FERNBANK
COMMUNITY DESIGN PLAN

MASTER SERVICING STUDY
Volume 1 of 2

DRAFT

JUNE 2009

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COMMUNITY DESIGN PLAN

MASTER SERVICING STUDY
Volume 1 of 2

NOVATECH
ENGINEERING
CONSULTANTS LTD.

May 26, 2009

BY COURIER

City of Ottawa
Planning, Transit and the Environment Department
Community Planning & Design Division
110 Laurier Ave West, 4th Floor
Ottawa, Ontario
K2P 1J1
Mail Code 1-15

Attention: Myles Mahon

Dear Sir:

Reference: *DRAFT* Master Servicing Study
Fernbank Community Design Plan
Our File No.: 101108-0

Please find enclosed thirty-eight (38) copies of the ***DRAFT* Master Servicing Study** dated June 2009 in support of the Fernbank Community Design Plan. We respectfully submit this report to your office for public circulation.

Do not hesitate to contact the undersigned should you have any questions or comments.

Sincerely,

NOVATECH ENGINEERING CONSULTANTS LTD

Mark Bissett, P.Eng.
Project Engineer

cc:	Mr. Peter Nesbitt	Brookfield Homes (Ontario) Ltd.
	Mr. Steve Upton	Del Corporation
	Mr. Rob Pierce	Monarch Corporation
	Mr. David Kardish	Regional Group of Companies
	Ms. Wendy Nott	Walkner Nott Dragicevic Associates Ltd.

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Suite 200, 240 Michael Cowpland Dr., Ottawa ON K2M 1P6 Tel: (613) 254-9643 Fax: (613) 254-5867 www.novatech-eng.com

Consulting Engineers & Planners

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Executive Summary

The Master Servicing Study for the Fernbank Community Design Plan is one component of three concurrent and integrated Class Environmental Assessment Studies; the other studies are the Transportation Master Plan and the Environmental Management Plan.

The Master Servicing Study provides a planning-level design solution for on-site storm drainage, wastewater collection, and water distribution in the Study Area. Future Plan of Subdivision development applications under the *Planning Act* are intended to build upon and refine the solutions presented herein. The impact to off-site municipal infrastructure is evaluated, and where necessary, potential design solutions are explored.

The existing servicing conditions were established through field investigation, record drawings and municipal reports. Constraint areas were identified in the Environmental Management Plan and include terrestrial and aquatic natural environment features, geotechnical restrictions, watercourse erosion thresholds, easement corridors, transportation networks, infrastructure capacity, and the like. These findings ultimately have direct bearing upon to the selected infrastructure design.

Servicing alternatives for the storm, sanitary, and water infrastructure systems are evaluated. It was concluded that an expansion and upgrade of the municipal infrastructure system provides the best servicing alternative to achieve the land use objectives, while minimizing negative impact to both the social and natural environment.

The subsequent municipal servicing evaluation of five alternative Demonstration Plans concludes that all plans have fairly similar ratings and none are constrained by planning layout. This suggests that factors other than municipal servicing will likely dictate selection of the final Demonstration Plan; these factors would include planning rationale, design of transportation corridors, public feedback, input from the Technical Advisory Committee, etc.

The Environmental Management Plan for the Fernbank Community recommended a series of eight wet ponds for stormwater management within the Study Area. The Master Servicing Study has built upon the conclusions of the EMP to develop a storm drainage and stormwater management plan for conveyance of runoff to the proposed SWM facilities.

The Carp River subwatershed is located north of the Trans Canada Trail, while the Jock River subwatershed is located to the south. Groundwater infiltration will be promoted using best management practices. Baseflow temperatures in the outlet channels will be mitigated using canopy cover and reduced wet pond areas.

The storm drainage system is designed using the dual-drainage concept. The minor system will be regulated using inlet control devices to convey the 5-year peak flow. Overland flow is not permitted during a 5-year rainfall event. Major system events are conveyed overland to a SWM Facility, dry pond, or watercourse, and will not cross the arterial road. The major and minor system designs will conform to the City of Ottawa Sewer Design Guidelines.

The storm ponds will provide quality treatment of rainfall runoff, and quantity control to the 100-year event (except Ponds 2 & 3 that are control to the 10-year event). The outlet ditch for the Granite Ridge Pond will be abandoned with controlled flow from this facility piped to Pond 1.

The proposed development has been evaluated with respect to the recommendations of the *Third Party Review, Carp River Restoration Plan* (Greenland, March 2009) and the recommendations from the City of Ottawa Planning and Environment Committee. The proposed SWM strategy for the Carp River will not present an increase in downstream flood risk. The post-development runoff volume from the Fernbank Lands tributary to the Carp River will not exceed 40,000m^3 above the existing conditions for the 100-year event. Interim development phasing will make provision for deficit volume storage and will be limited to 65% of the overall development plan prior to completion of the restoration plan or model calibration. The hydrologic and hydraulic analyses completed for the Fernbank Lands indicate that the proposed SWM strategy will meet the recommended targets.

Wastewater servicing to the Fernbank community will be entirely with gravity sewers. A new trunk sewer parallel the Trans Canada Trail will provide a sanitary outlet that discharges to the Hazeldean Pump Station. The sanitary hydraulic grade line is at least 0.50m below basement elevation. Residual capacity will exist in the proposed wastewater network to permit urban intensification and design flexibility.

Sanitary flow is temporarily being discharged from the Kanata West Lands into the Stittsville Trunk which drains to the Hazeldean Pump Station. Once the Kanata West Pump Station is operational, wastewater from both Kanata West and a portion of the Stittsville area near Hazeldean Road will be routed to the KWPS.

The Hazeldean Pump Station will require increased pumping capacity around 2012 when the planned third submersible pump can be installed. It is anticipated that additional pumping will be required by 2016; this can be provided by upgrading the four existing dry pumps and impeller units. As development proceeds, flow monitoring should be used to determine the timing of the upgrade, rather than design projections. An emergency overflow can be constructed into Cell 1 of the Monahan Constructed Wetlands with a hydraulic grade line of 95.00m at the inlet manhole. This will protect all development lands in the Fernbank CDP area, and most of the sewershed, should a catastrophic failure occur at the pump station.

Numerous planned changes to the wastewater collection system of the West Urban Community will modify the sewershed boundaries and conveyance routes by 2031. Accounting for these changes, most trunk sewers will operate under free-flow conditions. The North Kanata Trunk, Glen Cairn Trunk, and South Glen Cairn Trunk have adequate conveyance capacity. However, the Tri-Township Collector is undersized for both existing and future design flows and needs additional conveyance capacity to accommodate development pressure throughout the WUC. This sewer can surcharge about 1.0m without risk to community or environment; flow monitoring and operational considerations, rather than design parameters, should dictate when the sewer is retrofitted or replaced.

A trunk network of 305mm watermain provides sufficient capacity to maintain appropriate pressures and fire flows throughout the Fernbank development. Service areas with ground elevation below 105.7m are susceptible to daily pressure greater than 80psi and will require individual pressure reducing valves. Based on ground elevation only, lands west of Shea Road will likely be considered part of the future Stittsville Pressure Zone.

Additional firm pumping capacity at the Glen Cairn Pumping Station and one of the Zone 2W pumping stations is required to meet the additional demands associated with the Fernbank Community. The timing of these upgrades is related to the overall rate of growth in the entire Zone 3W. The City of Ottawa is considering a site south of Fernbank Road for construction of an elevated storage tank. If this site is chosen by the city, then a strong 600mm feedermain should be considered along the arterial roadway to ensure sufficient flow between the Zone 3W pumping stations and the storage tank. The watermain and road layout for the Fernbank Community allows for future consideration of a large diameter feedermain within the arterial road.

The utility companies have indicated they have adequate infrastructure in the vicinity to supply the Fernbank Community as it grows.

The Implementation Section of the report outlines the anticipated approval requirements. High-level costing of municipal infrastructure that would be subject to a development charge is included. Phasing of the Fernbank Community will be governed by infrastructure requirements and the availability of capital. Key transportation and servicing improvements associated with each phase are outlined within the report.

Section 1.0 Introduction

The Fernbank Community is proposed to encompass approximately 674 gross hectares of land between the established communities of Stittsville, Kanata West and Kanata South, and the Study Area extends from Hazeldean Road on the north, the Carp River and Terry Fox Drive on the east, Fernbank Road to the south and, the existing Urban Area of Stittsville on the west, as shown on Figure 1.1 below.

Approximately 455 gross hectares of the Study Area are currently designated for urban development within the City of Ottawa (2003) Official Plan. The balance of the Study Area, while currently *non-designated*, will likely be incorporated into the urban boundary as part for the City of Ottawa Comprehensive Five-Year Review of the Official Plan. Irrespective of the precise timeline, this plan and the infrastructure required to support the CDP provides for eventual integration of these lands into the urban area and no further MEA Class EA approval requirements would be necessary.

The Study Area encompasses the entire area between Stittsville and Kanata extending from Hazeldean Road south to Fernbank Road which includes lands that were not approved as 'General Urban – Special Policy Area" and "Future Urban Area" in the OMB's decision. It is anticipated that these lands will eventually be developed for urban purposes. The time horizon is not known at this time, however this plan and the infrastructure required to support the CDP will provide for eventual integration of these lands into the urban area.

Three concurrent and integrated Class Environmental Assessment Studies/Master Plans were initiated: Transportation to provide the road network; Master Servicing Study for water, storm drainage and sanitary; and an Environmental Management Plan (EMP) for the natural environment and stormwater management/outlets. These reports have been prepared in conjunction with the Community Design Plan (CDP) for lands within the Study Area of the Fernbank Community. Approval of the CDP and subsequent development applications under the *Planning Act* will be supported by these Class Environmental Assessments/Master Plans. The three studies were prepared that followed integration with the *Planning Act* provision of the Municipal Engineers Association Class Environmental Assessment Process (June 2000 as amended in 2007) (Class EA):

- Environmental Management Plan
- Master Servicing Study
- Transportation Master Plan

The purpose of this introductory section of the report is to:

- Explain the planning and environmental assessment approval processes that the three Class EAs followed;
- Describe the co-ordination and integration involved in the Class EAs and the supporting studies;
- Document the public and agency consultation undertaken; and
- Outline the implementation plan as part of the next steps.

Figure 1.1: Study Area

1.1 Integration of the Environmental Assessment Act and the Planning Act

The Class EA process recognizes the benefits of integrating approvals under the *Environmental Assessment Act* and the *Planning Act*. Any project which would otherwise be subject to the Municipal Class EA, that meets the intent of the Class EA (Section A.2.9 attached) and receives approval under the *Planning Act* is considered to be a Schedule A project and may proceed to construction.

Specific projects within the Fernbank CDP that are subject to the requirements of the *Environmental Assessment Act* include:

- Construction of new roads or other linear paved facilities (>$2.2 Million - Schedule C);
- Widening of existing roads or other linear paved facilities (>$2.2 Million - Schedule C);
- Construction of a new transit system (Schedule C)
- Establish, extend or enlarge a water distribution system where the facilities are not in an existing road allowance or utility corridor (Schedule B);
- Establish, extend or enlarge a sewage collection system where the facilities are not in an existing road allowance or utility corridor (Schedule B); and,
- Establish new stormwater retention/detention ponds and appurtenances or infiltration systems including outfall to receiving water body (Schedule B).
- Transit projects are now eligible to follow the new process that will allow a faster implementation for transit projects. The findings and conclusions of this CDP will become supporting documentation for future transit EA studies.

The municipal infrastructure projects for the Fernbank CDP are being identified, planned and approved through the development application process under Section 51 of the *Planning Act* in a manner that fulfills the requirements of the Municipal Class Environmental Assessment (Section A.2.9) process. As such, these projects will have satisfied the requirements outlined in Section A.2.9 of the Class EA process and will require no additional EA approvals. This allows the integration of both planning processes while ensuring the intent and requirements of both Acts are met (Figure 2). Section A.2.9 of the Class EA requires the following steps be incorporated into the planning process to fulfill the EA requirements:

Phase 1 and 2

- Identify the problem or opportunity;
- Identify alternative solutions;
- Inventory existing environmental conditions;
- Impact assessment and evaluation of alternative solutions;
- Selected preliminary preferred solution;
- Consult with the review agencies and the public; and,
- Select preferred solution.

If the project is a Schedule B, issue a Notification to allow for public review of the documentation of the work undertaken.

If the project is a Schedule C, continue as follows:

Phase 3 and 4

- Identify alternative design concepts for the selected alternative solution;
- Update existing conditions inventory (as required);
- Impact assessment and evaluation of alternative design concepts;
- Select preliminary preferred alternative design concept;
- Consult with the review agencies and the public;
- Select preferred alternative design concept;
- Document the work undertaken; and,
- Issue a Notification to allow for public review of the documentation of the work undertaken.

Following the review and approval of the Schedule B and C Class EAs, the projects can proceed to Phase 5 as follows:

Phase 5

- Complete design drawings and tender documents;
- Construction and operation; and
- Monitor for environmental provisions and commitments.

This process was outlined, reviewed and accepted in the Terms of Reference for the Fernbank CDP (June 2006) in consultation with the City of Ottawa and approval agencies (RVCA, MVCA, MOE, MNR).

Review agencies and the public will have an opportunity to review the Class EA documentation being prepared for the Fernbank CDP, and have the ability to appeal to the OMB. The assessment and review process is being harmonized with the *Planning Act* as the development application process is occurring simultaneously. Notification of the conditions of planning approvals and the Class EA documents will be advertised through a Notice of Completion.

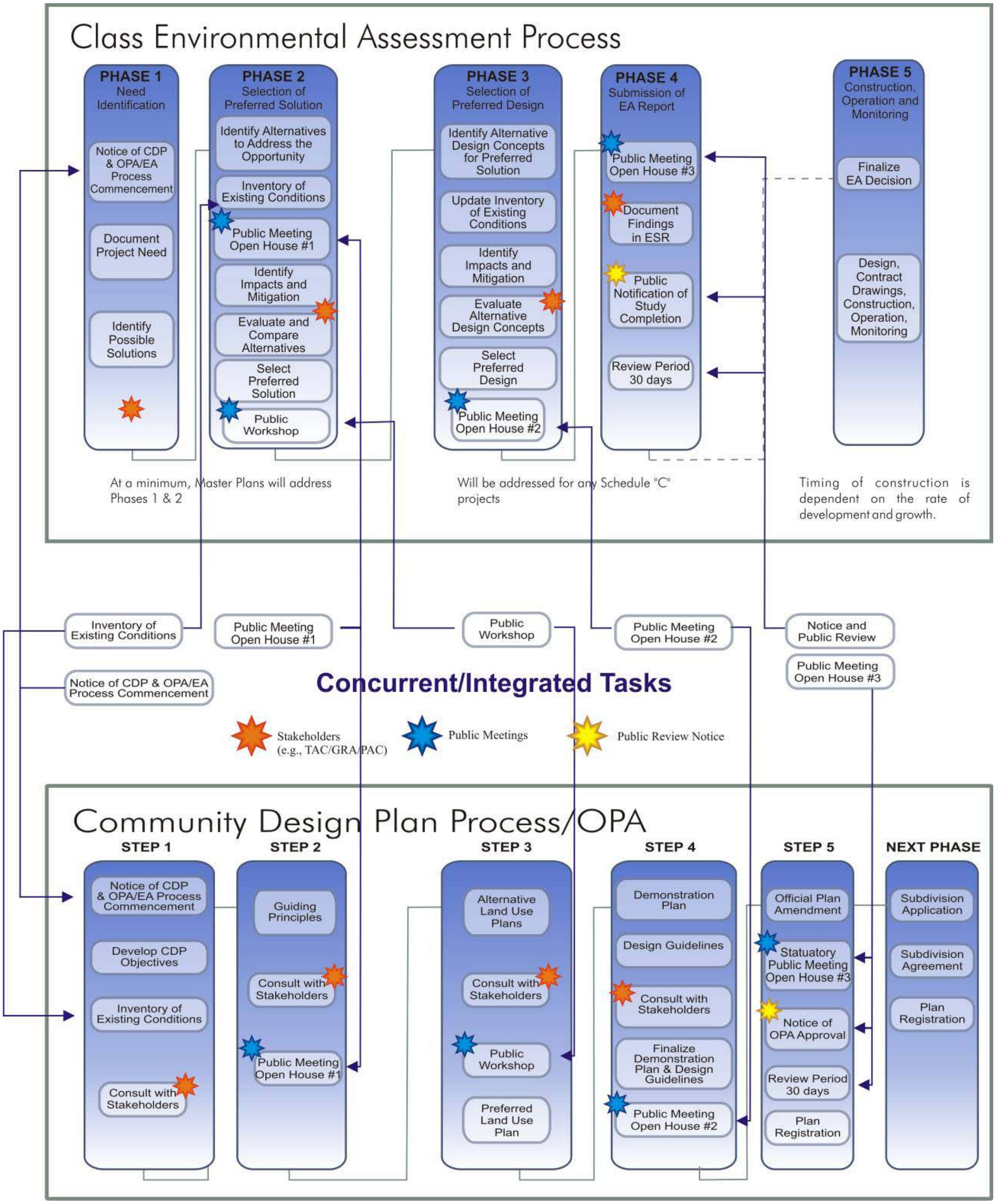
An integrated MEA Class EA *Planning Act* approach as identified in section A.2.9 of the MEA Class EA document allows for:

- A single point of contact ("One-Window") at the City and ensures consistent responses and notification to the public and media. If the CDP process and associated *Planning Act* application and Class EAs were not integrated, there could potentially be several different notices for meetings and public review periods in order to meeting the requirements of both processes.
- One approval framework schedule assists in ensuring that infrastructure and development would not proceed or be delayed if only one of the Class EA projects received a Part II Order request.
- Integrated Consultation – Consolidating the Planning Act and Municipal Class EA consultation will save time and money. Meetings can meet the requirements of both the land use planning and Class EA processes. This also helps to ensure consistent responses and notification to the public and media.
- Harmonized Review - Review agencies and the public will have an opportunity to review the Class EA documentation and the CDP documentation as an inclusive package and, accordingly, would be better able to understand the decision making processes.
- Integrated Review and Approvals – With the approval of the Official Plan Amendment and, by extension, the MEA Class EA projects through the Planning Act, any appeals will be considered by the OMB and it will have access to all the studies needed for an informed decision.

Once approved, the preferred municipal infrastructure projects will generally not be subject to additional MEA Class EA approval requirements with the submission of subsequent site plan or plan of subdivision applications. This ensures that the environmental protection measures identified in the MEA Class EAs to permit development in the Study Area will be adhered to by any subsequent developments. Any amendments or revisions would be made using the addendum procedures in the Municipal Class EA, with the appropriate public review.

The implementation, over time, of the Fernbank CDP and the required supporting infrastructure will take place as *Conditions of Approval*. The approvals will be conducted under the *Planning Act*.

Figure 1.2: Integrated Environmental Assessment and Planning Act Process



1.2 Co-ordination and Integration

The Study Team is large and consists of municipal staff from various City departments, many landowners, consultants, and approval agencies. The project proceeded under the direction of the City of Ottawa and benefitted from the direct involvement and guidance of:

- A Core Project Team (CPT) consisting of City staff and Councillors, Sponsoring Landowners and the consultants in a variety of disciplines;
- A Technical Advisory Committee (TAC) consisting of representatives from select government agencies and approval bodies;
- A Public Advisory Committee (PAC) consisting of representatives from directly affected Community Associations and interested community groups; and
- Government Review Agencies (GRA) who represent government agencies who administer specific permits and approvals.

Meetings were held and information was reviewed and shared amongst each of the study participants. Decisions were made in an integrated and iterative process throughout the course of the studies. Through this iterative discussion and consultation many additional tasks and investigations were undertaken to ensure compatibility between the various infrastructure requirements. The following table highlights the current activities/studies, how they were utilized and how they were integrated into the decision making process for the Study Team.

Table 1.1: Report Integration

Report/Action	Function/Role	Utilization
Fernbank Community Design Plan Existing Conditions Report - Natural Environment (Muncaster Environmental Planning, January 2007 / Addendum January 2008)	To review the existing documentation regarding the natural environment features and functions in and adjacent to the Study Area.	Used by Novatech to identify natural features and develop existing conditions and environmental constraints plans. Used by Delcan to avoid and assess potential impacts of the transportation network on the natural environment. Used by WND to develop land use patterns in consideration of the natural features of the study area.
Fernbank Community Design Plan Existing Conditions Report – Hydrogeology (J.F. Sabourin & Associates, January 2008)	To describe the site's geology and the groundwater conditions associated with that geology in terms of infiltration potentials, groundwater recharge and discharge, and the groundwater flow systems.	Used by Novatech to identify groundwater conditions and to assess the potential impact of development on the groundwater system, including wells to be abandoned and groundwater infiltration targets.
Fernbank Community Design Plan Existing Conditions Report – Fluvial Geomorphological Assessment (Parish Geomorphic, March 2008)	The intent of this report is to document the existing conditions of the streams, channels and watercourses within the Study Area.	Used by Novatech to develop existing conditions plans, to delineate reach boundaries and channel sensitivities; identify and prioritize key issues in the watershed and recommend both structural and non-structural rehabilitation and restoration measures to establish natural levels of erosion in the watershed (resulting in the environmental constraints plan).
Fernbank Preliminary Geotechnical Evaluation Report (Houle Chevrier, July 2007)	To provide preliminary engineering guidelines based on preliminary sub-surface conditions, as identified by borehole and test pit investigations.	Used by Novatech to identify soils conditions and develop servicing and grading plans in consideration of potential grade raise restrictions.

Report/Action	Function/Role	Utilization
Fernbank Community Design Plan Existing Conditions Report - Storm Drainage (Novatech, January 2007)	To document the existing storm drainage and hydrology for the Study Area including the Monahan, Flewellyn and Faulkner Municipal Drains which lie within the Jock River Subwatershed and the tributary of the Carp River and Hazeldean Creek within the Carp River Subwatershed.	Used by Novatech to establish existing conditions flows and constraints in all receiving watercourses, which are used as a baseline for evaluation of post development stormwater management solutions.
Fernbank Community Design Plan Existing Conditions Report - Municipal Infrastructure (Novatech, March 2007)	To document and provide an overview of the existing high-level water, sanitary, and utility infrastructure that currently services lands in the vicinity of the Study Area.	Used by Novatech to establish the capacities and configuration of existing servicing infrastructure which was used as a Baseline for determining impact and additional infrastructure required to service the development area.
Fernbank Community Design Plan Existing Conditions Report – Transportation (Delcan, January 2007)	To describe the current transportation infrastructure networks and operating conditions in the vicinity of the proposed Fernbank Community.	Used by Delcan to confirm existing intersection and screenline levels of transportation service. Baseline for determining long-term future peak traffic volumes and appropriate major transportation infrastructure needs (roads/rapid transit) to serve the proposed Fernbank and adjoining communities.
Fernbank Community Design Plan Existing Conditions Report – Archaeological (Kinickinick Heritage Consultants, January 2007)	To prepare a Stage 1 archaeological Assessment of the Fernbank Community lands, to identify areas of low or nil archaeological potential.	Used by WND to identify areas where additional archaeological assessment may be required prior to development.
Fernbank Community Design Plan Existing Conditions Report – Land Use (WND, January 2007)	To review the existing physical land use planning conditions, policy framework and other City initiatives that would affect the development of future plans for the Fernbank Study Area.	Used by WND to identify alternative and preferred land use concepts for the Fernbank CDP.
Below Ground Infrastructure (Water/Sewer/Storm)	Develop infrastructure collection/distribution system to service the Fernbank Community	Integrated with the roadway network development

The reports and planning were undertaken in an integrated fashion in a similar time frame which resulted in an iterative planning and decision making process which is illustrated below followed by examples of interrelated aspects of the infrastructure and land use planning process such as:

- Analysis of existing conditions led to the Environmental Constraints Plan which was utilized as the starting point for the Land Use/Demonstration Plan.
- The establishment of drainage corridors to be preserved and/or enhanced led to the stormwater management facility configuration which was also utilized for developing the Land Use/Demonstration Plan.
- The establishment of sanitary collector sewers along proposed road facilitates to support orderly and cost effective phasing of development;
- The internal water distribution system was developed which reflects the transportation network;
- The development of a rapid transit plan which is integrated with the transportation network.

These examples of collaboration between the different studies were key to ensuring the requirements of all the land use and infrastructure components were accommodated in an acceptable manner.

1.3 Public and Agency Consultation

Consultation is an integral part of both the Planning and Class Environmental Assessment process. Consultation and the exchange of information was undertaken throughout the assessments using a variety of methods including meetings with community associations and the general public, electronic information distribution and regular meetings with the Study Team, approval agencies, and the three Ward Councillors.

The consultation undertaken was extensive and involved various stakeholders from the public and government agencies. A Core Project Team (CPT) met nine (9) times from project initiation to the development of the preferred land use and demonstration. There was also a Technical Advisory Committee (TAC) and Public Advisory Committee (PAC) which met four (4) and two (2) times at key project milestones. Four (4) Public Meetings were held with a total attendance of almost three hundred (300) people. Additional meetings were held with area land owners and community groups as required. Scheduling of consultation opportunities corresponded to key project milestones throughout the process.

Meeting details, Public Notices, and Presentation Materials are contained in a separate report Fernbank Community Design Plan – Public Consultation Report along with the comments and inputs received.

1.3.1 Summary of Public Comments

A summary of the primary issues raised at the public meetings, from comment sheets and other submissions to the Study Team and Area Councillors are contained in Table 1-2 along with the response provided and any additional actions or clarifications. A more detailed account of the comments is contained in the Public Consultation Report.

Table 1.2: Summary of Comments and Responses

Issue Raised	Response
Natural Environment	Significant natural areas have been protected and incorporated into the CDP.
Density	A mix of densities has been incorporated into the CDP with consideration of existing adjacent densities in the Kanata and Stittsville communities.
Land use	Buffers have been incorporated into the CDP with consideration of existing adjacent land uses in the Kanata and Stittsville communities. A mix of land uses has been provided to serve the existing and future communities.
Schools	Primary and secondary school boards have provided input into the location and number of schools needed.
Internal Roads	A road network has been developed to serve the needs of both the existing and planned communities. Traffic circles will be incorporated where appropriate. Internal and external connectivity has been considered.
Transit	Identification of a rapid transit corridor, stations and an end-of-service Park and Ride lot have been included in the CDP. OC Transpo has been involved in the identification of potential local transit routes and the protection of appropriate right-of-way widths.

1.3.2 Government Agencies and Municipal Departments

Many government agencies, municipal departments and approval authorities were involved in the process. Agencies and individuals were contacted for specific advice and input regarding relevant issues and approvals or were given opportunities to review draft reports including:

Written and verbal comments were received from agencies and departments through the Advisory committee meetings and technical circulations. The comments received were typically focused on the agency's areas of interest or priorities. Some comments provided direction and guidance for upcoming approval and permitting requirements and others focused on specific technical issues. Input from these agencies was addressed through various means including:

- Individual and group agency meetings to provide clarification;
- Inter-agency sharing of comments, rationalizations, and decisions;
- Opportunities for continuing input;
- Completion of additional technical works;
- Design clarifications; and,
- Corrections and additions to the reports as appropriate.

Overall the studies benefited from a broad range of technical advice and direction.

Table 1.3: Information Way Finding

Information	Source/Report
Road Network	Fernbank Community Design Plan Existing Conditions Report – Transportation (Delcan, January 2007) Fernbank Transportation Master Plan (Delcan, June 2009)
Rapid Transit Corridor	Fernbank Community Design Plan Existing Conditions Report – Transportation (Delcan, January 2007) Fernbank Transportation Master Plan (Delcan, June 2009)
Stormwater Management	Fernbank Community Design Plan Existing Conditions Report - Natural Environment (Muncaster, January 2007) Fernbank Community Design Plan Existing Conditions Report – Storm Drainage (Novatech, January 2007) Fernbank Community Design Plan Existing Conditions Report – Fluvial Geomorphological Assessment (Parish, March 2008) Fernbank Community Design Plan – Master Servicing Plan (Novatech, June 2009) Fernbank Environmental Management Plan (Novatech, June 2009)
Drinking Water System Distribution	Fernbank Community Design Plan Existing Conditions Report – Municipal Infrastructure (Novatech, March 2007) Fernbank Community Design Plan – Master Servicing Plan (Novatech, June 2009)
Sanitary Sewers	Fernbank Community Design Plan Existing Conditions Report – Municipal Infrastructure (Novatech, March 2007) Fernbank Community Design Plan – Master Servicing Plan (Novatech, June 2009)
Land Use	Fernbank Community Design Plan Existing Conditions Report – Land Use (WND, January 2007) Fernbank Community Design Plan (WND, June 2009)
Natural Environment (watercourses, woodlots)	Fernbank Community Design Plan Existing Conditions Report - Natural Environment (Muncaster, January 2007) Fernbank Environmental Management Plan (Novatech, June 2009)
Archaeology	Fernbank Community Design Plan Existing Conditions Report – Archaeological (Kinickinick Heritage Consultants, January 2007)
Public Consultation	Fernbank Community Design Plan – Public Consultation Report (WND, March 2008)

Section 2.0 Master Servicing Study Process

This section outlines the process that was used to develop this report.

Existing servicing conditions were established for water supply, wastewater collection, and storm drainage using a combination of field investigation, record drawings, and approved municipal reports. The servicing information was compiled into two Existing Condition reports entitled *Municipal Infrastructure* dated March 2007 and *Storm Drainage and Hydrology* also dated March 2007. In this manner a baseline infrastructure scenario is established for the year 2006.

Constraint areas were identified through field investigation as part of developing the Environmental Management Plan. Constraint examples include terrestrial and aquatic natural environment features, geotechnical restrictions, watercourse erosion thresholds, easements corridors, transportation networks, and existing infrastructure capacity. These land use findings directly impact the development of the Demonstration Plan and the potential solutions to infrastructure servicing.

Fernbank CDP demand loads were established for the water, wastewater, and storm sewer systems to evaluate the impact on off-site municipal infrastructure and to develop an on-site master servicing solution. Infrastructure capacity constraints are identified and potential design solutions are proposed. Alternative on-site infrastructure solutions are evaluated, followed by selection of the preferred design.

Section 3.0 Existing Conditions

Development of infrastructure servicing requires the foreknowledge of numerous land characteristics. Several figures were developed that depict relevant existing condition information necessary for infrastructure servicing.

Figure 3.1 Ownership depicts the primary land owners situated within the study area (outlined in purple). The *designated* lands, pursuant to Ontario Municipal Board Order Numbers 2092, 3352, and 1604, are outlined in yellow. The balance of land within the study area carries a *non-designated* status and is classified as a "Future Urban Area". The determination as to if and when these non-designated lands within the Study area are included within the designated urban area will be a matter decided by the City Council through a comprehensive Official Plan review. The designation status primarily affects phasing of infrastructure works.

West Parcel: The water and wastewater designs are unaffected by the status or timing of these lands as they are located upstream of the sewer system under all design scenarios. Most storm drainage from this parcel flows into the Faulker Drain and would continue to do so irrespective of designation. A pocket in the north-west corner drains through the NEA lands, across Shea Road towards the Flewellyn Drain which would have to be accommodated until the lands received a designated status by the City of Ottawa.

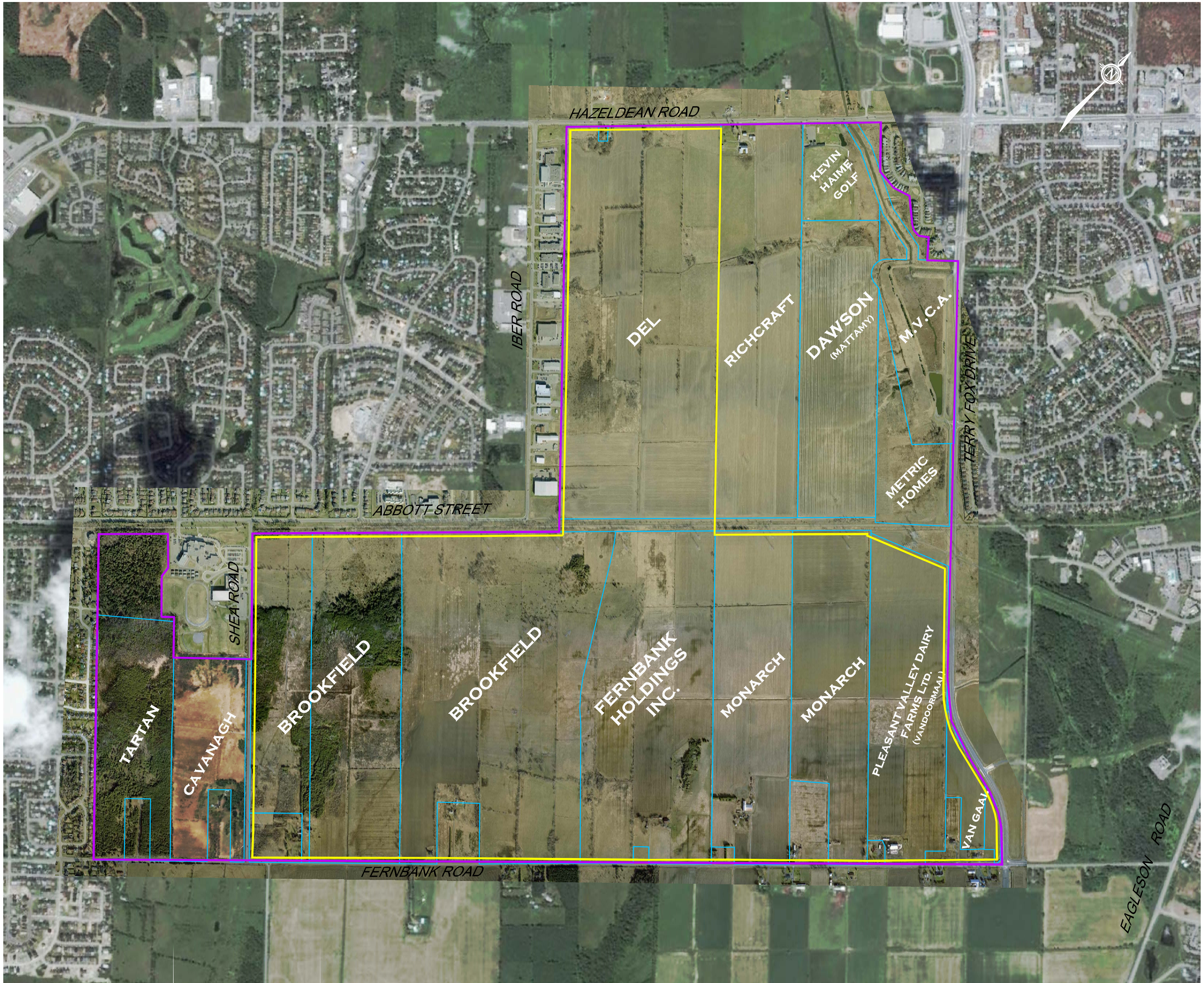
North-East Parcel: The water supply system is unaffected by the timing of these non-designated lands due the existing and proposed pipe network, and proximity to the Glen Cairn Pumping Station and Reservoir. The wastewater collection and storm drainage systems have been specifically designed to be independent of the timing of the non-designated lands. The preferred wastewater solution conveys flow from most of these lands to the Fernbank Trunk, isolating this parcel from risk associated with a deferral of the non-designated lands to an urban status. Similarly, the preferred storm sewer system routes most flow into the Carp River Tributary Headwater Facility (Pond 1). This configuration resolves potential issues with the non-designated lands and is environmentally beneficial with enhanced base-flow contributions to the tributary.

Figure 3.2 Topography is a contour map of the study area and significantly dictates drainage patterns for the storm sewer and wastewater collection systems. Topography considerably influences the location of storm water management facilities (both dry and wet pond types). In general, the grade is highest near Stittsville at the western boundary of the study area with gradually decreasing elevation to the east. The lowest areas are found near the Carp River and where the Monahan Municipal Drain outlets adjacent Terry Fox Drive.

Figure 3.3 Geotechnical outlines four distinct geotechnical zones located throughout the study area. Zone 1 is located in the western region and is underlain primarily by bedrock and glacial till materials; consequently there is no grade raise restriction for this area. Moving easterly through Zones 2, 3 and 4 the soil is characterized by clay materials with decreasing load bearing properties. Zone 4, near the Carp River and Terry Fox Drive, has a 1.0m grade raise constraint and is the most restrictive soil type within the study area. Geotechnical information has been provided by Houle Chevrier Engineering Ltd. in their report *Preliminary Geotechnical Investigation, Fernbank Community Design Plan,* (May 2007).

Figure 3.4 Subwatershed Boundaries presents the undeveloped watershed and drainage boundaries as they currently exist. In general, lands north of the Trans-Canada Trail drain to the Carp River while lands to the south drain into the Jock River (via the Monahan, Flewellyn, or Faulkner Municipal Drains).

Figure 3.5 Infrastructure shows the existing utility and municipal infrastructure in the vicinity of the study area. Connections to the trunk infrastructure (water, sanitary, utility) are required to service the Fernbank CDP Lands.



FERNBANK COMMUNITY DESIGN PLAN

City of Ottawa

MASTER SERVICING STUDY

FIGURE 3.1

Existing Conditions

Ownership

STUDY AREA

DESIGNATED LANDS

NOTE:
SMALL LAND HOLDINGS ARE NOT LABELLED ON THIS PLAN.

SOURCE AND DATE OF AERIAL PHOTOS:
a) FERNBANK CDP LANDS: BASE MAPPING CO. (JUNE 2006)
b) BACKGROUND COMMUNITY: GOOGLE EARTH MAP (YEAR VARIES)

0 50 100 200 400 600 metres

SCALE : 1:6000 -B1 Sheet
SCALE : Not to Scale -Report

APRIL 2008

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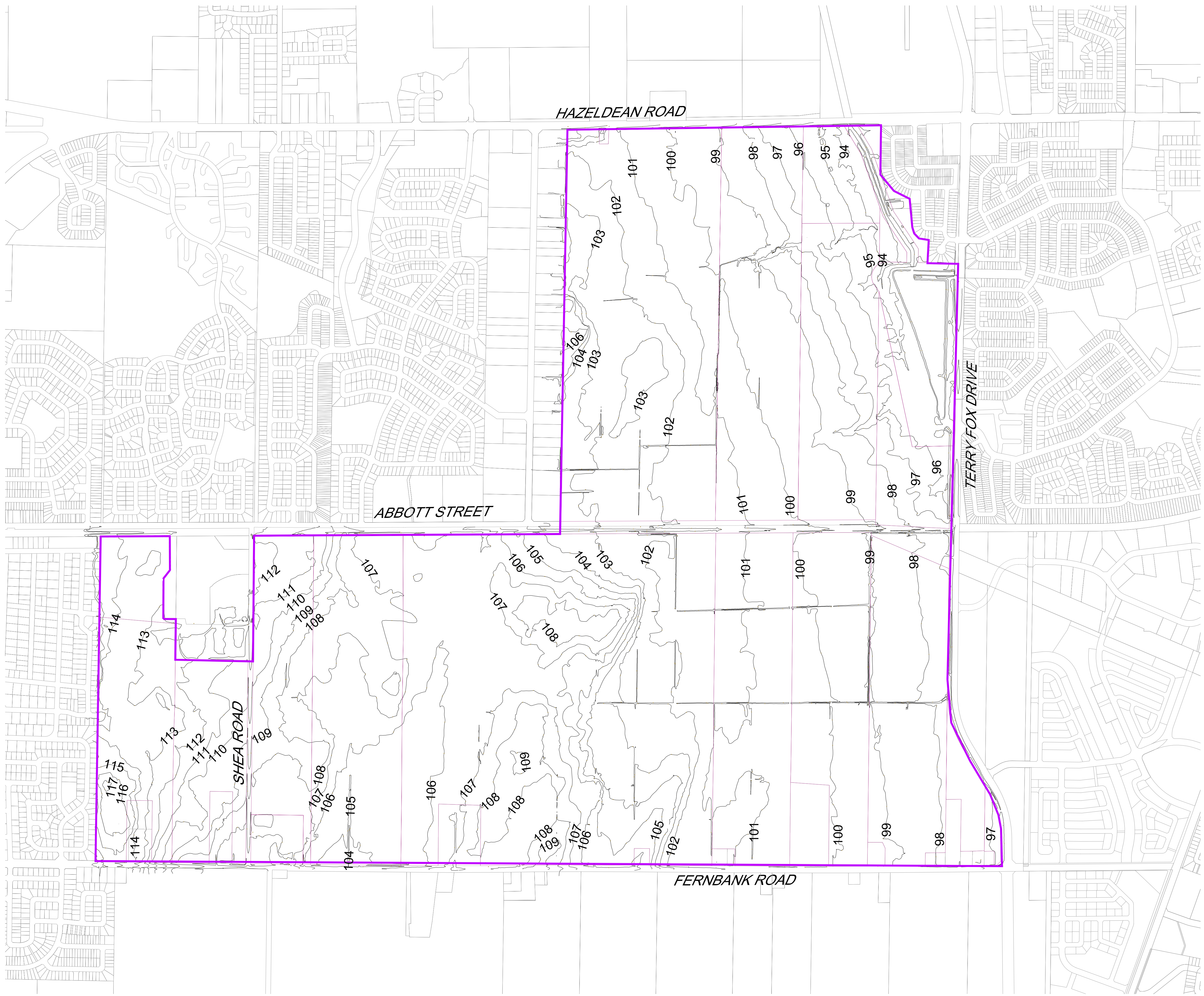

FERNBANK COMMUNITY DESIGN PLAN

City of Ottawa

MASTER SERVICING STUDY

FIGURE 3.2

Existing Conditions

Topography

STUDY AREA

98 CONTOUR ELEVATION

CONTOUR LINE

0 50 100 200 400 600 metres

SCALE : 1:6000 -B1 Sheet

SCALE : Not to Scale -Report

APRIL 2008

NOVATECH ENGINEERING CONSULTANTS LTD.
ENGINEERS & PLANNERS
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada
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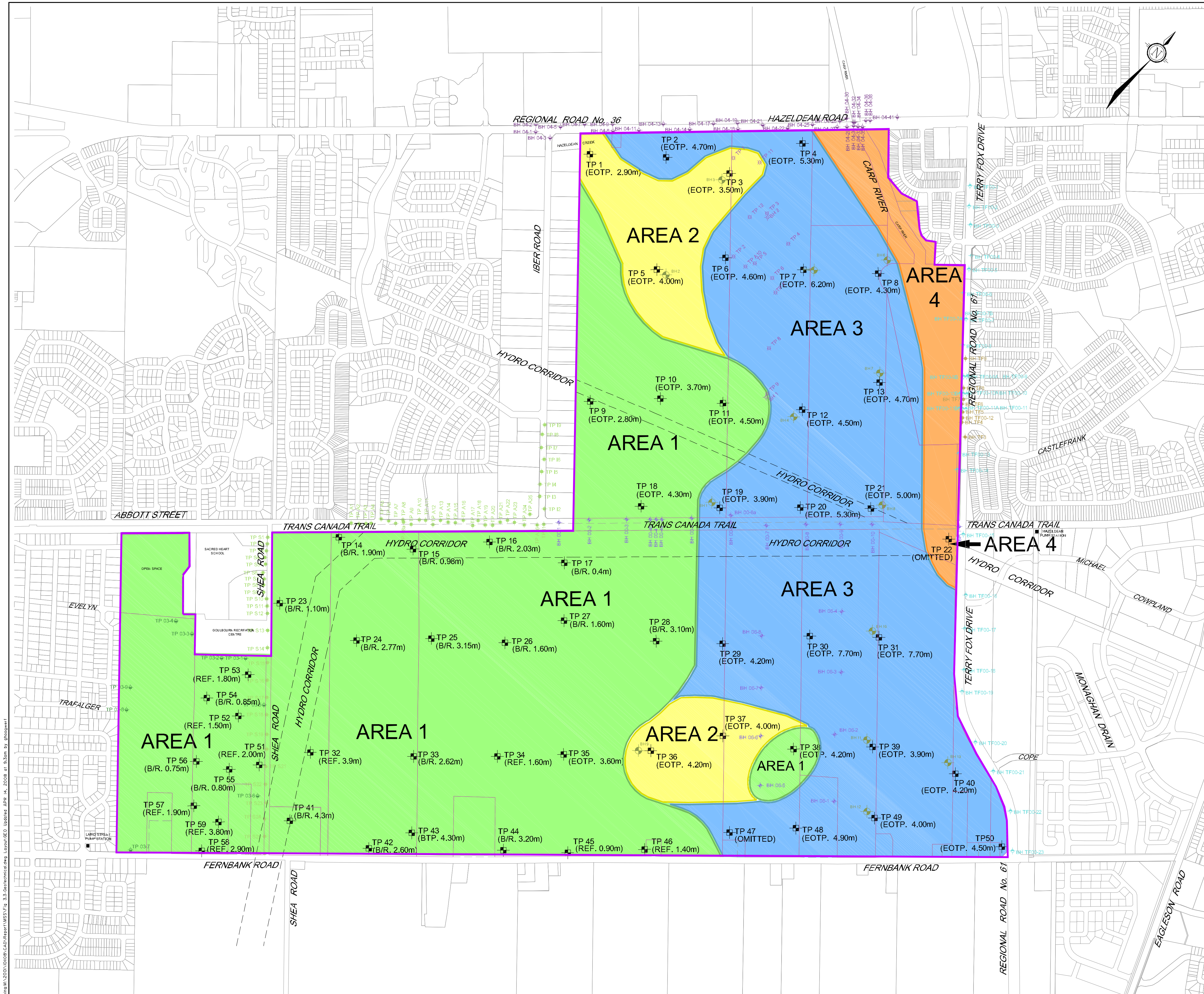

FERNBANK COMMUNITY DESIGN PLAN

City of Ottawa

MASTER SERVICING STUDY

FIGURE 3.3

Existing Conditions

Geotechnical

STUDY AREA

TP #	APPROXIMATE TEST PIT LOCATION IN PLAN, PRESENT INVESTIGATION BY HOULE CHEVRIER ENGINEERING LTD.
(B/R. 2.3m)	REFUSAL ON BEDROCK, MEASURED FROM ORIGINAL GROUND.
(REF. 3.6m)	PRACTICAL REFUSAL TO EXCAVATION ON BOULDER, MEASURED FROM ORIGINAL GROUND.
(EOTP. 3.2m)	END OF TEST PIT, MEASURED FROM ORIGINAL GROUND.
AREA 1	NO GRADE RAISE RESTRICTIONS
AREA 2	GRADE RAISE RESTRICTION 2.0 - 2.5m
AREA 3	GRADE RAISE RESTRICTION 1.2 - 1.5m
AREA 4	GRADE RAISE RESTRICTION 0.5 - 1.0m
TP #	APPROXIMATE TEST PIT LOCATION IN PLAN, PREVIOUS INVESTIGATION BY HOULE CHEVRIER ENGINEERING LTD. REPORT NUMBER 093-015
TP #	APPROXIMATE TEST PIT LOCATION IN PLAN, PREVIOUS INVESTIGATION BY GOLDER ASSOCIATES LTD. REPORT NUMBER 03-1120-028
BH #	APPROXIMATE BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION BY GOLDER ASSOCIATES LTD. REPORT NUMBER 001-2225
BH #	APPROXIMATE BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION BY JAQUES WHITFORD LTD. REPORT NUMBER ONO11725
BH #	APPROXIMATE BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION BY GOLDER ASSOCIATES LTD. REPORT NUMBER 011-2004-2
BH #	APPROXIMATE BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION BY GOLDER ASSOCIATES LTD. REPORT NUMBER 762195
BH #	APPROXIMATE BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION BY GOLDER ASSOCIATES LTD. REPORT NUMBER 06-1120-392

0 50 100 200 400 600 metres

SCALE : 1:6000 -B1 Sheet
SCALE : Not to Scale -Report

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FERNBANK COMMUNITY DESIGN PLAN

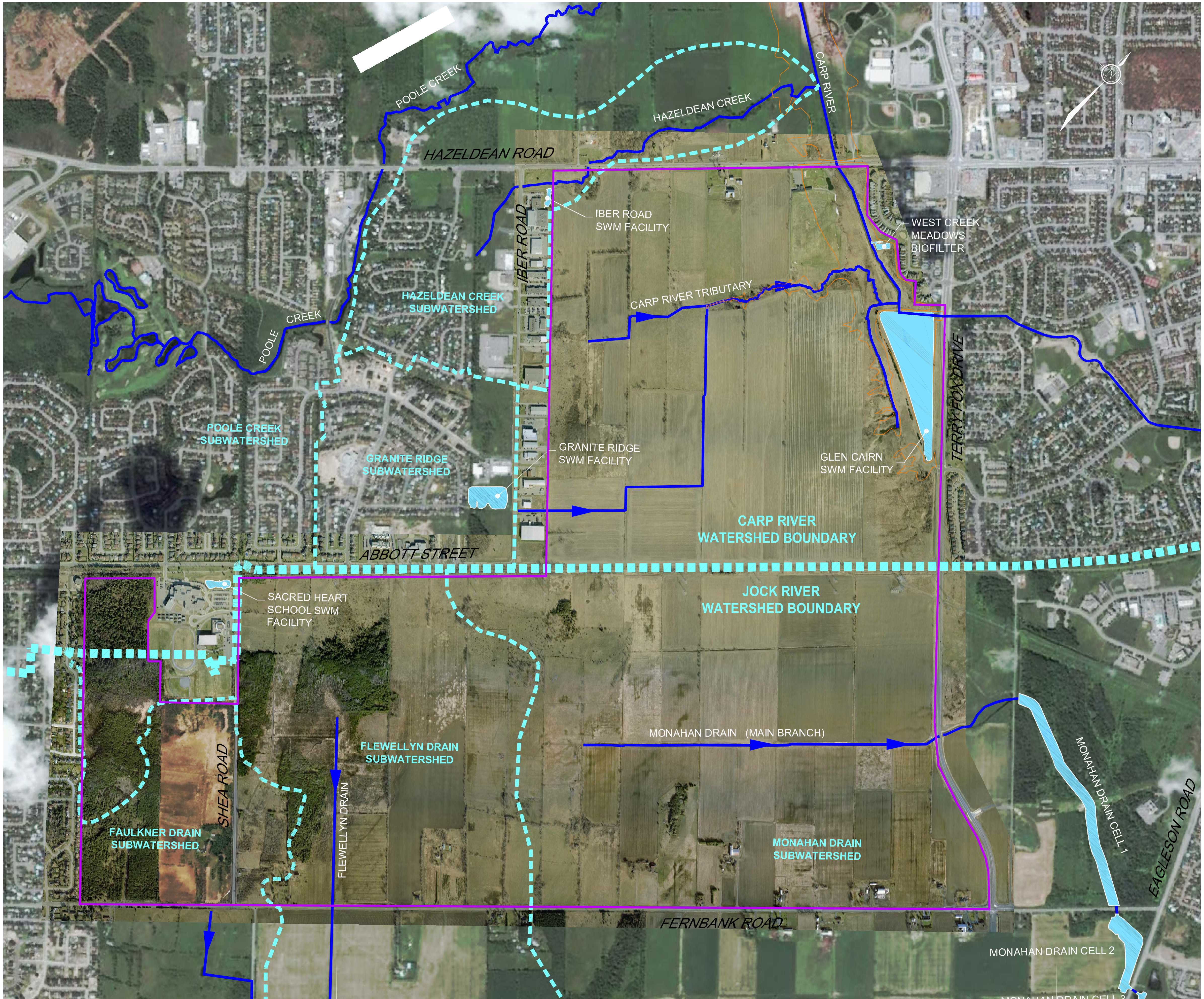
City of Ottawa

MASTER SERVICING STUDY

FIGURE 3.4

Existing Conditions

Drainage Features & Subwatershed Boundaries



STUDY AREA

CARP RIVER FLOOD PLAIN
WATERSHED BOUNDARY
DRAINAGE CHANNEL
EXISTING SWM FACILITY

SOURCE AND DATE OF AERIAL PHOTOS:
a) FERNBANK CDP LANDS: BASE MAPPING CO. (JUNE 2006)
b) BACKGROUND COMMUNITY: GOOGLE EARTH MAP (YEAR VARIES)

0 50 100 200 400 600 metres

SCALE : 1:6000 -B1 Sheet
SCALE : Not to Scale -Report

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FERNBANK COMMUNITY DESIGN PLAN

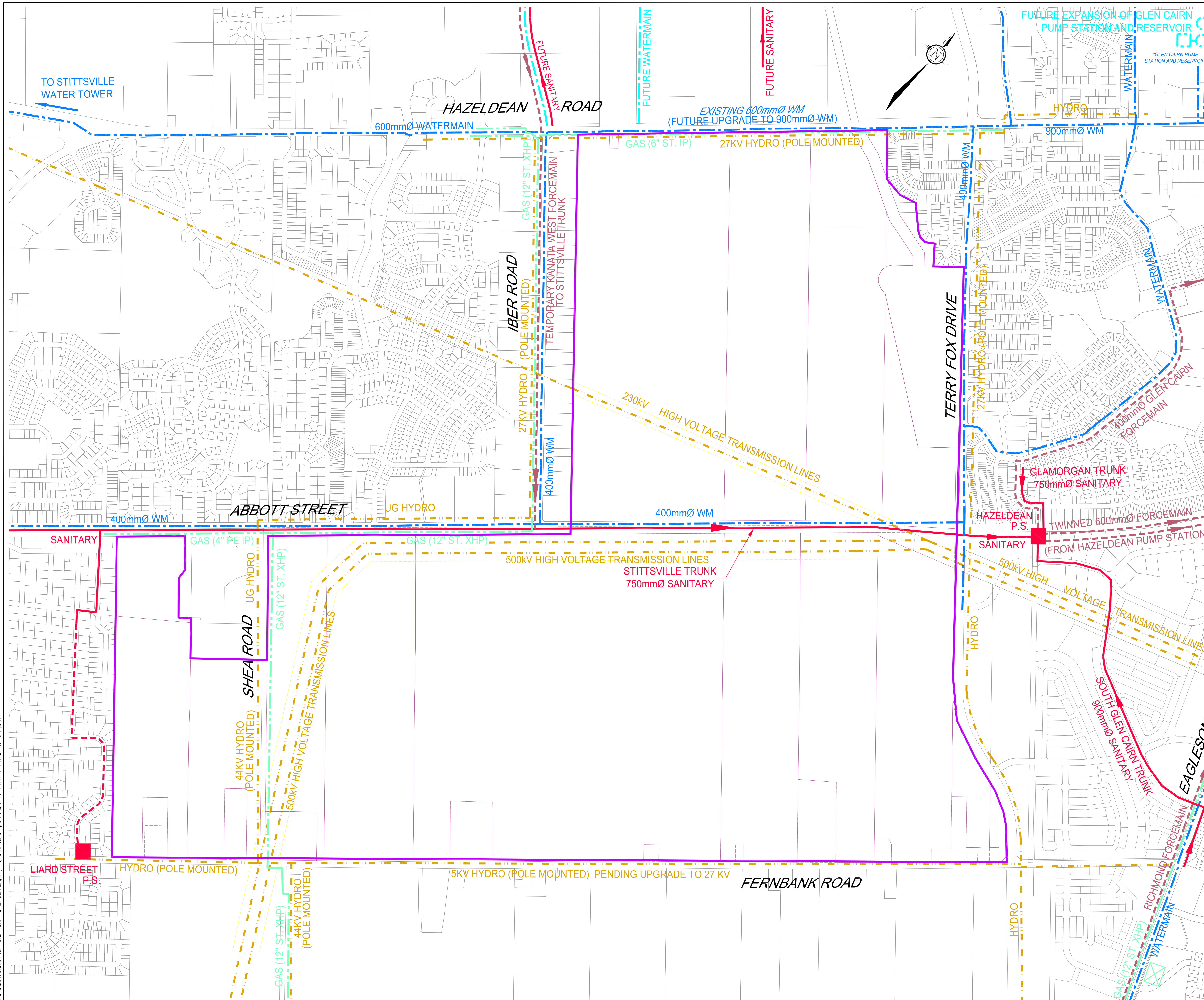
City of Ottawa

MASTER SERVICING STUDY

FIGURE 3.5

Existing Conditions

Infrastructure



STUDY AREA
SANITARY SEWER
SANITARY FORCEMAIN
WATERMAIN
GAS
HYDRO

0 50 100 200 400 600 metres

SCALE : 1:6000 -B1 Sheet
SCALE : Not to Scale -Report

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Section 4.0 Servicing Evaluation

As part of the integrated EA process, several municipal infrastructure options were considered to service the Fernbank Lands with a potable water supply, wastewater collection system, and storm water drainage.

Alternatives for municipal infrastructure were developed in a two stage process. The first stage was an itemization of possible servicing solutions with a course screening process to reject alternatives that would not achieve the objective. The second stage was the selection of a preferred solution, and refinement of that alternative into a more detailed solution.

4.1 Servicing Alternatives

"Alternative Solutions" are defined as feasible alternative ways of solving an identified problem or addressing an opportunity. In this case, the "problem and/or opportunity" is to develop a servicing strategy for storm drainage, wastewater collection, and potable water supply for the Fernbank Community that meets all applicable design criteria and meets all targets required for approval by regulatory agencies.

4.1.1 Storm Drainage Alternatives

Preliminary storm drainage alternatives for the Fernbank Lands include:

- Do Nothing
- Limit Growth
- Ditch & Culvert and/or Open Channel
- Piped Services

The *Do Nothing* and *Limit Growth* alternatives are not considered viable options as they do not meet the development targets established for the study area.

The *Ditch & Culvert* or *Open Channel* alternatives permit opportunities for infiltration, reduced flow velocity, and pre-treatment of runoff. Modern urban design practice generally precludes ditch and culvert type design; however, where opportunities exist the advantages of open channel design should be leveraged as part of the overall servicing design.

Piped Services are considered the only viable option to achieve the required development densities.

Table 4.1 on the following page outlines the alternative storm drainage solutions.

Note: Discussion on the alternative stormwater management facilities is found in the Environmental Management Plan.

Table 4.1: Alternative Solutions - Storm Drainage

Alternative Solution	Drainage and Land Use	Social Environment	Natural Environment	Comment	Carried Forward
Do Nothing	×	×	×	Does not satisfy the drainage requirements Does not address the problem/opportunity Does not meet the intent of the planning or drainage/servicing policies	***No***
Limit Growth	×	~	~	Will satisfy a reduced drainage requirement – some stormwater facilities will still be required Does not fully address the problem/opportunity Requires mitigation to lessen negative environmental impacts	***No***
Storm Drainage					
Open Ditches & Culverts	✓	✓	✓	Provides opportunities for infiltration. Lower velocities than piped sewers. Provides pre-treatment of storm runoff (some removal of pollutants & suspended solids)	***Yes***
Piped Services (sewers)	✓	✓	~	Lower land requirement than open ditches. More restrictions on minimum slopes, ground cover.	***Yes***
Storm Water Management					
No SWM Facilities (Storm Sewers outlet directly to receiving waters Lot Level / & On-site SWM controls)	×	×	×	Lot level controls alone will not be sufficient to meet SWM quality/quantity criteria. Should be included as part of "treatment train".	***No***
Expand Existing Facilities (Monahan Drain SWMF and/or Glen Cairn SWMF)	✓	×	~	Requires mitigation to lessen negative environmental impacts Agency rejection due to increased flood risk	***No***
New SWM Facilities for Development Areas	✓	~	~	Requires mitigation to lessen negative environmental impacts	***Yes***

× Negative Impact ✓ Positive Impact ~ Neutral Impact (can be mitigated)

4.1.2 Wastewater Collection Alternatives

Preliminary wastewater collection alternatives for the Fernbank Lands include:

- Do Nothing
- Limit Growth
- Private Septic Systems
- Communal Collection and Treatment System
- Municipal Service Extension and Upgrades

The *Do Nothing* and *Limit Growth* alternatives are not considered viable options as they do not meet the development targets established for the study area.

Private Septic Systems will satisfy a reduced sanitary demand. It would be difficult to address the intensive nitrate loadings into the groundwater system. This alternative would have negative environmental impacts.

A *Communal Collection and Treatment System* could satisfy the demand and land use criteria. Social and environmental concerns associated with this type of system suggest there may be better alternatives.

Municipal Service Extension and Upgrade resolves the problem and achieves the goal. This solution produces only minimal social and environmental impacts, and is relatively cost effective by using spare capacity in the municipal infrastructure system. The Provincial Policy Statement recommends municipal sewage services as the preferred form of servicing for settlement areas.

Table 4.2 on the following page outlines the alternative wastewater collection solutions.

Table 4.2: Alternative Solutions - Wastewater Collection

Alternative Solution	**Sanitary Demand and Land Use**	**Social Environment**	**Natural Environment**	**Comment**	**Carried Forward**
Do Nothing	×	×	×	Does not satisfy the sanitary requirements Does not address the problem/opportunity Does not meet the intent of the planning or servicing policies	***No***
Limit Growth	×	~	~	Will satisfy a reduced sanitary demand Does not fully address the problem/opportunity Requires mitigation to lessen negative environmental impacts	***No***
Private Septic Systems	×	~	×	Will satisfy a reduced sanitary demand Does not fully address the problem/opportunity Difficult to address negative environmental impacts (nitrate loading of groundwater)	***No***
Communal Collection and Treatment System	✓	~	×	Satisfies the demand and land use criteria Mostly solves the problem/opportunity Intermittent odour concerns Nitrate impact on groundwater	***No***
Upgrade Municipal Services	✓	~	~	Requires mitigation to lessen negative environmental and social impacts	***Yes***
Extend Municipal Services	✓	~	~	Requires mitigation to lessen negative environmental and social impacts	***Yes***

× Negative Impact ✓ Positive Impact ~ Neutral Impact (can be mitigated)

4.1.3 Water Distribution Alternatives

Preliminary water distribution alternatives for the Fernbank Lands include:

- Do Nothing
- Limit Growth
- Private Water Well
- Communal Water Well
- Municipal Service Extension and Upgrades

The *Do Nothing* and *Limit Growth* alternatives are not considered viable options as they do not meet the development targets established for the study area.

Private Water Well could satisfy a reduced water demand. This alternative does not conform to city infrastructure policy in the urban area and could potentially reduce groundwater levels, negatively impacting the environment.

A *Communal Water Well* could satisfy the demand and land use criteria. However, this alternative does not conform to city infrastructure policy in the urban area and could potentially reduce groundwater levels, negatively impacting the environment.

Municipal Service Extension and Upgrade resolves the problem and achieves the goal. This solution produces only minimal social and environmental impacts, and is relatively cost effective by using spare capacity in the municipal infrastructure system. The Provincial Policy Statement recommends municipal water services as the preferred form of servicing for settlement areas.

Table 4.3 on the following page outlines the alternative water distribution solutions.

Table 4.3: Alternative Solutions - Water Distribution

Alternative Solution	Water Demand and Land Use	Social Environment	Natural Environment	Comment	Carried Forward
Do Nothing	×	×	×	Does not satisfy the demand requirements Does not address the problem/opportunity Does not meet the intent of the planning or servicing policies	***No***
Limit Growth	×	~	~	Will satisfy a reduced water demand requirement – some infrastructure still required Does not fully address the problem/opportunity Requires mitigation to lessen negative environmental and social impacts	***No***
Private Wells	×	~	~	Will satisfy a reduced water demand Does not fully address the problem/opportunity Impact on groundwater system	***No***
Communal Wells	✓	~	~	Satisfies the demand and land use criteria Requires mitigation to lessen negative environmental impacts Does not conform to city infrastructure policy within the urban area	***No***
Extend Municipal Services	✓	✓	~	Satisfies the demand and land use criteria Requires mitigation to lessen negative environmental impacts	***Yes***

× Negative Impact ✓ Positive Impact ~ Neutral Impact (can be mitigated)

4.2 Preferred Servicing Alternative

An expansion and upgrade of the municipal infrastructure system was evaluated as the best servicing alternative to achieve the land use objectives, while minimizing negative impacts to both the social and natural environment.

4.3 Municipal Servicing: Criteria & Evaluation

The preferred servicing technique of expanding the municipal infrastructure system was applied to five alternative Demonstration Plans. The municipal servicing solution, particularly for water supply and wastewater collection, was found to be relatively independent of the concept plans. In other words, irrespective of changes made to the Demonstration Plan, the design solutions were similar in nature. Based on the analysis, infrastructure was not a determining factor in selection of the final Demonstration Plan.

For comparative purposes, a criteria and indicator list was created to evaluate the relative benefits of each servicing solution. **Table 4.4** outlines the criteria and indicators, while **Tables 4.5, 4.6** and **4.7** evaluate the alternative Demonstration Plans.

Table 4.4 - Servicing Criteria

Storm Water Management	
Criteria	**Indicator**
1. Land Use Compatibility	• Is the SWMF compatible with the proposed land use both aesthetically and functionally? • Does the design disrupt natural habitat?
2. Flood Protection	• Does the design minimize conveyance of 100-year overland flow across arterial and collector roadways?
3. Cost	• Is the design cost-effective? • Are the operation and maintenance costs reasonable?
Wastewater Collection System	
Criteria	**Indicator**
1. Constraints	• Does the sewer design require significant rock excavation? • Is the sewer design excessively deep? • Does the sewer system disrupt natural habitat? • Does the sewer design disrupt the social environment?
2. Serviceability	• Does the design make efficient use of residual capacity? • Can development be readily phased?
3. Cost	• Is the design cost-effective? • Are the operation and maintenance costs reasonable?
Water Distribution System	
Criteria	**Indicator**
1. Serviceability	• Does the design make efficient use of residual capacity? • Can development be readily phased?
2. Cost	• Is the design cost-effective? • Are the operation and maintenance costs reasonable?

Table 4.5: Municipal Servicing Evaluation – Storm Drainage

Criteria & Indicator	Demonstration Plan No. 1	Demonstration Plan No. 2	Demonstration Plan No. 3	Demonstration Plan No. 4	Demonstration Plan No. 5
1. Land Use Compatibility					
Is the SWMF compatible with the proposed land use both aesthetically and functionally? Does the design disrupt natural habitat?	Okay - All SMW ponds located in residential areas. Poor - Collector road in proximity to Monahan Drain may detract from environmental corridor (aesthetics & salt load). Worst - 5 elementary schools adjacent to a pond. Good – SWM ponds located to minimize tree removal, avoid watercourse crossings and enhance channels with flow contributions	Okay - All SMW ponds located in residential areas. Poor - Collector road in proximity to Monahan Drain may detract from environmental corridor (aesthetics & salt load). Poor - 2 elementary schools adjacent to a pond. Good – SWM ponds located to minimize tree removal, avoid watercourse crossings and enhance channels with flow contributions	Okay - All SMW ponds located in residential areas. Good – Buffer between drainage channel and roadway network. Okay - 1 elementary school adjacent to a pond. Good – SWM ponds located to minimize tree removal, avoid watercourse crossings and enhance channels with flow contributions	Okay – Most SWM ponds in residential areas; 1 pond in commercial block. Poor - Collector road in proximity to Monahan Drain may detract from environmental corridor (aesthetics & salt load). Okay - 1 elementary school adjacent to a pond. Good – SWM ponds located to minimize tree removal, avoid watercourse crossings and enhance channels with flow contributions	Okay - All SMW ponds located in residential areas. Good – Buffer between drainage channel and roadway network. Poor - Two elementary schools adjacent to a pond. Good – SWM ponds located to minimize tree removal, avoid watercourse crossings and enhance channels with flow contributions
2. Flood Protection					
Does the design minimize conveyance of 100-year overland flow across arterial and collector roadways?	Worst - Major overland flows will need to cross arterial/transitway to Monahan Drain & Carp River SWM ponds. (3 crossings)	Poor - Major overland flows will need to cross arterial/transitway to Carp River & Flewellyn SWM ponds. (2 crossings)	Good - No major overland flows across arterial/transitway.	Okay - Major overland flows will need to cross arterial/transitway to Carp River SMW pond. (1 crossing)	Worst - Major overland flows will need to cross arterial/transitway to Flewellyn, Monahan and Carp River SWM ponds. (3 crossings)
3. Cost					
Is the design cost-effective? Are the operation and maintenance costs reasonable?	Okay - Capital and O&M costs are equivalent for all options.	Okay -Capital and O&M costs are equivalent for all options.	Okay -Capital and O&M costs are equivalent for all options.	Okay -Capital and O&M costs are equivalent for all options.	Okay - Capital and O&M costs are equivalent for all options.
Rating: Storm	Worst	Okay	Best	Okay	Okay

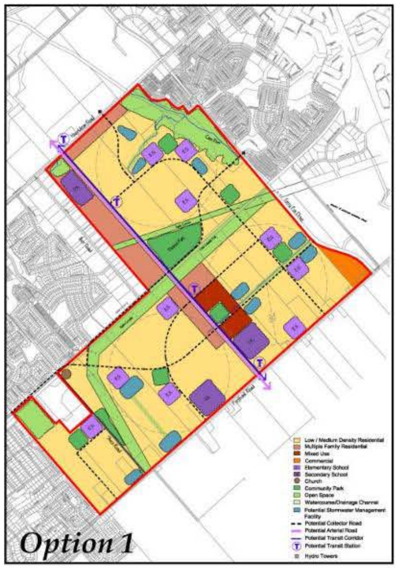
Table 4.6: Municipal Servicing Evaluation – Wastewater Collection System

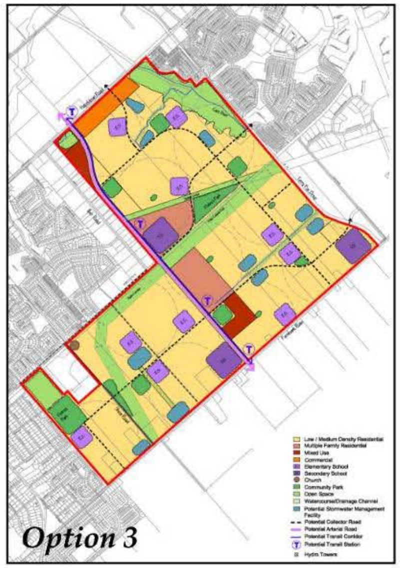
Criteria & Indicator	Demonstration Plan No. 1	Demonstration Plan No. 2	Demonstration Plan No. 3	Demonstration Plan No. 4	Demonstration Plan No. 5
1. Serviceability					
Does the sewer design require significant rock excavation? Is the sewer design excessively deep?	Poor - Rock: curvilinear roads creates indirect flow path, increases sewer depth and blasting requirement	Good - Rock: linear roads makes for direct route through ridge line	Good - Rock: linear roads makes for direct route through ridge line	Good - Rock: linear roads makes for direct route through ridge line	Poor - Rock: curvilinear roads creates indirect flow path, increases sewer depth and blasting requirement
Does the sewer system disrupt natural habitat? Does the sewer design disrupt the social environment?	Good - 1 watercourse crossing (Monahan)	Okay - 2 watercourse crossings (Monahan & Flewellyn)	Okay - 2 watercourse crossings (Monahan & Flewellyn)	Okay - 2 watercourse crossings (Monahan & Flewellyn)	Okay - 2 watercourse crossings (Monahan & Flewellyn)
2. Compatibility with Municipal Infrastructure					
Does the design make efficient use of residual capacity? Can development be readily phased?	Poor - Lands west of Shea Rd not directly connected by a roadway network; easement required through park and Hydro corridor.	Poor - Lands west of Shea Rd not directly connected by a roadway network; easement required through park and Hydro corridor.	Okay – Minor inefficiencies between wastewater collection and road network.	Good – Efficient conveyance routes from all areas of site following primary road networks.	Okay – Minor inefficiencies between wastewater collection and road network.
3. Cost					
Is the design cost-effective? Are the operation and maintenance costs reasonable?	Poor - Slight cost increase for land (easement) and infrastructure; also slightly increased rock excavation costs	Okay - Slight cost increase for land (easement) and infrastructure	Good – No significant cost impediments	Good – No significant cost impediments	Okay - Slightly increased rock excavation costs
Rating: Wastewater	Worst	Okay	Good	Best	Poor

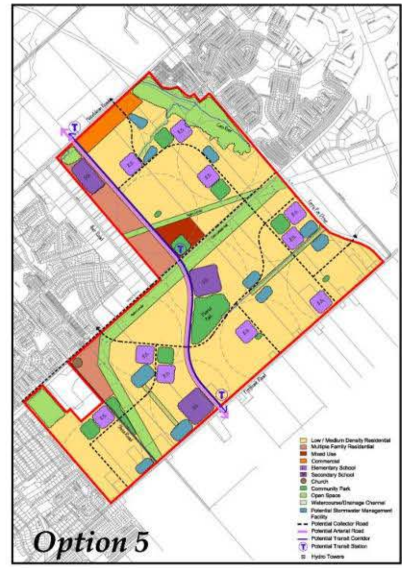
Table 4.7: Municipal Servicing Evaluation – Water Distribution System

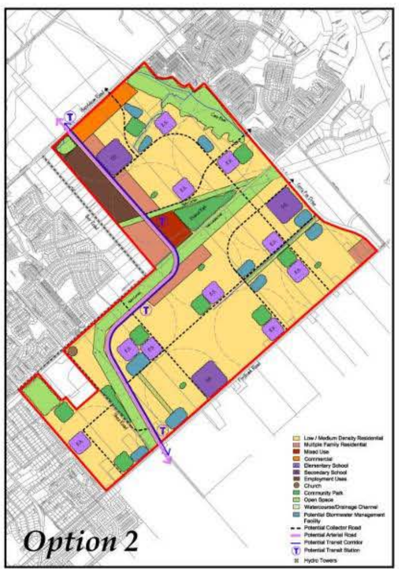
Criteria & Indicator	Demonstration Plan No. 1	Demonstration Plan No. 2	Demonstration Plan No. 3	Demonstration Plan No. 4	Demonstration Plan No. 5
1. Serviceability					
Does the design make efficient use of residual capacity? Can development be readily phased?	Okay - Lands west of Shea Rd somewhat isolated by macro-level road network will require looping through park and Hydro corridor. Okay - 2 watercourse crossings (Monahan & Carp River)	Good – Lands readily serviced by water. Poor – 3 watercourse crossings (Monahan, Carp River & Flewellyn)	Good – Lands readily serviced by water. Poor – 3 watercourse crossings (Monahan, Carp River & Flewellyn)	Good – Lands readily serviced by water. Worst – 4 watercourse crossings (Monahan, Carp River & Flewellyn)	Good – Lands readily serviced by water. Okay - 2 watercourse crossings (Monahan & Carp River)
2. Cost					
Is the design cost-effective? Are the operation and maintenance costs reasonable?	Poor - Slight premium to loop watermain through park and Hydro easement for lands west of Shea	Poor - Slight premium due to increased arterial roadway length (increased pipe length required).	Okay - Capital costs and O&M expenses exhibit near equivalency between the options (based on roadway length and ease of connection to external supply).	Okay - Capital costs and O&M expenses exhibit near equivalency between the options (based on roadway length and ease of connection to external supply).	Okay - Capital costs and O&M expenses exhibit near equivalency between the options (based on roadway length and ease of connection to external supply).
Rating: Water	Okay	Okay	Good	Good	Best
Total Rating	**Worst**	**Okay**	**Best**	**Good**	**Okay**

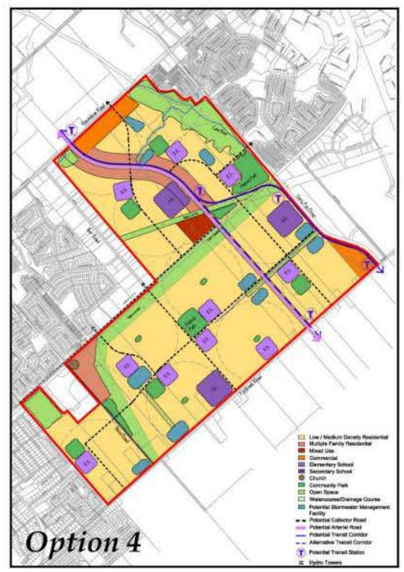
Figure 4.1: Alternative Demonstration Plans











4.4 Municipal Servicing: Conclusion

The municipal infrastructure design for alternative Demonstration Plans 1 through 5 was rated for the storm drainage, wastewater collection, and water distribution systems. Each category was assigned a qualitative rank as either Best, Good, Okay, Poor, or Worst. The cumulative criteria values were then used to rank the alternative Demonstration Plans.

In general, the demonstration plans all have fairly similar ratings and none are constrained by planning layout. This suggests that factors other than municipal servicing will likely dictate selection of the final demonstration plan; this would include planning rationale, design of transportation corridors, public feedback, input from the Technical Advisory Committee, etc.

Section 5.0 Servicing Constraints

5.1 Environmental Management Plan

An Environmental Management Plan (EMP) has been prepared in conjunction with the Master Servicing Study. Many of the findings associated with the EMP have direct bearing on the infrastructure design, these are outlined below:

Sub-Watershed Areas

Sub-watershed catchments in the study area were identified in the EMP and are depicted herein as **Figure 3.4**. By-and-large the sub-watershed boundaries are maintained, although slight modifications are anticipated in conjunction with development. Preservation of the watershed boundaries is identified as a servicing objective to maintain water balance and flow routing conditions. The storm sewer and grading design is significantly affected by this constraint.

Carp River

The Carp River 100-year floodplain skirts along the northeast boundary of the Fernbank Lands. All development will remain outside of this constraint limit as regulated by the Mississippi Valley Conservation Authority. The flood elevation is currently under review and will be adjusted when the Carp River Third Party Review is adopted by Council. Dwellings will be constructed to provide at least 0.50m elevation differential between the storm sewer hydraulic grade line and the basement floor slab.

Fluvial Geomorphology

Rainfall runoff from the Fernbank Lands outlets into one of the Carp River, Monahan Municipal Drain, Flewellyn Drain, or Faulkner Municipal Drain. The geo-fluvial characteristics of these drains were evaluated by Parish Geomorphic under separate cover, wherein the erosion threshold of each channel was determined. The conclusions stipulate a maximum discharge rate to ensure embankment stability. This criterion affects the permissible release rate and hence the size of each storm water management facility.

Natural Channels

The EMP designates two natural channel corridors for preservation. The lower reach of the Carp Tributary has considerable vegetation, canopy cover, and natural sinuosity. The Monahan Municipal Drain upstream of Terry Fox Drive is a linear agricultural outlet with numerous smaller offshoots. The main branch of this drain will be naturalized in compensation for the cumulative loss of low-quality aquatic habitat. A stormwater pond is located at the head of each channel to promote baseflow and improve aquatic habitat.

Woodlands

An area of medium quality terrestrial land is identified on the Demonstration Plan. This land could be purchased by the City of Ottawa should the corporation choose to acquire the parcel. Municipal services must be routed in such a manner to ensure a solution irrespective of whether these lands are acquired.

Geotechnical

Grade raise restrictions exist where the site is underlain by clay materials in Zones 2 through 4 as shown on **Figure 3.3**. The sewers must be designed to permit a gravity solution from all dwellings, while respecting the maximum permissible grade raise. Localized areas that exceed the criteria would require site specific engineering to compensate.

5.2 Demonstration Plan

Roadway Network

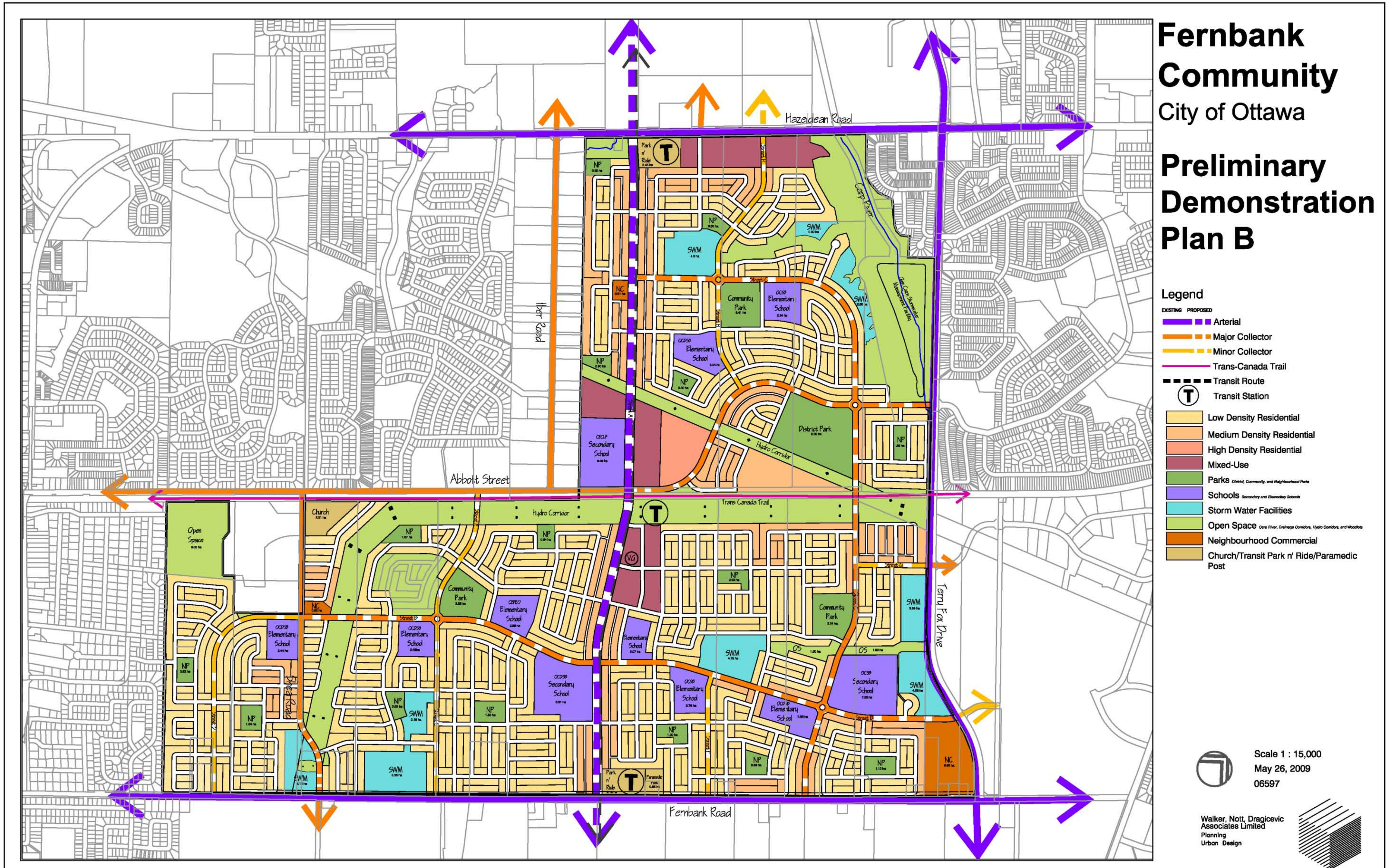
An internal system of roadways to has been designed by Delcan to service the Fernbank Lands. It is suggested that trunk municipal infrastructure should generally follow the collector roadways to the extent that is practical, thereby limiting easement requirements.

Hydro One

Two high-power transmission corridors traverse the study area and converge near Terry Fox Drive and the Trans-Canada Trail. Hydro One has substantial easements in favour of their base towers and transmission lines. Municipal infrastructure is permitted within their easement on a case-by-case basis however no construction is permitted within 50 feet of a tower base.

A copy of the Preliminary Demonstration Plan is attached on the following page as Figure 5.1. This plan forms the basis upon which the storm drainage, wastewater collection, and water servicing designs were prepared.

Figure 5.1: Preliminary Demonstration Plan



Section 6.0 Storm Drainage & Servicing

The Environmental Management Plan for the Fernbank Community recommended a series of eight wet ponds for stormwater management within the study area. Conceptual SWM facility designs are provided in the EMP.

The Master Servicing Study has built upon the conclusions of the EMP to develop a storm drainage and stormwater management plan for the study area. The general approach to the storm drainage design for the Fernbank Community is to utilize the dual drainage concept for conveyance of storm runoff:

- Storm sewers (minor system) will be used for conveyance of runoff for frequent to moderate storm events;
- An overland flow network (major system) consisting of the road network and other defined overland flow routes will be designed to provide safe conveyance of runoff from larger storm events when peak flows exceed the inlet capacity to the minor system.

6.1 Stormwater Management Criteria

Storm drainage and stormwater management criteria were determined as outlined in the Fernbank Community Environmental Management Plan (Novatech, 2008). The EMP also outlines the recommended locations of proposed SWM facilities to service the Fernbank Community. As the study area is located at the headwaters of several different watersheds, the stormwater management targets for the Fernbank Community lands must take into account the effects of development on the downstream areas. A summary of the criteria is provided below.

6.1.1 Carp River Subwatershed

Stormwater management criteria for the Fernbank Community lands tributary to the Carp River subwatershed have been developed based on the recommendations of the Carp River Subwatershed Study, the recommendations of the Carp River 3rd Party Review, and input from MVC:

- The proposed stormwater management strategy will need to adhere to all applicable policies and guidelines of Mississippi Valley Conservation; the City of Ottawa, MOE, and other approvals agencies.

Quality Control / Fish Habitat

- Level 2 - Normal protection for lands tributary to the Carp River (70% long term TSS removal);
- End-of-pipe SWM facilities are to provide extended detention storage for both baseflow enhancement and water quality control;
- The proposed development must have no adverse impacts on downstream fish habitat;
- The Carp River and the West Tributary have been classified as tolerant warmwater fish communities (Type 3 Communities), based on classifications from the *Carp River Watershed / Subwatershed Study*. Temperature mitigation measures are to be incorporated into all proposed SWM facilities, with the goal of ensuring that the temperature of discharged stormwater does not exceed the following target values:
    - Maximum Discharge Temperature = 25ºC
    - Preferred Discharge Temperature = 22ºC

Quantity Control

- Increases in runoff volume resulting from development are not to exceed an additional 40,000 m^3 above existing conditions for the 100-year event;
- All development within the Fernbank Community tributary to the Carp River accommodate a per hectare share of the 85,600 m^3 deficit volume identified in the Third Party Review until data is available to confirm the model.
- The proposed development must not result in any increase in downstream flood risk in the Carp River. Any proposed increases in flood elevations will need to be reviewed to ensure that they do not represent an increase in flood risk. Provided this criterion is met, the following design criteria are to be applied to proposed SWM facilities:
    - For SWM Facilities outletting directly to the Carp River, peak flow control is not required for major storm events (> 10 year event).
    - For SWM facilities outletting to tributaries of the Carp River, peak flow control is required for all storms up to the 100-year event.

Erosion control / Fluvial Geomorphology

- Continuous hydrologic modeling should be used to demonstrate that the proposed development will not result in an adverse change to the geomorphology of the Carp River West Tributary. The number of exceedences of the erosion thresholds established by the fluvial geomorphic analysis should not increase under post-development conditions.

6.1.2 Jock River Subwatershed

Stormwater management criteria for the Fernbank Community lands tributary to the Jock River subwatershed have been developed based on the recommendations of the Jock River Reach 2 River Subwatershed Study and input from RVCA:

- The proposed stormwater management strategy will need to adhere to all applicable policies and guidelines of the Rideau Valley Conservation Authority; the City of Ottawa, MOE, and other approvals agencies.

Quality Control / Fish Habitat

- Level 1 - Enhanced protection for lands tributary to the Jock River (80% long term TSS removal);
- End-of-pipe facilities will be designed to provide extended detention storage for both baseflow enhancement and water quality control.
- The proposed development must have no adverse impacts on downstream fish habitat.
- The Monahan Drain and Flewellyn Drain have been classified as intermittent watercourses supporting tolerant warm/cool water fish communities. The Faulkner Drain tributary is classified as an intermittent watercourse providing indirect fish habitat. Temperature mitigation measures are to be incorporated into all proposed SWM facilities tributary to the Jock River, with the goal of ensuring that the temperature of discharged stormwater does not exceed the following target values:
    - Maximum Discharge Temperature = 25ºC
    - Preferred Discharge Temperature = 22ºC

Quantity Control

- Ensure the proposed SWM infrastructure will not result in any adverse impacts on flood elevations or increase the extent of flooding in downstream watercourses.
- Ensure the Monahan Drain ponds are designed to have no adverse impacts the function of the Monahan Drain Constructed Wetlands SWM Facility. No additional analysis of the Constructed Wetlands will be required provided that the proposed development conforms to the following:
  - The main branch of the Monahan Drain is retained upstream of Terry Fox Drive;
  - Fernbank lands tributary to the Monahan Drain to be serviced by 3 SWM facilities:
    - One SWM facility at the headwaters of the Monahan Drain;
    - Two SWM facilities on each side of the Monahan Drain upstream of Terry Fox Drive.
  - The design of the Constructed Wetlands assumed a total drainage area tributary to the Monahan Drain upstream of Terry Fox Drive of approximately 296 hectares with an average imperviousness of 46%.
- Post-development peak flows are not to exceed pre-development levels for all storms up to the 100-year event.

Erosion control / Fluvial Geomorphology

- Continuous hydrologic modeling should be used to demonstrate that the proposed development will not result in an adverse change to the geomorphology of the outlet watercourses. The number of exceedences of the erosion thresholds established by the fluvial geomorphic analysis should not increase under post-development conditions.

6.1.3 Groundwater Infiltration & Water Balance

Implementation of infiltration BMPs as part of the storm drainage design for the Fernbank Community will reduce the impacts of development on the hydrologic cycle. Infiltration of clean runoff will have additional benefits for stormwater management. By reducing the volume of "clean" water conveyed to the SWM facilities, the performance of the SWM facilities will be increased.

The soils in the Fernbank area generally have a low impermeability (silty clay, till, bedrock) and are not conducive to infiltration, and end-of-pipe infiltration facilities are not feasible in this area. Infiltration of surface runoff is best accomplished through lot level and conveyance controls. However care must be taken to ensure that infiltration measures are suitable for the proposed type of development and soil conditions.

- Infiltration of runoff containing high concentrations of sediment can result in clogging of the pores in the soil, thereby reducing its infiltration capacity.
- Infiltration should be avoided in areas where there is potential for surface spills, which would potentially result in contamination of groundwater.

Infiltration BMPs

The majority of the Fernbank Community will be low and medium density residential development. The most suitable practices for groundwater infiltration include:

- Infiltration of runoff captured by rearyard catchbasins.
- Direct roof leaders to rearyard areas.
- Infiltration trenches underlying drainage swales in park and open space areas.
- The use of fine sandy loam topsoil in parks and on residential lawns.

Infiltration Targets

Infiltration targets have been identified for each of the subwatershed drainage basins within the Fernbank Study Area:

- Carp River: Post-development infiltration target of 100 mm/yr
- Faulkner Drain: Post-development infiltration target of 80 mm/yr
- Flewellyn Drain: Post-development infiltration target of 80 mm/yr
- Monahan Drain: Post-development infiltration target of 95 mm/yr

6.1.4 Baseflow Temperature Maintenance

Urbanization commonly results in an increase in the temperature of storm runoff, most often due to extended detention within stormwater management facilities. Wet ponds have been found increase the temperature of runoff by approximately 5.1ºC (MOE, 2003).

Incorporating the following mitigation measures into the design of the proposed SWM ponds will result in reduced thermal impacts from the SWM facilities:

- Design of SWM facilities using narrow pond configurations with bank plantings to promote shading and inhibit temperature increases;
- Deeper permanent pools (1.5 - 2.0 m) combined with bottom draw baseflow outlets: There is a minimal difference in temperature within the top metre of a permanent pool, but temperatures decrease with increasing permanent pool depths.
- Baseflows should be routed through a stone-filled subsurface trench: The length of the trench should be maximized to increase the opportunity for heat transfer from the water to the stone.
- Establishing/preserving riparian cover for outlet watercourses will further help to reduce the temperature of runoff.

6.2 Storm Drainage Design - Minor System

6.2.1 Minor System Criteria

The trunk storm sewers comprising the minor system have been designed based on the criteria outlined in the *Ottawa Sewer Design Guidelines* (January 2005). The design criteria used in sizing the storm sewers are summarized below:

Return Period

- 5 year - Local and Collector Roads
- 10 year - Arterial Roads and Transitways

Design Flows

- Storm Sewer Design Sheets created using Rational Method
- IDF Rainfall Data as per *Ottawa Sewer Design Guidelines*
- Initial Time of Concentration T_c = 15 minutes
- Runoff Coefficients
    - Mixed Use / Commercial C = 0.80
    - Arterial Roads / Transitway C = 0.70
    - Parks C = 0.40
    - Open Space/Hydro Corridor C = 0.20
    - Schools C = 0.60
    - High Density Residential C = 0.70
    - Medium Density Residential C = 0.60
    - Low Density Residential C = 0.50

Inlet Control Devices

Inlet control devices (ICD) are proposed within the roadways to ensure inflows to the storm sewer system are regulated to the 5-year peak flow (10-year peak flow for arterial roads and transitway). Inlet control devices are to be CB lead plug/insertion type, and ICD sizes are to be selected from the sizes listed in Section 13.1.19 of the *Ottawa Sewer Materials Specifications* (March 2007).

6.2.2 Trunk Sewer Sizing

Using the demonstration land use plan, a conceptual design of the trunk storm sewer network was developed for the Fernbank Community. The design of the trunk sewers is based on the road patterns shown on the demonstration plan, and is intended to provide a preliminary estimate of the required storm drainage infrastructure.

It is not required that future development follow exactly the drainage routes shown on the storm drainage area plan, and it is expected that refinements to the design of the trunk storm sewer system will be made as plans of subdivision are developed.

Development plans within the Fernbank Community should make an effort to maintain the drainage boundaries shown on the drainage area plan, as the SWM facility blocks have been sized to accommodate those areas. However, the SWM blocks have been slightly oversized to provide some flexibility for changes to the drainage areas and land use shown on the demonstration plan, and minor modifications will have negligible impact on the results of the high-level analysis completed for the Master Servicing Study.

The geotechnical study completed by Houle Chevrier Engineering as part of the existing conditions investigations for the site indentified areas with grade raise restrictions. These areas are broadly delineated in Figure 3.3, while zones that specifically affect servicing are identified on the Grading Plan within a hatched area entitled Grade Raise Constraint Area. A reduced sewer cover is likely in the grade raise constraint areas. Subject to detail design, dwellings in this zone would not have basements. The alternative is to employ geotechnical design techniques to increase the grade raise in excess of the preliminary constraint. Either design technique is plausible to resolve this constraint, but in our opinion an insulated sewer with reduced depth is an easy solution with minimal risk. The Master Servicing Study has demonstrated feasibility, while the specific design solution should be finessed at detail design.

Readers should note that portions of the Fernbank Community are constrained by level topography and to service these areas, large diameter sewers installed at reduced slopes are required.

The conceptual trunk sewer network is shown on the storm drainage area plan provided as **Drawing 101108-STM1**. Storm sewer design sheets for the drainage areas tributary to each of the proposed SWM facilities are provided in **Appendix B**.

6.2.3 HGL Analysis - Trunk Storm Sewers

An HGL analysis has been completed for the proposed trunk storm sewer network. A spreadsheet analysis was used for the analysis in lieu of a hydraulic model. The Fernbank Community will be serviced by multiple trunk storm sewers, each of which will outlet to one of the eight proposed SWM facilities. While the overall site is quite large (674 hectares), the individual trunk sewer runs to each SWM facility are relatively short and the total travel time through the minor system is correspondingly small. Consequently, there will be no significant attenuation of flows through the minor system, and a spreadsheet analysis can provide an accurate assessment of the HGL.

All trunk storm sewers were designed based on an inlet time of concentration of 15 minutes. Travel times through the trunk storm sewers were calculated based on full flow velocity (refer to storm sewer design sheets provided in **Appendix B**) and are summarized in **Table 6.1**.

Table 6.1: Trunk Sewer Travel Times

Trunk Sewer Location	From Node	To Node	Drainage Area (ha)	Starting T_c (min)	Ending T_c (min)	Travel Time (min)
Pond 1						
Outlet 1	107	POND1	23.17	15	19.70	4.70
Outlet 2	123	POND1	53.96	15	21.82	6.82
Pond 2						
Outlet 1	207	POND2	23.14	15	19.72	4.72
Pond 3						
Outlet 1	301	POND3	81.90	15	22.79	7.79
Outlet 2	321	POND3	9.78	15	20.67	5.67
Pond 4						
Outlet 1	407	POND4	42.61	15	21.78	6.78
Outlet 2	417	POND4	15.33	15	16.63	1.63
Pond 5						
Outlet 1	513	POND5	44.37	15	23.31	8.31
Outlet 2	531	POND5	94.19	15	22.74	7.74
Pond 6						
Outlet 1	611	POND6	55.99	15	24.28	9.28
Outlet 2	617	POND6	42.66	15	17.97	2.97
Pond 7						
Outlet 1	707	POND7	43.09	15	20.47	5.47
Pond 8						
Outlet 1	809	POND8	62.57	15	22.69	7.69

The maximum travel time (9.28 minutes) occurs in the trunk sewer to Pond 6.

Allowable inflows to the minor system have been assigned for each proposed land use, based on providing the requisite level of service. The capture rates have been evaluated using the SWMHYMO hydrologic model. Modeling files are provided in **Appendix B**. Minor system capture rates listed in **Table 6.2**.

Table 6.2: Minor System Capture Rates

Land Use	Level of Service	Runoff Coefficient	Capture Rate (L/s/ha)
Arterial Roads / Transitway	10 year	0.70	185
Collector Roads	5 year	0.70	145
Mixed Use / Commercial	5 year	0.80	150
High Density Residential	5 year	0.70	130
Medium Density Residential	5 year	0.60	115
Low Density Residential	5 year	0.50	100
Schools	5 year	0.70	115
Parks	5 year	0.40	70
Open Space	5 year	0.20	50

For the 100-year storm event, it is assumed that on-site detention will result in all tributary drainage areas contributing their maximum allowable flow rate to the minor system for a time period in excess of the travel times listed in **Table 6.1**. Consequently, the design flows used in the steady-state HGL analysis have been calculated based on the minor system capture rates listed in **Table 6.2**.

The results of the HGL analysis are summarized on **Figure 6.1**. HGL design sheets for each of the trunk storm sewers are provided in **Appendix B**. **Table 6.3** summarizes the overall level of service provided by the trunk sewers.

NOTES:

1) SANITARY HYDRAULIC GRADE LINE IS ANALYZED UNDER CATASTROPHIC FAILURE CONDITIONS WITH THE PROPOSED OVERFLOW.

2) STORM HYDRAULIC GRADE LINE IS ANALYZED UNDER 100-YEAR FLOOD CONDITIONS.

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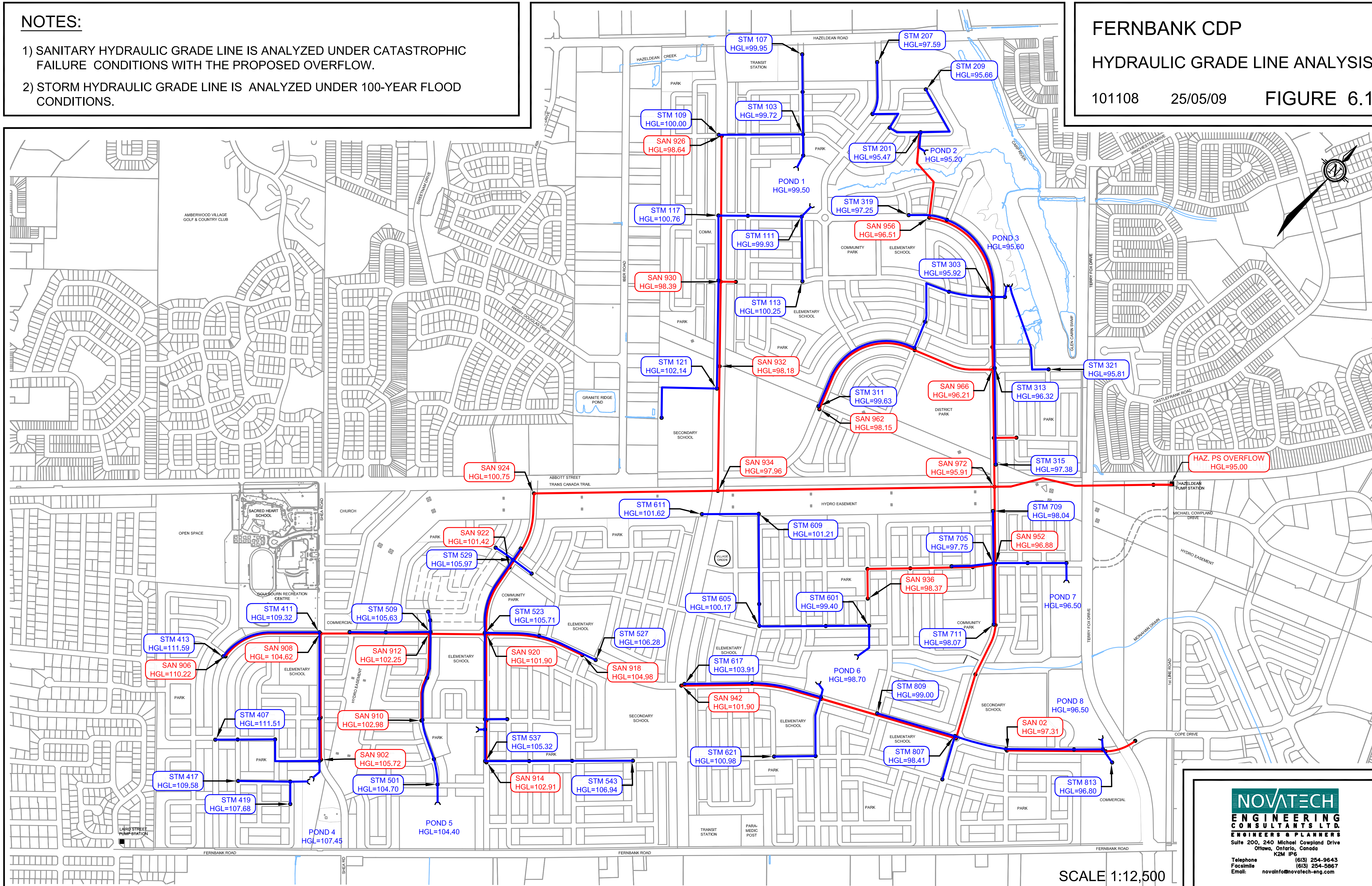
HYDRAULIC GRADE LINE ANALYSIS

101108 25/05/09 **FIGURE 6.1**



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Drawing:M:\2001\101108\CAD\Figure\101108-HGL.dwg Layout:list7 landscape Updated MAY 22, 2009 at 3:36pm by kmurphy

Table 6.3: Results of HGL Analysis

Trunk Sewer Location	From Node	To Node	Drainage Area* (ha)	Peak Flow at Outlet (L/s)	Overall Capture Rate (L/s/ha)
Pond 1					
Outlet 1	107	POND1	23.17	2,805	121
Outlet 2	123	POND1	51.20	8,227	121
Pond 2					
Outlet 1	207	POND2	23.14	2,754	119
Pond 3					
Outlet 1	301	POND3	74.02	7780	105
Outlet 2	321	POND3	8.37	834	100
Pond 4					
Outlet 1	407	POND4	37.94	4,017	106
Outlet 2	417	POND4	15.33	1,606	105
Pond 5					
Outlet 1	513	POND5	34.75	3,603	104
Outlet 2	531	POND5	87.01	8,914	102
Pond 6					
Outlet 1	611	POND6	47.05	5240	111
Outlet 2	617	POND6	42.66	5,064	119
Pond 7					
Outlet 1	707	POND7	32.44	3,371	104
Pond 8					
Outlet 1	809	POND8	62.43	7025	113

* Does not include Open Space area

6.3 Storm Drainage Design - Major System

An analysis of the major system was completed to evaluate the performance of the proposed grading design with respect to conveyance of overland flows during the 100-year storm event.

6.3.1 Major System Criteria

Design of the major system will adhere to the design standards outlined in Section 5.5 of the *Ottawa Sewer Design Guidelines* (January 2005). Criteria used in the major system design are summarized below:

<u>Major System Flow Outlets</u>
Major system flow must be directed to either:

- One of the proposed SWM facilities;
- An outlet watercourse; or
- Proposed dry ponds in open space areas, which will release stored flows back into the minor system at a controlled rate.

<u>Maximum Flow/Velocity on Streets</u>
The product of the overland flow Velocity (m/s) x Depth (m) should not be greater than 0.6.

<u>Cross-Street Flow</u>
No cross-street flow is permitted for the minor (5-year) storm event, and there is to be only minimal ponding within the roadways. Major system flow from local streets can be conveyed to other local or collector roads, or to a SWM facility or watercourse.

<u>Major System Flow Depths</u>
For events exceeding the minor system design storm and up to the 100 year design storm, flow depth is permitted in the right of way up to the following maximum water depths:

- Local: 300mm at edge of pavement
- Collector: 250mm at edge of pavement
- Arterial: No barrier curb overtopping. Flow spread must leave at least one lane free of water in each direction

6.3.2 Major System Drainage Areas

A macro-grading plan was developed using the Demonstration Plan that defines the major system overland flow routes within the Fernbank Community. A major system drainage area plan was developed based on the macro-grading plan that subdivides the site into overland flow catchment areas upstream of major intersections. The conceptual grading is shown on **Drawing 101108-GR**. The major system drainage area plan is shown on **Drawing 101108-STM2**.

6.3.3 Major System Modeling

Major system overland flows and storage requirements for the Fernbank Community were calculated using the SWMHYMO hydrologic model, which has the ability to model inlet restrictions, major system storage, and routing of major system flows. The SWMHYMO model was used to calculate 100-year major system peak flows and runoff volumes for various land uses and drainage areas on a per-hectare basis (unit peak flow rates).

Major system flow storage is recognized as part of the major overland system. This storage is most commonly provided by road sags created by using a saw toothed road design. Major system storage is considered a vital component of the major system that minimizes the cascading of overland flows from one area to another, thereby reducing the potential for property flooding.

SWMHYMO modeling files and supporting calculations for the major system analysis are provided in **Appendix B**.

Peak Flows

The Fernbank Community is comprised mainly of low density and medium density residential development. The storage in road sags in residential areas provides attenuation of peak flows from upstream drainage areas. This attenuation effect has been accounted for in the major system analysis by modeling the major system response for residential drainage areas ranging in size from 5 hectares to 25 hectares, and assigning a prorated major system peak flow for each major system subcatchment based on the total upstream drainage area.

Peak flows for other land uses were calculated based on small unit drainage areas, which were prorated based on the total tributary drainage area for that land use. Major system peak flows are illustrated on **Figure 6.2** and summarized in **Table 6.4**.

Runoff Volumes

The 100-year runoff volumes for each land use were calculated using the SWMHYMO model in the same manner as the peak flows. The runoff volumes were used to estimate dry pond storage requirements. Major system runoff volumes are illustrated on **Figure 6.3** and summarized in **Table 6.4**.

Table 6.4: Major System Peak Flows and Runoff Volumes

Land Use	'C'	% Imperv	Minor System		Major System		
			Inlet Rate (L/s/ha)	Storage (m^3/ha)	Unit Area (ha)	Peak Flow (L/s/ha)	Volume (m^3/ha)
Arterial Roads / Transitway	0.70	71%	185	0	2	101	63
Collector Roads	0.70	71%	145	40	2	125	84
Mixed Use / Commercial	0.80	86%	150	250	3	0	0
Schools	0.70	71%	115	50	3	130	67
Parks	0.40	29%	70	0	5	12	0
Open Space	0.20	0%	50	0	2	26	42
High Density Residential	0.70	71%	130	150	5	0	0
Medium Density Residential	0.60	57%	115	50	5	129	67
					10	90	59
					25	58	32
Low Density Residential	0.50	43%	100	50	5	76	57
					10	76	50
					25	47	26
Mixed Density Residential	0.55	50%	105	50	50	34	15

The major system analysis assumes that on-site storage will be provided for commercial areas and high-density residential areas for storms up to the 100-year event, and that no major system flows will be generated for these areas. The overall site grading does provide drainage outlets from these areas in the event that the available on-site storage is exceeded.

Figure 6.2: Major System Rating Curve (Peak Flows) for Residential Development

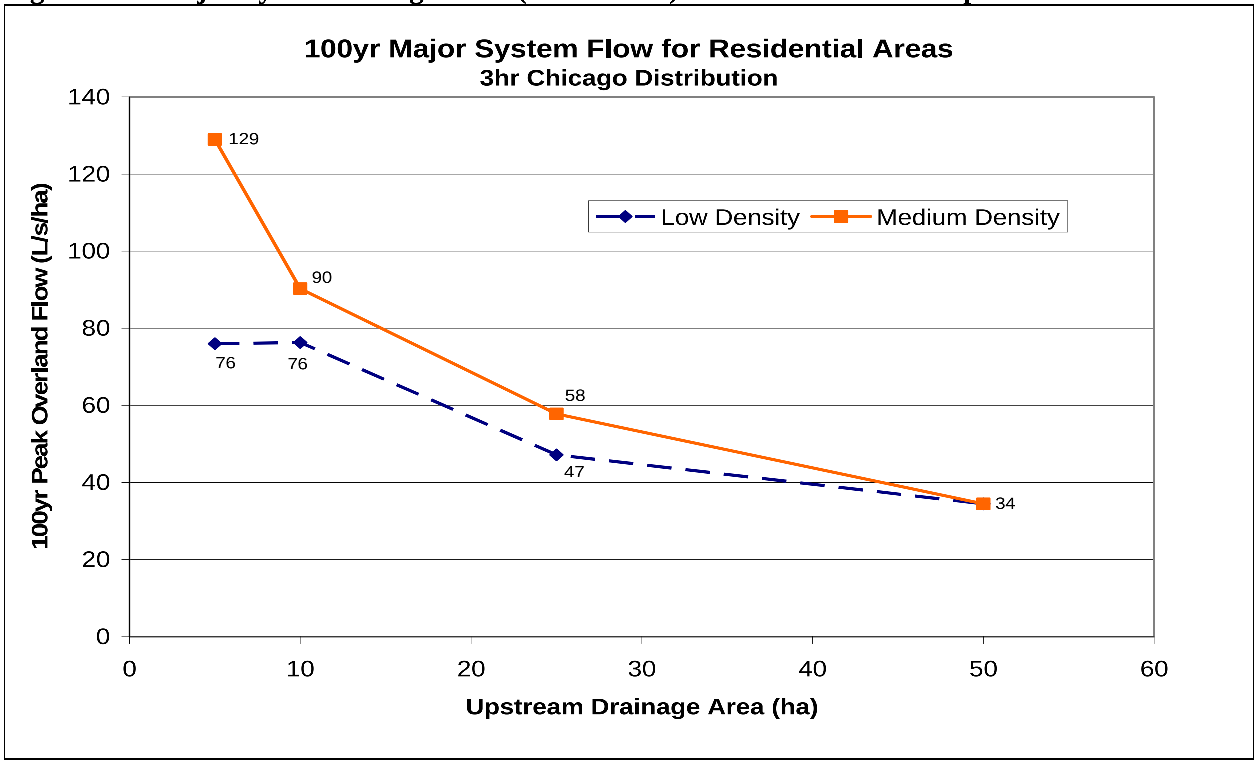
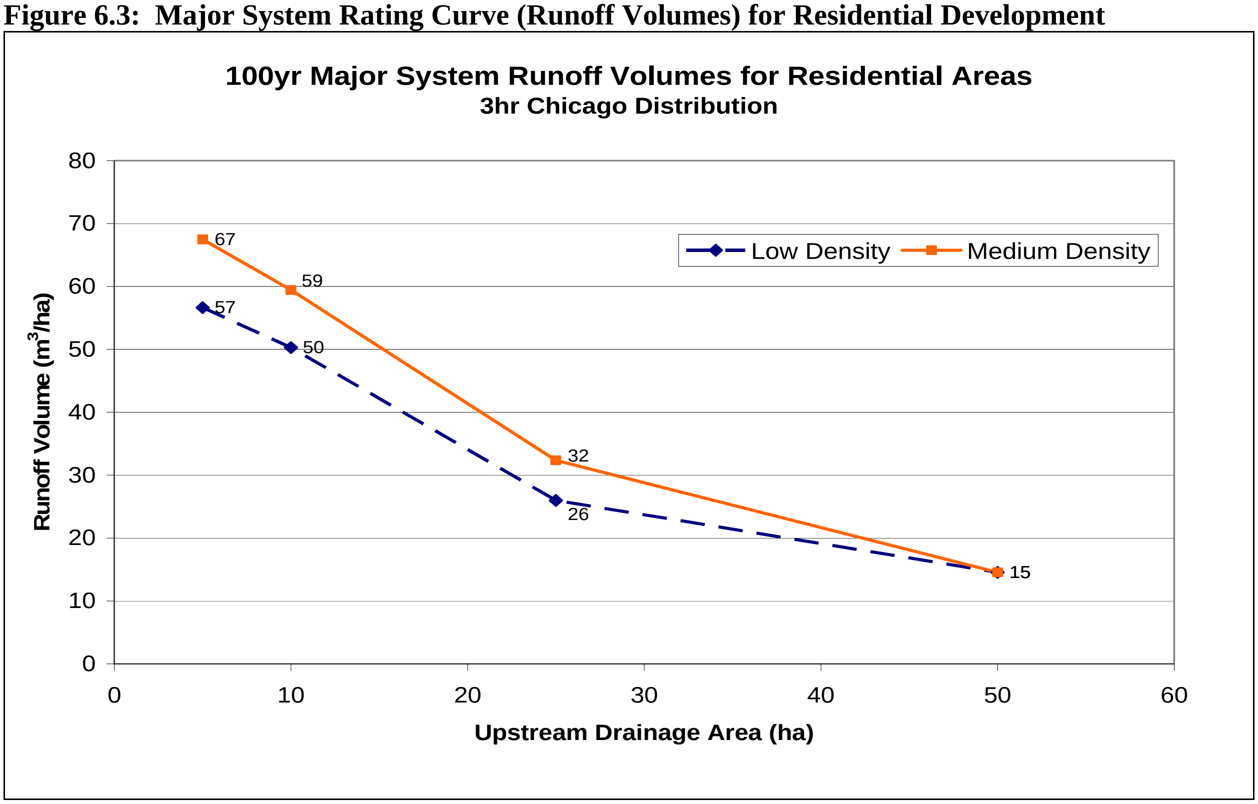


Figure 6.3: Major System Rating Curve (Runoff Volumes) for Residential Development



6.3.4 Major System Peak Flows

The major system peak flows have been evaluated to ensure that flow depths and velocities meet the City of Ottawa design criteria. The highest peak flows within each pond drainage area have been used in the evaluation. The evaluation has been completed using Manning's equation based on the average slope of the drainage area. A summary of the analysis is provided in **Table 6.5**. Design calculations are provided in **Appendix B**.

Table 6.5: Major System Peak Flows

Drainage Area	Catchment ID	Road Type	Peak Flow (m^3/s)		Road Slope	Depth (m)	Velocity (m/s)	D x V (m^2/s)
			Total	Per Side				
Pond 1	M1.9	Collector	**1.63**	0.82	0.23%	0.24	0.88	0.21
Pond 2	M2.3	Local	**0.94**	0.47	0.40%	0.18	0.94	0.17
Pond 3	M3.7	Collector	**2.15**	1.08	0.40%	0.24	1.15	0.28
Pond 4	M4.2	Collector	**1.80**	0.90	0.40%	0.22	1.09	0.24
Pond 5	M5.8	Collector	**1.43**	0.72	0.21%	0.23	0.81	0.19
Pond 6	M6.9	Local	**1.70**	0.85	0.21%	0.25	0.86	0.22
Pond 7	M7.4	Collector	**1.56**	0.78	0.30%	0.23	0.96	0.22
Pond 8	M8.3	Collector	**1.95**	0.98	0.26%	0.25	0.96	0.24

6.3.5 Dry Ponds

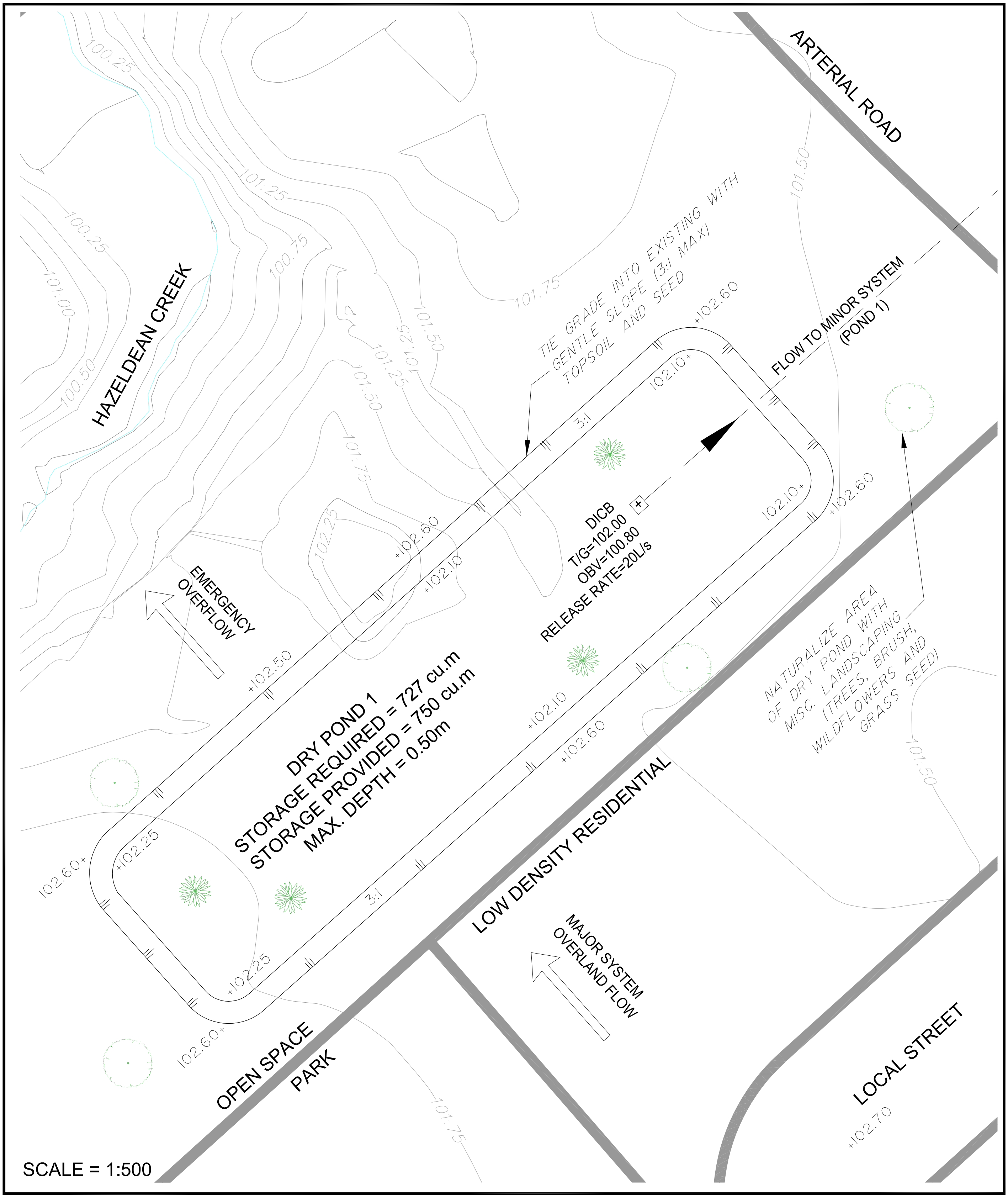
Open space areas provide opportunities for major system storage using dry ponds. Dry ponds are proposed within the hydro corridors for lands upstream of the north/south arterial road to prevent major system flows from crossing the arterial road, as well as within the hydro corridor east of Shea Road to reduce overland flow rates and volumes within the right-of-ways.

Dry pond storage volumes have been calculated to provide sufficient storage for the 100-year overland flow volume from the upstream drainage areas, based on the runoff volumes listed in **Table 6.4**. Runoff stored in dry ponds will be released back into the minor system at a controlled rate. Storage requirements for dry ponds are shown on **Drawing 101108-STM2** and in **Table 6.6**.

Table 6.6: Dry Ponds

Pond ID	Required Volume (m^3)	Release Rate (L/s)	Max Depth (m)	Area (ha)
Dry Pond 1	727	20	0.50	0.17
Dry Pond 2	774	20	0.50	0.18
Dry Pond 3	832	20	0.60	0.76
Dry Pond 4	641	20	0.50	0.16
Dry Pond 5	364	20	0.50	0.09

The dry ponds have been sized with 3:1 side slopes and a maximum ponding depth of 0.6 metres. The dry ponds are depicted on **Figure 6.4** through **Figure 6.8** inclusive on the following pages.



Drawing:M:\2001\101108\CAD\Figure\Dry Ponds.dwg Layout:Dry Pond 1 Updated MAY 04, 2009 at 1:38pm by kmurphy

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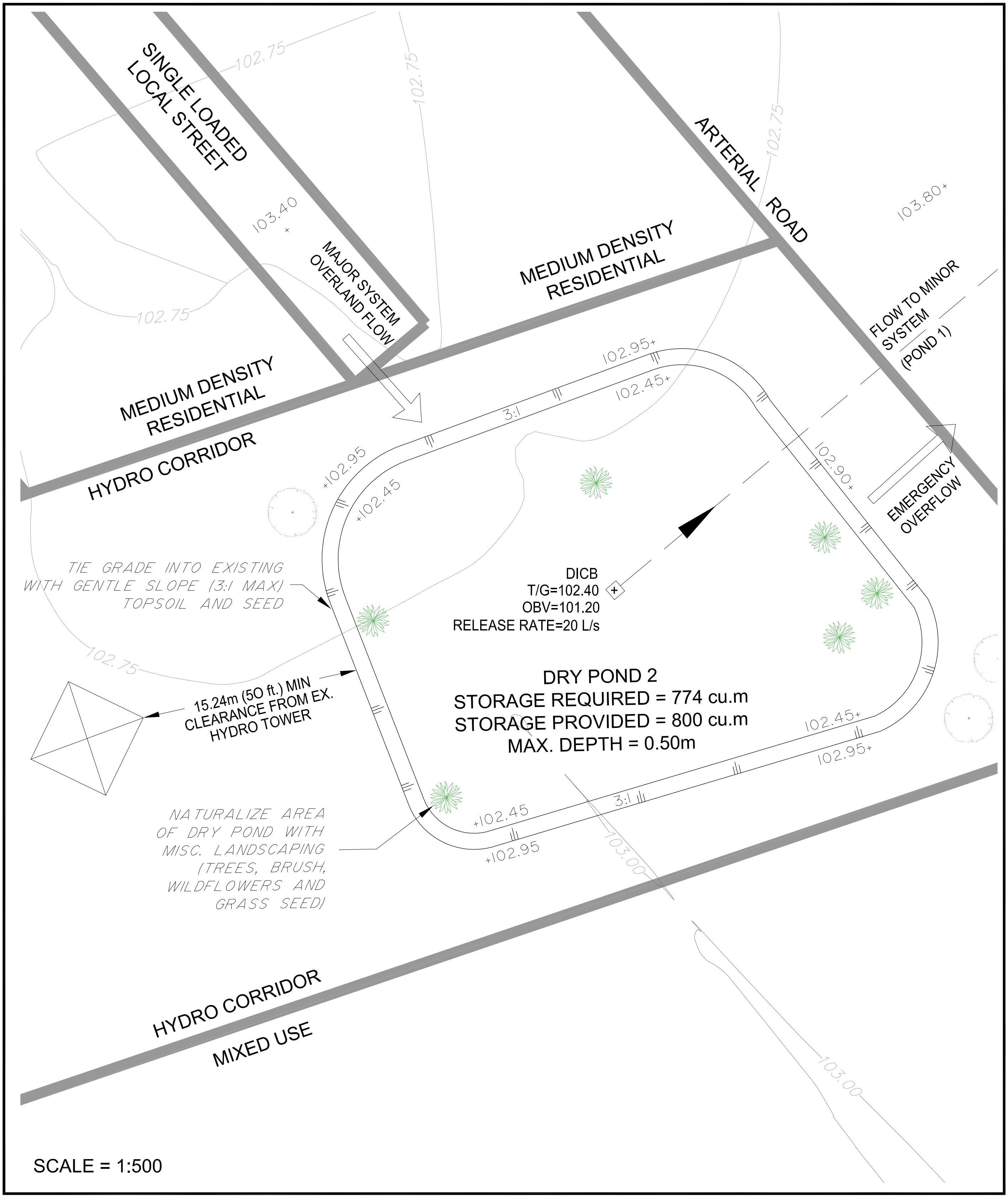
DRY POND 1

FIGURE 6.4

SHT8X11.DWG - 216mmX278mm



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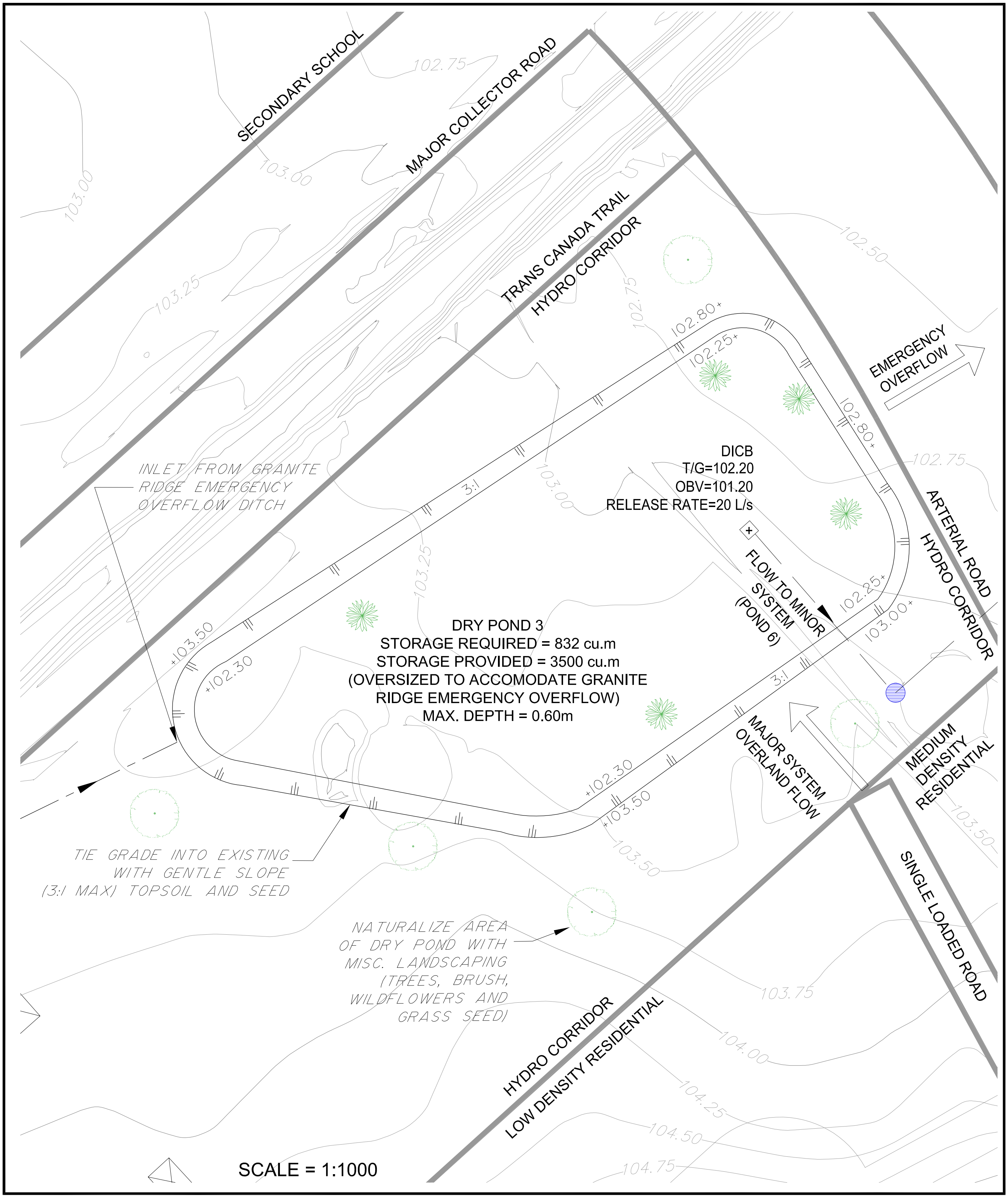
DRY POND 2

FIGURE 6.5

Drawing:M:\2001\101108\CAD\Figure\Dry Ponds.dwg Layout:Dry Pond 2 Updated MAY 04, 2009 at 1:38pm by kmurphy

SHT8X11.DWG - 216mmX278mm



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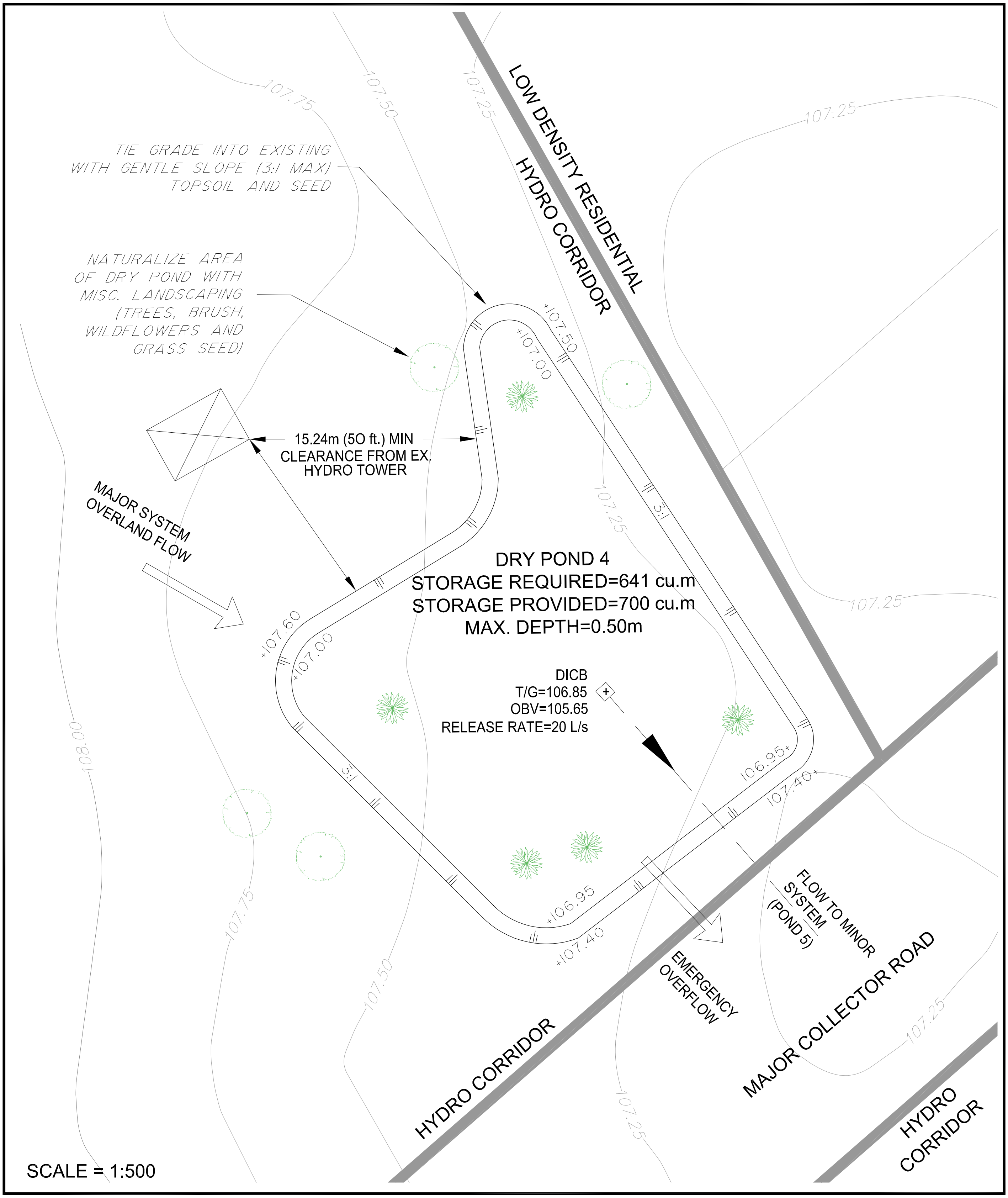
DRY POND 3

FIGURE 6.6

SHT8X11.DWG - 216mmX278mm



Drawing:M:\2001\101108\CAD\Figure\Dry Ponds.dwg Layout:Dry Pond 4 Updated MAY 04, 2009 at 1:38pm by kmurphy

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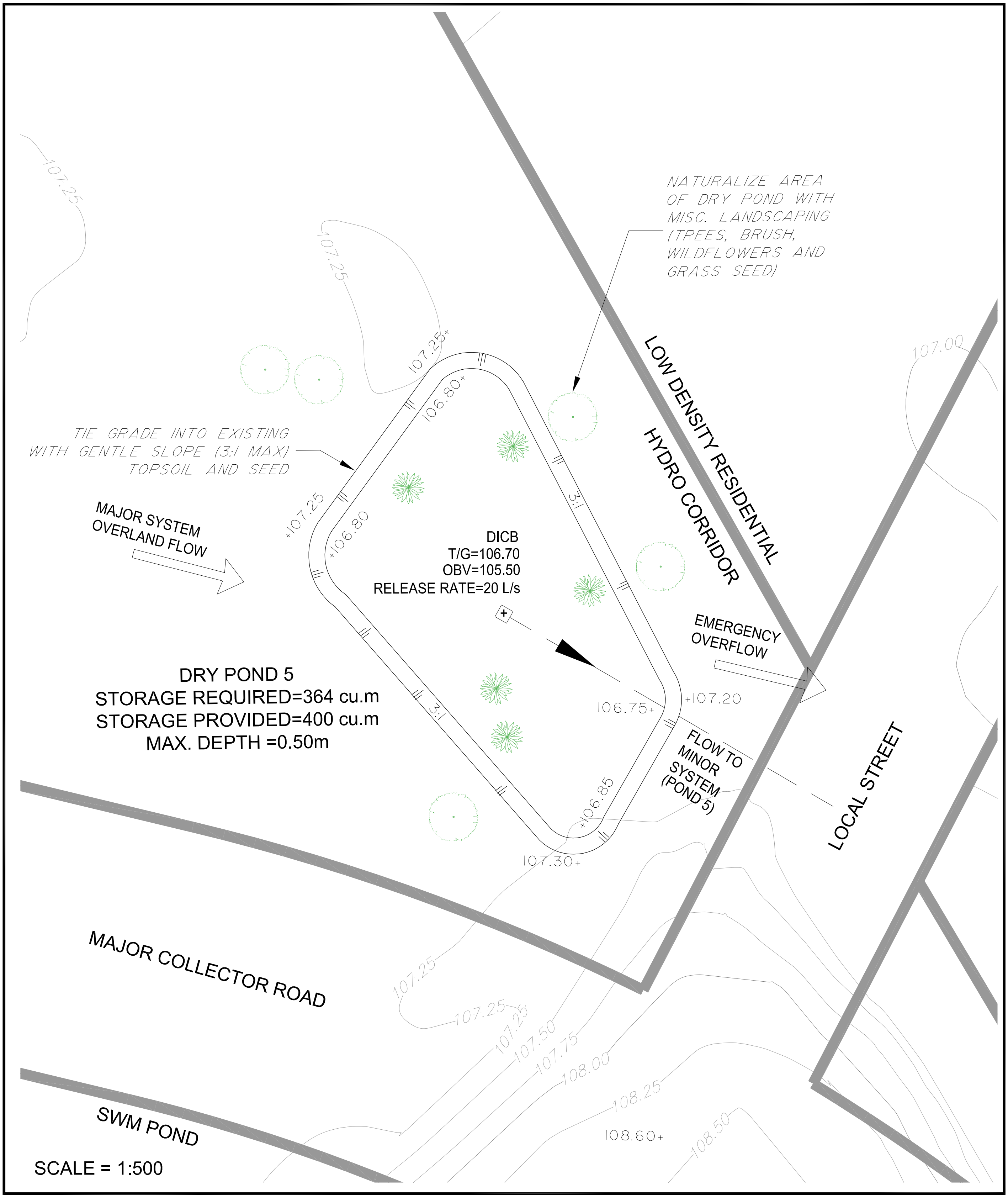
DRY POND 4

FIGURE 6.7

SHT8X11.DWG - 216mmX278mm



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FERNBANK CDP

DRY POND 5

FIGURE 6.8

SHT8X11.DWG - 216mmX278mm

Drawing:M:\2001\01108\CAD\Figure\Dry Ponds.dwg Layout:Dry Pond 5 Updated MAY 04, 2009 at 1:39pm by kmurphy

6.3.6 Summary of Major System Design

Major System to Pond 1

The major system for lands tributary to Pond 1 has been designed to ensure that there will be no overland flow crossing the proposed north/south arterial road and transitway. For lands west of the arterial road, major system flows will either be directed to a dry pond adjacent to Hazeldean Creek (Dry Pond 1), or to a proposed dry pond that will be located in the hydro easement adjacent to the north/south arterial road (Dry Pond 2).

On-site major system storage will be required for the commercial block adjacent to Hazeldean Road (Area M1.3), as topography precludes routing overland flow from this area back toward Pond 1.

Major system flows for the remaining lands east of the arterial road will be conveyed overland along the local and collector roads to Pond 1. Pond 1 has been designed to provide storage for both the major and minor systems and will attenuate post-development peak flows to pre-development levels for all storms up to the 100-year event.

Major System to Pond 2

Major system flows will be conveyed overland along the local and collector roads to Pond 2, which has been designed to provide quality and quantity control for storms up to the 10-year event. Major and minor system flows from larger storm events will still be routed to the SWM facility, but will be discharged uncontrolled directly to the Carp River pursuant to recommendations from the Carp River Watershed Study.

Major System to Pond 3

Major system flows will be conveyed overland along the local and collector roads to Pond 3, which has been designed to provide quality and quantity control for storms up to the 10-year event. Major and minor system flows from larger storm events will still be routed to the SWM facility, but will be discharged uncontrolled directly to the Carp River pursuant to recommendations from the Carp River Watershed Study.

Major System to Pond 4

Major system flows will be conveyed overland along the local and collector roads to Pond 4, which has been designed to provide quality and quantity control for storms up to the 100-year event.

Major System to Pond 5

Major system flows will be conveyed overland along the local and collector roads to Pond 5, which has been designed to provide quality and quantity control for storms up to the 100-year event. The design is based upon the lowering of Flewellyn Drain as recommended in the EMP.

Overland flows from the residential development adjacent to Shea Road will be conveyed to the hydro corridor. Two dry ponds are proposed within the hydro corridor east of Shea Road (Dry Ponds 4 and 5) to prevent overland flows from the hydro corridor from outletting onto the collector roads, and will also aid in reducing the overland flow volume through downstream areas to Pond 5.

Major System to Pond 6

The major system for lands tributary to Pond 6 has been designed to ensure that there will be no overland flow crossing the proposed north/south arterial road and transitway. For lands west of the arterial road, major system flows will be directed to a proposed dry pond located in the hydro easement adjacent to the north/south arterial road (Dry Pond 3). Major system flows from a portion of the arterial road may also be directed to the dry pond.

Major system flows from lands east of the proposed north/south arterial road will be conveyed overland along the local and collector roads to Pond 6, which has been designed to provide quality and quantity control for storms up to the 100-year event.

Major System to Pond 7

Major system flows will be conveyed overland along the local and collector roads to Pond 7, which has been designed to provide quality and quantity control for storms up to the 100-year event.

The existing drainage pattern for the hydro corridor south of the Trans-Canada Trail will be maintained, with major system flows conveyed eastward within the corridor to the roadside ditch on Terry Fox Drive.

Major System to Pond 8

Major system flows will be conveyed overland along the local and collector roads to Pond 8, which has been designed to provide quality and quantity control for storms up to the 100-year event.

The major system analysis assumes on-site major system storage will be provided for the commercial block at the intersection of Fernbank Road and Terry Fox Drive. However, it is possible to convey major system flows from this area to Pond 8.

6.3.7 Granite Ridge Major System

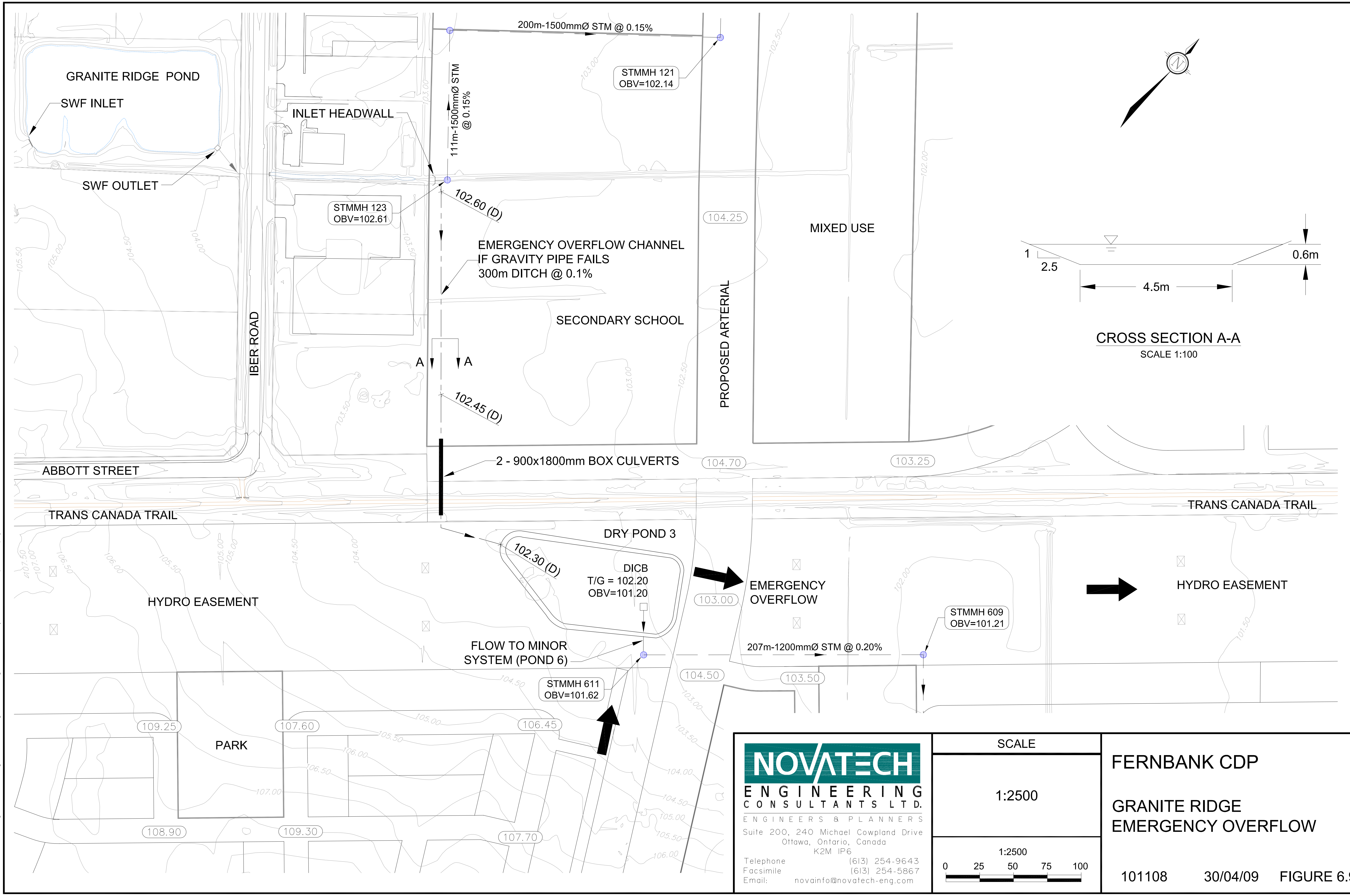
The Granite Ridge SWM facility is located on the west side of Iber Road in Stittsville. This facility provides water quality and quantity control for an upstream drainage area of approximately 69.5 ha for storms up to the 100-year event. Under existing conditions, outflows from the pond are conveyed under Iber Road to a tributary of the Carp River that runs through the Fernbank Community site.

Under post-development conditions, the upper reach of the outlet channel will be abandoned, and controlled outflows from the Granite Ridge pond will be conveyed within the proposed trunk storm sewer to Pond 1. The downstream trunk sewers have been sized to convey controlled outflows from the pond up to the 100-year event.

The Fernbank site shall be graded such that in the event that the inlet to the minor system is blocked, or in the occurrence of a storm greater than the 100-year event, an overland drainage outlet is provided for storm runoff from the Granite Ridge subdivision.

Provision shall be made for an overland flow route from the Granite Ridge subdivision along the property line between the Fernbank Community and the Iber Road Industrial Park.

A feasible emergency storm outlet from the Granite Ridge Subdivision is presented in **Figure 6.9** that would direct overland flows southward along the rear property line of the secondary school, under the Trans-Canada Trail and empty into Dry Pond 3 within the Hydro One easement. The emergency flow route would only operate in the event extreme events greater than the 100-year storm, or failure of the gravity system as might occur with a pipe blockage. Dry Pond 3 has been oversized to provide some additional storage for the emergency flows. In the event that the capacity of the dry pond is exceeded, overland flows would spill across the arterial road and be conveyed within the right-of-ways to Pond 6. This potential drainage path represents a redirection of flow from the Carp River subwatershed to the Jock River subwatershed during an emergency situation such as a blockage of the outlet, or during a storm in excess of the 100-year rainfall event.



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Section 7.0 Wastewater Servicing

7.1 Introduction

The Acres Road Pump Station services the West Urban Community (WUC), and is identified in the Fernbank CDP scope of work as the downstream limit to be used for wastewater analysis. The Acres Road sewershed services the communities of Kanata, Stittsville, Richmond, and Carp.

To provide wastewater service to the Fernbank CDP Lands, a sewer capacity analysis and pump station evaluation was completed. The analysis considers background growth and planned wastewater modifications from the 2009 Draft Infrastructure Master Plan. The purpose of the evaluation was to:

- Identify where capacity constraints exist within the sewershed.
- Recommend feasible design solutions where constraints exist.
- Project timelines to implement municipal wastewater upgrades.

Details of the onsite wastewater solution are presented in **Drawing 101108-SAN** in **Appendix F**.

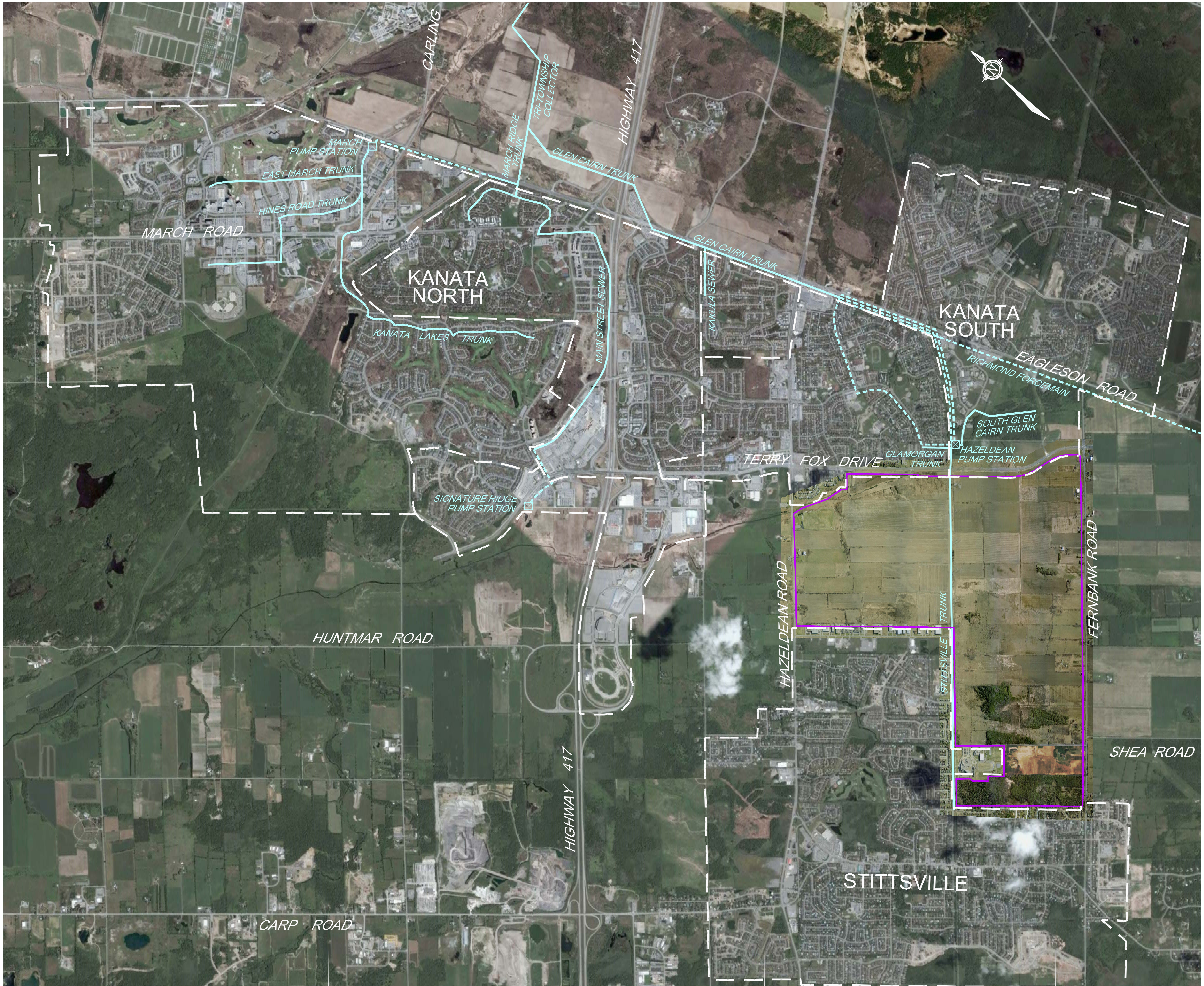
7.2 Wastewater Sewersheds

7.2.1 Existing Sewershed (2006)

A simplified version of the existing WUC sewershed is depicted in **Figure 7.1**. The existing sanitary catchment areas have been populated using City of Ottawa data from their Sanitary Sewer Spreadsheet Model. Attached in **Appendix C** is a copy of the raw city-issued 2006 sewershed data, a Novatech spreadsheet that reconfigures the raw data on a sewershed basis, and correspondence with the city outlining minor inconsistencies identified in the raw data. Distillation of the preceding creates a baseline 2006 existing condition data set upon which future growth is modeled. Trunk sewershed information is summarized in **Table 7.1**.

Table 7.1: Sewershed Data (2006) - Existing Conditions

Sewershed	Population	Area (ha)		
		Residential	Industrial	Commercial Institutional
Fernbank CDP Trunk	0	0	0	0
South Glen Cairn Trunk	19,848	277	26.0	32.0
Hazeldean Pump Station	54,123	926	68.5	201.8
Glen Cairn Trunk	61,290	1,138	81.2	261.9
Tri-Township Collector	92,091	1,768	227.5	669.7
North Kanata Trunk	92,091	1,768	227.5	732.1



FERNBANK COMMUNITY DESIGN PLAN

City of Ottawa

MASTER SERVICING STUDY

FIGURE 7.1

WUC SEWERSHED CATCHMENTS

Existing Conditions (2006)

FERNBANK COMMUNITY DESIGN PLAN STUDY AREA

DRAINAGE AREA BOUNDARY (SHOWN IN WHITE ON AIR PHOTO)

TRUNK SEWER

FORCEMAIN

PUMP STATION

SCALE : Not to Scale -Report

APRIL 2008

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7.2.2 Built-Out Sewershed (2031)

A simplified version of the built-out WUC sewershed is depicted in **Figure 7.2**. The trunk sewershed information is summarized in **Table 7.2**. The population values used in the wastewater analysis correlate to a "High Growth" estimate for the West Urban Community; as such the off-site trunk sewer capacity analysis is conservative. For simplicity, build-out of the system is considered to occur in 2031, except at the Hazeldean Pump Station where a more detailed year-by-year growth projection was calculated.

Table 7.2: Sewershed Data (2031) - Build Out

Sewershed	Population	Area (ha)		
		Residential	Industrial	Commercial Institutional
Fernbank CDP Trunk	30,169	282	0	81.8
South Glen Cairn Trunk	33,113	433	50.5	57.2
Hazeldean Pump Station	104,123	1422	104.7	311.7
Glen Cairn Trunk	139,101	1975	334.8	694.9
Tri-Township Collector	171,791	2413	536.7	855.0
North Kanata Trunk	206,948	2970	762.9	1133.7

Planned Wastewater Modifications

There are numerous planned modifications to the wastewater collection system outlined in the draft 2009 Infrastructure Master Plan. Many of these changes will fundamentally alter the wastewater flow route. Following is a summary of the principal network changes proposed within the WUC:

North Kanata Trunk (NKT): Around 2010, the NKT will be extended from node nk01000 to the March Pump Station using either a 1500mm or 1650mm sewer[1].

March Pump Station (MPS): Around 2011, the MPS will be converted into a low-lift station that discharges into the NKT and the March Forcemain will be abandoned. This will reroute sanitary flow away from the March Ridge Trunk and Tri-Township Collector, alleviating capacity constraints therein.

Signature Ridge Pump Station (SRPS): Around 2012, a capacity upgrade of the SRPS will occur[2]. Several reaches of the Main Street and Penfield Drive Sewers will be upgraded to resolve capacity constraints. A flow diversion weir at Campeau Drive and Kanata Avenue directs the first 170L/s into the Kanata Lakes Trunk; this diversion has been maintained for modeling purposes, although other configurations are possible.

Kanata West Pump Station (KWPS): The KWPS will be constructed and convey wastewater to the Glen Cairn Trunk via a new forcemain along Kakulu Drive. The temporary forcemain discharge from Kanata West Lands into the Stittsville Trunk will be abandoned. Numerous local pump stations in the Hazeldean Road vicinity will be abandoned, their flows routed away from the Stittsville Trunk and into the new KWPS. The KWPS design information is preliminary and based on the Kanata West Master Servicing Study.[3]

[1] North Kanata Sanitary Sewage Infrastructure Upgrade Environmental Screening Report by R.V. Anderson Ltd and Ainley Group dated February 2001.
[2] Assessment of Capacity Upgrade Alternatives for the Signature Ridge Pump Station Upgrade Study, Final Report by R.V. Anderson Ltd dated May 2007.
[3] Kanata West Master Servicing Study by Stantec and IBI Group dated June 16, 2006.

FERNBANK COMMUNITY DESIGN PLAN

City of Ottawa

MASTER SERVICING STUDY

FIGURE 7.2

WUC SEWERSHED CATCHMENTS

Build-out Conditions (2031)

FERNBANK COMMUNITY DESIGN PLAN STUDY AREA

DRAINAGE AREA BOUNDARY (SHOWN IN WHITE ON AIR PHOTO)

TRUNK SEWER

FORCEMAIN

PUMP STATION

SCALE : Not to Scale -Report

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7.3 Hydraulic Modeling

7.3.1 Modeling Parameters

The following City of Ottawa peak flow design parameters have been used in the sewer capacity analysis:

Table 7.3: Modeling Parameters

Parameter	Design Parameter
Residential Flow Rate, Average Daily	350 L/cap/day
Residential Peaking Factor	Harmon Equation (min=2.0, max=4.0)
Industrial Flow Rate	50,000 L/day/ha
Commercial & Institutional Flow Rate	35,000 L/day/ha
ICI Peaking Factor	1.5
Infiltration Rate	0.28 L/s/ha

7.3.2 Modeling Results (Fernbank CDP Lands)

Development Planning

The Fernbank Community is currently divided into *designated* and *non-designated* lands as depicted on **Figure 1.1**. Pursuant to OMB Order Numbers 2092, 3352, and 1604, the City of Ottawa will decide at what time these *non-designated* lands can be developed. The wastewater solution developed for the Fernbank CDP Lands must be cognizant of this decision and permit the timely and efficient development of both land ownership groups. The Demonstration Plan has a yield of 10,977 dwellings and 97.9 hectares of combined institutional and commercial land.

Alternative Municipal Wastewater Solutions

Wastewater from the existing urban community around the Fernbank CDP Lands (Stittsville, Glen Cairn, Bridlewood, and Kanata South Business Park) presently drains to the Hazeldean Pump Station. When the Kanata West Pump Station comes on-line it will capture sanitary flow from the Kanata West development lands, some lands in northern Stittsville, and lands south of Highway 417 that presently drain to the Signature Ridge Pump Station. Both the Hazeldean Pump Station and the future Kanata West Pump Station are significant wastewater pumping facilities owned and operated by the City of Ottawa. These two facilities represent the only economically viable wastewater solution for the Fernbank CDP Lands. In discussion with the City of Ottawa Infrastructure Planning Unit the following alternative wastewater servicing scenarios for the Fernbank Lands were analyzed:

Alternative 1: All wastewater drainage is routed to the Hazeldean Pump Station.
Alternative 2: Wastewater from land north of the Trans-Canada Trail is routed to the KWPS; while land south of the Trans-Canada Trail is routed to the Hazeldean Pump Station.
Alternative 3: Land north of the Trans-Canada Trail, plus land west of the proposed Arterial is routed to the KWPS; while land east of the Arterial is routed to the Hazeldean Pump Station.

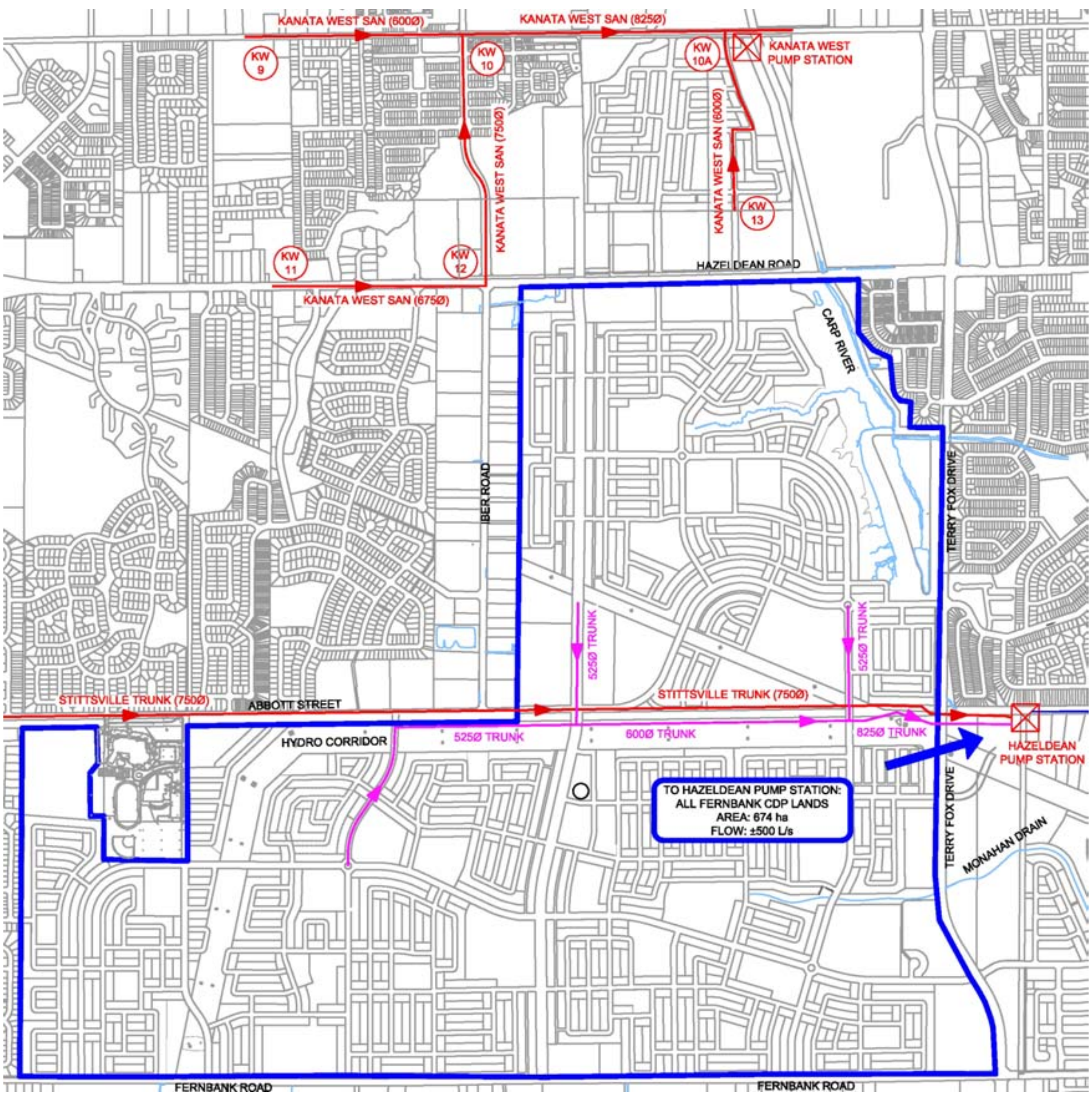
Criterion used to evaluate the preferred alternative design and the selection process follows:

- Technical feasibility (gravity drainage and HGL freeboard)
- Planning (implementation, use of infrastructure, and long-term flexibility)
- Social Impacts (environmental, proposed community, and existing communities)
- Economic (capital costs, maintenance & replacement, life-cycle costs)

Alternative 1:

All Fernbank CDP wastewater is routed to the Hazeldean Pump Station (HPS) at approximately 500L/s. This configuration shown in **Figure 7.3** is technically feasible and offers a free-flow gravity drainage solution. The hydraulic grade line analysis demonstrates that under catastrophic failure conditions at the HPS all structures are protected. The design is fully compatible with the Phasing Plan and permits independent development of the *designated* and *non-designated* lands. This alternative makes use of the Cope Drive Sewer which connects into the South Glen Cairn Trunk however residual capacity cannot be leveraged from the nearby Stittsville Trunk for reasons of elevation and capacity. Interim capacity at the HPS is used with a moderate station upgrade required to convey build-out flows under Alternative 1. Environmental impacts are minor, however a crossing the Carp Tributary and Monahan Drain is required. Social disturbance is minimal with no service interruptions, and with construction predominantly on private property. Capital costs for the sewer works are estimated at $2.1M with limited rock excavation and one deep sewer line. The cost to upgrade the HPS is considered moderate; the retrofit makes use of existing facility infrastructure, however there are costs to replace pumps, motors, and electrical equipment. Grade raise is not governed by the sanitary HGL in this alternative.

Figure 7.3: Municipal Wastewater Alternative 1



Alternative 2:
Under this scenario, wastewater from the Fernbank Lands north of the Trans-Canada Trail would be routed to the Kanata West Pump Station (KWPS). This solution represents a diversion of approximately 200L/s or 40% of the Fernbank CDP wastewater away from the Hazeldean Pump Station (HPS) and towards the KWPS. This alternative, and its variants, is depicted on **Figure 7.4**.

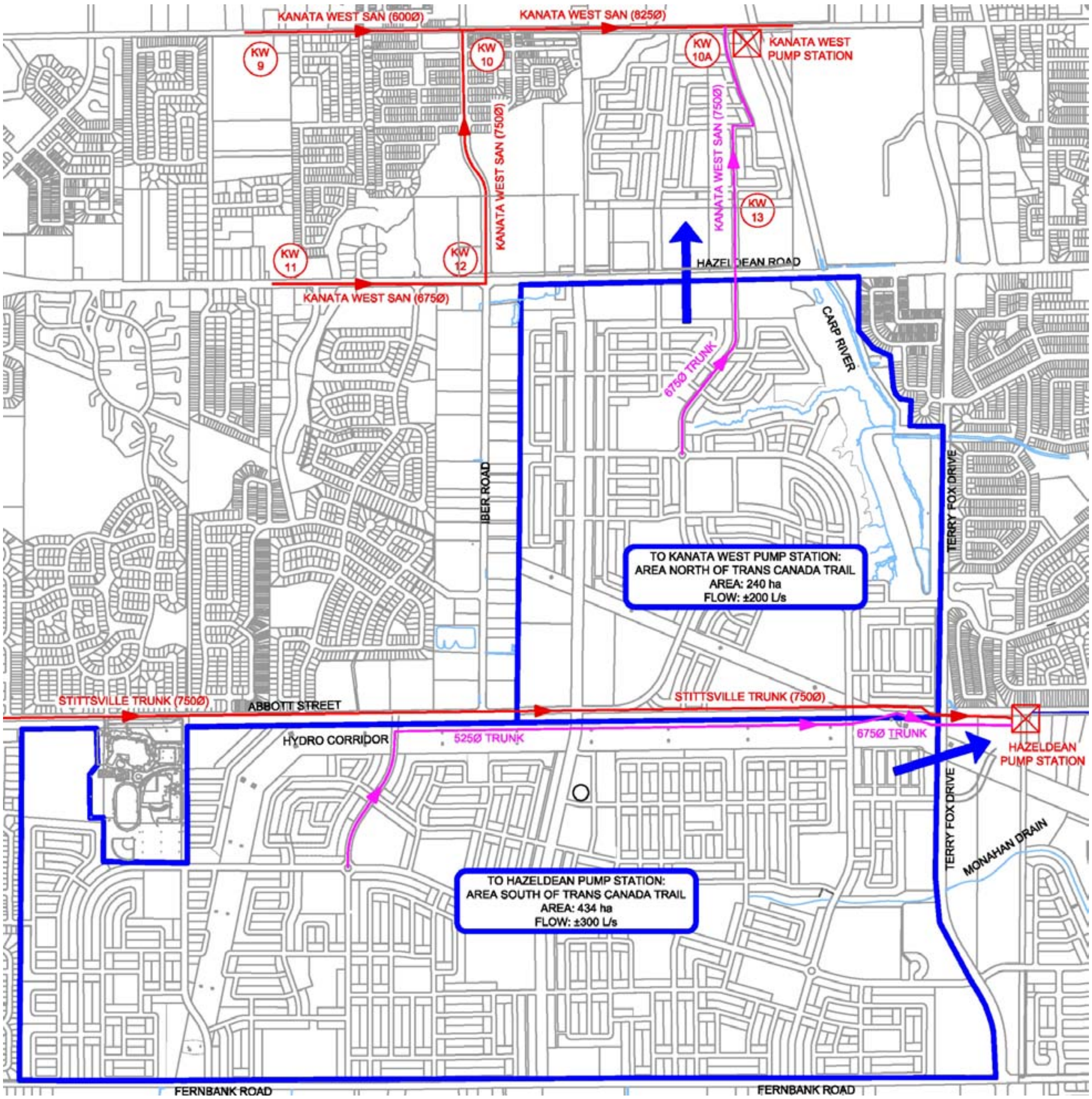
Alternative 2a: Node 12 - 10
Pursuant to the Kanata West Master Servicing Study, a 750mm sanitary trunk was recently installed in Huntmar Drive between Hazeldean Road and Pool Creek (Nodes 12 -10). Capacity restrictions aside, with an invert of 98.90m at Hazeldean Road, this sewer could only capture gravity flow from lands west of the proposed Fernbank Arterial. In other words, only 20% of the target area can be conveyed to this sewer by gravity. Conclusion: it is not technically feasible to use this sewer line.

Alternative 2b: Node 13 – 10A
Another sanitary trunk, yet to be constructed, will run parallel to the Carp River just south of the KWPS from Node 13 to 10A (see **Figure 7.4**). This is a proposed 600mm sanitary sewer designed to convey 77.5L/s. Review of the sanitary design sheet for this trunk reveals the sewer has been oversized by two pipe sizes to control the sanitary hydraulic grade line (HGL) along this reach. Further review of the HGL analysis suggests weir effects have not been accounted for at the pump station overflow, but rather the analysis was initiated at the weir invert elevation of 95.00m. Using the design drawings available to this office with a bypass chamber 1.80m wide, we calculate the weir effect will increase the sanitary HGL by 0.38m at the pump station. Further review of the conceptual KWPS design shows the overflow discharging into an adjacent storm water management facility (SWMF) with a 100-year water elevation of 94.91m. This means there is limited freeboard between the 100-year water level in the SWMF and the KWPS bypass; furthermore, it is uncertain if weir effects have been taken into account at the SWMF spillway. Additional flow contributions into this sewer from the Fernbank Lands will only increase the sanitary HGL. Depending on the extent to which the sewer is oversized, the modeled HGL almost breaks to surface. The geology in this area suggests there is a restrictive grade raise constraint; this makes design very difficult (or expensive) to resolve the HGL constraint. Alternative 2 also presents a design problem at the upstream end of the sewer system in the Fernbank community for the lands west of Terry Fox between the Trans Canada Trail and the Glen Cairn SWF. Under catastrophic failure conditions the HGL is close the ground in this low-lying area. Based on the foregoing, there are significant design challenges to connect into the Kanata West sewer (Node 13-10A), and conveyance of additional wastewater through this conduit to the KWPS is judged undesirable for reasons of complexity, risk, and economy.

Notwithstanding the technical discussion above, an evaluation of Alternative 2 follows. A free-flow gravity solution is technically feasible, with about 50% of the trunk more than 5.0m below finished ground. A crossing of the Carp Tributary and low ground near the Glen Cairn Pond are responsible for the deep sewer condition. The hydraulic grade line analysis demonstrates that under catastrophic failure conditions at the KWPS dwellings in the Fernbank CDP near the Carp River are at risk; similarly dwellings in Kanata West near the Carp River may not have appropriate freeboard from the sanitary HGL. We believe there is a high probability that modifications will occur between the final Demonstration Plan generated as part of this community design process and what actually is build on the ground. Long-term flexibility for the city is somewhat improved by directing more wastewater to the north; although it is noted there is no apparent technical reason the HPS could not be upgraded to accommodate significant additional flow. The environmental impact of the alternatives is similar, with a sewer crossing of the Carp Tributary and Hazeldean Creek. A sewer crossing of Hazeldean Road will have a short term social impact from construction related affects. Capital costs are estimated at $2.0M, although increased maintenance and replacement costs are projected in this alternative due to sewer over-sizing within Kanata West (self-cleansing may be problematic if sewers only flow 25% full).

Conclusion Alternative 2b: This solution is technically feasible. This alternative offers slightly improved long-term flexibility for the City of Ottawa through balancing of wastewater flows between the KWPS and the HPS. Disadvantages include possible phasing constraints, the requirement for a temporary pump station, design constraints within Kanata West (sanitary HGL, grade raise, pump station overflow elevation), catastrophic failure design constraints within Fernbank Lands, uncertainties related the Kanata West SWF P5 and maintenance issues with significantly oversized sewers.

Figure 7.4: Municipal Wastewater Alternative 2



Alternative 3:

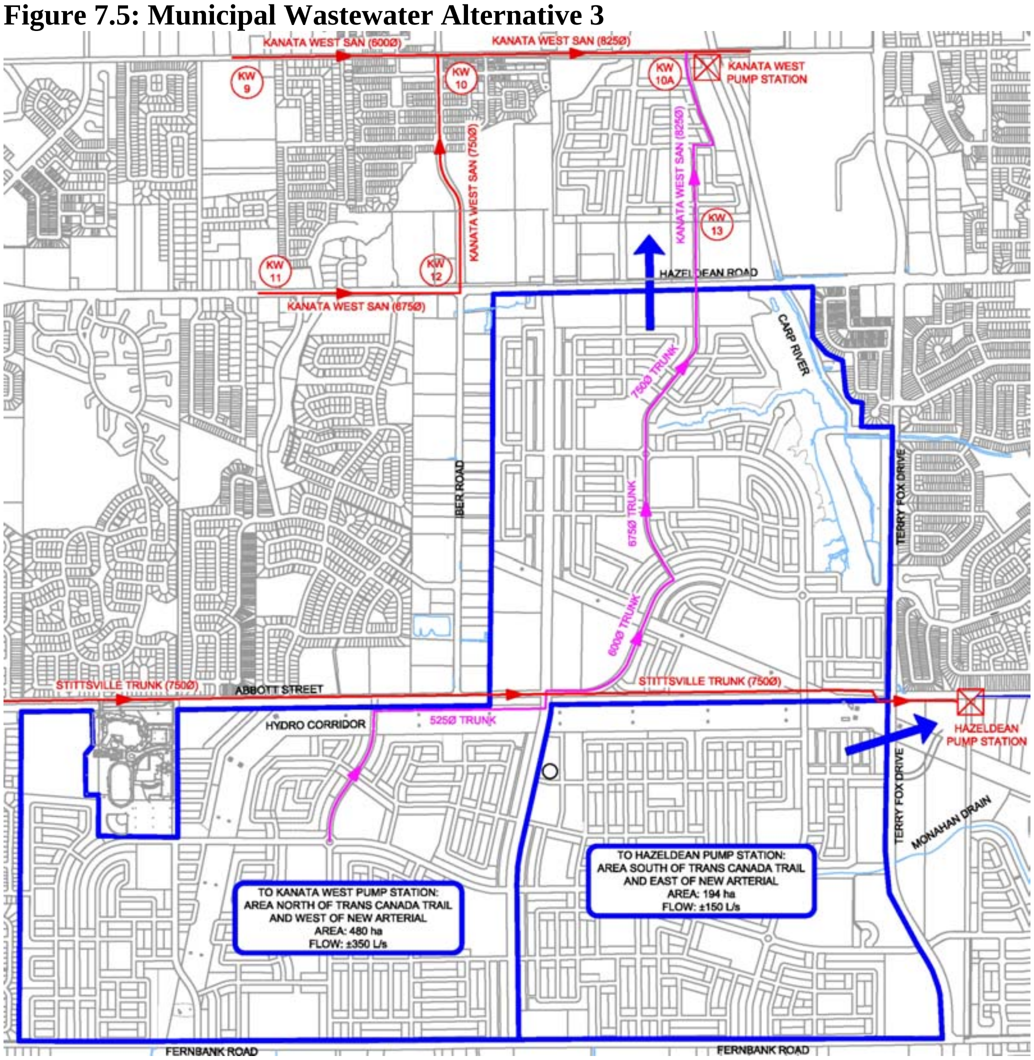
Under this scenario, wastewater from CDP land north of the Trans-Canada Trail and wastewater from the lands west of the proposed Arterial is routed to the Kanata West Pump Station (KWPS). This solution represents a diversion of approximately 350L/s or 70% of the Fernbank CDP wastewater away from the Hazeldean Pump Station (HPS) and towards the KWPS. This alternative is depicted on **Figure 7.5**.

<u>*Alternative 3b: Node 13 – Node 10A*</u>

Upon review, this scenario is essentially a variant of Alternative 2 with twice as much area routed to the KWPS. All of the discussion outlined above holds true for this alternative. Lands east of the Arterial Road would likely be routed to the HPS for reasons of topography, but a free-flow gravity solution to the KWPS is technically feasible for the balance of lands. With six times the current design flow, we believe it would be unwise to route wastewater along a shared sewer between Node 13 and 10A. The sanitary HGL would increase making a difficult civil design task even more challenging.

Conclusion Alternative 3b: This route is technically feasible. The long-term flexibility for the city is improved however many of the disadvantages outlined in Alternative 2b are exacerbated under this scenario. The phasing risk potentially affects large areas of *designated* lands, the sanitary HGL will rise making grade raise more problematic, while all the uncertainties associated with the KWPS, SWF P5, and the Carp River would still exist. The capital cost of this solution is estimated at $2.4M.

Figure 7.5: Municipal Wastewater Alternative 3



Preferred Municipal Wastewater Solution

The Alternatives Evaluation summary in **Table 7.4** finds Alternative 1 the preferred design solution. Each alternative is ranked against the criteria below and assigned a score between zero and two points. Zero points are assigned if there is a negative impact, one point is assigned if the impact is deemed neutral, and two points are given for a positive impact. It is noted that the value assigned to any given criteria is inherently subjective and could be assigned a greater or lesser importance depending on the individual or group surveyed. For example, one person might place environmental concerns before all else, while another might allocate greater importance to cost. For the purpose of this evaluation all criteria were given an equal weighting. The calculation of capital costs for each alternative is attached as **Table D-12** in **Appendix D**.

Table 7.4: Wastewater Alternatives Evaluation Summary

Criteria, Equal Weight Ranking		Alternative	1	2	3	Max Score
Technical						
1	Gravity Drainage (Free Flowing Sewer)		2	2	2	2
2	HGL Freeboard (0.5m to Basement min)		2	0	0	2
Planning						
3	Implementation		2	1	1	2
4	Use of Existing or Planned Infrastructure		1	1	1	2
5	Flexibility, Long Term Planning for City		1	2	2	2
Social						
6	Environmental Impacts (creek crossings)		1	2	2	2
7	Impact on Fernbank Community		2	1	1	2
8	Impact on Other Communities		2	0	0	2
Economic						
9	Capital Costs (cost effective design)		1	1	0	2
10	Maintenance & Replacement Costs (Depth/Oversized)		2	1	1	2
11	Life-Cycle Cost		1	1	1	2
	Total		17	12	11	22
	RANK		1	2	3	

As outlined in the analysis above, there are technical complications with routing Fernbank wastewater to the KWPS; additionally there is risk of incompatibility with the phasing plan that could halt the development of large areas of *designated* lands under Alternatives 2b and 3b; by contrast there is no risk of phasing incompatibility under Alternative 1. However, it should be noted that as of May 2009 there are indications the *non-designated* lands will be brought into the urban boundary[4]. There is no apparent technical reason the Hazeldean Pump Station could not be upgraded to accommodate the total drainage area. As an additional benefit, containment of the wastewater solution within the Fernbank CDP study area avoids revisions to approved servicing studies along with complex phasing and cost sharing arrangements. For these reasons, in addition to the criteria ranking above in **Table 7.4,** Alternative 1 is deemed the best overall design.

[4] Joint Agriculture and Rural Affairs Committee and Planning and Environment Committee by Nancy Schepers dated 20 March 2009.

Fernbank CDP Lands, Internal Wastewater Design

The wastewater collection system for the Fernbank CDP Lands incorporates a major trunk sewer along the Hydro One easement that drains to the Hazeldean Pump Station. A series of minor trunk connections tie into the major system line, all of which provide a free-flow gravity outlet for the Fernbank CDP Lands. A localized area of 32.92 hectares near Terry Fox Drive and Fernbank Road will make use of the existing Cope Drive sanitary sewer that was specifically extended to service a portion of the Fernbank CDP Lands. **Drawing 101108-SAN** depicts the sewer alignments and catchment areas **(Appendix F)**; the corresponding design sheets and hydraulic grade line calculations are presented in standard spreadsheet-style format in **Appendix D**. Note: the wastewater HGL analysis is modeled under catastrophic failure conditions at the Hazeldean Pump Station with the contemplated station overflow.

At the request of the Infrastructure Planning Unit the possibility of directing flow from the Stittsville Trunk into the future Fernbank Trunk, thereby combining these two sewers into a single wastewater conduit was evaluated. This is technically feasible as the Stittsville Trunk near Iber Road is at higher elevation and the Fernbank Trunk is only at the design stage. Under build-out conditions the Stittsville Trunk will convey 578.5L/s (accounting for re-directed flow to the KWPS). The analysis suggests the Fernbank Trunk would need to be oversized three pipe sizes relative to the current design to convey both Stittsville and Fernbank Land flows. Installed in 1978, the reinforced concrete Stittsville Trunk has a life expectancy of approximately 100 years per the Sewer Design Guidelines. This office is unaware of any literature suggesting the Stittsville Trunk has material failures at this time.

Novatech has prepared a present worth analysis that evaluates the relative cost of maintaining versus abandoning the Stittsville Trunk. Novatech has used City of Ottawa cost data from the 2009 Infrastructure Master Plan and applied a 57.5% premium to convert construction costs into capital costs. Operation and Maintenance costs of $5,851/km/year were used. The discount rate was set to 5.0% for this analysis. A 100-year life-cycle was selected for concrete pipe.

Scenario 1 would maintain the Stittsville Trunk and permit construction of a smaller new trunk dedicated exclusively to the Fernbank CDP Lands. Operation and maintenance costs would be required on both trunk sewer systems. The present worth of Scenario 1 is $1,908,627.

Scenario 2 would abandon the Stittsville Trunk in favour of constructing a new larger Fernbank Trunk that would convey all of the existing Stittsville and Fernbank community wastewater. There are higher capital costs associated with the larger sewer that must be paid up-front, however there is only one sewer with maintenance costs. The present worth of Scenario 2 is $2,214,124.

Our conclusion is that it is more cost effective to maintain the existing Stittsville Trunk and install a dedicated trunk sewer that would service only the Fernbank lands. The detail calculations of the present worth analysis are located in **Table D-13** of **Appendix D**.

Once the new Fernbank Trunk has been constructed, there is significant flexibility in phasing options for this development. There is approximately 75km of new wastewater sewer that will be constructed in conjunction with development of the Fernbank Lands. Using Civil3D CAD technology, an interference check was conducted and there are no sewer-crossing conflicts between the concept storm and sanitary sewer networks; this is also apparent on the sewer profile drawings found in **Appendix F.**

The conclusion is that all of the Fernbank CDP development lands can be readily serviced with a wastewater collection system using gravity drainage to the Hazeldean Pump Station.

Sensitivity Analysis

The wastewater collection network within the Fernbank Lands was tested by adjusting two of the key design parameters. The purpose of this modeling exercise is to test the sensitivity of the wastewater network to variance in the design conditions, and to evaluate system response should the land use density increase appreciably. In the first test, the population flow was increased from 350L/s to 450L/s (+28.5%), and in the second test the infiltration rate was increased from 0.28L/s/ha to 0.50L/s/ha (+78.6%). In these two scenarios, all other design conditions were fixed to the modeling parameters outlined in **Section 7.3.1**. The results are summarized in **Table 7.5** with the detailed calculations found in **Appendix D**.

Table 7.5: Wastewater Sensitivity Analysis

SEWER REACH					RESULTS		
Location	**From Node**	**To Node**	**Nominal Pipe Size (mm)**	**Free-Flow Capacity (L/s)**	**Design Condition**	**Flow (L/s)**	**Q/Qcap (%)**
Fernbank Trunk (lower reach)	972	974	825	669.7	Standard Design	528.0	78.8
					Scenario 1 Q_{pop}=450L/s	614.6	91.8
					Scenario 2 Q_{Inf}=50L/s/ha	649.8	97.0
Fernbank Trunk (middle reach)	934	972	600	326.6	Standard Design	282.8	86.6
					Scenario 1 Q_{pop}=450L/s	332.1	101.7
					Scenario 2 Q_{Inf}=50L/s/ha	345.3	105.7
Fernbank Trunk (upper reach)	922	924	525	215.2	Standard Design	190.0	88.3
					Scenario 1 Q_{pop}=450L/s	224.7	104.4
					Scenario 2 Q_{Inf}=50L/s/ha	232.0	107.8
Del Lands (lower reach)	932	934	525	141.9	Standard Design	97.6	68.8
					Scenario 1 Q_{pop}=450L/s	114.9	81.0
					Scenario 2 Q_{Inf}=50L/s/ha	114.6	81.8
Del Lands (middle reach)	930	932	450	99.1	Standard Design	77.4	78.2
					Scenario 1 Q_{pop}=450L/s	92.8	93.7
					Scenario 2 Q_{Inf}=50L/s/ha	90.7	91.5
Dawson Lands (lower reach)	966	970	525	173.8	Standard Design	121.8	70.1
					Scenario 1 Q_{pop}=450L/s	143.7	82.7
					Scenario 2 Q_{Inf}=50L/s/ha	144.0	82.9
Monarch Lands (lower reach)	952	972	450	218.6	Standard Design	166.8	75.3
					Scenario 1 Q_{pop}=450L/s	195.3	89.4
					Scenario 2 Q_{Inf}=50L/s/ha	200.6	91.8
Monarch Lands (middle reach)	948	950	450	115.2	Standard Design	85.2	74.0
					Scenario 1 Q_{pop}=450L/s	99.5	86.4
					Scenario 2 Q_{Inf}=50L/s/ha	101.0	87.7

The conclusion from the preceding analysis is that the wastewater system has been designed with an appropriate amount of residual capacity to permit land use flexibility and to safeguard the community should flow rates temporarily exceed expected values. This design approach permits a moderate degree of intensification within the CDP Lands. In similar fashion, minor adjustments to the land use plan are readily accommodated.

7.3.3 Modeling Results (Off-Site)

The design parameters from **Section 7.3.1** were used to analyze the hydraulic grade line (HGL) and capacity conditions of the trunk sewers directly affected by the Fernbank CDP Lands.

Table 7.6 summarizes the peak design flows modeled in each trunk sewer for existing conditions (2006) and at build-out. The last column depicts the approximate free-flow sewer capacity within each trunk. Apparent from this table, only the Tri-Township Collector has inadequate capacity to convey the build-out design flows.

Table 7.6: Peak Wastewater Flow

Trunk Sewer	Peak Wastewater Flow (L/s)		Sewer Capacity (L/s)
	Existing Conditions (2006)	Build-Out	
Fernbank CDP Trunk	0	528.0	670
South Glen Cairn Trunk	371.5	591.7	650
Glen Cairn Trunk	1,274.7	2,932.5	3,000
Tri-Township Collector	2,308.1	3,689.3	1,800
North Kanata Trunk	2,379.7	4,646.9	4,800

North Kanata Trunk (Lower Reach)

The North Kanata Trunk (NKT) is an 1800mm diameter outlet sewer that services the West Urban Community. The NKT discharges into the Watts Creek Trunk that in turn empties into the Acres Road Pump Station. A capacity and hydraulic grade line analysis of the trunk at build-out indicates trace surcharge levels (92mm) from MH4 to MH5. No surcharge is modeled at either the upstream or downstream ends of this trunk. With an average depth of 5.6 metres below grade, the assessment is that the surcharge is so miniscule as to be irrelevant. Our conclusion is that effectively, the North Kanata Trunk operates under free-flow conditions and is able to convey the design wastewater flows to build-out.

Tri-Township Collector

The Tri-Township Collector (TTC) is currently over capacity using design flows from the sewershed. The TTC has been identified for future replacement or upgrade in numerous reports, as far back as 1993[5]. The impact of bringing the Fernbank CDP Lands on-stream will be to slightly advance the ultimate replacement schedule for this trunk sewer. The draft 2009 Infrastructure Master Plan suggests this sewer should be replaced around 2014. We suggest 1,200m of 1350mm diameter sewer could be constructed at 0.63% parallel to the existing TTC trunk between nodes tr01000 and tr02200. The proposed configuration would provide free-flow conditions at build-out of the WUC. The actual date of replacement should be dictated by flow monitoring and operational considerations, rather than projected design flows that are inherently difficult to predict. Alternate alignments have been explored for the TTC

[5] Modeling of the Western Growth Area Trunk Sanitary Sewer System (Internal Report) by Planning and Programme Development Branch dated November 1993.

that may prove more efficient; however for the purpose of this study we have elected to follow a known route within an existing easement. The ultimate alignment of the TTC should be evaluated at detail design.

It is important to note that numerous changes are proposed within the sanitary collection network and the planned conversion of the March Pump Station into a low-lift facility will permit redirection of all sanitary flow from the Kanata Lakes, Marchwood, and East March Trunk sewers into the North Kanata Trunk. This measure will significantly alleviate capacity and operational constraints currently affecting the Tri-Township Collector. Our analysis concludes that sections of the TTC will continue to experience surcharge even with the proposed flow alleviation efforts. While the City of Ottawa strives to achieve free flow conditions in its sanitary sewer system, it is recognized that, for historical or economic reasons, some sewers may operate from time to time under surcharge.

In-and-of-itself, a temporary surcharge condition is not necessarily problematic provided it can be demonstrated there are no negative impacts as a result of this condition. The Tri-Township Collector for example runs through relatively unpopulated lands with only the Glen Cairn Trunk and March Ridge Trunk making connections at the upstream end. Therefore, preventing surcharge to ground level becomes a design consideration. As outlined in the February 2001 study North Kanata Sanitary Sewage Infrastructure Upgrade, Environmental Screening Report a maximum surcharge level of 1.0m above obvert was recommended to and adopted by the City of Ottawa as an appropriate surcharge limit within the TTC. In our opinion, this is reasonable provided 0.5m of freeboard is maintained between the HGL and ground level thereby containing wastewater within the collection network and ensuring there is no impact on the social or natural environment even during extreme events.

Glen Cairn Trunk

The Glen Cairn Trunk is a 1200mm diameter sewer which flows north along Eagleson Road from Hazeldean to Corkstown with a capacity in the range of 3,000 L/s. Flow from Kanata West lands will discharge into this sewer near Kakulu once the KWPS is operational. At build-out this sewer will be under free-flow conditions operating at 90% capacity. The hydraulic grade line is below the sewer obvert under all modeled scenarios with a simplified profile in **Appendix D**. We conclude the Glen Cairn Trunk has adequate capacity beyond the build-out horizon.

Hazeldean Pump Station

Background

The Hazeldean Pump Station (HPS) services the village of Stittsville, Bridlewood, Kanata South Business Park, and the Glen Cairn communities. A detailed capacity study of the HPS was completed in 1999 followed by an infrastructure upgrade. The station retrofit was designed to convey sanitary flow from within the existing urban boundary up to the year 2021 (1,000 L/s), with provision for an additional pump to accommodate build-out flows. As point of reference, the flow calculations in the Hazeldean Pump Station study are informative, but obsolete as they predate the Kanata West and Fernbank Community Design Plans.

A cost-benefit analysis for the city concluded that construction of a new wet well, 2 submersible pumps, and a 600mm forcemain offered the best solution for upgrading the Hazeldean Pump Station. These design recommendations were recently implemented with the reconstruction of the Hazeldean Pump Station and were projected to meet the urban boundary 2021 design flow targets specified within that study and would offer expansion capability to meet the build-out population projection of the sewershed.

The pump station in its current configuration consists of two components:

1. Four model B5416 pumps equipped with 489mm impellers located within a dry well that discharge into a set of 1-400mm & 1-600mm forcemains; and
2. Two submersible pumps with 504mm impellers located within a wet well which discharges into a 600mm forcemain.

Flow projections for the design of this facility evaluated three scenarios:

A. Flow monitoring data was applied to existing development lands and these flow rates were extrapolated to future growth areas (least stringent);
B. Applied flow monitoring results to existing lands and applied city design guidelines to future growth areas;
C. Applied city design guidelines to all areas (most stringent).

The City of Ottawa applied Scenario B flow projections for the design of the Hazeldean Pump Station. This approach follows the middle road and permits some degree of economy while retaining confidence in the facility’s operational capability. Continuing with this methodology, Novatech has applied the same rationale in our current analysis of the Hazeldean Pump Station.

Projected Flow

Hazeldean Pump Station flows were projected using a combination of monitored flow from existing lands and design flow from growth areas. This approach was used by the city in the recent upgrade of the Hazeldean Pump Station[6] and was accepted as the basis upon which to analyze station upgrade alternatives. This design methodology applies a sensible balance between risk and economy at the pump station. Attached in **Appendix E** is SCADA flow monitoring records at the Hazeldean Pump Station for 2004 and a large historical event at the station that occurred on June 27, 2002.

A recent hydrograph analysis by Infrastructure Management suggests a concurrent dry and wet weather peak flow of 850L/s would occur at the Hazeldean Pump Station (January 2008). Accordingly, this represents the starting point for our capacity analysis at the HPS.

The HPS capacity analysis is particularly challenging due to the large number of variables that affect how and when this station will need to be upgraded. These parameters include growth within the sewershed,

[6] Report on Hazeldean Pumping Station Capacity Study by CH2M Gore & Storrie Ltd dated February 1999

timing to construct the KWPS, changes to the sewershed boundary, phased and/or alternate station upgrades, and actual versus monitored flow rates.

As outlined is **Section 7.2.2**, the Kanata West lands will discharge wastewater into the Stittsville Trunk until the Kanata West Pump Station comes online. Accordingly the question that needs to be answered is simply, how many years will a specific station configuration last before additional upgrades or flow redirection is required?

To answer this question, Novatech compiled the Vacant Residential and Employment land in the Hazeldean sewershed as this represents all of the available growth areas. **Figure 7.6** depicts the HPS sewershed boundary under existing conditions and under ultimate conditions when the KWPS comes online (accounting for the abandonment of several small pump stations and the associated flow redirection). The diversion area away from the HPS is hatched for easy visual reference.

Establishing a reasonable growth rate within the sewershed is an essential part of the analysis as this affects the *timing* of upgrades. Within the West Urban Community the 10-year historical land absorption rate is 48.0 net hectares per year[7]. The Official Plan specifies an overall density of 29 units per net hectare[8], therefore on average, 1392 units are constructed each year in the WUC. Novatech estimates that approximately 65% of all development in the WUC has occurred within the current boundaries of the HPS sewershed. This translates into approximately 900 units constructed each year within the HPS sewershed The Vacant Residential land data identifies a unit potential of 24,505 as of December 2005. With a consumption rate of 900 units per year, this suggests build-out will take 27.2 years and occur in 2033. Build-out for ICI growth in the HPS sewershed was set to match the residential timelines.

Flow generation at the HPS can now be calculated with reasonable accuracy using flow generation parameters from the Sewer Design Guidelines and also using historical monitored values for comparison. The calculations are completed to build-out assuming the KWPS is off-line, and then again assuming the station is operational; all of which is graphically presented on **Figure 7.7.** The detailed growth and wastewater flow calculations are attached for reference in **Appendix D.** Station flow for current (2008) and build-out conditions is presented in **Table 7.7.**

Table 7.7: Hazeldean Pump Station Flows

Year	Flow
Existing (2008)	850 L/s
Build-out (2033)	1,498 L/s

[7] Report to Joint Agricultural and Rural Affairs Committee and Planning and Environment Committee 28 January 2009 Table 3, page 31 by Nancy Schepers, Deputy City Manager

[8] City of Ottawa 2003 Official Plan, Section 3.6.4 Developing Communities page 3-20

Figure 7.6: Hazeldean Pump Station Sewershed

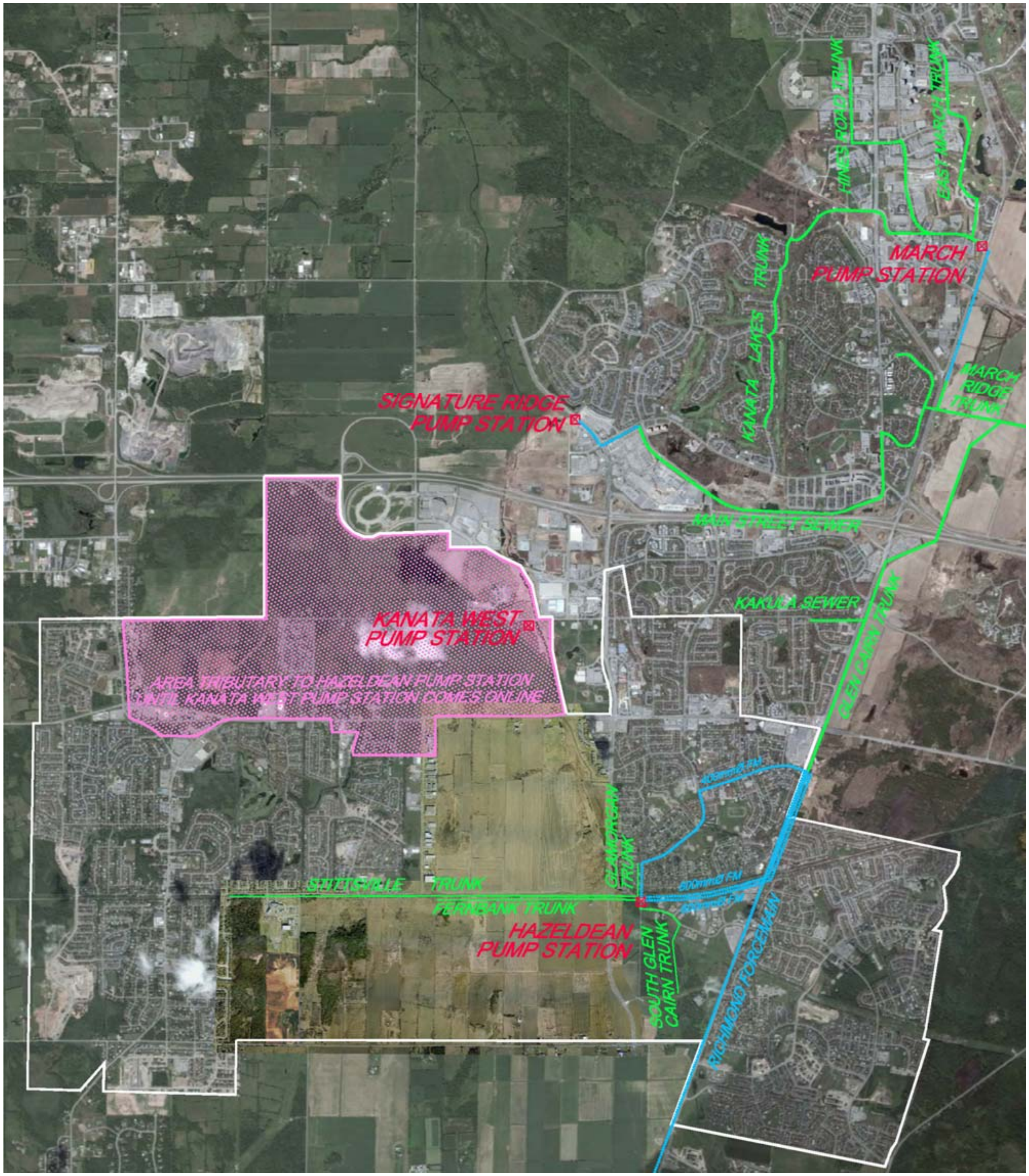
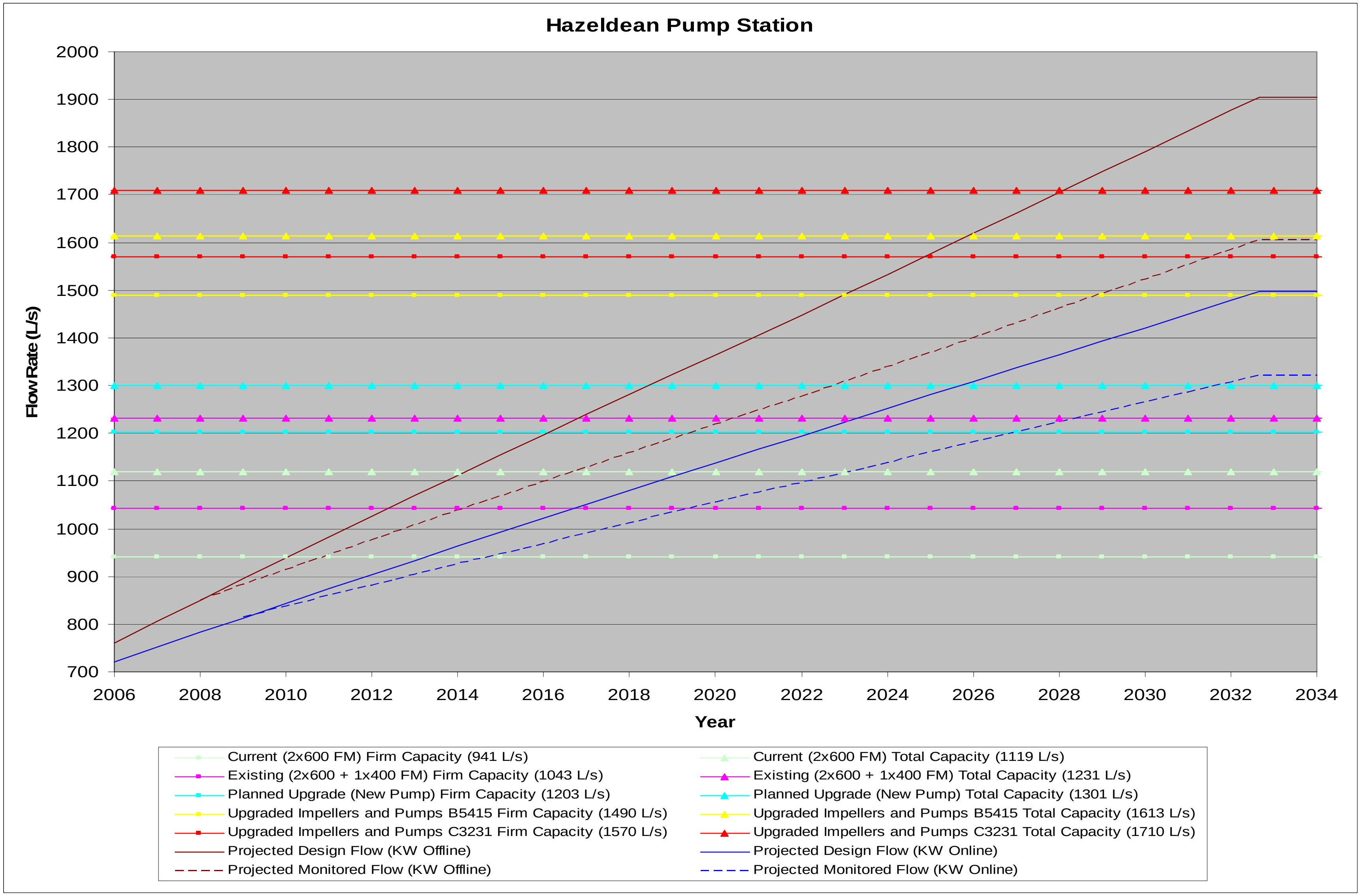


Figure 7.7: Hazeldean Pump Station – Inlet Flow vs. Year (KWPS online and off-line)



Capacity Alternatives

As part of the 1999 Hazeldean Pump Station capacity analysis, head-discharge curves were created for numerous pump-impeller options to evaluate their peak discharge capability through various forcemain outlets; details of which are attached in **Appendix E**. The existing forcemains discharge into the Glen Cairn Trunk. Following is a summary of the existing and conceptual expansion capacity for this facility. For the purposes of this study we have primarily used pump hardware and impeller options previously developed in the Hazeldean Pump Station Capacity Study and that were considered as viable solutions in that study to achieve the expansion requirements; future optimization efforts may identify superior design solutions. In addition to the pump and impeller upgrades, Novatech has investigated the effect of upgrading the forcemains.

Table 7.8: Alternative Pump Station Upgrades

Upgrade Scenario	Station Capacity	Capacity at Low Static Lift
Build-out Flow Rate (2033): Design Parameters only Build-out Flow Rate (2033): Monitored + Future Design		Q_{SAN} = 1,795 L/s Q_{SAN} = 1,498 L/s
Pump Only Solutions		
Existing Conditions (2-600mm Forcemains)	Firm Capacity Total Capacity	941 L/s =(491+450) 1131 L/s =(521+610)
400mm Glen Cairn Forcemain returned to service	Firm Capacity Total Capacity	1043 L/s =(593+450) 1241 L/s =(631+610)
New Submersible Pump	Firm Capacity Total Capacity	1203 L/s =(593+610) 1301 L/s =(631+670)
New Dry Pumps & Impeller †	Firm Capacity Total Capacity	1490 L/s =(880+610) 1613 L/s =(943+670)
Pump & Forcemain Solutions‡		
New 1-600mm forcemain w/ submersible pump system	Firm Capacity Total Capacity	1747 L/s =(880+867) 1977 L/s =(943+1034)
New 1-600mm forcemain w/ quad-dry pump system	Firm Capacity Total Capacity	1779 L/s =(1169+610) 1986 L/s =(1316+670)
New 2-600mm forcemains w/ both pumping systems	Firm Capacity Total Capacity	2036 L/s =(1169+867) 2350 L/s =(1316+1034)

† Includes head contribution from new submersible pump.
‡ Includes head contribution from new submersible pump **and** quad dry pump-impeller upgrade.

The analysis demonstrates there are numerous options to increase the capacity of this facility. The station can readily increase the firm pumping capacity on short notice by 102L/s if the 400mm Glen Cairn forcemain is returned to service, and by another 160 L/s by adding the planned third submersible pump in the wet well. The retrofit option of Hazeldean Pump Station specifically provided for this capability.

As outlined above, several expansion options were analyzed that focused on improved discharge from the four older model pumps in the dry well. Replacement of the four older pumps with newer model B5415 units equipped with 533mm impellers will increase the station firm capacity to 1,490L/s.

Alternatively, Flygt pump model C3231 has slightly greater head-discharge values that would increase the firm capacity to 1,570 L/s and the total capacity to 1,710 L/s under low-lift conditions. These firm capacity values correlate to 103.6% of the design flow or 117.6% of the monitored flow, with residual capacity of 54 L/s and 235 L/s respectively.

In the abundance of caution, Novatech has investigated the capacity increase that could be achieved if a forcemain solution is coupled with the pumping alternatives. For example, if a new 600mm forcemain connected to the submersible pump system is constructed in addition to the quad pump-impeller upgrade, the station firm capacity would rise to 1,747 L/s. A slight capacity improvement (32 L/s) would be realized if a new forcemain was connected to the quad-pump system; however we believe the reliability benefits of a redundant forcemain outlet from the submersible pump system is a better overall solution. If two new forcemains were constructed with the pump and impeller upgrades discussed previously, the station firm capacity could reach 2,036L/s.

The point of the preceding exercise is to demonstrate the feasibility of expanding the HPS. We are of the opinion however that given the good condition of the existing 400mm forcemain and the community disruption that would ensue from construction of a new 600mm forcemain, that it is preferable to implement a pumping solution.

Upgrade Timelines

Novatech has compared the flow projections to the station capacity in several configurations to determine when an upgrade is required. This is summarized in **Table 7.9** which identifies how long a specific station configuration will accommodate the modeled flow rates (for example the HPS currently has capacity to 2010; the operational horizon would extend to 2012 if the 400mm forcemain is returned to service).

Table 7.9: Pump Station Configuration vs. Horizon Year

Hazeldean Pump Station Configuration	Firm Capacity (L/s)	Horizon Year	
		Design	Monitored
Existing Conditions (2-600mm forcemains)	941	2010	2011
Glen Cairn Forcemain returned to service (2-600mm & 1-400mm forcemains)	1043	2012	2014
Third Submersible Pump added	1203	2016	2019
Dry Pump & Impeller Upgrades B5415	1490	2023	2029
Dry Pump & Impeller Upgrades C3231	1570	2024	2031

Our conclusion is that retrofitting the pump station is viable and bestows economic advantage in the utilization of spare capacity and existing equipment. The design makes efficient use of the existing building, roadways, power supply, pumps and mechanical equipment through re-utilization of existing infrastructure.

The Glen Cairn Forcemain should be returned to service immediately and the planned submersible pump should be installed around 2012 as capacity is used up in the station. Our recommendation is that flow monitoring dictate when the pump is added, instead of design flow projections. This pump is easily installed and will provide an additional 160 L/s firm capacity to the station. A front ending agreement is being explored by the KWOG and Fernbank Landowners to accelerate installation of the pumping upgrades at the HPS.

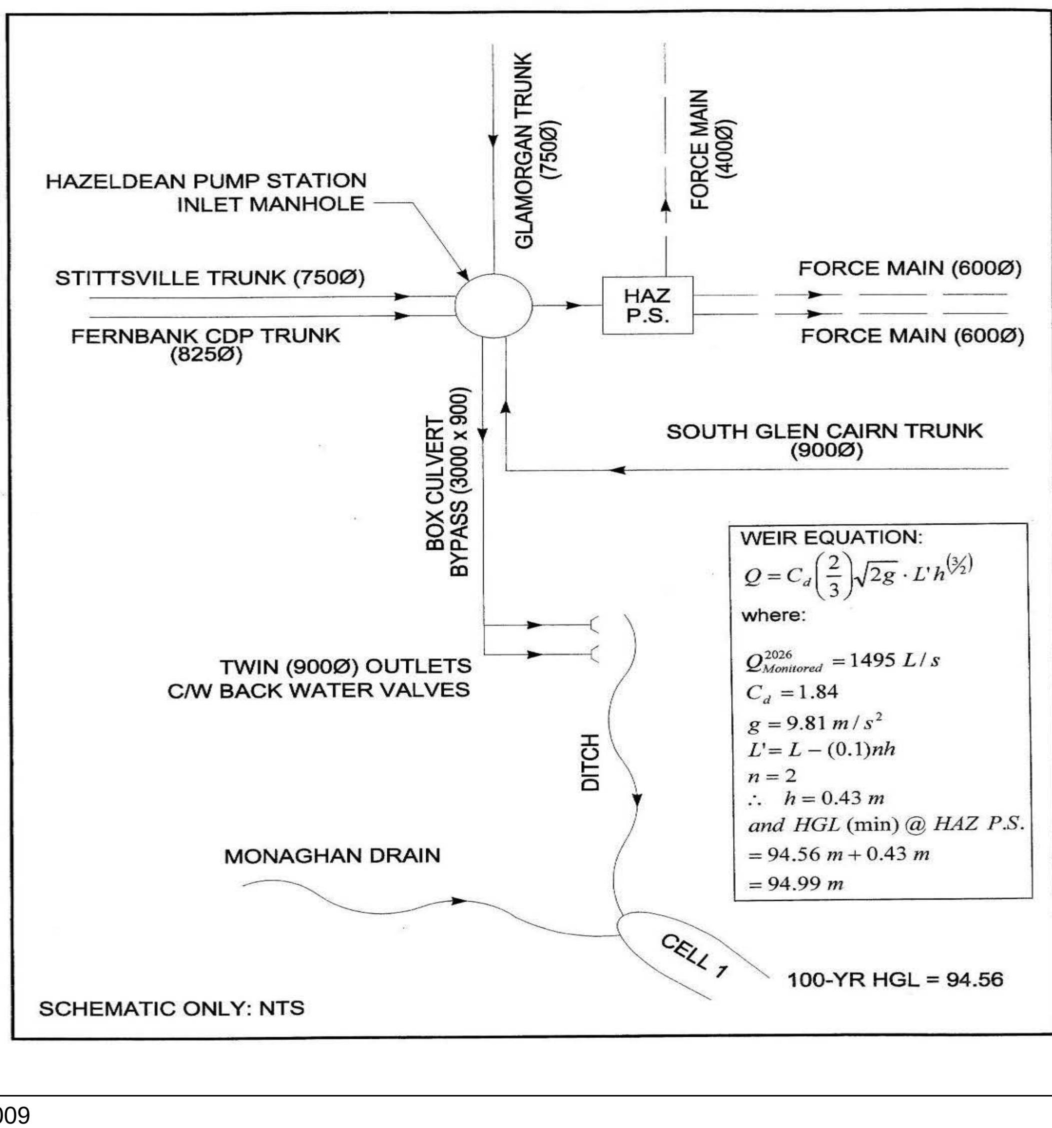
A subsequent expansion will be required to provide the ultimate capacity under build-out conditions. Our recommendation is that the four older pumps in the dry well are replaced around 2016 with newer model C3231 units and new impellers. This upgraded station would convey the build-out peak flow using the monitored 2008 flows plus design flow from growth areas. In the unlikely event monitoring identifies higher than expected flow rates, one of the auxiliary forcemain solutions could be implemented. Additionally, we recommend the use of variable frequency drives on all pumps to limit cavitation problems, moderate forcemain system pressures, reduce pump cycling times, and reconcile wet well size constraints associated with fixed cycle pump systems.

Station Overflow & Inlet Manhole

The current Hazeldean Pump Station overflow is grossly undersized with a bypass into a storm sewer that is potentially surcharged precisely when the overflow is required as catastrophic failure would likely coincide with an extreme wet weather event. To resolve this condition, we have explored overflow solutions for the station and in our opinion the only viable solution is a bypass into Cell 1 of the Monahan Constructed Wetlands immediately south of the station. With a 100-year hydraulic grade line of 94.56 in Cell 1, an overflow can be constructed at the station inlet manhole that would discharge into the adjacent ditch using a box manhole structure (3048mmx914mm); accounting for weir effects the HGL at the station inlet manhole would be approximately 95.00. This HGL value can be manipulated somewhat depending upon the outlet configuration and risk tolerance. Conceptually, we recommend two 900mm bypass pipes outfitted with municipal-grade backflow prevention valves that would connect the overflow box manhole to the outlet ditch. This configuration would protect the Hazeldean Pump Station, all of the development lands within the Fernbank CDP, and much of the pump station sewershed from sanitary backup. A schematic of the contemplated pump station overflow is attached as **Figure 7.7**.

The existing inlet manhole must be reconstructed to permit access for the new Fernbank Trunk and the conceptual station overflow discussed above.

Figure 7.8: Hazeldean Pump Station Bypass



South Glen Cairn Trunk

The South Glen Cairn Trunk (SGCT) is a 900mm diameter sewer that runs south from the Hazeldean Pump Station and services the Kanata South Business Park and Bridlewood areas. This sewer has a free-flow capacity of approximately 650 L/s which exceeds the projected flow condition at build-out in 2031. It is proposed that the SGCT would service a small 25ha parcel within the Fernbank CDP Lands located south of the Monahan Municipal Drain and west of Terry Fox Drive (refer to **Drawing 101108-SAN** for catchment boundary).

Hydraulic grade line (HGL) calculations for the SGCT do not appear to exist. This is likely because the Hazeldean Pump Station does not currently have a viable overflow solution; instead the sewershed is protected by a system of redundant pumps and backup diesel generators. Discussed in the previous section, an overflow can be constructed from the HPS with a starting HGL of 95.00. The modeled HGL back through the SGCT demonstrates that development lands within the Fernbank CDP area will not be constrained by the sanitary HGL. A supplemental HGL analysis is attached which explores a possible secondary bypass near Cope Drive and Atkerson Road. Detailed calculations are attached in **Appendix D**.

Stittsville Trunk

The Stittsville Trunk is a 750mm diameter trunk sewer that flows easterly to the Hazeldean Pump Station and is located within the Abbott Street road allowance. The upper reach of this trunk (west of Iber Road) is essentially at capacity, while some residual capacity exists within the lower reaches closer to the pump station.

The Stittsville Trunk does not have adequate capacity or appropriate elevation to service the entire Fernbank CDP Lands. Accordingly, the preferred wastewater solution does not connect into the Stittsville Trunk. Further discussion about the Stittsville Trunk and its potential application is located in Section 7.3.2 on the Fernbank CDP Lands, Internal Wastewater Design.

Kanata West Wastewater

The Kanata West Owners Group (KWOG) has constructed a temporary forcemain along Iber Road that connects into the Stittsville Trunk. This wastewater solution by KWOG leverages residual capacity in the Stittsville Trunk and defers construction of the Kanata West Pump Station.

Once the Kanata West Pump Station is operational, several smaller pump stations in the Hazeldean Road vicinity will be abandoned. These smaller pump stations that currently discharge to the Stittsville Trunk will have their flows redirected to the Kanata West Pump Station. When the KWPS comes online, flow to the Hazeldean Pump Station will be notably reduced.

7.4 Wastewater Summary and Recommendations

Following is a summary of the core wastewater system findings for the Fernbank CDP Lands:

1. The Draft 2009 Infrastructure Master Plan calls for the extension of the North Kanata Trunk, conversion of the March Pump Station, abandonment of the March Forcemain, and upgrading of the Signature Ridge Pump Station. These municipal works will modify some of the sewershed boundaries and affect the peak sewer flows.
2. The North Kanata Trunk has adequate capacity to build-out.
3. The Tri-Township Collector is undersized for both existing and future design flows; this sewer needs to be upgraded given development pressure throughout the WUC. The sewer can surcharge about 1.0 metre without risk to community or environment. Flow monitoring and operational consideration, rather than design parameters, should dictate when the trunk sewer is replaced.
4. The Glen Cairn Trunk has adequate capacity to build-out.
5. The Hazeldean Pump Station sewershed services the communities of Stittsville, Glen Cairn, Bridlewood, and the Kanata South Business Park. Background growth and development suggest the planned third submersible pump will be required by 2012 using current (2008) monitored flow data for existing land and design flow from future development areas. A subsequent capacity upgrade will be required in 2016 to replace four pump and impeller units; this will provide the necessary capacity to build-out. Actual flow monitoring at the station is recommended to determine when upgrades are required. Installation of a third 600mm forcemain would provide an additional 289 L/s capacity from the station, for a firm capacity of 1,779 L/s and total capacity of 1,986 L/s. Analysis suggests a forcemain upgrade is not required, but the information provides a level-of-comfort and expansion possibilities should flow rates exceed expectations.
6. An overflow can be constructed at the Hazeldean Pump Station into Cell 1 of the Monahan Constructed Wetlands with an HGL of 95.00 at the inlet manhole. This will protect all development lands in the Fernbank CDP area, and most of the sewershed, should a catastrophic failure occur at the pump station.
7. Kanata West lands are temporarily discharging sanitary flow into the Stittsville Trunk (Hazeldean Pump Station sewershed). When the Kanata West Pump Station comes online, wastewater from both Kanata West and a portion of the Stittsville area near Hazeldean Road will be routed away from the Hazeldean Pump Station.
8. The South Glen Cairn Trunk has adequate capacity to built-out.
9. An alternatives analysis of the internal Fernbank wastewater system found that conveyance of all sanitary drainage to the Hazeldean Pump Station was the preferred design solution.
10. The Fernbank CDP Lands will be entirely serviced using free-flow gravity sewers. A new trunk sewer within the Hydro One easement will provide a wastewater outlet that discharges to the Hazeldean Pump Station. Even with a catastrophic failure condition at the Hazeldean Pump Station, the sanitary hydraulic grade line can be maintained at least 0.30 metres below the underside of footing of all structures (or 0.50m below the top of basement slab elevation). A sensitivity analysis demonstrates residual capacity exists in the wastewater network; this permits design flexibility for urban intensification and suggests the system can readily accommodate moderate change.

Section 8.0 Water Distribution

Stantec Consulting was retained to analyze the regional-level impact to the water distribution system associated with development of the Fernbank Community. Novatech Engineering recognizes the efforts of Mr. Kevin Alemany, P. Eng. and Mr. John Krug, P. Eng. of Stantec Consulting for preparation of the water distribution section of this report (Section 8.0). Their analysis and findings are presented below:

8.1 Introduction

8.1.1 City of Ottawa Water Supply System

Water for the City of Ottawa municipal water distribution system is taken from the Ottawa River. It is treated at the Lemieux Island and Britannia Water Purification Plants and then distributed through pumping stations, storage facilities and over 2,600km of watermain. The City of Ottawa's water distribution system is divided into nine (9) major pressure zones and five (5) minor pressure zones. Pressures are maintained in the distribution system by either pumping alone or by a combination of pumping and elevated storage. Due to the complex operation of the City's many different pressure zones, planning and analyses are needed for each major pressure zone as well the system as whole.

The design of the City's water supply system has evolved over the years based on management practices, legislative requirements, engineering methods, and public health and safety considerations. The current design practices have allowed the City to establish a water supply system that provides a good level of service and value to the residents and businesses of the City of Ottawa. Planning of the public water system has been developed based on the following basic set of objectives:

1. Quality (to provide drinking water that meets or exceeds all federal and provincial health guidelines, standards and regulations)

2. Quantity (to provide sufficient water at adequate pressure to meet the needs of the existing population and future growth, taking into account patterns of peak demands and fire fighting requirements)

3. Reliability (to ensure a constant supply of water even under emergency conditions such as power failures or failures of individual system components)

4. Demand Management Planning (to pursue demand management opportunities as a cost effective means of ensuring the long term sustainability of the water supply system)

5. Affordability (to minimize life-cycle costs of the water supply system while maintaining appropriate levels of services)

8.1.2 Background

The 3W Pressure Zone encompasses the majority of the West Urban Community (WUC) including most of Kanata and Stittsville. This is one of the most rapidly growing areas in the City of Ottawa.

Previous studies that Stantec was involved with which provide recommendations for meeting the anticipated increase in water demands in the WUC include:

- "Zone 3W Pump Station Study and Functional Design – Addendum #1" (Stantec, 2006),
- "Stittsville Pumping Station Environmental Assessment and Preliminary Design Report" (Stantec & Delcan, 2005 & ongoing),
- "Pressure Zone 3W – Kanata North Potable Water Planning Study" (Stantec, 2007),
- "Zone 3W Pump Station Study and Functional Design" (Stantec et. al, 2004)
- "Water Master Plan Review and Update Strategy" (Stantec, 2003),
- "Kanata West Concept Plan Water Study" (Stantec, 2002 & 2005), and
- "2W, 3W and Barrhaven Pressure Zones Infrastructure Assessment Study" (Stantec, 2001).

Among other infrastructure, the most recent study, the "Zone 3W Pumping Station Study and Functional Design Report – Addendum #1", recommended the following elements to ensure continued water supply to Zone 3W to the year 2021:

<u>Internal to Zone 3W</u>

1) New 100ML/d pumping station (PS) on Campeau Drive
2) New 914mm feed and discharge piping to new Campeau Drive PS
3) New 9.0ML elevated water storage tank in Zone 3W
4) New 35ML/d pumping station to feed portion of Stittsville
5) New 1067mm W/M from Glen Cairn PS (GCPS) to Hazeldean
   (potential need to increase to 1220mm to accommodate Brookfield/Tridel lands)
6) Twin 914mm on Hazeldean from twinned 1067mm pipes to Castlefrank
7) New 914mm W/M on Hazeldean from Castlefrank to Iber (replace existing pipe)
   (potential need to increase to 1067mm to accommodate Brookfield/Tridel lands)
8) New 762mm W/M on Hazeldean from Iber to Stittsville Tank (replace existing pipe)
9) New 610mm W/M loop (Campeau to Hazeldean) through proposed Kanata West Business Park

<u>External to Zone 3W</u>

10) New 1067mm W/M from Britannia 2W PS to Bells Corners on Carling, Corkstown, Moodie
    (potential need to increase to 1220mm to accommodate Brookfield/Tridel lands)
11) New 914mm W/M from Bells Corners to Eagleson on Timm Drive
    (potential need to increase to 1220mm to accommodate Brookfield/Tridel lands)
12) New 34ML inground storage at existing Glen Cairn Reservoir site

Comment: The need for a new elevated tank by 2021 in Zone 3W is contingent on the condition of the existing Stittsville Tank – it is not required to meet demands related to growth depending on the pumping capacity provided to Zone 3W through the Glen Cairn and Campeau Drive PS's. It has been included in the hydraulic analysis where indicated.

8.1.3 Study Objectives

The development scenario being evaluated for the Fernbank CDP considers full development of the rural lands north of Fernbank, south of Hazeldean, east of Iber/Caribou and west of Terry Fox/Didsbury. The estimated build-out population of this area is approximately 28,028 persons, based on projections provided by Novatech Engineering Consultants (Novatech) on September 08, 2008. The future model also includes growth projections for the remaining lands in Kanata and Stittsville.

It is expected that inclusion of the Fernbank lands may require changes to the previously proposed servicing infrastructure for Zone 3W. The infrastructure needs for these two development conditions will thus be compared to the previously recommended infrastructure needs to service the western growth area, as provided in the Zone 3W Pump Station and Functional Design Report Addendum #1 (February, 2006). The background information and recommendations presented in the earlier report will be used as a basis for this analysis, as will the growth projections, the demand rates and distributions, storage requirements, pumping needs and watermain and transmission main routings and sizing.

The principal purpose of this investigation is to demonstrate the technical feasibility of servicing (water) the subject lands by developing a servicing concept(s). This will include identification of appropriate connections to the existing system and any changes to storage, piping and pumping to Zone 3W.

8.1.4 Development Projections

Fernbank Community

Future land use designations, housing densities and household sizes for Fernbank were obtained from Novatech Engineering on February 28, 2008, and additional updates were provided by Novatech on April 27, 2009. The following **Table 8.1** summarizes the updated residential development projections for the Fernbank Community (ultimate growth assumed in 2031):

Table 8.1: Residential Population - Fernbank Community

Residential	Area (ha)	Density (units/ha)	# Units	Persons per Unit	2031 Population
Single-Low Density	218.5	28	6,118	3.3	20,189
Town homes-Medium Density	57.5	60	3,451	2.5	8,628
Apartments-High Density	5.0	75	378	1.8	680
Mixed Use Residential	11.5	90	1,030	1.8	1,854
Total	**292.5**	**-**	**10,977**	**-**	**31,351**

The following **Table 8.2** summarizes the industrial, commercial and institutional (IC) land areas projected for the Fernbank Community (obtained from Novatech Engineering on February 28, 2008). In the absence of employment densities, the City of Ottawa Infrastructure Planning Unit indicated that for new development lands designated as industrial, commercial and institutional, the assumed employee density is 100 employees/ha. Water demands for the commercial, institutional and mixed use commercial were calculated based on total land areas.

Table 8.2: Employment Areas – Fernbank Community		
ICI	Area (ha)	Number of Jobs
Industrial	0.0	0.0
Mixed Use Commercial	10.9	1,094
Commercial	7.8	784
Institutional	70.6	7,057
Total	**89.3**	**8,935**

Water Pressure Zone 3W

Population projections and employment projections for the entire Zone 3W were updated in August 2008 based on information provided by the City of Ottawa. Residential units, densities and populations for existing and future Zone 3W lands were derived from catchment area information, whereas employment figures were derived from traffic zone area. The hydraulic model was setup using this information to distribute the demands across the pressure zone.

The following **Table 8.3** summarizes the populations and employment projections for Zone 3W, with and without the Fernbank Community:

Table 8.3: Development Projections Summary – Zone 3W		
	Existing (2006)	Ultimate (2031)
Zone 3W Population (without Fernbank)	71,124	133,937
Zone 3W Population (with Fernbank)	71,124	165,288
Employment (jobs) (without Fernbank)	22,008	41,779
Employment (jobs) (with Fernbank)	22,008	50,714

Note that the resulting ultimate population projections without the Fernbank Community (133,937 persons) compare to the April 2004 "Low Growth" estimate (127,280 persons) and the resulting ultimate population projections with the Fernbank Community (165,288 persons) compare to the April 2004 estimate (158,600 persons), used in the Zone 3W Pump Station Study and Functional Design – Addendum #1 (Stantec, 2006).

8.1.5 Water Demand Projections

Unit Water Demands

In an email correspondence dated March 6, 2008, the City of Ottawa Infrastructure Planning Unit provided Stantec Consulting Ltd. with unit demands and patterns to be used for modeling growth scenarios in the Fernbank development. **Table 8.4** summarizes the “post 2001” unit demands used in the hydraulic model (peak hour factors derived from dimensionless demand curves as shown in **Table 8.5**).

Table 8.4: Residential and ICI Unit Demands for Future Growth Areas

Demand	Singles (L/unit/d)	Town Homes (L/unit/d)	Apartments (L/unit/d)	ICI (L/empl/d)
BSDY	**835**	**720**	**265**	**175**
OWD	**1485**	**0**	**0**	**0**
MXDY	**2320**	**720**	**265**	**175**
PKHR	**5787**	**958**	**352**	**173**

Maximum day diurnal patterns were provided for single family homes, town homes & apartments and ICI and are presented in **Table 8.5**. The ICI patterns were applied to commercial, institutional and mixed use commercial land uses in the hydraulic model.

Table 8.5: Residential and ICI Dimensionless Peaking Factors

Hour Time Step	Basic Day			Peak Day
	Single Family	Row and Apartment	ICI	Single Family OWD
1	0.58	0.50	0.50	0.33
2	0.48	0.40	0.44	0.23
3	0.48	0.32	0.00	0.37
4	0.43	0.32	0.00	0.00
5	0.49	0.32	0.00	0.33
6	0.80	0.32	0.36	0.35
7	1.63	0.70	0.53	0.12
8	1.68	1.68	1.22	0.34
9	1.24	1.40	1.30	1.02
10	1.09	1.25	1.66	1.07
11	1.05	1.15	1.77	1.06
12	1.00	1.12	1.80	0.90
13	0.99	1.11	1.63	0.76
14	0.91	1.05	1.74	0.74
15	0.95	1.03	1.48	0.80
16	0.93	1.01	1.46	0.97
17	1.08	1.02	1.24	0.97
18	1.21	1.40	1.29	1.43
19	1.35	1.52	0.95	2.21
20	1.36	1.44	0.85	2.86
21	**1.24**	**1.33**	**0.99**	**3.20**
22	1.22	1.30	0.95	2.26
23	1.05	1.20	0.97	1.21
24	0.76	1.20	0.86	0.49

8.1.6 Water Demand Allocation

The demand allocation process for future growth areas in Fernbank was accomplished by assigning the land use areas of the sanitary sewer catchment areas to corresponding demand nodes in the hydraulic model. Using a spreadsheet, the sub-areas of each land use were assigned demands which were then related back to the corresponding demand nodes in the hydraulic model. **Table A-0.1 (Appendix A)** provides the total land areas assigned to each demand node in the hydraulic model. Model node IDs are provided in **Figure A-1**. The next step was to apply the unit demands described in **Table 8.4** to the land use areas assigned to each demand node. The resulting total demands based on land use type are summarized in **Table 8.6**. The individual demands assigned to future growth nodes in the hydraulic model are listed in **Tables A-0.2 & A-0.3 (Appendix A)**.

Table 8.6: Ultimate Water Demand Projections - Fernbank Development

Land use	BSDY		MXDY		PKHR	
	(ML/d)	*(L/s)*	(ML/d)	*(L/s)*	(ML/d)	*(L/s)*
Singles - Low Density	5.1	*59.1*	5.1	*59.1*	6.3	*73.3*
Outdoor Water Use	0.0	*0.0*	9.1	*105.1*	29.1	*336.4*
Town Homes - Medium Density	2.5	*28.7*	2.5	*28.7*	3.3	*38.2*
Apartments - High Density	0.1	*1.2*	0.1	*1.2*	0.1	*1.5*
Mixed Use - Residential	0.3	*3.2*	0.3	*3.2*	0.4	*4.2*
Mixed Use - Commercial	0.2	*2.2*	0.2	*2.2*	0.2	*2.2*
Commercial	0.1	*1.6*	0.1	*1.6*	0.1	*1.6*
Institution	1.2	*14.3*	1.2	*14.3*	1.2	*14.3*
TOTAL	**9.5**	***110.3***	**18.6**	***215.4***	**40.8**	***471.8***

Demands for the remaining Zone 3W network were provided from previous studies. **Table 8.7** summarizes the total demands for each of the growth areas within Zone 3W. Without the Fernbank developments, the MXDY demand was previously projected to be 112.3ML/d. The addition of Fernbank would result in an increase of 18.6ML/d for a total of 130.9ML/d.

Table 8.7: Ultimate Water Demand Projections - Zone 3W

Area	BSDY		MXDY		PKHR	
	(ML/d)	*(L/s)*	(ML/d)	*(L/s)*	(ML/d)	*(L/s)*
Zone 3W	45.4	*525.7*	112.3	*1299.6*	268.3	*3105.5*
Fernbank	9.5	*110.3*	18.6	*215.4*	40.8	*471.8*
TOTAL	**54.9**	***636.0***	**130.9**	***1515.0***	**309.1**	***3577.3***

8.2 Preliminary Assessment of External Infrastructure Needs

8.2.1 Glen Cairn/Campeau Drive Pumping

The rated pumping capacity of each pump in the Glen Cairn Pumping Station (GCPS) is as follows (Zone 3W Pressure Zone Operation Manual - Draft, Stantec 2007):

RPE1	25 ML/d*
RPE2/RPD2	40 ML/d
RPE3	37 ML/d
RPE4/RPD4	40 ML/d
Total Capacity (*)	142 ML/d
Firm Capacity (*)	102 ML/d

*RPE1 was reported in 2005 to be upgraded to the same capacity of RPE4 (i.e. 25 to 40ML/d) however recent information obtained by Stantec indicates otherwise. Regardless, with the proposed upgrade to RPE1 the total and firm capacity of the Glen Cairn Pumping Station will increase to **157ML/d** and **117ML/d** respectively.

The Campeau Drive Pumping Station (CDPS) was identified in the Zone 3W Functional Design Report Addendum #1 to have an upper capacity limit of 100ML/d (current design capacity approximately 90ML/d). Therefore assuming the RPE1 upgrade and the current design for the Campeau Drive Pumping Station, the total and firm capacity of both Zone 3W Pumping Stations is **247ML/d** and **207ML/d** respectively.

8.2.2 Fire Flow Pumping and Storage

Following the MOE design guidelines for fire flow requirements of large service areas, based on a service population greater than 40,000 equivalent persons, Pressure Zone 3W is suggested to have a fire flow capability of 378L/s (22,680L/min) over a period of 6 hours (for a volume of 8.2ML). It is proposed that by 2021 a new 9.0ML elevated storage tank will replace the existing 4.5ML Stittsville Tank in the future. Therefore assuming 40% (3.6ML) of the future storage volume is available for fire flow, the fire flow pumping requirement is determined to be **18.4ML/d**. Combined with the projected maximum day demands of **130.9ML/d**, the total build-out MXDY + FF pumping requirement in Zone 3W will be **149.3ML/d**.

Since the firm capacity of the Zone 3W pumping stations is anticipated to be 207ML/d, which is well above the required MXDY+FF, there is sufficient capacity to meet the zone's maximum day fire flow needs with the Fernbank demands included.

8.2.3 Peak Hour Pumping Needs (Initial Estimate)

The projected peak hour demand of Zone 3W with Fernbank is **309.1ML/d** as per **Table 8.7**. In developing an initial estimate for the peak hour pumping requirement under future build-out demand conditions, it is estimated that approximately 40% of the future 9.0ML (3.6ML) elevated storage tank will be available to balance demands greater than the firm pumping capacity of the two pumping stations. The current planned firm pumping capacity (without Fernbank) is **207ML/d**. Based on the diurnal patterns presented in **Table 8.6** and the hydraulic 3W patterns in the model, the length of time in which the peak maximum day demand is expected to exceed 1.6 times maximum day demand is approximately 4 hours. Therefore 3.6ML of balancing storage translates to a flow of **21.6ML/d** over a period of 4 hours. The resulting total pumping (207ML/d) and storage flow (21.6ML/d) of **228.6ML/d** is not sufficient to meet the projected peak hour demand and additional pumping or storage is required.

Assuming an additional **40.8ML/d** of firm pumping capacity (i.e. the equivalent of peak hour for Fernbank only) is added to the system at the Glen Cairn Pumping Station the total firm capacity increases to 244.6ML/d or 1.9 times maximum day demand. As a result the length of time in which the peak maximum day demand is expected to exceed 1.9 times maximum day demand is 3 hours. Following the method described above, the total available firm pumping (244.6ML/d) and storage flow (**28.8ML/d** over 3 hours) of **273.4ML/d** does not satisfy the future peak hour demand pumping and storage requirement. In order to meet the projected future peak hour demand (309.1ML/d) an additional **35.6ML/d** of Zone 3W firm pumping capacity or storage will be required on top of the 37.6ML/d needed for Fernbank.

8.2.4 Zone 3W Feedermain Sizing (Internal)

The current Fernbank CDP modeling work was undertaken with the latest growth projections available for Zone 3W. With the addition of the Fernbank Community to the pressure zone, the previously proposed upgrades to the Hazeldean Watermain are determined to be adequate to support the additional growth. The following summarizes the Hazeldean pipe sizes required to support future growth within Zone 3W (Zone 3W Pumping Station Study and Functional Design Addendum #1, 2006):

- Twin existing 1067mm w/m with new 1067mm w/m from Glen Cairn PS discharge to Hazeldean (up-size new w/m to 1220mm to accommodate Fernbank lands)
- Twin 914mm on Hazeldean from twinned 1067mm pipes to Castlefrank
- Replace existing w/m with 914mm on Hazeldean from Castlefrank to Iber (up-size new to 1067mm accommodate Fernbank lands)
- Replace existing w/m with 762mm on Hazeldean from Iber to Stittsville Elevated Storage Tank

8.2.5 Zone 3W Feedermain Sizing (External)

In June 2007, Delcan Corporation prepared a report for the City of Ottawa titled: "Zone 3W Feedermain Sizing Assessment". The report states that the sizing of the new Zone 3W feedermain includes additional demands from the Tridel lands development (i.e. Fernbank Community). The following is quoted from the report:

> *"The Zone 3W Feedermain sizing, as documented in the EA Report, is based on the City's official 2021 projections. However, a 2006 Addendum to a subsequent April 2004 report, which was related to the EA Report, recommended that final sizing should consider the proposed development of the Tridel lands which were outside the existing urban envelope but would be served by the Feedermain in the event the development was approved. The City has confirmed that the 2031 demands considered in the WSSOS exceed the demands associated with the sum of the official 2021 projections and the Tridel lands development."*

As per Delcan's findings, the following Zone 3W feedermain sizing is recommended:

1. 1067mm feedermain, from the 1524mm connection at the Ottawa River Parkway and Carling Ave. to the 1220mm connection at Bells Corners (Zone 3W Phase 1 Feedermain)
2. 914mm feedermain from the 1067mm connection at Moodie Dr. and Timm Dr. to the 1067mm connection at Eagleson Rd. (Zone 3W Phase 2 Feedermain)
3. 914mm watermain from Teron Rd. and Campeau Dr. to the proposed 3W Pump Station.
4. 914mm watermain from the proposed 3W Pump Station to the 610mm connection north of HWY 417 and east of Kanata Drive.

This will not be reviewed further as part of this report.

8.2.6 Zone 2W+ Pumping

Pumps at the Britannia Water Purification Plant and the Carlington Heights Pumping Station boost water into Zone 2W which in turn services Zone 3W and Zone BARR. Storage facilites at Glen Cairn and Barrhaven help to balance flows into the downstream pressure zones. As such, the anticipated pumping upgrade requirement at either of the Zone 2W pumping stations attributed to the Fernbank development is equivalent to the Fernbank Community maximum day demand of **18.6ML/d**.

8.2.7 Costing

Pumping costs estimated at $16,000 per ML/d of pumping for the Glen Cairn and Brittannia 2W Pumping Stations includes an allowance for pump change-out and miscellaneaous appurtenances only (does not include cost for allowance for new building and/or building expansion, nor back up power). This value is based on the costs of a recent upgrade to the Britannia 2W pumping station. The value includes an additional 57.5% for EA, contingency, engineering and project management. Additional backup power for the Glen Cairn Pumping Station is estimated at $250K. The additional infrastructure required to provide potable water service to the proposed Fernbank development are as follows:

1) Additional firm pumping capacity at Glen Cairn Pumping Station (37.5ML/d)*:		$ 600,000
2) Additional firm pumping capacity at Zone 2W Pumping Station (18.6ML/d):		$ 300,000
3) Backup power costs at Glen Cairn Pumping Station:		$ 250,000
	Total:	$1,150,000

8.3 Hydraulic Analysis

8.3.1 Model Development & Assumptions

The hydraulic analysis was completed using H_2OMap Water Version 8.0. As directed by the City of Ottawa Infrastructure Planning Unit, the model file used for the analysis is the complete pipe Zone 3W hydraulic model previously developed by Stantec Consulting Ltd. for the Zone 3W Pumping Station Functional Design Study.

The model demands of the existing and future 3W distribution network were modified and determined based on the most recent land use planning projections as presented in **Section 8.1** of this report. The node and pipe IDs of the future infrastructure are provided in **Figures A-1** and **A-2** for reference purposes.

Ground elevations across the Fernbank development vary from a low of approximately 96m in the eastern portion of the new development near Terry Fox to a high of approximately 114m in the west portion of the new development near Stittsville. Future node elevations within Fernbank (based on ground elevations) are shown in **Figure A-3**.

The pump station feeds to Zone 3W were simulated with fixed head reservoirs at the discharge side of the pumping stations with elevations set at 163m and 161m at CDPS and GCPS respectively. Flows from the pumping stations were monitored to determine the anticipated peak flows from each pumping station based on the future pipe network configuration.

In addition to including the future watermain within Kanata West, Kanata Lakes North and Fernbank, the existing watermain along Hazeldean was upgraded to reflect previously proposed watermain sizing requirements. This included twinning of the 914mm diameter watermain just downstream of the Glen Cairn Pumping Station along Hazeldean Road to Castlefrank Road, replacement of existing 610mm diameter watermain with a 914mm diameter watermain from Castlefrank Road to Iber Street and replacement of watermain with a 762mm diameter watermain from Iber Street to the Stittsville Elevated Storage Tank.

Figure A-4 shows the current "2005" watermain diameters in the vicinity of the Fernbank development area. Initially, various trunk watermain sizing configurations were considered for the Fernbank network. The final proposed trunk watermain sizing for the Fernbank development area is shown in **Figure A-5.** The proposed distribution network consists of 305mm diameter trunk watermain throughout the entire Fernbank area.

In order to verify interim conditions, a phasing concept was developed. **Figure A-6** shows how Phase 1 of the Fernbank CDP is to be constructed. Phase 1 consists of two areas of development: one is the lands just south of Hazeldean Road in the north western quadrant and the other is the parcel of land between Abbott Street E and Fernbank Road in the south eastern quadrant.

In order to verify the reliability of the proposed trunk watermain network, eight key locations were identified for pipe breaks under both the interim Phase 1 scenario and the build-out scenario of the Fernbank CDP. The location of these modeled pipe failures is shown in **Figure A-7**.

In addition to verifying the ability to service the Fernbank Community with the proposed 9.0ML Stittsville elevated storage tank (replace the existing 4.5ML tank), Stantec reviewed the ability to service future growth in the entire Zone 3W with a new 9.0ML elevated storage tank (replacing Stittsville Elevated Tank) located in the south west corner of the Fernbank community on an elevated parcel of land just south of Fernbank along Shea Road (**Figure A-8**). This location was identified as a possible future storage site due to its high ground elevations. The piping network with the elevated storage tank consists of 305mm diameter watermain throughout Fernbank (as described previously). Additionally a new 610mm diameter feedermain from Hazeldean Road along the north-south arterial road in Fernbank Community follows a road alignment to a location in the vicinity of Shea Road at Fernbank Road. **Figures A-8** and **A-9** present the node and pipe IDs of the "new tank" scenario. **Figure A-10** shows the ground elevations of the Fernbank area including the new nodes along the proposed 610mm diameter feed to the tank. **Figure A-11** shows the proposed pipe sizes throughout Fernbank with the new 610mm diameter feed to the tank.

8.3.2 Model Results

Build out - Maximum Day/Peak Hour (Extended Period Simulation - EPS)

The modeling output results presented in Tables A-1 to A-4 (Appendix A) indicate that with the proposed 305mm diameter watermain network within Fernbank, the lower projection peak hour demand HGL in Fernbank is expected to range between 150m and 161m which equates to pressures ranging from 50 to 92 psi (345 to 634kPa). With the higher density population projection demand in Fernbank (results not shown), the results are slightly impacted with a drop in minimum pressure of 1psi (7kPa).

With respect to maximum pressures, at a hydraulic gradeline of 161m approximately 60% of the nodes in the Fernbank build out network exceed 80 psi (550kPa). Based strictly on ground elevations (i.e. neglecting headlosses) lands with elevations less than **105.7m** can expect pressures to exceed 80 psi (550kPa) at some time. **In accordance with the Ontario Building/Plumbing Code, all units expected to have a service that exceeds 80 psi (550kPa) require a pressure reducing valve be installed.**

The extended period maximum day demand conditions were modeled with and without the Fernbank development to determine the peak pumping needs based on dynamic model results.

Without Fernbank, the estimated Zone 3W peak hour pumping requirements at Campeau Drive PS and Glen Cairn PS is **84.0ML/d** and **163.8ML/d** respectively for a total of **247.8ML/d.**

With the Fernbank development included, the estimated Zone 3W peak hour pumping requirements at Campeau Drive PS and Glen Cairn PS is **89.1ML/d** and **191.1ML/d** respectively for a total of **280.2ML/d.**

Build out - Maximum Day + Fire Flow

The results presented in Table A-5 (Appendix A) indicate that with the proposed 305mm diameter watermain network, fire flows in exceedance of 217L/s (13,000L/min) can be provided at all locations along the trunk watermain within Fernbank under maximum day (steady state) demand conditions. Within the City of Ottawa, a fire flow of 125L/s (7,500L/min) is considered an acceptable level of service for all residential dwelling types and a fire flow of 217L/s (13,000L/min) is considered an acceptable minimum level of service for a mixed use industrial, commercial and institutional area.

Build out - Reliability – Basic Day + Fire Flow + Pipe Failure

Table A-6 (Appendix A) presents the results of a reliability analysis to determine the integrity of the system under a pipe failure scenario. The results show that with the proposed 305mm diameter network interconnected to numerous feed locations, the system is capable of providing greater than 217L/s (13,000L/min) for all eight of the failure conditions modeled.

A pump station failure analysis was modeled to verify Zone 3W's ability to provide build-out basic day demands and fire flow when the Glen Cairn Pumping Station is offline. The model results showed that without the Glen Cairn Pumping Station, both the Stittsville Elevated Tower and the new Campeau Drive Pumping Station were capable of providing fire flows greater than 217L/s (13,000L/min) throughout the Fernbank lands.

A final failure scenario was modeled to determine the level of reliability and redundancy of pipes in the southeast corner of Zone 3W. This was carried out by simulating a pipe failure along Eagleson Road just north of Stonehaven (See **Figure A-12**). This section of Eagleson was selected because of its limited redundancy; there is only a single 305mm diameter watermain loop along Shetland Ave that provides pipe redundancy to a large area of Zone 3W. Three scenarios were modeled:

1. without a connection to Fernbank through the SOHO lands,
2. without the Fernbank connection and with a break as described above, and
3. with the Fernbank connection and with a break as described above.

Fifteen random nodes (along larger diameter watermain) within the residential lands east of Eagleson Road and south of Robertson Road were selected for monitoring fire flows in the model. Under the first scenario, all locations selected were capable of providing greater than 217L/s (13,000L/min). Under the second scenario, the break along Eagleson resulted in the inability for the system to maintain high fire flows, the resulting flows for the fifteen locations ranged between 130L/s (7,800L/min) and 205L/s (12,300L/min). With the break still in place a connection through Fernbank significantly improves the failure conditions and fire flows greater than 217L/s (13,000L/min) were observed at each of the fifteen locations. This analysis confirms that a connection through the Fernbank lands through to Eagleson Road in the east has a positive impact on the reliability and redundancy of the pipe network in the south east area of Zone 3W.

Phase 1 Model

A theoretical Phase 1 simulation was modeled to evaluate water supply characteristics and reliability. For the purpose of this analysis, the Phase 1 boundary was chosen to include all lands east of the Arterial Road excluding the non-designated parcels west of the Carp River. As discussed in Section 12 of this report, phasing will be determined by a set of trigger requirements and the availability of capital, rather than by geography. Accordingly, this analysis represents a possible interim construction phase. Depending on actual construction patterns, Infrastructure Planning may require additional modeling of the interim water distribution system; this would likely occur in conjunction with Plan of Subdivision applications.

Phase 1 - Maximum Day/Peak Hour (Extended Period Simulation)

The results presented in **Tables A-7** to **A-10 (Appendix A)** indicate that with the proposed 305mm diameter watermain network, the typical HGL for the nodes in Phase 1 is expected to range between 153 and 161m which translates to pressures of **64** to **91 psi (441** to **627 kPa).** In accordance with the Ontario Building/Plumbing Code, all units expected to have a service that exceeds 80 psi (550kPa) require a pressure reducing valve.

Phase 1 - Maximum Day + Fire Flow

The results presented in **Table A-11 (Appendix A)** indicate that the proposed Phase 1 network is capable of providing fire flows greater than 217L/s (13,000L/min) at all locations along the trunk watermain under maximum day (steady state) demand conditions.

Phase 1 - Reliability – Basic Day + Fire Flow + Pipe Failure

Table A-12 (Appendix A) presents the results of a reliability analysis to determine the integrity of the system under a pipe failure scenario with only Phase 1 of the Fernbank network constructed. The results show the proposed network is capable of providing greater than 217L/s (13,000L/min) for six of the eight failure conditions modeled.

Of the two failure scenarios that do not maintain 217L/s (13,000L/min) at all locations (pipe break locations B & C) the lowest fire flow that is observed is 173L/s (10,380L/min). This fire flow meets the City’s requirement for residential level of service. The observed fire flows are considered to be adequate for the short duration in which these pipe failures will occur. Furthermore as development proceeds to build-out the additional looping of the network will continue to improve the overall capacity of the entire Fernbank network.

Build Out – with New Elevated Tower

Tables A-13 to **A-16 (Appendix A)** provide the maximum day (EPS) demand results for Fernbank with a new 9.0ML elevated storage tank located in the south west corner of the Fernbank community on an elevated parcel of land just south of Fernbank along Shea Road. The model results show that using the same boundary conditions and tank water levels similar to Stittsville, the network is capable of filling and drawing the tank between 40 and 100% while maintaining appropriate pressures throughout Fernbank and the rest of Zone 3W. Similarly **Table A-17 (Appendix A)** shows that the new elevated storage is capable of maintaining available fire flows greater than 217L/s (13,000L/min) at all locations along the trunk watermain in Fernbank.

8.4 Water Distribution Conclusions

The following conclusions are presented as a summary of the findings of this hydraulic analysis for the proposed Fernbank CDP:

- A 305mm diameter trunk watermain network provides sufficient capacity to maintain appropriate pressures and fire flows throughout the Fernbank development.
- Upgrading internal watermain within Fernbank does little to improve conditions outside the Fernbank boundaries except if elevated storage is considered.
- A small portion of the Fernbank community is located in lands that may be considered to be part of the future Stittsville Pressure Zone (SPZ) based on ground elevation. As such the boundaries of the future SPZ should be reviewed in consideration of the Fernbank development.
- A large area in the Fernbank development is expected to experience pressures greater than 80psi (550kPa) if the hydraulic gradeline is maintained at the current objective of 161 to 163m. As such, individual PRVs will be required for a high number of services. Service areas with ground elevations below 105.7m are susceptible to daily pressures exceeding 80psi (550kPa).
- Additional firm pumping capacity at the Glen Cairn Pumping Station and one of the Zone 2W pumping stations is required to meet the additional demands associated with the Fernbank Community. The total cost for these upgrades is estimated to be in the order of $1,150,000. The timing of these upgrades is related to the overall rate of growth in the entire Zone 3W.
- By adding elevated storage to an area adjacent to the Fernbank development in the South, pressures in Fernbank increase very minimally, no significant benefit observed in level of service with respect to pressures provided. Fernbank community would benefit from additional fire flow capacity however the existing design already meets the fire flow requirements of the community. If elevated storage is considered south of the Fernbank development, it is recommended that a strong feedermain of at least 610mm in diameter be considered to ensure sufficient flow capacity between the Zone 3W pumping stations and the storage tank. The watermain and road layout proposed for Fernbank allows for future consideration of a large diameter feedermain along an arterial road way.

Section 9.0 Utility Infrastructure

9.1 Hydro One

Hydro One protects a 106.7m (350 ft) easement which traverses the length of the Brookfield and Monarch development lands for a pair of 500kV tower-mounted transmission lines. The high-voltage lines cross Fernbank Road near Shea Road in a northerly direction and deflect easterly at Abbott Street parallel to the Trans Canada Trail. West of Terry Fox Drive the transmission lines deflect in a south-easterly direction towards Eagleson Road.

A second Hydro One corridor 45.7m (150 ft) wide is protected for a single-tower 230kV transmission line which extends north-westerly from the transformer station adjacent Terry Fox Drive. This corridor bisects the southern edge of the Del, Craig and Dawson Lands.

9.2 Hydro Ottawa

Pole mounted Hydro Ottawa infrastructure surrounds most of the study area. Overhead lines run along the south side of Hazeldean Road, the east side of Terry Fox Drive, the north side of Fernbank Road, the west side of Shea Road, and the east side of Iber Road. Underground Hydro Ottawa plant runs along the north side of Abbott Street between Shea Road and Iber Road, and along a portion of Shea Road.

The Alexander distribution station that services this area is located on Maple Grove Road near Terry Fox Drive. Hydro Ottawa intends to improve the reliability of the local power supply with construction of a new distribution station near Terry Fox Drive and the Trans-Canada Trail; and with planned upgrades to the pole mounted infrastructure on Fernbank Road, Shea Road, and on Abbott Street to the future distribution station. Hydro Ottawa intends to address historical power interruptions.

Hydro Ottawa will be servicing the CDP area through the installation of medium voltage overhead distribution along the proposed arterial road, and either overhead or underground medium voltage distribution along the major and minor collector roads. Hydro Ottawa may install overhead distribution along right-of-ways within industrial and commercial areas depending on the nature of development and the phasing of the development.

The existing aerial lines on Shea Road must be relocation as part of the Shea Road realignment work.

In consultation with Hydro Ottawa, the supply lines can be extended to service future development communities within the study area. Developers are advised to contact Hydro Ottawa in the early stages when Plan of Subdivision applications are being drafted. This will permit Hydro Ottawa an opportunity to evaluate service alternatives when the community is first being constructed.

9.3 Enbridge Gas

Enbridge Gas reports that 12" steel extra-high pressure gas mains exist on the west side of Iber Road, the south side of Abbott Street, and the east side of Shea Road. Just beyond the study area on the west side of Eagleson Road at Fernbank Road there is another 12" steel extra-high pressure gas main. These mains represent the largest volume gas transmission lines inside the City of Ottawa (Trans-Canada Pipeline excluded), and are ideal candidates to supply future large-scale development projects.

Other gas lines in the vicinity of the study area include a 6" steel intermediate pressure main on the south side of Hazeldean Road, and a 4" polyethylene intermediate pressure line on the south side of Abbott Street west of Shea Road.

9.4 Communications

Bell Canada reports there is a switching station near Hazeldean Road and Sweetnam Drive from which fibre optic cable would be extended to service the entire study area. At Plan of Subdivision, developers must coordinate the location of trees, street fixtures, telecommunications equipment, utility and light poles, and signs. To the extent practical, designers should consider locating utility equipment away from public view by landscape screening and other such means.

Rogers Ottawa has backbone fibre-optic lines near Eagleson Road and Hope Side Road. Rogers advises there are no design constraints to service the study area lands.

9.5 Utility Conclusions

The utility infrastructure is graphically depicted on **Figure 3.5**. The preceding information was developed in consultation with the utility companies. Ongoing coordination with the utility companies during the development approvals process will be required to ensure that utilities are in place when development proceeds. The utility firms have requested they are kept apprised throughout the CDP process; but no additional investigation or analysis appears necessary until detail design is initiated.

Section 10.0 Project Listing

The Master Servicing Study component of the Fernbank CDP satisfies the requirements of Phase 1 and 2 of the Municipal Class EA Process. The process is outlined in detail in Section 1.1 Integration of the Environmental Assessment Act and the Planning Act. Infrastructure projects that will be undertaken in concert with development of the Fernbank CDP and their schedule classification are outlined below.

10.1 EA Projects

The following projects fall under the *Environmental Assessment Act*:

Sanitary Servicing Projects

- Trunk Wastewater sewers in future roadways and utility corridors (Schedule B)

Water Distribution Projects

- Trunk Watermain in future roadways and utility corridors (Schedule B)

Stormwater Management Projects

- Dry Pond #1 and associated storm sewers (Schedule B)
- Dry Pond #2 and associated storm sewers (Schedule B)
- Dry Pond #3 and associated storm sewers (Schedule B)
- Dry Pond #4 and associated storm sewers (Schedule B)
- Dry Pond #5 and associated storm sewers (Schedule B)
- Refer to the Environmental Management Plan for wet pond EA requirements

All of the above projects will require a *Certificate of Approval* from the Ministry of the Environment.

Review agencies and the public will have an opportunity to review the Class EA documentation being prepared for the Fernbank CDP, and have the ability to appeal to the OMB. The assessment and review process is being harmonized with the *Planning Act* as the development application process is occurring simultaneously. Notification of the conditions of planning approvals and the Class EA documents will be advertised through a **Notice of Completion** and there will be an opportunity to appeal to the Ontario Municipal Board (OMB).

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

The implementation, over time, of the Fernbank CDP and the required supporting infrastructure will take place as *Conditions of Approval*. The approvals will be conducted under the *Planning Act*, and other acts as listed in **Section 10.2**.

10.2 Other Approval Requirements

The Fernbank CDP satisfies the EA requirements under the *Planning Act*. Additional approvals will be required for implementation of the proposed development plan including, but not limited to, the following:

10.2.1 Ontario Water Resources Act

All stormwater facilities are regulated under the *Ontario Water Resources Act* and will require a *Certificate of Approval* from the Ministry of the Environment.

10.2.2 Drainage Act

Drainage works regulated under the *Drainage Act* are exempt from the Ontario *EA Act*. Engineer's Reports will be required for the projects which fall under the *Drainage Act*, which include the following:

- Naturalization and enhancement of the main branch of the Monahan Drain for approximately 700 metres upstream of Terry Fox Drive, and abandonment of the various tributary branches of the Monahan Drain within the limits of the study area
- Abandonment of the Flewellyn Drain upstream of Fernbank Road
- lowering of the Flewellyn Drain for approximately 375 meters downstream of Fernbank Road (optional)

10.2.3 Fisheries Act

Enclosing a portion of the Granite Ridge Outlet (upstream of Stormwater Management Pond #1) and the proposed compensation works in the MVC owned lands adjacent to the Carp River will constitute a harmful alteration, disruption or destruction (HADD) of fish habitat and will require authorization from DFO under the *Fisheries Act*.

10.2.4 Conservation Authorities Act

Proposed enhancements to watercourses are regulated under Section 28 of the *Conservation Authorities Act* – Development, Interference with Wetlands, and Alterations to Shorelines and Watercourses

- Proposed enhancement works to the Monahan Drain will require an application to RVCA.
- Proposed enhancement works to the Carp River West Tributary will require an application to MVC.

10.2.5 Official Plan Policy

Section 3.2.2 of the City of Ottawa *Official Plan* states that an Environmental Impact Statement is required in conjunction with all new development (including new lot creation) situated within 30 metres of the boundary of a designated Natural Environment Area.

Section 11.0 Cost Estimates

11.1 Municipal Infrastructure

High-level costing of municipal infrastructure that could be subject to development charges follows. Tables 11.1 through 11.3 depict the Construction Cost, the Capital Cost Allowance, and the Total Capital Cost for each item. The capital cost allowance is a 57.5% increase over the construction estimate to account for engineering, contingency allowance, project management and construction supervision costs. For simplicity, all costs have been rounded to the nearest thousand dollars. Items with DC in the Unit Rate column have been extracted from the draft 2009 City of Ottawa Development Charges Study.

Table 11.1: Costing – Storm Drainage

Item Description	Qty	Unit Rate (/m)	Construction Cost ($)	Capital Cost Allowance ($)	Capital Cost ($2006)	Currently Planned Project	New Project
1 Storm Sewer:							
a) 1800 mm dia.	0 m	$1,957	$0	$0	$0		✓
b) 1950 mm dia.	790 m	$2,217	$1,751,000	$1,007,000	$2,758,000		✓
c) 2100 mm dia.	570 m	$2,508	$1,430,000	$822,000	$2,252,000		✓
d) 2400 mm dia.	215 m	$3,229	$694,000	$399,000	$1,093,000		✓
Total: Storm Drainage					**$6,103,000**		

Table 11.2: Costing – Wastewater Collection

Item Description	Qty	Unit Rate (/m)	Construction Cost ($)	Capital Cost Allowance ($)	Capital Cost ($2006)	Currently Planned Project	New Project
1 Sanitary Sewer:							
a) 450mm dia.	1875	$230	$431,000	$248,000	$679,000		✓
b) 525mm dia.	1926	$273	$526,000	$302,000	$828,000		✓
c) 600mm dia.	1185	$330	$391,000	$225,000	$616,000		✓
d) 825mm dia.	652	$616	$402,000	$231,000	$633,000		✓
2 Tri-Township Collector 1350mm	1 LS	DC			$4,000,000	✓	
3 Hazeldean PS							
a) 3rd Wet Pump	1 LS	DC			$1,000,000	✓	
b) 4 Dry Pumps & Impeller Upgrades	1 LS	DC			$2,400,000		✓
c) Inlet Manhole & Overflow Bypass	1 LS	DC			$310,000		✓
Total: Wastewater					**$10,466,000**		

Table 11.3: Costing – Water Distribution

Item Description	Quantity	Unit Rate	Capital Cost ($2006)	Currently Planned Project	New Project
1 Glen Cairn Pumping Station:					
a) Additional pumping capacity	1 LS	DC	$600,000	✓	
b) Backup power	1 LS	DC	$250,000	✓	
2 Zone 2W Pumping Station: Additional pumping capacity	1 LS	DC	$300,000	✓	
Total: Water Distribution			**$1,150,000**		

Section 12.0 Implementation and Phasing

12.1 EA Project Amendment/Change Process

The Fernbank CDP demonstration plan has been developed through the Integrated EA process, and represents one possible development scenario for the CDP lands, based on the environmental constraints and opportunities identified through the environmental inventory and evaluated as part of the EMP and Master Servicing Study. The Demonstration Plan is intended to illustrate the feasibility of implementing the recommended environmental management strategy and municipal servicing design.

The intent of the Master Servicing Study is to develop a municipal servicing design for storm drainage, wastewater collection, and water supply that would support development of the Demonstration Plan. The MSS has created a blueprint for development while maintaining sufficient flexibility to allow for future changes to the land use plan.

It is prudent to develop a process to recognize that due to unforeseen circumstances, it may not be feasible to implement the projects as described in the environmental assessment reports. The following sets out the process to deal with changes which occur after filing and obtaining approval of the environmental assessments and prior to construction.

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

Minor Changes
Minor design changes may be defined as those which do not appreciably change the expected net impacts associated with the project. For example, a design change in lighting treatment, landscaping, noise attenuation, median width, pathway connections, and underground infrastructure sizes, would be considered minor. Slight changes in alignment or facility footprints, which to not affect more than 2 participating landowners, would also be considered as minor. All affected landowners and appropriate stakeholders will be provided details of the modification. The majority of such changes could likely be dealt with during the detailed design phase and would remain the responsibility of the proponent to ensure that all relevant issues are taken into account.

Major Changes
Major changes may be defined as those which change the intent of the EAs or appreciably change the expected net impacts associated with the project. An example of a major change would result from a proposed shift in a preferred design alignment or configuration which would warrant changes in mitigation as described in the EA and affect 3 or more landowners. If the proposed modification is major the recommendations and conclusions in this report would require updating. An addendum to the EA would be required to document the change, identify the associated impacts and mitigation measures and allow related concerns to be addressed and reviewed by the appropriate stakeholders.

12.2 Detail Design

The Master Servicing Study has developed a high-level servicing solution that demonstrates feasibility and guides future development. The report is not intended to provide a street-by-street detail design; rather this enhanced level of detail will be completed in conjunction with Plan of Subdivision and/or Site Plan applications. The more rigorous field investigation and design undertaken on a site-by-site basis will inevitably lead to adjustments from the design herein. These alterations are both normal and expected as any design evolves into a final constructed format (a discussion of minor versus major design change is outlined above in **Section 12.1**).

The detail design solution will depend upon several constraint factors such as final geotechnical information, including grade raise for units and roadways, dwelling configuration and layout, final flood elevations in the Carp River, etc. These constraints can be dealt with and/or mitigated by a variety of design techniques, such as pre-loading, light-weight fill, slab-on-grade dwellings (no basement), or pile foundations. The precise engineering technique(s) to resolve localized constraints are best finessed during detail design. The key point is that the Master Servicing Study demonstrates a feasible design solution for the Fernbank CDP area that will guide future designers in developing detailed design solutions.

12.3 Phasing

The overall phasing plan for development is determined by a number of factors including:

- Early construction of the North-South Arterial Road;
- Approved planning status of the lands;
- Location relative to the existing sanitary sewer pump station and the existing watermain distribution system which will service the lands;
- Road access opportunities; and,
- Physical site characteristics and initial pond locations dictated by topography

As demonstrated in the Master Servicing Plan, Transportation Master Plan and the Existing Conditions Report, development can generally proceed from any location within the Study Area. As opposed to a geographically defined phasing plan, development will be governed by the availability of capital to pay for the installation key infrastructure components including the arterial road, trunk water and wastewater infrastructure, stormwater management facilities, and the like.

It is anticipated that development will occur incrementally through Plans of Subdivision with associated infrastructure and services being installed. Details of proposed works and improvements are set out in the accompanying **Table 12.1** and will be influenced by the future development rate, municipal budgeting priorities, and front-ending agreements. In any scenario, the proposed Arterial will be constructed to a 2-lane cross-section between Fernbank Road and Abbott Street as part of the first phase of development.

Dependant upon confirmation of satisfactory front-ending agreements, Neighbourhood and Community Parks are to be built concurrently with Draft Plans of Subdivision. Options for front-ending by developers will be explored by proponents in order to secure appropriate timing for both construction and repayment.

Table 12.1: Key Infrastructure Requirements for Development Phasing

Infrastructure Requirement	Development Capacity
Sanitary Servicing	
Hazeldean Pump Station capacity (with Glen Cairn forcemain returned to service)	+ 3,900 units
Hazeldean Pump Station upgrade (Third submersible pump)	+ 3,300 units
Hazeldean Pump Station upgrade (Replace 4 dry pumps and impellers) Assumption: KWPS online	+ 7,400 units
Water Servicing	
Trunk water mains and distribution	No constraints to development phasing
Stormwater Management	
Stormwater management facilities	By sub-watershed
Transportation	
N-S Arterial Road: Two lanes between Fernbank Road and Abbott Street (including collector road connection to Iber Road)	3,000 units
N-S Arterial Road: Two lanes between Abbott Street and Hazeldean Road Hazeldean Road: Four lanes	+ 5,000 units
Terry Fox Drive: Four/six lanes as per 2008 Transportation Master Plan	Balance of the planned development of the Fernbank CDP
N-S Arterial Road: Four lanes	As travel demands warrant

Section 13.0 Conclusions

This report provides a planning-level functional design to service the Fernbank Community. An internal servicing design is included to facilitate future detail design work. The servicing solutions presented herein are not intended to be absolute; in fact it is anticipated that Plan of Subdivision applications will alter some of the local road and layout configurations. To this end, the servicing design is intentionally conservative to permit flexibility in the land use plan and development densities.

Some offsite infrastructure will require upgrade or retrofit as a result of the Fernbank development coming on-stream. These municipal projects are identified along with potential design solutions and a projected year for the works.

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

Storm Drainage

- Groundwater infiltration will be promoted using best management practices.
- Baseflow temperatures in the outlet channels will be mitigated.
- The Environmental Management Plan dictates that eight (8) stormwater management ponds are required to service the Fernbank Community.
- The storm sewer system is designed using the dual drainage concept.
- The minor system typically conveys the 5-year peak flow. Inlet control devices regulate the flow; there is no overland flow during a 5-year rainfall event.
- The major system is conveyed overland to a SWM Facility, dry pond, or watercourse; major system flow will not cross the arterial road.
- Each SWMF will provide quality and quantity treatment of the rainfall runoff.
- Ponds 2 & 3 provide quantity control to the 10-year event; all other ponds control runoff to the 100-year event.
- The Granite Ridge pond outlet ditch will be abandoned; controlled flow from this facility will be conveyed to Pond 1. Provision is made for an overland flow route from the Granite Ridge Pond along the property line between the Fernbank Community and the Iber Road Industrial Park to Dry Pond 3.
- The major and minor system design will conform to the City of Ottawa Sewer Design Guidelines.

Wastewater Collection

- The 2009 Draft Infrastructure Master Plan calls for the extension of the North Kanata Trunk, conversion of the March Pump Station, abandonment of the March Forcemain, construction of the Kanata West Pump Station, and upgrading of the Signature Ridge Pump Station. These municipal works will modify some of the sewershed boundaries and affect the peak sewer flows.
- The North Kanata Trunk has adequate capacity to build-out.
- The Tri-Township Collector is undersized for both existing and future design flows; this sewer needs to be replaced given development pressure throughout the WUC. The sewer can surcharge about 1.0 metre without risk to community or environment. Flow monitoring and operational consideration, rather than design parameters, should dictate when the trunk sewer is replaced.
- The Glen Cairn Trunk has adequate capacity to build-out.

- The Hazeldean Pump Station sewershed services the communities of Stittsville, Glen Cairn, Bridlewood, and the Kanata South Business Park. Background growth and development in the Fernbank CDP Lands, suggest the planned third submersible pump will be required by 2012 using monitored flow from existing land and design flow from future development areas. A subsequent capacity upgrade will be required in 2016 to replace four pump and impeller units; this will provide the necessary capacity to build-out. Installation of a third 600mm forcemain would provide an additional 289 L/s capacity from the station, for a firm capacity of 1,779 L/s and total capacity of 1,986 L/s. Analysis suggests a forcemain upgrade is not required, but the information provides a level-of-comfort and expansion possibilities should flow rates exceed expectations.
- An overflow can be constructed at the Hazeldean Pump Station into Cell 1 of the Monahan Constructed Wetlands with an HGL of 95.00 at the inlet manhole. This will protect all development lands in the Fernbank CDP area, and most of the sewershed, should a catastrophic failure occur at the pump station.
- Kanata West Lands are temporarily discharging sanitary flow into the Stittsville Trunk (Hazeldean Pump Station sewershed). When the Kanata West Pump Station comes online a portion of the Stittsville sewershed near Hazeldean Road will be routed to the KWPS.
- The South Glen Cairn Trunk has adequate capacity to built-out.
- The Fernbank CDP Lands will be entirely serviced using gravity sewers. A new trunk sewer within the Hydro One easement will provide a wastewater outlet that discharges to the Hazeldean Pump Station. The sanitary hydraulic grade line will be at least 0.50 metres below all basement elevations. Residual capacity exists in the wastewater network to permit design flexibility for urban intensification.

Water Distribution

- A 305mm diameter trunk watermain network provides sufficient capacity to maintain appropriate pressures and fire flows throughout the Fernbank development.
- Upgrading internal watermain within Fernbank does little to improve conditions outside the Fernbank boundaries except if elevated storage is considered.
- A small portion of the Fernbank community is located in lands that may be considered to be part of the future Stittsville Pressure Zone (SPZ) based on ground elevation. As such the boundaries of the future SPZ should be reviewed in consideration of the Fernbank development.
- A large area in the Fernbank development area is expected to experience pressures greater than 80psi (550kPa) if the hydraulic gradeline is maintained at the current objective of 161 to 163m. As such, individual PRVs will be required for a high number of services. Service areas with ground elevations below 105.7m are susceptible to daily pressures exceeding 80psi (550kPa).
- Additional firm pumping capacity at the Glen Cairn Pumping Station and one of the Zone 2W pumping stations is required to meet the additional demands associated with the Fernbank Community. The total cost for these upgrades is estimated to be in the order of $1,150,000. The timing of these upgrades is related to the overall rate of growth in the entire Zone 3W.

- By adding elevated storage to an area adjacent to the Fernbank development in the South, pressures in Fernbank increase very minimally, no significant benefit observed in level of service with respect to pressures is provided. Fernbank community would benefit by additional fire flow capacity however the existing design already meets the fire flow requirements of the community. If storage is considered south of the Fernbank development, it is recommended that a strong feedermain of at least 610mm in diameter be considered to ensure sufficient flow capacity between the Zone 3W pumping stations and the storage tank. The watermain and road layout proposed for Fernbank allows for future consideration of a large diameter feedermain along an arterial road way.

Utility Infrastructure

- Each utility company (Hydro One, Hydro Ottawa, Enbridge Gas, Bell Canada, Rogers Ottawa) has confirmed their plant is in reasonable proximity to the study area, and that their is adequate supply to service the Fernbank Community.

All of which is respectfully submitted.

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