37.2 Ha.)</b>
<b>Residential</b>			
Townhouse	<b>7.7 Ac. (3.1 Ha.)</b>	<b>5.9 Ac. (2.4 Ha.)</b>	<b>12.7 Ac. (5.1 Ha.)</b>
Multiple Family	<b>19.2 Ac. (7.7 Ha.)</b>	<b>12.7 Ac. (5.1 Ha.)</b>	<b>25.4 Ac. (10.3 Ha.)</b>
Seniors Housing	<b>5.0 Ac. (2.0 Ha.)</b>	<b>5.0 Ac. (2.0 Ha.)</b>	<b>25.2 Ac. (10.2 Ha.)</b>
Single Family	<b>9.1 Ac. (3.7 Ha.)</b>	<b>7.6 Ac. (3.1 Ha.)</b>	<b>10.9 Ac. (4.4 Ha.)</b>
<b>Subtotal</b>	<b>41.0 Ac. (16.6 Ha.)</b>	<b>31.2 Ac. (12.6 Ha.)</b>	<b>74.2 Ac. (30 Ha.)</b>
Roads/ROW	<b>15.4 Ac. (6.2 Ha.)</b>	<b>15.4 Ac. (6.2 Ha.)</b>	<b>16.7 Ac. (6.7 Ha.)</b>

**Overall Site Area 193.3 Ac. (78.25 Ha.)**

