



# City of Whitehorse Whistle Bend Neighbourhood Phases 3-7

Planning, Design & Preliminary Engineering Servicing

Submitted to:

City of Whitehorse

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Crowdbrite

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**Appendix A:** Summary of Phases 3-7 Concept Plans and Sections (Golder Associates Ltd. and Morrison Hershfield Engineers), August 2013.

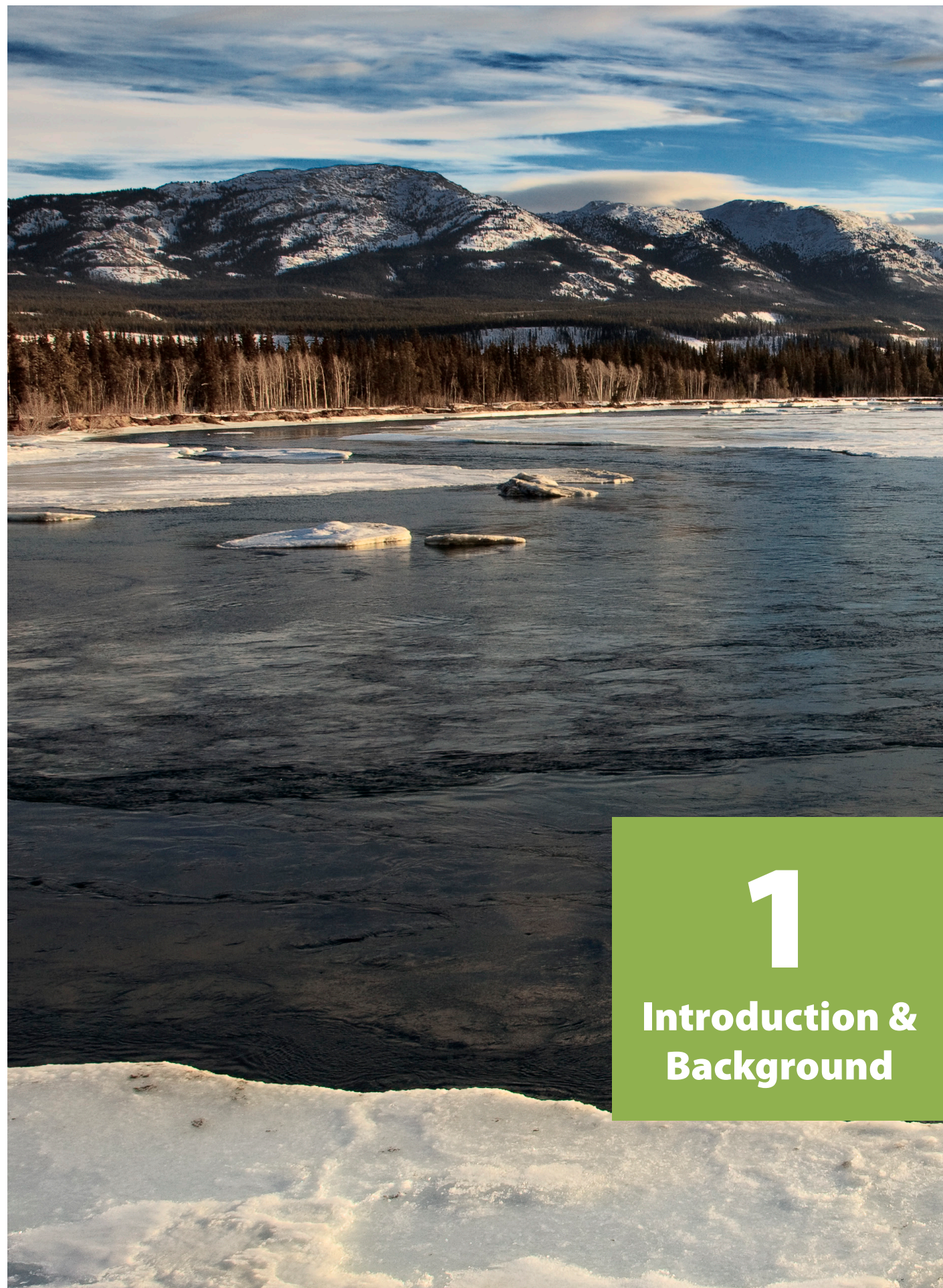
**Appendix B:** Traffic Impact Analysis, AECOM, 2012.

**Appendix C:** Onsite Water System Technical Brief, Morrison Hershfield Engineers Ltd, 2013 (modified from Quest Engineering Group, 2011.

**Appendix D:** Infiltration\_Testing, EBA, 2012.

**Appendix E:** Infiltration Alternatives, Morrison Hershfield Engineers Ltd., 2013.

**Appendix F:** Cost Estimates, Morrison Hershfield Engineers Ltd., 2013.



# 1

## Introduction & Background



## 1

# Introduction & Background

## 1.1 Purpose

### 1.1.1 Vision for a Sustainable Neighbourhood

The Whistle Bend Neighbourhood Plan outlines a detailed vision for planning, design and engineering servicing of Phases 3-7. It is the summation of a comprehensive community engagement process, master development plan and incorporates new strategies, building on outcomes in the development and construction of Phases 1 and 2, initiated in 2011.

Whistle Bend Neighbourhood Phases 3-7 is an important step and milestone in building a more sustainable city. The neighbourhood is designed with specific attributes and the physical structure for sustainable community design. It prioritizes the creation of a vibrant and walkable neighbourhood. This is achieved with pedestrian-friendly streets and greenbelt connections, a mix of land uses, variety of housing and increased density to support transit use and provide for affordable housing in the community. To achieve this some trade offs were necessary. For instance, smaller, more affordable lots result in the lessened ability to maintain a fewer number of existing trees and vegetation. Where possible, this Plan seeks to balance these trade-offs and offer mitigation strategies where choices and balance of needs was necessary.

The development is also an integral part of the City's overall long-range growth management strategy and will satisfy a need for certain types of housing that could not be accommodated by infill development elsewhere in the City. This includes a variety of ground oriented housing types to accommodate a broad range of family types, lifestyles and income levels. As well, the City's vacancy rate has remained low, housing costs are rising, and there is a minimal supply with likely shortage of future residential lots. Whistle Bend Phases 3-7 will supply the majority of family oriented residential housing options required to meet this future demand.

### 1.1.2 How is this Plan Used?

The Whistle Bend Neighbourhood Plan will be approved by Council to provide the framework and guidance for detailed engineering design and for the review and approval of development applications. Section 3 outlines the specific development objectives and overall design intent (based on the Master Concept Plan). Section 4 provides an overview, highlights key aspects of the neighbourhood, and provides the land use, subdivision, green network, active transportation and zoning plans for Phases 3-7. Section 5 outlines transportation planning and Section 6 provides the preliminary engineering servicing in preparation for detailed design.

Planning and engineering sections within this plan are mutually supportive. The land use, location of density, open space and network connectivity plans are organized specifically with street design, layout and servicing. The overall functionality of the neighbourhood depends on these aspects working together. Integrating these elements ensures sustainability goals are achieved.

To this end:

- Detailed design shall be guided by an integrated approach and overall neighbourhood design intent with each Phase of development.
- Detailed design for servicing should carefully review planning sections and adhere to the framework set out in this Plan.

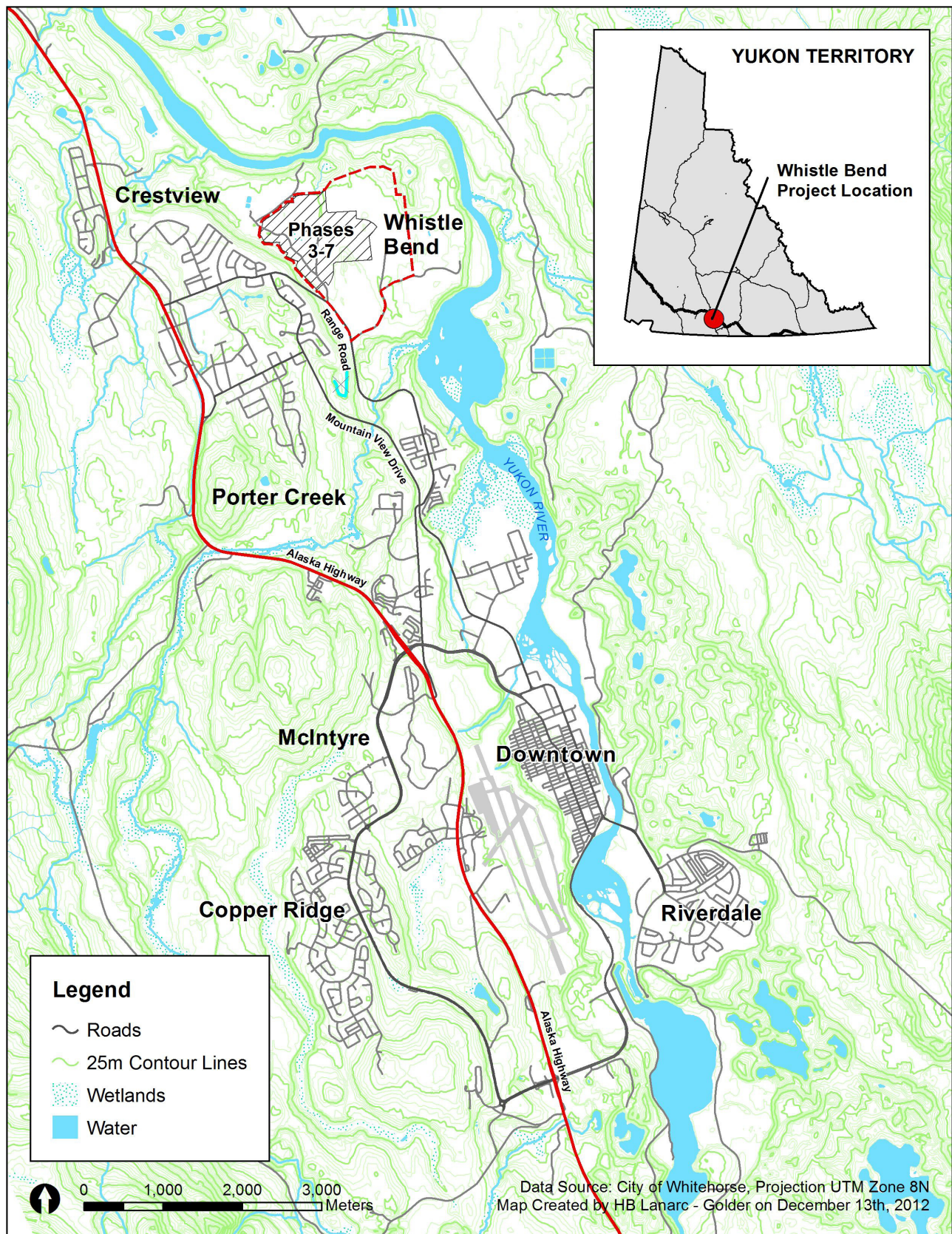


Figure 1.1. Plan area for Whistle Bend Phases 3-7.

### 1.1.3 Plan Area

Whistle Bend Neighbourhood is located 7km north of downtown Whitehorse (Figure 1.1). The neighbourhood development area sits on a plateau bounded by the Yukon River to the east and a steep ridge to the south and west where the neighbourhood of Porter Creek sits above.

Existing vehicle access to the neighbourhood is from Whistle Bend Way and Mountain View Drive which in turn links the community to the downtown. While not required at this time, an alternate potential vehicle access route has been proposed at Whistle Bend Way/Range Road through a Whistle Bend connector across to Pine Street and Pine Street connector to the Alaska Highway. As such, both access routes are included in this Plan as part of the study for development of Phases 3-7.

In addition to vehicle routes, the neighbourhood development has focused on providing a connected pedestrian and transit accessible street network and trail system with the intent to provide multi-modal and active transportation options for residents.

## 1.2 Background

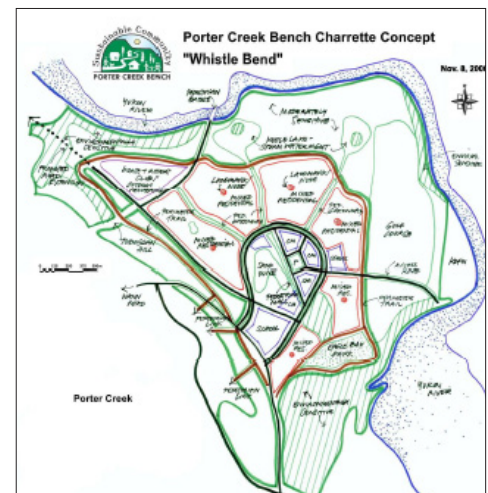
### 1.2.1 Planning History

In November 2006, the City engaged the community of Whitehorse in a visioning charrette and public engagement process that resulted in a critical concept for the area. This formed the foundation for a Master Concept Plan for Whistle Bend Neighbourhood. It included a set of guiding principles, objectives and actions. The Master Concept Plan, approved by Council in February 2009, was to guide land use, City services and provide direction for detailed zoning and subdivision, and phasing within the Whistle Bend Neighbourhood. For additional information on this process, refer to Whistle Bend Master Concept Plan Volume 1 and 2 (AECOM, 2009).

Zoning and subdivision design for Whistle Bend Phases 1 and 2 was prepared and approved in 2009. Construction of Phases 1 and 2 began in the summer of 2010. During construction, it became apparent a more detailed review of site conditions and possible revision to the original master plan was necessary to ensure adequate lot and site drainage, reduce overall flood risk, and meet regulatory requirements.

### 1.2.2 Whistle Bend Phases 3-7

Revisions to the original Master Plan, including lot and road layout was necessary to ensure sustainability goals and issues identified in Phases 1 and 2 were fully addressed. In response, work was initiated in May 2011 to further refine the



**Figure 1.2. Original Porter Creek Bench Charrette Concept from the 2006 charrette.**



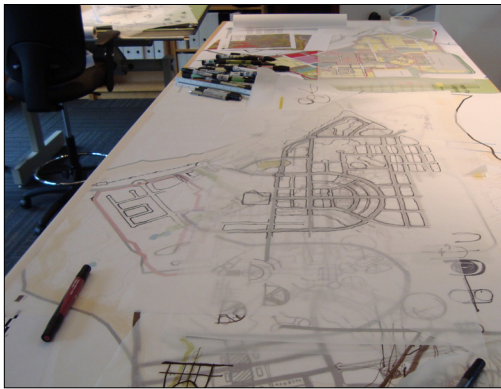
**Figure 1.3. Whistle Bend Master Concept Plan (AECOM, 2009).**

original concept plan and prepare designs for remaining phases of Whistle Bend area, along with the corresponding YESAB Submission for development.

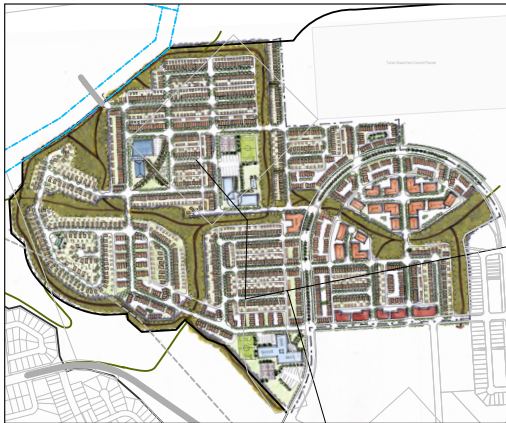
An overview of the work program is as follows:

### **Task 1: Project Start-up, Background Research and Site Familiarization**

Project kick off took place in June 2011. This included an initial overview, site visit, site assessment and document review. A presentation to Council and Senior Management and discussions with key staff provided feedback on overall issues and opportunities, preliminary design and planning options and identification of issues with the current zoning regulations. An updated and more detailed assessment of site conditions for Phases including soils structure and topography was conducted alongside the



**Figure 1.4. Whistle Bend Phases 3-7 internal design workshop for neighbourhood layout.**



**Figure 1.5. Initial draft plan developed for Whistle Bend Phases 3-7.**

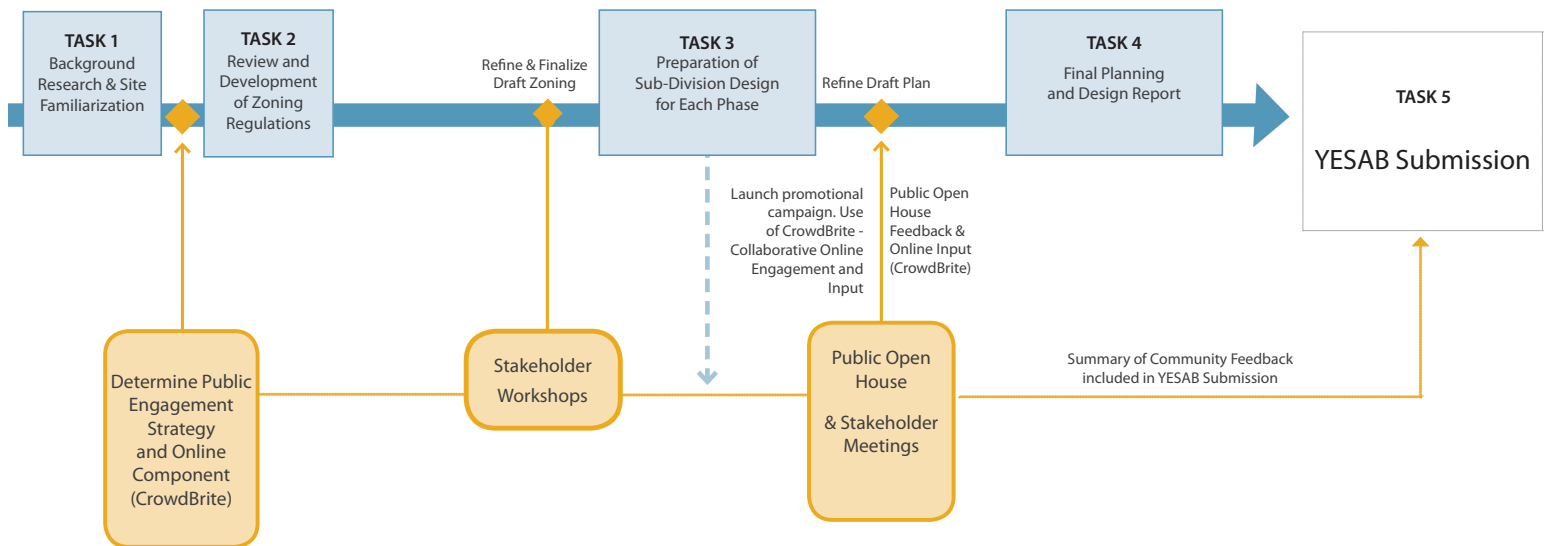
development and drafting of detailed design for Phases. Design work also triggered a separate traffic analysis to review and finalize the need for off-site infrastructure related to the development of Whistle Bend. This report up-dated the original Porter Creek Bench Transportation Network Impact Study (AECOM, 2009) that recommended road connections to the Alaska Highway be established by the 50% build out point for the entire Whistle Bend Neighbourhood.

### **Task 2: Review and Revision of Zoning Regulations**

A zoning review was initiated in July 2011. The process reviewed existing zoning and its application to the emerging site plan and design vision for the neighbourhood. It also included consultation with home builders, property owners, residents and City staff through workshops to identify issues and opportunities within the existing zoning. This formed the basis for recommended revisions to the zoning to accommodate new building types and overall vision for Whistle Bend Phases 1 and 2 and future Phases. Section 3.0 contains an overview of the feedback received and a summary of revision recommendations to the zoning.

### **Task 3: Preparation of Subdivision Design for Each Phase**

A site layout and neighbourhood design concept plan was drafted over the course of three consultant team workshops. This work considered the original master plan, a background review of issues and opportunities and previous consultation with City staff. The concept was provided for public review at an open house in October 2011 and posted for online feedback (using the CrowdBright Online Engagement tool) for two weeks following. Section 3.0 contains an overview of the engagement process, a summary of public feedback and the recommended design layout changes. The concept was also introduced and reviewed with the Ta'an Kwach'an First Nation in March 2012. Collected public and stakeholder feedback was considered in the revised draft concept.



**Figure 1.6. Work program for the Phases 3-7 of Whistle Bend.**

The final neighbourhood design and planning concept was submitted for a second review with staff and presented to Council in January 2012.

#### **Task 4: Preparation of Final Planning & Preliminary Engineering Design Report**

Preparation of the final planning and preliminary engineering design was completed in Fall 2012 with additional revisions proposed and completed in Spring of 2013. This process took into account feedback on the final draft plan from staff, Council and Yukon Government.

#### **Task 5: Yukon Environmental and Socio-Economic Assessment (YESA) Submission**

Preparation of the YESA submission was assembled throughout the planning and engineering design work as it progressed. YESAB was first notified at project initiation, invited to public events and updated during the final draft stages of the plan. An additional meeting to review content and overall approach for the submission was held in March 2012. YESA Application will be completed and submitted in 2013.

## 1.3 Consultation Process

### 1.3.1 Consultation Overview

Building on the project history of public engagement and the desire to maintain community involvement in the design of Phases 3-7 for Whistle Bend was an important goal throughout the process.

Consultation program events included and are described in the following:

#### **Builder and Home Owner Workshop**

A zoning workshop was held on July 13th, 2011 for both home builders and property owners. The workshop consisted of a short presentation followed by a discussion period and a review of case study examples. Four participants attended and provided comment regarding changes they would like to see incorporated into the revised zoning.

#### **Zoning Regulations Survey**

A mail out survey was developed and sent out to property owners in Stan McCowan, Takhini North and Ingram neighbourhoods and to home builders within the City in June 2011. Twelve responses were received from property owners and five responses from home builders.

#### **City Staff Interviews and Council Workshop**

A zoning workshop (similar in content to the stakeholder zoning workshop) was held on July 13th, 2011 for Council, who provided input and feedback on preliminary recommendations for zoning

revisions. City staff provided a list of common issues encountered during the development and building permit application process.

#### **Draft Plan – Public Open House**

The objective of the draft plan public open house was to review the Draft Subdivision Plan for Whistle Bend Phases 3-7 and obtain specific feedback on the following proposed plan aspects:

- Plan layout
- Land use
- Housing typologies, choice and flexibility
- Green network
- Identity and character



**Figure 1.7. Whistle Bend draft plan open house, October, 2011.**

Opportunities for engagement at the open house included:

- Display boards outlining information on each of the neighbourhood plan aspects
- Team members and City staff were available for questions and discussion
- A small presentation and workshop introduction to the online tool Crowdbrite
- IPads were available with a direct online link to the Whistle Bend Crowdbrite page for real time input at the event

### Crowdbrite – online forum and engagement tool

Crowdbrite is an engaging, visually compelling, graphical idea mapping and reporting tool. It is web-based and web-hosted software that combines a dynamic front end canvas with a robust and back end server infrastructure.

Crowdbrite allowed participants to place ideas in context—on plans, maps and drawings, as well as red-line drawings using any web browser or iOS mobile device. Using web-based social media outlet, participants could easily share these plans with the broader community.

For a two week period, after the event, residents followed up with comments online. Within the comment period, participants were specifically asked to:

- Identify their own examples and best practices
- Identify what aspects they liked and disliked about the plan
- Identify concerns and posed questions to the team

In addition, Crowdbrite also allowed for people to comment on the ideas submitted by others, providing a forum for discussion.

### 1.3.2 Summary of Feedback - Zoning

In summary, the following issues and challenges with the current zoning were identified:

- Difficulty fitting larger vehicles in the front yard due to limited distance from main house and attached garage to street
- Some zoning requirements are seen by builders as unnecessarily increasing the cost of a unit. Therefore, not all mandatory improvements are supported

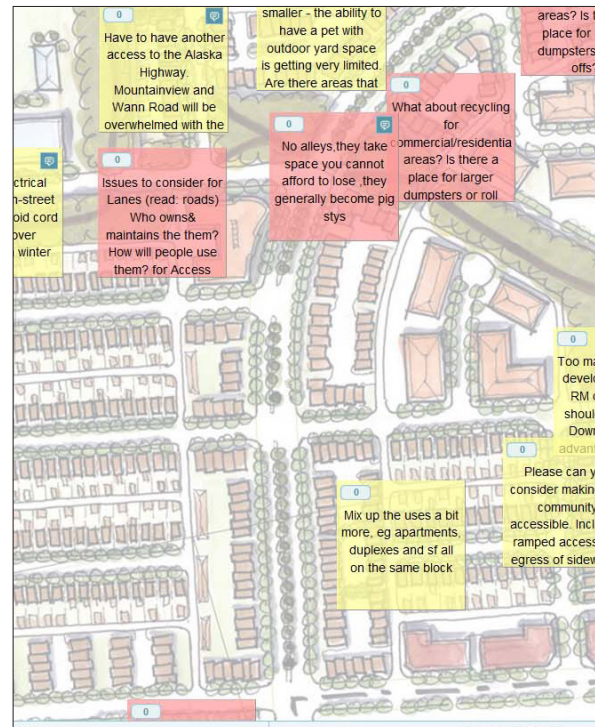


Figure 1.8. Crowdbrite online layout and comments on the draft plan.

- Difficult to implement zoning bylaws sensitive to existing site ecology / vegetation if development site is disturbed beyond recognition to accommodate servicing constraints.
- Existing porch depths do not create public interaction and are seen as costly to build. Finding stock plans with a setback garage is difficult/expensive
- Lots are too small/narrow and larger sizes would be better
- Lanes pose some difficulties to builders
- Minimal challenges in meeting the City's Green Building Standards
- Builders should be able to pick any colour they choose
- Difficulties meeting setbacks on smaller lots/cut corner lots
- Staggered front façade for townhouse/multi family is expensive
- Tree retention in rear yard limits possible development
- 10% variance incentives are not well used

As a result of feedback received, the following changes were made with respect to Zoning Changes:

- More detailed information about the intended building types (and associated accessory buildings and uses) for each zone
- The creation of General Zoning Requirements applied to all zones to avoid duplication
- Use diagrams and illustrations to help describe building types and development requirements for each zone
- Use of existing zoning as a basis for new zones to provide the opportunity for future consolidation of both

### 1.3.3 Summary of Feedback - Design and Layout

In summary, the following issues and challenges were identified at the open house and through online input with respect to the concept plan:

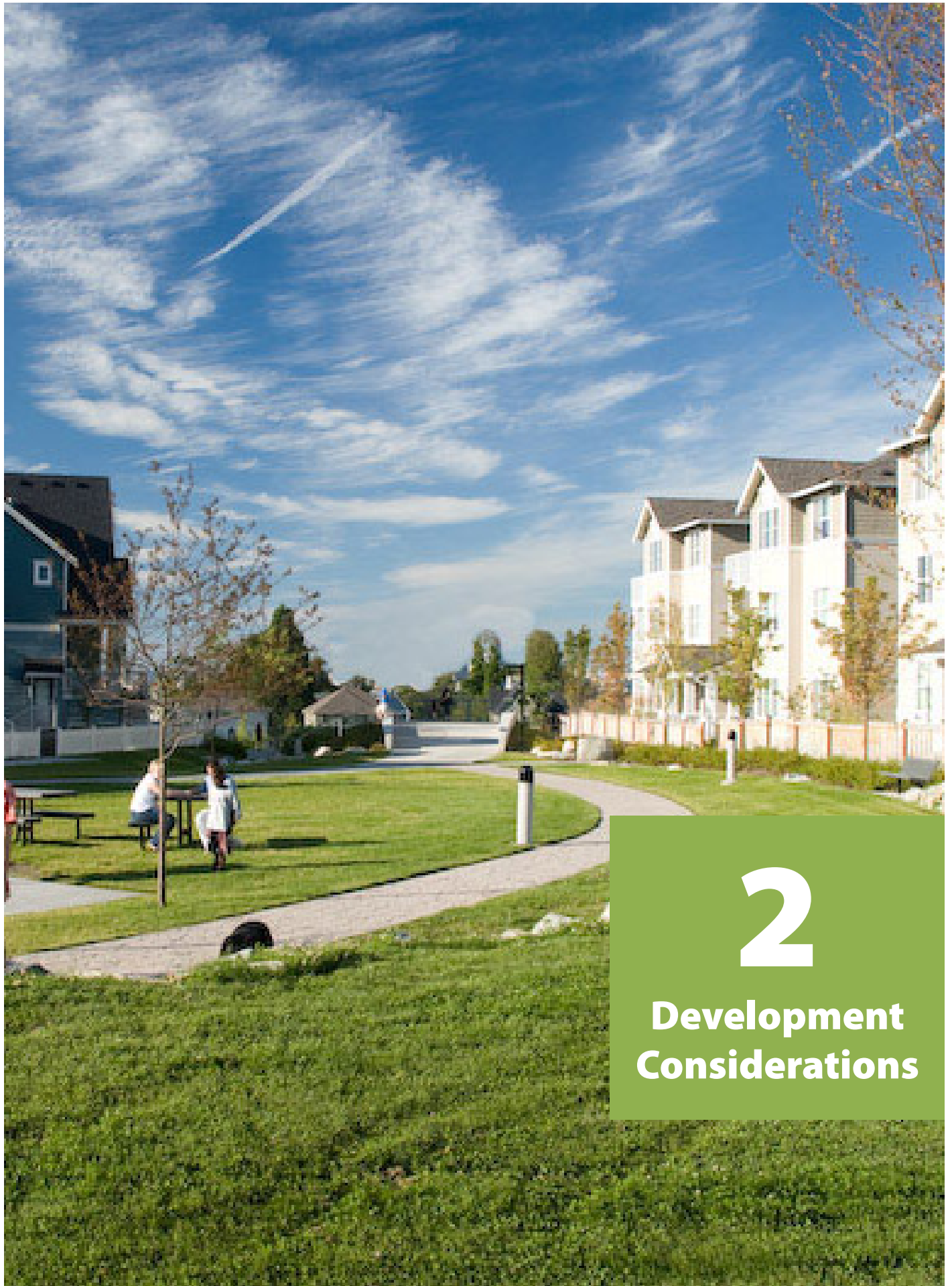
- Concern that some areas of multi-family housing were too large and may create a 'ghetto' of low-income or rental housing
- Concern that housing would not be affordable for a variety of income levels within the neighbourhood
- Concern that cleared areas would not retain and protect trees (response to extensive site clearing of Phases 1 and 2)
- Support for lanes, walkable streets / greenbelt connectivity
- Desire to cluster the highest density housing nearest to the commercial centre
- Suggestion to move some of the local-serving commercial outside the village centre into the neighbourhood

- Concern that lots were too narrow and there would not be sufficient room for boats, ATVs, or other recreational items, etc., a frequent suggestion was made to provide common lot storage areas throughout the neighbourhood
- Concern for ensuring pedestrian safety within the neighbourhood if it was to be a 'walkable' neighbourhood

As a result of feedback received, the following changes were made with respect to the concept plan design and layout:

- Increase the mix of housing types and placement throughout the plan with higher density housing (mixed of apartment and ground oriented housing) located within the central neighbourhood area and adjacent to community amenities and commercial services
- A smaller sub-node of commercial was created within Phase 4 of the neighbourhood (outside the central commercial core) to increase the walkability
- The location of the greenbelt was shifted slightly to ensure it captured areas that were not already cleared in the construction of Phases 1 and 2
- The distribution of lot sizes was changed to ensure a more even distribution in area and width
- Street sections were reviewed and revised to ensure traffic calming measures and a high quality pedestrian environment





# 2

## Development Considerations



## 2.1 General Site Conditions and Existing Land Use

## Development Considerations | 23

### 2.1.2 Site Conditions

The neighbourhood development site is located on lower Porter Creek Bench. It is relatively flat, and bound by slopes leading to the Yukon River and McIntyre Creek (south), and a steep slope up to the existing Porter Creek Neighbourhood on the west. The surrounding development consists primarily of residential development to the south and west of the development and the Mountainview Golf Course



Figure 2.2. Existing site context showing parcel ownership, cleared areas and surrounding development.

and Eagle Bay Park to the east. The now decommissioned Porter Creek sanitary road right of way and sewage lagoons are located to the north west.

The Whistle Bend development site consists of largely undeveloped forested area. There are several depressions in the area where most storm water infiltrates into the ground. There are a series of unpaved roads and undesignated recreational trails within the property.

With the development of Phases 1 and 2, land was cleared for the installation of the sanitary force main and Casca Boulevard as well as smaller access routes for development, site drainage and use of fill materials for Phases 1 and 2 (as shown in the air photo in Figure 2.2).

### 2.1.3 Land Ownership

The Yukon Government owns the majority of the development land with the exception of several privately owned parcels. Each parcel and its ownership within the plan area and areas adjacent to it are described as follows.

1. The Navigation Canada facility - removed from the site for the development of Phase 1.
2. Heiland Property (Lot #1139) – an 8 ha parcel of privately owned land located east of the development site. This property will not be directly impacted by the development of Phases 3-7 for Whistle Bend Neighbourhood.
3. Ta'an Kwäch'än Council C-9B – 20 ha parcel located to the north of Phases 1 and 2 and east of the development site. This property will be somewhat impacted by the development of the Phases 3-7. Efforts have been taken to provide connections and appropriate adjacencies to the parcel should it be developed in the future.
4. Kwänlin Dun First Nation C-43 – a 17 ha parcel located on the east side of the Mountain View Golf Course. This property will not be directly impacted by this development plan.
5. Mountain View Golf Course Leads #375 and 375A – 137 ha property that is held under lease to the Government of Yukon. The Golf Course is located along the eastern perimeter of Phase 1 and 2 developments. The Golf Course also holds another 52 ha lease that extends north-east along the Whistle Bend development but is currently undeveloped land. These properties will not be directly impacted by this development plan.
6. Canadian Broadcasting Corporation Lease (CBC) (Lot #439) – 19 ha parcel located within the development area. This property is leased from YG. When the lease ends, all equipment will be removed from the site.
7. Yukon Horse and Riders' Association (Lot #1390) – 6 ha parcel leased from the City of Whitehorse and will be relocated to another suitable site. The Association has identified the decommissioned Porter Creek lagoons as a possible alternative location or within another off-site location.
8. Porter Creek Lagoons – 1 ha parcel owned by the City of Whitehorse that encompasses this small, 3-cell sewage lagoon, a facility that was decommissioned in 1996. The sludge pit at this facility will require rehabilitation prior to future development of this area.

## 2.2 Geotechnical

Soil information is based on the analysis of 20 boreholes in the EBA Geotechnical Evaluation Whistle Bend Subdivision, Whitehorse, Yukon (August 2009).

The report covers soil composition, groundwater, and slope stability. In addition, recommendations on concrete, the pavement structure design, foundations, and underground utilities. It is imperative that any construction activity adhere to this and any subsequent geotechnical report recommendations.

The geotechnical conditions on site are summarized below:

- Soil conditions throughout the Porter Creek Upper Bench, along Larch Street, Cedar Crescent, Balsam Crescent and Evergreen Crescent, are fairly consistent with medium to fine grained silty sand overlying coarse glaciofluvial gravel.
- Near the east side of site varying thicknesses of eolian sand overlying glaciolacustrine silt soils is common at all locations where test holes were advanced. Generally, less than one meter of sand exists over the underlying glaciolacustrine soils.
- Soil conditions along the bank overlooking the Yukon River are comprised of granular soils.

Key geotechnical recommendations for the Whistle Bend Subdivision Development are:

- Under paved roadways with concrete sidewalks and curb & gutter, a recommended minimum of 1.7m of non-frost susceptible granular structure to minimize the potential for frost heave damage and subgrade softening during spring thaw. The minimum roadway structure must include: 75 mm of hot-mix asphalt, 150mm of base course gravel (20 mm diameter crushed gravel), and at least 300mm of sub-base gravel (50 mm diameter crush gravel or 100 mm pit-run). The actual thickness of gravel placed will be dependent on what is necessary to ensure a 1.7 m of non-frost susceptible roadway structure. Areas containing glaciolacustrine silt subgrade sections may require up to 1.7 m sub-cut.
- Underground utilities can be installed using conventional construction methods. The primary soil type will be dry sand over moist to wet glaciolacustrine silt. Sand excavated from utility trenches will be acceptable for sand bedding. The silt may be used for backfill, but not within 1.7 m of final road elevations.

Further geotechnical evaluation was recommended to be done during the final design stages of this project. These include:

- Confirmation of sub-cut depths and volumes under roadways.
- Confirmation of infiltration pit locations and actual hydraulic conductivity of accepting soils.
- Soluble sulphate testing to establish cement type.

As per the above recommendation the actual hydraulic conductivity of accepting soils was investigated in the Soil Infiltration Testing that was completed for this report. The test results are discussed in Section 6.4 – Stormwater Management. The report, dated December 19, 2011 is included as an Appendix.

## 2.3 Environmental and Socio-Economic

### 2.3.1 Environmental

Gartner Lee Ltd (2006), AEM (2000) and AECOM (2010) have provided a detailed description of important environmental and heritage features associated with Whistle Bend development and associated infrastructure footprint. Of particular interest in the area is the McIntyre Creek Corridor, described in more detail below.

### 2.3.2 McIntyre Creek Corridor

The McIntyre Creek corridor is valued as habitat for various species and as an important connector of upland habitat with the Yukon River. The area also provides important recreational and heritage value. This corridor is located to the south of the Whistle Bend site extending south of the existing Porter Creek Neighbourhood. The Phases 3-7 of Whistle Bend will not directly affect this corridor. The McIntyre Creek Corridor will be reviewed and discussed as part of Porter Creek infill development.

### 2.3.3 Recreation Use

The Whistle Bend site is mainly used as a year-round recreational area, for activities such as dog-walking, skiing, bird watching, golfing, and motorized recreational vehicles. There is a fairly extensive existing trail network in the vicinity of Whistle Bend, including trails throughout and adjacent to the McIntyre Creek Corridor and connections to Mountain View Golf Course and Eagle Bay Park (to the south east). Existing recreational activities have been considered as part of the planning process for the neighbourhood. Further information in relation to socio-economic conditions associated with the Whistle Bend project area can be found in Porter Creek Bench Socio-Economic Background Report (2006).

### 2.3.4 Archaeological

The following information was obtained from AECOM (2010) and Matrix Research Ltd. (2009; 2005), and is presented below with only slight modifications as a summary:

Two heritage resource impact assessments were completed for the Whistle Bend Project by Matrix Research Ltd (2009; 2005). These assessments involved an office review of air photos, contour maps, ethnographic and archaeological records, as well as historic information prior to the field work component which involved transects and subsurface testing.

One assessment covered the entire Whistle Bend Study Area. Three heritage sites were identified within the development study area prior to completion of the Whistle Bend Master Plan. The results of this survey were taken into account and the footprint of the entire development will not impact the identified archaeological or cultural heritage resources. These sites have sufficient buffer areas established to provide appropriate protection.

A second, earlier assessment examined the Whistle Bend Way area where three additional heritage sites were identified. It does not appear that any of these sites will be impacted by the current Whistle Bend development, including an extension of Pine Street, should this be required in the future.

## 2.4 Existing Utilities

With the construction of Phase 1 and 2, there are some existing utilities in the vicinity. Modifications, connection, upgrades and extensions will be required to service the subject lands. Details of these utilities are included in later sections of this report with a short summary of considerations following.

There is an existing 400mm HDPE sanitary forcemain that goes through the development to the Porter Creek Flush Tank (PCFT). This has been constructed in what will be a future roadway. Therefore detailed design of the underground utilities and roads will need to consider any crossings or proximity to this forcemain.

There is a power transmission line that runs along the west edge of the development. The proposed development has taken into consideration the proximity of lots to this utility. Any setback requirements will need to be confirmed prior to final lot layout and land subdivision.



# 3

## Development Objectives



## 3

# Development Objectives

## 3.1 Development Objectives and Design Intent for Phases 3-7

The following objectives were developed from the original sustainability framework set out in the Master Concept Plan (2009) and early feedback received in the planning process. The objectives outline and provide greater detail on the overall design intent for Phases 3-7 of the neighbourhood. Objectives were used to guide the redesign and layout of Phases 3-7 in Whistle Bend.



### LANDSCAPE, ENERGY, ECOLOGY & ENVIRONMENT

- Maintain some of the existing boreal forest and vegetation within a designated greenbelt area and encourage preservation of mature trees on privately owned lots, where possible.
- Encourage energy efficiency.
- Maximize passive solar gain by including south and west-facing porches, patios and balconies and indoor activity areas.
- On all institutional and multi-family lots, soften buildings and better integrate them into their natural surroundings through the preservation and augmentation of the existing natural vegetation.
- Encourage the retention of key ecological and hydrological resources and functions.



### AFFORDABILITY, LAND USE EFFICIENCY & FLEXIBILITY

- Ensure a variety of housing forms with an emphasis on compact lots to encourage affordability, housing choice, and flexibility.
- Encourage and locate density and ensure a connected open space network to support public transit and non-motorized forms of travel.
- Encourage a variety and mix of housing types to accommodate a range of ages, income levels and lifestyles.
- Allow for adaptability and flexibility in use over time at the building, lot and block scale



## WALKABILITY & LIVABILITY

- Create a safe, pedestrian focused neighbourhood with a variety of compatible uses.
- Create a welcoming and attractive residential street front by incorporating human scale design elements that make buildings practical and visually attractive.
- Mitigate impacts of vehicle speed, onsite access, servicing, and parking in the pedestrian realm.
- Create useable and comfortable outdoor amenity spaces on residential lots that include south and west-facing porches, patios, balconies and play areas.
- Sensitive transition between land uses and building types.
- Maximize solar exposure and views and minimize shading impacts.
- Ensure privacy for residents by differentiating public, semi-public and private open spaces.
- Integrate a range of passive and active recreational opportunities into the neighbourhood.



4

Development  
Concept



## 4

# Development Concept

## 4.1 Overview

Whistle Bend Neighbourhood Phases 3-7 creates capacity for approximately 2,000 new units and an estimated 5,000 people over the next 10 to 20 years.

## 4.2 How is this Neighbourhood Sustainable?

Whistle Bend Neighbourhood is based in sustainable neighbourhood planning which seeks to achieve long-term social, environmental and economically healthy communities. The following highlights key sustainable features of Phases 3-7:

- Streets are organized in a fine-grained, interconnected grid pattern creating small blocks and lanes; a key aspect of neighbourhood walkability.
- Streets are primarily organized east-west to maximize solar exposure and passive heat to housing.
- An extensive green belt as the defining structural and character element throughout the neighbourhood. The green belt preserves a large area of mature vegetation and trees, thereby maintaining valuable habitat and parts of the original trail system. It also links, via this trail system, phases of development (including 1 and 2), commercial areas, and activity nodes (parks, community uses), thus providing an 'off-road' transportation option through the neighbourhood, reducing vehicle use for within-neighbourhood trips.
- The neighbourhood includes a variety of housing types, providing for a mix of incomes (affordability) and lifestyle needs. Typically smaller, fee-simple lots require clearing of vegetation for buildings and re-vegetation through landscaping.
- Compact, higher density housing maintains a greater efficiency of infrastructure and provides the population to support a vibrant community.
- High density housing is located closer to the commercial areas, main arterials and collector routes providing easy walking access for the majority of residents and creating transit supportive densities for more frequent service.
- A centrally located commercial street and smaller community-oriented commercial

node provide local services to meet some of residents daily needs, reducing the number of trip required (vehicle) outside the neighbourhood and encouraging pedestrian activities where basic services are within a five-minute walk from home.

- Neighbourhood centre provides a social 'heart' to the neighbourhood and amenities within the neighbourhood create gathering sites (community use, public service sites, etc.) fostering a sense of community and social sustainability.
- One community use site and two large institutional-recreation sites are allocated to provide largely for residents recreational and education needs as well as offer potential primary civic uses, such as a library, community centre (programming) clustered with smaller commercial sites that could include, daycare, coffee shops, etc. This area provides for some of the recreational, educational and service needs of residents within the neighbourhood, reducing the need for residents to travel outside the neighbourhood. Additionally, residents can develop social connections.
- Two seniors supportive housing sites are identified within walkable and transit accessible distance to community amenities and services directly within their community.
- Tree-lined boulevards, on-street parking and development designed to address the street create a high quality public realm and ensuring more eyes on the street (safety).
- Lanes provided at the rear of dwelling units for the majority of neighbourhood dwellings ensure garages and driveways do not dominate the front yard.
- On-site stormwater management follows drainage patterns as much as possible to maintain the existing drainage patterns, minimizing impacts to the environment.

### 4.3 Illustrated Plan For Whistle Bend Phases 3-7

Whistle Bend Phases 3-7 builds on the character and layout of Phases 1 and 2 (Figure 4.1). The neighbourhood maintains large areas of natural greenspace, reinforcing a strong 'green' character. Housing is compact and mixed with higher density housing located along major corridors. A neighbourhood centre is located between Phases 1-2 and 3-7 and smaller community - recreational nodes located in the north-west and south-east areas of the neighbourhood.

GREEN STREETS

Neighbourhood incorporates unique features such as 'green streets', small linear parks lined with housing.



COMMUNITY AMENITY SITE & COMMERCIAL NODE

A smaller community-oriented commercial-recreational node.



GREENBELT AND TRAIL NETWORK

The green belt is a defining structural and character element of the neighbourhood. The green belt preserves mature vegetation, it also links, via this trail system, phases of development and key destinations.



MIX OF HOUSING TYPES

A variety of housing types, provide for a mix of incomes and lifestyle needs. Higher density housing is located close to the commercial areas, main arterials and collector routes that foster transit supportive nodes.



REFERENCE

Base data obtained from the City of Whitehorse.



COMMUNITY / NEIGHBOURHOOD PARK

Smaller community and neighborhood parks are located throughout the neighbourhood to meet residents recreational and leisure needs. These sites also serve as connection points to the greenbelt.



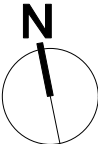
NEIGHBOURHOOD COMMERCIAL HIGH STREET

A centrally located commercial street provides local services to meet some of residents daily needs, reducing the number of trip required (vehicle) outside the neighbourhood, encouraging pedestrian activity and social interaction.



PUBLIC SERVICE LOTS

Two large institutional-recreation sites provide for residents recreational and education needs



WHISTLE BEND NEIGHBOURHOOD PHASES 3-7

ILLUSTRATED PLAN



Sustainable Communities

RECORD OF REVISIONS:

February, 2012
March, 2012
July, 2012
December, 2012; July, 2013

SCALE : NTS

FIGURE 4.1





**Figure 4.2. Residential character of the neighbourhood is envisioned to be primarily compact, ground oriented housing with a strong visual and physical connection to public streets and open spaces.**

#### 4.3.1 Residential Character

Residential areas are largely defined as compact, ground oriented housing with a strong visual and physical connection to public streets and open spaces. This is achieved through the size and location of lots, predominantly short front yard setbacks and building design elements embedded within the revised zoning that are intended to improve the attractiveness, accessibility and human scale of the neighbourhood. High density housing is located closer to neighbourhood amenities, large areas of greenspace and the primary arterials and collector streets for greater accessibility to transit and neighbourhood services. Furthermore, flexibility with regards to siting, design, form, density and type of housing is built into the sub-division plan and zoning to allow greater choice and adaptability over time. For example, a standard single family lot can be developed as a duplex, a narrow single family lot can be combined with an adjoining parcel to be developed as a duplex and both allow for the option of garden and living suites. Duplex lots (separately titled but sold in pairs) are currently in high demand. Lots may be identified to be sold in pairs for this purpose. Transition areas between standard single family and higher density townhouse forms of housing are suitable areas to apply this type of flexibility. As a result, there is a greater range of housing types, forms and densities that can be developed within the same block or sub area. This provides a diversity of housing forms but with a cohesive and unified residential character and allows for market flexibility.

*It is important to note that where any two lots are combined, City of Whitehorse Planning Department's approval is required For detailed information on housing see Section 4.4.*

#### 4.3.2 Streetscapes

Streetscapes within Whistle Bend Phases 3-7 place a strong emphasis on creating a highly walkable and pedestrian-friendly environment. This is fostered by a highly connective grid pattern street, with short blocks, rear lane access, sidewalks, pedestrian crossings, landscaped boulevards, street furniture and on-street parking. Pedestrian oriented streets are further emphasized by ensuring adjacent buildings, whether residential, commercial or institutional, present a "friendly face" to the fronting public street or open space.

*For detailed information on streets and circulation, see Section 5.0.*

### 4.3.3 Open Space and Green Network

Green space is a major structural and character defining element for Phases 3-7. The retention of mature trees and existing vegetation as a green belt expresses a distinct 'green' identity for the neighbourhood. This is further supported by neighbourhood parks and institutional / recreation sites, and green links and green streets (linear parks). Each type is layered and integrated to perform multiple functions including circulation, recreation, natural habitat and ecology, and natural surface drainage.

*For detailed information on the open space and green network of the neighbourhood, see Section 4.6.*

### 4.3.4 Amenities

Whistle Bend Phases 3-7 will provide for a range of private, public and institutional amenities. These include a variety of local neighbourhood shops and services such as a grocer, pub, restaurants, cafes, and other publicly oriented active uses. The commercial high street is envisioned as the centre of commercial activity for the larger neighbourhood (including Phases 1 and 2). The nature of its central location and smaller parcel configuration fosters a direct street orientation, small-scale building footprints, human scale environment with high quality design furnishings and consideration for solar exposure. On-street or rear of building parking areas will ensure a pedestrian oriented environment compatible with surrounding residential uses. Connected by direct green links, this central high street area will be easy to access from the residential areas by bike or on foot. Two public service lots, a community/recreational centre and smaller neighbourhood park spaces within each phase will provide areas for informal active and passive activities, children's play and other resident interests. Additionally, the neighbourhood will include two seniors supported housing apartment buildings.

*For more detailed information on neighbourhood amenities, see Section 4.4, 4.6 and 4.7.*



**Figure 4.3.** Phases 3-7 envisions a neighbourhood centre supporting a variety of local shops and services such as a grocer, pub, restaurants, cafes, and other publicly oriented active uses.

## 4.4 Land Use

The land use plan describes the location, density and type of housing, commercial uses, green space, institutional and community use that will be developed. Land use designations are aligned with the Official Community Plan, maintain the intent of the Master Development Concept for the entire neighbourhood and are guided by the principles and targets for sustainable community development endorsed within these two documents.

The total developable area for Phases 3-7 is 120.5 ha. Just under half the developable area is dedicated to housing and approximately a third of the area is retained as green space (parks, recreation and natural areas). Commercial/mixed use, located along Keno Way, is the neighbourhood high street and central community node for the entire neighbourhood. It is assumed this commercial street will be supported and supplemented by future phases, currently designated commercial and community use, and located directly south of this street. Future commercial and community uses here should maintain a street oriented pattern and build form and provide direct pedestrian oriented routes to and from Keno Way.

**Table 4.1. Summary of Land Use by Area**

Land Use Designation	Area (ha)*	Area (%)	Master Concept Plan **
Low Density Housing	12.02	10%	37ha (Housing Mix 'A')
Medium Density Housing	27.24	22%	19ha (Housing Mix 'B')
High Density Housing	6.35	5%	
Institutional - Seniors Supported Housing	0.8	1%	Not included
Commercial High Street	1.5 (100,000 sqft. of built space)	1%	0.8ha (majority of commercial allocated to future phases)
Institutional / Recreation	7.0	6%	7.3ha
Greenbelt, Green Links, Green Streets	29.5	23%	29.2ha
Parks / Recreation Areas	1.6	2%	
Community Use	1.82	2%	2.3ha

\* Area is the total developable area for Phases 3-7 only, approximately 30% of this area is dedicated to streets and lanes.

\*\* Estimates outlined for original Whistle Bend Master Concept Plan (AECOM, 2009) are based on Phases 3-5 only. Phasing has changed and therefore comparisons are not exact and for general reference only.

Phases 3-7 maintain approximately the same ratio of land use as the original Whistle Bend Master Concept Plan (AECOM, 2009), with the exception of housing. The original Master Concept Plan designates more area into Housing Mix 'A', a predominantly standard single family housing with some allowance for duplex and triplex, as opposed to Housing Mix 'B', predominantly duplex, triplex, townhouses, and apartments. The plan for Phases 3-7 reverses this, allocating more area for medium and high density housing, but mainly in the form of ground oriented housing types (as opposed to an increased number of apartments). This plan introduces several new housing types: narrow lot single family homes, cottage cluster homes, and courtyard town houses (see Summary of Housing & Housing Types below or refer to Section 4.8: Zoning, for additional detail) and new green space types, including the 'green street', a residential, pedestrian-only linear park (green) space with housing that fronts onto it.

#### 4.4.1 Residential Land Use

There are three categories of residential land use designations: low, medium and high density. Most of the residential capacity is 'medium density' which offers the greatest number of housing types and flexibility for development. These dwelling types are accommodated in the subdivision plan and zoning (through lot size, rear lane access, and other requirements).

**Table 4.2. Summary of Housing Types**

\* Percentage of housing is calculated based on the total area dedicated to housing only (46.41ha).

	Units per Hectare	Percentage of Total Housing Units (by area)	Housing Types
Low Density Housing	15-20	26%	Standard singly family and duplex, allows for garden and living suites
Medium Density Housing	25-40	58%	Narrow lot single family, duplex, cottage cluster, triplex, townhouse, allows for garden and living suites in narrow single family lots.
High Density Housing	40-100	15%	Apartment (includes seniors housing)

In addition to Subdivision & Development and Zoning Bylaws, the following outline requirements for each residential designation in Whistle Bend Neighbourhood Phases 3-7.

#### 4.4.2 Low Density Residential

Low density residential allows for standard single family and duplex housing (on a standard single family lot), with or without a garden and/or living suites. Lots vary in size and frontage, ranging from 400m<sup>2</sup> to >600m<sup>2</sup> (4,300sqft. to 6,450 sqft) and frontage from 15m to 22m width, with and without lanes and at densities of 15 to 20 units per hectare.

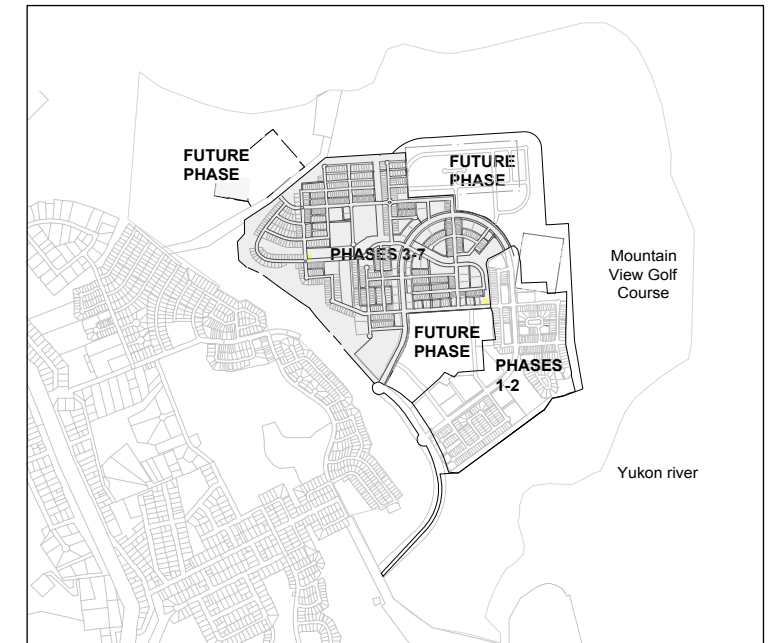
##### Low Density Residential Areas:

Requirements for low density areas are as follows:

- Flexible front setbacks are permitted to maximize solar exposure and placement of the dwelling for private amenity space.
- Living suite and garden suites are permitted on lots whether or not there is rear lane access.
- Corner lots allocate additional site area and greater setbacks with an option for garden suites which provides an increase in housing diversity, but maintain unity with the streetscape.
- Shared front driveways are permitted where there is no rear access to lots.
- On-street parking is permitted on both sides of the street to provide additional parking opportunities.
- Maximum building height up to 10 m
- Building fronts must address (face) the street.



- upHa = net units per hectare



## WHISTLE BEND NEIGHBOURHOOD PHASES 3-7

# LAND USE PLAN

RECORD OF REVISIONS:	
February, 2012	SCALE 1: 10,000
March, 2012	
July, 2012	FIGURE 4.4
July, 2013	



Figure 4.5. Definition and intent for each land use designation.

		Land Use Designation	Intent
		Low Density Residential	To provide single family detached housing, duplex; with option for garden suite or living suite. Densities range from 15–20 units / hectare. Low density residential is located in areas where solar exposure is limited due to topography and/or adjacent greenspace (larger lots allow for greater spacing between housing).
		Medium Density Residential	To provide a variety of smaller, more affordable single family lots with options for duplex, garden suite and living suites. Densities range from 25–30 units / hectare. Narrow lots located where there is lane access and sized for flexibility to accommodate a variety of housing types.
			To encourage density and mix of housing and ground oriented affordable units that are family friendly including duplex, triplex, townhomes and cottage clusters. Densities range from 30–40 units/hectare. Housing to be ground oriented and street facing.
		High Density Residential	To encourage greater density and mix of housing with affordable units. Densities up to 100 units/hectare. Maximum building height of 4– 6 storeys. This designation may include a mix of townhomes and apartments together (encouraged where directly adjacent to Casca Boulevard).
		Mixed Use Commercial	To encourage local serving retail uses in the neighbourhood. Apartments with pedestrian oriented retail/ commercial uses on the ground floor. Minimum building height of 3–4 storeys. Commercial sites located in the centre area and adjacent to community uses.
		Community Use	To provide neighbourhood amenities including library, recreational facilities, or other civic uses and supportive services. This area acts as a 'node' within Phases 3– 7. Small or seasonal internal commercial uses should be permitted.
		Institutional/Recreation	To provide public service lots for Secondary and Elementary School, recreational needs and affordable housing in the neighbourhood. School sites will accommodate some of the recreational park needs for the neighbourhood. Housing sites for affordable seniors housing.
		Greenbelt	To preserve large areas of connected natural vegetation as green fingers throughout the neighbourhood which connect phases of development within Whistle Bend. Greenways and natural areas includes a connected multi-use trail system. Two types of trail typologies will accommodate primarily non-motorized with limited designated motorized trails.
		Neighbourhood & Community Parks	To provide recreational greenspace and formal play spaces in the neighbourhood. Park requirements to be determined.
		Green Links & Green Streets	Green links provide pedestrian connections within the neighbourhood and to larger green space and trails. Green streets are 'linear parks'; pedestrian only streets (houses front onto a green space) within the neighbourhood.
		Protected Areas (areas outside the development boundary)	To preserve but provide access via an existing trail network to areas surrounding Whistle Bend Neighbourhood. These areas include McIntyre Creek, the greenspace along the banks of the Yukon River, and steep slopes between Whistle Bend and Porter Creek.



**Figure 4.6. Options for living and garden suite in low density residential.**



**Figure 4.7. Incentives for tree retention and replacement.**



**Figure 4.8. On-street parkings and both front and rear lane access.**

- Where there is front access only (no rear lane), garages must be set back from the front façade of the house and should not dominate the front of the building.
- A sizable (greater than 2m) covered front area that defines a semi-private area in front of the unit is required.
- High quality materials and finishes are required.
- Where possible, on-lot tree retention and replacement is encouraged.
- Lots facing designated 'green streets' shall have the primary entrance to face the green street. See Section 5.2.8 for more detail and location of green streets.
- Front fencing shall not be permitted for lots facing designated 'green streets'. See Section 5.2.8 for more detail on green streets.
- Parking may be restricted to one side of the street during winter months to allow for snow storage on streets.
- High efficiency thermal insulation (EnerGuide 85) and arctic entry door ways are strongly encouraged for energy efficiency and reduced heating demands.

#### 4.4.3 Medium Density Residential

Medium density residential generates a more compact neighbourhood with both single family lots and ground oriented, multi-family attached housing. This retains a single family character while providing a range of housing types. Developments in this designation allow for single family units on narrow 320m<sup>2</sup> (3,400 sqft.) lots, duplex or triplex housing with the assemblage of two adjacent lots, townhouses in blocks of 3-6 units, strata townhomes and cottage cluster housing where larger lots abut green space. Medium density is between 25 to 40 units per hectare.

##### Medium Density Residential:

Requirements for medium density areas are as follows:

- Short front setbacks are permitted for multi-family, ground oriented units reinforce and relate to the street while still allowing for a semi-private entryway/ transition zone, while accommodating for more room

and amenity space at the rear.

- Garages and ancillary dwelling units must be accessed via the rear lane (corner units can be accessed via the side street).
- On-street parking is permitted on both sides of the street to provide additional parking for visitors.
- Multi-family buildings must have a strongly defined front entry that relates to the street (strata lots can have both internal and street facing units).
- A useable, covered front entry ways should be provided on street oriented ground entry units.
- A clear delineation of public and semi-private space.
- Grouped, attached units must add to interest and rhythm of the streetscape by providing a variety (number and articulation) of units when located together in one block.
- High quality building materials are required.
- Parking may be restricted to one side of the street during winter months to allow for snow storage on streets.
- High efficiency thermal insulation (EnerGuide 85) and arctic entry door ways are strongly encouraged for energy efficiency and reduced heating demands.
- Where possible, on-lot tree retention and replacement is encouraged.

#### 4.4.4 High Density Residential

High-density residential allows for 40 to 100 units per hectare. High density residential is located nearest the central neighbourhood commercial high street and along collector and arterial streets.

##### High Density Residential:

Emphasis for high density residential is to ensure a compatibility of design and transition to adjacent residential areas.

Requirements for high density areas are as follows:

- Building entry ways are required to face the street.



**Figure 4.9. Medium density residential includes a variety of multi-family housing types.**



**Figure 4.10. Buildings are articulated to add interest and rhythm to the streetscape.**



**Figure 4.11. A strongly defined entrance that fronts to the street.**



**Figure 4.12. Local streets defined by street trees.**



**Figure 4.13. High density neighbourhood development.**



**Figure 4.14. A focus on pedestrian scaled neighbourhood commercial.**



**Figure 4.15. Green streets within neighbourhood commercial areas.**



**Figure 4.16. Institutional / recreation sites.**

- Resident common outdoor amenity spaces are required.
- Maintenance of mature vegetation or high quality landscaping is required where a site is adjacent to a greenbelt.
- High-quality materials are required and must be compatible with adjacent single family and townhouse areas.

#### 4.4.5 Neighbourhood Commercial

Neighbourhood Commercial provides small-scale, street-oriented, retail and service developments to accommodate a portion of the daily needs of local residents. To ensure convenient walking distance to commercial amenities for residents located outside the central node, a smaller secondary neighbourhood commercial area is located north west portion of the neighbourhood, adjacent to the recreational node and community use.

##### Neighbourhood Commercial:

- Residential and office uses are permitted above the ground floor.
- Commercial located with the Community Use area should provide limited, small scale, neighbourhood commercial amenities appropriate and supportive of the adjacent community and recreational use (not compete with the neighbourhood centre).

#### 4.4.6 Institutional / Recreation

Institutional / Recreation provides reserve sites for schools and additional space to meet future educational and recreation needs of residents in the neighbourhood. Yukon Government Education to determine the development of schools.

##### Institutional / Recreation:

- Buildings should adapt to the natural topography of the site and maintain at least 40 percent of existing forest areas or natural conditions where they abut greenspace or steep slope.
- Vegetation should be maintained on slopes and the design and use of naturalized wetland/retention ponds where application of infiltration for surface water is desired is highly encouraged.
- Institutional/Recreation sites have potential for additional habitat and natural areas. These sites will also contribute

highly to the character of the neighbourhood. Landscape plans should be submitted to the City's Parks & Recreation Department for review and approval of design.

#### 4.4.7 Greenbelt, Green Links and Green Streets

The greenbelt preserves large areas of connected natural and mature vegetation as habitat and as a corridor for circulation and recreational activities. The greenbelt supports a connected multi-use trail system. Two types of trails accommodate non-motorized trail use within the neighbourhood and connect to staging areas for access to off-site trails and to a designated motorized perimeter trail.

Green links and green streets are defined as 'urban greenbelts'. These are linear, pedestrian only, landscaped streets and walkways within residential areas. The primary intent of green links and green streets is to create pedestrian and bike only routes, provide green space relief in higher density housing and add to the green character and overall permeability of the neighbourhood.

- Parks & Recreation Department should review design and oversee construction and maintenance of trails, green links and green streets.

See Section 4.6 for more detail information on the green network system.

#### 4.4.8 Neighbourhood and Community Parks

Neighbourhood and Community Parks provide recreational greenspace and formal play spaces within the neighbourhood to meet resident recreational needs.

- A minimum of 30 percent of neighbourhood parks should be covered by tree canopy, particularly at the park edge, thus ensuring a strongly vegetated edge and 'green' character for the neighbourhood. For more detailed information on parks, see Section 4.6.

#### 4.4.9 Community Use

Community Use provides for neighbourhood amenities. This may include civic and small-scale supportive commercial uses and services. Recommendations include, a library, small



**Figure 4.17. Neighbourhood and community parks and place spaces.**



**Figure 4.18. Park spaces that meet the recreational needs of residents.**



**Figure 4.19. Community uses within walking distance to residents.**

neighbourhood house or community centre, recreation facilities/programming space for residents or other supportive services such as day care centres, seniors or youth spaces.

Community use buildings should maintain the neighbourhood character, address the street front and emphasize pedestrian routes by:

- Providing direct pedestrian connections from building entrances to street sidewalks, Green Links, Green Streets or Greenbelt trails.
- Providing pedestrian and cyclist facilities (bike racks, seating, etc.).
- Providing parking in the rear or side of buildings (not front).

## 4.5 Subdivision plan

The subdivision plan defines parcels of land to be used for the legal sale of lots. The lot size, organization and distribution of lots is designed to support the intent and goals for a sustainable community. The subdivision plan will be provided to the Yukon Government for the physical development and ultimate sale of the developed land once planning, consultation, and engineering design and approvals are complete. It is expected that single family, duplex lots and fee simple multi-plex lots will be offered through lottery and larger multi-family developments through a bid process. In some cases, lots will be 'packaged' with the option for development as single family or duplex.

### 4.5.1 Lot Size, Organization and Distribution

Whistle Bend Phases 3-7 provide a range of lot sizes for development. All lot sizing considers drainage, snow storage, removal, and access. An emphasis was placed on offering a variety of more compact, livable, ground oriented lots and to introduce new, more affordable types of housing that fit comfortably on slightly narrower lots that provide for a more compact, sustainable and walkable community. Additionally, lot sizes consider flexible options for development that respond to market needs. For example, narrow lots are sized to be developed as narrow lot single family homes or may be assembled to accommodate duplex or triplex housing. Duplex lots, separately titled, but sold in pairs allows for this choice and flexibility. Transition zones (areas between townhomes and standard single family lots) are suitable for incorporating and allowing for this type of flexibility in development.

The Yukon Government typically sells assembled lots for townhouse and pairs of lots for duplex development. Figure 4.20 identifies townhouse lot groups but not duplex development. It is recommended the number of duplex lot sales provided be dependent on sales in previous phases to allow for flexibility and market demand. Duplex lots can be integrated within the neighbourhood as assembled narrow lots (RCS) or within standard single family lots (RCS3) where minimum lot width is 15m and lot area greater than 675m<sup>2</sup>. Location of duplex lots are often suitable at block ends (corner lots where each unit faces a separate street), adjacent to higher density housing (as a transition in housing density), along collectors (increased density for transit) and where there is lane access to minimize the number of driveways (unless there are shared driveways).

Larger and wider single family lots are located primarily at the outer edges of the neighbourhood. These are areas where adjacent topography or greenspace may limit the amount of solar exposure and



### Summary of Lots by Phase

Lot Type / Zoning	Total No. of Lots	Average Lot Size	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7
RCS 3 Standard Single Family	204	575sqm.	12	0	130	31	31
RCS Narrow Lot Single Family	354	410sqm.	144	28	57	66	59
RCM3 Cottage Cluster	18	825sqm.	1	0	11	0	6
RCT Fee Simple Townhouse	213	250sqm.	49	59	13	43	49
RCT2 Strata Townhouse	22	varies	18	2	2	0	0
RCM2 Apartment	17	varies	5	10	0	1	1
PS Institutional	4	varies	3	0	0	1	0
CN2 Comprehensive Neighbourhood Commercial	18	825sqm.	16	0	0	0	2
PR Community Use	1	1.82ha	0	0	0	0	1
PR Parks	4	varies	1	0	2	1	0
<b>Total:</b>	<b>855</b>		249	99	215	143	149

### Townhouse/Duplex Lots

The Yukon Government typically sells assembled lots for townhouse and pairs of lots for duplex development. It is recommended the townhouse lots be grouped and offered as shown here and the number of duplex lot provided be dependent on sales in previous phases to allow for flexibility and market demand. Duplex lots can be integrated within the neighbourhood as assembled narrow lots (RCS) or within standard single family lots (RCS3) where minimum lot width is 15m and lot area greater than 675m<sup>2</sup>. Location of duplex lots are suitable at block ends, corner lots, lots adjacent to higher density housing, along collectors (increased density for transit) and where there is lane access to minimize the number of driveways (unless there are shared driveways).

## WHISTLE BEND NEIGHBOURHOOD PHASES 3-7

## SUBDIVISION AND PHASING


 <div> <div>Golder Associates</div> <div>Sustainable Communities</div> </div>	RECORD OF REVISIONS:		
	February, 2012	July, 2012	SCALE 1: 10,000
	March, 2012	October, 2012	<div>FIGURE</div> <div>4.20</div>
	May, 2012	July, 2013	
	June, 2012		

Table 4.3. Summary of the Number of Units and Population Capacity for Phases 3-7

Zoning, Housing Typologies, and Community Amenities		UPHa	Area		Number of Lots	Max Lot Coverage	FSR
			(Ha)	%			
RCS 3	Standard Single Family / Duplex	15-20	12.02	10%	204	35%	n/a
RCS	Narrow Lot Single Family / Duplex	25-30	14.95	12%	354	60%	n/a
RCM3	Cottage Cluster	25-30	1.39	1%	18	45%	n/a
RCT	Multiplex Fee Simple	30-40	5.50	5%	213	45%-60%	n/a
RCT2	Multiplex Strata (Duplex, Triplex, Townhouse and Cottage Cluster)	30-40	5.40	4%	22	45-60%	0.7
RCM2	Apartment	75-100	6.35	5%	17	45%	1.2
CMU	Commercial - Mixed Use	40 - 60	1.53	1%	16	70%	0.6
PS	Public Service Lots (seniors care)	50-75	0.77	1%	2	50%	0.5
CN	Neighbourhood Commercial	n/a	0.29	0%	2	70%	n/a
PS	Public Service Lots (schools, recreational)	n/a	7.01	6%	2	n/a	n/a
PR	Parks (neighbourhood and community)	n/a	1.60	1%	4		
PS	Community Use	n/a	1.82	2%	1	n/a	n/a
PG	Natural Areas / Greenbelt	n/a	29.50	24%	varies	n/a	n/a
		88.13	73%	855			

Total Developable Area (Phases 3-7 only):

120.50

Roads, Lanes, Green Links and Green Streets:

32.37 27%

Table 4.4. Distribution of Single Family Lots

Lot Area	Minimum Lot Width	Lot Distribution	Zoning
320m <sup>2</sup> - 400m <sup>2</sup>	10.3m	26%	RCS
400m <sup>2</sup> - 450m <sup>2</sup>	12.1m	23%	RCS
450m <sup>2</sup> - 500m <sup>2</sup>	15.3m	18%	RCS 3
500m <sup>2</sup> - 600m <sup>2</sup>	>18.3m (varies)	21%	RCS 3
>600m <sup>2</sup>	>18.3m (varies)	12%	RCS 3

Gross Buildable (sq.m)	Net Buildable (sq.m)	Average Unit Size (sq.m)	Est. # of Units per Lot	Est. # of Primary Residential Units	Est. POP/DU	Est. # of Secondary Suites (living/garden suites)	Est. POP/DU	Est. Population
n/a	n/a	275	1 to 3	265	3.1	102	1.2	945
n/a	n/a	200	1 to 2	354	2.8	177	1.2	1204
n/a	n/a	175	4	72	2.6	n/a	n/a	187
n/a	n/a	165	1	213	2.5	n/a	n/a	533
37,800	37,800	165	varies	229	2.5	n/a	n/a	573
76,200	68,580	93	varies	737	1.7	n/a	n/a	1254
9,174	8,257	70	varies	118	1.2	n/a	n/a	142
3,840	3,456	75	varies	46	1.5	n/a	n/a	69
2035						279		4905

Table 4.5. Summary of Lots by Phase & Type

Lot Type	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Total No. Lots
RCS 3 Standard Single Family	12	0	130	31	31	204
RCS Narrow Lot Single Family	144	28	57	66	59	354
RCM3 Cottage Cluster	1	0	11	0	6	18
RCT Fee Simple Townhouse	49	59	13	43	49	213
RCT2 Strata Townhouse	18	2	2	0	0	22
RCM2 Apartment	5	10	0	1	1	17
PS Institutional	3	0	0	1	0	4
CN2 Comprehensive Neighbourhood Commercial	16	0	0	0	2	18
PR Community Use	0	0	0	0	1	1
PR Parks	1	0	2	1	0	4
Total	249	99	215	143	149	855

therefore the larger lots allow for flexibility and distance between buildings (providing for better solar exposure). These larger lot areas transition to medium and narrow lots near central and community amenity nodes. Intermediate lot sizing allows for the greatest variety in type of housing (narrow single family, duplex, triplex, fee simple townhomes). Strata townhome and apartment lots are located near the primary collectors (transit accessible) and in areas of the neighbourhood where there is greater solar exposure and direct access to greenspace.

Most lots are provided with rear lane access allowing for an attached or detached garages. Access to garages from the rear lane is mandatory for all lots with rear lane access. Where existing subdivision pattern or terrain conditions prevent lane access, access is provided at the front of the house with requirements for garage placement (in accordance with zoning) to ensure a positive orientation to the street. All streets allow for on-street parking.

Lot frontage has been sized to allow for buildable lot width that closely reflect building standards. Building frontages are divisible by 2 ft lengths to reduce waste and cost for homebuilders and to account for 12-18" thick wall construction.

Table 4.3 provides a summary of the number of units and population capacity for Phases 3-7 based on the subdivision plan. The overall capacity for Phases 3-7 is approximately 2,035 new primary residential units, 279 secondary units and total estimate of 4,905 residents. The estimated number of units per lot refers to the potential for additional units on one lot, in that, zoning allows for more than one housing type (single family or duplex) and secondary suites (as garden or living suites). For standard single family lots, the estimated number of primary residential assumes that 70% of lots have one primary unit and 30% will have two (duplex). For narrow single family lots, it is estimated that 50% of lots would contain secondary suites (garden or living suite). The average unit size is based on average lot size and maximum lot coverage. For multi-family it is estimated (assuming a mix of 1,2,3 bedroom).

Table 4.4 provides a summary of the distribution of single family lots by area illustrated in the subdivision plan. Phases 3-7 provides lots sized 320m<sup>2</sup> - 600m<sup>2</sup> with some over >600m<sup>2</sup>. The majority number of lots focus on smaller, more affordable single family lots.

#### 4.5.2 Development Phasing

The overall phasing plan for the entire Whistle Bend Development is shown in Figure 4.21. This phasing is different than previously developed phasing plans. There have been a number of phasing schemes since the inception of this development, all with varying boundaries, land uses and naming. Comparisons made between previous phasing plans and this current plan will need to consider the differences.

Table 4.5 outlines the total number of lots by phase and type. This includes neighbourhood amenities such as commercial, community use, and parks. There are 855 lots in total for Phases 3-7. The number of lots per phase range from approximately 100-250. The highest number of lots developed occur in Phases 3 and 5.

The staging of the development is to occur in a rational extension of municipal infrastructure while taking into account market conditions and planning. The main considerations for the progression of development are:

- **Market Demand**

- » Phasing size was selected to achieve approximately 150- 200 lots per phase to allow development to progress as market conditions allow.
- » Early phases were selected based on anticipation of early demand for single detached lots.

- **Engineering Services**

- » **Power Servicing**  
To provide power service to the development a looped system (no dead-ends) is required. Any staging of development for the entire phase or portion of each phase must include consideration for this.
- » **Water Distribution**  
To provide water distribution to the development a looped system (no dead –ends) is required. Any staging of development for the entire phase or portion of each phase must include consideration for this.
- » **Underground Deep Utilities**  
The intent of the phasing is to limit the amount of underground infrastructure that would be constructed in undeveloped portions. However, based on the planning requirements of which areas are to be developed first on a market basis, it is necessary to build some portions of the underground utilities in areas that would be developed at a later date.
- » **Stormwater Management**  
Based on the proposed phasing, it will be necessary to construct a number of stormwater management facilities initially. This would include detention ponds, bio-swales, and trunk mains that will also service later phases.
- » **Roadways**  
Phasing will take into account the construction of roadways as required to provide sufficient access to the developed lots as well as overall circulation. With the construction of storm sewers, roads will need to be developed, and therefore may be required for that purpose beyond the phase limits.

Based on this plan, the initial development, Phase 3, will include a number of infrastructure projects that will also benefit later stages. Some examples of this are: Casca Boulevard construction, Whistle Bend Way extension, storm sewer trunks and storm water management facilities. Likewise, Phase 5 Development would require construction of the west lift station and sewer main that will also service Phases 6 and 7.

#### **4.5.3 Recommendations for Future Phases**

Phases 3-7 include design of the north side of Keno Way between Casca Boulevard east and west but does not incorporate planning and design of the south or what the master plan had outlined as the town centre area. For purposes of design of servicing, construction, cost and marketing for Keno Way High Street within Phase 3, it is recommended the future design of the south side of Keno Way High Street and Whistle Bend Town Centre (labelled ‘future phase’) be forwarded as a priority for City Planning.

All other future phases should undergo planning and predesign as needed to accommodate growth and market conditions.



Future Phases

All future phases have been outlined for development as required.

For the purposes of servicing design, construction, cost and marketing for Keno Way High Street within Phase 3, it is recommended planning and design for the south side of Keno Way High Street and Whistle Bend Town Centre ('Future Area A') be forwarded as a priority for City Planning.

WHISTLE BEND NEIGHBOURHOOD PHASES 3-7			
DEVELOPMENT PHASING			
 Golder Associates   Sustainable Communities	RECORD OF REVISIONS:		
	February, 2012	July, 2012	SCALE 1: 10,000
	March, 2012	October, 2012	FIGURE 4.21
	May, 2012	July, 2013	
	June, 2012		



LEGEND

- Greenbelt
- Green Links/Green Streets
- Institutional / Community with Recreational Use
- Neighbourhood/Community Park Sites
- Perimeter Trail (Phases 3-7)
- Local Trails (Phases 3-7)
- Existing Off-Site Trail Connections
- Trails (Phases 1 and 2)

- Winter Motorized Trail (2012)
- Trail Connection Points
- Trail Staging Area
- Whistle Bend Planning Area
- Proposed Stormwater Ponds

CONTEXT MAP



WHISTLE BEND NEIGHBOURHOOD PHASES 3-7

GREEN SPACE NETWORK PLAN



RECORD OF REVISIONS:		SCALE 1:10,000  FIGURE 4.22
February, 2012		
March, 2012		
June, 2012		
October, 2012; July 2013		

## 4.6 Green Network, Open Space and Trail Design

A total of 38.34 hectares (94.7 acres) of Phases 3-7 is allocated for an integrated system of public open space, natural areas, green streets and pedestrian green links (Figure 4.22).

There are three distinct types of green space identified for the neighbourhood, this includes:

1. parks and recreation / institutional sites,
2. greenbelt (natural areas), and
3. green links and green streets (linear parks and pedestrian walkways)

Each is described within this section.

**Table 4.6. Summary of green network and open space types for Phases 3-7**

Open Space Type		Total No. of Sites	Total Site Area (Ha)
Parks, Recreation, Institutional Sites	Institutional / Recreation Sites	2	7.01
	Community & Neighbourhood Parks	4	1.60
Greenbelt (Natural Areas)*		connected through neighbourhood	29.5
Green Streets, Green Links (Linear Parks)		3 green streets, various green links	1.45

\* Does not include greenbelt along Casca Boulevard (2.3ha)

The majority of greenspace in Phases 3-7 is allocated as greenbelt/natural areas. This results in a lower amount of developed park space in comparison to standard metrics for recreational open space typically used. However this approach is aligned with the intent to reinforce a strong 'green' character and focus on more spontaneous outdoor, all season, recreational activities available to residents.

### 4.6.1 Recommendations for Recreational Amenities

Based on population and general trends, the recreational and community needs of residents in Phases 3-7 have been recommended. The following Table 4.7 outlines each green space type and the recommended recreational or community amenities this space should offer.

Table 4.7. Amenities / Types of Open Space to be included in Phases 3-7

Type of Open Space	General Use	*Recommended Amenities (for Phases 3-7)
Greenbelt	Areas designated as greenbelt are aligned with the Official Community Plan and shall be largely oriented to the maintenance of natural park areas, the protection of scenic sites and mature forest. Uses may include outdoor recreational use (bike skills park), trails, interpretive signage, play spaces, picnic sites, and public utilities and utility corridors, including sites identified as locations for stormwater dry ponds.	<ul style="list-style-type: none"> <li>• local and multi-use trails (throughout)</li> <li>• 2-3 picnic areas (adjacent to park sites, community use or school/recreational sites)</li> <li>• bike skills practice area (west side, dry pond area)</li> </ul>
Green Links/Green Streets	Green links and green spaces are for off-street circulation within the neighbourhood. These areas should include landscaping, pathways, seating and adequate lighting.	<ul style="list-style-type: none"> <li>• trails, seating, landscaping (all)</li> <li>• lighting (safety)</li> </ul>
Institutional/with Recreational Use	The primary intent of areas designated as institutional/recreation are as school sites, however, as park space for Phases 3-7 is limited, recreational uses including, sports fields/courts, outdoor skating rinks, skateboard parks, water play, special events, and informal passive activities are strongly supported.	<ul style="list-style-type: none"> <li>• 1-2 soccer/softball fields</li> <li>• 1-2 tennis/basketball courts</li> <li>• 1-2 outdoor skating rinks and toboggan slope (south site)</li> </ul>
Neighbourhood/Community Park Sites	Smaller neighbourhood park spaces should accommodate dog walking, sitting, children's playspaces, picnic sites, gardening, and informal sports play. Larger park spaces should be designed to accommodate social, cultural, educational and physical activities of particular interest to the community. These spaces should be multi-purpose and can include field areas and sports facilities where space permits.	<ul style="list-style-type: none"> <li>• 4-5 children's play grounds (natural/standard)</li> <li>• 4 informal greenspace areas</li> <li>• 1-2 tennis/basketball courts</li> </ul>
Community Use Site	The community use site is targeted for facility based recreational programming. Additional facilities offered here could include a pool/gym spaces, drop-in meeting and programming for seniors/youth, children's programs and/or daycare for neighbourhood residents, and library	<ul style="list-style-type: none"> <li>• 1 neighbourhood/recreational centre that provides the following: <ul style="list-style-type: none"> <li>• pool and/or gym space with recreational programming</li> <li>• daycare/preschool facility</li> <li>• seniors/youth drop-in or meeting space</li> <li>• satellite library</li> <li>• outdoor skateboard/youth park</li> </ul> </li> </ul>
Future Recreational Park Site	This site is located to the north west of Phases 3-7. As formal green space is limited in the neighbourhood, this area provides a larger space to accommodate multiple field spaces and/or other larger facilities.	<ul style="list-style-type: none"> <li>• up to 4 soccer/softball fields (capable of hosting tournaments)</li> <li>• warm up/informal green space</li> <li>• change room/washroom facilities with option for seasonal commercial concession</li> <li>• 1-2 outdoor skating rinks and toboggan slope</li> </ul>

\*This list is provided as a general guideline for the neighbourhood. It is recommended this be reviewed in detail at the time of development to assess residents needs and interests, and the overall current City-wide needs, facility distribution and budgets.

## 4.6.2 Greenbelt / Natural Areas and Storm Water Dry Ponds

### Definition

The greenbelt is located throughout the neighbourhood. The greenbelt is a major defining element for the entire neighbourhood as a connected green network system. These areas support surface drainage, provide for connected habitat, as well as the opportunity for both passive and active recreation and commuter routes within the neighbourhood.

The greenbelt is largely based on the original Master Concept Plan outline. However, revision of the greenbelt was required to account for already cleared areas from the construction of Casca Boulevard and Phases 1 and 2. It was realigned to correspond with existing mature vegetation remaining on site and to better accommodate valued areas as identified by the Whistle Bend / Porter Creek Bench Ecosystem Map (Gartner Lee, 2006) and moderate to high sensitivity areas identified within the Significant Wildlife Classes (Gartner Lee, 2006).

### Use

Areas designated as greenbelt are aligned with the Official Community Plan and shall be largely oriented to the maintenance of natural park areas, the protection of scenic sites and mature forest. Uses may include outdoor recreational use (bike skills park), trails, interpretive signage, play spaces, picnic sites, and public utilities and utility corridors, including sites identified as locations for stormwater dry ponds.

Stormwater dry ponds are identified in three locations within Phases 3-7 (see Figure 4.22). To the extent possible and appropriate to their classification, clearing of the landscape should be minimized and revegetation designed to meet objectives of the following planning classifications.

To better integrate these ponds as useful spaces and within the natural areas and landscape of the neighbourhood, dry ponds should where possible, be wide and shallow. It is likely the ponds would not hold water year round and therefore, these spaces could provide residents with 'park-like' spaces for passive and spontaneous recreational activities. These spaces could provide winter staging areas for motorized recreation and access to perimeter and off-site multi-use trails.



**Figure 4.23 Examples of storm ponds, naturalized and shallow, turf based.**

### 4.6.3 Institutional/Recreation Sites

#### Definition

Institutional/recreation sites are public service lots reserved for future school and recreation needs of the community. There are two sites identified for the neighbourhood. The two sites are centrally located within walking distance of the surrounding residential neighbourhood and accessible by neighbourhood collector and arterial streets, the greenbelt and trail system for multi-modal access.

#### Use

Areas designated as institutional/recreation are primarily intended to be used as school sites. However, as develop park space for Phases 3-7 is limited, recreational uses including, sports fields/courts, outdoor skating rinks, skateboard parks, water play, special events, and informal passive activities are also supported.

### 4.6.4 Neighbourhood / Community Park Sites

#### Definition

The intent of neighbourhood and community park sites is to provide active and passive spaces for residents use. These areas range in size and are within easy and short walking distance to residents. These areas are especially important in higher density areas.

#### Use

Smaller neighbourhood park spaces should accommodate dog walking, sitting, children's playspaces, picnic sites, gardening, and informal sports play. Larger park spaces should be designed to accommodate social, cultural, educational and physical activities of particular interest to the community. These spaces should be multi-purpose and can include field areas and sports facilities where space permits.

### 4.6.5 Community Use / Recreational Park Site

#### Definition

The intent of the community use/recreational park site is to provide a recreational/community facility and adjacent open space areas.

#### Use

The community use site is targeted for facility based recreational programming. Additional facilities offered here could include a pool/gym spaces, drop-in meeting and programming for seniors/youth, children's programs and/or daycare for neighbourhood residents, and library.

### 4.6.6 Trails

The trail network within Phases 3-7 is primarily located within the greenbelt but extends and connects through the neighbourhood phases via green links, green streets, and to external trail locations (Figure 4.26). Trail routes are shown conceptually as desire lines. Exact route location should be confirmed through detailed design.

- Construction of trails should consult the City of Whitehorse Trail Plan, 2007.
- Where possible, trails should replicate and/or utilize existing trail routes within the area.
- Trails should connect to existing off site network locations.
- Where existing trails need to be relocated to allow new development to take place is the responsibility of the developer.

- Trail construction should conform to current City standards (City of Whitehorse Trail Plan, 2007).
- Trails within the greenbelt should be constructed alongside stormwater ditches/bioswales as an integrated part of the major drainage system, see Figure 6.17 Major Drainage System, and to minimize disturbance and revegetation of greenspace.
- The intent is for trails to be routed around storm ponds.
- Storm ponds should be integrated as much as possible within the greenspace and trail system. Trails should be located around storm ponds and where possible, be utilized as a recreational amenity.
- Staging areas should include small parking areas for out of neighbourhood trail users.

There are two main types of trails:

1. Multi-use trail, and,
2. Local / nature trail.

### Multi-use Trail

The multi-use trail is a recreational and commuter trail accommodating pedestrian and cyclists. This trail connects to destinations within the neighbourhood and to the perimeter trail system. The perimeter trail connects with off-site staging areas and external trail systems to destinations outside the neighbourhood (adjacent neighbourhoods, Golf Course, Eagle Bay park, etc.). As a formal trail network within the neighbourhood, lighting should be provided along multi-use trails. The surface should be paved and maintained as part of the green network system. Motorized vehicles are permitted on multi-use perimeter trails. Consideration for a dual-track along the perimeter path way is recommended to reduce conflict of motorized and non-motorized users.

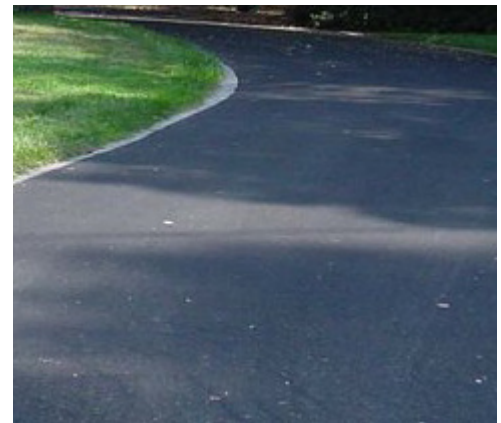
### Local Trails

Local trails are considered recreational and accommodate pedestrians only. This trail type allows for some existing routes within the area to be maintained and connected to the main multi-use trail network system but remain 'natural'. It is anticipated these trails will require ground truthing at the time of construction and some maintenance to establish the correct routing and connections. The local trail system will not be lit. A standard vegetation clearance is required for visibility and safety along the trail. Trails should be maintained as part of the overall green network.

#### 4.6.7 Signage and Wayfinding

The City may, in conjunction with other agencies and government departments, develop a trail signage program, which encourages trail use and facilitates visitor appreciation of the City's natural, cultural, and historic attributes of the area.

**Figure 4.24. Proposed trail surface materials.**



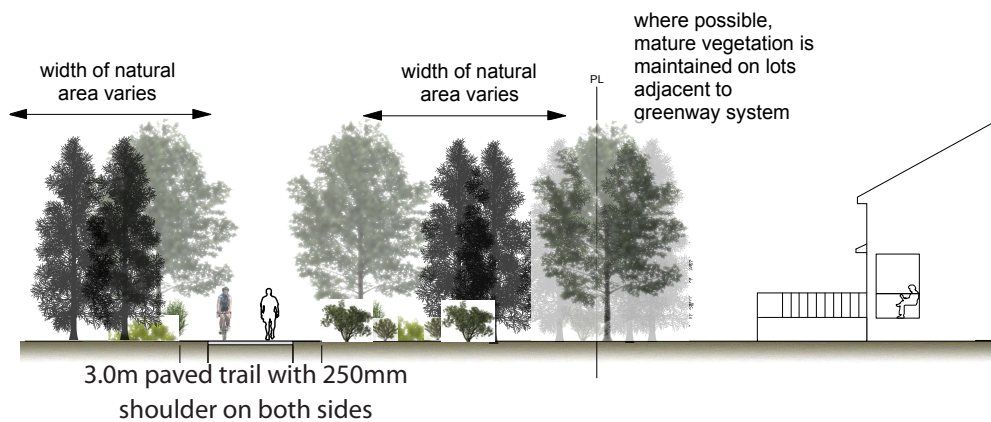
**a) Multi-use paved trail system acts as a primary active transportation and recreational route for residents.**



**b) Local trail systems maintain some existing routes and opportunities for passive recreation.**

Proposed conceptual trail types for Whistle Bend Phase 3-7. Constructed trails should adhere to the City of Whitehorse Trail Plan and Standards.

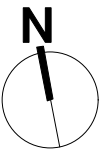
**Figure 4.25. Proposed trail types for Whistle Bend Phases 3-7.**



**a. Phases 3-7 perimeter (paved) and multi-use trails.**



**b. Phases 3-7 local trail (unpaved, non-motorized).**



Summary of Trail Network

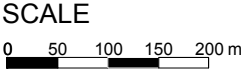
	Trails	Trail Description	Length (m)
Phases 3-7	Multi-use Perimeter Trail	Motorized/non-motorized, 3 meter, paved	2,255
	Multi-use Local Trails	Non-motorized, 1.5 meter, gravel	3,332
	Off-Site Whistle Bend Way (between two rounabouts at Casca Blvd.)	Motorized/non-motorized, 3 meter, paved	563
	Off-Site Whistle Bend Way to Mountain View	Motorized/non-motorized, 3 meter, paved	863
Phases 1-2	Existing / Proposed Trails in Phases 1 and 2	As proposed in Phases 1 and 2	as per P1-2
City-wide Trails	Existing Off-Site Trail (Motorized Winter 2012)	Existing	offsite
	Existing Off-Site Trail (Ski)	Existing	offsite

CONTEXT MAP



LEGEND

- Green Links/Green Streets
- Multi-use Perimeter Trail (paved)
- Multi-use Local Trails (within Greenbelt areas)
- Existing Off-Site Trail (Motorized Winter 2012)
- Existing Off-Site Trail (Ski)
- Existing/Proposed Trails in Phase 1 & 2
- Connections to off-site trails
- Staging areas (motorized recreational)
- Planning Area



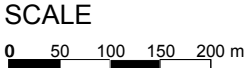
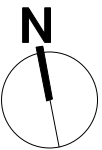
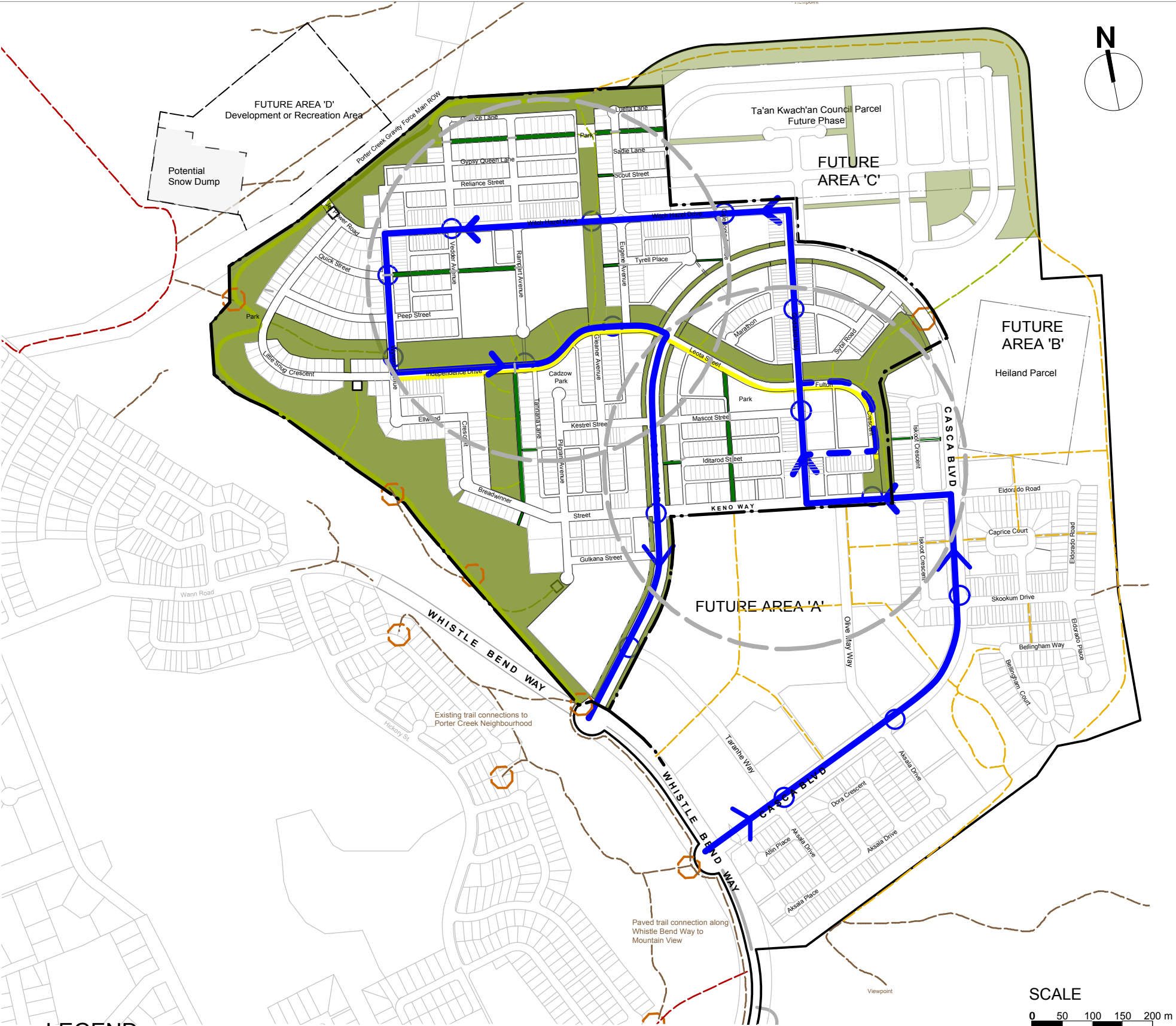
Base data obtained from the City of Whitehorse.

WHISTLE BEND NEIGHBOURHOOD PHASES 3-7

TRAIL NETWORK PLAN



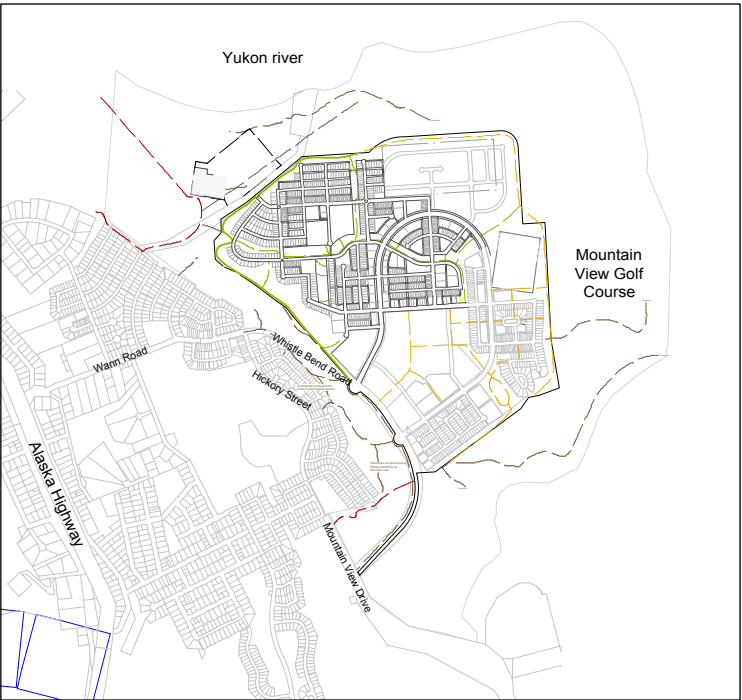
RECORD OF REVISIONS:	
February, 2012	SCALE 1:10,000
March, 2012	
July, 2012	FIGURE 4.26
July, 2013	



LEGEND

- Transit route
- Proposed Additional Transit Route at Senior Housing
- Recommended Transit Stops
- Dedicated bikeway
- Green Links/Green Streets
- Recommended Traffic Calming Roundabouts
- Perimeter Trail (Phases 3-7)
- Local Trails (Phases 3-7)
- Trails (Phases 1-2)
- Existing Off-Site Trails
- Trail Connection Points
- Walk Circles (5mins)

CONTEXT MAP



WHISTLE BEND NEIGHBOURHOOD PHASES 3-7

TRANSIT & ACTIVE TRANSPORTATION PLAN



RECORD OF REVISIONS:	
February, 2012	SCALE 1:10,000
March, 2012	
July, 2012	FIGURE 4.27
July, 2013	

Base data obtained from the City of Whitehorse.

#### 4.6.8 Recreation Areas Designation

All areas immediately outside of the plan boundary are designated as ‘recreation areas’ in the Official Community Plan. Trail usage is the primary use of these areas and the City will work towards the continued enhancement of trails as identified in this plan and in the City Trail Plan. These areas contribute to active living and active transportation such as walking and cycling, and improve the quality of life in the neighbourhood.

### 4.7 Transit and Active Transportation

The active transportation plan for Whistle Bend Phases 3-7 includes a variety of non-motorized modes of transportation which use on and off-street facilities (e.g. sidewalks, multi-use pathways, cycle lanes, etc.), with walking (including wheeled transport) and bicycling as the principal desired mobility options for destinations within the neighbourhood. Other modes of movement, including more recreational activities such as jogging, in-line skating, skateboarding, cross-country skiing and snowshoeing are also accommodated within the neighbourhood. The active transportation network is supported throughout the neighbourhood as a series of multi-use corridors connected to destinations. The system is intended to encourage alternatives to vehicle travel and provide opportunities for passive recreational use throughout the neighbourhood.

#### 4.7.1 Transit Route and Stops (Keno Way)

Keno Way loop is identified as the primary transit route through Phases 3-7. This is envisioned as a frequent, minimum service of 10-15 mins headway or better during peak hours and 20mins service headway in off-peak hours.

Requirements for transit is as follows:

- Transit stops should be appropriately spaced and located to integrate with pedestrian activity nodes and amenities and minimize conflicts with driveways.
- Transit routes should directly connect with transit exchanges and destinations outside the neighbourhood.
- Direct service to downtown is desirable during peak hours for regular commutes. Bus stops should provide clear signage, seating and shelter from weather.
- It is recommended transit phased first along Casca Blvd. only (Phases 3, 4), Casca Blvd. to Leota St/ Independence Dr., to Keno Way (Phase 5), then Casca Blvd. full loop along Keno Way (Phases 6, 7).
- Transit route should be reviewed and adjusted as future phases are developed (Ta'an and Heiland properties).

## 4.8 Zoning

Comprehensive development zoning regulations, which were first implemented for the Stan McCowan and Ingram neighbourhoods, refined for the Takhini North Neighbourhood and again for Whistle Bend. Implementation of these zones has generally delivered improvements to the form and character of these new neighbourhoods.

Review/revision was based on:

- addressing issues identified by home builders, property owners, residents, City staff, and Council and the consulting team;
- achieving the goals and intent of the revised Master Plan and associated Sub-division Plan for Whistle Bend Phases 3-7 (e.g. pedestrian oriented streets, transit supportive densities, greater housing choice, affordability and flexibility, maximizing solar exposure, etc.);
- ensuring the revised zoning is applicable to Whistle Bend phases 3-7 as well as to Whistle Bend Phases 1-2, and
- simplifying the zoning to enhance usability and stream line implementation of Whistle Bend Phases 1-7.

Revised zoning is applied to Phases 1 and 2 and Phases 3-7. The broad intent of the revised zoning for Whistle Bend is to facilitate the development approvals process by clarifying and simplifying requirements while achieving the intended building and neighbourhood design objectives for the area.

This is accomplished by:

- a more prescriptive approach toward the intended building types for each zone (see zoning map);
- creating a General Zoning Requirements section applicable to all or most zones allowing for their removal from individual zones to avoid duplication (see updated zoning bylaw); and
- recommendation for the use of diagrams and illustrations to help describe building types and development requirements for each zone;
- ensure that new zones reflect existing zoning as much as possible (while still addressing identified issues and achieving the unique objectives for Whistle Bend 3-7).

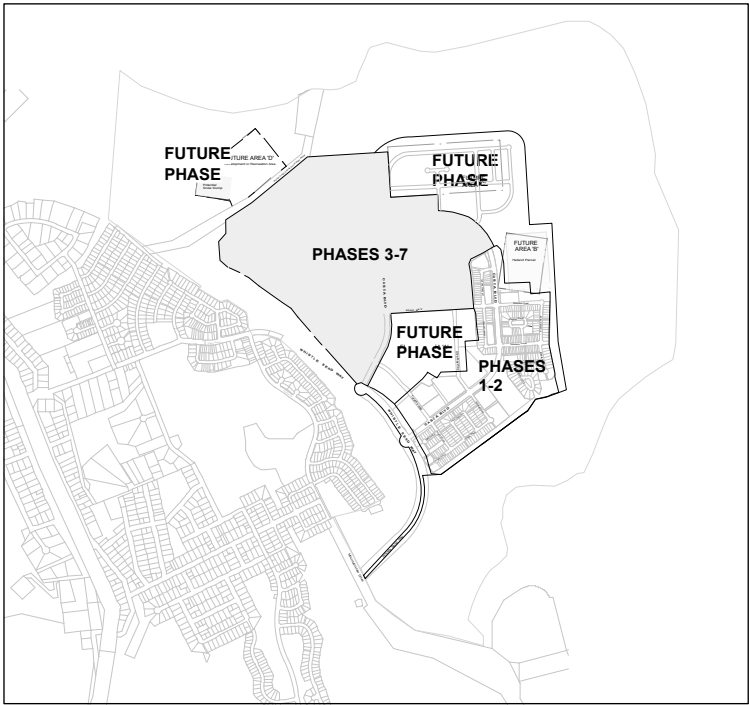


LEGEND

- |   |  |
|---|--|
| RCS 3 (Comprehensive Residential Single Family 3) | RCM2 (Comprehensive Residential Multi Family 2)              |
| RCS (Comprehensive Residential Single Family)     | CNC2 (Comprehensive Neighbourhood Commercial 2)              |
| RCM 3 (Cottage Cluster Homes)                     | PR Parks and Recreation (and Community Facility)             |
| RCT (Comprehensive Residential Townhouses)        | PG Greenbelt   |
| RCT2 (Courtyard Townhouses)                       | PS Public Services (Seniors Supported Housing, School Sites) |

— Whistle Bend Planning Area Phases

CONTEXT MAP



WHISTLE BEND NEIGHBOURHOOD PHASES 3-7

ZONING PLAN PHASES 3 - 7



RECORD OF REVISIONS:		
October, 2011	July, 2012	SCALE: 1:10,000  FIGURE 4.28
Dec, 2011	Dec, 2012	
March, 2012	July, 2013	
May, 2012		

Base data obtained from the City of Whitehorse.





**5**

**Transportation  
Network**

## 5

# Transportation Network

## 5.1 Transportation Overview

Whistle Bend is considered the largest future growth area and greatest traffic generator within the City. This section includes a summary of the internal road network and the Traffic Impact Analysis for the Whistle Bend development Phases 3-7.

Figure 5.1 illustrates the overall circulation network for Phases 3-7. The circulation network includes the street, trail and green open space systems. The two systems support and integrate with each other to provide for multi-modal transportation options. They enhance the overall connectivity of the neighbourhood, including pedestrian and bike network to support active modes of travel and direct connections to transit throughout the neighbourhood.

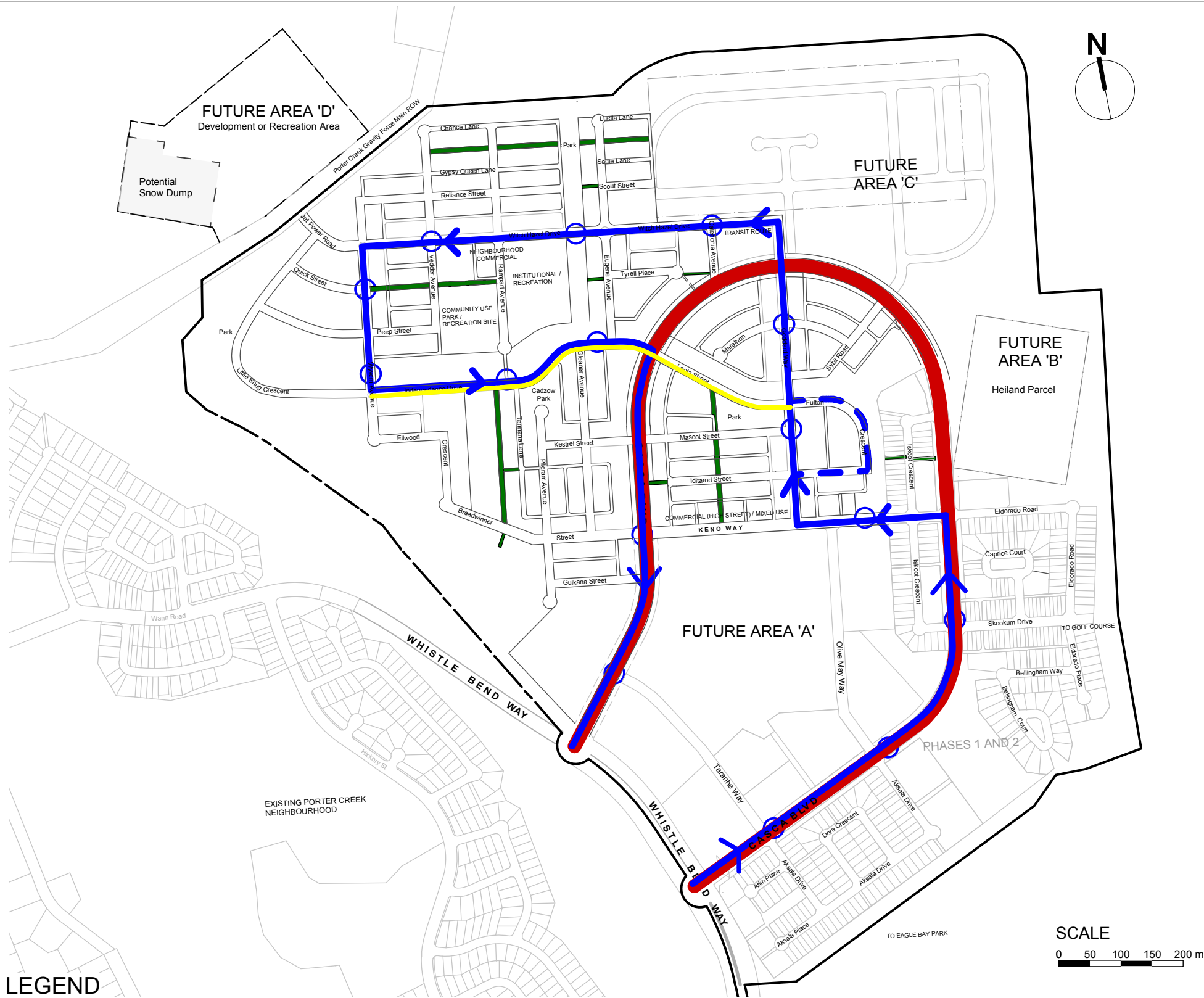
**Table 5.1. Summary of Streets, Lanes, Green Streets and Green Links**

Road Type	Right of Way Width (m)	Notes
Arterial (Casca Boulevard)	50m (10m greenbelt on each side)	Primary arterial to Whistle Bend Neighbourhood Phases 1-8, connects to Whistle Bend Way
Collector (Keno Way/Transit Loop)	22m	Keno Way is an extension of phases 1 and 2
Commercial High Street (Keno Way)	25m	A larger ROW here allows room for more comfortable pedestrian environment and on street parking on both sides
Local	18m	Local roads are intended as “queuing streets” and allow for on street parking
Lanes	6m (exception: 10m at Green Streets)	Exception to lane width - adjacent to green streets are 10m width, to allow for emergency vehicle access and infrastructure
Green Street (Pedestrian, Cyclist and Emergency Vehicles only)	14m (10m with 2m on each side for constructability)	Green streets are pedestrian streets with housing fronting onto the greenway, vehicle access is limited to emergency and utility vehicles
Green Links	4-6m	Green links are pathway connections adjacent to and through development

\* Queuing streets are local streets whereby parking is permitted on both sides and thereby creates one driving lane. These streets are effective for traffic calming.

### 5.1.1 Snow Routes

Proposed snow plow route priorities are best accommodated on the arterial and collector streets (blue and red lines) shown on Figure 5.1. Snow could be hauled to the potential snow dump site at the old Porter Creek Lagoon site immediately north west of the subdivision.



## LEGEND

- Primary Arterial (Casca Boulevard)
- Collector (Keno Way) and proposed transit route  
dashed indicates potential alternative routing to  
accommodate seniors housing.
- Greenway Street and proposed bike way
- Green Street and Green Links
- Existing Roads (as labelled)
- Whistle Bend Planning Area
- Local Roads and Lanes

## WHISTLE BEND NEIGHBOURHOOD PHASES 3-7

### CIRCULATION NETWORK PLAN



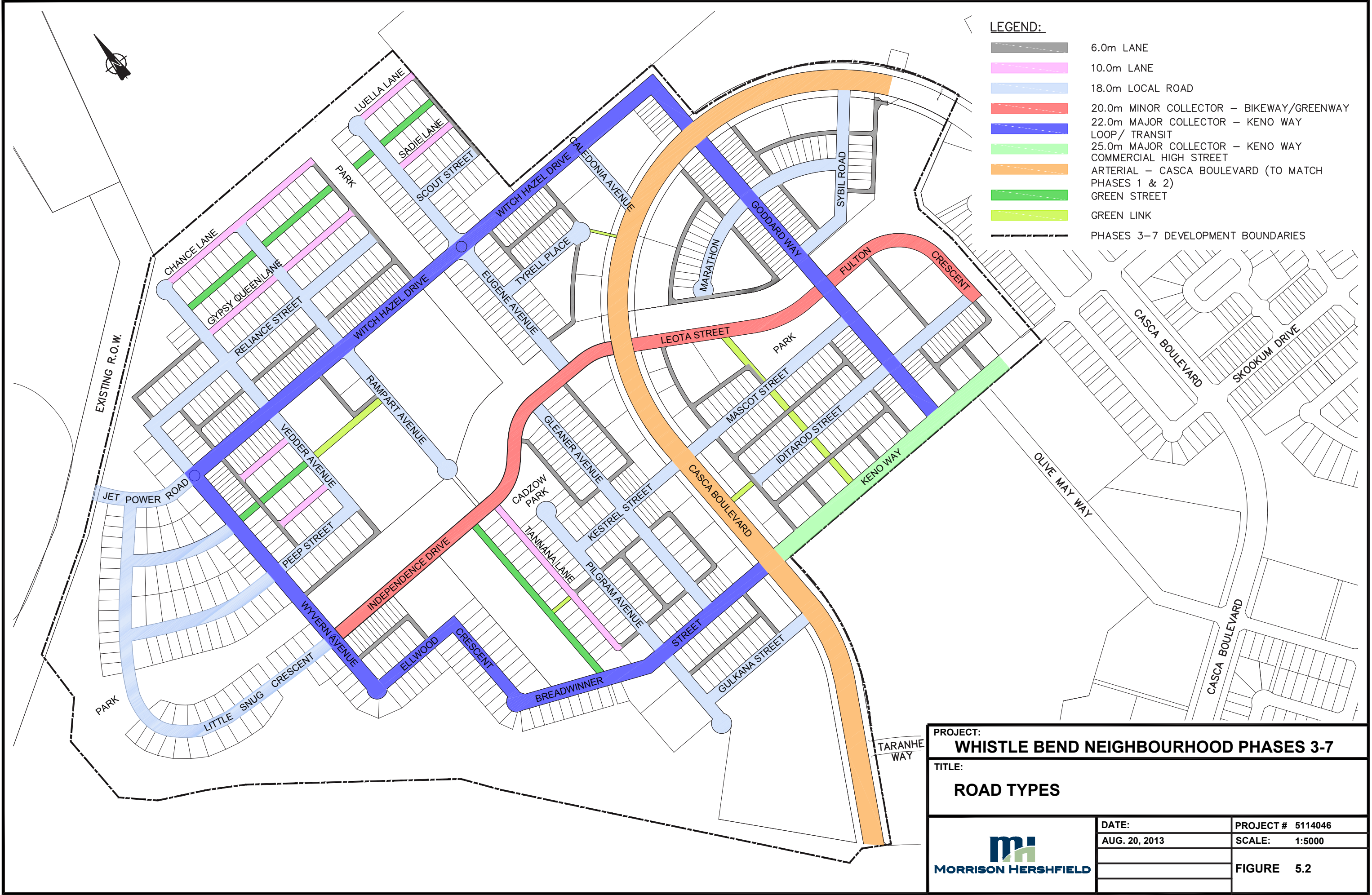
Sustainable  
Communities

#### RECORD OF REVISIONS:

January, 2012	1:10,000
July, 2012	
October, 2012	
July, 2013	

FIGURE 5.1

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PLOTTED: August 21, 2013 - 3:35 PM  
ANSI B SIZE 11"x17" (279.4mm x 431.8mm)



## 5.2 On-Site Street Classifications

The street network includes one main arterial, two primary collector streets, and local streets with predominantly short blocks and rear lanes. Together, the street network provides multiple route choices, and a refined pedestrian and cyclist network. Each street type is designed to support multiple travel modes but emphasizes a primary mode of transportation, as described below. All street types accommodate pedestrians with sidewalks and include landscaped boulevards including street trees to support the green character of the neighbourhood.

The following street classifications are applicable for Whistle Bend Phases 3-7. These classifications are in accordance with the classification system in Roads and Transportation Association of Canada (TAC) manual, Geometric Design Standards for Canadian Roads and Streets.

- Arterial
- Major Collector
- Minor Collector
- Local
- Lanes

These road types are shown on the overall plan in Figure 5.2. The proposed road cross-sections are shown in Figures 5.3-5.8, and described below. There are some variations to the standard City of Whitehorse cross-sections that are project specific.

Access to Phases 3-7 will be via Whistle Bend Way and then along Casca Boulevard.

### 5.2.1 Arterial (Casca Boulevard)

Casca Boulevard is a defining street for the entire Whistle Bend Neighbourhood. It loops through the central portion of the neighbourhood and acts as the primary arterial in and out, connecting to Whistle Bend Way and external destinations. Casca Boulevard is intended to accommodate a multi-modal street with vehicle, transit, cycling lanes and a 10m greenbelt on both sides with a multi-use pathway for pedestrian comfort. The design and landscape treatment of this street is important for the overall character of the neighbourhood. Development within Phases 3-7 directly fronts onto the greenbelt addressing the street. This is a key aspect and character element for defining the neighbourhood and activating Casca Boulevard as a pedestrian and cycling route.

Casca Boulevard provides the access to all phases of the development. The first segment of this has been designed and constructed as part of Phase 1 and 2 development. Casca Boulevard for phases 3-7 will follow Phase 1 and 2 design and be constructed in Phase 3.

### 5.2.2 Major Collector Streets (Keno Way)

Keno Way is the smaller loop road connecting to Casca Boulevard through Phases 3-7, continuing as the high street within the central neighbourhood. The street is intended as the primary transit loop for Phases 3-7. The focus of the street is to facilitate good pedestrian environment and travel lanes for efficient transit service and vehicle use.

This street section, shown in Figure 5.3, has some modifications to the standard Major Collector. This is consistent with Phase 1 and 2. It consists of a 22 m wide Right-of-Way and a 11.5 m road surface. These roads have two 5.75 m wide lanes. There are separate sidewalks on both sides. There is a 0.75 m buffer between the property line and the back of sidewalks. Street lighting is provided on one side of the road as shown. The underground services shown include communications cable, storm sewer, sanitary sewer, and water. The watermain is positioned at 2.5 m offset from the road centre line. The sanitary sewer is 0.5 m from the road centre line, opposite of the watermain, and the storm sewer is 2.0 m from the sanitary sewer, and 5.0 m from the watermain. A minimum of 3.0 m separation between water main and sanitary sewer will be maintained to ensure compliance with servicing standards. Communications cables will be installed 1.0m from inside the curb to the trench centre line on both sides of the roadway. There are treed boulevards on both sides of the road.

### 5.2.3 Major Collector Streets (Keno Way Commercial High Street)

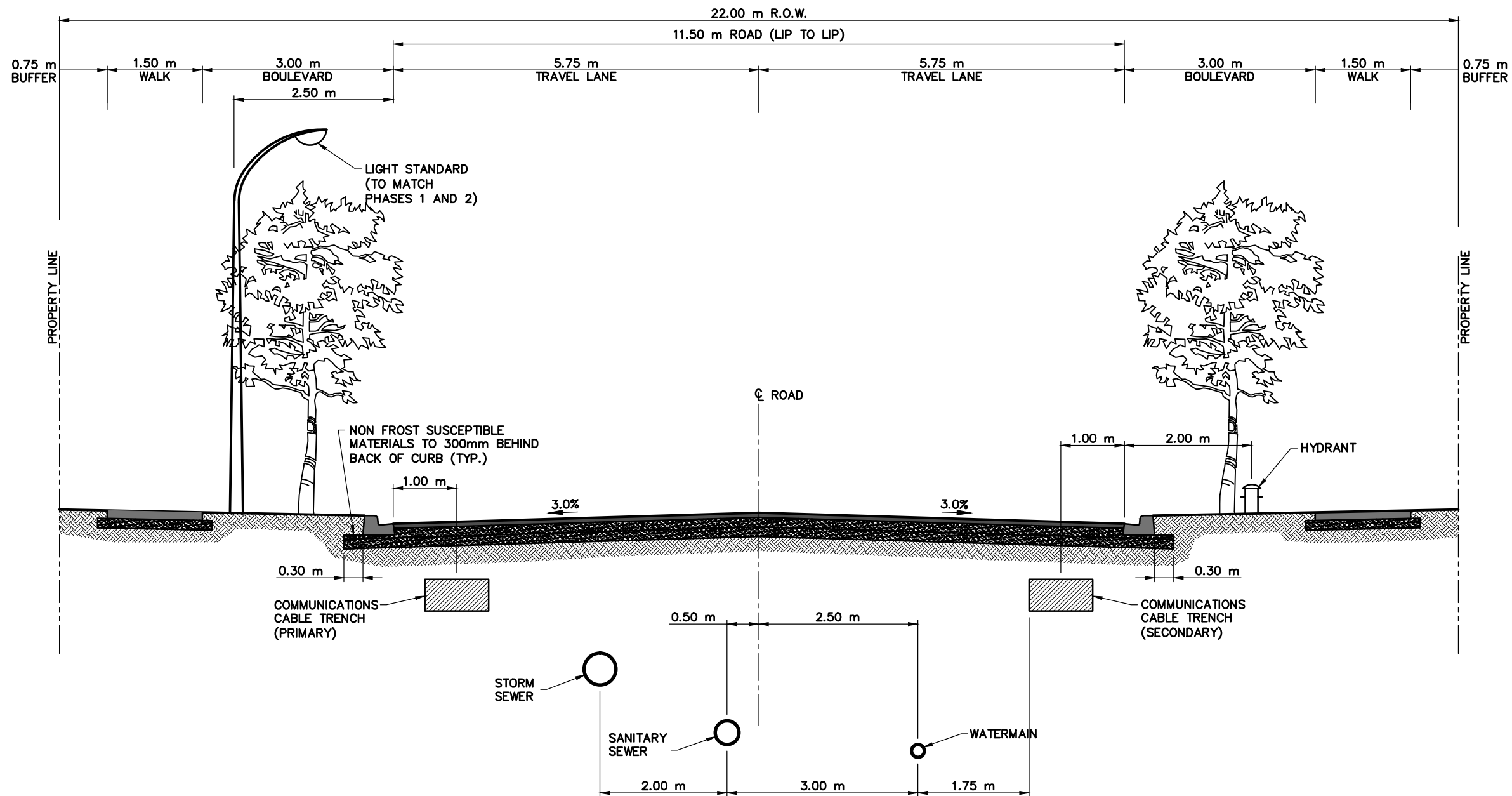
Keno Way between Casca Boulevard east and Casca Boulevard west is designated as the commercial high street for the neighbourhood. This 25m ROW street is envisioned as a human-scaled, pedestrian-friendly and economically vibrant community node with smaller scaled shops and services for residents. The street accommodates one travel lane in each direction, a shared bike/parking lane on one side and a bike lane with angled parking on the other side of the street and a 3.0m pedestrian realm side walk with street trees and high quality lighting to support a comfortable pedestrian environment.

This street section, shown in Figure 5.4, has some modifications to the standard Major Collector. It consists of a 25 m Right-of-Way and an 18m road surface. This road has two 3.5 m wide travel lanes, a 1.5 m wide bike lane, a 4.2 m wide parking / bike lane, and 5.3 m wide angle parking. There are separate sidewalks on both sides. There is a 0.3 m buffer between the property line and the back of sidewalks. Street lighting is provided on both sides of the road as shown. The underground services shown include communications cable, storm sewer, sanitary sewer, and water. The watermain is positioned at 2.5 m offset from the road centre line. The sanitary sewer is 0.5 m from the road centre line, opposite of the watermain, and the storm sewer is 2.0 m from the sanitary sewer, and 5.0 m from the watermain. A minimum of 3.0 m separation between water main and sanitary sewer will be maintained to ensure compliance with servicing standards. Communications cables will be installed 1.0m from inside the curb to the trench centre line on both sides of the roadway. There are treed boulevards on both sides of the road. The east end on Keno Way Commercial High Street, (for 210m west of Casca Boulevard) was constructed with Phase 2, as a collector road with a 22 m ROW and 11.5 m paved surface. There will need to be a transition at the location of the tie-in from this road to the larger ROW and road of Keno Way Commercial High Street constructed for Phase 3.

### 5.2.4 Minor Collector Streets (Greenway/Bikeway)


The greenway street is a minor collector east west through Phases 3-7 parallel to the Green Belt, over the sanitary force main line adjacent to key recreation, community use and institutional sites within the neighbourhood. The focus of this street is to provide a comfortable pedestrian and cycling express route through the neighbourhood connecting to the multi-modal Casca Boulevard arterial greenbelt pathway

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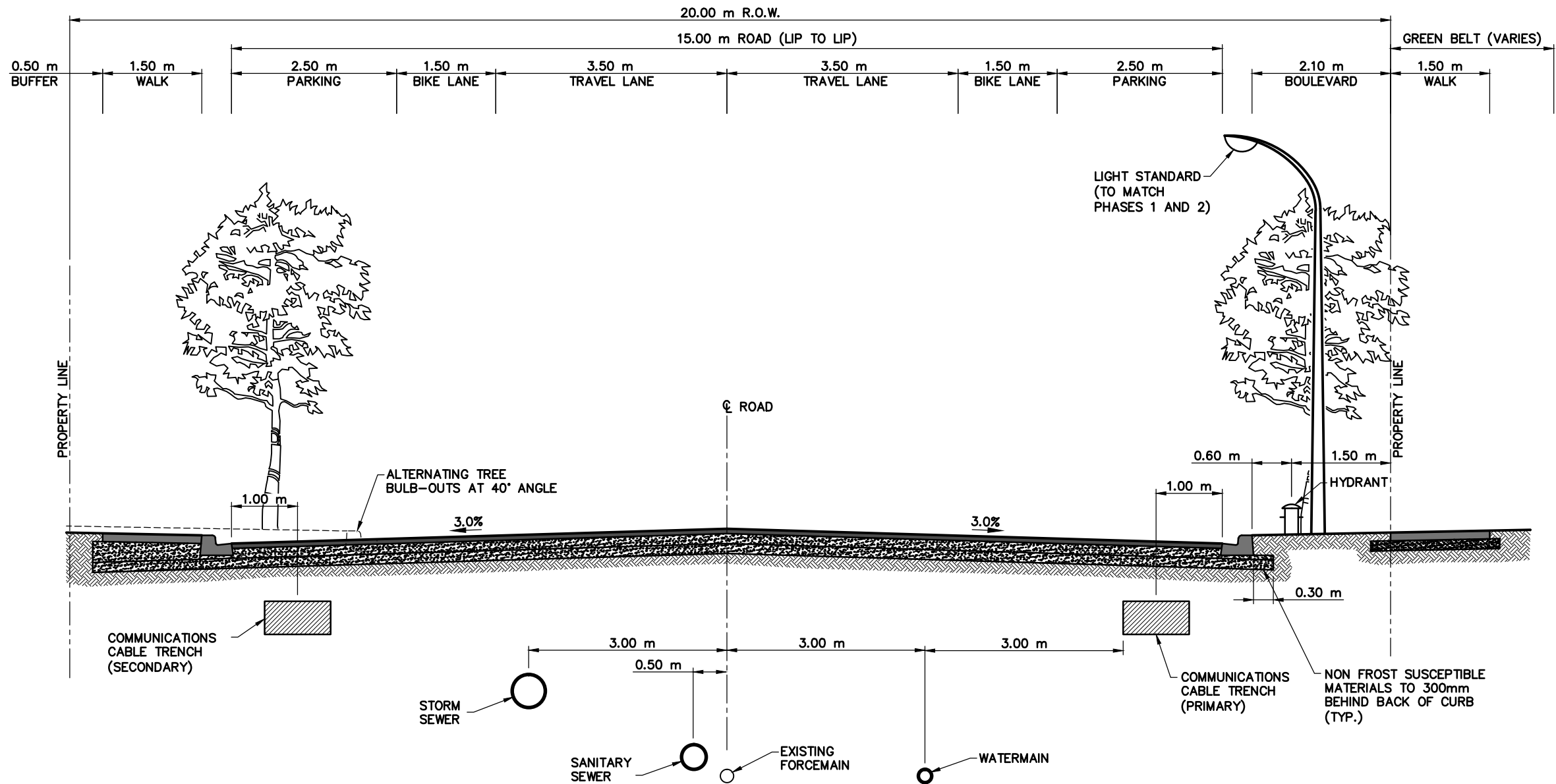


**NOTES:**

1. ALL WATERMAINS TO HAVE A MINIMUM DEPTH OF COVER OF 3.5m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
2. ALL SANITARY SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 2.8m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
3. ALL STORM SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 1.2m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
4. FIBRE OPTIC CABLE INSTALLATION BY AND FOR NWTEL.


PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>PROPOSED 22.0m COLLECTOR ROAD SERVICING (KENO WAY LOOP / TRANSIT)</b>		
	DATE:	PROJECT # 5114046
	AUG. 20, 2013	SCALE: 1:75
		FIGURE 5.3

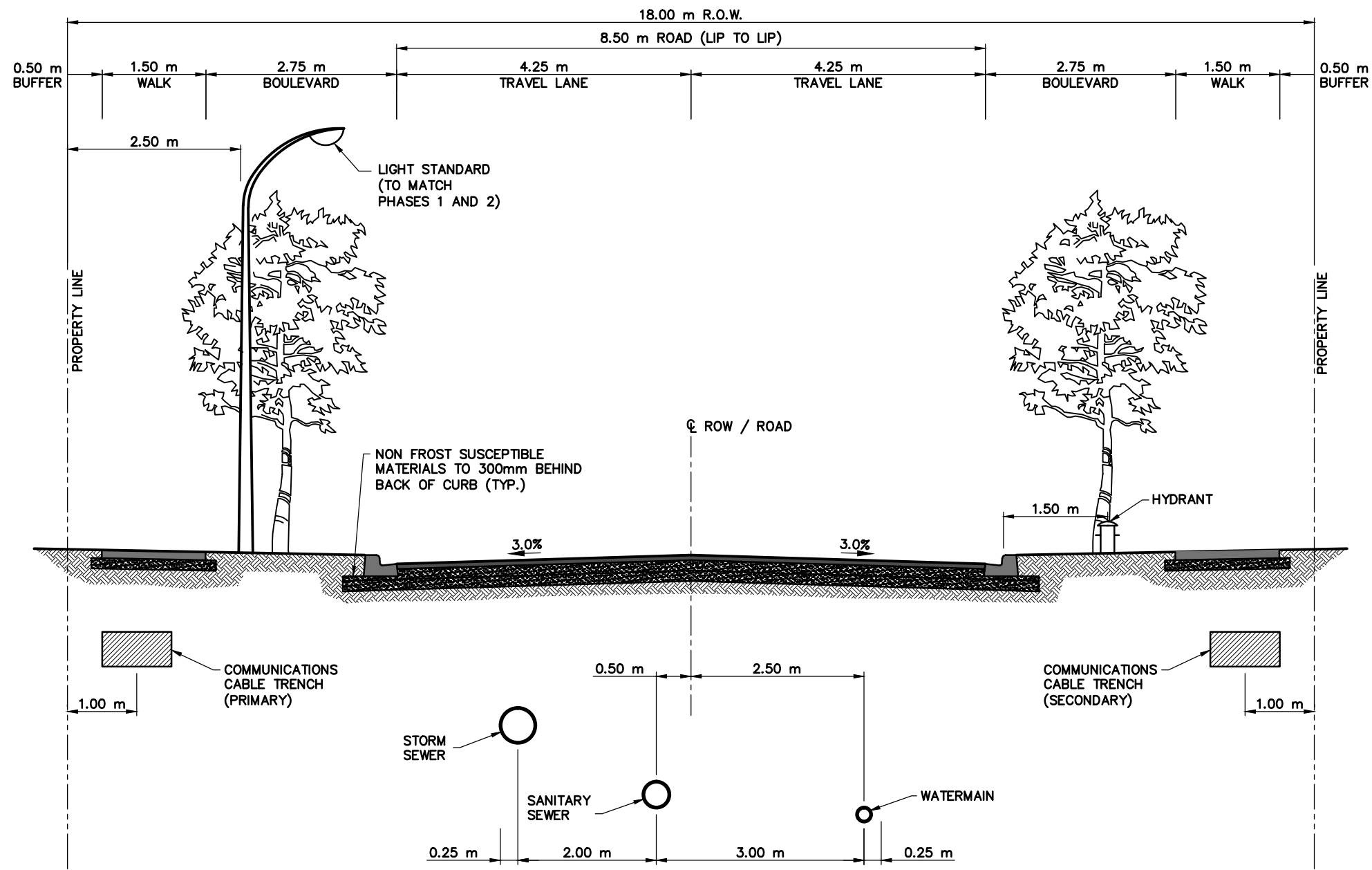




**NOTES:**


1. ALL WATERMAINS TO HAVE A MINIMUM DEPTH OF COVER OF 3.5m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
2. ALL SANITARY SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 2.8m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
3. ALL STORM SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 1.2m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
4. FIBRE OPTIC CABLE INSTALLATION BY AND FOR NWTEL.

PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>PROPOSED 20.0m GREENWAY ROAD / BIKEWAY (OVER EXISTING FORCEMAIN) SERVICING</b>		
	DATE:	PROJECT # 5114046
	AUG. 20, 2013	SCALE: 1:75
		FIGURE 5.5



**NOTES:**

1. ALL WATERMAINS TO HAVE A MINIMUM DEPTH OF COVER OF 3.5m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
2. ALL SANITARY SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 2.8m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
3. ALL STORM SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 1.2m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
4. FIBRE OPTIC CABLE INSTALLATION BY AND FOR NWTCL.

PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>PROPOSED 18.0m LOCAL STREET SERVICING</b>		
	DATE:	PROJECT # 5114046
	AUG. 20, 2013	SCALE: 1:75
		FIGURE 5.6

and designated bike lanes for designations outside the neighbourhood and through to Phases 1-2. The street supports one travel lane in each direction, a designated bike lane, on street parking on one side and, alternating on street parking on the other side with sidewalks on both sides.

This street section, shown in Figure 5.5, has some modifications to the standard Minor Collector. It consists of a 20 m wide Right-of-Way and a 15.0 m wide road surface. These roads have two 3.5 m wide travel lanes, two 1.5 m wide bike lanes, and parking on both sides. There are sidewalks on both sides, one being separate. The separate sidewalk is proposed to be located in the Greenbelt, to accommodate for the narrower ROW. There is a 0.5 m buffer between the property line and the back of sidewalk on the side opposite of the Greenbelt. Street lighting is provided on one side of the road as shown. The underground services shown include communications cable, storm sewer, sanitary sewer, and water. The watermain is positioned at 3.0 m offset from the road centre line. The sanitary sewer is 0.5 m from the road centre line, opposite of the watermain, and the storm sewer is 2.0 m from the sanitary sewer, and 5.0 m from the watermain. A minimum of 3.0 m separation between water main and sanitary sewer will be maintained to ensure compliance with servicing standards. There is an existing forcemain under a portion of this type of road that will be situated at the centre of the roadway. A minimum of 3.0 m separation between water main and sanitary sewer will be maintained to ensure compliance with servicing standards. Communications cables will be installed 1.0 m from inside the curb to the trench centre line on both sides of the roadway. There are treed boulevards on both sides of the road.

### 5.2.5 Local Streets

The intent of local streets is to provide vehicle, cycling and pedestrian access to local residential areas. All local streets allow parking on both sides leaving a narrow queuing traffic lane in the centre, thereby self-regulating traffic speeds in these areas and keeping paved areas to a minimum. Local streets have sidewalks on both sides, adjacent to the street, distinguished by paving material and low roll-over curb. The intent of the design choice is to provide a 'shared street' feel within the neighbourhood, yet provide a designated area for pedestrians.

The proposed local street design consists of an 18 m wide Right-of-Way and an 8.5 m wide road surface as shown in Figure 5.6. This is consistent with Phase 1 and 2. These roads will have two 4.25 m wide travel lanes/on-street parking with sidewalks on both sides. Street lighting is provided on one side of the road as shown. The underground services shown include communications cable, storm sewer, sanitary sewer, and water. The watermain is positioned at 2.5 m offset from the road centre line. The sanitary sewer is 0.5 m from the road centre line, opposite of the watermain, and the storm sewer is 2.0 m from the sanitary sewer, and 5.0 m from the watermain. A minimum of 3.0 m separation between water main and sanitary sewer will be maintained to ensure compliance with servicing standards. Communications cables (primary) will be installed 1.0 m the property line to the trench centre line. Communications cables (secondary) will be installed 1.0 m from the property line to the trench center line, underneath the sidewalk. There are treed boulevards on both sides of the road.

### 5.2.6 Laneways

The provision of residential blocks with lanes is a fundamental component of the neighbourhood design intent, particularly regarding pedestrian orientation and the character of public and private development.

This includes:

- Allowing for narrower lots not dominated by front garages
- Enabling rear lane access for vehicles and storage, and allowing for a 'friendly face' to the street, in turn, enhancing the urban streetscape and pedestrian quality of the neighbourhood
- Providing for an increased parking supply, which is critical for Phases 3-7 lot density and potential for garden and living suites
- Allowing for the continuous planting of street trees, in turn, improving site drainage

Lanes provide rear access to housing and public corridors for and connections to neighbourhood infrastructure. Lanes are not lit or intended for regular pedestrian use.

The proposed laneways within the development consist of a 6.0 m width and 10.0 m width as shown in Figure 5.7 and 5.8. The 10 m wide lanes have street lighting on one side. No underground utilities are proposed to be located in the lanes, with a few exceptions as listed below:

Sanitary pipe from MH59 to MH96 (refer to Figure 6.3) is to be located in a 6.0 m lane. This is adjacent to a green belt and provides additional width for construction or maintenance if required. A portion of this will consist of a watermain installed in the same lane. These are to be placed 1.5 m from the centre line for a minimum 3.0 m separation.

Sanitary pipe from MH17 to MH13 is to be installed in a 6.0 m lane. This will be installed at 1.5m from lane centre line.

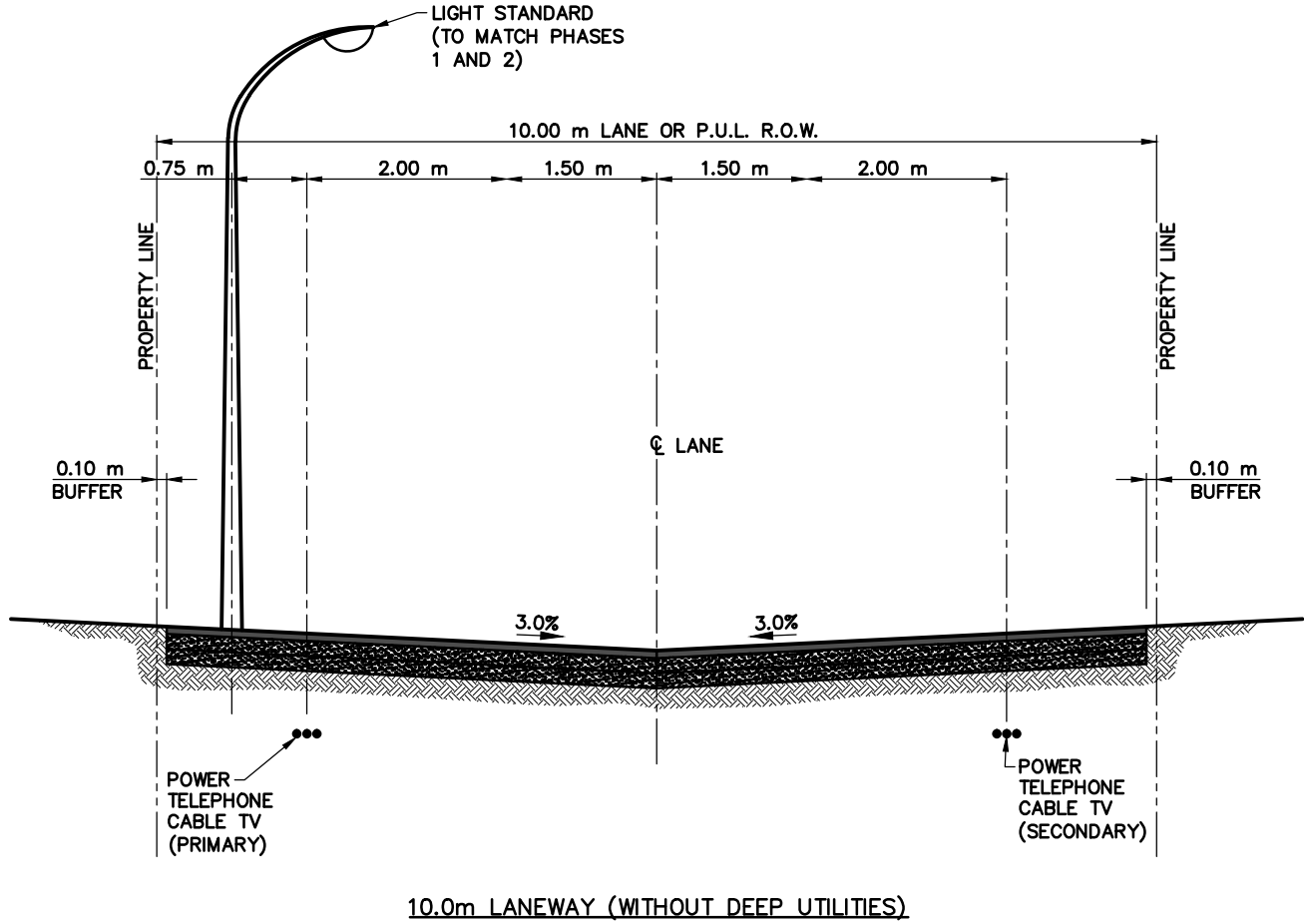
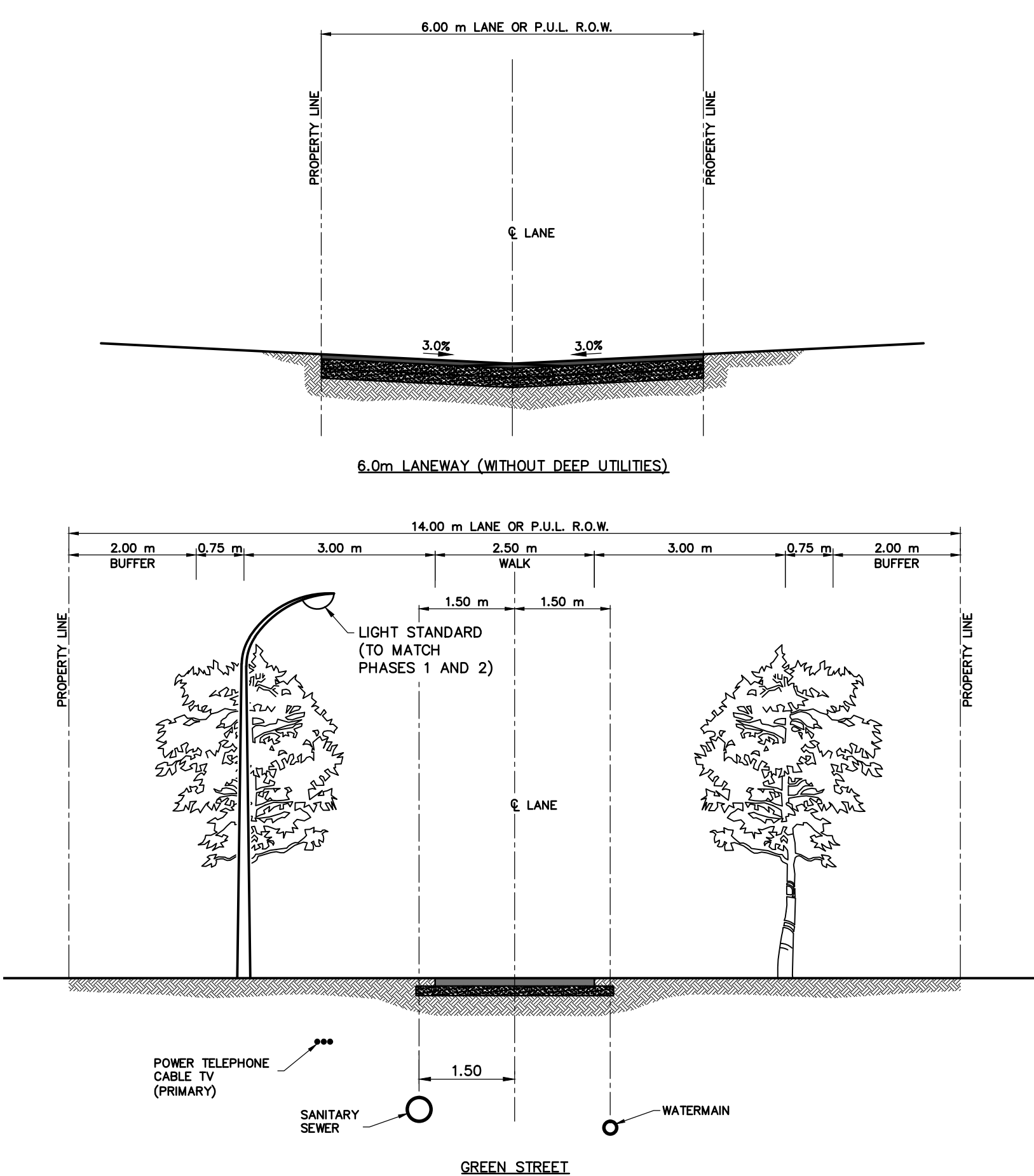
There are two instances where the proposed watermain is to be located in a 6.0 m lane. These are adjacent to a green belt and provides additional width for construction or maintenance if required. The watermain is to be installed 1.5 m from lane centre line, opposite of sanitary line, to maintain a minimum of 3.0 m separation.

There is one location for storm sewer to Dry Pond 2, where it is located in the centre of a 10 m lane. This is adjacent to a green belt and provides additional width for construction or maintenance if required.

### 5.2.7 Pavement Structure

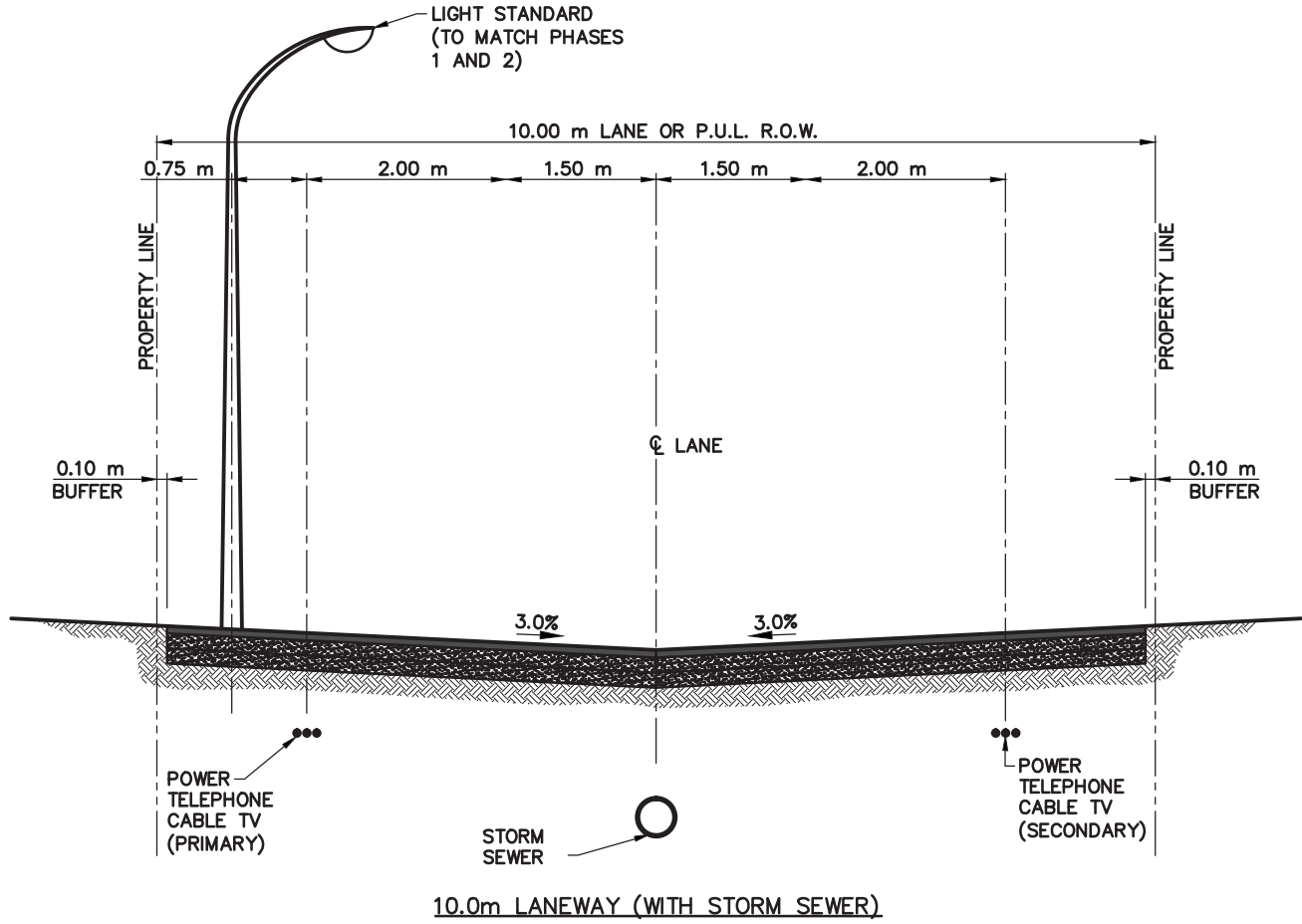
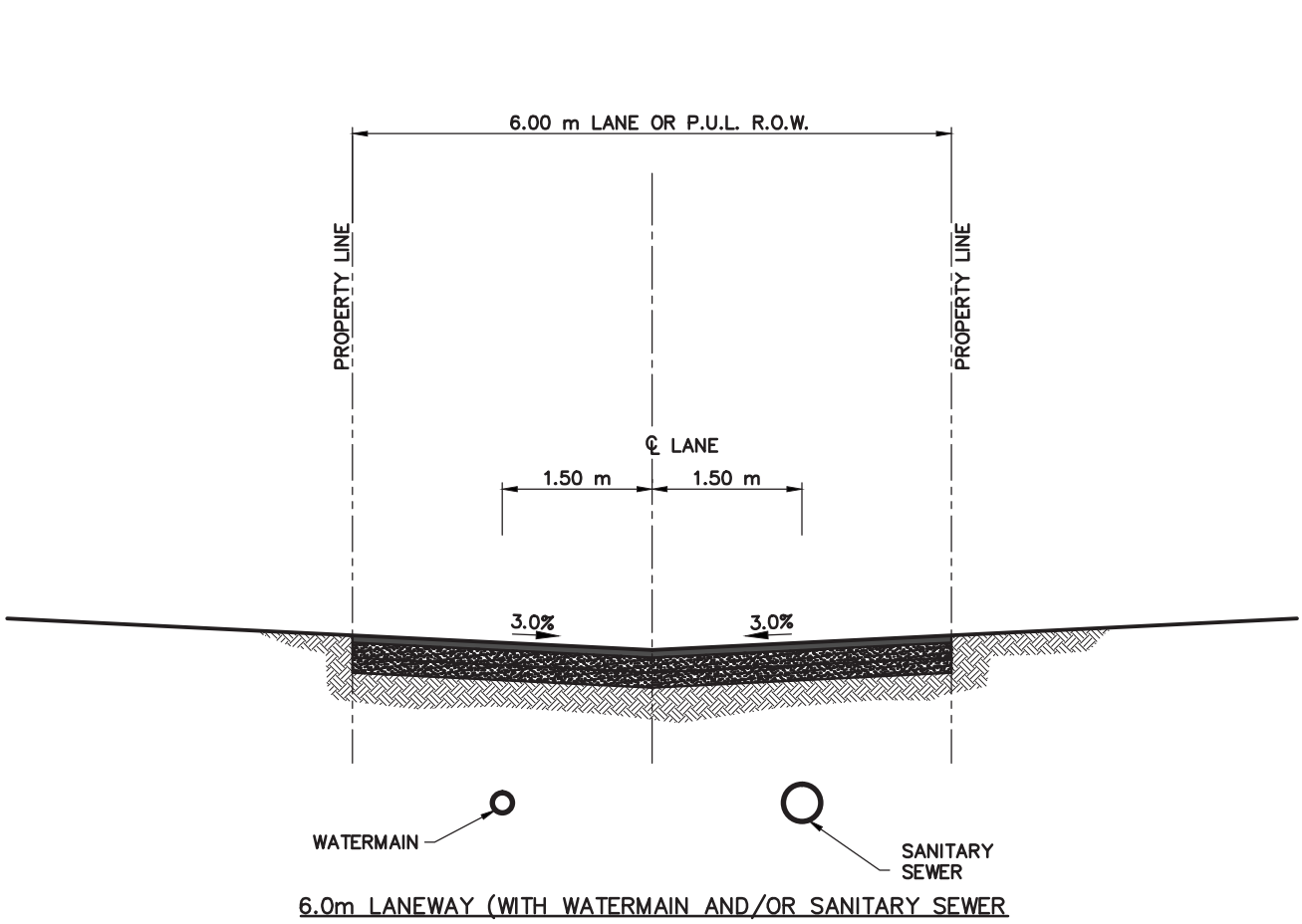
The road structure design is to be as per recommendations of the Geotechnical Evaluation-Whistle Bend Subdivision by EBA Engineering Consultants Ltd. (August 2009). The recommended minimum roadway structure includes 75 mm hot mix asphalt, 150 mm base course gravel (20 mm crush) and at least 300mm of sub-base gravel (50 mm crush is preferred but 100mm pit run is acceptable). The first phase of Casca Blvd. was constructed with 100mm of asphalt and this should continue for the remaining phases. This can be laid in two lifts with the second lift being placed at the Final Acceptance.

ANSI B SIZE 11"x17" (279.4mm x 431.4mm)  
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- NOTES:
1. ALL WATERMAINS TO HAVE A MINIMUM DEPTH OF COVER OF 3.5m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
  2. ALL SANITARY SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 2.8m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
  3. ALL STORM SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 1.2m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
  4. FIBRE OPTIC CABLE INSTALLATION BY AND FOR NWTEL.

PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>PROPOSED 6.0m AND 10.0m LANEWAY GREEN STREET SERVICING</b>		
	DATE:	PROJECT # 5114046
	AUG. 20, 2013	SCALE: 1:75
		FIGURE 5.7



NOTES:

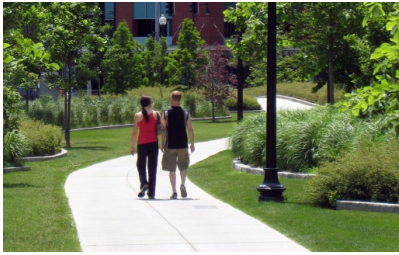
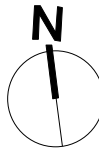
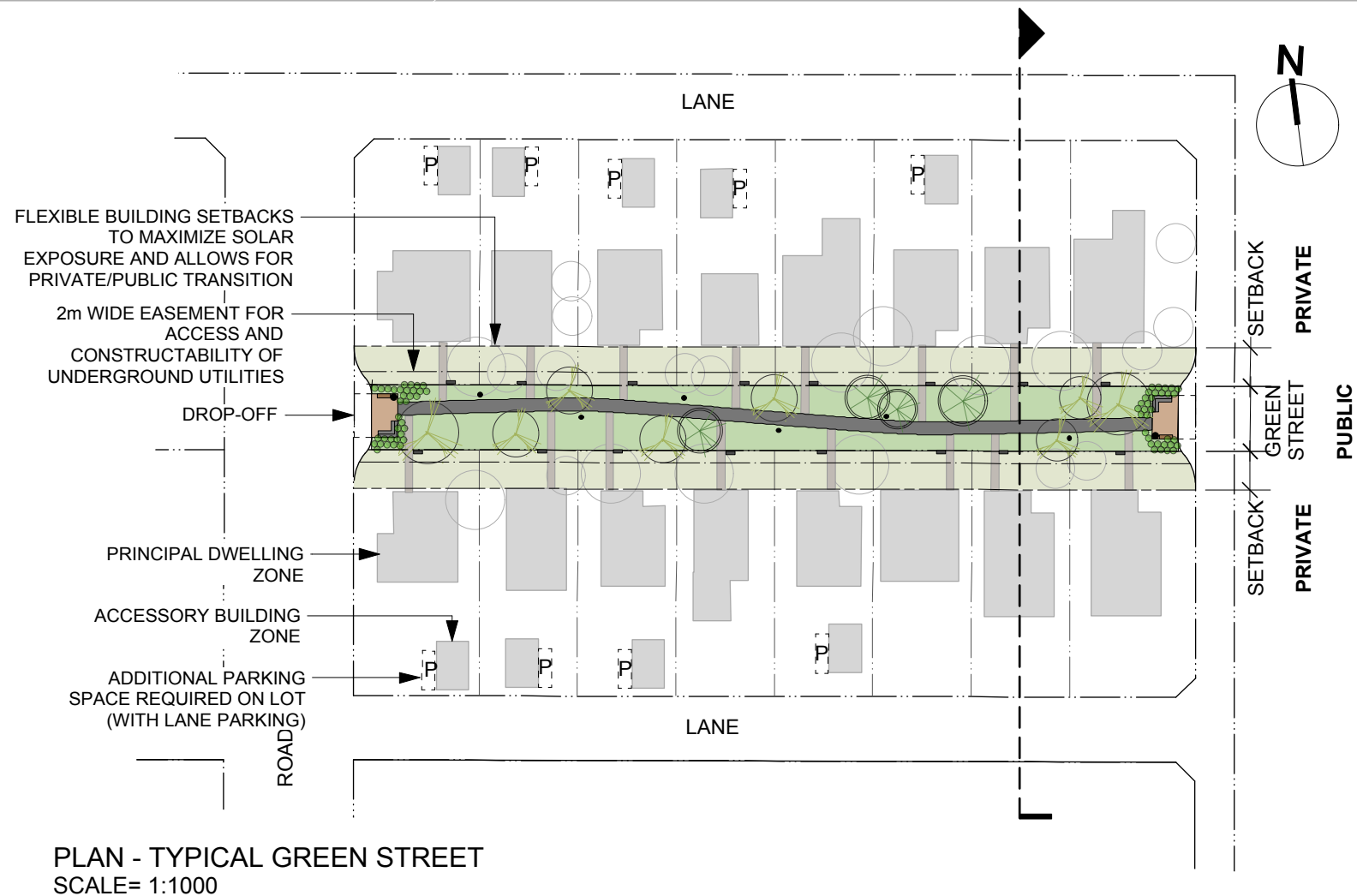
1. ALL WATERMAINS TO HAVE A MINIMUM DEPTH OF COVER OF 3.5m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
2. ALL SANITARY SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 2.8m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
3. ALL STORM SEWERS TO HAVE A MINIMUM DEPTH OF COVER OF 1.2m FROM PIPE OBVERT TO FINISHED SURFACE GRADE.
4. FIBRE OPTIC CABLE INSTALLATION BY AND FOR NWTEL.

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**

TITLE:  
**PROPOSED 6.0m AND 10.0m LANEWAY  
(WITH UTILITIES)**



DATE:	PROJECT # 5114046
AUG. 20, 2013	SCALE: 1:75
	FIGURE 5.8



PRECEDENT IMAGES

**DESCRIPTION:**

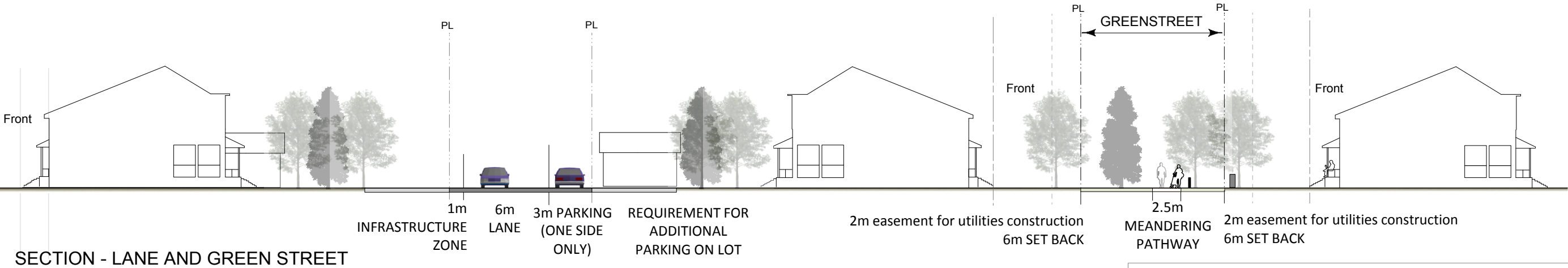
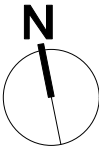
- Demonstration of a new street typology
- A linear park
- Pedestrian only
- Housing fronts onto the green street
- Lanes provide access (& street address)

**KEY BENEFITS:**

- Adds to the character of the neighbourhood
- Encourages pedestrian activity
- Supports a strong social interaction/community feel
- Offers additional, unique greenspace adjacent to housing

**PROPOSED DESIGN:**

- 2.5m wide meandering paved pathway
- Paved entry plaza with mail kiosk, seating and lighting
- 1 Stall for drop-off/pick up at entry
- Light bollards along central pathway
- Pier with address signage at front house
- Street address indicated at back of house
- No front fencing in setback, softscape screening only
- Feature planting at entries
- Minimum 30% tree cover
- Sod lawn or meadow in greenway



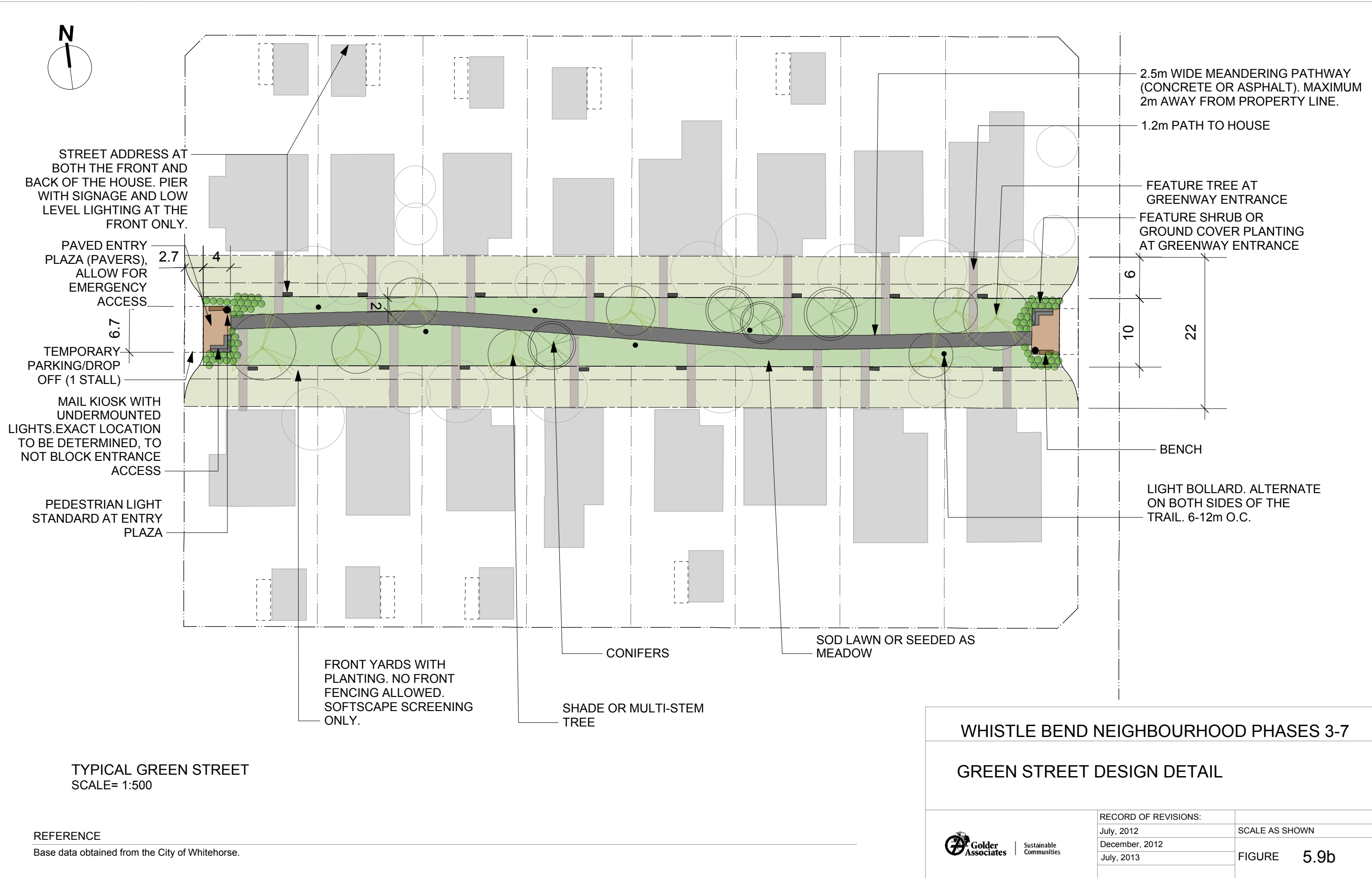
WHISTLE BEND NEIGHBOURHOOD PHASES 3-7

GREEN STREET DESIGN OVERVIEW

**REFERENCE**  
Base data obtained from the City of Whitehorse.



RECORD OF REVISIONS:	
July, 2012	SCALE AS SHOWN
December, 2012	
	FIGURE 5.9a



Some portions (glaciolacustrine silt sub-grade areas) of the development will require sub-cutting to ensure that there is 1.7 m of non-frost susceptible road structure.

The above recommended road structure is to be verified at the detailed design stage.

### 5.2.8 Green Streets

Green Streets are shown in Figure 5.9 (a and b). Green streets are public right of ways envisioned as linear parks and designed in a “park-like” way, allowing for pedestrian and cycling only (and emergency access).

The intent of green streets is to:

- Support and add a unique character, look and feel to the neighbourhood
- Provide significant open space amenity for adjacent residents and the larger community
- Encourage pedestrian activity
- Support a strong social interaction/community and safe space for residents

The proposed green streets, shown in Figure 5.9, consist of a 10.0 m width plus 2.0 m on each side for access and constructability of underground utilities. The green street consists of a 2.5 m wide trail, trees, lighting as shown. Underground utilities include power/communications cable, water, and sanitary sewer. The watermain is to be located 1.5 m from the centerline of the right of way, and the sanitary sewer is to be located 1.5 m from the centre line opposite of the watermain. A minimum of 3.0 m separation between water main and sanitary sewer will be maintained to ensure compliance with servicing standards. Detailed design and construction of green streets should adhere to the following:

- Dwelling units should front onto the green street.
- Lots abutting the green street are not permitted to have fencing in front (landscaping only).
- Flexible setbacks allow for options in placement and size of outdoor amenity space and options to maximize solar exposure.
- Where green streets exist, rear lanes provide access and infrastructure.
- Building address should be from the lane but also indicated in the front.
- Mail delivery is accessed from side street community mail boxes, located adjacent to the sidewalk and pathway.
- Parking is located within the rear yard and on the lane. On-street parking is located on the side streets only.

### 5.2.9 Green Links

Green links are small pedestrian oriented routes, managed by the City of Whitehorse as a public right of way, varying in width. Green links ensure easy, direct pedestrian connections within the neighbourhood

to facilitate increased pedestrian activity. Green links are located where they can provide a more direct connection from residential areas to public transit, trails, larger green spaces, destinations and existing trails outside the neighbourhood boundary. Green links should include consistent signage and, as part of the overall neighbourhood trail system.

### 5.2.10 Street Trees

Phases 3-7 include a boulevard and street trees on all streets. The City of Whitehorse Parks & Recreation Department should be consulted with regard to correct tree spacing and appropriate species for Whistle Bend Phases 3-7. All paved sidewalks should be within 3 metres (10 ft.) of a tree and it is recommended (dependent on species) that these areas should be underlaid with structural soil to avoid sidewalk heaving. Trees should be at least 5cm (2inch) diameter at breast height when installed to ensure survival. Trees are to be placed at 7.0 m on centre on both sides of the road.

Recommended street tree species include:

- Northwest Poplar (*Populus x 'Northwest'*): Fast growing canopy tree. Great shelterbelt tree that does not sucker.
- Paper Birch (*Betula Papyrifera*): Ornamental shade tree with appealing peeling bark. Indigenous species. Tall slender tree up to 12m. Cities such as Whitehorse use this as a street tree in their downtown.
- Mayday (or Bird Cherry) (*Prunus padus Commutata*): This is probably one of the nicest flowering prunus you can plant. Early fragrant flowers. Leaves appear quite early in the spring. Small berries are appreciated by birds. Great shade tree.
- Manitoba Maple (*Acer Negundo*): Very vigorous tree, native to the eastern prairies. It is drought resistant and grows well in wet soil. Bright green leaves that turn yellow in the fall.

### 5.2.11 Signage & Wayfinding

A primary objective of Phases 3-7 is to create a pedestrian-friendly community. The neighbourhood trail system and green links should incorporate an overall wayfinding scheme.

This may include but is not limited to:

- Colour coding/naming the arterial and perimeter trails separately from the local trail system and greenlinks,
- Posting maps/signage of the neighbourhood trail network system at key community destinations,
- Clearly identifying trailheads and green link routes and ensuring entry is welcoming and an obvious 'public space', and,

- Implementation of a regular maintenance program for upkeep of green links, trails and signage
- Street signage for commercial areas should be designed and scaled to accommodate businesses and should maintain consistent theme(s) within the neighbourhood, where applicable.

### 5.2.12 Traffic Calming and Pedestrian Safety

A grid layout and short blocks with frequent intersections provide for traffic calming in local residential areas. However, where there are long, straight streets, such as Keno Way, Wyvern Ave, Witch Hazel Dr. and Independence Dr., speed may be a concern and could have a significant impact on pedestrian safety and comfort. These streets are candidates for traffic calming.

Recommended traffic calming measures for Phases 3-7 include:

- Street design for 50kph and posted speed limit at 40kph.
- Stop lights and signed cross walks at primary intersections.
- Roundabouts as shown on the plan along Wyvern Ave and Witch Hazel Dr. (additional locations to be confirmed in detailed design).
- Raised intersections, corner bulges and/or pedestrian activated lights should be considered where:
  - green streets and green links intersect and cross a street at an intersection and mid-block
  - adjacent to schools
  - on Casca Boulevard adjacent to Transit stops and at trail connections
  - nearby mixed use communities

## 5.3 Traffic Impact Analysis

A traffic study was undertaken to assess the on-site and off-site roadway and intersection requirements to service the proposed land uses within the subdivision. According to the traffic impact analysis completed for the Whistle Bend Onsite Servicing Report, AECOM (November 6, 2009) and the Traffic Impact Analysis Update Report, AECOM (February 7, 2012), the existing on-site and off-site road networks can accommodate the development with some modifications. The Traffic Impact Analysis Update Report is attached in as Appendix B.

### 5.3.1 On-Site Traffic Impact Analysis

The key findings from the Traffic Impact Analysis for the on-site road network is summarized as follows:

- The full build-out Whistle Bend will generate 3,044 and 3,707 external vehicle trips during the AM and PM peak hours respectively.
- Analysis shows both single-lane roundabouts at the intersection of Whistle Bend Way and Casca Boulevard (W), and the intersection of Casca Boulevard and Skookum Drive operate well at full build-out.

- A multilane roundabout at the intersection of Whistle Bend Way and Casca Boulevard (E) will operate within the acceptable Level of Service of D.
- The installation of traffic signals is required at the intersection of Casca Boulevard and Taranhe Way/Akaka Drive.
- Laning requirement of Casca Boulevard at full build-out suggests:
  - Two lanes per direction between Whistle Bend Way and Taranhe Way E
  - One lane per direction between Taranhe Way E and Taranhe Way W
  - Two lanes per direction between Taranhe Way W and Whistle Bend Way.
- Intersection operations at the Casca Boulevard corridor indicate recommended improvements in place, all intersections and all turning movements will operate within the acceptable LOS of “D” during both AM and PM peak hours under full build-out conditions.

Peak hour volumes and recommended laning along the study corridor at full build out are illustrated in Figure 5.10.

**Figure 5.10: Traffic Volumes and Laning – Full Build Recommended AM Peak Hour**



### 5.3.2 Off-Site Traffic Impact Analysis

This section aims to supplement and clarify some of the results of the Whistle Bend Traffic Impact Analysis Update, AECOM (March 27, 2012) as found in the Appendix B.

#### 5.3.2.1 Assumptions

It is understood the Pine Street Extension is not being considered as an option at this time. However the traffic study indicated a need to consider this option at a population of 50,000 to accommodate new development and resulting traffic volumes anticipated for this area of Whitehorse. AECOM's analysis indicated "the extension will not be well used at the short-term stage". It was therefore recommended "this option be deferred and reconsidered in the medium term horizon". The medium and long term analyses did indicate benefits from the construction of the Pine Street Extension and consequently, it was included in the recommendations for those scenarios".

#### 5.3.2.2 Summary of Results

The purpose of this review and summary is to target the following question: What upgrades would be required along the existing two-lane Mountain View-Copper-Quarts Corridor, which connects the proposed community with the downtown, in order to accommodate the proposed development traffic, with and without the planned connection to the Alaska highway, at both medium and long term (As per AECOM's report, medium and long term horizons are defined as City's population at 35,000 and 46,800 people respectively). Thus, the following options were reviewed and the results are summarized in Figures 5.11-5.14:

- Option 1a – NO Highway Connection -Mid-Term
- Option 1b – NO Highway Connection -Long-Term
- Option 2a – WITH Highway Connection -Mid-Term
- Option 2b – WITH Highway Connection -Long-Term

The following is a summary of general recommendations.

##### 5.3.2.2.1 Mountain View-Copper-Quarts Corridor function, classification and upgrades:

The corridor should function as typical urban arterial roadway. In the absence of City's roadway classification standards, TAC standards for urban roadways are recommended (Geometric Design Guide for Canadian Roads, Transportation Association of Canada (TAC)).

A 4-lane urban arterial cross-section is warranted for the corridor under any scenario. Forecasted average daily traffic along the corridor ranges from 12,000 to 30,000 vehicles per day, which is the typical capacity of an urban arterial road. The upgrade from existing 2-lane to a 4-lane facility may be warranted at some point between the short and medium term, subject to the progression of the Whistle Bend development.

Localized intersection improvements for each option are shown and summarized in the enclosed figures. All recommended intersection upgrades were recommended to meet or exceed industry accepted performance level of service (LOS). Refer to AECOM's report (pp. 9-10) for LOS definitions.

### 5.3.2.2.2 Alaska Highway

The existing highway from Two Mile Hill Rd to Wann Rd. is basically a two-lane highway facility with capacity improvements at key intersections.

Regardless of any option, twinning of the highway will likely be warranted at about medium term, due to increasing background highway traffic in excess of 10,000-12,000 vehicles per day (vpd), which is generally considered a threshold for highway twinning.

Where a connection between the community and the Alaska Highway is constructed, the section of highway between Two Mile Hill Rd. and the new connection may experience significant volume increase, at which point, capacity improvements may need to be confirmed.

### 5.3.2.2.3 Build versus No-build Pine Street Extension

As far as the Mountain View-Copper-Quartz Corridor concerns, build versus no-build of a connection to the highway does not appear to make a significant difference, since most of the development traffic will travel south along the corridor between the community and downtown Whitehorse. Forecasted average daily traffic along the corridor ranges from 12,000 to 30,000 under any scenario, which is the typical capacity of a 4-lane urban arterial road. Furthermore, build versus no-build scenario, renders minimum differences along the corridor reflected only as localized intersection improvements for each scenario.

Traffic diverted to the highway by the new connection, may add significant traffic to the section of highway between Two Mile Hill Rd. and the new connection. As mentioned, capacity improvements may be needed and confirmed prior to building the connection.

As AECOM have indicated, “the Pine Street Extension had been identified as part of City’s long term network plan in earlier studies and therefore was taken as a committed project. Furthermore, AECOM’s analysis indicated that “the extension will not be well used at the short term stage” (short-term being up to Phase 7 of Whistle Bend) therefore, in their latest update, AECOM analyzes did include the With and Without extension scenarios for medium and long term. From a traffic standpoint alone, AECOM analyzes shows no major differences between With or Without the connection, it is more about other benefits such as increased connectivity for the Town as whole.

We noted the impacts of Build versus No-build Pine Extension as follows:

- As far as the Mountain View-Copper-Quartz Corridor concerns, build versus no-build of a connection to the highway does not appear to make a significant difference, since most of the development traffic will travel south along the corridor between the community and downtown Whitehorse. Forecasted average daily traffic along the corridor ranges from 12,000 to 30,000 under any scenario, which is the typical capacity of a 4-lane urban arterial road. Furthermore, build versus no-build scenario, renders minimum differences along the corridor reflected only as localized intersection improvements for each scenario.
- As far as the Alaska Highway concerns, the traffic diverted to the highway by the new connection, may add significant traffic to the section of highway between Two Mile Hill Rd. and the new connection. Capacity improvements may be needed and confirmed prior to building the connection.



**Study Site**

Medium Term  
City's Population = 35,000  
Whistle Bend Development = 80% Built-out

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound left turn bay*</li><li>- Add northbound right turn bay*</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound right turn bay*</li><li>- Add northbound left turn bay*</li><li>- Channelize existing northbound right turn lane</li><li>- Add northbound right turn bay*</li><li>- Add eastbound left turn bay*</li><li>- Add westbound left turn bay*</li><li>- Add eastbound right turn bay*</li><li>- Add westbound right turn bay*</li><li>- Optimize signal timing (see AECOM report pp.38 for details)</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound left turn bay*</li><li>- Add southbound right turn bay*</li><li>- Add northbound left turn bay*</li><li>- Add eastbound left turn bay*</li><li>- Add westbound left turn bay*</li><li>- Optimize signal timing (see AECOM report pp.39 for details)</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add northbound left turn bay*</li><li>- Add southbound left turn bay*</li><li>- Add eastbound left turn bay*</li><li>- Add westbound left turn bay*</li><li>- Optimize signal timing (see AECOM report pp.39 for details)</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound left turn bay*</li><li>- Add southbound right turn bay*</li><li>- Add eastbound right turn bay*</li><li>- Add northbound left turn bay*</li><li>- Optimize signal timing (not specified in AECOM report )</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound left turn bay*</li><li>- Add northbound left turn bay*</li><li>- Optimize signal timing (see AECOM report pp.40 for details)</li></ul>

Optimize signal timing (see AECOM report\*\* pp.39 for details)

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**

TITLE:  
**MID TERM - NO CONNECTION TO ALASKA HIGHWAY**

	DATE:	PROJECT # 5114046
	AUG. 20, 2013	SCALE: N.T.S.
		FIGURE 5.11

LEGEND:

- 4 - lane Urban Arterial
- 4 - lane Highway

NOTE: Intersection **8 9 10 11** may required auxiliary lanes although not specified in AECOM report

\* Storage length to be confirmed at detail engineering

- 13** Optimize signal timing (see AECOM report\*\* pp.40 for details)
- 14** No improvements required
- 15** Optimize signal timing (see AECOM report\*\* pp.49 for details)

No improvements required



LEGEND:

- 4 - lane Urban Arterial
- 4 - lane Highway
- Proposed Road Connection

NOTE: Intersection 8 9 10 11 may require auxiliary lanes although not specified in AECOM report

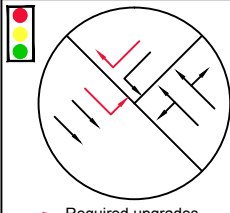
\* Storage length to be confirmed at detail engineering

- 13 Optimize signal timing (see AECOM report\*\* pp.40 for details)
- 14 Optimize signal timing (see AECOM report\*\* pp.40 for details)
- 15 Optimize signal timing (see AECOM report\*\* pp.40 for details)

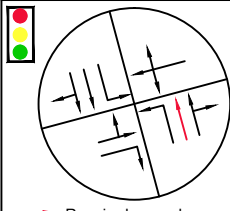
Study Site

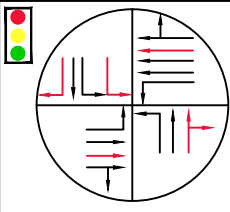
Long Term  
City's Population = 46,800  
Whistle Bend Development = Full Built-out

- 1 No geometric improvement required beyond mid-term improvements
- 2 - No geometric improvement required beyond mid-term improvements  
- Optimize signal timing (see AECOM report\*\* pp.38 for details)
- 3 Optimize signal timing (see AECOM report\*\* pp.39 for details)

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound left turn bay*</li><li>- Add westbound right turn bay*</li></ul>

- 5 No geometric improvement required beyond mid-term improvements

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add northbound through</li><li>- Optimize signal timing (see AECOM report** pp.39 for details )</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add additional southbound left turn bay*</li><li>- Add southbound right turn bay*</li><li>- Add northbound shared right and through lane</li><li>- Add eastbound through lane</li><li>- Add westbound through lane</li><li>- Optimize signal timing (see AECOM report pp.40 for details)</li></ul>

Optimize signal timing (see AECOM report\*\* pp.39 for details)

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**  
TITLE:  
**LONG TERM - NO CONNECTION TO ALASKA HIGHWAY**



DATE:	PROJECT # 5114046
AUG. 20, 2013	SCALE: N.T.S.
	FIGURE 5.12



**Study Site**

Medium Term  
City's Population = 35,000  
Whistle Bend Development = 80% Built-out

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Intersection geometric improvement required</li><li>- Add southbound left turn bay*</li><li>- Add northbound right turn bay*</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Channelize existing northbound right turn lane</li><li>- Add northbound right turn bay*</li><li>- Add eastbound left turn bay*</li><li>- Add westbound left turn bay*</li><li>- Optimize signal timing (see AECOM report pp.26 for details)</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound left turn bay*</li><li>- Add northbound left turn bay*</li><li>- Optimize signal timing (not specified in AECOM report)</li></ul>

LEGEND:

- 4 - lane Urban Arterial
- Proposed Road Connection
- 4 - lane Highway

NOTE: Intersection **8 9 10 11** may require auxiliary lanes although not specified in AECOM report

\* Storage length to be confirmed at detail engineering

- 13** Optimize signal timing (see AECOM report\*\* pp.28 for details)
- 14** No improvements required
- 15** Optimize signal timing (see AECOM report\*\* pp.36 for details)

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound left turn bay*</li><li>- Add northbound left turn bay*</li><li>- Add eastbound left turn bay*</li><li>- Add westbound left turn bay*</li><li>- Optimize signal timing (see AECOM report pp.26 for details)</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound left turn bay*</li><li>- Add westbound right turn bay*</li></ul>

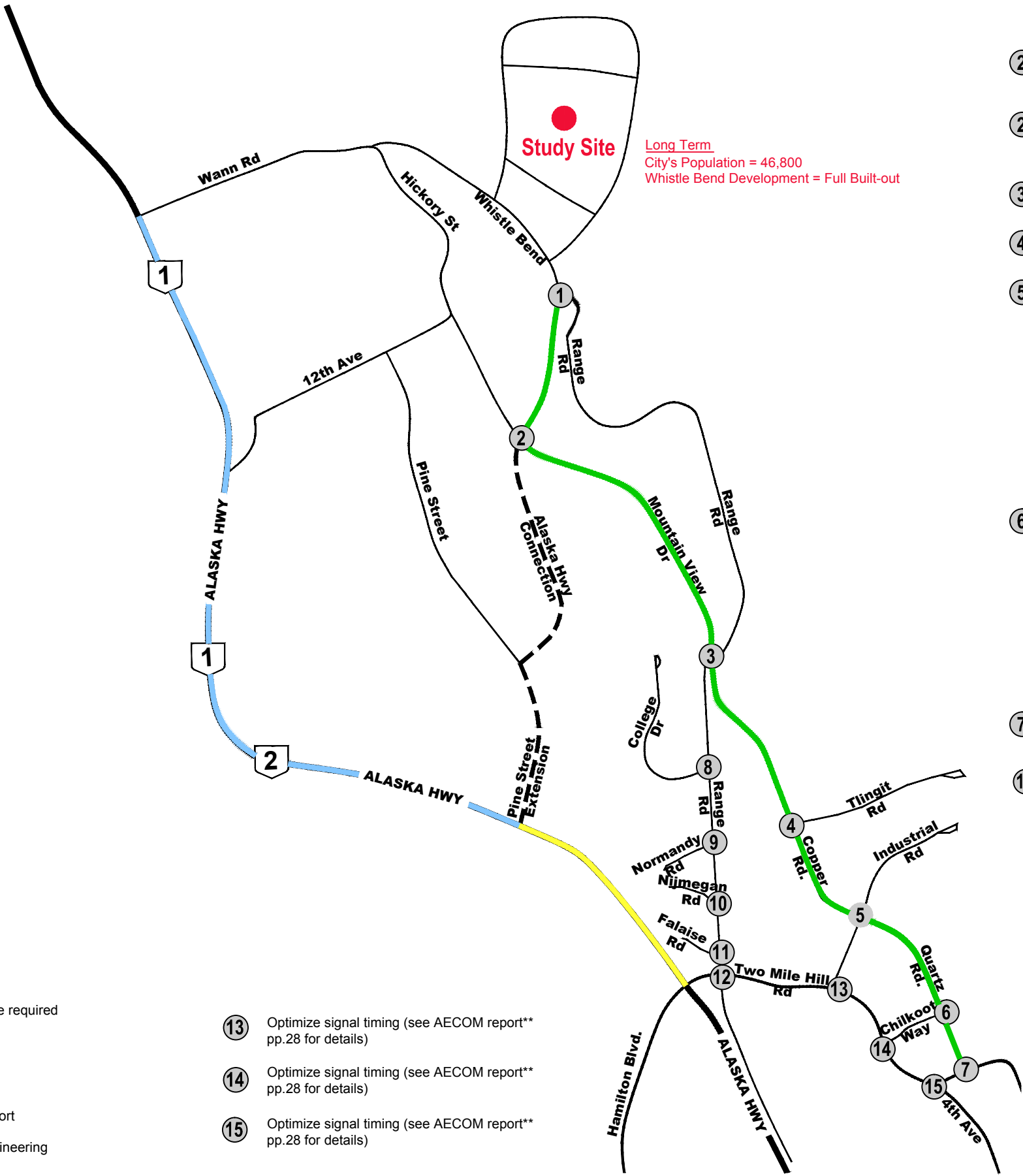
Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add northbound shared through-right turn lane**</li><li>- Add southbound shared through-right turn lane**</li><li>- Add eastbound left turn bay*</li><li>- Add westbound left turn bay*</li><li>- Optimize signal timing (see AECOM report pp.35 for details)</li></ul>

Configuration	Upgrades
	<ul style="list-style-type: none"><li>- Add southbound left turn bay*</li><li>- Add southbound right turn bay*</li><li>- Add eastbound right turn bay*</li><li>- Add northbound left turn bay*</li><li>- Optimize signal timing (see AECOM report** pp.35 for details)</li></ul>

Optimize signal timing (see AECOM report\*\* pp.27 for details)

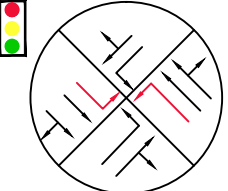
PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>MID TERM - WITH CONNECTION TO ALASKA HIGHWAY</b>		
	DATE:	PROJECT # 5114046
	AUG. 20, 2013	SCALE: N.T.S.
		FIGURE 5.13

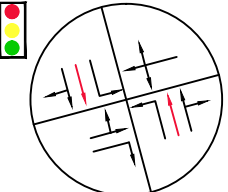
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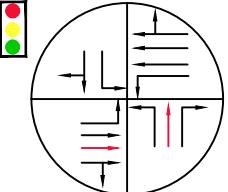
Long Term  
City's Population = 46,800  
Whistle Bend Development = Full Built-out

- ② No geometric improvement required beyond mid-term improvements
- ② Optimize signal timing (see AECOM report\*\* pp.26 for details)
- ③ Optimize signal timing (see AECOM report\*\* pp.26 for details)
- ④ No upgrades required

Configuration	Upgrades
 Required upgrades	<ul style="list-style-type: none"><li>- Add northbound left turn bay*</li><li>- Add southbound left turn bay*</li><li>- Optimize signal timing (see AECOM report pp.35 for details)</li></ul>

Configuration	Upgrades
 Required upgrades	<ul style="list-style-type: none"><li>- Add northbound through lane</li><li>- Add southbound through lane</li><li>- Optimize signal timing (see AECOM report** pp.35 for details )</li></ul>

- ⑦ Optimize signal timing (see AECOM report\*\* pp.27 for details)

Configuration	Upgrades
 Required upgrades	<ul style="list-style-type: none"><li>- Add northbound through lane</li><li>- Add eastbound through lane</li><li>- Optimize signal timing (not specified in AECOM report)</li></ul>

- LEGEND:
- 4 - lane Urban Arterial
  - 4 - lane Highway
  - Proposed Road Connection
  - Capacity Improvements may be required


NOTE: Intersection ⑧ ⑨ ⑩ ⑪ may required auxiliary lanes although not specified in AECOM report

\* Storage length to be confirmed at detail engineering

- ⑬ Optimize signal timing (see AECOM report\*\* pp.28 for details)
- ⑭ Optimize signal timing (see AECOM report\*\* pp.28 for details)
- ⑮ Optimize signal timing (see AECOM report\*\* pp.28 for details)

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**

TITLE:  
**LONG TERM - WITH CONNECTION TO ALASKA HIGHWAY**



DATE:  
AUG. 20, 2013

PROJECT # 5114046

SCALE: N.T.S.

FIGURE 5.14

The latest upgrades for both With and Without connection were summarized in Figures 5.11, 5.12, 5.13, 5.14. Note that we did not examine in any detail the improvements that might be needed on the Alaska Highway as part of this project.

Travel time between Whistle Bend and downtown is anticipated to be around 15 minutes in the peak direction and is comparable in both cases. Travel time between Porter Creek “D” and downtown is anticipated to be around 12 minutes in the peak direction with the McIntyre Creek Crossing, and 16 minutes in the peak direction without the McIntyre Creek Crossing.

No specific trigger point for this connection was identified. It is recommended this be investigated in consideration of a wider range of factors, such as, future development, population and other benefits, such as increased connectivity for the Town as whole.

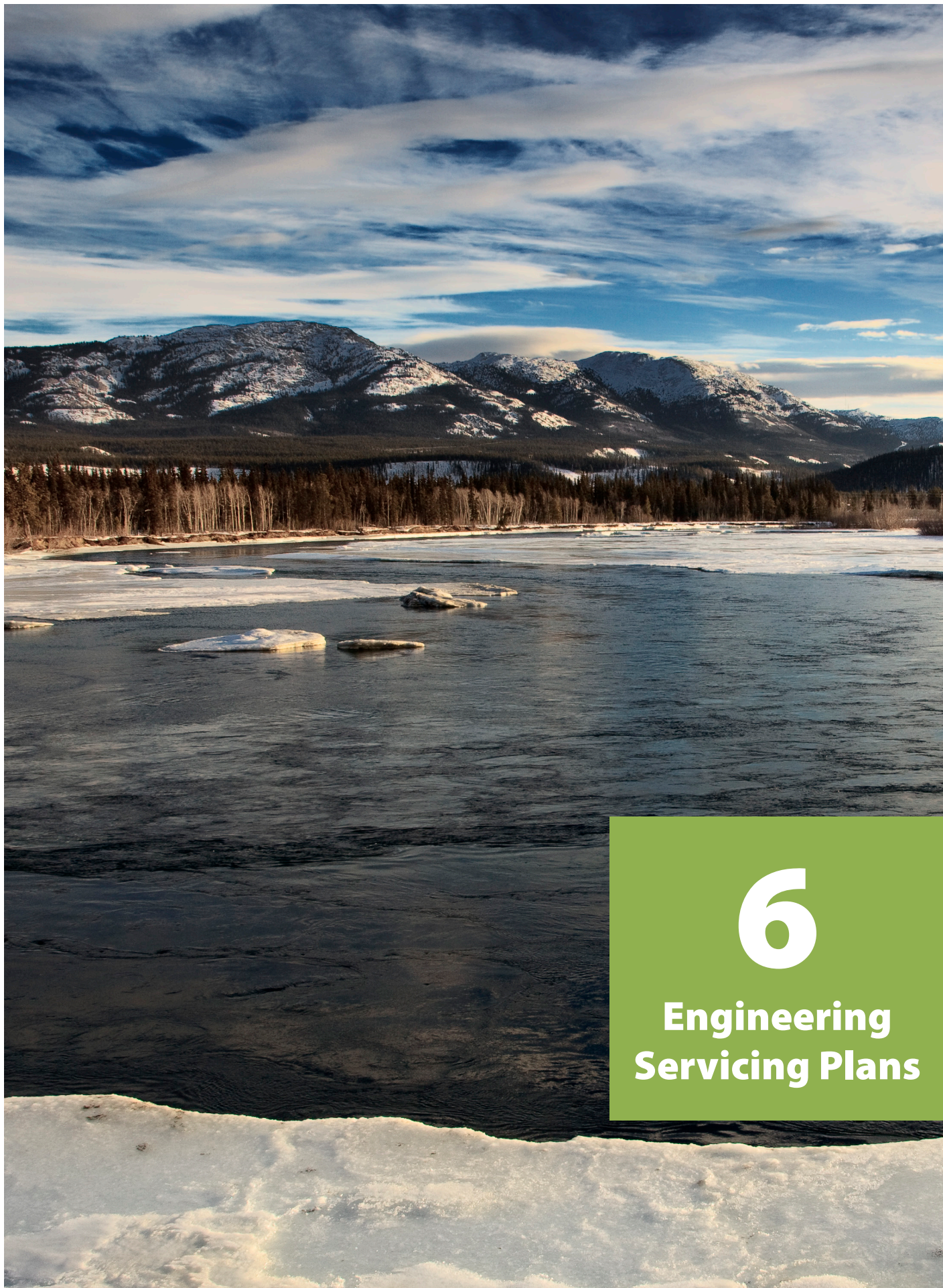
#### **5.3.2.2.4 Other Comments**

It is understood the City’s commitment to sustainable transportation and their interest in incorporating Complete Street principles that accommodate all road user (cyclists, transit, pedestrians, motorists). As development progresses, it is recommended that designer/developers make all reasonable provisions for the accommodation of bicycles, pedestrians and transit users along the Mountain View-Copper-Quarts corridor in the planning, design, and construction stages, except where pedestrians, bicyclists and/or transit services are prohibited by law or where unsafe or impractical.

## **5.4 Whistle Bend Way Extension and Round About**

For Phase 3 development it will be necessary to extend Whistle Bend Way from the existing portion done as part of Phase 1 and 2 development. This will connect to Casca Boulevard with a proposed round-about. This will require approximately 250 m of roadway to be constructed plus a single lane round-about. This road section is to match the existing initial road design, consisting of: two 3.75 m wide travel lanes separated by a 6.5 m wide centre boulevard and 3.0m wide bike lanes on each side.





# 6

## Engineering Servicing Plans



## 6

# Engineering Servicing Plans

This section describes the preliminary servicing plan for the municipal infrastructure required for Whistle Bend Phases 3-7. It is important to note that planning and engineering sections are mutually supportive and the overall functionality and sustainability of the neighbourhood depends on these two aspects working together.

**Detailed design for servicing should review planning sections and be guided by goals, overall design intent and an integrated approach for each Phase of development.**

Planning documents for “future areas” referenced in this section should take precedence over this preliminary engineering report. The area south of Keno Way is especially important as the lack of detailed planning in this area could impact future servicing and marketability of the area along the north side of Keno Way in Phase 3.

## 6.1 Site Grading

The site grading plan for Phases 3-7 was developed with consideration of the following principles:

- Stormwater management – Ensure proper drainage for both minor and major storm events and consider underground piping depth and slopes.
- Sanitary sewer – Ensure proper depth of bury and minimum/maximum slope requirements.
- Roads – Ensure sufficient slopes for overland drainage, and minimize steeper slopes. Conform to existing topography wherever possible.
- Existing vegetation retention – Evaluate and identify opportunities to maintain existing vegetation within the lots and green belts. Clearing of vegetation in this plan occurs where cut/fill is outlined.
- Minimize earthworks – Provide a plan that requires the least amount of earthworks to grade the development. The amount of fill material that is imported or excess that needs to be hauled away should be minimized. The current plan has an average cut depth of 0.66 m and an average fill depth of 0.58 m within the road ways. Note this is to final grade elevations (and does not take into account the road structure components of granular materials, asphalt, or sub-excavation of poor soils) and represents an approximation of earth balance for the site.

The overall grading concept plan, Figure 6.1, identifies the existing ground contours and spot elevations for proposed finish grades of the roads with the corresponding cut/fill's shown. Other key components of the grading plan, such as; storm ponds, bio-swales, and existing depressions are also shown.

A portion of Phase 3 (between Keno Way and Mascot Street) and a portion of Future Area A was cleared during the development of Phases 1 and 2. Casca Boulevard road right-of-way is already cleared. A large hill and surrounding area was excavated and hauled to the nearby Phase 1 and 2 development.

Therefore the contours and cut/fill labels for this area would need to be updated with current topographic data at the time of detailed design.

For cuts and fills of 0.5 m or more, clearing will be required on lots to achieve the maximum/minimum allowable slopes. The Yukon Government may consider pre-grading in areas where there are more significant cuts and fills as a cost saving measure for purchasers.

Most lots that require clearing will be done for the purpose of placing fill in order to reach the proposed design grades. Typically lots needing to be cleared are situated lower than the adjacent roads. In order to achieve proper drainage it is necessary to raise the elevation of those lots.

Fronts of lots will be cleared to allow for the construction of the services from the mains to the property line.

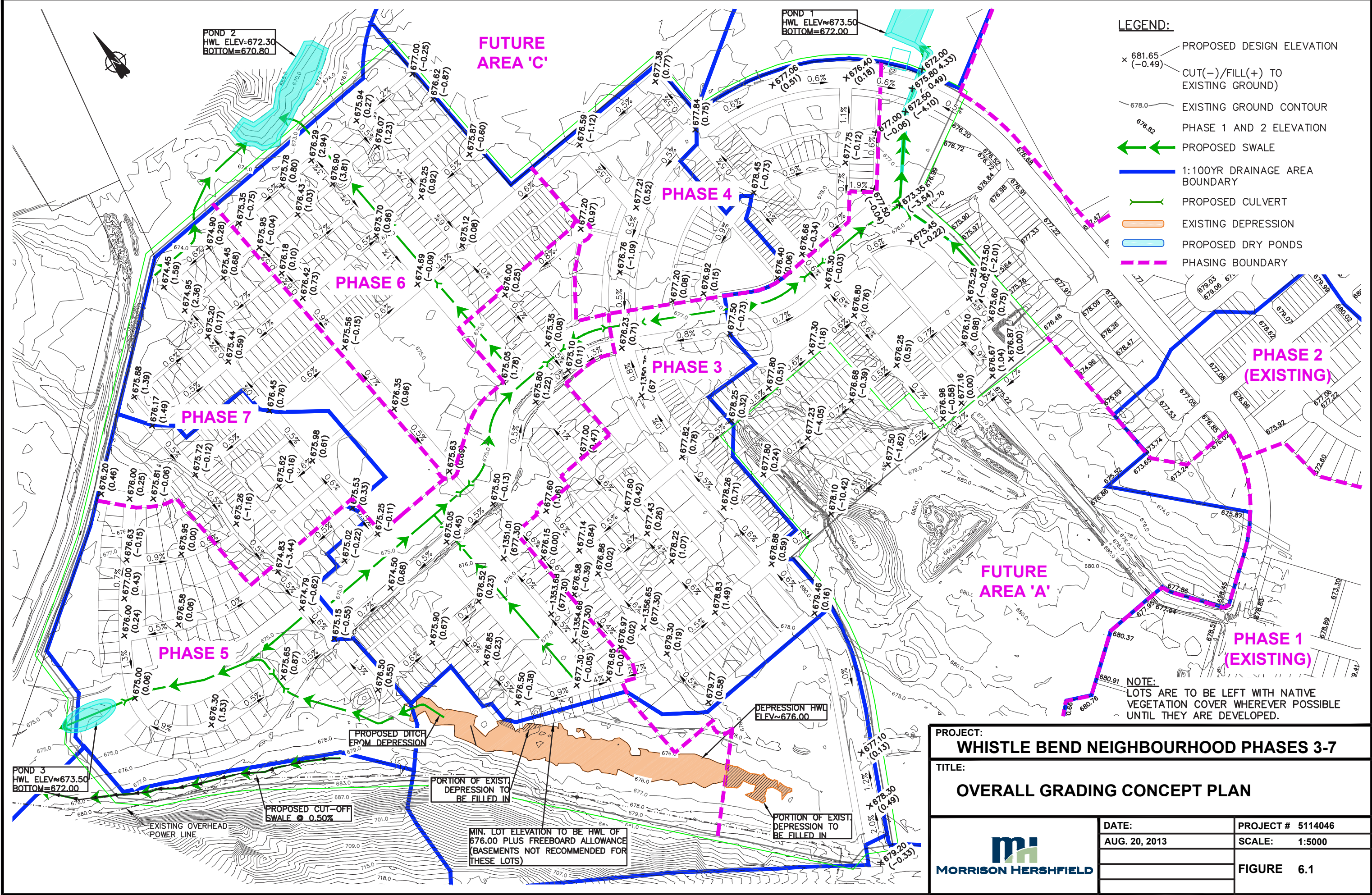
Low spots and areas that need to be raised to maintain proper drainage throughout the development could impact the adjacent lots, and in some cases require the lots to be raised to provide proper lot drainage.

The type of individual lot grading will be dependent on the roads, lane grades, and drainage. Large lots (Commercial, Institutional, etc), may require tree clearing, but will depend on the size and type of structure, parking lots, etc. These areas could remain treed until such time that development occurs. The final configuration of each lot will be determined during detailed design.

Lots that back onto low areas and storm ponds, may require special consideration for basement design, as ground water and High Water Level (HWL) in these areas could pose a risk to basements, both in the short term or in the future if water levels rise over time. Restrictions on basements may need to be implemented depending on the specific situation of certain lots. It is recommended that no basements be permitted for lots that are adjacent to the existing depression along Breadwinner Street.

Roadways will require clearing for the construction of the road surface, sidewalks, and utilities including street lighting. There is potential that some native vegetation could remain at the edges of the right-of-way's in instances where the existing grades match the design elevations.

Laneways will also require clearing. The grading design of the lanes will be mainly dependant on roadways. The lanes will drain towards the roads. Generally this will require that the lane be elevated in the middle to drain towards either end, or sloped from one end to the other depending on nearby road elevations. The lanes have been evaluated and have been confirm that the proposed grading plan will provide reasonable drainage of the lanes. The lanes will have a minimum slope of 0.5% and grades established by tying into the roads. Design grades for lanes adjacent to greenbelts have been included on Figure 6.1.



Green Streets will need to be cleared to allow for underground utilities, lighting and sidewalk construction. In most cases the locations of the Green Streets require minor grade change. Strategic alignment of the sidewalk/trail could also be done to minimize the amount of clearing. These areas will be landscaped.

Green Belt areas are not to be cleared with the exception of drainage swales, trails, and storm ponds as indicated. These areas will receive run-off from streets and surrounding areas, which will help maintain the vegetation. Green Belts are to be maintained as close to the natural state as possible. Location and construction of trails and drainage ditches /bio-swales should be done in a way that minimizes disturbance and maintains high value vegetation. This could include alignments that are designed to limit the need for clearing (an example is curved versus straight). Areas that are disturbed shall can be re-vegetated as part of the landscaping.

### 6.1.1 Lot Drainage Types

For the development of Phases 3-7, there will be three (3) primary lot drainage types. These include:

- Front-to-back,
- Back-to-front, and;
- Split lots.

These are included in the City of Whitehorse Servicing Standards Manual. These apply most specifically to the Residential Single Detached, Single Family, and Townhouse lots. For other types, the site specific use may require some variation or combination of lot drainage to accommodate the specific requirements of the individual site.

## 6.2 Sanitary Sewer Servicing

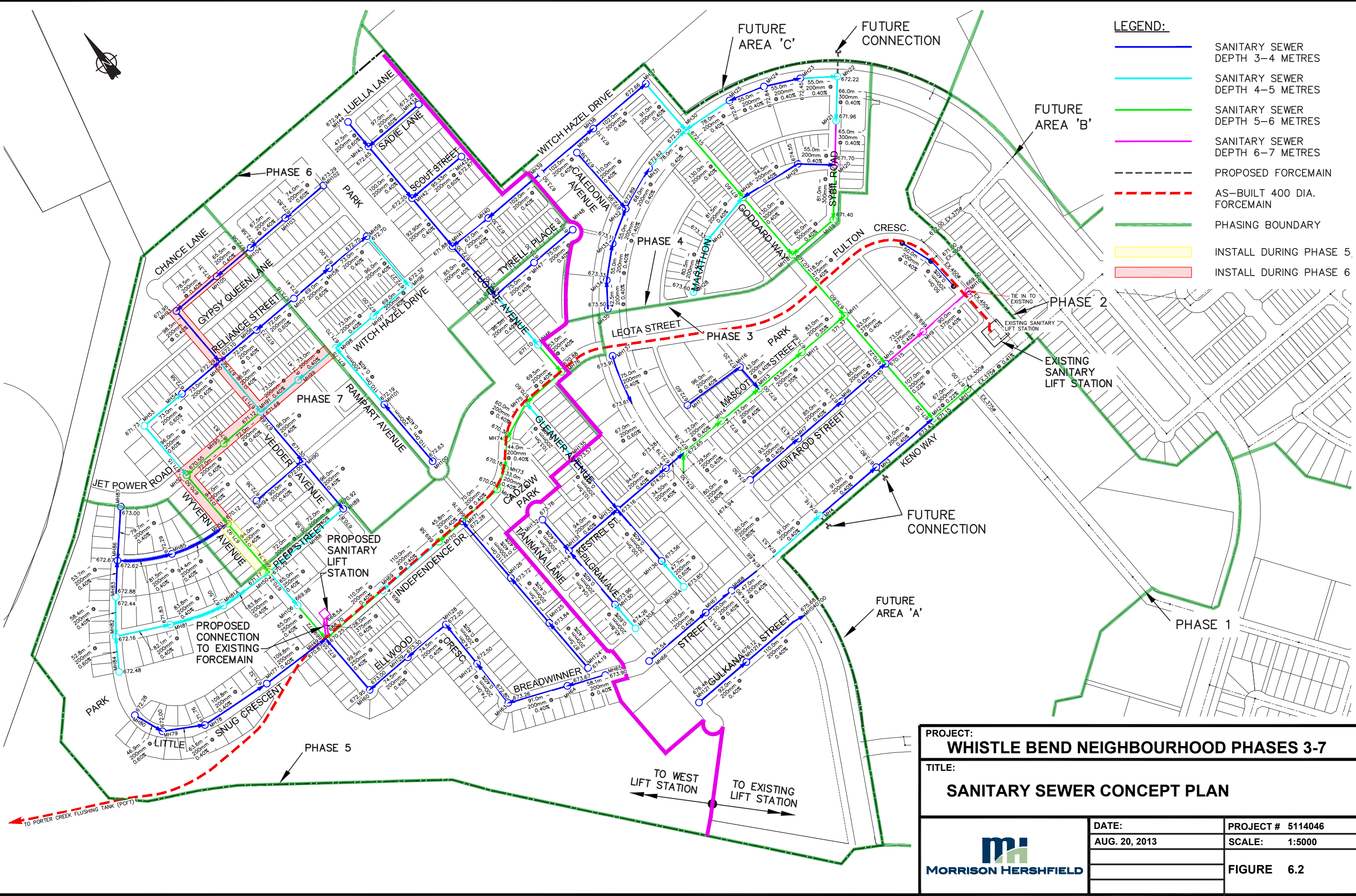
The sanitary sewer system consists of on-site and off-site components (Figure 6.2). The on-site components are considered those within the development boundaries. The off-site components are those items that are beyond the development boundaries, but are required as a direct result of the added demands placed on infrastructure as a result of this proposed development.

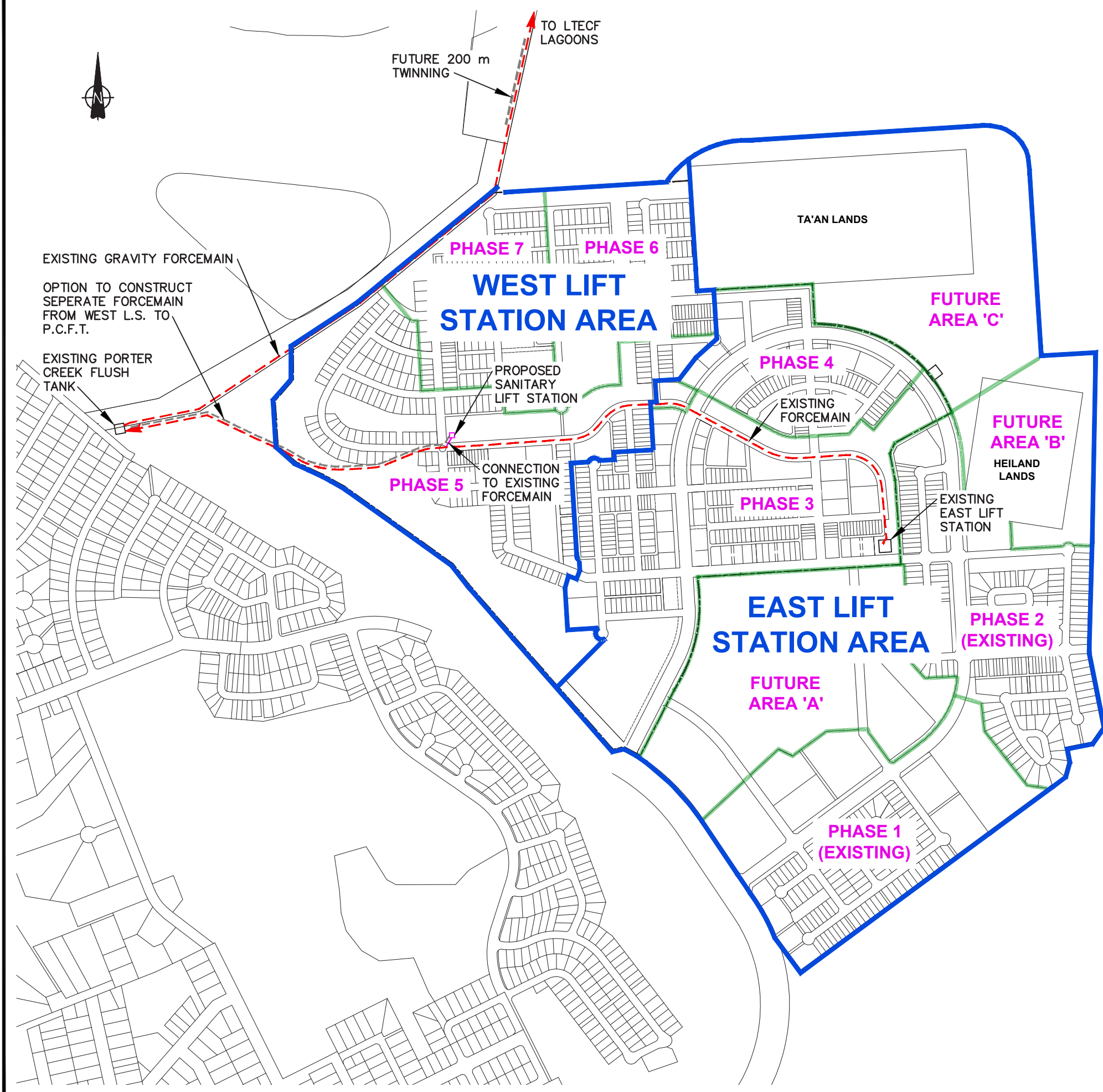
### 6.2.1 On-site Sanitary Sewer Servicing

The piping routes for the on-site sanitary system will follow the roadways. The proposed grading plan, Figure 6.1, shows elevations that the sanitary and storm drainage design are based on.

An underground pipe network of 200 mm to 375 mm diameter is proposed to convey sanitary sewage by means of gravity to two lift stations. Figure 6.2 shows the proposed on-site sanitary system.

One lift station, the “east lift station”, is being constructed as part of Phase 1 and 2 construction and will ultimately service Phases 1-2, 3-4, and the Future Areas A, B and C. A second, proposed lift station, the “west lift station”, will be constructed to service Phases 5, 6, and 7. These two lift stations will pump the wastewater through a force main to the Porter Creek Flush Tank (PCFT). This configuration is consistent with the previously developed Option 2 in the On-site Servicing Report by AECOM, and was further developed as part of the Whistle Bend Sanitary Sewer Master Plan-Phase 1-5, by Associated Engineering (September, 2010).





LEGEND:

- PHASING BOUNDARY
- LIFT STATION CATCHMENT AREA
- AS-BUILT 400 DIA. FORCEMAIN

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**

TITLE:  
**OFF-SITE SANITARY**



DATE:	PROJECT # 5114046
AUG. 20, 2013	SCALE: 1:10000
	FIGURE 6.3

It is noted that the phasing plan has since been modified and the changes to the phasing titles are listed below in Table 6.1.

**Table 6.1 Changes to Phasing Titles**

Phase Split as referenced in Previous Reports	Current Whistle Bend Neighbourhood Plan (3-7)
Phase 1	Phase 1
Phase 2	Phase 2 and Future Area B (incl. Heiland Lands)
Phase 3	Phases 3 and 4
Phase 4	Future Area A
Phase 5	Future Area C (incl. Ta'an Lands)
Phase 6	Phases 5, 6, and 7

\*Associated Engineering, Sanitary Master Plan (Sept 2012)

The Future Area C (including the Ta'an Lands) and Future Area A catchment areas are included for the purpose of allowing for servicing of those lands; lift station capacity and sewer main sizing. The Future Area B (including Heiland Lands) has been included in Phase 2 for reference.

#### 6.2.1.1 Design Criteria

The following criteria were used in the preliminary design of the sanitary system:

- Maximum Manhole Spacing = 110 m
- Pipe sizing based on a flow depth of 80% full during peak flow
- Minimum velocity to be 0.70 m/s or greater
- Maximum velocity to be 3.0 m/s or less
- Pipe Burial Depth = 2.8 m from ground to crown of pipe
- Manning's Pipe roughness coefficient = 0.013
- Minimum pipe slope for 200mm pipe to be 0.4% to achieve self-cleansing. Flatter slopes will be considered for larger diameters. At the top end of the system 0.6% slopes are recommended due to low flows.
- Average Domestic Flow: 337 l/c/d (reduced from 450 l/c/d as part of the water reduction strategy and as per the AECOM report), is based on 90% of water consumption (375 l/c/d) Refer to the Water Demand section.
- Peak Flow: Max. Peaking Factor = 5.0, Minimum Peaking Factor = 1.5 (Harman Equation)
- Infiltration 6000 l/ha/day

#### 6.2.1.2 Sanitary Flows

The sanitary sewer system shall be of sufficient capacity to carry peak flows plus infiltration (Peak Wet Weather Flow (PWWF)). Section 2.4 of the City of Whitehorse Servicing Standards Manual provides the factors to be used in the design of the sanitary sewage system.

During the early stages of development during winter conditions there is the possibility of freezing of the sewer mains. Temporary bleeders may have to be installed to keep the system open.

The preliminary design of the sanitary sewer system is based on the proposed land use and population. The information used for this purpose was the estimated population for each land use and the number of lots, for which the average number of people per lot was calculated. The number of units and people per unit were not used as these values include ranges of numbers as well as primary and secondary units that are not reflected on the base plan. The total estimated population, based on land use, is 4,907 people for Phase 3-7. The breakdown for each phase is shown in the Table 6.2.

**Table 6.2: Population and Land Use Phases 3-7**

				Phases									
				Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Land Use	#Lots	Pop.	P/Lot	#Lots	Pop.	#Lots	Pop.	#Lots	Pop.	#Lots	Pop.	#Lots	Pop.
RCS3 Standard Single Family	204	945	4.63	12	56	0	0	130	602	31	144	31	144
RCS Narrow Lot	354	1204	3.40	144	490	28	95	57	194	66	224	59	201
RCM3 Cottage Cluster	18	187	10.39	1	10	0	0	11	114	0	0	6	62
RCT Multiplex Fee Simple	213	533	2.50	49	123	59	148	13	33	43	108	49	123
RCT2 Multiplex Strata	22	573	26.05	18	469	2	52	2	52	0	0	0	0
RCM2 Apartment	17	1254	73.76	5	369	10	738	0	0	1	74	1	74
CMU Commercial Mixed Use	16	142	8.88	16	142	0	0	0	0	0	0	0	0
PS Institutional (Seniors Care)	2	69	34.50	2	69	0	0	0	0	0	0	0	0
CN2 Neigh. Commercial	2	0	0	0	0	0	0	0	0	0	0	2	0
PR Community Use	1	0	0	0	0	0	0	0	0	0	0	1	0
PS Institutional	2	0	0	1	0	0	0	0	0	1	0	0	0
PR Parks	4	0	0	1	0	0	0	2	0	1	0	0	0
<b>Total</b>	<b>855</b>	<b>4907</b>		<b>249</b>	<b>1727</b>	<b>99</b>	<b>1033</b>	<b>215</b>	<b>995</b>	<b>143</b>	<b>549</b>	<b>149</b>	<b>603</b>

As indicated in the table above, the largest phase based on population is Phase 3 at 1,727 people. Phase 6 is the smallest at 549 people. The average number of lots and population per phase is 171 lots and 982 people.

The table below shows the calculated PWWF from each Phase separately.

**Table 6.3: Sanitary Flow Phases 3-7**

	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7
lpcd	337.5	337.5	337.5	337.5	337.5
Population	1727	1033	995	549	603
ADWF (m3/day)	582.86	348.51	335.80	185.44	203.51
ADWF l/s	6.75	4.03	3.89	2.15	2.36
Peaking Factor	3.63	3.79	3.80	3.95	3.93
PDWF l/s	24.52	15.29	14.77	8.48	9.26
Area (ha)	38.08	13.20	38.90	15.60	14.73
I/I	2.64	0.92	2.70	1.08	1.02
PWWF l/s	27.16	16.21	17.47	9.57	10.28

The table above shows that Phase 3 has the largest flow generation at 27.216 l/s, and Phase 6 has the smallest flow generation at 9.6 l/s.

Table 6.4 shows the total calculated PWWF from Phases 5, 6, and 7 which is included in the proposed west lift station catchment. There is a slightly lower peaking factor, of 3.56, based on the larger cumulative population.

**Table 6.4: Sanitary Flow West Lift Station Catchment**

West Lift Station	
	Phase 5,6,7
lpcd	337.5
Population	2147
ADWF (m3/day)	724.75
ADWF l/s	8.39
Peaking Factor	3.56
PDWF l/s	29.88
Area (ha)	69.22
I/I	4.80
PWWF l/s	34.68

Table 6.5 shows the total calculated PWWF from Phases 3 and 4 which contributes to the east lift station catchment area. There is a slightly lower peaking factor when these are combined, of 3.47, based on the larger cumulative population.

**Table 6.5: Sanitary Flow from Phase 3 and 4 to East Lift Station**

East Lift Station	
	Phase 3,4
lpcd	337.5
Population	2760
ADWF (m3/day)	931.37
ADWF l/s	10.78
Peaking Factor	3.47
PDWF l/s	37.44
Area (ha)	51.28
I/I	3.56
PWWF l/s	41.00

The lift station capacity requirements are based on the above PWWF's and discussed further in the section 6.2.1.4 Lift Station Capacity.

### 6.2.1.3 Pipe sizing

The number of lots and the corresponding population per lot was applied in determining the sewage generation for the pipe sizing. Preliminary pipe sizing was determined using a spreadsheet model, utilizing Manning's Formula, with the above mentioned criteria along with the following criteria used in combination with the proposed land use and lot layout.

The residential flow generation is calculated using the following:

Population Density:

- Standard Single Family (lots): 4.63 people/lot
- Medium Density (lots): 3.40 people/lot
- Medium Density (area): 110 people/ha
- High Density-Apartment (area): 200 people/ha

Detailed land use for the Future Areas A and C is not available. Assumptions were made in the land use of the contributions from these areas in the sewer main upsizing. Future Area B (including Heiland Lands) have been included in Phase 2 design.

- Future Area C (including Ta'an Lands): 50-100 people/ha
- Future Area A: 110 people/ha for the 3 ha area contributing to the sewer main along Keno Way Commercial High Street.

Details for building types on commercial and institutional lands are not available and therefore population equivalents are used to determine the flows generated from these land uses.

Population Equivalents:

- Commercial (area): 110 people/Ha (City of Toronto Sewer and Watermain Design Criteria Manual)
- Institutional (area): 86 people/Ha (City of Toronto Sewer and Watermain Design Criteria Manual)

Sewer main sizes for Phases 3 and 4 were designed to have enough capacity for the Future Area C. This catchment is proposed to connect at MH22. The 3 Ha portion of the Future Area A that connects to a trunk main in Phase 3 at MH4 and MH3 is also included in the sewer main sizing. The land use in these areas would require detailed analysis in future design stages, to confirm the contributing flows.

#### 6.2.1.4 Lift Station Capacity

Wastewater flows from Phase 3 and 4 will discharge into the existing east lift station; wastewater from Phase 5, 6, and 7 will discharge into the proposed west lift station. The contribution split for each lift station is illustrated on Figure 6.2.

The west lift station will pump into the existing 400 mm HDPE forcemain that goes to the PCFT. This would require some controls to establish proper pumping with discharge from the east lift station. An alternative would be to construct a separate forcemain to the PCFT from the West Lift Station. The summary of sanitary flows for Phase 3 to 7 is shown in the table below.

**Table 6.6: Summary of Sanitary Flows for Phases 3 to 7**

Description	Units	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7
Peak Flow	l/s	27.16	16.21	17.47	9.57	10.28
Population	People	1,727	1,033	995	549	603
Discharge/Lift Station		East		West		
Total Peak Flow	l/s	41		35		
Total Population	People	2,760		2,147		

The total peak sanitary flow from Phases 3 and 4 going to the east lift station is 41 l/s. The total capacity required for Phases 5, 6 and 7 for the proposed west lift station is 35 l/s. These lift stations are discussed further in the following sections.

#### 6.2.1.5 East Lift Station

For Phases 3 and 4, the wastewater will flow to the existing east lift station, as shown in Figure 6.2. The pumps, piping, valves and controls in this lift station are sized to handle Phase 1 and 2 flows. The Discussion Paper 2 – 60% Design Wastewater Pump Station, by Associated Engineering (December 9, 2010) has the east lift station design capacity of 137 l/s and 8,200 people. However it should be noted that “Phases 1-5” that were previously established in terms of size, location and land use, have since been modified and changed. Refer to Table 6.1 presented earlier in this section for the Phasing Changes. The east lift station capacity is split up as indicated in the table below:

**Table 6.7: East Lift Station Sanitary Flow**

Previous Phasing Scheme (used for lift station design)		Current Phasing Scheme		
Sanitary Master Plan-Phases	Peak Flow to East Lift Station (l/s)	Current Phasing	Updated Peak Flow to East Lift Station	Comments
Phase 1-2 (3,220 people)	60	Phase 1-2 (3,220 people)	60	Includes Future Area B
Phase 3 (1,280 people)	21	Phase 3-4 (2,760 people)	41	Larger area now, and higher density
Phase 4 (1,640 people)	26	Future Area A	31-39 (available)	Smaller areas now, flow will be less, smaller population
Phase 5 (2,060 people)	30	Future Area C		
Total (l/s)	137 (design=140)*		132-140	

\* Actual lift station design capacity is 140 l/s (Associated Engineering)

Phases 1 and 2, and Phases 3 and 4 account for 101 l/s, which leaves 39 l/s (difference of the design capacity (140 l/s) and estimated flows for the east area (101 l/s)) for the Future Areas A and B. If the entire Whistle Bend development is based on 10,000 people and the current plans for Phase 1-7 accounts for 8,127 people, then there is a remainder of 1,873 people that can be allocated to the Future Areas A and C. This population and an approximate land area of 64 ha, would require 31 l/s. Therefore, the 39 l/s remaining capacity would be sufficient to service these two future land areas.

The east lift station design capacity of 140 l/s is sufficient for Phases 1 and 2, Phases 3 and 4, Future Area A, B, and C based on a total Whistle Bend (all Phases) population of 10,000.

The capacity of the existing 400 mm HDPE forcemain from the east lift station to the PCFT will need to be confirmed at the design stage.

Modifications, with respect to the pumps in the east lift station will be required as development occurs. At this time it is assumed that the Phase 1-2 will provide two pumps, with the third pump required for Phases 3 and 4. The third pump would be installed with Phase 3 development. Data from operations of the existing lift station should be reviewed to determine the exact pump size requirements and timing of installation. For the development of Future Area lands, pump requirements and lift station upgrades will need to be addressed during the design of those areas.

Other possible modifications, listed below, will need to be considered at the detailed design stage:

- Upgrading grinder capacity
- Replacement of smaller pumps with larger pumps
- Installation of ionizers for odour control
- Space for odour control

There are no modifications expected for the lift station wet well capacity, as it will be constructed to the ultimate size initially.

#### **6.2.1.6 West Lift Station**

For Phases 5,6, and 7, the wastewater will flow to the proposed west lift station, as shown in Figure 6.2, and pumped to the existing 400 mm diameter HDPE forcemain, that discharges to the PCFT. The west lift station will need to have a capacity of 35 l/s peak wet weather flow to service the proposed population of 2,147 people.

The West lift station is proposed to be located within a greenbelt on the northwest corner of Wyvern Avenue and Independence Drive. This is in close proximity to the existing forcemain that goes from the existing East lift station to the PCFT. The lift station will need to be approximately 6.5 m deep based on the preliminary grading plan and sanitary sewers.

A short forcemain, approximately 20 m long, will be installed to link the west lift station to the existing forcemain. The forcemain sizing and lift station design is outside the scope of this report and is to be completed as part of the next steps in the development process. It will be necessary to integrate the control systems for the two lift stations and confirm the capacity of the single force main with both stations running

Another option would be to construct a separate forcemain from the west lift station to the PCFT. This would require about 850m of forcemain. This option could be assessed in the is to be refined in the detailed design stage of Phase 5 and compared with the recommended option to connect to the existing forcemain.

### **6.2.2 Off-Site Sanitary System**

The Off-Site Servicing Report, AECOM and Quest Engineering (December 9, 2008), included an analysis of the Whistle Bend development off-site infrastructure impacts. Recommendations were made regarding the off-site sanitary system infrastructure. In total 4 options were considered. With the present development proceeding in Phase 1 and 2 based on Option 2 in that report. Phase 3-7 will also follow in line with this. The off-site sanitary system is shown in Figure 6.3.

#### **6.2.2.1 Porter Creek Flush Tank**

The previous report, Off-Site Servicing Report, AECOM and Quest Engineering (December 9, 2008), indicated that the Porter Creek Flush Tank (PCFT) forcemain has additional capacity to accommodate 90 l/s PWWF from Whistle Bend. Phase 1 and 2 are now going to diminish that capacity by 60 l/s. Therefore there should be 30 l/s capacity, for Phase 3 and possibly a portion of Phase 4. This would require monitoring as development progresses to anticipate when upgrades to handle the remaining development phases would be needed.

As previously recommended in the Off-Site Servicing Report, AECOM and Quest Engineering (December 9, 2008), the proposed off-site upgrades required, for this particular configuration (Option 2), would include:

- Construct a 200 m long, 450 mm diameter force main to twin the existing PCFT force main.
- Connect 300 m of existing 450 mm river crossing.

The Off-site Servicing Report, AECOM and Quest Engineering (December 9, 2008), estimated the implementation of this at 15-20 years from the start of development. Actual flow measurements as development progresses should be collected to provide the most accurate estimate of the timing for the upgrade. Based on the calculated flows for the development, the above proposed upgrade would be required at some stage of Phase 4.

The detailed design phase will need to address the continued use of the Rotork Valve at the bottom of Jet Ski Hill.

#### **6.2.2.2 Livingston Trial Environmental Control Facility (LTECF)**

An in-depth design brief of the capacity of the LTECF by David, Nairne and Associates (June 7, 1996) was completed. The review of this work was done as part of Off-Site Servicing Report and was determined that the facility does have a capacity for the Whistle Bend development. Phase 3-7 development is consistent with the servicing concept and there are no changes in the recommendation at this time.

## **6.3 Water Distribution**

The water distribution system consists of on-site and off-site components. The on-site components are considered those within the development boundaries. The off-site components are those items that are beyond the development boundaries, but are required as a direct result of the added demands placed on infrastructure as a result of this proposed development.

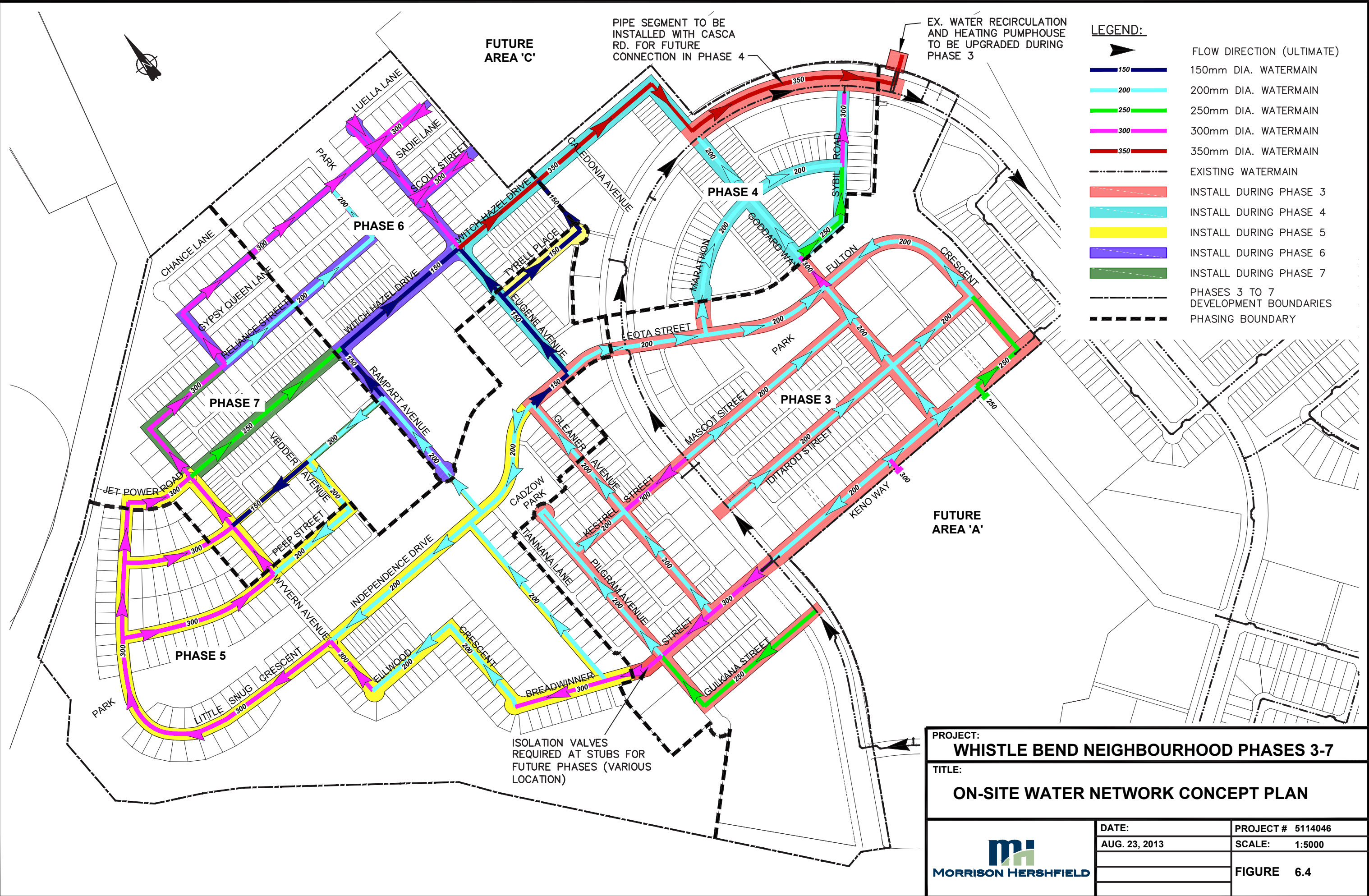
### **6.3.1 On-Site Water Distribution**

A Technical Brief for the on-site water system was completed, for this preliminary design report by Quest Engineering Group and is included in an Appendix C. It is noted that the design brief refers to Phases 3-5, but has since been changed to Phase 3-7. There was no change to the overall development area or the analysis. The information presented below is a summary of the document. The water distribution network is shown in Figure 6.4 -Water Network Concept Plan. The Appendix C includes the pressure and flow plans and heat loss calculations.

#### **6.3.1.1 Water Demand**

The estimated population for Phase 3-7 development is 4,924 people. The service population for Phases 1-2 was previously identified in the Discussion Paper 2-60% Design Wastewater Pump Station (Associated Engineering, Dec. 9, 2010) to be approximately 3,220 people. Future Areas A, B and C are

ANSI B SIZE 11"x17" (279.4mm x 431.4mm)  
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- LK:urach - August 23, 2013 - 11:06 AM



also included in the water modeling as these future developments will require water supply for the currently planned distribution zones. Therefore the total design population for Whistle Bend used in this pre-design is 10,000 people, as detailed in table below:

**Table 6.8: Population by Phase**

Phase	Population
Phases 1 and 2	3,220
Phases 3-7	4,907
Sub-Total	8,127
Future Areas	1,873
<b>Total</b>	<b>10,000</b>

The anticipated water demand is based on 375 litres per person per day. The resulting Average Daily Demand (ADD) for a population of 10,000 will be 43.4 l/s. It is noted that the demand is lower than that City of Whitehorse standards, and has been considered appropriate in following water reduction strategies.

- New toilets with efficient flow rates
- Faucets can be retrofitted with spout-end flow control devices.
- Low flow shower heads
- High efficiency clothes washers
- Metering and fee structures
- Prompt leak detection and repair
- Building design use of recycled water and/or storm water collection use.
- Landscaping with little or no water – xeriscaping

### 6.3.1.2 Design Criteria

The following design criteria have been used in the analysis:

Average Daily Demand (ADD)	375 l/c/day (residential) (ultimate demand) 43.4 l/s total ADD
Maximum Day Demand (MDD)	2 x ADD
Peak Hour Demand (PHD)	4 x ADD (due to lower base demand)
Night Fill Demand (NFD)	0.1 x ADD (no flow-through NFD in this area)
Minimum Velocity	0.15 m/s @ ADD (or as identified by Thermal Analysis)
Maximum Velocity	3.0 m/s @ PHD 5.0 m/s @ MDD plus Fire
Minimum Pressures	280 kPa @ MDD (ground level) 140 kPa @ MDD plus Fire (ground level)
Maximum Pressures	550 kPa (80 psi) (desirable) 700 kPa (100 psi) (max with PRV's on affected Services)
Minimum Fire Flow	75 l/s (Residential) <sup>1</sup>

Maximum Fire Flow	25 l/s (Multi-family row housing) <sup>1</sup>
	250 l/s (Commercial and Public Use)
	300 l/s (based on Fire Fighting Capacities)

<sup>1</sup> Based on recommendations from IAO (Insurers Advisory Organization) Fire flow requirements are higher due to increased development density and reduced exposure distances between dwellings units.

Min. Depth of Bury (looped systems un-insulated mains)	3.5 m, obvert to gutter line
Services	2.4 m, obvert to gutter line/property line
Ground Heat Transfer	3.1 W/m C (dry sand and silt)
Design Ground Temperature	3 Celsius (for Lower Bench Area)
Pipe Heat Transfer	50 W/m C (ductile iron)

### 6.3.1.3 Water System Analysis

The complete water system analysis is included in the attached Technical Brief. The City of Whitehorse EPA Net water model was used.

Water model results indicate that the proposed watermain system can provide the required fire flows with acceptable maximum and minimum velocities.

- Available fire flows 125 to 300 l/s
- Required fire flows 75 l/s minimum to 250 l/s maximum
- Minimum residual 140 kPa at ground elevation (nominal node Pressure elevation) at MDD plus fire
- Maximum Velocity 2.5 m/s at MDD plus fire
- Minimum Velocity 0.02 m/s at NFD

Note that the current water modeling includes an allowance for future population on the Taan and Heiland parcels to ensure that these areas can be adequately serviced in the future.

The water system layout and pipe sizing provides balanced system circulation flows without the need for balancing valves installed in the system, for the ultimate development concept. Some flow balancing may be required during phased development, and should be checked at each development phase to confirm adequate balancing. The development can be adequately serviced with a partially constructed water system. Return loops will tie back to the recirculation pumphouse.

Flow balancing in the loops is controlled by pipe head loss balancing throughout the development. During the early stages of development, the flow balancing will have to be checked for each phase to ensure adequate flow balance is maintained. The positioning of isolation valves and the temporary closed/opened positions could direct flows for interim conditions. As well, some short segments of piping are proposed to provide interim looping, to minimize the amount of piping to be installed beyond phase boundaries (An example is the proposed 200 mm pipe from Eugene Avenue across Casca to Leota Street).

This would provide looping for Phase 3 initially, until Phase 4 is constructed).

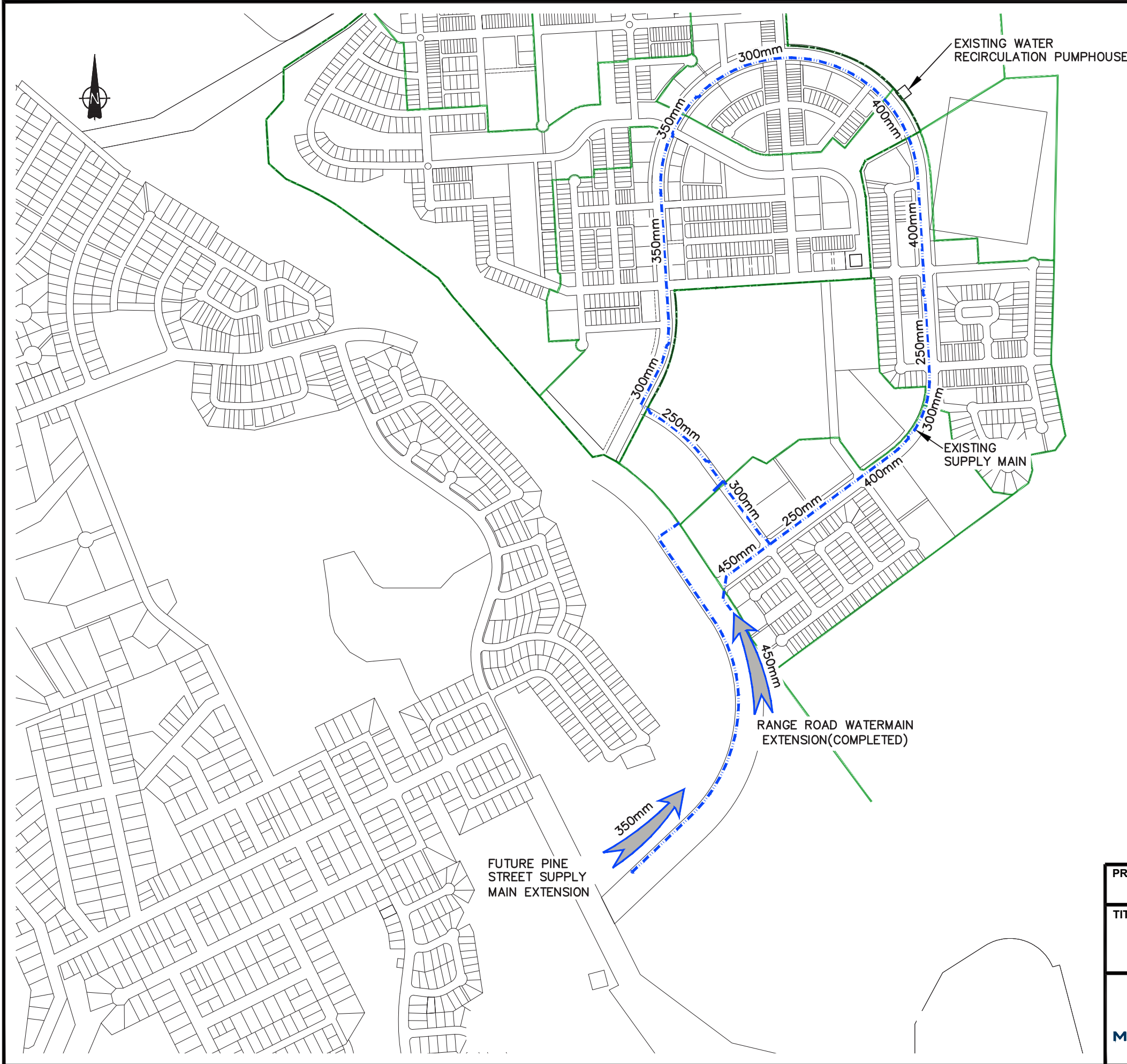
The primary service loop will be constructed along the proposed Casca Boulevard route, with distribution mains extended to the future commercial core area, or into Phase 3 to 7, depending on the demand for development type in the area. Either expansion option provides adequate recirculation and fire flow for all Phases, depending on the development sequence selected.

The current location of the recirculation and heating pumphouse accommodates return loop development to the pumphouse, however, the previous development concept assumed the return loop would pass through the proposed Taan Land selection to provide service to that area as well. The current plan does not incorporate the Taan Development, therefore the return loop is required to be constructed as a parallel main along a portion of Casca Boulevard. This section of main may have to be abandoned in the future, to accommodate Taan land development, so no services should be connected to this section of return loop.


Recirculation and Thermal Analysis were also completed. The required recirculation flow to maintain a maximum 2 C heat loss is 80 l/s assuming a 4 C supply temperature and a 2 C return temperature. The water system thermal analysis suggests a total system heat loss of approximately 680 kWatts. Based on 85% efficiency the required boiler input capacity for ultimate development (Phase 1-7) would be 800 kWatts.


Based on the water system analysis completed the recommended on-site water system improvements include:


- Installation of a new 350, 300, and 250, 200 and 150 mm looped watermain system in the proposed expansion area, with forced circulation provided from the new circulation pump station.
- Watermain construction will be completed as staged developments.
- A supply trunk main is being constructed (Phase 1 and 2) following the proposed Casca Boulevard roadway. From this primary trunk main, parallel loops can be constructed for phased development as required.
- A single recirculation and heating pump house has been located on the main trunk main loop, such that a single pump house can provide recirculation and heating for the entire development.
- Return loops will tie back to the recirculation pump house. Flow balancing in the loops is controlled by pipe head loss balancing throughout the development (temporary valve closures, etc). During the early stages of development, the flow balancing will have to be checked for each phase to ensure adequate flow balance is maintained.
- The pump house will have a common return suction header, and a common discharge header.
- A one-way bypass and fire flow bypass valve will connect the suction and discharge headers to allow by-directional flow through the pump house for fire conditions, to increase available fire flows while minimizing distribution pipe sizes.
- Fire hydrants will be installed at regular spaced intervals to provide 75 m radius coverage for all residential lots and 45 m radius coverage for all commercial lots. These hydrants will be installed in-line with the watermain (no hydrant leads) with bends to the hydrant locations as per the road section details. Insulated service stubs will be provided to each lot.



**LEGEND:**

 EXISTING WATER SUPPLY MAIN

 PHASING BOUNDARY

PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>OFF-SITE WATER</b>		
	DATE:	PROJECT # 5114046
	AUG. 20, 2013	SCALE: 1:10000
		FIGURE 6.5



- Minimum residential service to be 20 mm, insulated and impedance heat traced, or insulated recirculating services with 25 mm supply / 20 mm return.
- Minimum commercial services to be insulated recirculating services with 50 mm supply / with 20 mm return circulation line.
- All watermain construction will be as per the City of Whitehorse Servicing Standards Manual, latest edition.

#### 6.3.1.4 Water Recirculation Pump House (Phases 1-7)

The ultimate configuration for the pump house includes the following components:

- 2 recirculation duty pumps and 1 standby pump (100% capacity)
- recirculation pump capacity is 5 kW (7.5 HP), 84 l/s @ 8 m TDH (65% overall efficiency assumed)
- 2 oil fired duty heating boilers and 1 standby boiler
- Boiler capacity is 400 kW input, 350 kW output (85% efficiency assumed)
- Each boiler provides 50% of required maximum heat load for water system heating. 2 duty boilers required for maximum heat load.
- An emergency generator capable of running 2 recirculation pumps and 2 duty boilers for maximum heat load requirements, plus building and control loads.
- An electrical room with switch gear has been provided, and is coupled with a remote standby generator which also services the sewage lift station.
- A local SCADA control system with integration into the City's overall SCADA system is provided.
- Pump house exterior design and elevations have been incorporated to fit into the primarily residential development area.

At the time of this report the planned construction of Phase 1 and 2 will include the pump house and will provide one (1) recirculation pump, one (1) standby pump, and one (1) duty boiler and one (1) standby boiler. Therefore, Phases 3-7 will require one (1) recirculation pump, one (1) duty boiler, piping and control modifications. Development of Phase 3 would include these upgrades.

#### 6.3.2 Off-Site Water System

The Off-Site Servicing Report, AECOM and Quest Engineering (December 9, 2008), included an analysis of the Whistle Bend development off-site infrastructure impacts. Recommendations were made regarding the off-site water system infrastructure. Subsequent review and updates to the proposed water distribution system have been completed by Quest Engineering, with the most recent being the on-site brief completed for Phase 3-7.

The updated off-site water system is shown in Figure 6.5.

The proposed Whistle Bend development will receive its water from primary and secondary supply lines. The primary supply is provided by an extension of the Range Road 450 mm diameter water trunk main. This extension was constructed as part of Phase 1 and 2. The new development distribution system will be fed by the primary supply main from the intersection of Casca Boulevard and Whistle Bend Way, south roundabout location. This primary supply line provides all the domestic flow, with capability to

provide up to 150 l/s fire flow.

The secondary supply and additional fire flow supply is proposed as an extension to the Pine Street Supply main. This 350 mm trunk main would provide for alternate domestic flow and additional fire flow up to 280 l/s. This supply would feed in from the north roundabout location and would then provide the development with two independent water supplies. A pressure reducing vault would be required on this alternate supply. The timing and requirement of this additional supply is dependent on the nature of the development as once commercial/institutional development occurs it will require additional fire flow capacity.

An update to the off-site servicing was completed as part of the Whistle Bend Subdivision Cost Estimate Summary by AECOM (November 2009). There were some changes made to the previous recommendations:

- Selkirk Pump House upgrades are no longer included and were to be completed as part of a separate study.
- Addition of a new 6,000 cu.m cell to the Porter Creek Reservoir for 25-50% build out
- Further updates to some of these upgrades have been completed and are noted as follows:
- Valleyview and Porter Creek Reservoirs reconsidered and size requirements have changed. (Opus/Daytonknight Design Report 2011)
- Porter Creek Reservoir is being twinned at 4,000 cu.m and expansion to be complete in 2012.
- The Phase 3-7 development will require that the off-site improvements are carried forward and reviewed as development progresses.

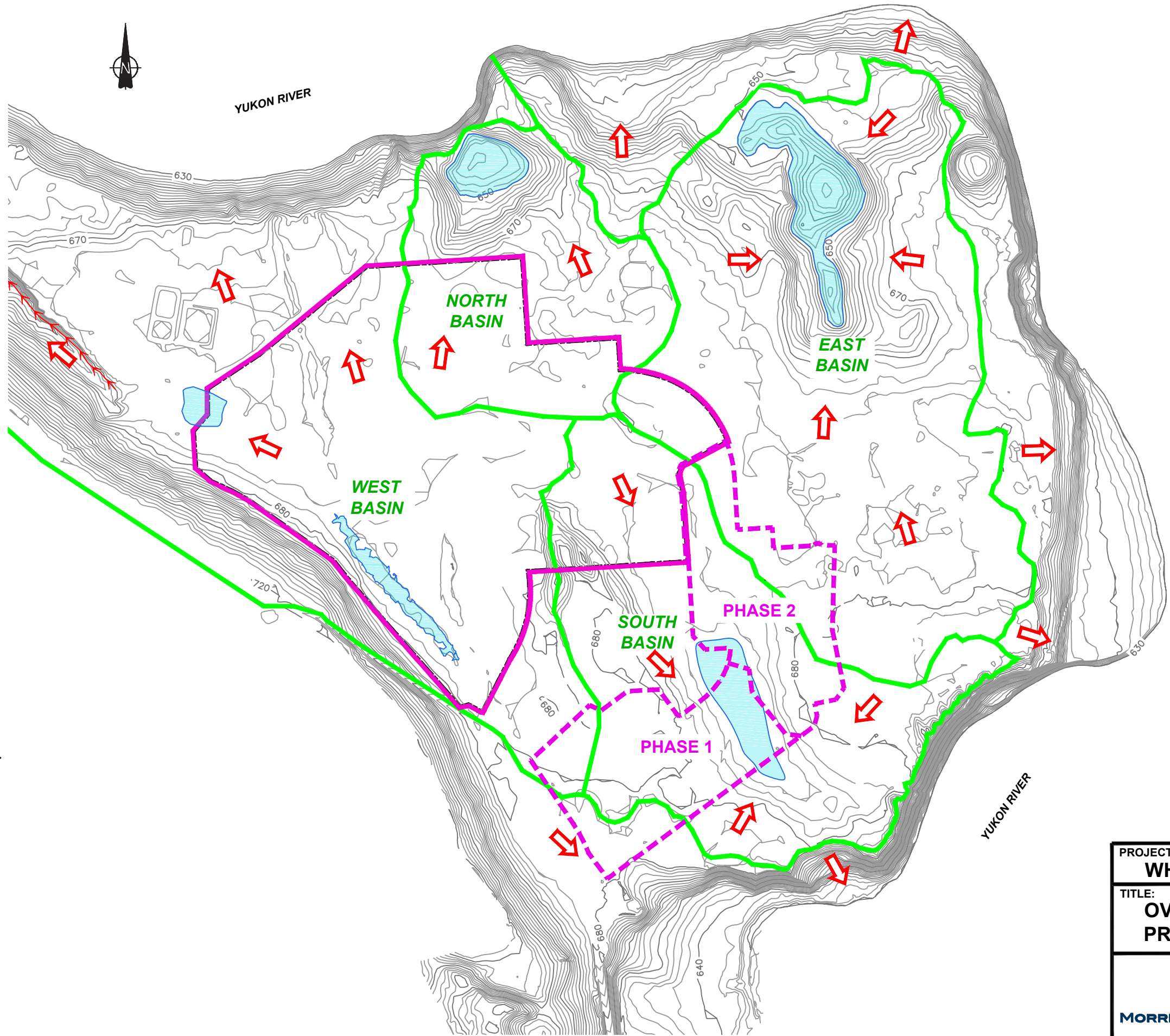
## 6.4 Stormwater Management

### 6.4.1 Background

Previously developed drainage strategies for Whistle Bend, including the On-site Servicing Report AECOM (November 2009), intend to achieve a zero discharge system. Generally the Whistle Bend site has favourable conditions to incorporate infiltration strategies which would reduce the run-off from the development. An infiltration test was conducted to assess the applicability of zero discharge system and discussed in later sections.

The overall drainage concept proposed in the past are based on using the existing drainage basin patterns to service the entire development. This overall drainage concept minimizes the earthwork and re-grading of the land. Existing low points were designated to receive runoff from the site. These concepts had no runoff from the site going to the Yukon River.

In the Technical Memorandum, Whistle Bend Subdivision Stormwater Management Facility Review by Associated Engineering (January 2011), it was proposed that a stormwater pond with an outlet to the Yukon River is the most feasible option for Phase 1 and 2. However, due to environmental and associated cost impact, this option was not preferred by the Yukon Government. It was then proposed that a two stage storage system with temporary pumping be evaluated.



- LEGEND:
- STUDY AREA BOUNDARY (PHASES 3 TO 7)
  - PHASE 1 AND 2 STUDY AREA BOUNDARY
  - MAJOR PRE-DEVELOPMENT BOUNDARY
  - DEPRESSIONS (LOW-LYING AREAS)
  - PRE-DEVELOPMENT OVERLAND FLOW DRAINAGE DIRECTION
  - PRE-DEVELOPMENT OVERLAND FLOW DRAINAGE DIRECTION

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**

TITLE:  
**OVERALL STORMWATER MANAGEMENT PLAN  
PRE-DEVELOPMENT CONDITIONS**



DATE:	PROJECT # 5114046
AUG. 20, 2013	SCALE: 1:12500
	FIGURE 6.6



The stormwater management plan for Phase 3-7 considered these goals as well as the feasibility, and environmental impacts of any proposed stormwater management methods.

### 6.4.2 Existing Drainage Patterns

The study area currently drains in 4 directions; west, east, north, and south. Three (3) of the four (4) areas (North, South, and East Basins) drain ultimately into depressions as shown on Figure 6.6. The fourth basin area (West Basin) ultimately drains into depressions and directly overland into the Yukon River. There is an existing water course in the west basin area which takes some runoff from this basin and discharges it directly into the Yukon River downstream as shown on Figure 6.6.

The proposed stormwater management plan will follow these existing drainage patterns as much as possible to maintain the existing drainage patterns and minimize any impacts to the environment.

### 6.4.3 Stormwater Management Components and Design Criteria

The stormwater management plan for the Whistle Bend Phase 3-7 development follows the criteria as specified in the City of Whitehorse Servicing Standards Manual and is augmented, only where required, by systems that have been assessed using engineering principles and numeric analysis based upon applications in other jurisdictions.

As part of this process, drainage components such as on site infiltration (for single family lots) was assessed as an option to deal with smaller, frequent rain events. However it was determined such systems would be challenging to implement for single family lots (in particular, smaller, compact lots) at this time. Furthermore, on site infiltration mechanisms would typically be overwhelmed by large storms and spring melts and therefore, would not replace the need for a conventional drainage system to prevent flooding and protect property, but act as a compliment to the current proposed system outlined in this plan. Where future implement of on site infiltration is considered, the use of an infiltration chamber or trenches constructed on each site where native soil percolation rates are favourable should be explored. In addition, the preservation of native vegetation and soils on building sites is strongly encouraged. Where possible, native vegetation should be maintained and soils retained or re-used to increase runoff absorption.

There are two separate components that combine to comprise of the stormwater management system for the Whistle Bend Development; the conveyance system and the disposal system. These require different, yet defensible solutions to the needs of the development in preventing future risks of flooding to the extent intended by the design criteria of the City of Whitehorse. The conveyance system consists of the minor and major systems which both collect stormwater from site and convey it to a safe disposal area downstream. The disposal area is the offsite or onsite component where storm water is disposed of into the ground through infiltration or discharged into a water course connected to the Yukon River. The following sections describe the design criteria used to for the minor and major systems.

#### 6.4.3.1 Minor System

The minor system consists of local and trunk storm sewers, catchbasins, and street gutters which are provided to rapidly remove runoff from minor storms up to as the 1:5 year storm event. These storms occur more frequently at relatively short return periods.

The minor storm system for this study area will be designed to convey peak flows up to the 1:5 year storm event. Storm pipes are designed to be less than 90% full discharge into proposed Storm Water Management Facilities (SWMFs) downstream. Storm pipes should have a minimum cover of 1.2m to obvert. Where this requirement cannot be met, the pipe should be insulated to prevent freezing. As SWMFs, dry ponds are proposed for the study area. The ponds are dry the majority of the time and are open to playground use or other recreational activities and can be landscaped to be rather attractive areas.

All dry ponds will discharge through an outlet pipe at a maximum controlled rate equal to the pre-development rate. Emergency spillways will be placed in these ponds to handle any storms exceeding the 1:100 year event. The emergency spillway is for safety reasons where the pond spills downstream. The spillway is not connected to the outflow pipe. Erosion protection such as rip-rap will be required on this spillway as well as the outlet discharge location.

Concrete pipe shall be used for any outfall structure from each pond that is larger than 600 mm in diameter. For pipe diameters less than 600, Corrugated Steel Pipe (CSP) will be allowed. Either concrete or Utraflow pipe can be used in the minor system design as they both have the same Manning's n value of 0.013.

#### **6.4.3.2 Major System**

Any runoff in excess of the capacity of the minor system will flow overland into green belts via the streets, gutters, proposed bio-swales/ditches, following a route that ultimately discharges into SWMFs for detention. SWMFs can be dry ponds, wet ponds, wetlands or some combination. Storm run-off exceeding the 1:5 year storm will be conveyed through the major system.

Major runoff through arterial roads is to be minimized in order to allow for traffic to be able to flow smoothly during a heavy storm event. The bio-swales and ditches located in the green belts or park areas should not conflict with the use of the proposed trails as these trails will less likely be used during a heavy storm event. Trees within the proposed green-belt areas will be preserved where grading allows and runoff will work its way around them.

The discharge rate from each SWMF will be controlled to the 1:100 year pre-development rate in order to prevent flooding downstream and maintain the pre-development discharge to environmentally sensitive areas downstream. Each permanent SWMF will be designed to detain excess runoff from the most critical storm event and release it at a controlled rate. Controlling the discharge rate reduces the outlet pipe size as well as channel size needed to direct flow from SWMF to the ultimate location such as a water course or depression.

#### **6.4.4 Stormwater Management Modelling**

The stormwater management modeling for the study area consisted of completing two separate assessments. The first assessment consisted of a continuous detailed computer simulation using QUALHYMO to evaluate the opportunities and the constraints of an infiltration system that would eliminate the need for a surface discharge to the Yukon River. This assessment also included determination of the pre-development runoff rate at site. The second assessment consisted of a single storm event detailed computer simulation using XP-SWMM to evaluate the performance of the minor and major systems while controlling the discharge to a maximum allowable rate equal to the 1:100 year pre-development rate.

The infiltration system was evaluated using 42 years of continuous climate data from the Environment Canada gauging station. This data included hourly temperature, hourly rainfall, daily precipitation, and monthly evaporation for the forty two (42) year period from 1960 through 2001.

The evaluation of the minor and major drainage system requirements was undertaken with a single event design storm methodology. The minor system pipe sizes were first computed for a 5 year design storm event followed by an assessment of the surface or major system storage that was required for a 100 year design storm event.

#### 6.4.4.1 Modeling Input Parameters

The following parameters were utilized in all models. The basic runoff coefficients for the analysis were obtained from the City's manual and were augmented to reflect the various land uses in this project. For catchments with more than one land use a weighted value was calculated. The runoff coefficients utilized for each land use are shown in Table 6.9.

**Table 6.9: Runoff Coefficients**

Description	Run-off Coefficient
Open Space	0.15
Parks	0.15
Residential - Low Density	0.35
Residential - Medium Density	0.50
Residential - High Density	0.70
Commercial	0.70
Institutional / School	0.70
Community Use	0.70
Pavement	0.90

Computer modeling basic input parameters required for estimation of infiltration loss and other hydrological input parameters are summarized in Table 6.10.

**Table 6.10 Summary of Hydrological Parameters**

Parameter	Unit	Value	
Maximum Infiltration Rate (Fo)	mm/hr	75	
Minimum (Asymptotic) Infiltration	mm/hr	7.5	
Decay Rate of Infiltration	1/sec	0.00115	
		Impervious Area	Pervious Area
Depression storage	mm	1.6	3.2
Manning’s “n”	-	0.014	0.030

Zero Detention	(%)	25	-
Total Study Area (Including Upstream Areas)	Ha	193.5	
Weighted Imperviousness (Including Upstream Areas)	(%)	48	
Average Catchment Width (Within Study Area)	m	150	
Catchment Slope Range	(%)	0.3 - 18.6	

#### 6.4.4.2 Continuous Simulation

Two separate continuous simulations have been undertaken to evaluate the potential for disposal without discharge to the Yukon River. The first simulation involves detention and infiltration to ground on possible locations onsite. The second simulation analyzed infiltration offsite using the two existing depression areas (North and East Basin depressions shown on Figure 6.6) for disposal.

The following infiltration strategies can be used onsite:

- Directing roof leaders to all lawns and connecting gardens to open spaces;
- Surface runoff into low lying green belt open spaces or bio-swales;
- Use of rain barrels to collect storm runoff and re-use for gardening;
- Use of exfiltration catchbasins and green belts before they overflow into storm sewers and ultimately into the storm water management ponds.

It is recommended that these options be implemented where ever possible onsite. The computer model QUALHYMO was used to continuously simulate runoff onsite and offsite and to estimate the operational requirements of the disposal system that is comprised of storage or detention volume plus a disposal to ground through infiltration. The result files are available as a separate Volume to this report.

QUALHYMO can be used to continuously simulate runoff and to estimate detention pond and sedimentation facility performance. The selection of this continuous water quality/quantity simulation model allows a single model to undertake all of these analyses. QUALHYMO can be used as a general tool for simulating rainfall runoff; however, it is most suited to analyses in basins where the land surface is developing from a rural or undeveloped state to an urban land use.

QUALHYMO is distinct from SWMHYMO and OTTHYMO in its ability to simulate the generation and routing of pollutants, and in its orientation towards continuous simulation. Constituents that can be simulated are:

1. Stormwater runoff,
2. Sediment (in up to 5 size fractions), and/or
3. One pollutant exhibiting first order decay

Long term (42 year) continuous precipitation, temperature, and evaporation records are used to simulate the response of the system under operational conditions for the outflow criteria, to establish the adequacy of detention pond outflows and capacities, and to test any necessary adjustments. Through such operational studies it is possible to have a better understanding of the drainage system's response to extended wet weather conditions (multiple events) that might cause the sedimentation facilities to overflow. The use of the entire set of climate data allows for snowpack accumulation in winter and its melt during warmer periods of the year.

Infiltration systems as envisioned have a very restricted discharge rate which will often result in a carryover of detention storage from storm event to storm event. This carryover of stored volumes precludes the use of either the "Rational" method or a design storm approach for this analysis. The preferred approach involves continuous hydrologic simulation which allows the analyses to include the periods between storms, or the inter-event periods, and accounts for the carryover of stored volumes from one runoff event to another. The continuous simulation results in an estimate of the flows and volumes over the long term which can be assessed with standard statistical tools.

The probabilities attached to various events, or put another way, their return periods, are correctly determined so as to properly assess any flooding risks and storage requirements associated with the disposal system. The probabilities are determined by frequency analyses of the simulation results, in exactly the same way as if there were recorded data available. This is particularly important where relatively small discharge rates are available such as with disposal to ground solutions.

#### **6.4.4.2.1 Infiltration Testing**

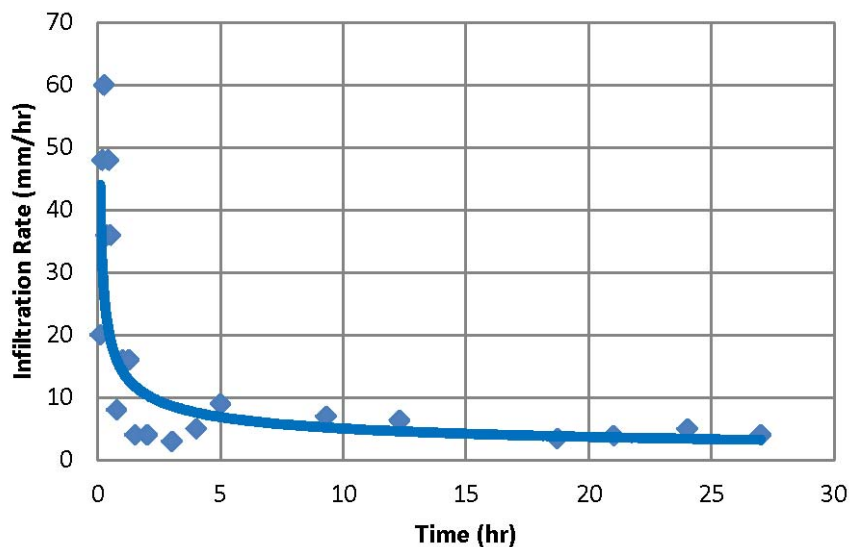
The first and most important part of the detention and infiltration system is an adequate infiltration location and size; both surface area and volume of the system are required to store and infiltrate the runoff. EBA was retained to conduct an investigation to determine the soil infiltration properties in the study area (see Appendix D). A series of infiltration tests were completed to provide an estimate of the design infiltration rates that are available across the study area.

The sizing of the storage and infiltration to ground facilities can be determined using the long term infiltration rates that have been measured in the field investigation undertaken by EBA. The test pit locations are shown on Figure 6.7 (following page).

**Figure 6.7: Test Pit Locations**

The test pit locations were chosen to establish the infiltration capacity of the underlying silts at a depth of approximately 3 meters to provide information on the capacity of the ability of the soils to accept water. The tests were designed to measure actual vertical infiltration of water over an extended period so as to establish long term capacity of the soils.

Test Hole 1 is located farthest north and would be representative of approximately the rate available for a single off-site system which would receive water from the entire future development area plus Phase 2. The results of the infiltration test are shown on Figure 6.8.

**Figure 6.8: Test Pit 1 Infiltration Rates**

The test results clearly show a relatively high initial infiltration rate that decreases rapidly over the first few hours and trailing off to an almost steady state rate of approximately 4 mm per hour. This shape of curve is typical of those found for the other test locations. A summary of the long term infiltration rate is shown in Table 6.11.

**Table 6.11: Summary Infiltration Test Results**

Test Pit	Limiting Infiltration Rate (mm/hr)
1	4
2	5
3	6
4	12

Evaluation of the size and operational effectiveness of various retention and infiltration systems have been undertaken using the lowest measured infiltration rate. The size and operational effectiveness of various retention and infiltration systems will be discussed in more detail in Section 6.4.4.2.4.

#### 6.4.4.2.2 Climate Input Data

Climate information in the form of long term recorded data is required for the continuous simulations. Environment Canada operates a gauging station at the Whitehorse Airport (Climate Station ID 2101300) and the available data from that station was used in this analysis. The data included hourly temperature, hourly rainfall, daily precipitation, and monthly evaporation for the forty two (42) year period from 1960 through 2001. The raw data supplied by Environment Canada was assessed and modified where necessary for precipitation, temperature and evaporation.

The process of data verification included comparing the daily total precipitation with the sum of the hourly rainfall data reported on a daily basis. Where snowfalls occurred, hourly estimates of snowfall were included in the rainfall file. A verification of rainfall totals was also undertaken and any missing hourly data was estimated to provide a match of the total hourly precipitation on a daily basis with the total daily precipitation amounts. The completeness of the temperature records were also verified prior to use in the computer model.

The entire evaporation record was not complete in the data provided by Environment Canada. An average of the monthly values was included for the months with missing data, this will provide a better estimate than including a zero value for missing data.

#### 6.4.4.2.3 Pre-Development Runoff Rates

The continuous model was simulated under pre-development conditions to determine the pre-development discharge rate from site that would be contributed to the existing depressions or wetlands. The site development area, including upstream basins which contribute flow towards the depressions was considered in this assessment.

The pre-development rates in Litres/second per hectare have been established as shown in Table 6.12. These values were determined through frequency analysis of the peak annual discharge rates under pre-development conditions. The return period, a recurrence interval is an estimate of the interval of time between flood events of a certain intensity or size. For example, the 100 year return period would be the largest possible flood event within 100 years.

**Table 6.12: Predevelopment Discharge Rates**

Return Period (years)	Unit Area Discharge (L/s/ha)
200	3.0
100	2.4
50	1.9
25	1.4
10	0.9
5	0.6
3	0.4
2	0.3

The site should be controlled up to a maximum discharge from site equal to the 1 in 100 year return period of 2.4 L/s/ha. Most municipalities control discharge from new developments up to this rate. This will prevent any flooding downstream as well as maintain the site discharge to the natural pre-development conditions under the 1:100 year storm event.

#### 6.4.4.2.4 Onsite Infiltration/Evaporation System

The size of the retention and infiltration systems onsite is a function of the total infiltration discharge as estimated by the infiltration rate, times the surface area available for infiltration and the amount of available storage required to prevent overflows to the Yukon River. As indicated previously a methodology utilizing continuous simulation was used to evaluate the combination of infiltration discharge and storage over time to account for inter-event carryover of stored volume.

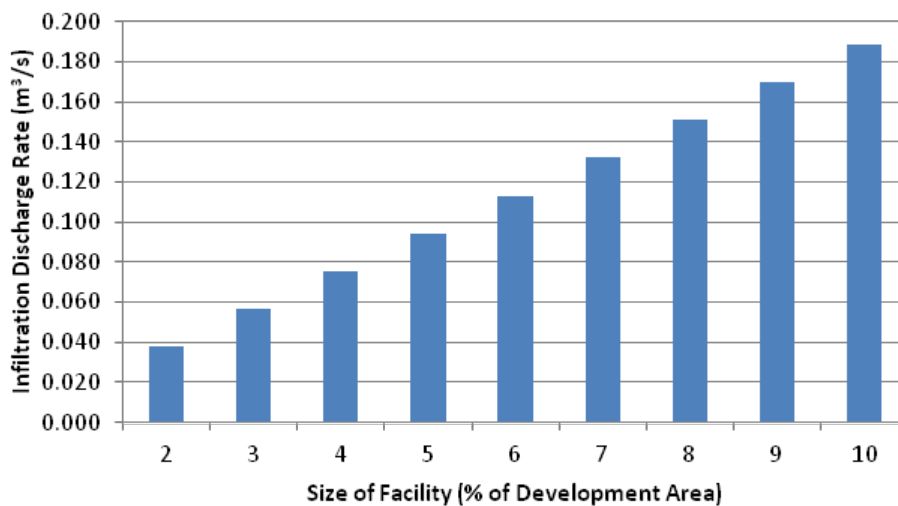
The initial analysis has been undertaken with post-development conditions, without a clearly identified location for the storage and infiltration systems. Whether they are located onsite within dedicated utility lots, onsite within the road right-of-ways, on individual private lots, or a combination of all of these possible locations. The attached Appendix E – Infiltration Alternatives, describes each storage and infiltrations system in more detail.

An evaluation of system performance includes determining an optimum size for the facilities onsite. To test the operation of the systems and to provide an estimate of the optimal system size a number of different sized facilities were tested within the QUALHYMO model. The 1 in 100 year return period detention volumes were estimated by a frequency analysis of the calculated annual maximum detention volume for the simulation period starting in 1960 and ending in 2001, a total of 42 years. The facility footprint sizing and total discharge rate is shown in Table 6.13.

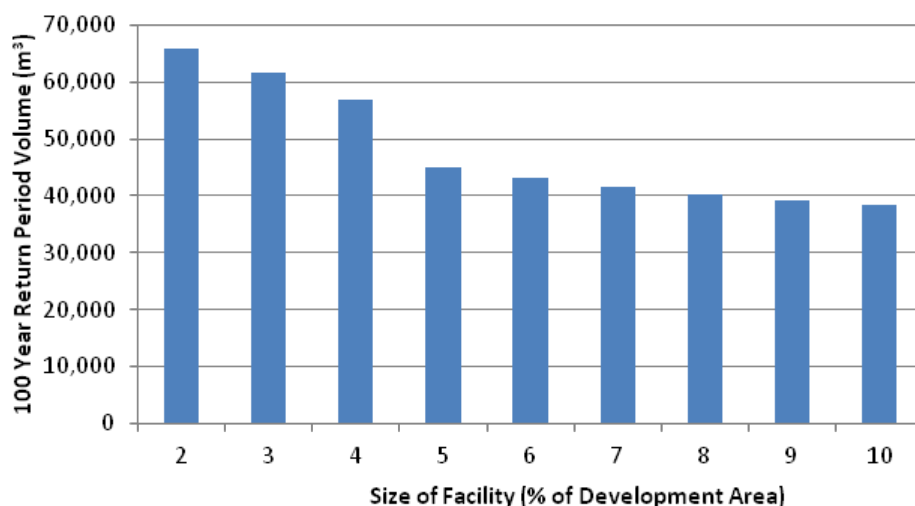
**Table 6.13: Infiltration System Sizes and Discharge Rates**

% of Contributing Development Area	Infiltration System Surface Area (ha)	Infiltration Rate (m <sup>3</sup> /s)	100 Year Detention Volume (m <sup>3</sup> )
2	3.40	0.038	65,976
3	5.09	0.057	61,591
4	6.79	0.075	56,823
5	8.49	0.094	44,975
6	10.19	0.113	43,110
7	11.88	0.132	41,504
8	13.58	0.151	40,294
9	15.28	0.170	39,303
10	16.98	0.189	38,410

As shown in Figure 6.9, the estimated infiltration rate will increase with an increase surface area of the infiltration/storage system.

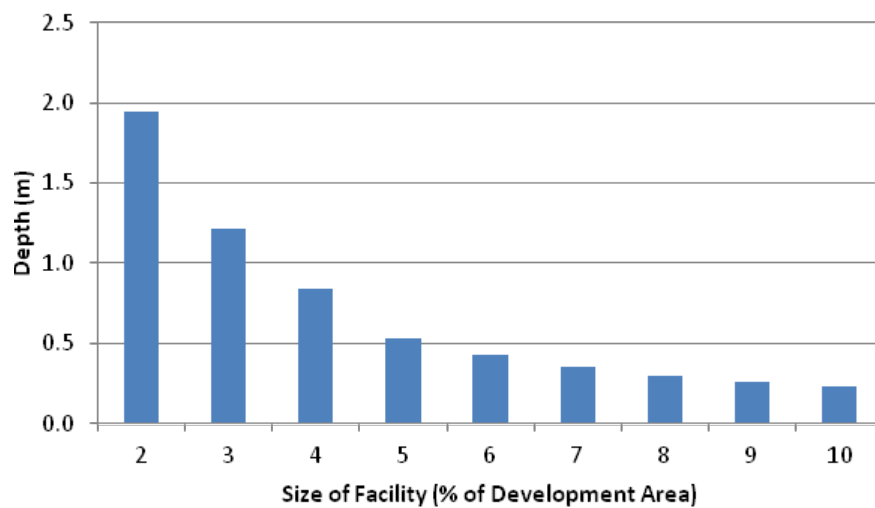
**Figure 6.9: Infiltration Discharge Rates**

This means less storage is required for an infiltration system with a larger surface area. The 1 in 100 year return period storage volume for the various sizes of facility is shown on Figure 6.10.

**Figure 6.10: 1 in 100 Year Detention Volume**

As this the relationship between area and volume is not linear there is an optimum size where any decrease in area results in a much greater increase in detention volume. The optimum surface area of the infiltration systems, a size where any decrease will result in a large increase in detention volume is approximately 5% of the development area as can be seen on Figure 6.11. This indicates that the optimum size of the infiltration and detention systems are approximately 8.45 ha with a detention volume of 45,000 m<sup>3</sup>.

Based upon the volume and surface area shown in Table 6.13, the maximum depth of water within the infiltration system storage can be calculated. These values are shown on Figure 6.11.

**Figure 6.11: 1 in 100 Year Retention Depth**

The depth of the retention is important for two reasons; configuration of the storage and the ability to contain sediment washed off the development.

For an open system is envisioned the depth would simply be the depth of water in storage and an allowance for winter operation would be required. If the system is underground to avoid the problems associated with winter operation then it would likely be filled with coarse drain rock with a void ratio of approximately 30%. This would effectively triple the depth of storage. The depth associated with the system sized at 5% of the contributing area or 8.5 ha would have a depth of 1.5 meters.

The size of these infiltration and retention systems is huge. The 8.5 ha of surface area required is approximately 60% of the size of Phase 4. Stormwater can be lost on-site through infiltration systems but these systems are both expensive to install and carry a large operational risk that if they ever seal off with silt or freeze in the winter, flooding could occur on site. This may lead to many legal issues with home owners over the long term and increase the cost to maintain these systems.

#### **6.4.4.2.5 Offsite Infiltration/Evaporation System**

The potential problems and issues that apply to the infiltration systems onsite has led to development of a second disposal method offsite that would comply with the criteria to limit the volume of discharge to the Yukon River. The proposed disposal systems are to be located at the depression locations of the North and East pre-development basins shown on Figure 6.6. While these depressions have been identified as environmentally sensitive and that they should be protected, they do form the low point in the area and receive most of the predevelopment discharges. For this reason the analysis for estimating their capacity to receive stormwater from the Whistle Bend Development Area was undertaken. The Offsite Servicing Report by AECOM, December 9, 2008, indicates that these depression areas are likely underlain by alluvial gravel and hydraulically connected to river. For this reason the north and east depressions were used for disposal. The north and east depressions have total storage volumes of approximately 192,000 cu.m and 526,000 cu.m respectively before they spill into the Yukon River.

A system that uses the existing depression areas and that relies upon a combination of evaporation and infiltration has been analyzed. While this system would have environmental impacts on the wetland areas, it is imperative that this system be assessed for operation to determine whether it is feasible for the Whistle Bend Development.

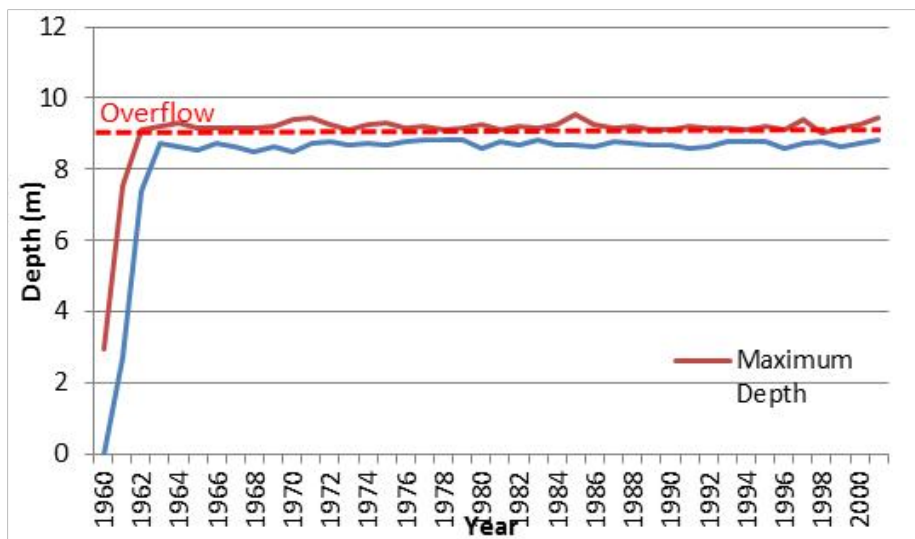
An assessment of the potential to provide a storage and disposal system utilizing the northern most existing depression located in the North Basin (Figure 6.6) was completed. To simplify the assessment several assumptions were made that can be revised should the concept appear to be feasible. The assumptions include:

- The development is complete at the beginning of the continuous hydrologic simulation,
- There is little contribution from areas outside the development area (i.e. upstream basins), and
- The exfiltration flows from groundwater are approximately equal to the infiltration losses from the depression.

The initial analysis included the northern most depression with all development discharge being directed to this low spot in the terrain. The model was set to report on the depth of the water in the depression with the normal level being set to an initial stage of zero (0.0) for the simulation. This corresponds to an elevation of 642.0 m. The geometry of the wetland was determined based on available contours in the area.

The simulation indicates that with all of the runoff being directed to this depression it would fill to capacity, a stage of 9.0 m corresponding to an elevation of 651.0 m and would begin to spill to the Yukon River in the second year of operation. This can be seen in Figure 6.12. Following the initial filling of the depression to a depth of over 9.0 m almost all additional inflow would overflow to the river. These results are based on the 42 years of continuous input climate data provided for simulation from 1960 to 2001. Climate data used is based on raw measured data at the Whitehorse Airport.

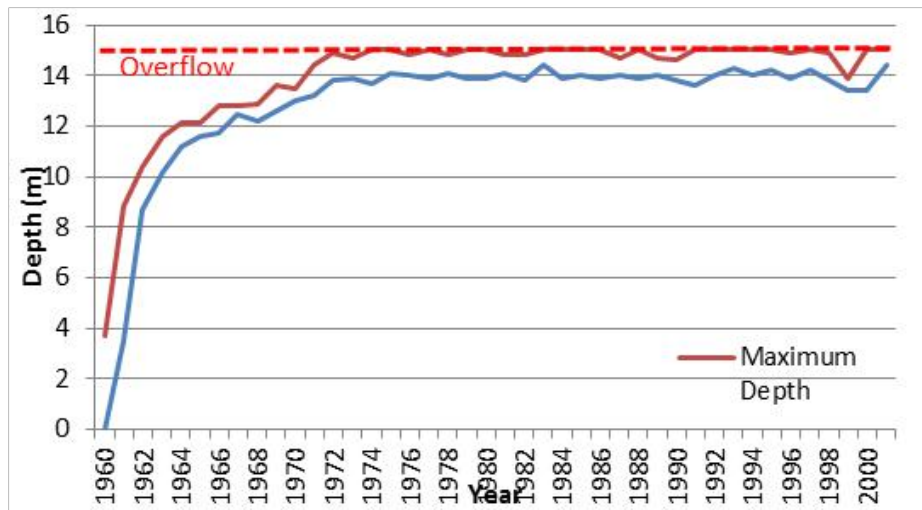
**Figure 6.12: North Depression Operation**



This represents a case where the surface area of the depression is not large enough to allow the combined evaporation and infiltration to dispose of the excess surface runoff.

A second simulation was completed whereby both, the North and East Basin depression areas (See Figure 6.6) would be utilized for evaporation and infiltration. Again the hydrologic simulation tracked the water levels in the depression beginning at an initial stage of zero (0.0 m) equivalent to an elevation of 634.0. In this simulation it was also assumed that the runoff would be diverted into both depression areas in proportion to the storage and depths available. The results indicate that the total depth of water in the depressions would increase over a period of approximately ten (10) years to a depth of 15 m at an elevation of approximately 649.0 and would subsequently overflow to the Yukon River (See Figure 6.13).

Figure 6.13: Combined Depression Operation



Again the continuous hydrologic simulation has demonstrated that the use of the depressions as a disposal system through a combination of evaporation and infiltration will not be a practical long term solution. This method may increase the potential of inducing a slope failure of the steep escarpment of the Yukon River.

Given the estimated operation of the depressions and their lack of capability for disposal of the quantities of surface runoff from the Whistle Bend Development their use cannot be recommended for long term evaporation and infiltration disposal of the surface runoff. However, controlling the site to the maximum allowable pre-development rate may reduce the rate of discharge towards these depressions and therefore allow more time for infiltration. This leads to the solution of controlling the runoff from site in the next section using a Single Event Simulation.

#### 6.4.4.2.6 Single Event Simulation

The single event analysis was completed using XP-SWMM, an industry accepted hydraulic modeling software. The model was set up to analyze the minor and major systems for the 5 year and the 100 year rainfall events, respectively. The components of this analysis include:

- Utilize the set maximum allowable rate (1:100 Year pre-development rate) to control runoff from post-development conditions.
- Determine the storm drainage system requirements such as minor and major system components and controls.
- Size the proposed Storm Water Management Facilities (SWMFs) for the most critical storm event (1:100 Year storm) based on maximum allowable discharge rate (Pre-development rate).

XP-SWMM is capable of determining runoff hydrographs and routing them through storage ponds, flow transfer facilities such as weirs, orifices or pumps, and conveyance systems such as pipes, channels, ditches and rivers. Simulation output takes the form of water surface elevations, discharge and velocity at selected locations.

#### 6.4.4.2.7 Minor System

The minor piped system will be designed based on the 1 in 5 year rainfall intensities. A separate minor storm system for three (3) of the major drainage basins will be designed to direct flows to the respective SWMF. Figure 6.14 shows the proposed minor system including the drainage basin areas for each sub-basin or manhole. The entire minor system drains into three (3) proposed dry ponds for detention. The outfall location of each dry pond is shown on Figure 6.14. The North, East, and West ponds can discharge through an outlet pipe and naturally flow overland to their ultimate locations.

Upstream basins such as Area 63, 64, 61, and 60 do not drain into proposed minor system. Areas 63 is diverted away from study area by constructing a swale/ditch to divert it west into the natural water course just west of study area, refer to Figure 6.15. Runoff from Area 64 drains into an existing depression and ultimately discharges west through a proposed swale/ditch when it exceeds the 1:100 year level in the depression.

Figure 6.16 shows additional details of the proposed swales/ditches. The Cut-off swale will be sloped at approximately 0.5% to intercept upstream runoff from Area 63. The proposed ditch connected to the south depression may only flow at events greater than the 1:100 year.

Both, Area 60 and 61 will drain into the east pond (Pond1). The Phase 1 and 2 trunk from Area 60 will be connected to the pond as a separate inlet. Area 61 will be directly discharging into the east pond through a proposed swale (by Associated Engineering) or pipe from that area that runs along the green belt just east of existing east lift station. It is recommended that both, Area 60 and 61, control their discharge rates to the pre-development rate. This will help minimize the size of the east pond in Phase 3.

The minor system analysis was completed using the most up to date 5-year 1-hour Chicago distribution rainfall event. Total rainfall for this event is approximately 8.85 mm. The rainfall event was developed using Intensity-Duration-Frequency (IDF) parameters derived from Meteorological Service of Canada rainfall data for the Whitehorse Airport (Climate Station ID 2101300). An “r” value (time to peak) of 0.5 was also used for the design storm to place the peak intensity at the point in time equal to 0.5 times the duration.

The proposed minor system was designed to mimic the natural drainage patterns as the site splits and drains into four (4) low areas. This will help prevent areas downstream of site from drying up or flooding and will assist in maintaining any environmentally sensitive areas.

The system has been sized for the 1:5 year event and Figure 6.16 shows the required pipe sizes to accommodate the flow. The minor system ultimately drains into dry ponds where the runoff is controlled to discharge at a maximum allowable rate of 2.4 L/s/ha based on the calculated 1:100 Year pre-development rate in Section 6.4.4.2.3. Table 6.14 summarizes the results of the proposed minor system such as the drainage area, size, slope, length, and ground and invert elevations. The system was designed to ensure it meets the minimum cover requirements of 1.2 m and that the pipes were not over capacity. To minimize runoff into minor systems, the roof leaders should drain to the surface to landscaped areas, directed away from the buildings. Weeping tile should be installed around basements to collect ground water to a sump pump that will discharge to the surface, on landscaped areas away from the building. Weeping tile is not to be connected to the sanitary sewer system.

Table 6.14. Minor Storm System Design

TABLE 6.14: MINOR STORM SYSTEM DESIGN

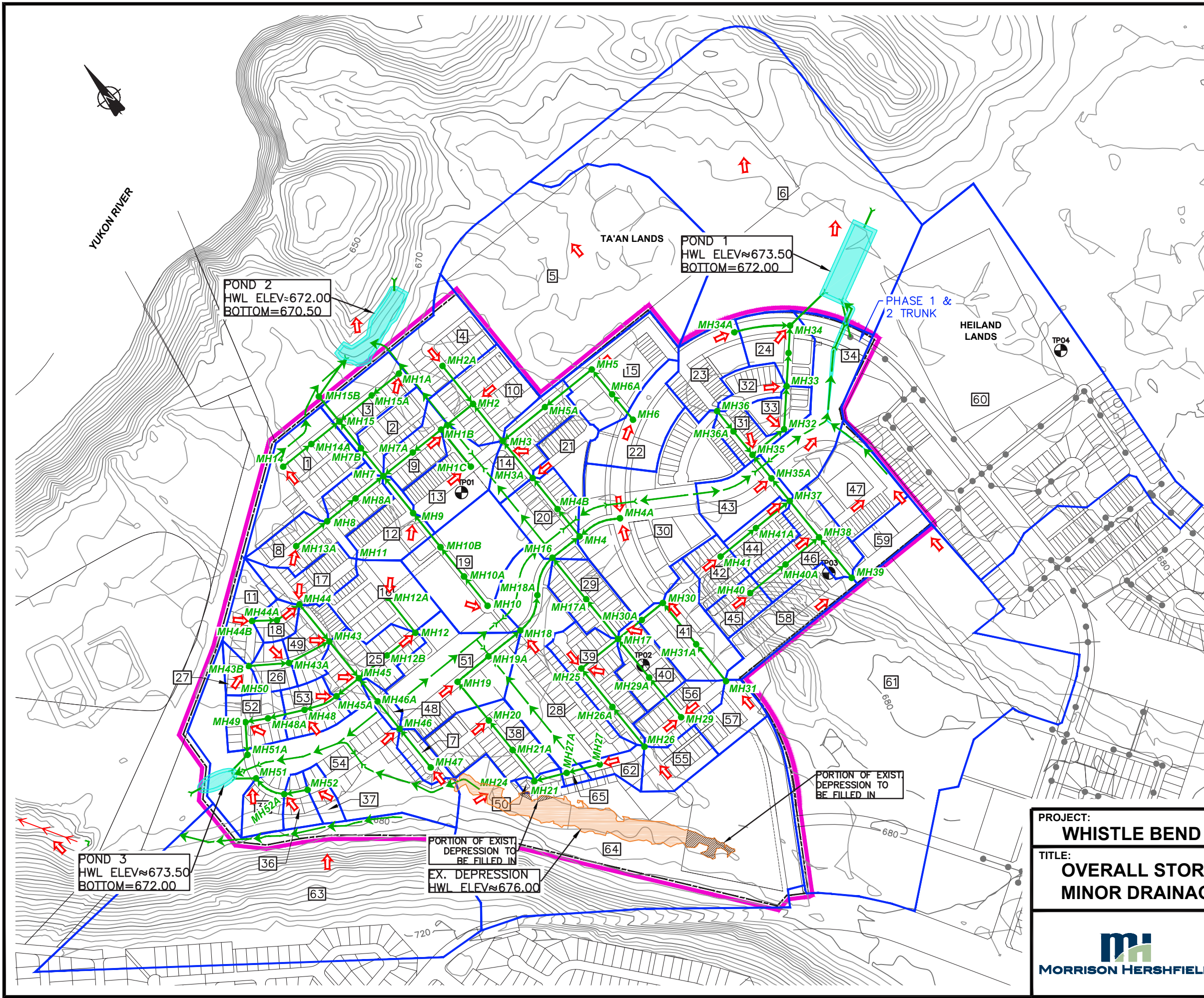
From MH	To MH	MH Area (A)	Total MH Area	Runoff Coefficient	A x C	Total A x C	Total Time of Con.	Intensity	Q Design	Pipe Size Diameter	Slope of Pipe	Length of Pipe	Q Capacity	Percent Full	Design Velocity	Full Velocity	Ground Elev.		Invert		Avg. Cover
		ha	ha	C	ha	ha	minutes	mm/hr	m³/s	mm	%	m	m³/s	%	m/s	m/s	U/S	D/S	U/S	D/S	
																	m	m	m	m	m
39	38	2.15	2.15	0.78	1.68	1.68	8.00	28.43	0.132	525	0.15	110.140	0.167	79%	0.85	0.77	676.96	676.25	674.14	673.97	2.0
40	40A	0.82	0.82	0.61	0.50	0.50	8.00	28.43	0.040	300	0.25	83.785	0.048	82%	0.76	0.68	677.23	676.68	674.65	674.44	2.1
40A	38	0.00	0.82	0.00	0.00	0.50	9.83	25.07	0.040	300	0.25	83.785	0.048	82%	0.76	0.68	676.68	676.25	674.41	674.20	1.9
38	37	2.22	5.19	0.67	1.49	3.67	11.66	22.58	0.230	675	0.15	96.430	0.326	71%	0.99	0.91	676.25	676.80	673.82	673.68	2.1
41	41A	1.03	1.03	0.57	0.59	0.59	8.00	28.43	0.046	375	0.15	81.590	0.068	68%	0.66	0.61	677.80	677.30	674.22	674.10	3.0
41A	37	0.00	1.03	0.00	0.00	0.59	10.06	24.72	0.046	375	0.15	81.590	0.068	68%	0.66	0.61	677.30	676.80	674.07	673.95	2.7
37	35A	1.14	7.36	0.60	0.68	4.94	13.29	20.85	0.286	675	0.22	56.740	0.394	73%	1.20	1.10	676.80	676.30	673.65	673.52	2.3
35A	35	1.68	9.04	0.39	0.66	5.60	14.08	20.13	0.313	675	0.22	55.690	0.394	79%	1.22	1.10	676.30	676.66	673.49	673.37	2.4
36	36A	0.28	0.28	0.68	0.19	0.19	8.00	28.43	0.015	300	0.22	57.435	0.045	33%	0.58	0.64	679.30	677.98	673.97	673.84	4.4
36A	35	0.28	0.56	0.68	0.19	0.38	9.66	25.33	0.027	300	0.22	57.435	0.045	59%	0.67	0.64	677.98	676.66	673.81	673.69	3.3
35	32	0.28	9.88	0.68	0.19	6.17	14.84	19.49	0.334	675	0.25	82.570	0.420	80%	1.30	1.17	676.66	677.33	673.31	673.10	3.1
32	33	0.85	10.73	0.63	0.54	6.71	15.89	18.69	0.348	675	0.30	84.760	0.460	76%	1.41	1.29	677.33	678.00	673.04	672.79	4.1
33	33A	0.80	11.53	0.69	0.55	7.26	16.89	18.01	0.363	675	0.30	63.895	0.460	79%	1.43	1.29	678.00	677.20	672.76	672.57	4.3
33A	34	0.00	11.53	0.00	0.00	7.26	17.64	17.54	0.363	675	0.30	63.895	0.460	79%	1.43	1.29	677.20	676.40	672.54	672.35	3.7
34A	34	1.87	1.87	0.63	1.19	1.19	8.00	28.43	0.094	450	0.22	102.420	0.134	70%	0.91	0.84	677.06	676.40	672.80	672.57	3.6
34	DRY POND 1	1.66	15.06	0.68	1.12	9.57	18.38	17.10	0.455	900	0.11	110.000	0.600	76%	1.04	0.94	676.40		672.12	672.00	
27	27A	0.78	0.78	0.67	0.52	0.52	8.00	28.43	0.041	300	0.30	68.065	0.053	78%	0.83	0.75	676.65	677.30	675.32	675.12	1.5
27A	21	0.00	0.78	0.00	0.00	0.52	9.37	25.81	0.041	300	0.30	68.065	0.053	78%	0.83	0.75	677.30	676.50	675.09	674.88	1.6
21	21A	0.30	1.08	0.66	0.20	0.72	10.74	23.74	0.047	450	0.15	74.925	0.110	43%	0.67	0.69	676.50	676.85	674.73	674.62	1.5
21A	20	0.00	1.08	0.00	0.00	0.72	12.61	21.53	0.047	450	0.15	74.925	0.110	43%	0.67	0.69	676.85	676.21	674.59	674.48	1.5
20	19	2.51	3.59	0.59	1.47	2.19	14.48	19.78	0.120	525	0.25	94.880	0.215	56%	1.02	0.99	676.21	674.78	674.40	674.16	0.7
19	19A	3.85	7.44	0.39	1.51	3.70	16.03	18.59	0.191	600	0.25	81.950	0.307	62%	1.14	1.09	674.78	675.05	674.09	673.88	0.3
19A	18	0.00	7.44	0.00	0.00	3.70	17.22	17.79	0.191	600	0.25	81.950	0.307	62%	1.14	1.09	675.05	675.50	673.85	673.65	0.9
18	18A	5.17	12.61	0.38	1.96	5.67	18.42	17.08	0.269	750	0.15	78.875	0.431	62%	1.03	0.98	675.50	675.65	673.50	673.38	1.4
18A	16	0.00	12.61	0.00	0.00	5.67	19.70	16.39	0.269	750	0.15	78.875	0.431	62%	1.03	0.98	675.65	675.80	673.35	673.23	1.7
26	26A	1.21	1.21	0.63	0.77	0.77	8.00	28.43	0.060	300	0.50	99.655	0.068	88%	1.09	0.97	679.30	678.08	675.83	675.34	2.8
26A	25	0.00	1.21	0.00	0.00	0.77	9.52	25.56	0.060	300	0.50	99.655	0.068	88%	1.09	0.97	678.08	677.14	675.31	674.81	2.3
25	17	2.13	3.34	0.66	1.41	2.17	11.04	23.35	0.141	450	0.40	87.450	0.180	78%	1.25	1.13	677.14	677.60	674.66	674.31	2.4
29	29A	1.35	1.35	0.67	0.90	0.90	8.00	28.43	0.071	375	0.25	99.175	0.088	81%	0.88	0.79	678.83	678.22	674.91	674.66	3.4
29A	17	0.00	1.35	0.00	0.00	0.90	9.87	25.00	0.071	375	0.25	99.175	0.088	81%	0.88	0.79	678.22	677.60	674.63	674.38	3.0
31	31A	1.13	1.13	0.64	0.72	0.72	8.00	28.43	0.057	300	0.45	103.115	0.065	88%	1.04	0.92	678.88	678.26	675.91	675.45	2.6
31A	30	0.00	1.13	0.00	0.00	0.72	9.66	25.33	0.057	300	0.45	103.115	0.065	88%	1.03	0.92	678.26	677.82	675.42	674.96	2.6
30	30A	2.47	3.60	0.59	1.46	2.18	11.32	22.99	0.139	450	0.40	58.640	0.180	77%	1.25	1.13	677.82	677.71	674.81	674.57	2.6
30A	17	0.00	3.60	0.00	0.00	2.18	12.10	22.08	0.139	450	0.40	58.640	0.180	77%	1.25	1.13	677.71	677.60	674.54	674.31	2.8
17	17A	1.40	9.69	0.58	0.81	6.06	12.88	21.25	0.358	675	0.35	106.290	0.497	72%	1.51	1.39	677.60	677.00	674.08	673.71	2.7
17A	16	0.00	9.69	0.00	0.00	6.06	14.05	20.15	0.358	675	0.35	106.290	0.497	72%	1.51	1.39	677.00	675.80	673.68	673.31	2.2
16	4	1.61	23.91	0.63	1.01	12.73	20.97	15.78	0.558	1050	0.10	75.800	0.864	65%	1.06	1.00	675.80	675.10	672.93	672.86	1.5
4A	4	7.09	7.09	0.58	4.12	4.12	8.00	28.43	0.325	675	0.22	89.570	0.394	82%	1.23	1.10	676.23	675.10	673.43	673.23	1.7
4	4B	1.89	32.89	0.48	0.90	17.75	22.16	15.25	0.752	1200	0.15	74.750	1.510	62%	1.41	1.34	675.10	675.35	672.71	672.59	1.4
4B	3A	0.00	32.89	0.00	0.00	17.75	23.05	14.89	0.752	1200	0.15	74.750	1.510	62%	1.41	1.34	675.35	676.00	672.56	672.45	2.0
3A	3	1.14	34.03	0.65	0.74	18.49	23.93	14.55	0.747	1200	0.15	95.870	1.510	62%	1.41	1.34	676.00	675.12	672.42	672.28	2.0

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Table 6.14. Minor Storm System Design continued...

From MH	To MH	MH Area (A)	Total MH Area	Runoff Coefficient	A x C	Total A x C	Total Time of Con.	Intensity	Q Design	Pipe Size Diameter	Slope of Pipe	Length of Pipe	Q Capacity	Percent Full	Design Velocity	Full Velocity	Ground Elev.		Invert		Avg. Cover
		ha	ha	C	ha	ha	minutes	mm/hr	m³/s	mm	%	m	m³/s	%	m/s	m/s	U/S m	D/S m	U/S m	D/S m	
6	6A	2.12	2.12	0.67	1.43	1.43	8.00	28.43	0.113	450	0.22	63.090	0.134	84%	0.94	0.84	677.21	676.90	673.82	673.68	2.9
6A	5	0.00	2.12	0.00	0.00	1.43	9.12	26.25	0.113	450	0.22	63.090	0.134	84%	0.94	0.84	676.90	676.59	673.65	673.52	2.7
5	5A	2.67	4.79	0.67	1.80	3.22	10.23	24.46	0.219	600	0.22	110.610	0.288	76%	1.12	1.02	676.59	675.86	673.37	673.12	2.4
5A	3	0.00	4.79	0.00	0.00	3.22	11.88	22.33	0.219	600	0.22	110.610	0.288	76%	1.12	1.02	675.86	675.12	673.09	672.85	1.9
3	2	1.82	40.64	0.59	1.07	22.78	25.07	14.15	0.895	1200	0.15	95.000	1.510	74%	1.46	1.34	675.12	675.25	672.25	672.11	1.8
2A	2	2.40	2.40	0.42	1.02	1.02	8.00	28.43	0.080	450	0.22	97.415	0.134	60%	0.88	0.84	676.07	675.25	673.01	672.80	2.3
2	1B	2.44	45.48	0.58	1.41	25.20	26.15	13.79	0.965	1200	0.15	81.923	1.510	80%	1.48	1.34	675.25	675.70	672.05	671.92	2.3
1C	1B	2.08	2.08	0.61	1.27	1.27	8.00	28.43	0.100	375	0.45	95.000	0.118	85%	1.20	1.06	674.69	675.70	673.15	672.72	1.9
1B	7A	1.13	48.70	0.58	0.66	27.13	27.08	13.50	1.017	1200	0.15	72.807	1.510	84%	1.50	1.34	675.70	676.06	671.89	671.78	2.8
7A	7	0.00	48.70	0.00	0.00	27.13	27.89	13.26	1.017	1200	0.15	75.270	1.510	84%	1.50	1.34	676.06	676.42	671.75	671.64	3.3
13A	8	1.25	1.25	0.61	0.76	0.76	8.00	28.43	0.060	375	0.22	79.416	0.082	73%	0.81	0.74	675.81	675.44	672.90	672.72	2.4
8	8A	1.25	2.49	0.61	0.76	1.53	9.63	25.39	0.108	450	0.20	72.709	0.128	84%	0.90	0.80	675.44	675.93	672.65	672.50	2.7
8A	7	0.00	2.49	0.00	0.00	1.53	10.98	23.43	0.108	450	0.20	71.215	0.128	84%	0.90	0.80	675.93	676.42	672.47	672.33	3.3
10	10A	4.07	4.07	0.67	2.72	2.72	8.00	28.43	0.215	600	0.22	75.086	0.288	75%	1.12	1.02	675.63	675.99	673.08	672.91	2.2
10A	10B	0.00	4.07	0.00	0.00	2.72	9.12	26.24	0.215	600	0.22	75.086	0.288	75%	1.12	1.02	675.99	676.35	672.88	672.72	2.8
10B	9	0.00	4.07	0.00	0.00	2.72	10.24	24.44	0.215	600	0.22	87.196	0.288	75%	1.12	1.02	676.35	675.56	672.69	672.50	2.8
9	7	1.48	5.55	0.72	1.07	3.79	11.54	22.72	0.239	600	0.30	95.000	0.336	71%	1.29	1.19	675.56	676.42	672.47	672.18	3.1
7	7B	0.00	56.74	0.00	0.00	32.45	28.72	13.02	1.173	1200	0.35	71.336	2.307	64%	2.16	2.04	676.42	676.07	671.58	671.33	3.6
7B	15	1.13	57.87	0.50	0.56	33.01	29.27	12.87	1.180	1200	0.35	68.664	2.307	64%	2.16	2.04	676.07	675.35	671.30	671.06	3.3
14	14A	3.14	3.14	0.38	1.20	1.20	8.00	28.43	0.094	450	0.20	71.974	0.128	74%	0.88	0.80	674.45	674.90	672.10	671.96	2.2
14A	15	0.00	3.14	0.00	0.00	1.20	9.37	25.82	0.094	450	0.20	72.000	0.128	74%	0.88	0.80	674.90	675.35	671.93	671.78	2.8
1A	15A	1.59	1.59	0.37	0.59	0.59	8.00	28.43	0.047	300	0.30	69.800	0.053	89%	0.85	0.75	676.20	675.78	672.42	672.21	3.4
15A	15	0.00	1.59	0.00	0.00	0.59	9.37	25.80	0.047	300	0.30	82.934	0.053	89%	0.85	0.75	675.78	675.35	672.18	671.93	3.2
15	15B	0.00	62.60	0.00	0.00	34.80	29.80	12.73	1.230	1200	0.30	64.635	2.135	72%	2.06	1.89	675.35	674.88	671.03	670.84	3.0
15B	DRY POND 2	0.00	62.60	0.00	0.00	34.80	30.33	12.59	1.230	1200	0.30	92.546	2.135	72%	2.06	1.89	674.88		670.78	670.50	
12A	12	2.30	2.30	0.60	1.38	1.38	8.00	28.43	0.109	450	0.22	88.574	0.134	81%	0.94	0.84	675.98	675.53	673.77	673.57	1.6
12	12B	0.00	2.30	0.00	0.00	1.38	9.58	25.47	0.109	450	0.22	72.423	0.134	81%	0.94	0.84	675.53	675.18	673.51	673.35	1.5
12B	45	0.00	2.30	0.00	0.00	1.38	10.86	23.58	0.109	450	0.22	72.423	0.134	81%	0.94	0.84	675.18	674.83	673.32	673.16	1.3
44B	44A	1.13	1.13	0.36	0.41	0.41	8.00	28.43	0.032	300	0.22	49.857	0.045	71%	0.70	0.64	676.00	675.81	673.85	673.74	1.8
44A	44	0.55	1.69	0.53	0.29	0.70	9.19	26.12	0.051	375	0.22	54.932	0.082	62%	0.78	0.74	675.81	675.72	673.66	673.54	1.8
44	43	1.37	3.05	0.62	0.85	1.56	10.36	24.28	0.105	450	0.22	94.839	0.134	78%	0.93	0.84	675.72	675.26	673.47	673.26	1.7
43B	43A	0.48	0.48	0.44	0.21	0.21	8.00	28.43	0.017	300	0.22	80.763	0.045	37%	0.59	0.64	676.63	675.95	673.82	673.64	2.3
43A	43	0.67	1.15	0.47	0.32	0.53	10.27	24.41	0.036	300	0.22	91.353	0.045	79%	0.71	0.64	675.95	675.26	673.61	673.41	1.8
43	45	1.10	5.40	0.62	0.74	2.82	12.41	21.74	0.170	600	0.10	94.161	0.104	88%	0.77	0.60	675.26	674.83	673.11	673.01	1.4

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- LEGEND:**
- MINOR FLOW DRAINAGE DIRECTION
  - MINOR SYSTEM WITH M.H. NO.
  - EXISTING STORM SYSTEM
  - MINOR DRAINAGE BASIN BOUNDARIES WITH AREA ID.
  - EXISTING DEPRESSION
  - PROPOSED DRY PONDS
  - DEVELOPMENT BOUNDARY
  - PROPOSED BIO-SWALE
  - EXISTING NATURAL WATERCOURSE
  - TEST PIT LOCATION

MINOR DRAINAGE BASIN TABLE					
AREA ID	AREA	RUNOFF C.	AREA ID	AREA	RUNOFF C.
1	3.14 Ha	0.38	34	3.26 Ha	0.45
2	1.13 Ha	0.50	35	0.93 Ha	0.33
3	1.59 Ha	0.37	36	0.60 Ha	0.35
4	2.40 Ha	0.42	37	0.50 Ha	0.36
5	15.38 Ha	0.15	38	2.51 Ha	0.59
6	23.47 Ha	0.15	39	2.13 Ha	0.66
7	0.61 Ha	0.61	40	1.40 Ha	0.58
8	2.49 Ha	0.61	41	2.47 Ha	0.59
9	1.13 Ha	0.58	42	1.03 Ha	0.57
10	2.44 Ha	0.58	43	1.68 Ha	0.39
11	1.13 Ha	0.36	44	1.14 Ha	0.60
12	1.48 Ha	0.72	45	0.82 Ha	0.61
13	2.08 Ha	0.61	46	2.22 Ha	0.67
14	1.82 Ha	0.59	47	2.37 Ha	0.56
15	2.67 Ha	0.67	48	0.35 Ha	0.68
16	2.30 Ha	0.60	49	1.19 Ha	0.62
17	1.37 Ha	0.62	50	0.30 Ha	0.66
18	0.55 Ha	0.53	51	3.85 Ha	0.39
19	4.07 Ha	0.67	52	1.23 Ha	0.52
20	1.89 Ha	0.48	53	1.09 Ha	0.46
21	1.14 Ha	0.65	54	6.90 Ha	0.23
22	2.12 Ha	0.67	55	1.20 Ha	0.63
23	1.87 Ha	0.63	56	1.35 Ha	0.67
24	1.66 Ha	0.68	57	1.13 Ha	0.64
25	2.01 Ha	0.56	58	2.15 Ha	0.78
26	0.67 Ha	0.47	59	1.21 Ha	0.74
27	0.48 Ha	0.44	60	22.83 Ha	0.51
28	5.17 Ha	0.38	61	25.83 Ha	0.52
29	1.61 Ha	0.63	62	0.60 Ha	0.64
30	7.09 Ha	0.58	63	19.59 Ha	0.15
31	0.84 Ha	0.68	64	18.82 Ha	0.38
32	0.80 Ha	0.69	65	0.18 Ha	0.67
33	0.85 Ha	0.63			

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**

TITLE:  
**OVERALL STORMWATER MANAGEMENT PLAN  
MINOR DRAINAGE SYSTEM**



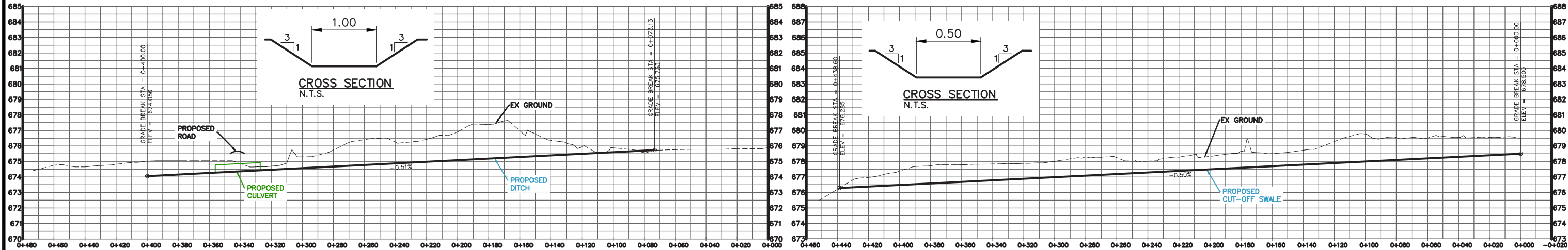
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AUG. 20, 2013

PROJECT # 5114046

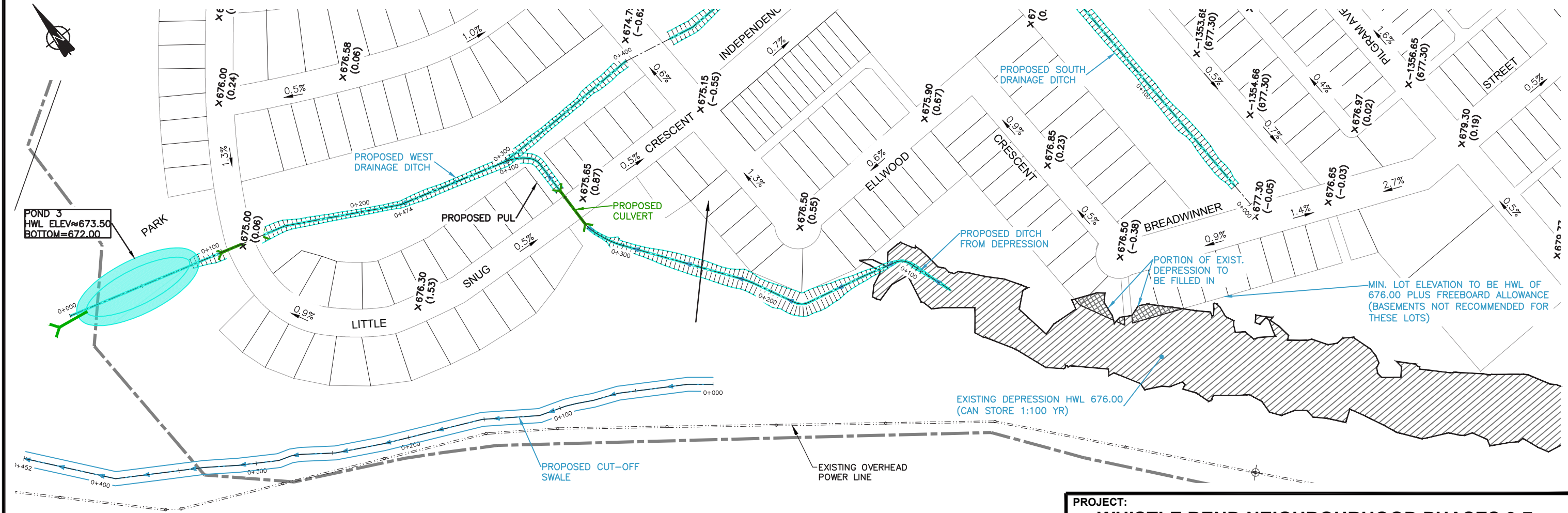
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FIGURE 6.14



PROPOSED DITCH FROM DEPRESSION

PROPOSED CUT-OFF SWALE



LEGEND:

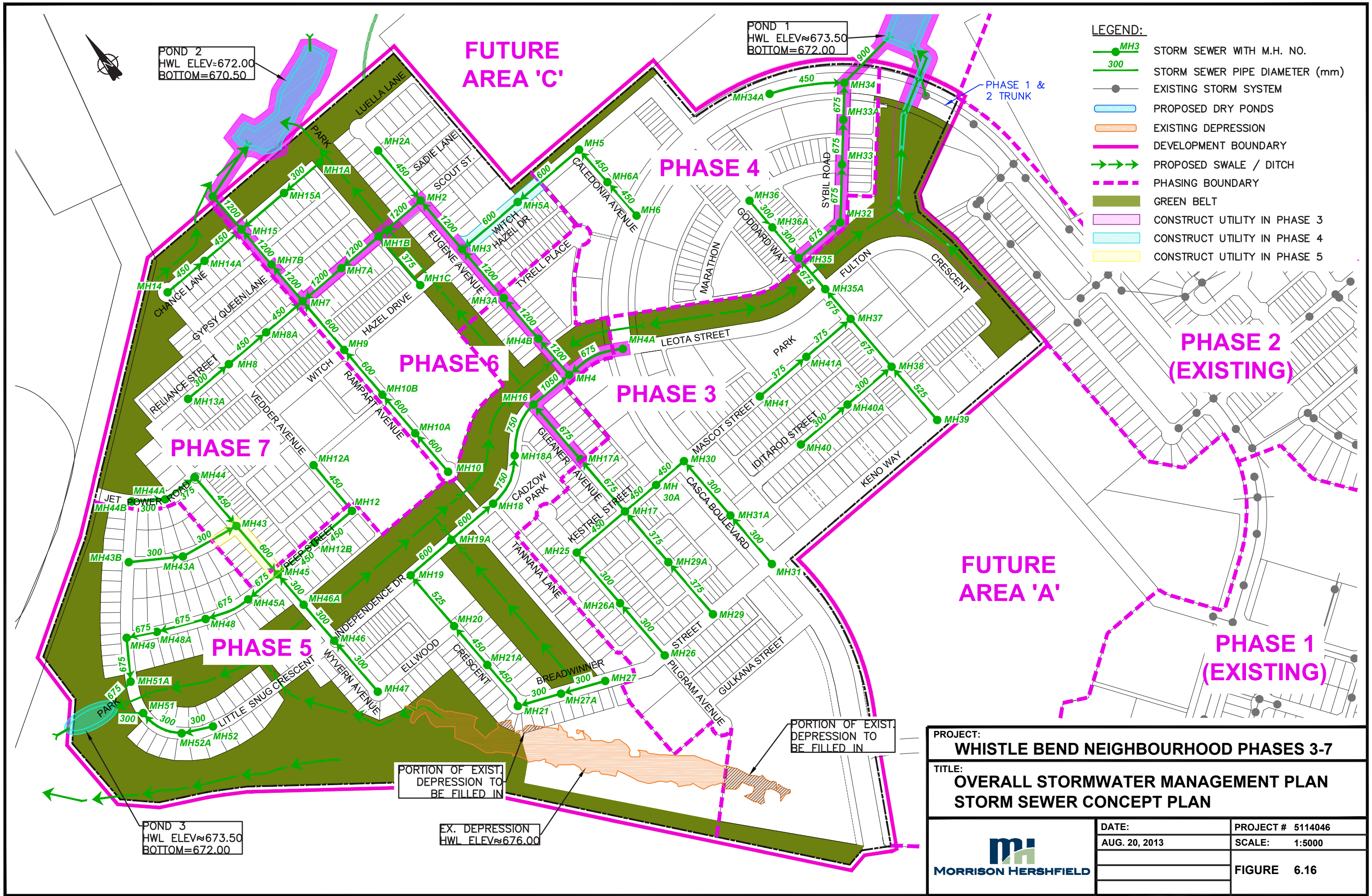
- PROPOSED DESIGN ELEVATION
- CUT(-)/FILL(+) TO EXISTING GROUND
- EXISTING GROUND CONTOUR
- PROPOSED DITCH

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**

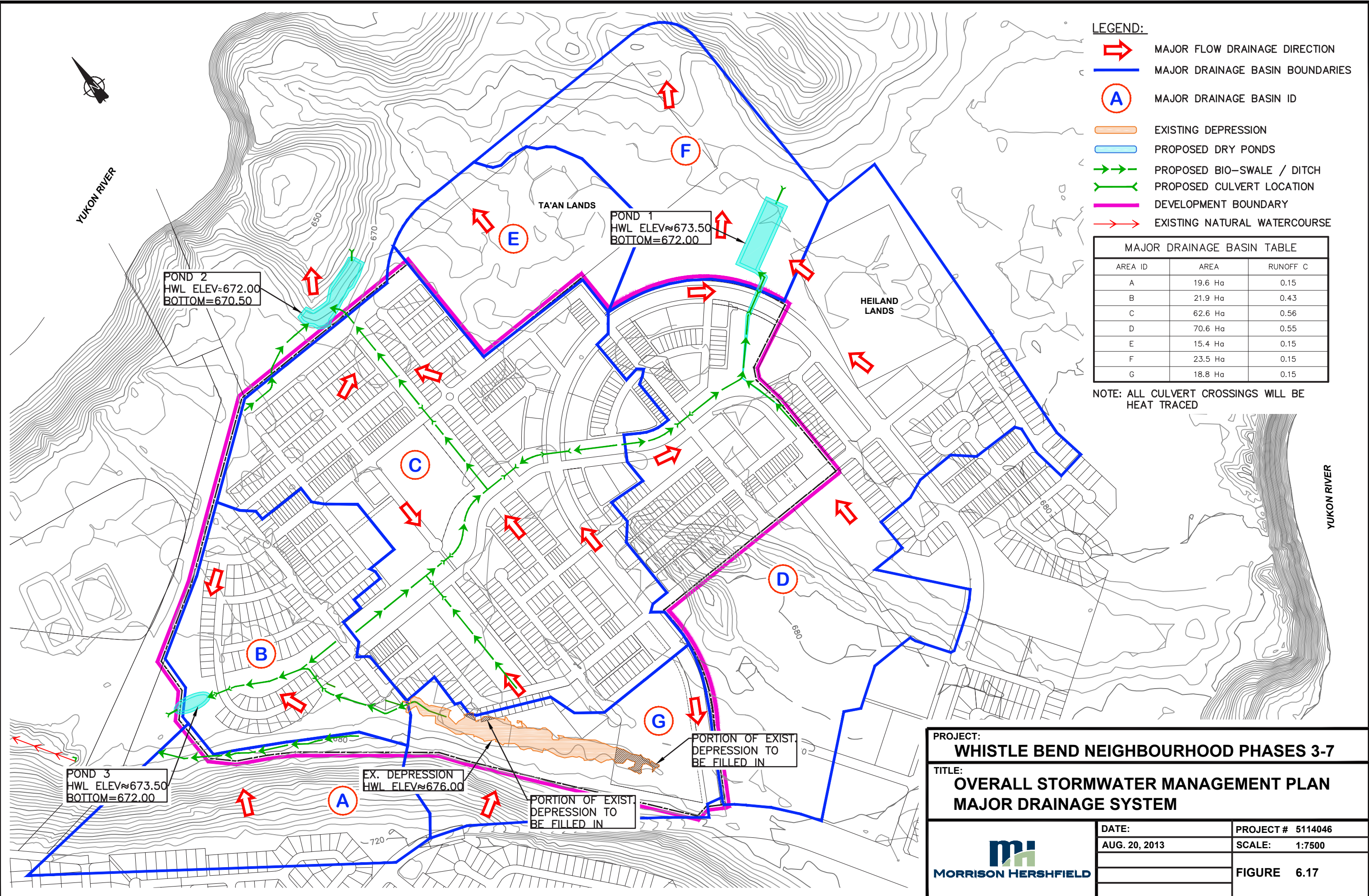
TITLE:  
**PROPOSED SOUTHWEST DITCH DESIGNS**



DATE:	PROJECT # 5114046
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	FIGURE 6.15



ANSI B SIZE 11"x17" (29.4mm x 431.4mm)  
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- LEGEND:**
- MAJOR FLOW DRAINAGE DIRECTION
  - MAJOR DRAINAGE BASIN BOUNDARIES
  - MAJOR DRAINAGE BASIN ID
  - EXISTING DEPRESSION
  - PROPOSED DRY PONDS
  - PROPOSED BIO-SWALE / DITCH
  - PROPOSED CULVERT LOCATION
  - DEVELOPMENT BOUNDARY
  - EXISTING NATURAL WATERCOURSE

MAJOR DRAINAGE BASIN TABLE		
AREA ID	AREA	RUNOFF C
A	19.6 Ha	0.15
B	21.9 Ha	0.43
C	62.6 Ha	0.56
D	70.6 Ha	0.55
E	15.4 Ha	0.15
F	23.5 Ha	0.15
G	18.8 Ha	0.15

NOTE: ALL CULVERT CROSSINGS WILL BE HEAT TRACED

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**

TITLE:  
**OVERALL STORMWATER MANAGEMENT PLAN  
MAJOR DRAINAGE SYSTEM**

	DATE:	PROJECT # 5114046
	AUG. 20, 2013	SCALE: 1:7500
		FIGURE 6.17

#### 6.4.4.2.8 Major System

The 100 year 24 hour duration storm was used for the assessment of the major drainage system. Inlet controls generally limit the inflow into the minor system up to the 5 year design. Storm events that exceed the 5 year 1 hour design storm must be routed along the streets, green belt areas, through culverts, ditches, bio-swales, or other specified rights of way where they can pond up to a certain level less than 0.3 m and continue safely to a designated final discharge location such as the dry pond. Culverts crossings will need to be heat traced with a power supply.

The total rainfall for the 1:100 year 24 hour event is approximately 46.8 mm, approximately 5 times the 1:5 year storm amount. Again, the rainfall event was developed using IDF parameters derived from Meteorological Service of Canada rainfall data for the Whitehorse Airport (Climate Station ID 2101300).

The proposed major system consists of Basins A to G shown on Figure 6.17. Basins B, C, and D all drain into their corresponding dry ponds and are shown on Figure 6.18. Proposed bio-swales throughout the development are shown in Figures 6.18, 6.19, 6.20, 6.21, and 6.22. The extents of the side slopes are shown to illustrate the width required for the swale within the greenbelt/natural areas. The routing of the swale is shown as more linear for clarity and to establish starting point for further detailed design. The location and shape of the alignment could be modified at the time of construction to achieve a more natural look or aligned with the trail route to minimize additional disturbance to existing green belt vegetation.

Basin C will require proposed ditches or bio-swales at the North part of the site near Pond No.2 by Chance Lane Road to control major flows and direct them towards the pond instead of the North depression. Figure 6.18 shows the proposed ditch plan as well as profile and typical cross section.

Basin A is an upstream basin which slopes towards site and Basins E and F slope away from the study area. Basin A will be diverted away from site through a proposed ditch or bio-swale which will direct upstream basin flows to the water course located just west of study area. As depicted earlier, Figure 6.16 shows additional details of these proposed ditches or bio-swales. The ditches/bio-swales are approximately at slopes ranging from 0.3% to 0.5% to minimize the depth of excavation.

Basin G, includes the The existing South depression which will utilize one ditch as an emergency spillway for events greater than the 1:100 year event. The east portion could be filled in to allow for more developable area of the proposed lot (school site) for recreational facility and use.

Basins E and Basin F slope away from the site and therefore have no effect on proposed study area. It is recommended that the owners of Basins E and F develop their own storm water management plan to control their flows to the pre-development rate to help prevent flooding downstream. Refer to Figure 6.18, which shows the overall proposed major drainage system and the locations of the proposed dry ponds.

Two dry ponds (Pond 1 and 2) will ultimately discharge into depressions downstream at the pre-development rate and the Pond No.3 will discharge into a natural drainage course downstream and ultimately into the Yukon River. The stormwater management plan proposed is to mimic the natural drainage patterns at site. This will ensure the natural areas downstream are maintained and prevent flooding. Flooding or ponding should occur up to the road curb height, and then spill overland, via the green belts, and ultimately to the ponds. Sediment traps are proposed at the inlet and outlet of each dry pond to meet the water quality requirements before discharging into the natural areas downstream.

Channels from the ponds to the existing kettle depressions will be designed with erosion protection.

XP-SWMM was simulated using the parameters in Table 6.10 under the 1:100 year 24 hour event to generate a hydrograph at specific nodal locations forming a Runoff Block. EXTRAN, a hydraulic flow routing model which XP-SWMM uses, receives these hydrographs and performs a dynamic routing of storm water runoff throughout the drainage system to the outfall locations.

The 1:100 year 24 hour storm event is considered the most critical storm event. A summary of the modeling results is shown in Table 6.15, see Volume 1 (separate attachment) for the complete results.

**Table 6.15. Summary of the 1:100 Year 24 Hour Modeling Results**

Pond ID	Drainage Area (ha)	Total Rainfall (mm)	Average Run-off Amount (mm)	Elevation of Pond Bottom (m)	Total Storage Volume Required (m <sup>3</sup> )	Maximum Discharge Rate (m <sup>3</sup> /s)
1	70.6	46.7	20.3	672.0	10,200	0.169
2	62.6			670.5	9,300	0.150
3	21.9			672.0	2,500	0.053
Total	155.1				22,000	0.372

Based on results, the dry ponds must be sized to store a total 1:100 year 24 Hour Storm event volume of 22,100 cu.m. The maximum allowable discharge rate from dry pond during this event was 2.4 L/s/ha and was controlled using a control structure with an orifice downstream of the each dry pond.

A typical section of each dry pond is shown in Figure 6.19. All dry ponds will have a control structure to limit flow during a 1:100 year storm to the pre-development rate. A gate with an orifice hole will control the flow from each pond. The gate will be opened during emergency situations when the orifice gets plugged. Emergency overflows routes to the depression areas or watercourse will be considered in the detailed design of all dry ponds as they are immediately adjacent to their ultimate discharge location. A minimum freeboard of 0.3 m will be required at these facilities for safety.

#### 6.4.4.2.9 Water Quality

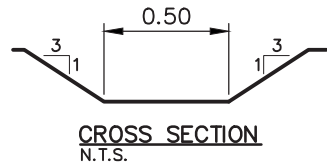
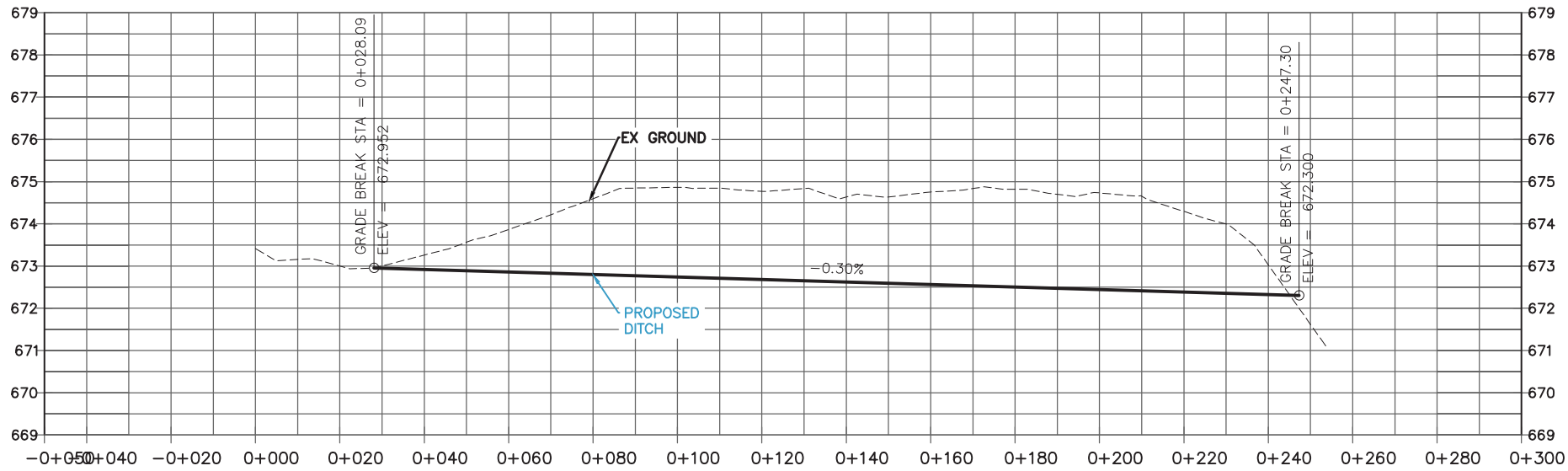
Water quality is a very important measure in the design of a storm water management plan. Runoff from proposed developments generate more sediment and debris which need to be removed to improve water quality downstream.

Consideration of water quality has been implemented for the proposed development. Each dry pond will have a proposed sediment trap at the inlet and outlet location as shown on Figure 6.19. This will allow sediment particles to settle in trap before the storm water discharges from outlet. Proper sizing of these sediment traps will be determined in the detailed design stage.

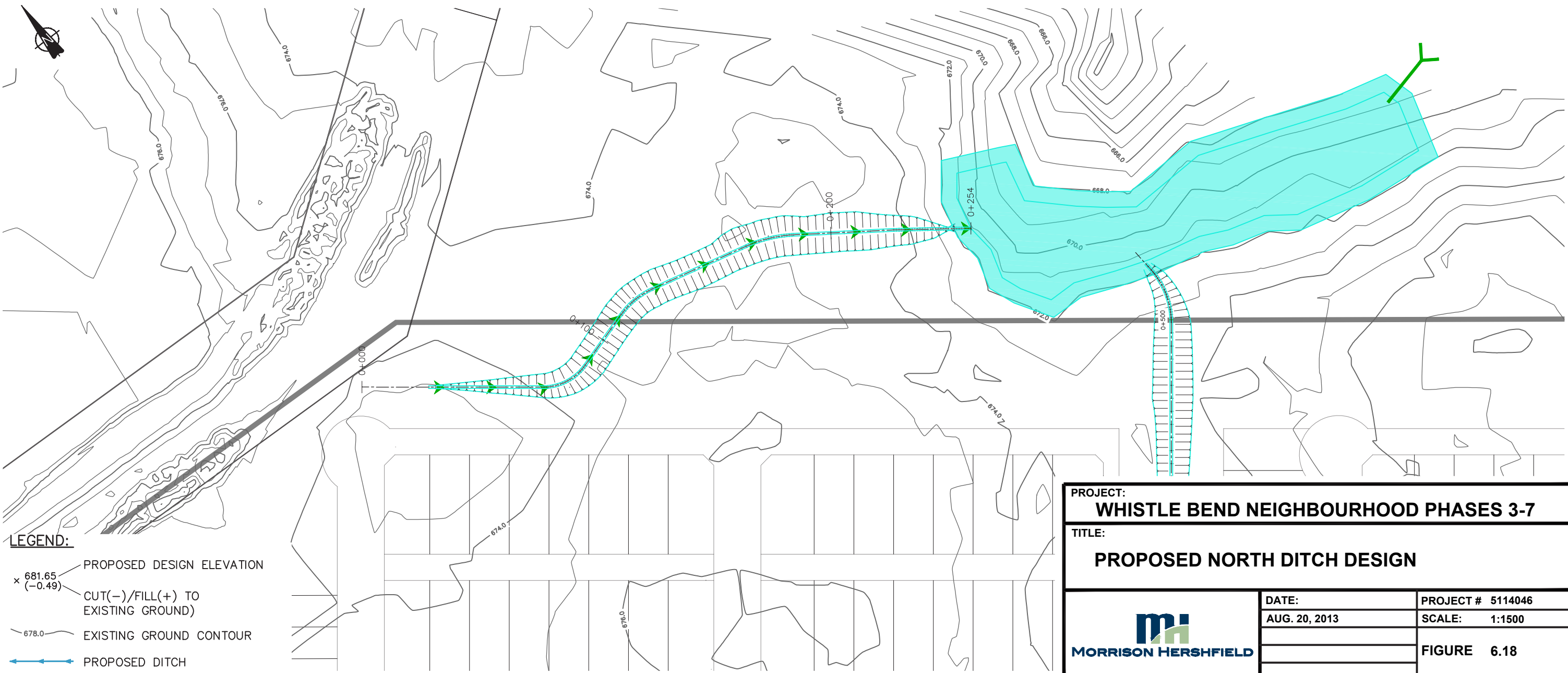
Dry ponds were proposed in order to keep the depth shallow and open to playground use or other recreational activities and can be landscaped to be rather attractive areas. However, wet ponds or wetlands or a combination of both can also be proposed for the area. These ponds tend to be much deeper and may need to be fenced to prevent any children from accessing them; however, they may provide better water quality treatment before discharging to the areas downstream.

Water quality standards may need to be established and then applied as part of the final design of the drainage system.

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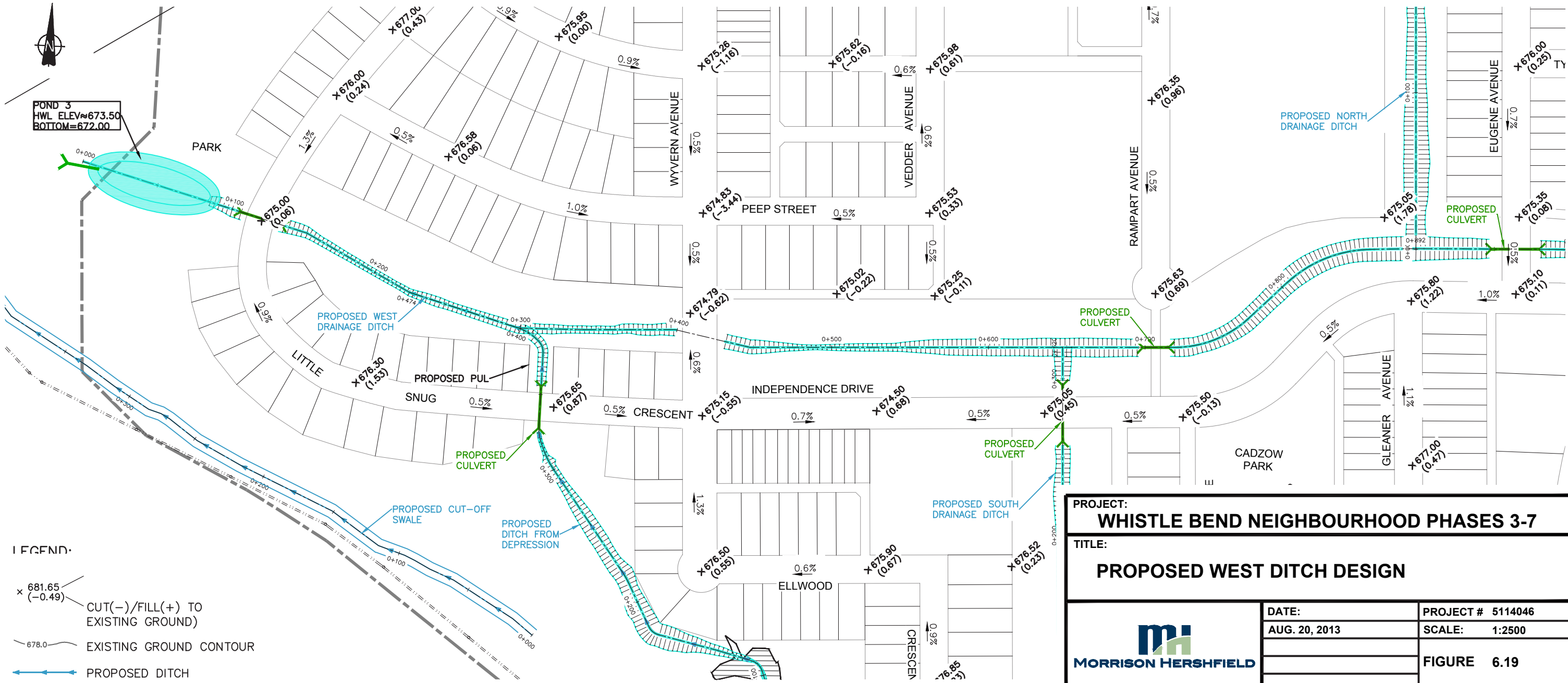
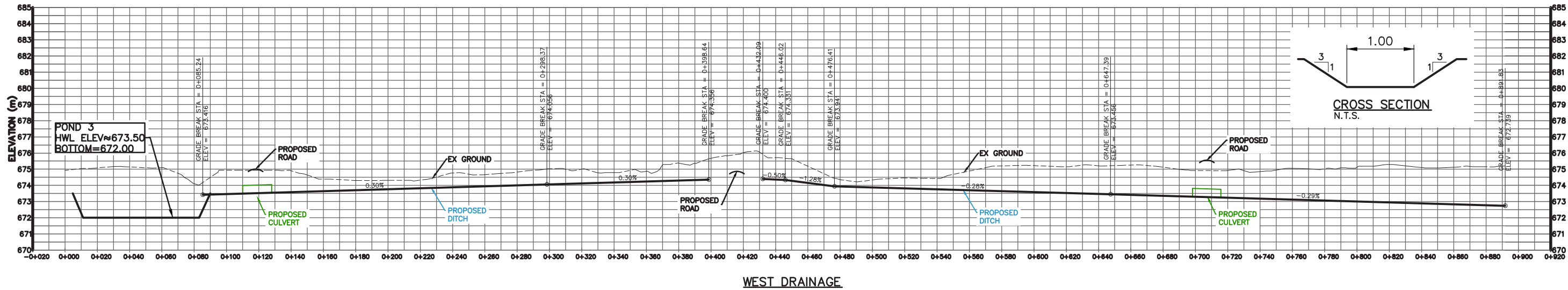
PROFILE #1



- LEGEND:**
- × 681.65 (-0.49) PROPOSED DESIGN ELEVATION
  - CUT(-)/FILL(+) TO EXISTING GROUND
  - 678.0 EXISTING GROUND CONTOUR
  - ← PROPOSED DITCH


PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>PROPOSED NORTH DITCH DESIGN</b>		
	DATE:	PROJECT # 5114046
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		FIGURE 6.18

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- LEGEND:
- X 681.65 (-0.49) CUT(-)/FILL(+) TO EXISTING GROUND
  - 678.0 EXISTING GROUND CONTOUR
  - PROPOSED DITCH

PROJECT: WHISTLE BEND NEIGHBOURHOOD PHASES 3-7  
TITLE: PROPOSED WEST DITCH DESIGN

	DATE:	PROJECT # 5114046
	AUG. 20, 2013	SCALE: 1:2500
		FIGURE 6.19

### 6.4.5 Stormwater Recommendations

The following are recommendations regarding stormwater, based on the analysis conducted in this report.

- It is recommended that SWMFs such as dry ponds with sediment traps are proposed for the study area. Controlling each SWMF to the maximum allowable discharge rate will help maintain the areas downstream and prevent flooding. Dry Ponds 1 and 2 will discharge at a controlled rate into the depressions downstream; however, it is very important that a monitoring program should be implemented at the early stage of the development to ensure the depressions downstream do not continue to fill up. Monitoring program can be implemented such as installing water level measurement sensors in each depression to measure the change in water level over time. This will ensure that these depressions are well maintained and that no slope failure occurs at the bank of the Yukon River.
- Possible mitigation techniques for stormwater management in this development include low-impact development techniques such as utilizing permeable pavement, rain barrels and creating rain gardens in majority of the lots being developed. This will promote infiltration and lessen the stormwater runoff as well as improve water quality into the drainage system.
- Ponds 3 will discharge at a controlled rate into the natural watercourse just west of study area and ultimately into the Yukon River.
- The South depression will discharge into a ditch utilized as an emergency spillway during events greater than the 1:100 year event. The east portion of the depression could be filled in to increase the developable area of the proposed lot (school site).
- It is recommended that developments upstream of study area which are flowing towards site are controlled to the maximum allowable discharge rate. This will help prevent any flooding downstream on Phases 2,3, and 4 of the development. Future areas downstream of these phases that are proposed for development, must also adhere to the controlled discharge rate.
- A geotechnical analysis is also recommended along the banks to ensure that these banks are stable and do not collapse under the condition where the depressions are full of stormwater.
- The ability of the entire Porter Creek Lower Bench area to handle to the additional stormwater flows generated as a result of the Whistle Bend Development is recommended for further study. This analysis should be completed in conjunction with the detailed design of the next phase of development. This evaluation will provide necessary information needed to complete stormwater management plan for the design of the development.
- A ground water study near existing low areas (ex. South depression) is to be completed

## 6.5 Shallow Utilities

The shallow utilities will be provided by the following companies Yukon Electric (Power) and Northwestel (Telephone/Cable).

### 6.5.1 Power

The power utility, provided by Yukon Electric, will follow the road cross section details. In locations where the services need to be outside of the roads, a utility easement or right-of way will need to be obtained. The power distribution will require a looped system to ensure that there is no loss of service. This will be important as the development is constructed in stages, so designs will need to consider how this looping will be achieved.

Yukon Electric has indicated that the proposed development for Phases 3-7 is serviceable, and they are currently in the process of providing servicing for Phase 1 and 2.

### 6.5.2 Telephone/Cable

The telephone and cable utilities, provided by Northwestel, will also follow the road cross section details. In locations where the services need to be outside of the roadways, a utility easement or right-of way will need to be obtained. These cables are to be installed by and for Northwestel.

## 6.6 Cost Estimates

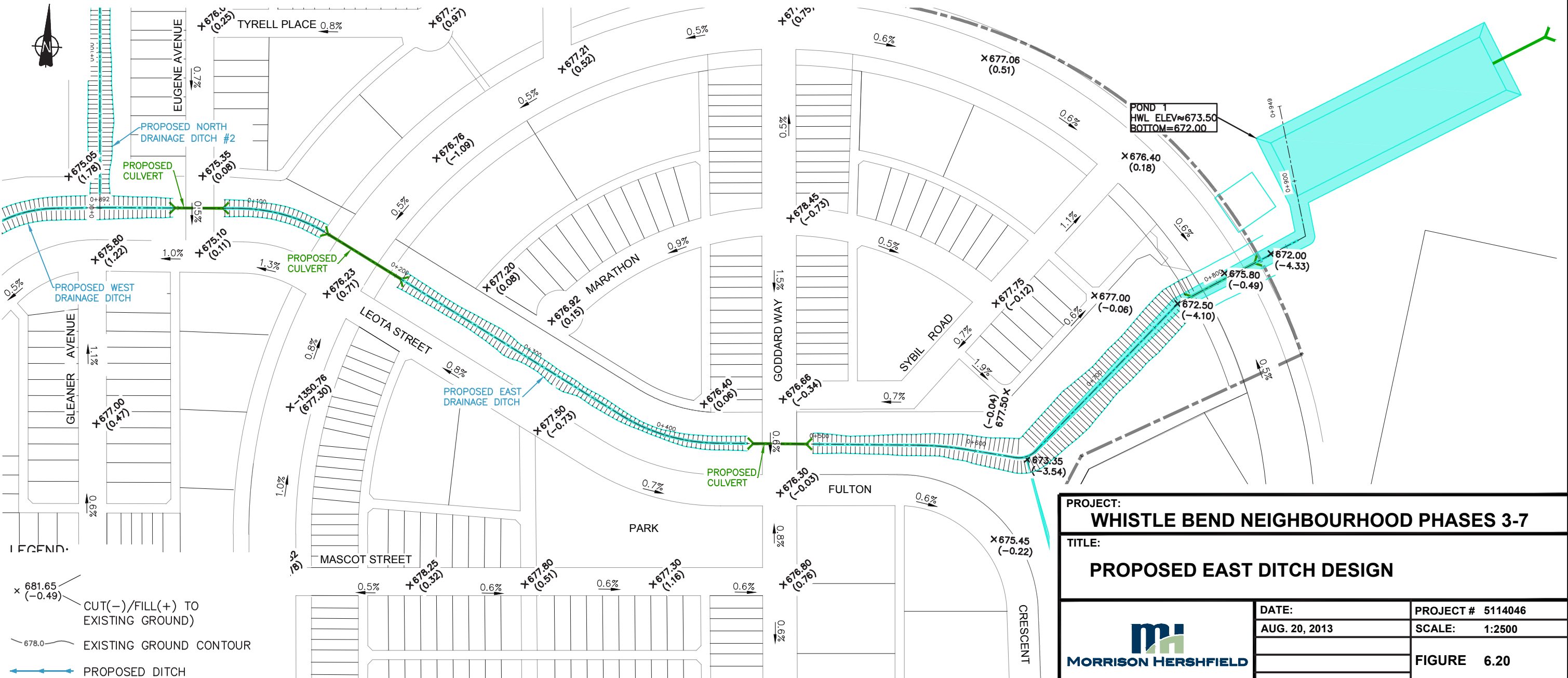
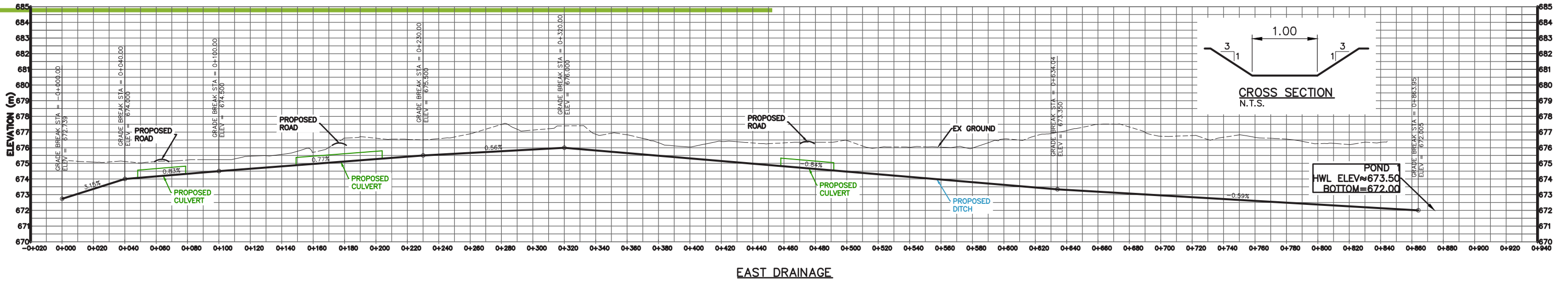
The following sections include cost estimates for the on-site and off-site infrastructure, as described in their respective sections in this report.


### 6.6.1 On-Site Cost Estimates

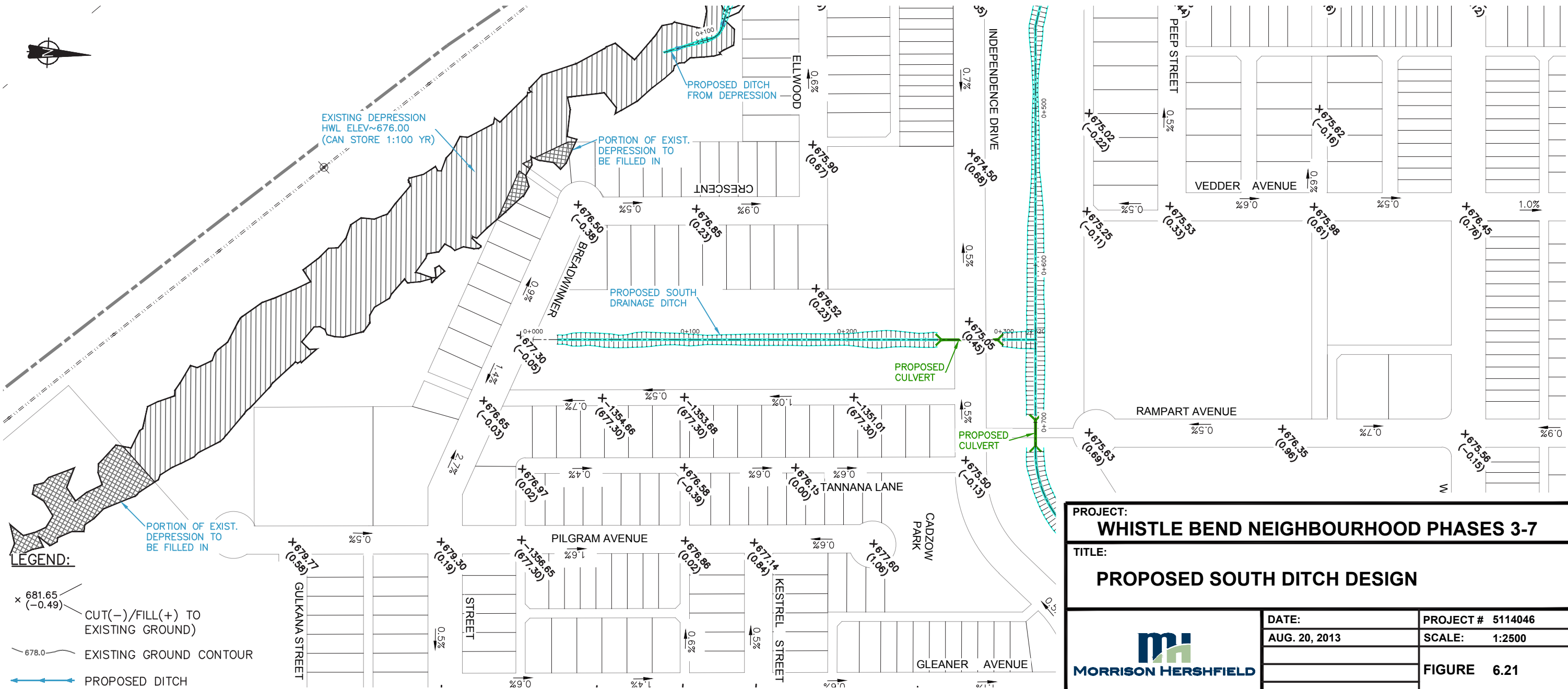
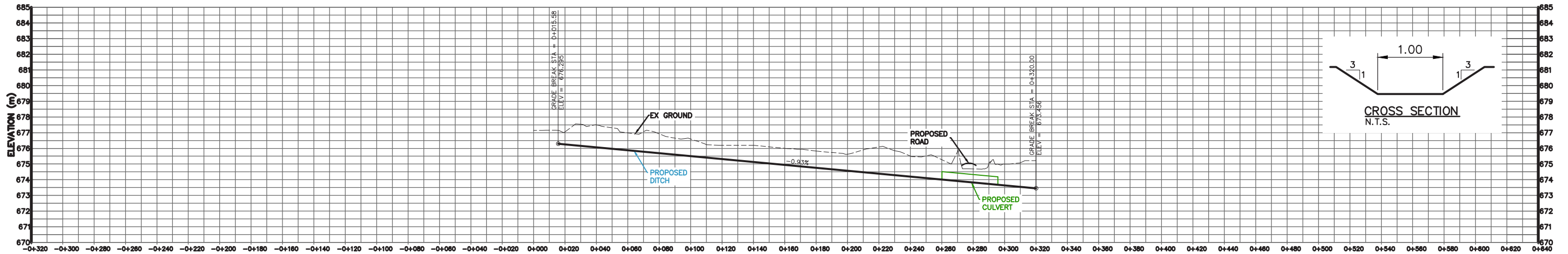
The following section represents the cost summaries for on-site services associated with the development of the Whistle Bend Subdivision Phases 3-7. These are Class “B” cost estimates for the purposes of obtaining effective project approval and for budgetary control. The quantity take-offs for the cost estimates have been based on the preliminary design drawings.


As previously mentioned, it should be noted that “Phases 3-5” were previously established in the Whistle Bend Onsite Servicing Report, November 2009 by AECOM, in terms of size, location and land use. These have since been modified and changed. Any comparisons must be adjusted accordingly. Detailed cost estimates for each Phase are included in an Appendix F. These are broken down in to detail for: Water Distribution System, Wastewater Collection and Disposal, Stormwater Management, Transportation, and Shallow Utilities.

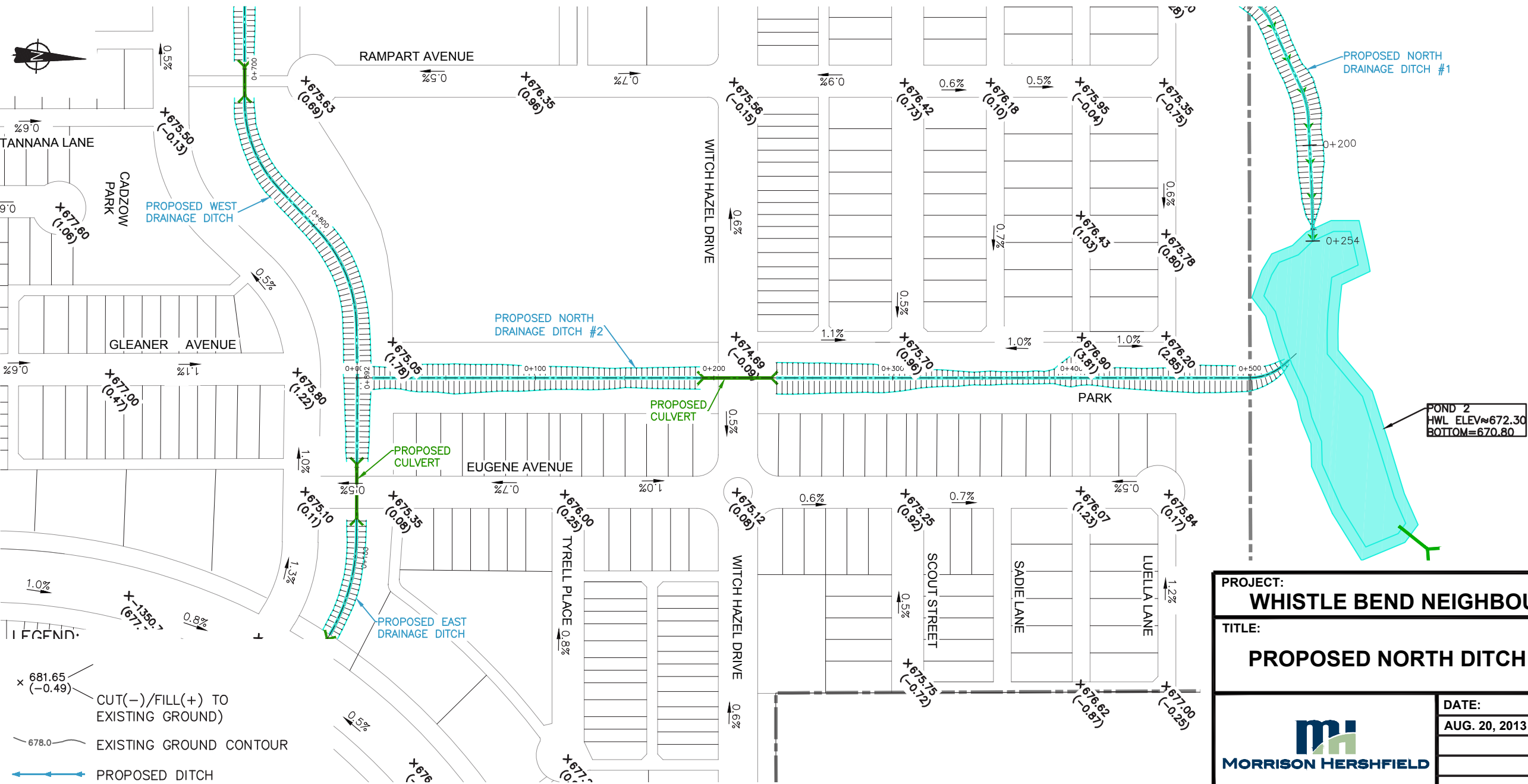
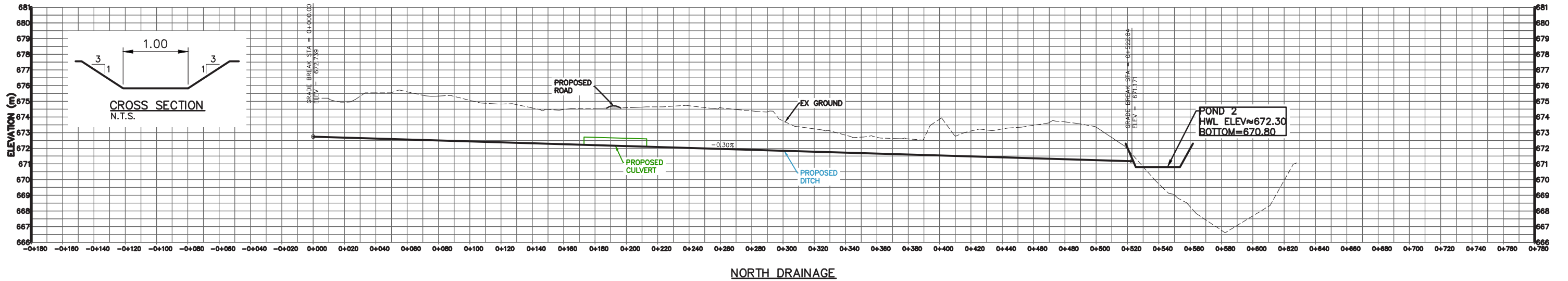
The current phasing plan will require that some infrastructure be constructed in undeveloped portions, beyond individual phasing boundaries. It is necessary to build some portions of the infrastructure in areas that would be developed at a later date. An example is water mains (for looping requirement), storm trunks and dry ponds (to convey stormwater and provide detention), as well as other underground utilities (sanitary sewer and shallow utilities). Roadways also may need to be constructed outside each phase under development to provide the adequate access and movement of traffic and people. For example, Phase 3 of Casca Boulevard will need to be constructed to extend the portion




PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>PROPOSED EAST DITCH DESIGN</b>		
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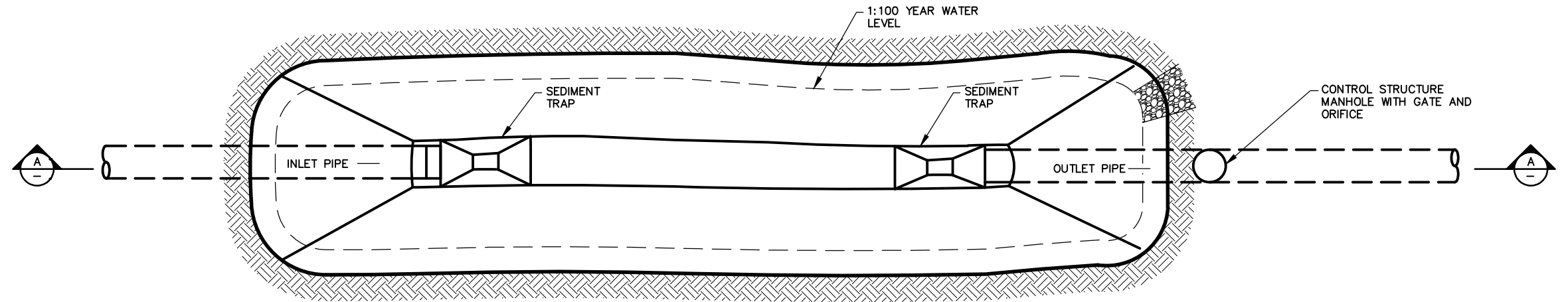


PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>PROPOSED SOUTH DITCH DESIGN</b>		
	DATE: AUG. 20, 2013	PROJECT # 5114046
		SCALE: 1:2500
		FIGURE 6.21

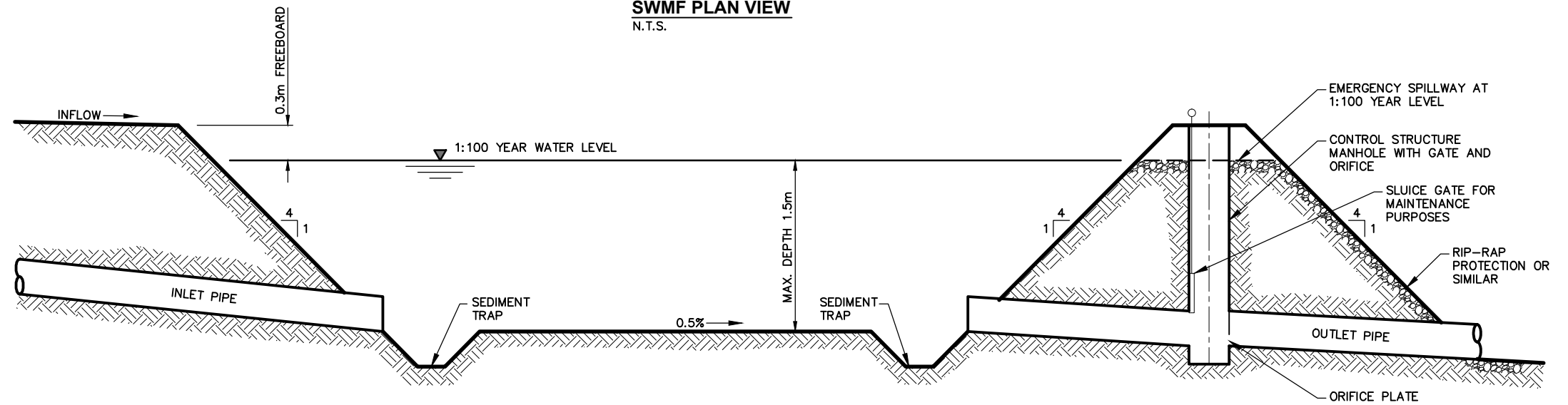


PROJECT: <b>WHISTLE BEND NEIGHBOURHOOD PHASES 3-7</b>		
TITLE: <b>PROPOSED NORTH DITCH #2 DESIGN</b>		
	DATE: AUG. 20, 2013	PROJECT # 5114046
		SCALE: 1:2500
		FIGURE 6.22

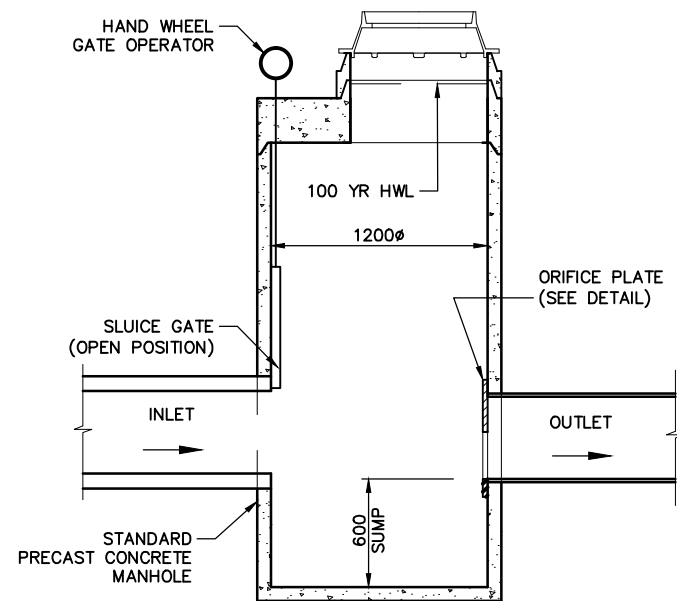
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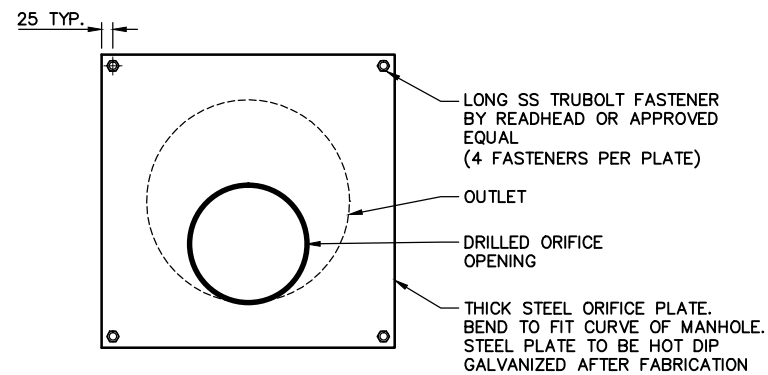
**SWMF PLAN VIEW**  
N.T.S.



**SECTION A-A**  
N.T.S.



**CONTROL STRUCTURE DETAIL**  
N.T.S.



**ORIFICE PLATE DETAIL**  
N.T.S.

PROJECT:  
**WHISTLE BEND NEIGHBOURHOOD PHASES 3-7**

TITLE:  
**OVERALL STORMWATER MANAGEMENT PLAN  
TYPICAL SWMF CROSS SECTION AND PLAN**



DATE:	PROJECT # 5114046
AUG. 20, 2013	SCALE: N.T.S.
	FIGURE 6.23

constructed with Phase 1 and 2. Other than Casca Boulevard, all other cost estimates developed for the roads were based only on the roads within the actual Phase boundary. The proposed west lift station would need to be constructed with Phase 5, that will service later Phases 6 and 7. The costs attributed to each phase can be found in Appendix F. For services that are to be constructed outside of the phase boundary, they have been highlighted, to show visually, on the corresponding drawings (water, sanitary, storm).

The cost estimates for each phase of development takes into account the required infrastructure to service the phase, even if it is located in another phase boundary. Figures 6.4- On-site Water Network, illustrates the water mains that are constructed with each phase. Figure 6.16 – Storm Sewer Plan, illustrates what is constructed during Phase 3, as a significant amount of infrastructure is required in this initial phase.

The cost estimates have been prepared by using the most recent costing information from projects of a similar size and scope as well as previous cost estimates completed for the Whistle Bend Development. Where applicable, the costs estimates for similar items were compared with the recently tendered prices from Phase 1 and 2 development (2011). For Phase 1 and 2 the average tender amount was \$20 Million, or \$10 Million per Phase. Note that the tenders did not include some items (asphalt, landscaping, etc), and therefore the total costs for development of Phase 1 and 2 would be higher.

A contingency and estimating allowance of 15% has been included. Engineering is included at 15%. Cost Estimates do not include Owner and City costs.

**Table 6.16: Cost Estimates by Phase**

	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Total
1. Water Distribution System	2,525,767	804,682	3,385,156	1,456,145	715,345	8,887,095
2. Wastewater Collection and Disposal	1,973,738	1,131,610	2,787,054	1,356,102	647,763	7,896,266
3. Stormwater Management	2,689,929	352,695	1,404,674	445,155	415,127	5,307,579
4. Transportation	11,820,691	3,214,292	5,052,858	3,646,173	3,458,821	27,192,835
5. Shallow Utilities	2,490,000	990,000	2,160,000	1,430,000	1,490,000	8,560,000
<b>Sub-Total</b>	<b>21,500,124</b>	<b>6,493,279</b>	<b>14,789,741</b>	<b>8,333,574</b>	<b>6,727,056</b>	<b>57,843,774</b>
Mobilization	100,000	100,000	100,000	100,000	100,000	500,000
Contingency and Estimating Allowance (+15%)	3,240,019	988,992	2,233,461	1,265,036	1,024,058	8,751,566
<b>Sub-Total</b>	<b>24,840,143</b>	<b>7,582,271</b>	<b>17,123,202</b>	<b>9,698,610</b>	<b>7,851,114</b>	<b>67,095,340</b>
Engineering (+15%)	3,726,021	1,137,341	2,568,480	1,454,791	1,177,667	10,064,301
<b>Total</b>	<b>28,566,164</b>	<b>8,719,611</b>	<b>19,691,683</b>	<b>11,153,401</b>	<b>9,028,781</b>	<b>77,159,641</b>

From the above table, the average cost per phase for Phases 3-7 is around \$12 Million per Phase (excluding the Contingency, and Engineering amounts) and is comparable to the average tender results for Phase 1 and 2 which equated to approximately \$10 Million per phase. Considering some required items may not have been included with Phase 1 and 2 tender, and taking into account some factor for escalation the current cost estimate, the average cost per Phase, for Phase 3-7 is comparable.

Previous cost estimates (including Contingency and Engineering) for Whistle Bend (On-Site Servicing Report AECOM, November 2009) had \$22.77 Million for Phase 1 and \$19.78 Million for Phase 2. In that report the remainder of the development (previously Phase 3-6, now Phase 3-7) was estimated to cost \$75 Million (to the total from Table 6.16 above of \$77 Million). These costs are comparable.

In addition to the above listed costs, there will be costs associated with landscaping and re-vegetation. This includes the parks, recreation areas, green belts (and bio-swales), green streets, stormwater ponds, and green links.

An order of magnitude cost has been determined to provide an estimating allowance for the landscaping enhancements that are envisioned for this development. Natural areas retained where possible, disturbed areas to be rehabilitated/re-vegetated.

Institutional/Recreations Sites would include schools with open play/sports fields. Typical landscaping components would include: irrigation, ball field, soccer field, planting and site seeding.

Community/Neighbourhood Parks would include: planting, seating areas, play structures, trash units, sodded site.

Green Belts/Natural Areas would include seating areas along pathways, planting, and seeding, and re-vegetation. Bio-swales to be re-vegetated.

Green Streets/Linear Parks would include seating along pathways, planting, seeding.

Landscaping for the stormwater ponds would include planting, seeding, pathways and seating area.

The costs for boulevard trees along streets have been included in the Transportation cost estimate.

Based on Phase 1 and 2 development and projects of similar size, an average amount of \$1.5 Million/Phase is deemed reasonable. Some phases will be more or less than this amount as the size and scope for each phase will vary. For phases 3-7, five (5) phases, the amount for landscaping works out to \$7.5 Million. The table below, shows this amount with the addition of Contingency and Engineering costs added in.

**Table 6.17: Landscaping Cost Allowance**

Landscaping	Cost (\$)
Five (5) Phases @ \$1.5 Million	7,500,000
Contingency (%15)	1,125,000
Sub-Total	8,625,000
Engineering (15%)	1,293,750
<b>Total</b>	<b>9,918,750</b>

An amount of \$ 9.9 Million is proposed to be added to the total to account for landscaping.

Therefore the total estimated cost for Phases 3-7 is \$ 87 Million. One third of these costs is for Phase 3, which will require construction of major infrastructure to service this phase as well as benefit the rest of the phases.

The above costs do not include the following:

- Owner and City Costs
- GST
- Escalation after 2013
- Land Costs
- Legal Survey
- Legal Costs
- Winter Work

For some of the items for site development, further breakdown by phase is presented in the following tables. These include the dry ponds, and the on-site trails. The cost below in tables 6.18 and 6.19 do not include the Mobilization, Contingency and Engineering amounts, as these are applied to overall phase costs.

Detailed costing for these is included in the Appendix F.

Costs (Item 3.15 in Detailed Cost Estimate) for Dry Ponds by Phase in which they are required to be constructed are shown below:

**Table 6.18: Dry Pond Cost by Phase**

Dry Pond	Built with Phase	Cost Estimate (\$)
No. 1	3	146,880
No.2	3	133,920
No.3	5	36,000
<b>Total</b>		<b>316,800</b>

Note: Costs do not include landscaping or underground piping.

Costs for Trails (Item 4.13 in Detailed Cost Estimate) by Phase in which they are located are shown below:

**Table 6.19: On-Site Trail Costs by Phase**

Phase	Length (m) Paved	Length (m) Gravel	Cost Estimate
3	203	928	78,880
4	-	-	-
5	1,381	1,657	303,810
6	195	400	51,200
7	345	36	57,000
<b>Total</b>			<b>490,890</b>

The phasing for construction of perimeter trails should be reviewed to confirm logical segments are incorporated to meet the needs of development progress.

## 6.6.2 Off-Site Cost Estimates

The off-site components are considered those items that are outside the development boundary, but are required as a result of the development. These items include components related to wastewater, water, and transportation.

Costs for these off-site improvements were developed in 2008 as part for the Off-site Servicing Report. These were then updated in the Whistle Bend Subdivision Cost Estimate Summary by AECOM (November 4, 2009). Contingency and Engineering amounts were included.

Applicable off-site improvements, based on the current planned development in Whistle Bend, are presented below and have been updated to 2013 dollars by increasing the costs by 25% to account for escalation. Some new projects have since been identified and included here. Build Out is defined as a percentage of the entire Whistle Bend Development.

**Table 6.20: Off-site Cost Estimate Updates - August 2013**

Service	Build Out	Item	Cost (2009)	Cost (2013)
Wastewater	75%	PCFT Forcemain Twinning	184,000	230,000
Water	25-50%	Poine Street Extension	663,700	829,625
Transportation	Phase 3	Whistle Bend Way Extension	N/A	1,279,188
	Phase 3	Off-site Trail (Whistle Bend Way) Paved 3m wide	N/A	120,000
	Phase 3	Off-site Trail (To Mountainview) Paved 3m wide	N/A	183,000
	50%	Whistle Bend Way Widening	2,010,000	2,512,500
	50%	Mountainview Dr/Whistle Bend Dr. Intersection	1,970,000	2,462,500
	50%	Mountainview Dr. Corridor Intersection Improvements	200,000	250,000
	75%	Mountainview Dr. - 4 laning (12th Ave to Range Rd)	3,330,000	4,162,500
	75%	Mountainview Dr. Intersection Improvements	200,000	250,000
	25%	Bike Trail	N/A	1,000,000
	25%	Range Road BST	N/A	250,000
	25%	Eagle Bay Park	N/A	200,000
	75%	Mountainveiw Dr. -4 laning Range Road to Tinglit	N/A	2,000,000
<b>Total Off-Site Costs</b>				<b>15,417,375</b>

Costs outlined here do not include the following:

- Owner and City Costs
- Landscaping Costs
- GST
- Escalation after 2013
- Land Costs
- Legal Survey
- Legal Costs
- Winter Work