Council Resolution; and
Corporate Report: East Clayton NCP Extension – West of 188 Street Stage 1 and 2 Report

MINUTES
REGULAR COUNCIL – PUBLIC HEARING
Monday, April 18, 2005

Item No. C003 East Clayton Neighbourhood Concept Plan Extension West of 188 Street Stage 1 and 2 Report
File: 6520-20 (East Clayton West)

It was Moved by Councillor Watts
Seconded by Councillor Hunt

That Council:

1. Receive this report as information;

2. Approve the final and complete East Clayton Neighbourhood Concept Plan ("NCP") Extension - West of 188 Street, as contained in Appendix "A" to this report, as a means of managing development and providing services, amenities and facilities in support of the development of this neighbourhood;

3. Instruct the City Clerk to introduce a by-law to amend the Surrey Official Community Plan By-law, 1996, No. 12900 (the "OCP By-law"), as documented in Appendix "D", to add the East Clayton NCP Extension - West of 188 Street to Figure 27 entitled "Map Showing Recently Approved Secondary Plans";

4. Instruct the City Clerk to introduce a by-law to amend Surrey Zoning By-law, 1993, No. 12000 (the "Zoning By-law"), as documented in Appendix "E", to require amenity contributions from development in the East Clayton NCP Extension – West of 188 Street area, based upon the density bonus concept; and

5. Authorize staff to amend the Clayton Local Area Plan (1999) on the basis of the approved final and complete East Clayton NCP Extension - West of 188 Street.

RES.R05-917 Carried

SURREY
CITY OF PARKS

Corporate Report

NO: C003

COUNCIL DATE: April 4, 2005

COUNCIL-IN-COMMITTEE

TO:	**Mayor & Council**	DATE:	**March 30, 2005**
FROM:	**General Manager, Planning and Development**	FILE:	**6520-20 (East Clayton West)**

SUBJECT: **East Clayton Neighbourhood Concept Plan Extension West of 188 Street - Stage 1 and 2 Report**

RECOMMENDATION

It is recommended that Council:

1. Receive this report as information;

2. Approve the final and complete East Clayton Neighbourhood Concept Plan ("NCP") Extension - West of 188 Street, as contained in Appendix "A" to this report, as a means of managing development and providing services, amenities and facilities in support of the development of this neighbourhood;

3. Instruct the City Clerk to introduce a by-law to amend the Surrey Official Community Plan By-law, 1996, No. 12900 (the "OCP By-law"), as documented in Appendix "D", to add the East Clayton NCP Extension - West of 188 Street to Figure 27 entitled "Map Showing Recently Approved Secondary Plans";

4. Instruct the City Clerk to introduce a by-law to amend Surrey Zoning By-law, 1993, No. 12000 (the "Zoning By-law"), as documented in Appendix "E", to

require amenity contributions from development in the East Clayton NCP Extension – West of 188 Street area, based upon the density bonus concept; and

5. Authorize staff to amend the Clayton Local Area Plan (1999) on the basis of the approved final and complete East Clayton NCP Extension - West of 188 Street.

INTENT

The purpose of this report is to:

- Inform Council of the planning and public consultation process related to the proposed East Clayton NCP Extension – West of 188 Street (the "NCP Extension");

- Provide an overview of the Stage 1 and Stage 2 components of the NCP Extension and obtain Council approval of the NCP Extension; and

- Obtain Council's approval to bring forward the necessary amendments to the OCP By-law and Zoning By-law to formalize the amenity contribution requirements for development in this NCP Extension area.

BACKGROUND

The area that is the subject of the NCP Extension is located immediately to the west of 188 Street, adjacent to the approved East Clayton NCP, as illustrated in Appendix "B". It is generally bounded by the 70 Avenue alignment to the north, 188 Street to the east, 68 Avenue/Fraser Highway to the south and approximately 186 Street to the west. A recently approved commercial development is located to the south of the plan area, south of 68 Avenue. While the plan area is subject to the 1999 Clayton General Land Use Plan, an NCP has not yet been adopted to guide development and determine servicing and amenity requirements.

Much of the 18 hectare (45 acre) NCP area is occupied by the Clayton Heights Secondary School, North Creek and storm water detention facilities. Approximately 8 hectares (20 acres) are privately-held lands. Recently, interest has been expressed in the development of a 4 hectare (10 acre) parcel within this area for a residential project. Hope United Church, owner of the property in the southwest corner of the area, has also indicated interest in building a religious facility on their property.

Engineering studies have confirmed that the lands within the area fall within the same servicing catchment as the lands to the east of 188 Street in the East Clayton NCP and sufficient capacity is available to service the area. North Creek, stormwater detention facilities and the Clayton Heights Secondary School act to separate the area from the rest

of the Clayton community, to the west. As such, it relates more to the area east of 188 Street and, therefore, forms a logical extension of the East Clayton NCP.

In September 2004, Council authorized the preparation of an NCP for the subject area and approved Terms of Reference for the planning and consultation process. Appendix "B" illustrates the subject area in the context of the Clayton General Land Use Plan and East Clayton NCP. Given the relatively small area, well defined boundaries, established land uses on most of the properties, well established planning parameters set by the Clayton General Land Use Plan and East Clayton NCP and the small number of private properties, the Stage 1 (Land Use Plan) and Stage 2 (development policies, servicing plans and amenity requirements) have been consolidated into this one report.

DISCUSSION

Planning Context

The plan area is designated Suburban in the OCP. The Clayton General Land Use Plan designates the existing school (Clayton Heights Secondary School), detention pond, buffers/linkages/open space and creeks/riparian setbacks. A storm water detention pond is constructed within the NCP Extension area and the City is in the process of acquiring additional land for construction of an addition to the pond. The area that contains the pond will also be developed to function as a public recreational amenity area with trails and landscaping. The Clayton Plan designates the area bounded by North Creek, 188 Street and 68 Avenue is as Multi Family Residential and the remaining area to the west of North Creek is designated Institutional. Current land uses in the area include suburban residential and low intensity agricultural uses and a plant nursery. Clayton Park High School and East Clayton Elementary School are located in the northerly part of the plan area.

The Clayton General Land Use Plan shows 68 Avenue connecting to 184 Street to the north of Fraser Highway, via 186 Street and 70 Avenue, to link the East Clayton area with the area west of 188 Street. A pedestrian overpass across Fraser Highway at 186 Street is also proposed in the Clayton General Land Use Plan.

Planning Process and Public Consultation

In September 2004, Council authorized the preparation of the NCP Extension and approved the Terms of Reference for the planning process. This process was recommended as a result of requests by landowners in the area who were interested in developing their land and who had submitted a development application to the City. Consultation between the applicants, their consultants, School District staff, City staff and staff of other relevant agencies took place between October and December of last

year. Consultation with other property owners in the plan area was undertaken in November 2004.

A public open house was held on December 8, 2004 to present a draft land use plan and servicing concept and to receive comments from the public. Consultation with property owners and other stakeholders has been ongoing in relation to the resolution of specific issues.

Approximately 42 people attended the December 8, 2004 open house and 11 completed questionnaires were returned. Ten of the 11 respondents have properties outside the plan area. Four of the respondents supported the draft plan while seven indicated concerns. An analysis of the comments revealed that opposition was not due to concerns about the draft plan itself, but was related to more general issues such as loss of trees and green spaces as a result of development, the pace of development and concern that upgrading of roads and services is not keeping up with development. Concerns were also expressed over the amount of high-density residential and commercial development in the area and possible impacts on drainage and wildlife.

Concerns that were more specific to the proposed NCP Extension included the need for more green space, desire for a mix of housing other than townhouses on 188 Street and for buffering between the commercial development to the south of 68 Avenue and the residential area north of 68 Avenue. The land use plan, as proposed in this report, addresses these issues, as follows:

- To address the concern regarding the provision of green space, the plan includes a significant protected riparian area along North Creek, two greenways (as extensions of 69 Avenue and 68A Avenue) and a storm water detention facility, which will be developed to allow the land around the detention pond to be used as public open space.

- To address the concern regarding providing a mix of housing in the plan area, the preliminary plan of development, as prepared by the landowners for a 10-acre site fronting 188 Street within the plan area, was displayed at the open house. It showed townhouses on 188 Street with a proposed density in the range of 22 to 45 units per acre to reflect the townhouses on the east side of 188 Street and also illustrated apartment buildings to the south of the townhouses within the same development, which will achieve a mix of housing types within the same development.

- The proposed apartment buildings, as referenced above, also act to provide a suitable transition/buffer between the commercial development to the south of 68 Avenue and the family-oriented townhouse development to the north.

Hope United Church, the owner of the property located immediately north of Fraser Highway and west of North Creek, identified concerns about the potential loss of land to creek protection, trails and road dedication, access to their site from 68 Avenue and concern about potential vandalism and liability arising from the proposed public access trails along the creek riparian area.

The protection of the creek riparian area is a requirement of the DFO. The potential impact from road dedication and trails on the developable area of the site should be relatively minor. The issue of access to the site from 68 Avenue and liability concerns from public trails can be addressed at the time of a development application for the site. The Church has been advised that the trails will be designed with due consideration to CPTED principles. Similar trails and greenways elsewhere in the City are being used extensively and have had a positive impact on the areas in which they are located.

Guiding Principles for the Plan

As an extension of the East Clayton NCP, the land use pattern and development framework of this NCP are intended to reflect the sustainable development principles of the East Clayton NCP. These principles and how they are addressed by this NCP are discussed below:

Principle No. 1

Conserve land and energy by designing compact walkable neighbourhoods. This will encourage pedestrian activities where basic services (e.g. schools, parks, transit, shops, etc.) are within a five to six-minute walk of their homes.

Schools, parks, bus service on Fraser Highway and the recently-approved commercial development to the south of 68 Avenue are located within a walking distance of the future homes within the plan area. The pedestrian and road networks, which are extensions of the pattern established in the East Clayton NCP, will enhance pedestrian connections.

Principle No. 2

Provide different dwelling types (a mix of housing types, including a broad range of densities from single-family homes to apartment buildings) in the same neighbourhood and even on the same street.

The 22-45 upa (High Density) residential designation for the developable land within the NCP will allow opportunities for a variety of multiple residential housing types,

including row houses, townhouses and apartments. This will contribute to the housing mix in East Clayton.

Principle No. 3

Communities are designed for people; therefore, all dwellings should present a friendly face to the street in order to promote social interaction.

Future multiple residential units on 188 Street, 68 Avenue and 68A Avenue will be designed to be street-oriented with front entrances, porches, verandas and living rooms facing the streets to provide people-friendly streetscapes and promote social interaction.

Principle No. 4

Ensure that car storage and services are handled at the rear of dwellings.

Parking for the multiple residential developments will be provided at the rear from the interior of the sites or will be provided underground.

Principle No. 5

Provide an interconnected street network, in a grid or modified grid pattern, to ensure a variety of itineraries and to disperse traffic congestion; and provide public transit to connect East Clayton with the surrounding region.

The street and pedestrian network of the East Clayton NCP extends across 188 Street into the NCP Extension area to provide a variety of routes for pedestrian and vehicle circulation.

Principle No. 6

Provide narrow streets shaded by rows of trees to save costs and to provide a greener, friendlier environment.

Each of 68A Avenue, 68 Avenue and 188 Street will be constructed in keeping with the road standards of the East Clayton NCP, including requirements for tree planting. Trees will also be required along the internal roads of the multiple residential developments.

Principle No. 7

Preserve the natural environment and promote natural drainage systems (in which storm water is held on the surface and permitted to seep naturally into the ground).

The on-site drainage of the future development sites will be designed in keeping with the drainage standards and policies of the East Clayton NCP. Also, the stormwater detention facility located within the NCP Extension area and the riparian protection area along North Creek will contribute to the natural drainage of the NCP Extension area and East Clayton neighbourhood.

Proposed Land Use Plan

Land Use

The proposed Land Use Plan for the Extension area, attached as Appendix "C", is consistent with the Clayton General Land Use Plan, providing for the development of multiple unit residential at a 22 to 45 units per acre (upa) density. The plan's policies provide for housing forms such as apartment buildings with a density of up to 70 units per acre adjacent to the proposed commercial development to the south, provided that the overall density within the residential designation remains at between 22 and 45 units per acre. The number of multiple residential units anticipated is approximately 280 units, at an average density of 30 upa. The build-out population of the NCP Extension area will be approximately 800.

The Institutional designation for the church-owned land to the west and south of North Creek, as shown in the Clayton General Land Use Plan, will accommodate the religious facility uses proposed for this site.

Park, Open Space and Pedestrian Circulation

Existing recreational amenities in and adjacent to the area include the area around the storm water facility which will be designed to function as a public open space, playfields on the Clayton Heights Secondary School site and on Clayton Park. A greenway at the southerly edge of the Clayton Heights Secondary School property, as envisioned in the Clayton General Land Use Plan, will be retained in this plan.

The proposed NCP Land Use Plan provides for the extension of 68A Avenue to the west of 188 Street as a cul-de-sac with a pedestrian corridor leading to the west from the end of the cul-de-sac to the proposed trail network around the storm water detention facility. As this pedestrian amenity will be located on private property, a public right-of-way will be required. The pathway corridor and the greenway along the south side of the Clayton Heights Secondary School will provide a pedestrian circulation grid concept, which will contribute to the integration of the NCP Extension area with the East Clayton NCP. Pedestrian trails along the North Creek riparian area and stormwater facility, and the playfields on the school site, will link the plan area with Clayton Park. A proposed three metre wide pathway on the west side of 188 Street will provide a pedestrian/bicycle connection to the commercial development south of 68 Avenue and to the future

commercial village centre at 72 Avenue and 188 Street, while a pathway on the north side of 68 Avenue will facilitate the pedestrian/bicycle connection to Fraser Highway.

The connection of 68 Avenue to 72 Avenue via 185B Street, as shown on the Clayton General Land Use Plan, has been deleted due to the need to connect 68 Avenue directly to Fraser Highway. This revised connection will serve the recently approved commercial development south of 68 Avenue. A proposed pedestrian overpass across Fraser Highway, which was shown in the Clayton General Land Use Plan, has been replaced by a signalized intersection at 68 Avenue.

Schools

The plan area is within the catchment areas for the Clayton and East Clayton Elementary Schools and Clayton Heights Secondary School. The Surrey School District advises that the combined capacity of the two elementary schools, at present, is 240 students and the total enrolment is 256. By 2007, it is estimated that the combined enrolment at the two schools will increase to approximately 423 students, not including approximately 46 new students anticipated from the plan area. In 2008-2009, however, a new school is expected to open in East Clayton, which will relieve the overcrowding at the two existing schools.

The Clayton Heights Secondary School has a capacity for 1,000 students. Current enrolment is 1,127. The projected enrolment in 2007 is 1,313, not including the anticipated 23 students from the plan area. At present, a new secondary school site is approved for purchase and construction is proposed for 2008.

Development in the plan area will occur over the next few years as the residential units are built and occupied and some of the students will not arrive until after the new schools have opened. In the meantime, the students will need to be accommodated in the existing schools.

Amenity Requirements

As is the case with all other NCPs in the City, to address the impact of new growth, monetary contributions will be required from new developments in this NCP Extension area towards the provision of police, fire protection and library services and development and enhancement of parkland. The park amenity contributions will be used towards the following:

- Development and improvement of pedestrian trails;
- Enhancement of the stormwater detention area for use as a public open space;
- Development of the east-west greenway along the south side of the Clayton Heights Secondary School site;

- Amenities in the future village centre at 72 Avenue and 188 Street; and
- Natural Area Management, as required.

The following table summarizes the proposed amenity contribution amounts and estimated revenues, at build-out, of the NCP Extension from these contributions. The draft amenity contribution amounts were prepared in 2004. The figures in the table below have been adjusted to 2005 dollars:

East Clayton NCP Extension – West of 188 Street
Proposed Amenity Contributions (in 2005 Dollars)

	Residential Contribution Per Unit/Lot (Based on ±280 New Dwelling Units)	*Non-residential Contribution Per Acre (Based on ±3.75 Acres)*	*Estimated Revenue at Build-out (Approximate)*
Parks and Greenway	$768.06	n/a	$215,057
Library Materials	$127.30	n/a	$35,643
Police Protection	$56.66	$227.48	$16,718
Fire Protection	$245.63	$982.84	$72,461
Total:	$1,197.65 per new unit/lot	$1,210.32 per acre	$339,879

Implementation of the NCP

Amendments to the OCP

Implementation of this NCP Extension will require a redesigntion from Suburban to Multiple Residential in the OCP. As has been the practice with other NCPs, this will be completed as part of the development application process on a site-by-site basis. At the time of development applications, a City-initiated amendment will be brought forward to redesignate the public lands within the plan area.

Figure 27 in the OCP, depicting the locations of approved secondary plans in the City, will need to be amended to recognize this NCP Extension. Proposed amendments to the OCP are documented in Appendix "D".

Zoning By-law Amendments

To implement the amenity contribution requirements, Schedules F and G of the Zoning By-law will need to be amended. These amendments are documented in Appendix "E".

Form and Character of New Developments

The Development Permit Guidelines of the OCP will apply to new developments in the plan area and the policy guidelines related to the 22-45 upa (High Density) residential designation in the NCP Extension will supplement the OCP guidelines. The guidelines contained in the East Clayton NCP and considered relevant to this NCP will also apply.

Servicing and Financing

Servicing and financing strategies, to allow reasonable implementation of the NCP Extension, are described in a separate Corporate Report from the Engineering Department, included on the same agenda as this report.

CONCLUSION

Based on the above discussion, it is recommended that Council:

1. Approve the final and complete East Clayton Neighbourhood Concept Plan Extension - West of 188 Street, as contained in Appendix "A" to this report, as a means of managing development and providing services, amenities and facilities in support of the development in this neighbourhood;

2. Instruct the City Clerk to introduce a by-law to amend the OCP By-law, as documented in Appendix "D", to add the East Clayton NCP Extension - West of 188 Street to Figure 27 entitled "Map Showing Recently Approved Secondary Plans";

3. Instruct the City Clerk to introduce a by-law to amend the Zoning By-law, as documented in Appendix "E", to require amenity contributions from development in the East Clayton NCP Extension – West of 188 Street area, based upon the density bonus concept; and

4. Authorize staff to amend the Clayton Local Area Plan (1999) on the basis of the approved final and complete East Clayton NCP Extension - West of 188 Street.

Murray Dinwoodie
General Manager
Planning and Development

BP/kms/saw

Attachments:
Appendix "A" - Final and Complete NCP: East Clayton NCP Extension - West of 188 Street
Appendix "B" - Context Map - East Clayton NCP Extension, West of 188 Street
Appendix "C" - Proposed Land Use Plan - East Clayton NCP Extension, West of 188 Street
Appendix "D" - Proposed OCP By-law Amendment
Appendix "E" - Proposed Zoning By-law Amendments

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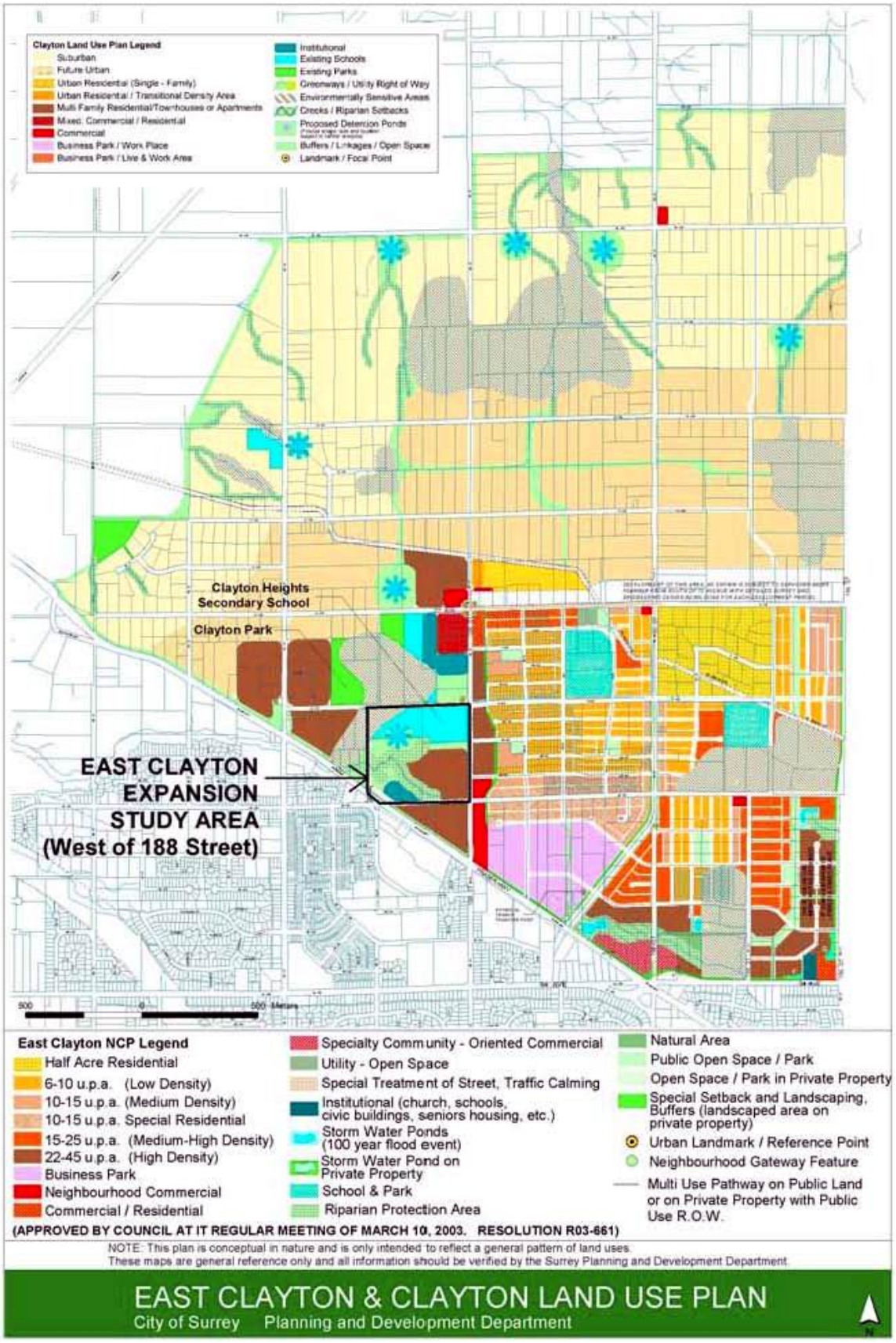
Appendix "A"

Final and Complete NCP
East Clayton NCP Extension – West of 188 Street

Appendix "B"

Context Map
East Clayton NCP Extension – West of 188 Street



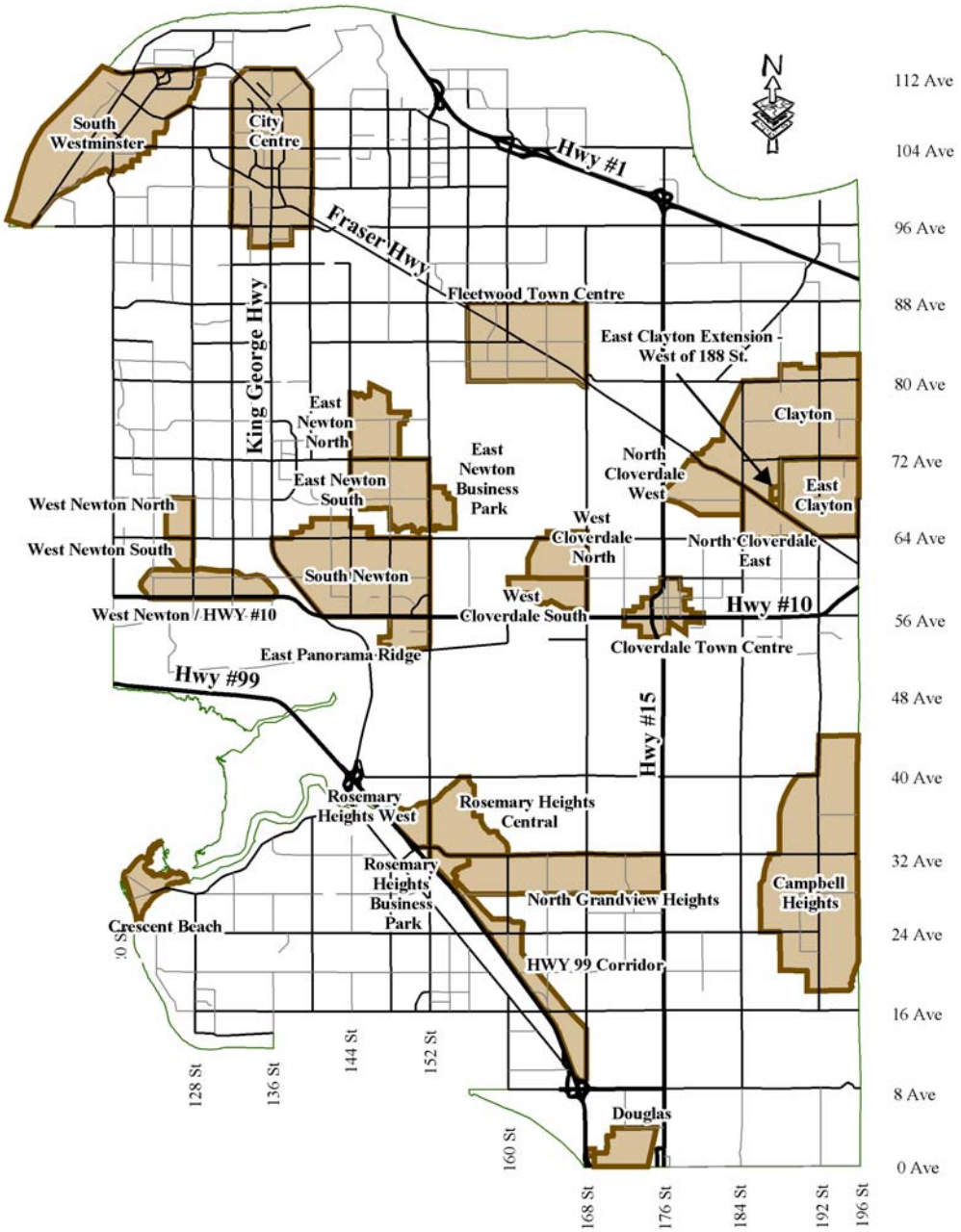
Appendix "C"

Proposed Land Use Plan
East Clayton NCP Extension – West of 188 Street

Appendix "D"

Proposed Amendment to
Surrey Official Community Plan By-law, 1996, No. 12900, as amended

1. Replace Figure 27, Map Showing Recently Approved Secondary Plans, in Division A, Part 5 of the Official Community Plan, with the following Figure.

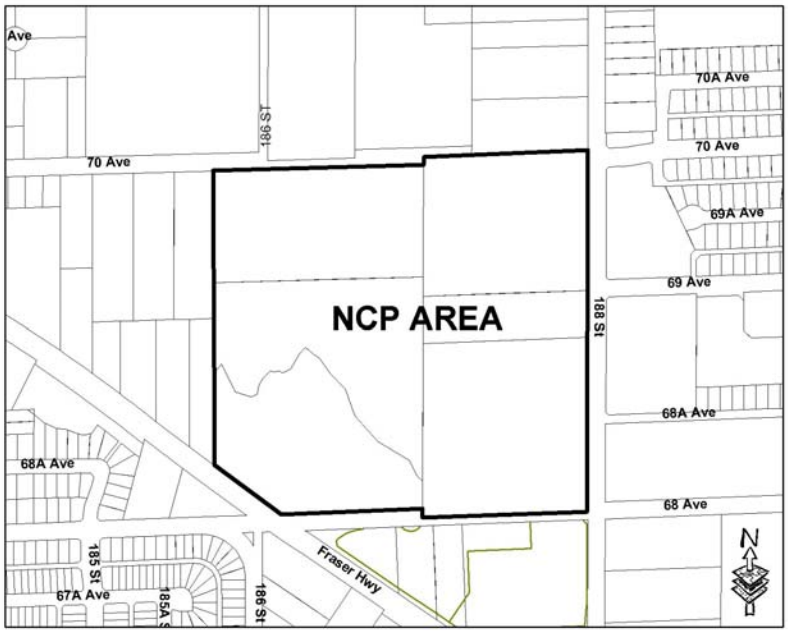


Appendix "E"

Proposed Amendments to
Surrey Zoning By-law, 1993, No. 12000, as amended

1. Amend Schedule F - Map of Neighbourhood Concept Plans and Infill Areas to add a new item 22, as shown below, following item 21.

22. Area XXII



2. Amend Schedule G - Amenity Requirements in Neighbourhood Concept Plan (NCP) and Infill Areas to add a new item 22, as described below, following item 21.

NCP and Infill Areas		Amenity	Contributions Per Dwelling Unit ①	Contributions For All Other Land Uses ②
22.	Area XXII on Schedule F of this By-law	Parks and Greenway	$768.06	N/A
		Library Materials	$127.30	N/A
		Fire Protection	$245.63	$982.84 per acre
		Police Protection	$56.66	$227.48 per acre
		Total Amenity Contributions (2005 Dollars) – Area XXII	$1,197.65	$1,210.32 per acre

Council Resolution; and
Corporate Report: East Clayton NCP Extension – West of 188 Street Engineering Servicing Plan

MINUTES
REGULAR COUNCIL – PUBLIC HEARING
Monday, April 18, 2005

Item No. R062 East Clayton Neighbourhood Concept Plan (NCP) Extension West of 188 Street - Engineering Servicing Plan
File: 6520-20 (EC)

It was Moved by Councillor Watts
Seconded by Councillor Tymoschuk

That Council:

1. Adopt the engineering servicing and financial strategies as outlined in this report and as specified in the East Clayton NCP Extension – West of 188 Street Expansion Report.

2. Continue to endorse the sustainability objectives as outlined in the original East Clayton NCP and associated reports to Council.

RES.R05-919 Carried

SURREY
CITY OF PARKS

Corporate Report

No: R062

COUNCIL DATE: April 4,2005

REGULAR COUNCIL

TO:	**Mayor and Council**	DATE:	**March 31, 2005**
FROM:	**General Manager, Engineering**	FILE:	**6520-20 (EC)**
SUBJECT:	**East Clayton Neighbourhood Concept Plan (NCP) Extension West of 188 Street – Engineering Servicing Plan**		

RECOMMENDATIONS

It is recommended that Council:

1. Adopt the engineering servicing and financial strategies as outlined in this report and as specified in the East Clayton NCP Extension – West of 188 Street Expansion Report.

2. Continue to endorse the sustainability objectives as outlined in the original East Clayton NCP and associated reports to Council.

INTENT

The purpose of this report is to provide Council with an overview of the engineering servicing and financial strategy for the East Clayton NCP West Expansion, in conjunction with a report submitted separately by the Planning and Development Department on the land uses in this NCP.

BACKGROUND

The Proposed Land Use Concept Plan for the Expansion Study area is being presented for approval in a separate Corporate Report from the General Manager of the Planning and

Development Department. This report outlines the engineering servicing issues and financial issues for the East Clayton NCP West Expansion.

DISCUSSION

The engineering services discussed in this report relate mostly to major community infrastructure and how the subject area can be serviced within the original East Clayton NCP context. Only infrastructure which is presently in or could be added to the 10 Year Plan and funded through Development Cost Charge (DCC) program is discussed in detail. Local servicing requirements of individual developments have been considered, but as they will be provided and funded by development, they are not addressed in the overall financial aspects of this report.

The original East Clayton NCP had a number of unique features and challenges that have been reviewed in this expansion, including:

- Extensive sustainable development initiatives throughout the NCP;
- Significant downstream drainage constraints;
- Two main servicing catchment areas defined by topography; and
- Until recently, limited existing servicing due to the rural nature of current land uses.

Since large portions of the original East Clayton NCP have been developed or are currently being developed, some of the servicing upgrades have been completed and present servicing opportunities for this Western expansion.

Sanitary Sewer

This area of East Clayton (Catchment B) sends sanitary sewer flows into the existing 68 Avenue trunk sewer located west of 188 Street. This existing trunk sewer discharges flows to an existing pump station located at 176 Street. Sewerage flows are pumped south via an existing forcemain from this pump station to the GVS&DD regional trunk sewer.

The existing pump station located at 176 Street has a capacity of 100 l/s and could be upgraded, in the future, to an ultimate capacity of 400 l/s. The proposed upgrade will be undertaken when required and will be funded through DCC contributions collected from the entire west catchment of the East Clayton area. The expansion area is to be serviced by the existing sanitary sewer system on 188 Street and 68 Avenue. Trunk sanitary sewers exist along the frontages of the expansion area including a 300mm diameter pipe on 188 Street and 375mm diameter pipe fronting 68 Avenue.

The original East Clayton NCP recommended that four sections of the sanitary system be upgraded (along 188 Street and 68 Avenue) to accommodate development. Recent analyses based on more accurate land use assumptions have indicated that even with the proposed NCP expansion, only two sections of the 188 Street sewer require upgrading.

There will be no adverse impact on the original East Clayton NCP servicing concept or downstream infrastructure for sanitary sewers.

Drainage

The NCP expansion area lies in the western catchment area (Catchment B) of the original East Clayton NCP. The catchment slopes in a westerly direction and drains to North Cloverdale Creek which is tributary to the Serpentine River via the Fry's Corner pump station.

Stormwater management is a cornerstone of the ecological sustainability strategy of the East Clayton NCP and this expansion must meet the same objectives. The requirements for infiltration systems and landscaping are outlined in the "Green Infrastructure Performance Standards and Guidelines" provided in the original NCP. It is proposed that the same requirements be incorporated in this expansion area.

The infiltration and low impact development strategies proposed in the NCP deal with small frequent rain events to protect ecological features but are not designed to deal with the large less frequent storms that lead to flooding. In order to meet our servicing requirements of protecting life and property for these less frequent larger events, a conventional conveyance and detention system is required. Under the original NCP, a detention pond (Pond E in the original NCP) and a 1050mm diameter trunk sewer along 68 Avenue west of 188 Street was proposed. These were constructed in part over the last three years and were designed with enough capacity to accommodate flows from the expansion area assuming full development. The actual land use proposed in this expansion plan will lead to no increase in detention requirement that were originally anticipated and accounted for in the NCP's funding analysis.

However, the final stage of the pond has yet to be completed and must be constructed before development in the expansion can proceed (or interim detention must be provided on subject sites).

Water

The expansion area is located in the "Clayton" pressure zone and is fed by an existing 400mm diameter grid main on 188 Street from the existing GVRD's Whalley/Clayton 900mm diameter water main on 72 Avenue, and the Clayton Reservoir and Pump Station located at 72 Avenue and 190 Street.

The water demand for the residential areas within the expansion area have been calculated in accordance with the City's design criteria. The additional water demands are being added to the City's network model to confirm the capacity of the existing 400mm diameter feeder water main on 188 Street and proposed 350mm diameter water main on 68 Avenue, east of 188 Street.

In addition to the water demand calculations, an analysis of the distribution network was completed, in order to determine sizing for a proposed water main on 68 Avenue, west of 188 Street to Fraser Highway, and on 68A Avenue cul-de-sac road west of 188 Street. In order to provide fire flow requirements for the study area, it was determined that a 250mm diameter water main was required on 68A Avenue and a 300mm diameter water main was required on 68 Avenue. These mains are local servicing requirements that are the responsibility of the developers of individual properties.

Based upon the East Clayton NCP engineering servicing report, the addition of the proposed study area will not adversely impact the East Clayton water supply system, provided that the new pump station is operational by the summer of 2006, subject to confirmation of water main sizing by water main modeling.

There are no DCC eligible water infrastructure elements required for construction in the study.

Transportation

All roads in the area will require upgrading from the existing rural cross-sections to urban standards. The neighbourhood traffic analyses undertaken as part of this expansion focused on the following impacts and access provisions:

- Impact at the Fraser Highway: 188 Street and 68 Avenue, and 188 Street/68 Avenue intersections with and without the extension of 72 Avenue to Fraser Highway; and
- Access locations on 68 Avenue and 188 Street considering need and access for currently approved developments.

In order to maintain a four-lane cross-section at Fraser Highway, extension of 72 Avenue to Fraser Highway is recommended by 2016. 72 Avenue would also be a four-lane facility west of 192 Street. Detailed intersection and cross-section requirements corresponding to the 2016 recommendations are listed in the report and must be implemented as development progresses. These are consistent with the recommendations made in the original NCP. The City will ensure that all driveways to fronting properties along 68 Avenue are located such that the operation of 68 Avenue, 188 Street and Fraser Highway is not compromised.

Financing

It is anticipated that west extension of the East Clayton NCP will generate approximately $1,917,500 of DCCs for engineering services ($127,000 for sanitary, $450,000 for drainage, $224,000 for water, $1,116,500 for transportation). There are enough DCC revenues to compensate for extra DCC expenditures off-site such as water, sanitary pump stations, stormwater detention facilities, and roadworks.

Development Phasing

Development has proceeded quickly to date in the East Clayton NCP. Development within this expansion can progress as local infrastructure is provided by others or by the subject developers. Also, verification of major regional infrastructure (water supply and sanitary pump stations) will continue to ensure development does not out pace upgrades listed above. Ultimately, as in other NCP areas, the market will determine the actual development patterns and phasings.

CONCLUSION

A comprehensive servicing and financial plan has been developed for the West Expansion to the East Clayton NCP. Based on this plan, development within the expansion area can proceed in accordance with the overall objectives of the original East Clayton NCP.

Paul Ham, P.Eng.

General Manager, Engineering

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REPORT TO

CITY OF SURREY

FOR

EAST CLAYTON NEIGHBOURHOOD CONCEPT PLAN

EXTENSION – WEST OF 188 STREET

NCP EXPANSION REPORT

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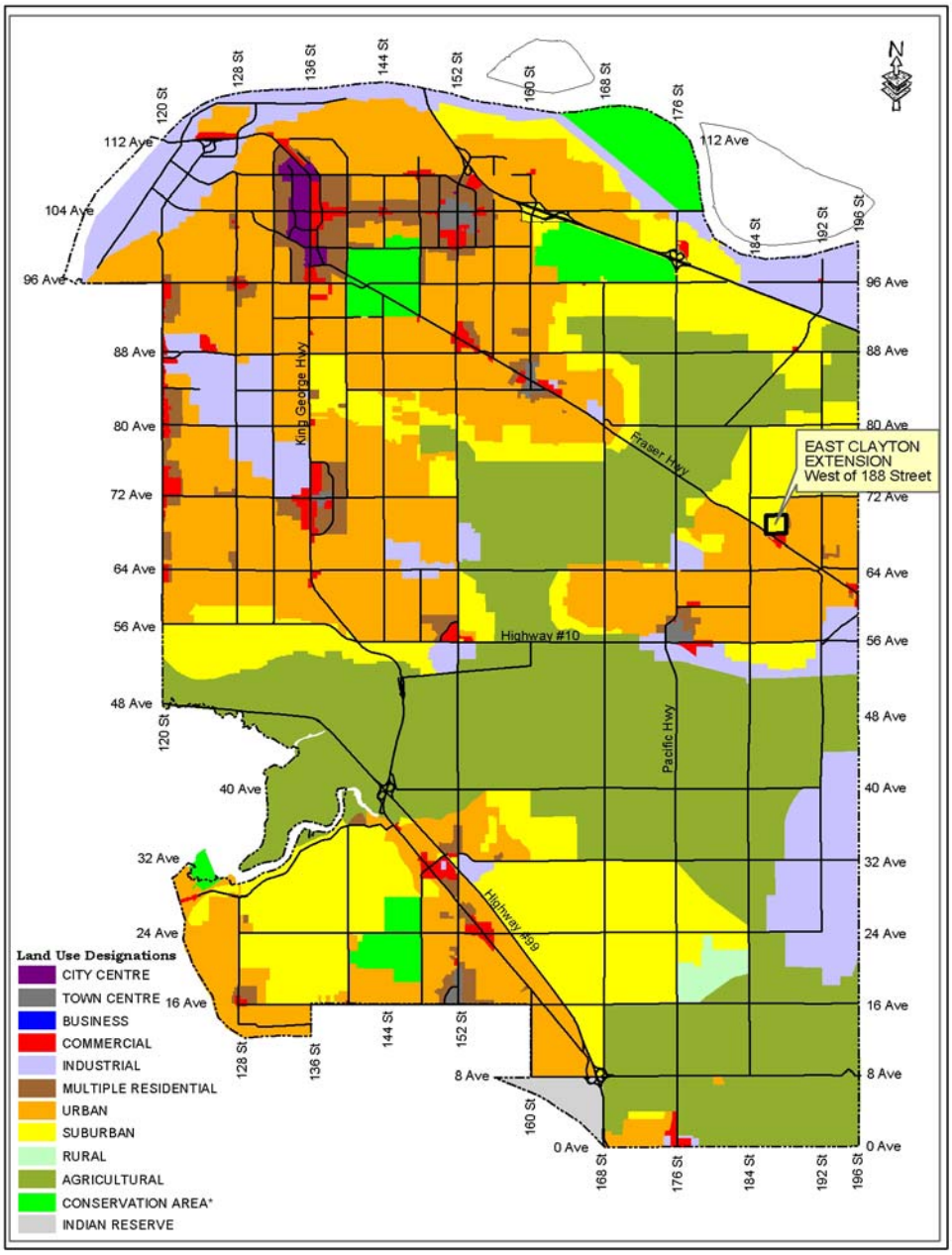

Figure 1 – East Clayton West Neighbourhood in Surrey

Part I: Background

1. Context

The East Clayton West of 188 Street Neighbourhood Concept Plan Extension area (East Clayton West) is located in the Clayton community and is defined by 188 Street, 68 Avenue, 186 Street and 70 Avenue (Figure 1). It is located immediately to the west of the East Clayton NCP area. Presently, it is subject to the Clayton General Land Use Plan (approved by Council in 1999) that establishes general land uses and planning framework for the broader Clayton community (see Figure 2).

The East Clayton West area is 17 hectares (43 acres) in size and has well defined boundaries including existing development and features to the west and north and 188 Street and 68 Avenue to the east and south. These include Clayton Secondary School, riparian protection areas associated with the headwaters of North Creek, and a stormwater detention facility. These features limit opportunities to continue roads and land uses to the west, thereby effectively separating the East Clayton West area from the broader Clayton community. The East Clayton West area more closely relates to the East Clayton NCP area from land use, connectivity, servicing, and amenity perspectives, and, as such, represents a logical extension of the East Clayton NCP.

Located to the north of the plan area are Clayton Park and East Clayton Elementary School, which are designated as Existing Park, Existing School, Buffers/Linkages/Open Space and Institutional in the Clayton General Land Use Plan. To the west of the plan area, lands are subdivided into one to five acre suburban parcels. These lands are designated as Multiple Family Residential in the Clayton General Land Use Plan but are presently used for low intensity residential purposes. The site immediately south of 68 Avenue has recently been approved for commercial uses.

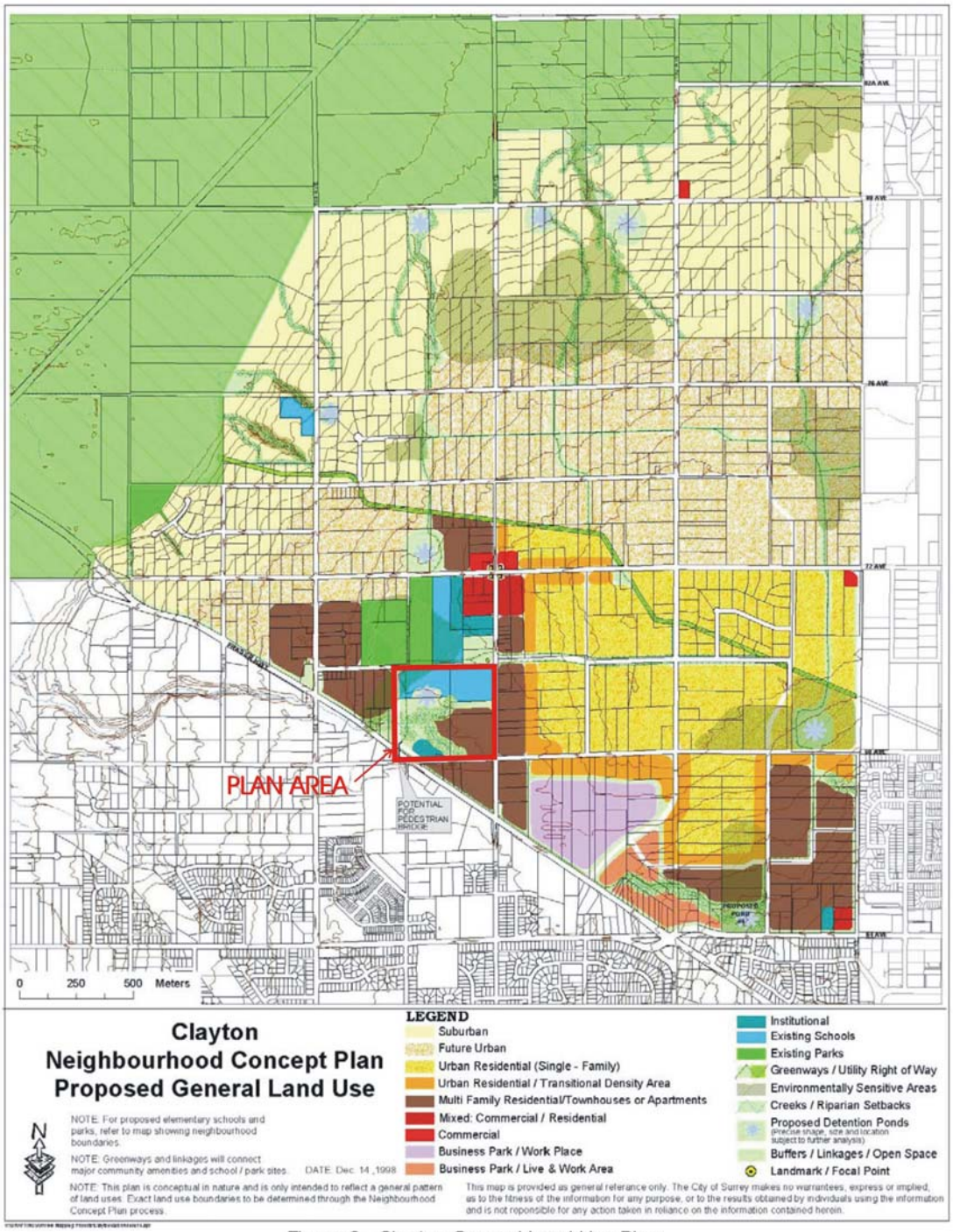

Figure 2 - Clayton General Land Use Plan

To the east of 188 Street, lands are subject to the East Clayton NCP and are intended for Multiple Family Residential and Commercial / Residential land uses. To date, two townhouse projects with a total of 129 units have been developed along 188 Street between 68A Avenue and 70 Avenue, and a neighbourhood commercial project is proposed between 68A Avenue and the Fraser Highway. Pedestrian and vehicle corridors that provide for neighbourhood connectivity are located east of 188 Street at 68, 68A and 69 Avenues and a greenway corridor parallels 188 Street, along the eastern edge of the higher density residential and commercial land uses.

2. The Plan Area

The plan area is designated Suburban in the Surrey Official Community Plan. The Clayton General Land Use Plan designates lands along 188 Street as Multiple Family Residential, while the Clayton Heights Secondary School, North Creek environmental area and stormwater detention facility are designated as Existing School, Buffers/Linkages/Open Space, Creek/Riparian Setbacks and Proposed Detention Ponds, respectively. A portion of the property in the southwest corner of the plan area is designated Institutional. This site (1.5 hectares / 3.7 acres) is owned by a religious organization and is presently used as a garden nursery.

Presently, all properties within the plan area, with the exception of the School and Institutional sites, are used for residential purposes and/or low intensity agriculture. Approximately half of the stormwater detention facility immediately to the south of the school site has been constructed. The city is in the process of acquiring additional land to allow its expansion to its ultimate size. The North Creek environmental area is heavily treed, as is a portion of the property immediately south of the secondary school.

3. Initiation of the East Clayton NCP Extension – West of 188 Street

During 2004 owners of one of the properties fronting 188 Street and designated Multiple Family Residential on the Clayton General Land Use Plan proposed a residential development, while owners of the Institutional property at 68 Avenue and Fraser Highway expressed a desire for a church development.

At the October 4, 2004 regular Council meeting staff advised Council of the absence of a detailed NCP for the lands. Council considered Corporate Report No. 258 and authorized the Planning & Development Department to proceed with a planning and public consultation process to prepare an NCP for the subject area. The approved the Terms of Reference for such a process is attached as Appendix I.

4. Opportunities and Constraints

The East Clayton West area offers a number of opportunities for consideration in the preparation of an NCP expansion, including the following:

- A viable and logical expansion of the rapidly developing East Clayton NCP area;
- A small, well defined area separated by a creek and school from the rest of the community;
- Well-established existing land use strategy set out in the East Clayton NCP to guide future planning;
- A limited number of stakeholders;
- A study area consisting mostly of large, vacant and underutilized parcels;

- A well-established and clearly-defined servicing relationship with the East Clayton NCP area with much of the infrastructure installed or proposed to be constructed/upgraded in the near future;

- Opportunity for continuation of the east/west pedestrian connectivity established in the East Clayton NCP, including connections between East Clayton and Clayton Park; and

- Established neighbourhood amenities and facilities within or in close proximity to the area.

The area also has some constraints and issues that must be considered, including the following:

- Continuation of the road grid pattern west of 188 Street is not possible because of the location of the secondary school and environmental area;

- North Creek supports coho salmon and cutthroat trout and must be protected with a minimum 30 metre no-disturbance buffers, unless a reduced buffer is approved by the Department of Fisheries and Oceans;

- The elimination of a man-made ditch adjacent to the 68 Avenue right-of-way necessitates compensation, including provision of wetland/riparian habitat within the expanded detention pond, and development of a new pond and wetland habitat and enhanced existing riparian areas adjacent to the retained portion of the creek;

- There needs to be a suitable transition between the Clayton Secondary School and future residential development; and

- Due to decision made in the consideration of the commercial development to the south, 68 Avenue will not be connected to 70 Avenue as shown in the Clayton General Plan. 68 Avenue will be connected to Fraser Highway to the east of 186 Street.

5. The Planning Process

The planning process, including the consultation phase, is based on the October 4, 2004 Terms of Reference. The following is a list of the major steps in the planning process leading to the completion of the NCP:

- Planning and engineering consultants retained (October 2004);
- Consultation with the Planning and Development, Engineering, Parks and Fire Departments, Surrey School District 36 and RCMP (October – December 2004);
- Initial consultation with the owners of property within the plan area (November 2004);
- Public open house on December 8, 2004 to present draft land use and servicing concepts to the public and to solicit feedback. Approximately 42 local residents attended the meeting; and
- On-going consultation with stakeholders to resolve issues (December - January 2004).

A questionnaire was distributed at the December 8 public information meeting to assist in assessing the level of support for the draft concepts and to identify issues. A total of 13 questionnaires were returned. Many respondents raised issues and concerns affecting the broader Clayton area and not specifically relating to the NCP Extension area, including the pace of development, road and servicing upgrades, school capacity, tree protection, and the amount of commercial development proposed. It was suggested that a similar planning process is needed for the lands to the west and north of the plan area. Comments directly relating to the East Clayton NCP Extension area focused on housing mix, buffering from neighbouring commercial development and roads, access to open space, and the amount of open space. Concern was also raised by the owner of the church property about the loss of development potential as a

result of environmental protection areas, trails and setbacks and site access requirements.

Part II: Planning Objectives, Land Use Plan and Policies

1. Planning Objectives

As an extension of the East Clayton NCP, this NCP for the East Clayton West area is based on the same core planning objective of creating a sustainable community in Clayton. The seven principles of sustainable development that formed the basis of the East Clayton NCP are outlined below.

Principle No. 1

Conserve land and energy by designing compact walkable neighbourhoods. This will encourage pedestrian activities where basic services (e.g. schools, parks, transit, shops, etc.) are within a five to six-minute walk of their homes.

Principle No. 2

Provide different dwelling types (a mix of housing types, including a broad range of densities from single-family homes to apartment buildings) in the same neighbourhood and even on the same street.

Principle No. 3

Communities are designed for people; therefore, all dwellings should present a friendly face to the street in order to promote social interaction.

Principle No. 4

Ensure that car storage and services are handled at the rear of dwellings.

Principle No. 5

Provide an interconnected street network, in a grid or modified grid pattern, to ensure a variety of itineraries and to disperse traffic congestion; and provide public transit to connect East Clayton with the surrounding region.

Principle No. 6

Provide narrow streets shaded by rows of trees in order to save costs and to provide a greener, friendlier environment.

Principle No. 7

Preserve the natural environment and promote natural drainage systems (in which storm water is held on the surface and permitted to seep naturally into the ground). Also, sustainable engineering features, including infiltration and volume controls, shall be implemented.

Surrey's Official Community Plan requires that all local area plans and neighbourhood concept plans reflect the policies and directions of the Official Community Plan. Therefore, the East Clayton West Extension land use plan is also guided by the following City-wide objectives as expressed in the Official Community Plan. As an extension of the East Clayton NCP it reinforces the OCP objective of creating a complete community.

- Encourage growth and development that effectively utilizes land and City resources;
- Create orderly and cost-effective development by promoting a complete urban community;
- Provide a balanced range in choices in the type, tenure and cost of housing;
- Create a safe, attractive and people-friendly environment through the promotion of CPTED (Crime Prevention Through Environmental Design) principles;
- Protect and enhance the natural environment including fish, wildlife and bird habitats; and
- Provide and preserve linear green spaces consisting of open space, environmentally sensitive areas including fish and wildlife habitat, and trails

and walkways that connect parks and other open spaces, green belts and conservation areas.

2. Relationship of East Clayton West NCP with East Clayton NCP

The East Clayton West Extension area supports the East Clayton NCP's seven principles of sustainable development in the following ways:

Principle No. 1

The plan area is located close to schools, transit, parks and shops. Pedestrian and road networks are extensions of the road pattern established in East Clayton to enhance pedestrian connections.

Principle No. 2

The NCP allows opportunity for a variety of multiple residential housing types, including townhouse and apartments.

Principle No. 3

Future dwellings on 188 Street and 68 Avenue will be oriented towards the road to provide interesting and people-friendly streetscapes.

Principle No. 4

Parking for the multiple residential developments will be provided at the rear from the interior of the sites or will be provided underground.

Principle No. 5

The street and pedestrian network established in the East Clayton NCP extends across 188 Street into the East Clayton West area, which will provide a variety of opportunities for pedestrian and traffic circulation.

Principle No. 6

Trees will be planted along 188 Street and 68 Avenue and internal access roads. 68A Avenue will be constructed in keeping with the public road standards of the East Clayton NCP.

Principle No. 7

The riparian protection area for the North Creek and the storm detention facility will contribute to the natural drainage of the East Clayton neighbourhood and this NCP area. The on-site drainage of the development sites will be designed in accordance with East Clayton NCP drainage policies.

The proposed higher intensity residential land uses in the East Clayton West Extension area are compatible and consistent in terms of built form, character and density with the higher intensity residential and commercial land uses found immediately adjacent in the East Clayton NCP area. Together, they advance many sustainable planning principles, such as creating compact, walkable neighbourhoods, with most homes in easy walking distance of basic services and providing a range of housing options through different dwelling types, tenures and densities. The continuation of East Clayton vehicle corridors at 68 and 68A Avenues and pedestrian connections at 68A and 69 Avenues into East Clayton West will contribute to a high level of connectivity, continuity and mobility and allow for integration of this NCP area with the East Clayton area.

3. The Land Use Plan and Policies

The final Land Use Plan for the East Clayton West Extension area is shown in Figure 3. The land uses and supporting policies are based on those found in the East Clayton NCP. Land use descriptions and supporting policies detailed in the East Clayton NCP that are relevant to this NCP will apply.

3.1 Residential

The developable portions of the properties fronting 188 Street are designated 22-45 units per acre residential (High Density). This designation permits residential development at a density of 22-45 units per acre (u.p.a) in a range of built forms, including townhouses, row houses and garden apartments.

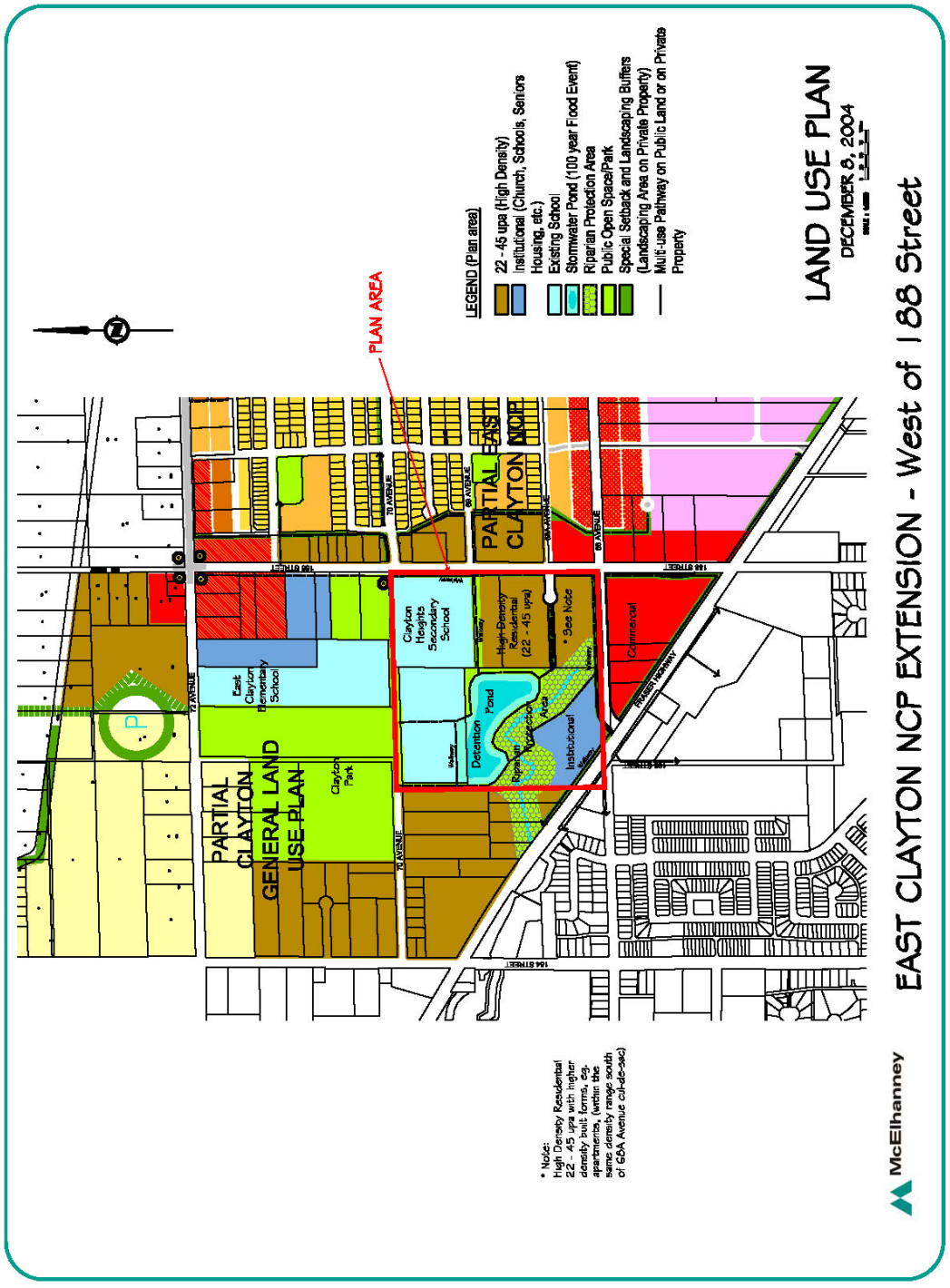

Figure 3 – East Clayton West of 188 Street Land Use Plan

The High Density residential area may be subdivided into smaller development sites and each site may be developed with different housing forms. Higher density housing forms, such as apartment buildings, will be located in the southern portion of the High Density Residential area, generally to the south of 68A Avenue alignment, and oriented toward commercial uses to the east and south. Other housing forms, such as townhouses and row houses may be located on the remainder of this area other than in the southern portion. Housing diversity will be achieved by ensuring that the higher density housing forms, such as apartment buildings, are included as part of a comprehensive plan for the area.

The density on a site located in the southern portion of this designation may exceed 45 u.p.a up to a maximum of 70 u.p.a provided that the average density of all sites within the designation is between 22 and 45 u.p.a and applications for OCP Amendment, rezoning and development permit are submitted and approved to allow the permitted densities. A comprehensive proposal will be required as part of the applications to show the proposed densities and built forms, including buildings that may have the density exceeding 45 u.p.a. and to demonstrate that the average density of all built forms will be between 22 and 45 u.p.a.

RM-30 and RM-45 Zones (Zoning By-law No. 12000) are considered appropriate to accommodate residential developments in this area. When these zones are considered inappropriate to accommodate a specific proposal, a CD Zone may be proposed provided that the residential density is in keeping with this NCP.

Policy Guidelines

- Recognition of and compatibility with the predominant single-family residential character of the East Clayton neighbourhood and inclusion of the highest possible number of ground-oriented units each having a direct connection to the streets will be the guiding principles in the design of all residential buildings.

- Residential developments will be designed to provide a strong street orientation, clear delineation between public and private spaces, articulated facades, unified residential character, massing that contributes to a human scale and will be built using high quality materials. "Gated" developments are not considered appropriate. Building setbacks smaller than 7.5 metres may be required to achieve a strong street orientation.

- Buildings will be designed to maximize opportunities for surveillance of the public corridors. CPTED principles will be applied to the design of all buildings and exterior spaces.

- Each residential development will have at least one access from a public road, with the access to the site south of the Clayton Heights Secondary School offset by a minimum of 25 metres from the 69 Avenue/188 Street intersection (measured (measured between nearside curb or property lines) or as required by the City's Engineering Department.[1]

- 68A Avenue will be extended to the west of 188 Street to provide public access into the High Density residential area. This, in conjunction with a multi-use pedestrian corridor, will provide a direct connection and access through the plan area to the public open space amenity on the west side of the plan area. It will also integrate the area into the East Clayton neighbourhood. 68A Avenue will be extended sufficiently to establish public realm within the area and create the perception of a public road.

- 68A Avenue extension may be either public or private. If it is provided as a private road, a right-of-way to allow public access will be required. Gates, fences and other structures that may block or restrict access/views from 188 Street so as to give perception of a private road will not be permitted and it

[1] Refer to the City of Surrey *Design Criteria Manual* for appropriate driveway offsets.

will generally be designed in keeping with the City's public road standards for the East Clayton NCP. The road dedication or statutory right-of-way provided will be sufficient to include sidewalks, grass boulevards with trees and on-street parking pockets in keeping with the policies and standards provided in the East Clayton NCP and to establish pedestrian-friendly public realm. Provided that the intent of this guideline area is maintained, locations for sidewalks and on-street parking, i.e. whether they are required on one side or both sides, may be reviewed and adjusted by the City during the review of a development application on the basis of the site-specific development proposal, the length of the road achieved and engineering criteria.

- The multi-use corridor will be a minimum of 15 metres in width, landscaped and include a paved pathway. The pathway will be of sufficient width to allow its safe use by multiple users including pedestrians and bicycle riders. Buildings, outdoor spaces such as patios and decks and fences flanking this corridor will be designed to be pedestrian-friendly, incorporate CPTED principles and will be set back sufficiently from the corridor and designed such that there will not be a "tunnel" effect along the corridor. The layout, design and landscaping of the corridor will incorporate CPTED principles and ensure visual and functional continuity of pedestrian connectivity from 68A Avenue extension to the public open space amenity on the west side. A right-of-way to allow public access will be required over the entire corridor. Bollards will be used at all pathway connections to roads.

It is estimated that at build-out the Residential area will generate approximately 280 units and a population of approximately 784, assuming 2.8 persons per unit.

Table 1 – NCP Build-out Estimates

Land Uses	Land Area (hectares/ acres)	Density (uph / upa)	Dwelling Units	Population
High Density Residential	3.8 / 9.3	71 / 30	280	784
Institutional	1.5 / 3.8			
Existing School	5.7 / 14.0			
Parks and Open Space	1.9 / 4.7			
Detention Pond / Riperian Area	4.3 / 10.6			
Roads	0.2 / 0.6			
Total	17.4 / 43.0			

3.2 Institutional

The property at 68 Avenue and Fraser Highway is designated Institutional.

Future development will be oriented towards 68 Avenue, and parking facilities will be screened from Fraser Highway and 68 Avenue. High quality design will be encouraged that resolves any visual impact of building massing with consideration for site context and reduces any impact on the riparian protection area.

Site access will be located as far east as possible without impacting the riparian protective area and to avoid traffic impacts at the 68 Avenue and Fraser Highway intersection. Development standards/regulations will conform to the approved zoning of the site and generally be in accordance with the PA-1 or PA-2 Zones contained in the Surrey Zoning Bylaw, No. 12000. A site-specific CD zone may also be considered where existing zones are considered inappropriate.

3.3 Parks and Open Space

Given the limited opportunity to provide park and open spaces in this NCP and the proximity of the existing Clayton Park, the only park spaces designated are the linear park (i.e., greenway) along the south side of the Clayton Heights Secondary School and the space bordering the stormwater detention facility. The area surrounding the stormwater facility will be designed and landscaped to maximize opportunities for its use as a public open space.

The proposed greenway will facilitate improved pedestrian connectivity from the East Clayton neighbourhood to Clayton Park. Its recommended total width is 20 metres, including a portion on the school site. The 20 metre width may be reduced if it is demonstrated at the time of a development application that this width restricts the development potential of the property south of the school site. A portion of the greenway is shown on the School site where opportunity exists for the partial location of the greenway due to the existing 5-metre storm sewer right-of-way. The greenway's ultimate location and width will be determined by the City in consultation with the private property owners and the School District on the basis of CPTED considerations and good urban design.

3.4 Schools

This NCP area is located within the catchments for the Clayton Elementary, East Clayton Elementary and Clayton Heights Secondary schools.

The Surrey School District, which was consulted throughout the plan preparation process, advises that East Clayton Elementary has a capacity of 125 students and currently has 26 kindergarten and 80 grade 1 – 3 students. Clayton Elementary also has a capacity of 125 students, with a current enrollment of 150 grade 4 – 7 students. By 2007 it is estimated that enrollment will increase at each of the schools: 205 students at Clayton and 218 students at East Clayton, respectively. However, in 2008-2009 it is anticipated that enrollment will decrease as the first of two new East Clayton elementary schools opens. The

second elementary school is planned for a 2010 opening. The status of Clayton and East Clayton schools will be assessed as the new schools open.

It is estimated that approximately 280 units could generate approximately 46 new elementary students. The School District advises that these students can be accommodated until the new elementary schools are opened. It should be noted that these students will not suddenly enter the school system on mass but will instead gradually arrive as the area develops and units are sold. As a result, the majority of the projected new students may not arrive until after the new school has opened.

The School District also advises that Clayton Heights Secondary School has a capacity of 1,000 students, based on 25 students per class. Current enrollment is 1,127 and the projected enrollment in 2007 is 1,313. The School District is planning for a new secondary school north of 72 Avenue to service Clayton and Port Kells. It could potentially open in 2011. Typically, multiple family units do not generate a significant number of secondary students on a per unit basis. Therefore, it is estimated that the proposed townhouse and apartment units could generate approximately 23 new students. These students could be accommodated at Clayton Heights Secondary School. There are also other schools nearby, including Lord Tweedsmuir, Cloverdale Traditional and Fleetwood Park, that could absorb some students, if required.

3.5 Circulation

Pedestrian/bicycle connectivity is provided within the East Clayton West area by extending the network east of 188 Street into the neighbourhood at 68, 68A and 69 Avenue. Trail connections are provided along the east and west side of North Creek, around the stormwater detention facility, and to Clayton Park and East Clayton Elementary School to the north. The proposed network of multi-purpose and pedestrian trails is shown on the Land Use Plan.

As 188 Street and 68 Avenue are primary pedestrian connections from areas south of Fraser Highway to the Clayton Heights Secondary School. 3.0m wide multiuse pathways will be provided along the west side of 188 Street and north side of 68 Avenue. Cross-sections of these two roads are shown in the appendices. Sidewalks will eventually be extended to 72 Avenue to provide a connection to the future village centre. A 4.0 metre multi-use pathway is envisioned along the Fraser Highway.

A public access corridor will be provided from 188 Street to the proposed park area along the 68A Avenue alignment. The greenway will be landscaped, include a pedestrian trail, and will widen at the park to maximize sight lines.

To enhance pedestrian safety near the school, the intersection of 188 Street and 70 Avenue will incorporate a traffic-calming feature, which will be confirmed later through consultation with the School District and the Engineering Department. The traffic-claming feature will be funded through DCC revenues.

Part III: Implementation

1. Amenity Contributions

To address the amenity needs associated with the new growth anticipated in the East Clayton West Expansion area, all new residential development will be required to make monetary contributions towards the provision of new police and fire protection services, library materials and the development of park amenities. Non-residential land uses are exempted from contributing towards park amenities and library materials because these types of uses will have minimal impact on these services, as they do not directly require such services.

The monetary contributions will be collected at the time of rezoning or subdivision approvals or building permit issuance, whichever occurs first. The required contributions towards police, fire and library materials will offset the capital costs of providing these services for the new development and are applied on a standardized basis in all Neighbourhood Concept Plan areas in the City. The contributions towards the development of park amenities are based on an estimate of the capital costs for these improvements for this particular NCP area. In the case of residential developments, the total capital cost is divided by the number of anticipated dwelling units to arrive at the contribution amount. In the case of non-residential development, the contributions are collected on the basis of site area.

A summary of the applicable amenity contributions (per dwelling unit/lot or per acre) and the estimated revenue the City can expect to receive from the East Clayton West Expansion area at build-out is outlined in the following table. All figures are in 2005 dollars.

Table 2 – NCP Amenity Contributions

	Residential Contribution Per Dwelling Unit *(Based on ±280 units)*	*Non-Residential Contribution Per Acre* *(Based on ±3.75 acres)*	*Anticipated Revenue at Build-out (approximately)*
Parks and Greenway	$768.06	n/a	$215,057
Police Protection	$56.66	$227.48	$16,718
Fire Protection	$245.63	$982.84	$72,461
Library Materials	$127.30	n/a	$35,643
Total	$1,197.65 per unit	$1,210.32 per acre	$339,879

The park amenity contribution will be used towards the following projects:

- Enhancement of the detention pond area;
- Development and improvement of pedestrian trails;
- Development of the proposed east-west greenway along the south side of the Clayton Heights Secondary School;
- 188 Street / 72 Avenue village center amenities; and
- Natural area management, as required.

A summary of the estimated cost of developing these park amenities is included in Appendix II.

The estimated costs of the various amenities are distributed evenly to each dwelling unit in the area based on the anticipated number of dwelling units, which are derived from the estimated base density of 30 units per acre in the High Density Residential designation. Therefore, if a land use designation on a site is amended in the Land Use Plan such that the number of dwelling units decreases the proponent will be expected to “top up” the amenity fees for that development

based on the original housing density in the Land Use Plan. This will ensure that there is no shortfall in the funding for the proposed amenities.

2. Amendments

2.1 Official Community Plan

Where amendments to the Official Community Plan are required to implement this Plan (e.g., redesignation from Suburban to Multiple Residential), they should occur on a site-by-site basis in conjunction with the related development application review process to ensure that the redesignated area conforms to the actual site.

2.2 Neighbourhood Concept Plan

All proposed minor and major amendments to the East Clayton West Expansion area shall be undertaken in accordance with the policy to amend secondary plans contained in Part 5, Division A of the Official Community Plan.

2.3 Zoning By-law

An amendment to the Zoning By-law No. 12000 is required to implement the amenity contribution component of this Plan. Further, to implement the land use plan specific sites proposed for development/redevelopment will require rezoning in accordance with the established rezoning process.

3. Form and Character Guidelines

All developments will be reviewed in accordance with the Development Permit Guidelines of the Official Community Plan. Also, any guidelines contained in Part 2 of this NCP and the relevant guidelines of Part 3 of the East Clayton NCP will supplement the OCP guidelines and will apply.

4. Servicing, Phasing and Financing

The East Clayton NCP Extension Servicing Plan is included in Part IV. It addresses infrastructure and servicing (including Sanitary Sewer, Drainage, Water, and Transportation) and funding impacts and strategies to implement the proposed servicing infrastructure.

Part IV: Servicing Plan

This engineering servicing analysis reviews and describes the impact of the proposed East Clayton Expansion to the West of 188 Street (the study area) on the original East Clayton NCP engineering servicing concepts, including proposed recommendations for servicing upgrades and amendments and an analysis of the cost implications associated with the proposed changes.

The East Clayton NCP engineering servicing plan prepared by Earth Tech Canada Inc. was developed and adopted by the City of Surrey in March, 2003. This engineering servicing plan was developed to support the East Clayton NCP Land Use Plan and to provide engineering design guidelines for the development of the neighbourhood.

1. Sanitary Sewer

The East Clayton NCP area is to be serviced by two existing sanitary sewer systems that eventually discharge flows westward into the existing GVS & DD regional trunk sewer located along 56 Avenue. See Appendix III for a detailed sanitary sewer analysis.

The western region of the NCP, Catchment B (114 ha) conveys sanitary sewer flows into the existing 68 Avenue trunk sewer located west of 188 Street. This existing trunk sewer discharges flows to an existing interim pump station located at 176 Street. Sewerage flows are pumped south via an existing forcemain from the interim pump station to the GVS & DD regional trunk sewer.

It should be noted that the interim pump station located at 176 Street has a capacity of 100 l/s and will be upgraded, in the future, to an ultimate capacity of 400 l/s.

The study area is to be serviced by the existing sanitary sewer system on 188 Street and 68 Avenue and consists of three sub-catchment areas (B1-1, B1-3 & B1-4), which forms part of the 114 ha Catchment B area.

Trunk sanitary sewers exist along the frontages of the study area including a 300 mm diameter pipe on 188 Street and 375 mm diameter pipe fronting 68 Avenue.

The original East Clayton NCP recommended that one section of existing 300 mm diameter sanitary sewer on 188 Street between manhole nodes B27 and B26 will be marginally undersized for maximum peak flows and require upsizing. In addition, the NCP also recommended that three sections of existing 375 mm diameter sanitary sewer on 68 Avenue between manhole nodes B22 to B25 will also be undersized for maximum peak flows and require upsizing.

Based upon the revised sanitary sewer study prepared by McElhanney, it was confirmed that the section of sanitary sewer on 188 Street between manhole nodes B27 and B26 will be undersized for maximum peak flows and this section of sanitary sewer should be replaced. The revised sanitary sewer study also indicated that the section of the sanitary sewer on 188 Street between nodes B27 and B28 is also undersized and will require replacement. In addition to the above, a zoning discrepancy with the original sanitary sewer calculations was revealed and it was determined that the three existing sections of 375 mm diameter sanitary sewer on 68 Avenue between manhole nodes B22 to B25 were not undersized and do not require upsizing.

Since the original East Clayton NCP recommended replacement of four sections of existing sanitary sewers on 188 Street and 68 Avenue for a total capital cost of $230,000 and this report recommends the replacement of two sections of existing sanitary sewers on 188 Street only, the net impact of the proposed NCP extension will be a capital cost savings of approximately $105,000 plus the additional sanitary sewer DCC contributions generated by the development of the proposed NCP extension area.

There will be no adverse impact on the original East Clayton NCP servicing concept or downstream infrastructure.

Developers will be eligible for DCC contribution for 100% of the cost of sanitary sewer replacement on 188 Street as per East Clayton Trunk Sewer DCC Item Table 7.3.7. The estimated cost of the sanitary sewer replacement on 188 Street is approximately $125,000.00 (this has been accounted for in the East Clayton NCP).

The proposed upgrade of 176 Street interim pump station estimated at $250,000.00 will be undertaken by the City of Surrey and shall be paid for through DCC contributions collected from East Clayton NCP developments.

It is estimated that the sanitary sewer DCC revenues generated by the study area will be approximately $127,000, not including DCC's from future school expansion.

2. Drainage

Surface drainage from East Clayton NCP area flows to two major catchment areas.

- Catchment A is the eastern and southern area and comprises approximately 190 hectares of land. The catchment slopes southeasterly, while partially draining into McLellan Creek (with an outfall across 64 Avenue) and partially to the east into the Township of Langley storm sewer system (through culverts across 196 Street).

- Catchment B is the western area and comprises approximately 85 hectares of land. The catchment slopes in a westerly direction and drains to North Cloverdale Creek, that outfalls west across 188 Street at 68 Avenue.

Both of the above catchments form part of the Nicomekl-Serpentine river system. (See Appendix V for a detailed drainage analysis). Flows from the East Clayton

NCP area and the subject NCP area must be managed in an environmentally sustainable and economical manner involving infiltration, volume controls and other sustainable engineering strategies. The requirement for infiltration systems is outlined in the "*Green Infrastructure Performance Standards and Guidelines*" in section 4.0 of the East Clayton NCP.

The NCP servicing strategy is to convey stormwater runoff via storm sewers to a series of five (5) detention ponds, four (4), of which, are located within the NCP area and Pond E that is located within the study area but outside the NCP area. The purpose of these detention ponds is to control the post-development 100-year flows to pre-development levels. It should be noted that the City of Surrey has purchased the property for Pond E and Stage 1 construction of the detention pond was constructed in 2003 together with a 1050 mm diameter trunk sewer that was installed along the south property line of Clayton Heights Secondary School. Pond E was originally designed to accommodate flows from the study area, assuming full development (associated construction costs were accounted for in the East Clayton NCP).

Developers will be eligible for drainage DCC rebates in the event that they construct the ultimate construction of Pond E.

It is estimated that the drainage DCC revenues generated by the study area will be approximately $450,000, not including DCC's from future school expansion.

3. Water

The study area is located in the "Clayton" pressure zone and is fed by an existing 400 mm diameter grid main on 188 Street from the existing GVRD's Whalley/Clayton 900 mm diameter watermain on 72 Avenue and the Clayton Reservoir and Pump Station located at 72 Avenue and 190 Street. It should be noted that Clayton Heights Secondary School is located within the study area and is already connected to the existing 400 mm diameter grid watermain located on 188 Street. See Appendix VI for a detailed water service analysis.

The water demand for the residential areas within the study area have been calculated based upon an average daily allowance of 500 l/capita/day, a maximum day allowance of 1,000 l/capita/day plus fire flow and a peak hour demand of 2,000 l/capita/day, in accordance with the City's design criteria.

It is recommended that the additional water demands be added to the City's network model to confirm the capacity of the existing 400mm diameter feeder watermain on 188 Street and proposed 350mm diameter watermain on 68 Avenue, east of 188 Street.

In addition to the water demand calculations, an analysis of the distribution network was completed, in order to determine sizing for a proposed watermain on 68 Avenue, west of 188 Street to Fraser Highway and on 68A Avenue cul-de-sac road, west of 188 Street. In order to provide fire flow requirements for the study area, it was determined that a 250 mm diameter watermain was required on 68A Avenue and a 300 mm diameter watermain was required on 68 Avenue. A copy of the water calculations is included in Appendix VII.

Based upon the East Clayton NCP engineering servicing report the addition of the proposed study area will not adversely impact the East Clayton water supply system, provided that the new pump station is operational by the summer of 2006, subject to confirmation of watermain sizing by water main modeling.

It is recommended that the water demands for the proposed NCP extension be added to water network model to confirm the capacity of the existing 400mm diameter watermain on 188 Street and the proposed 350mm diameter watermain on 68 Avenue, east of 188 Street.

There are no DCC eligible infrastructure elements required for construction in the study area except for water distribution construction, which are to be installed at the Developer's cost.

It is estimated that the water DCC revenues generated by the study area will be approximately $224,000, not including DCCs from future school expansion.

4. Transportation

The neighbourhood traffic analysis focused on the following impacts and access provisions:

- Impact at the Fraser Highway/188 Street, Fraser Highway/68 Avenue, and 188 Street/68 Avenue intersections with and without the extension of 72 Avenue to Fraser Highway; and

- Provide guidance on access locations on 68 Avenue and 188 Street considering need and access for currently approved developments

Analysis is to be undertaken for the weekday AM and PM peak hours on opening day (assumed to be 2006) and the 10 year horizon (2016). Sunday morning analysis will be required only to examine left turn needs on 68 Avenue into the church site.

The impact of extending 72 Avenue to Fraser Highway was evaluated for the 2016 horizon only. The 72 Avenue extension would consist of a four lane section west of 192 Street. See Appendix VIII for a detailed traffic analysis.

Using the assumed land uses within the West Clayton Expansion area, the number of development trips was calculated and added to the existing background and the projected background trips generated by the original East Clayton development area. The Institute of Transportation Engineer's (ITE) Trip Generation Manual was used to determine the number of development trips for the weekday AM/PM and the Sunday morning peak hours. Because the institutional site (assumed to be a regional-scale church) will have an assembly hall component, an assumption was made that the assembly hall would consist of ¼ the building area (16,250 ft^2), and the remaining building area (48,750 ft^2)

would function as a church facility. Thus, trip generation for the church site was broken down into church and assembly hall uses. It should be noted that the assumed size of the church plus assembly hall is quite large, and will most likely be smaller.

The residential/church developments will generate in the order of 213 and 346 trips during the weekday AM and PM peak hours, respectively. As expected, the church site will generate a significant number of trips on Sundays, typically peaking in the morning. For apartment and townhouse uses, the ITE manual only provides Sunday trip rates for the 'peak hour of generator', which generally occurs around early to mid-afternoon. The Sunday morning trip rates for apartments/townhouses were estimated to be half the peak hour of generator.

Capacity analysis for 2006, 2016 without the extension of 72 Avenue and 2016 with 72 Avenue extension traffic simulations were modelled. Level of Service (LOS) calculations were performed using Synchro. In the East Clayton NCP, it was assumed that the intersection of 68 Avenue and 188 Street would be controlled by a signal. However, in consideration of the proximity of one existing signal at 188 Street /Fraser Highway and the planned signal at 68 Avenue/Fraser Highway as well as possible access restrictions on both 188 Street and 68 Avenue, a roundabout was considered for the control at the 188 Street/68 Avenue intersection. Roundabouts analysis was modelled using AASidra, Rodel, and VISSIM. Findings are located in Appendix VIII.

Conclusions:

Without a 72 Avenue extension to Fraser Highway, a six lane basic cross-section is required on Fraser Highway to achieve acceptable Levels of Service at intersections. With an extension of 72 Avenue to Fraser Highway, the east west demand to and from Fraser Highway can be spread evenly over several intersections and acceptable Levels of Service at each intersection within the study area can be achieved while maintaining a four lane basic cross-section on Fraser Highway. As a four-lane scenario with ultimate widening for transit lanes

is preferred for Fraser Highway, extension of 72 Avenue is recommended by 2016. 72 Avenue would also be a four-lane facility west of 192 Street.

Therefore, the following conclusions can be made regarding the analysis, assuming extension of 72 Avenue to Fraser Highway:

- A signal at Fraser Highway / 68 Avenue is required in the short term to accommodate EB left turn traffic. The SB left turn from 68 Avenue will only require a 30m minimum standard storage, but the EB left turn from Fraser Highway will require 60m of storage. As there are low volumes for the southbound left turn movement, the green time for each cycle could be lower than the minimum requirement assuming there are few pedestrian movements.

- A single lane roundabout is recommended at the 188 Street / 68 Avenue intersection with wider flares, a 30m inscribed diameter, splitter islands. Corner cuts of 5x5 must be provided at each of the four corners in order to construct the roundabout and fit in the sidewalks.

- The Fraser Highway / 188 Street intersection will experience a poor Level of Service by 2016 due to background traffic alone. To accommodate 2016 PM traffic volumes, this intersection will require the following improvements:

    - Separate WB right turn lane from Fraser Highway

    - NB laning consisting of L, T & R

    - SB laning consisting of 2L, T, R (with 45m storage per SB left turn lane)

    - Channelized N-S right turns

- A northbound left turn lane on 188 Street to the proposed 68A Avenue extension west of 188 Street is not warranted.

- A minimum 25m offset between 69 Avenue and the proposed townhouse driveway on 188 Street.

- The City plans to extend a raised median on 68 Avenue from the proposed roundabout at 188 Street to the Clayton Crossing commercial driveway, thus restricting the proposed multiple family residential driveway to right-in, right-out. The residential driveway on 68 Avenue should be located no closer than 20m from the N-S property line at 188 Street. To ensure proper operation of the roundabout, the appropriate queuing distance within the access must be maintained.

- Maximum 2016 queues on 68 Avenue, at the SB left turn lane to Fraser Highway and the left turn lane into the church site, will not exceed 25m for any of the analyzed time periods (Weekday AM/PM & Sunday AM).

- The distance on 68 Avenue, between the SB stop line at Fraser Highway and the church driveway, will accommodate two back-to-back left turn lanes, consisting of a 40m SB left turn lane at Fraser Highway, a sub-standard 25m taper transition and a 20m left turn lane into the church site. Anticipated upgrades will not affect the anticipated DCC expenditures for the East Clayton NCP.

- It is estimated that the Arterial and Major Collector Road DCC revenues generated by the study area will be approximately $1,116,500.

5. Funding Impacts and Strategies

It is estimated that anticipated neighbourhood development will generate approximately $1,917,500 of DCCs for engineering services (i.e., water, sanitary sewer, drainage and arterial and major collector roads) and parkland acquisition, based on current DCC rates. This amount represents a surplus to the East Clayton NCP area (see Table 7.6.1 of the East Clayton NCP) and will assist in funding neighbourhood servicing, including the stormwater detention facility for the local catchment. The traffic-calming required at 188 Street and 70 Avenue (see Section 3.5 Circulation) will need to be funded through DCC revenues.

Part V: Appendices

Appendix I - East Clayton West NCP Expansion Terms of Reference

SURREY
CITY OF PARKS

Corporate Report

NO: _____

COUNCIL DATE: _____

REGULAR COUNCIL

TO:	**Mayor & Council**	DATE:	**September 28, 2004**
FROM:	**General Manager, Planning and Development**	FILE:	**6520-20 (West Clayton)**

SUBJECT: **Proposed Planning and Consultation Process for Land in Clayton Immediately West of the East Clayton Neighbourhood Concept Plan Area**

RECOMMENDATION

It is recommended that Council:

1. Receive this report as information; and

2. Approve the Terms of Reference documented in Appendix I of this report for the planning and public consultation process that will form the basis for reviewing development applications on lands in the Clayton area bounded to the east by 188 Street, to the south by 68 Avenue, to the north by the Clayton Heights Secondary School and Clayton Park and to the west by 186 Street.

INTENT

The purpose of this report is to obtain Council authorization for a planning and consultation process related to allowing development on lands within the Clayton area, immediately west of 188 Street, adjacent to the East Clayton Neighbourhood Concept Plan ("NCP") area. The subject lands are bounded by 188 Street, 68 Avenue, 70 Avenue and 186 Street, as illustrated on the map attached as Appendix "A" to Appendix I.

BACKGROUND

During the preparation of the East Clayton NCP and the expansion of development in East Clayton to the north of 72 Avenue, it was noted that a small area of land on the west side of 188 Street falls within the same engineering catchment area as the lands in the

East Clayton NCP. The East Clayton NCP was approved in 2003. The Stage 1 component of the East Clayton NCP expansion, to the north of 72 Avenue, was approved in July 2004. The individual who owns most of the privately-held properties (about 4 hectares or 10 acres) south of Clayton Heights Secondary School on the west side of 188 Street, has expressed an interest in developing these properties for residential purposes. The owner of a smaller lot (about 0.8 hectares or 2 acres) in this same area, has also indicated an interest in proceeding with the development of a religious facility.

These lands, located immediately west of the East Clayton NCP area and west of 188 Street, are bounded by watercourses and parkland to the west and the Clayton Heights Secondary School to the north. To the south, are 68 Avenue and a shopping centre proposal (i.e., the Triangle Holdings site).

The subject lands are within the area covered by the Clayton General Land Use Plan (see map attached as Appendix "A" to Appendix I), but have not yet been incorporated into a more detailed NCP. The General Land Use Plan designates the central portion of the subject lots for multi-family residential townhouses or apartments surrounded by institutional uses (Clayton Heights Secondary School) and environmentally sensitive areas and parkland (Clayton Park). The most south-westerly corner of the area is designated for institutional uses, primarily because it is owned by a religious organization. This area forms a compact and logical extension to the East Clayton NCP, with well-defined boundaries.

The lands are separated from the general Clayton area to the west and to the north by the parks and school. They relate more to the existing East Clayton NCP area, particularly from the perspective of amenities, services and infrastructure. Therefore, it is appropriate that the lands be considered for development in connection with the lands in the East Clayton NCP, which are being developed rapidly. Most of the land in the East Clayton NCP will be fully approved for development within the next one to two years.

DISCUSSION

Since the lands on the west side of 188 Street are not covered by an NCP, it is necessary to undertake a minor planning exercise to facilitate the processing of development applications related to these lands. This planning process, which is to be undertaken by consultants hired by the owners of the lands, is described in Appendix I. It will establish the alignment of roads and lanes (public and private), the forms of development, development densities, subdivision patterns, if applicable, and the location of parkland, walkways and open spaces, all based upon the principles of sustainable development as prescribed in the East Clayton NCP. The planning process will also address the implementation of engineering services, amenity contributions and the impacts of this development on schools and other City services.

The proposed planning and public consultation process for this study area is in general accordance with the Council-approved process for proposed amendments to an approved NCP.

This planning and public consultation process is designed to ensure orderly and sustainable development, recognizing that there are no significant impediments to this area proceeding to the development stage in the short term. It is anticipated that new

residential units in this area could be developed and available for occupancy in 2005, thereby assisting to address the current market demand for dwelling units in the popular East Clayton community.

It is worthy to note that since the Official Community Plan ("OCP") designation for the subject lands is currently Suburban, an OCP amendment will also be necessary as part of the development application process to allow urban forms of development to occur on the subject lands.

CONCLUSION

Based on the above discussion, it is recommended that Council approve the Terms of Reference documented in Appendix I of this report, for the planning and public consultation process that will form the basis for reviewing development applications on lands in the Clayton area, bounded to east by 188 Street, to the south by 68 Avenue, to the north by the Clayton Heights Secondary School and Clayton Park and to the west by 186 Street.

Murray Dinwoodie
General Manager
Planning and Development

WW/kms/saw

Attachment
Appendix I Terms of Reference

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Terms of Reference

Proposed Planning and Consultation Process for Certain Lands in Clayton Immediately Adjacent to East Clayton

October 2004

Purpose

This Terms of Reference provides a framework for planning and public consultation in relation to land development and related engineering servicing for specific lands immediately west of the East Clayton Neighbourhood Concept Plan ("NCP"). The specific lands are those lands located west of 188 Street and east of 186 Street, between 68 Avenue and 70 Avenue, as illustrated on the map attached as Appendix "A".

Background

In the preparation of the East Clayton NCP and the expansion of East Clayton, north of 72 Avenue, it was recognized that a small area of land on the west side of 188 Street falls within the same engineering catchment area as the lands in the East Clayton NCP. The East Clayton NCP was approved in 2003 and its expansion to the north of 72 Avenue (Stage 1) was approved by Council in July 2004. The owner of the majority of the lots (involving about 4 hectares or 10 acres), located between 68 Avenue and 70 Avenue on the west side of 188 Street, has expressed an interest in developing these properties as soon as possible, for residential purposes. The owners of a smaller remaining site (about 0.8 hectares or 2 acres) have also indicated an interest to proceed with the development of a church.

Rationale

The subject lands are located immediately west of the East Clayton NCP area, west of 188 Street and are bounded by watercourses and parkland to the west, the Clayton Heights Secondary School to the north and 68 Avenue to the south, south of which is triangular area for which a rezoning by-law to accommodate a shopping centre development received third reading by Council on September 27, 2004. This shopping centre project also involves an Official Community Plan ("OCP") amendment from Suburban to Commercial.

The subject lands are within the area covered by the Clayton General Land Use Plan (see map attached as Appendix "A"), but have not yet been incorporated into a more detailed NCP. The General Land Use Plan designates the central portion of the subject lots for multi-family residential townhouses or apartments, surrounded by institutional uses (Clayton Secondary School) and environmentally sensitive areas and parkland (Clayton Park). The most south-westerly corner of the area is designated for institutional uses, primarily because it is owned by a religious organization. The area forms a compact and logical extension to the East Clayton NCP, with well-defined boundaries.

The lands are separated from the general Clayton area to the west and to the north by the parks and school. They relate more to the existing East Clayton NCP area, particularly from the perspective of amenities, services and infrastructure. Therefore, it is appropriate that the lands be considered for development in connection with the lands in the East Clayton NCP, which are being developed rapidly. Most of the land in the East Clayton NCP will be fully approved for development within the next one to two years.

Guidelines for Preparing a Development and Servicing Plan

The land use pattern for this study area is intended to be similar and complimentary to the land use plans related to the lands immediately to the east of 188 Street and should reflect the development framework identified in the East Clayton NCP. The owners and their consultants will be required to demonstrate, to the satisfaction of the Engineering Department, that these lands can be provided with engineering services.

The planning exercise will determine the alignment of roads and lanes (public and private), forms of development, development densities, subdivision pattern if applicable and the location of parkland, walkways and open spaces, all based upon the principles of sustainable development, as prescribed in the East Clayton NCP. Of note, in relation to these principles, are connectivity objectives, pedestrian-friendly environments, flexible housing choices and others. The planning process will also address amenity contributions and the impacts on schools and other City services of development in the area.

It is proposed that the planning and public consultation process for this study area be similar to the Council-approved process undertaken for any proposed amendment to an approved NCP.

Since the current OCP designation for the subject lands is Suburban, an OCP amendment application needs to be processed as part of the approval process for individual development applications on the subject lands.

General Description of the Planning and Public Consultation Process

The proponents will undertake a qualitative and quantitative analysis of potential development in the study area. This will require that the proponent and/or the proponent's consultants:

1. Determine/confirm that the lands can be provided with engineering services and how such services will be provided. This is to be done in consultation with the Engineering Department.

2. Hold a public information meeting to discuss the proposed "NCP expansion" and development proposals and to receive input from the public. All property owners within at least 100 metres of the subject lands are to be notified of the meeting. City staff will assist with identifying those property owners and area residents to whom notices are to be sent and in developing an appropriate survey questionnaire, by which interested persons

may provide input/comments/concerns. Depending on the results of the first meeting, a second public information meeting may be necessary.

3. Demonstrate how the development will meet the sustainability requirements of the East Clayton NCP and provide details related to the financial implications of servicing the area with respect to the financial strategy approved in the East Clayton NCP.

4. Demonstrate the adequacy of the existing roads and routes for providing vehicular and pedestrian access for development in the area and identify off-site improvements necessary to provide acceptable vehicular and pedestrian accessibility. Based on existing traffic volumes, together with projections of traffic from development within East Clayton and within the study area, intersection analyses must be undertaken for the intersection at 188 Street and Fraser Highway, 68 Avenue at Fraser Highway and 68 Avenue at 188 Street. It is noted that the proponent of the shopping centre to the south is undertaking a transportation impact study and that the results of this study can be incorporated into the analysis for the subject lands. The report on the traffic impact analysis must provide recommendations with respect to how and where access to the ultimate developments on 68 Avenue, between Fraser Highway and 188 Street, should be provided and what improvements are to be constructed in support of the proposed access systems. City staff will also provide some data/analysis previously undertaken for the shopping centre proposed on the land south of 68 Avenue and east of 188 Street.

   The traffic impact analysis is to address the a.m. and p.m. peak period on the opening day and at the 10-year horizon. This exercise is to be undertaken in consultation with the City Transportation Engineer. Further details regarding the analysis requirements must be confirmed in consultation with the City Transportation Engineer, prior to the study commencing. The road layout must meet the character/objectives of the road pattern established for the East Clayton NCP and must identify which roads are planned to incorporate grass swales and confirm that any lanes are in the optimal locations to maximize grass swale treatment.

5. With respect to drainage, apply the low impact (sustainable) development objectives of the East Clayton NCP to the proposed development area. As outlined in the Engineering Servicing Plan Corporate Report No. C007, dated February 27, 2003, submitted with the NCP document, certain minimum sustainability elements or standards will be required for the entire plan area.

   Meet the following additional requirements:

   - The existing drainage boundaries and proposed future drainage boundaries must be confirmed;
   - Downstream constraints associated with proposed drainage plan must be highlighted;
   - Mitigation measures, required to deal with constraints, must be provided and the proponent must show how these vary from those presented in the NCP and Master

Drainage Plan, if applicable (this includes conveyance upgrades for minor and major flows as well as detention requirements);

- Servicing depths and grading requirements, necessary to implement the development, must be clearly highlighted; and
- Any proposed watercourse alterations or diversions of flows must be acceptable to senior government environmental agencies. Specifically, there is an existing watercourse running along the north side of 68 Avenue, through the subject lands. This is considered part of the headwaters of North Creek. If this watercourse is to be enclosed, appropriate mitigation plans will be required.

6. Provide the following information in relation to evaluating the water servicing capacity for the area:

- The Maximum Day Demand and Peak Hour Demand of the study area, to assess the need and schedule to upgrade/replace the Clayton Pump Station since this station is near capacity;
- The schedule and phasing of development;
- The size of all water mains to provide sufficient domestic demand and fire flow (supported with calculations) to the study area for the proposed land uses in accordance to the City's Design Criteria; and
- An impact assessment on the development of the Clayton Pump Station and the proponent's schedule, in relation with the construction of the Clayton Pump Station.

7. Confirm the following with respect to sewer servicing:

- The capacity of the 68 Avenue trunk sewer from 188 Street to 176 Street, relative to the City's design criteria;
- The details of any creek or environmentally-sensitive area crossings;
- The connection point with the existing 68 Avenue sewer; and
- The impact on the original trunk sewer sections when compared with the list in the East Clayton NCP and the costs must be computed for these additional trunk sewers.

8. Prepare a final report outlining the results of the engineering and land use analysis and public consultation process, which will act to complement the East Clayton NCP. The report must include:

- The proposed Land Use Plan for the study area;
- The engineering servicing strategy for the study area;
- A synopsis of the impact of development in the study area, including reference to land use, population, densities, schools, parks, impacts on amenities, facilities and utilities, roads and transportation and funding of services and public amenities;
- The financing strategy for the study area, including engineering services, parks and amenity contributions; and

- A listing of concerns of the property owners in and adjacent to the study area and how these concerns have been addressed.

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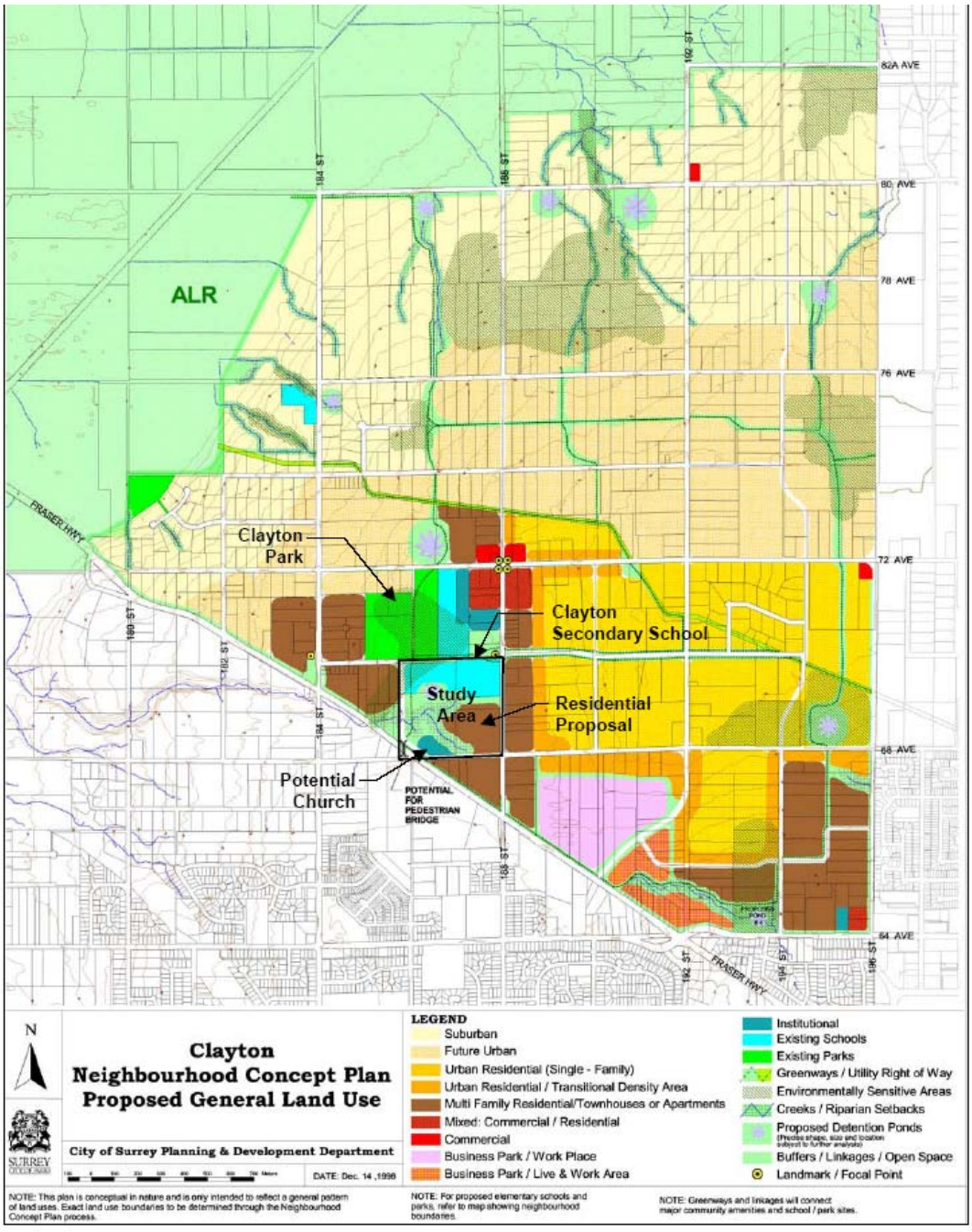
Appendix "A"


ALR
Clayton Park
Clayton Secondary School
Study Area
Residential Proposal
Potential Church
POTENTIAL FOR PEDESTRIAN BRIDGE
FRASER HWY
82A AVE
80 AVE
78 AVE
76 AVE
72 AVE
68 AVE
64 AVE
184 ST
186 ST
188 ST
190 ST
192 ST
196 ST
N
Clayton Neighbourhood Concept Plan Proposed General Land Use
City of Surrey Planning & Development Department
DATE: Dec. 14 ,1998
LEGEND
Suburban
Future Urban
Urban Residential (Single - Family)
Urban Residential / Transitional Density Area
Multi Family Residential/Townhouses or Apartments
Mixed: Commercial / Residential
Commercial
Business Park / Work Place
Business Park / Live & Work Area
Institutional
Existing Schools
Existing Parks
Greenways / Utility Right of Way
Environmentally Sensitive Areas
Creeks / Riparian Setbacks
Proposed Detention Ponds
Buffers / Linkages / Open Space
Landmark / Focal Point
NOTE: This plan is conceptual in nature and is only intended to reflect a general pattern of land uses. Exact land use boundaries to be determined through the Neighbourhood Concept Plan process.
NOTE: For proposed elementary schools and parks, refer to map showing neighbourhood boundaries.
NOTE: Greenways and linkages will connect major community amenities and school / park sites.

Appendix II - Estimated Park Amenities Development Costs

CAPITAL COST ESTIMATE
EAST CLAYTON WEST EXPANSION CONCEPT PLAN
LINEAR PARK, NATURAL AREA, VILLAGE CENTRE

PARK WORKS

ITEM	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	TOTAL
1	**LINEAR PARK WEST OF 188 ST (69 AVE EXTENSION)**				
	design and construction of landscaping and walkway	ls	1	$138,850.00	$138,850.00
	TOTAL - LINEAR PARK	*$138,850.00*			
2	**NATURAL AREA MANAGEMENT**				
	tree management, trails, planting	ls	1	$30,750.00	$30,750.00
	TOTAL - NATURAL AREA MANAGEMENT	*$30,750.00*			
3	CONTRIBUTION TO VILLAGE CENTRE				
	as per East Clatyon NCP (south)	ls	1	$17,405.00	$17,405.00
	TOTAL - VILLAGE CENTRE	*$17,405.00*			
				SUBTOTAL	$187,005.00
				15% CONTINGENCY	$28,050.75
				TOTAL	***$215,055.75***

estimated units: 280
$768.06

Appendix III – Sanitary Sewer Servicing

1. Sanitary Sewer

1.1 Background

The East Clayton NCP area is to be serviced by two existing sanitary sewer systems that eventually discharge flows westward into the existing GVS & DD regional trunk sewer located along 56 Avenue, as shown in Figure 4 (prepared by Earth Tech Canada Inc., Figure 7.3.1).

The western region of the NCP, Catchment B (114 ha) conveys sanitary sewer flows into the existing 68 Avenue trunk sewer located west of 188 Street. This existing trunk sewer discharges flows to an existing interim pump station located at 176 Street. Sewerage flows are pumped south via an existing forcemain from the interim pump station to the GVS & DD regional trunk sewer.

It should be noted that the interim pump station located at 176 Street has a capacity of 100 l/s and will be upgraded, in the future, to an ultimate capacity of 400 l/s.

The study area is to be serviced by the existing sanitary sewer system on 188 Street and 68 Avenue and consists of three sub-catchment areas (B1-1, B1-3 & B1-4), which forms part of the 114 ha Catchment B area, as shown in Figures 5 and 6 (prepared by Earth Tech Canada Inc., Figure 7.3.1 and Table 7.3.2).

Trunk sanitary sewers exist along the frontages of the study area including a 300 mm diameter pipe on 188 Street and 375 mm diameter pipe fronting 68 Avenue, as shown in Figure 5.

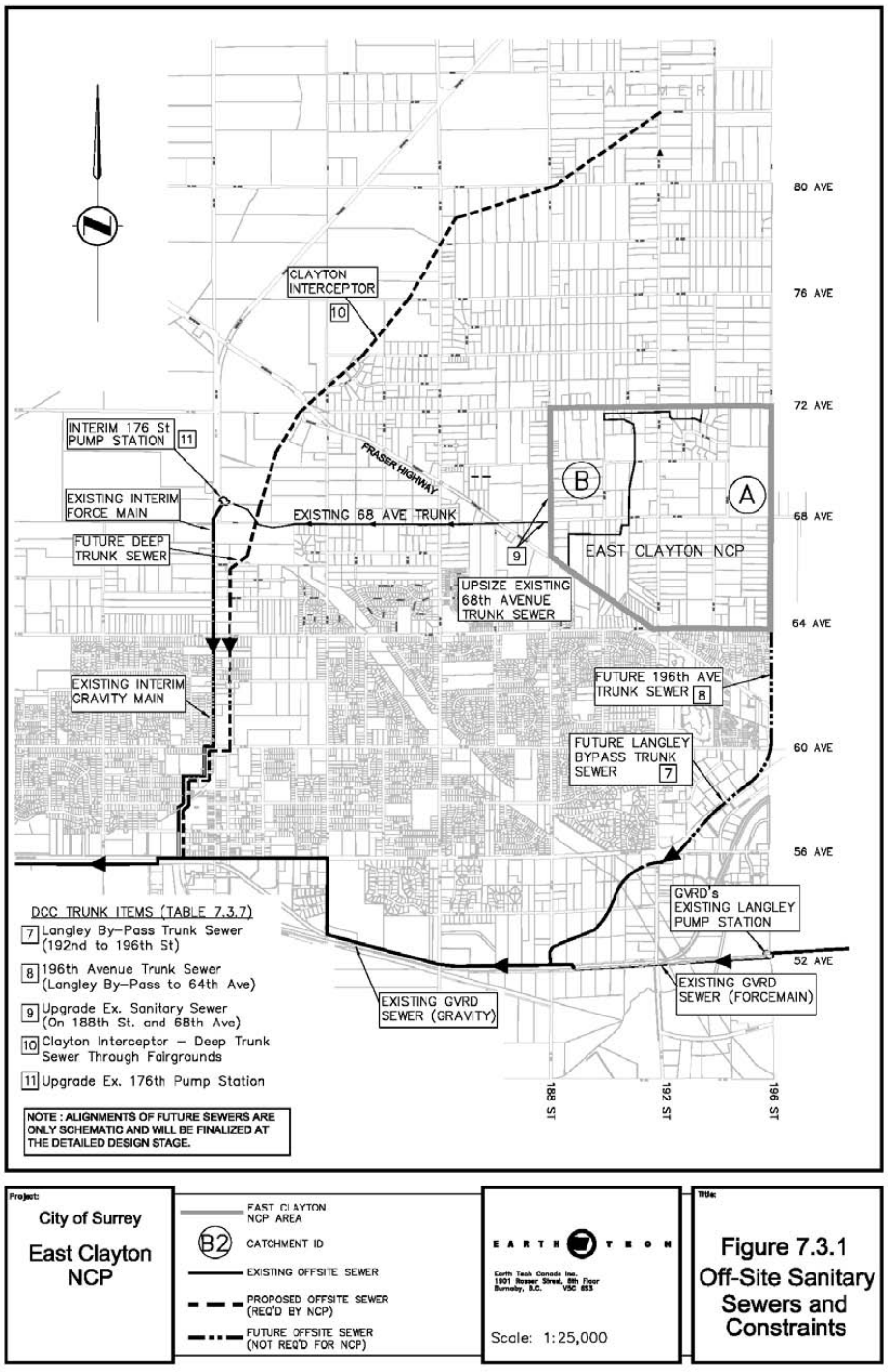


Figure 4 – East Clayton NCP Sanitary Sewer System

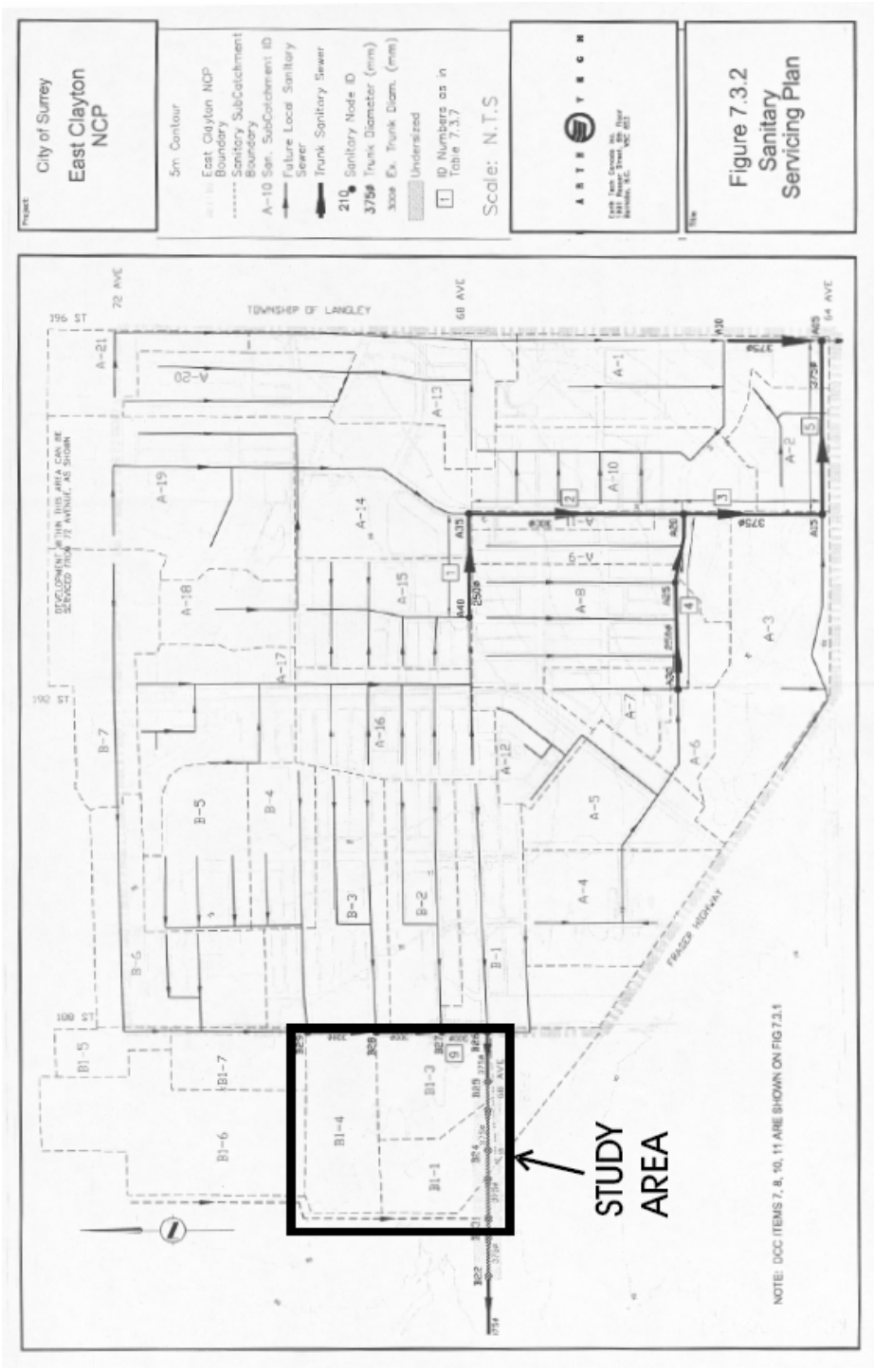


Figure 5 – Sanitary Sewer Catchment Areas

Table 7.3.5

East Clayton Planned Population & Peak Sanitary Flows by Catchment Area

Aver. Wastewater Flow/ Person 350 l/capita/day
Allowable Infiltration Rate 0.1 l/s/ha

Catchment	Total Area	Population Equiv.	Average QWastewater		Qinfiltrn	Total Qaverage	Harman Peaking Factor(HPF)	Total Flow (PWWF)
ID #	(ha)	# of People	l/day	l/s	(l/s)	(l/s)		(l/s)
A-1	13.8	1,629	570,150	6.60	1.38	7.98	3.65	25.49
A-2	5.5	454	158,886	1.84	0.55	2.39	4.00	7.90
A-3	15.1	406	141,941	1.64	1.51	3.15	4.02	8.11
A-4	9.6	745	260,736	3.02	0.96	3.98	3.88	12.67
A-5	8.4	570	199,626	2.31	0.84	3.15	3.94	9.95
A-6	2.4	582	203,700	2.36	0.24	2.60	3.94	9.53
A-7	4.0	466	162,960	1.89	0.40	2.29	3.99	7.93
A-8	13.1	889	311,322	3.60	1.31	4.91	3.83	15.12
A-9	6.7	455	159,226	1.84	0.67	2.51	3.99	8.03
A-10	11.6	1,103	385,944	4.47	1.16	5.63	3.77	18.01
A-11	1.8	122	42,777	0.50	0.18	0.68	4.22	2.27
A-12	4.6	495	173,349	2.01	0.46	2.47	3.98	8.44
A-13	10.1	1,048	366,898	4.25	1.01	5.26	3.79	17.09
A-14	12.1	1,045	365,608	4.23	1.21	5.44	3.79	17.24
A-15	10.3	1,179	412,628	4.78	1.03	5.81	3.75	18.95
A-16	10.9	941	329,349	3.81	1.09	4.90	3.82	15.64
A-17	10.8	922	322,661	3.73	1.08	4.81	3.82	15.36
A-18	4.9	29	9,981	0.12	0.49	0.61	4.36	0.99
A-19	19.1	222	77,813	0.90	1.91	2.81	4.13	5.63
A-20	7.2	705	246,884	2.86	0.72	3.58	3.89	11.84
A-21	5.0	446	156,170	1.81	0.50	2.31	4.00	7.73
TOTAL A	*187.0*	*14453.2*	*5,058,607*	*58.55*	*18.70*	*77.25*	*2.79*	*182.32*
B-1	11.8	1,328	464,708	5.38	1.34	6.71	3.72	21.33
B-2	9.2	1,053	368,561	4.27	1.04	5.31	3.79	17.19
B-3	12.3	704	246,375	2.85	1.00	3.86	3.89	12.11
B-4	5.9	320	112,171	1.30	1.56	2.86	4.07	6.84
B-5	8.2	787	275,606	3.19	0.52	3.71	3.86	12.84
B-6	12.1	1,174	410,795	4.75	0.72	5.48	3.75	18.57
B-7	11.3	767	268,545	3.11	0.72	3.83	3.87	12.76
B1-1	4.7	70	24,328	0.28	0.47	0.75	4.28	1.68
B1-2	4.2	820	286,901	3.32	0.42	3.74	3.85	13.22
B1-3	6.3	1,035	362,402	4.19	0.63	4.82	3.79	16.53
B1-4	7.2	1,164	407,400	4.72	0.72	5.44	3.76	18.44
B1-5	2.4	253	88,587	1.03	0.24	1.26	4.11	4.45
B1-6	14.2	1,125	393,818	4.56	1.42	5.98	3.77	18.59
B1-7	4.5	63	21,895	0.25	0.45	0.70	4.29	1.54
TOTAL B	*114.3*	*10663.1*	*3,732,092*	*43.20*	*11.43*	*54.63*	*2.93*	*137.86*

Figure 6 – Sanitary Sewer Catchment Areas

1.2 Design

The sizing of the proposed and existing sewers for the study area is based upon the City of Surrey 2004 Design Criteria and land use design populations. The land use design populations used for the study area are presented in the following table.

Table 3 – Sanitary Sewer Design Populations

Land Use	Area (ha)	Design Population (Capita/ha)	Design Population (Capita/Unit)	Actual Number of Units	Design Population
Secondary School (Institutional)	6.20	50	-	-	310
Institutional	2.95	50 u.p.a.	2.0	-	148
15-25 u.p.a.	3.19	-	2.8	139 + 25	459
25-45 u.p.a.	1.62	-	2.0	96	192

The City of Surrey Design Criteria includes school land use within the institutional land use category utilizing an equivalent design population of 50 persons / hectare. This equivalent design population has been used for the Clayton Heights Secondary School located within the study area and not the projected population of 1313.

The original East Clayton NCP sanitary sewer servicing report prepared by Earth Tech Canada Inc. included a detailed sanitary sewer sizing analysis based upon the original proposed East Clayton Land Use Plan, which was adopted in March 2003. In June, 2004 McElhanney Consulting Services Ltd. prepared a revised sanitary sewer catchment plan and detailed sanitary sewer capacity analysis for the western region of the NCP, Catchment B (114 ha). The purpose of the analysis was to analyze boundary and zoning changes that had occurred since March, 2003, based upon constructed developments and development

applications in process with the City. The boundary changes included the addition of the East Clayton NCP expansion area north of 72 Avenue and the BFW Development Ltd. single family subdivision area located at the northwest corner of 68 Avenue and 192 Street, as shown in Figure 7. These changes in land use and catchment boundary line location resulted in adjustments to population calculations and sewerage flows. The design population calculations were based upon the actual units, lots built or units per lot applied under current applications or NCP land use designation for properties that have not yet applied for development using the following reproduced tables from the East Clayton NCP's Tables 7.3.2 and Table 7.3.3.

Table 4 – East Clayton NCP Table 7.3.2

Land Use	Maximum Units (per acre)	Design Population (Capita per unit)	Design Population (Capita per ha)
Work/Live	25	2.8	173
Live/Work	25	2.8	173
100 ft Frontage Lots	7	3.2	55
6-10 u.p.a.	10	3.2	79
10-15 u.p.a.	15	3.2	119
15-25 u.p.a.	25	2.8	173
25-45 u.p.a.	45	2.0	222
Special Community	15	2.0	74
Commercial/Residential	15	2.0	74
Neighbourhood Comm.	15	2.0	74
Techno/ Business Park	18	2.0	89
Institutional	10	2.0	50

Table 5 – East Clayton NCP Table 7.3.3

Type of School	Population (pupils per school)	Approximate Area (ha)	Equiv. Land Use (population/ha)
Elementary	500	4.3	50
Secondary	1200	8.0	50

The above design population by land use designation was used to re-calculate the individual sub-catchment populations for the western region of the NCP, Catchment B. The revised population calculation for the western region including the study area population is shown in the following table.

Table 6 – Sanitary Sewer Population Table

Area #	Area (ha)	Area (ac)	Zoning	Lots or Units	Population per unit or lot	Population Increment	Total Area Population
1	10.82		RF-9	42*	3.2	134	
1		12.33	10-25 upa	308	2.8	863	
1		3.36	Com 15 upa	50	2.0	101	1098
2	1.97		RF-9	31*	3.2	99	99
3	4.30		School		50	215	
3			RF-9/RF-12	53*	3.2	170	385
4	3.86		RF-9/RF-12	63*	3.2	202	202
5	5.70		RF-9/RF-12	103*	3.2	330	
5		1.07	10-25 upa	27	2.8	96	458
6	4.30		RF-9/RF-12	54*	3.2	173	173

Area #	Area (ha)	Area (ac)	Zoning	Lots or Units	Population per unit or lot	Population Increment	Total Area Population
7	9.54		RF-9/RF-12	134*	3.2	429	429
8	4.98		RF-9/RF-12	59*	3.2	189	
8		3.50	10-25 upa	81*	2.8	227	416
9	1.68		RF-9/RF-12	20*	3.2	64	
9		0.65	10-25 upa	13*	2.8	36	100
10	10.24		RF-9/RF-12	171*	3.2	547	547
11	2.30		RF-9/RF-12	45*	3.2	144	144
12	8.02		RF-9/RF-12	36*	3.2	115	
12			10-25 upa	35*	2.8	98	
12		7.7	Com 15 upa	116	2.0	232	444
13		1.98	Com 15 upa	30	2.0	60	60
14A	3.19		10-25 upa	194*	2.8	543	543
14B	1.62		25-45 upa	96*	2.0	192	192
15	6.2		School		50	310	
15		1.32	10-25 upa	33	2.8	92	402
16		3.01	10-25 upa	75	2.8	211	
16		9.04	Com 15 upa	136	2.0	271	

Area #	Area (ha)	Area (ac)	Zoning	Lots or Units	Population per unit or lot	Population Increment	Total Area Population
16	2.51		Inst 10 upa		50	126	
16		4.10	Park	0	0	0	606
17	2.63		RF-9/RF-12	50*	3.2	160	160
18		7.16	Com 15 upa	107	2.0	214	214
19		3.61	Com 15 upa	54	2.0	108	108
20		0.52	Com 15 upa	8	2.0	16	
20	2.95		Inst 10 upa		50	148	
20		8.11	Pond Area	0	0	0	164
21		20.00	Park	0	0	0	
21		7.96	25-45 upa	318	2.0	637	637
Total							7582

* Denotes actual lots or units built or proposed under current applications.

The above sub-catchment populations were used to generate the detailed sanitary sewer capacity analysis, as shown on Table 4.2.1 and the Sanitary Catchment Plan as shown in Figure 8.

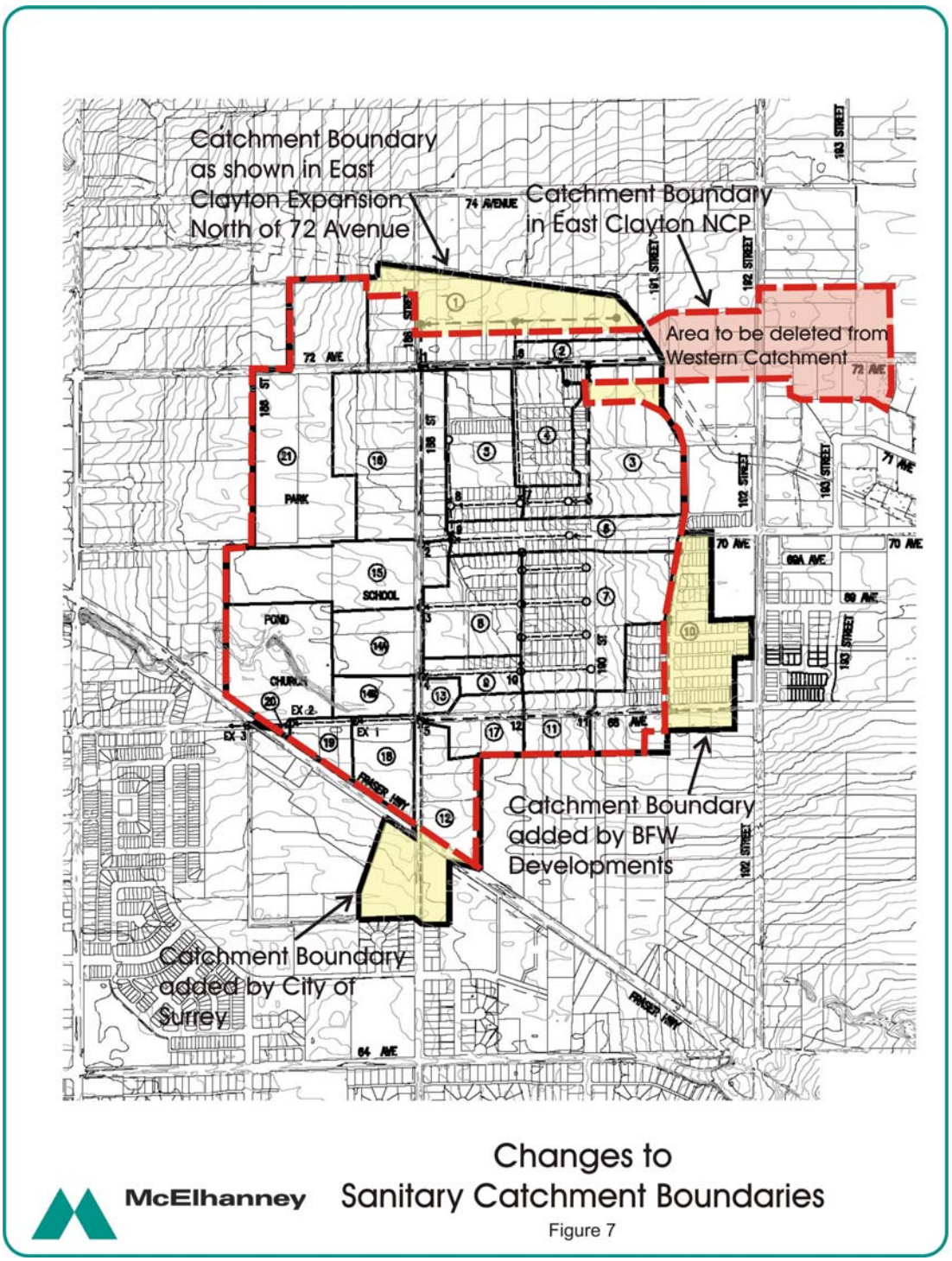


Figure 7 – Changes to Sanitary Sewer Catchment Areas

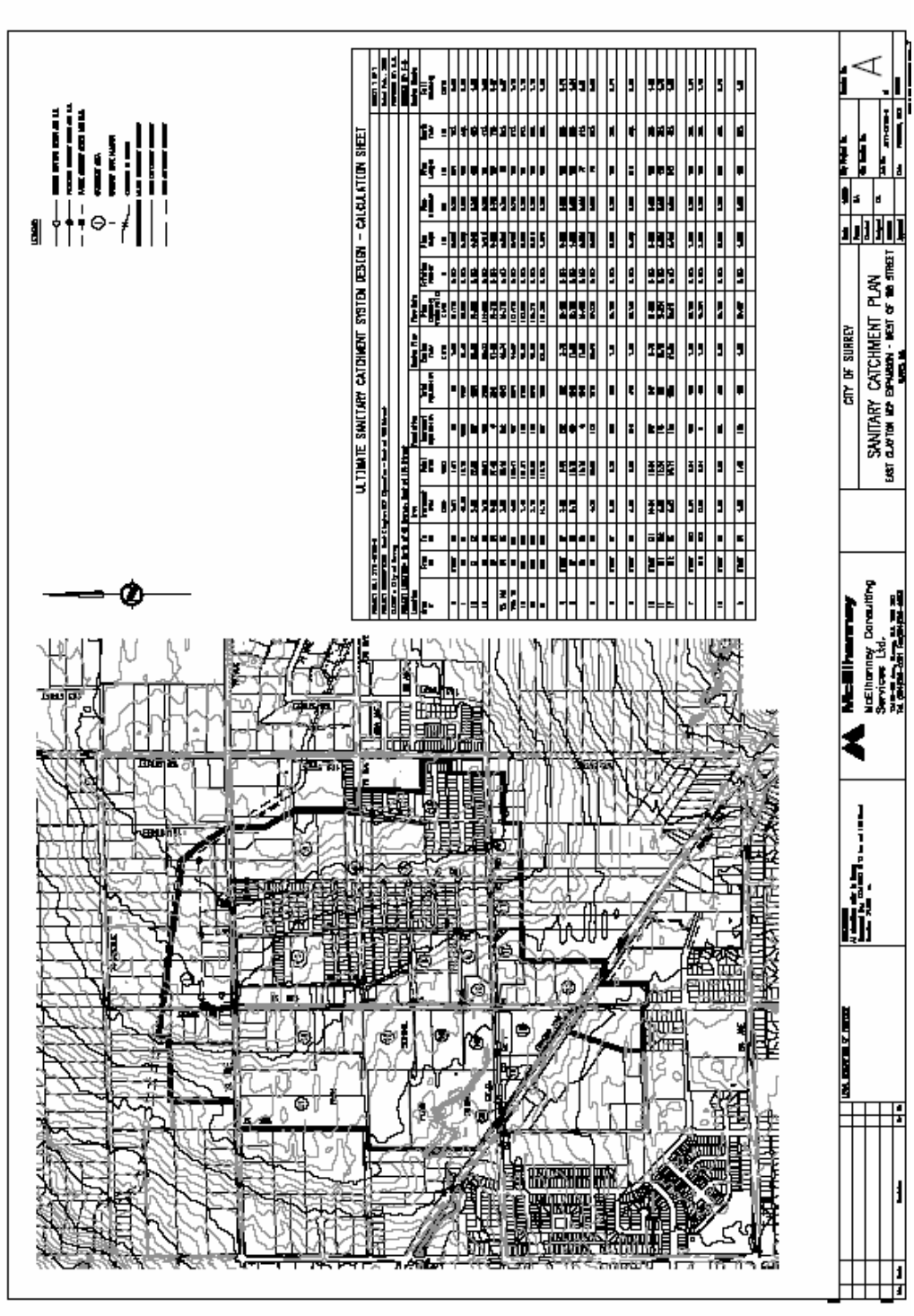


Figure 8 – Sanitary Catchment Plan

1.3 Impact on East Clayton Trunk Sanitary Sewers

The original East Clayton NCP recommended that one section of existing 300 mm diameter sanitary sewer on 188 Street between manhole nodes B27 and B26, as shown on Figure 5, will be marginally undersized for maximum peak flows and require upsizing. In addition, the NCP also recommended that three sections of existing 375 mm diameter sanitary sewer on 68 Avenue between manhole nodes B22 to B25 will also be undersized for maximum peak flows and require upsizing.

Based upon the revised sanitary sewer study prepared by McElhanney, it was confirmed that the section of sanitary sewer on 188 Street between manhole nodes B27 and B26 will be undersized for maximum peak flows, as shown on Figure 9 (prepared by Earth Tech Canada Inc., Figure 4.2.2) and this section of sanitary sewer should be replaced. The revised sanitary sewer study also indicated that the section of the sanitary sewer on 188 Street between nodes B27 and B28 is also undersized and will require replacement. In addition to the above, a zoning discrepancy with the original Earth Tech calculations was revealed and it was determined that the three existing sections of 375 mm diameter sanitary sewer on 68 Avenue between manhole nodes B22 to B25 were not undersized and do not require upsizing.

Since the original East Clayton NCP recommended replacement of four sections of existing sanitary sewers on 188 Street and 68 Avenue for a total capital cost of $230,000 and this report recommends the replacement of two sections of existing sanitary sewers on 188 Street only, the net impact of the proposed NCP extension will be a capital cost savings of approximately $105,000 plus the additional sanitary sewer DCC contributions generated by the development of the proposed NCP extension area.

There will be no adverse impact on the original East Clayton NCP servicing concept or downstream infrastructure.

Table 7.3.6
Existing & Proposed Clayton Sanitary Sewer Trunks

Average Wastewater Flow Per Person: 350 l/capita/day
Allowable Infiltration Rate: 0.1 l/s/ha

Existing Sanitary Sewer Trunks

Pipe ID #	U/S Node ID #	D/S Node ID #	Tributary Population	Tributary Area (ha)	Sanitary peak (l/s)	Qinfiltra (l/s)	Qtotal (l/s)	U/S Ground (m)	U/S Invert (m)	D/S Ground (m)	D/S Invert (m)	Length (m)	Slope	Diam. (mm)	Vel. (m/s)	Qdesign (70% full) (l/s)	Qtotal/ Qdesign
B1-12e	E29	E28	3,049	38	42	4	46	69.4	66.3	67.5	64.5	130.6	0.014	300	2.07	95.0	0.49
B1-14e	E28	E27	3,753	50	51	5	56	67.5	64.4	66.7	63.7	156.15	0.005	300	1.24	57.0	0.98
B1-15e	E27	E26	4,806	59	64	6	69	66.7	63.7	66.1	63.0	134.65	0.005	300	1.24	57.0	1.23
B1-16e	E26	E25	6,134	71	79	7	86	66.1	63.0	64.4	62.2	150.9	0.005	375	1.44	103.0	0.83
B1-17e	E23	E24	8,649	91	106	9	115	64.4	62.1	64.5	61.3	149.4	0.006	375	2.00	110.0	1.04
B1-18e	E24	E22	9,238	100	115	10	125	64.2	61.3	64.2	60.8	97.75	0.006	375	2.00	110.0	1.14
B1-19e	E23	E22	10,663	114	126	11	138	64.2	60.7	64.0	59.6	105.6	0.008	375	2.00	130.0	1.06

Existing pipe requires upsizing

Proposed Sanitary Sewer Trunks

Conduit ID #	U/S Node ID #	D/S Node ID #	Tributary Population	Tributary Area (ha)	Sanitary peak (l/s)	Qinfiltra (l/s)	Qtotal (l/s)	U/S Ground (m)	U/S Invert (m)	D/S Ground (m)	D/S Invert (m)	Length (m)	Slope	Diam. (mm)	Vel. (m/s)	Qdesign (70% full) (l/s)	Qtotal/ Qdesign
A1	A40	A35	3,042	32	42	3	46	79.00	74.50	73.00	70.50	240	0.017	250	1.9	64.0	0.71
A2	A35	A30	4,337	68	58	7	65	75.00	70.50	55.00	53.50	492	0.035	300	2.7	104.0	0.62
A3	A30	A25	2,858	29	40	3	43	61.00	59.50	56.50	54.50	200	0.025	250	2.2	77.0	0.56
A4	A25	A20	2,748	42	51	4	55	56.50	54.50	55.00	53.50	195	0.005	250	1.1	77.0	0.72
A5	A20	A15	8,662	119	106	12	118	55.00	53.50	42.00	40.50	330	0.040	375	3.3	200.0	0.41
A6	A15	A05	9,068	134	110	13	123	40.00	38.50	31.70	30.20	400	0.021	375	2.5	200.0	0.62
A7	A10	A05	4,993	46	65	5	70	36.00	31.50	31.70	30.20	220	0.006	375	1.4	112.0	0.62
A8	A05	A01	14,443	187	164	19	182	31.70	30.2	29.00	27.30	190	0.014	450	2.44	273	0.67

East Clayton Neighbourhood Concept Plan, 2003

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Figure 9 – Existing and Proposed Sanitary Trunk Sewers

1.4 Financing

Developers will be eligible for DCC contribution for 100% of the cost of sanitary sewer replacement on 188 Street as per East Clayton Trunk Sewer DCC Item Table 7.3.7. The estimated cost of the sanitary sewer replacement on 188 Street is approximately $125,000.00.

The proposed upgrade of 176 Street interim pump station estimated at $250,000.00 will be undertaken by the City of Surrey and shall be paid for through DCC contributions collected from East Clayton NCP developments.

It is estimated that the sanitary sewer DCC revenues generated by the study area will be approximately $127,000, not including DCC's from future school expansion.

Appendix IV - Clayton Pumping Station Upgrade, Final Report –
Earth Tech Canada Ltd.

October 29, 2004. Refer to File: L:\work\75000\75650\03-Report\Clayton 09_23_04 (KK's nd Jude's included).doc

City of Surrey
Engineering Department
14245 – 56th Avenue
Surrey, BC
V3X 3A2

Attention: **Jude Pillai, P.Eng.**

Re: **Clayton Pumping Station Upgrade –Water Supply Study: Final Report**

1.0 INTRODUCTION

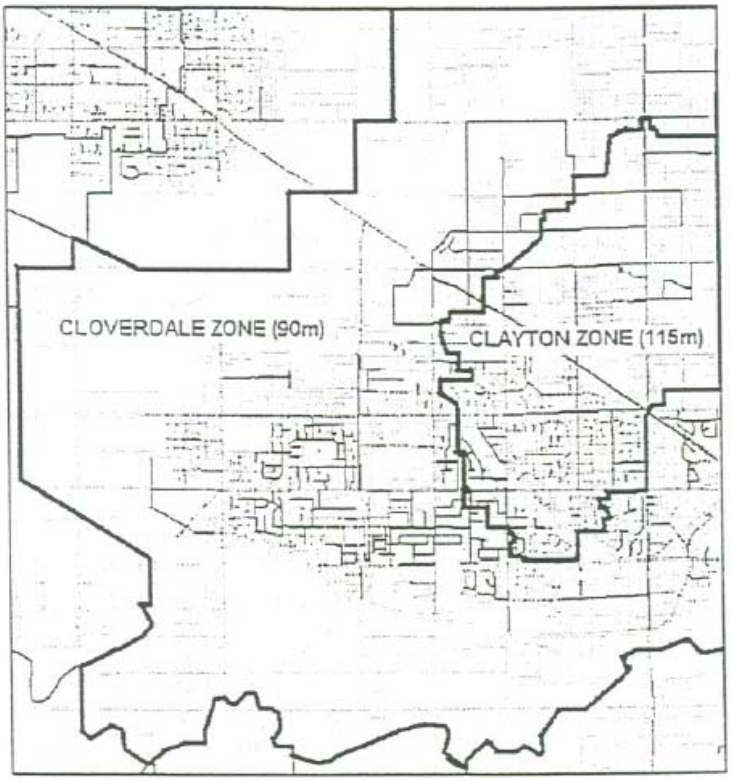
This report summarizes the study of demand projections in the Clayton and Cloverdale pressure zones and confirms the necessary schedule for the upgrading of the existing Clayton Pumping Station and construction of a future pumping station. This letter report addresses work tasks 1 to 15 that were outlined in our letter proposal dated March 8, 2004 (see ***Appendix A***).

2.0 BACKGROUND

The water supply system in the Clayton study area is separated into two pressure zones along a 50m contour (approximate). The upper or 'Clayton' pressure zone currently operates at 115m static head. The lower or 'Cloverdale' pressure zone operates at 90m static head. Water supply to the overall area is provided by the GVWD's Whalley/Clayton 900mm diameter watermain, which feeds the Clayton Reservoir at 72nd Avenue and 190th Street. During lower demand winter months the GVWD's Whalley/Clayton main operates between 125m and 139m static head and the 115m Clayton pressure zone is fed directly from the GVWD main via PRV stations at 72nd Avenue/184th Street and the Clayton Reservoir. In the higher demand periods throughout the summer, the HGL in the Whalley/Clayton main drops below 115m and all water supply to the Clayton zone must be pumped from the Clayton Pump Station, which is located immediately adjacent the reservoir. The Cloverdale pressure zone is fed directly from the GVWD supply system through PRVs at two locations (176th Street north of 66A Avenue and 54th Avenue and 192nd Street). The Cloverdale

pressure zone is also fed indirectly through fifteen (15) minor PRVs at the zone boundary between the Clayton and Cloverdale pressure zones. The City of Surrey has recently completed the construction of a new 600mm supply main along 54th Avenue that augments the existing supply to the Cloverdale pressure zone. *Figure 1* shows the existing pressure zone boundaries.

Figure 1: Clayton and Cloverdale Pressure Zone Boundaries



The rate of development of the Clayton area is increasing rapidly and the City needed to examine the best strategy to service the Clayton and Cloverdale areas with water supply in the immediate short-term as well as to confirm plans for phased upgrading and construction of the new Clayton pumping station. Ideally, the City wants to be able to extend the life of the existing pumping station for as long as possible, provided that they can still meet the service requirements of the developing neighbourhood.

3.0 METHODOLOGY

In order to complete the work tasks listed above, the following approach was used:

1. Relevant data was obtained including populations, land uses, PRV settings, pump station operations, contours, water consumption rates, etc.

2. Existing and imminent development activity including built-out sites, sites under construction and sites under development application were identified.

3. Existing and future residential and non-residential demands for the study areas were calculated including a review of the projected growth in the East Clayton area.

4. Flow from the higher pressure Clayton zone to the lower pressure Cloverdale zone was determined using flow balance equations.

5. The viability of using groundwater to reduce the projected long-term requirements for pumping was not pursued due to the high degree of uncertainty on the long-term yield of the wells.

6. Updated demand scenarios were used to determine the estimated remaining service life of the existing Clayton pumping station and the anticipated timing for construction of a new pumping station.

4.0 POPULATION AND DEMAND PROJECTIONS

4.1 Data Collection

The following information was collected to complete this portion of the project:

- Maps showing land uses, contours, lot layouts, and piping - from the City of Surrey GIS Department;
- Maps showing PRV locations, closed valve locations, pressure zone boundaries, lot layouts, and piping - from the City of Surrey Engineering Department;
- Immediate Development Population data for East Clayton – from the City of Surrey Planning and Development Department;

- Long-term population and future growth projections for the Clayton and Cloverdale areas - from the City of Surrey Planning and Development Department;
- Clayton pump station flow rates and PRV flow data – from the City of Surrey Operations Department;
- City of Surrey water consumption data from the GVWD 2002 Water Consumption Statistics; and
- Design demand data (ADD, MDD, PHD, and equivalent populations based on land use) from the City of Surrey 2002 Design Criteria Manual.

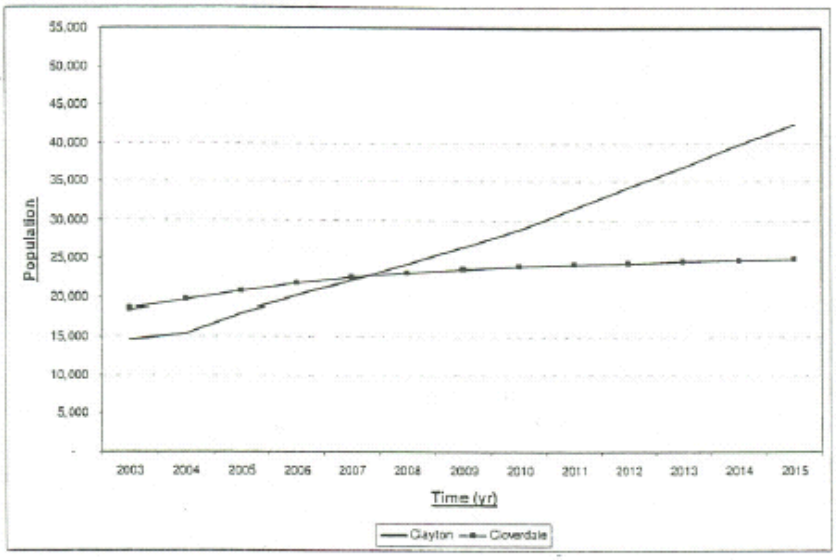
4.2 Population Projections

The City of Surrey Planning and Development Department provided the population projections up to the year 2021 for the Clayton and Cloverdale Pressure Zones to match the zone boundaries provided by the City Engineering Department. The estimated population projections for each of the zones are provided in ***Table 1*** and are shown graphically in ***Figure 2.*** The population projections take into account ongoing development activity that is currently taking place in the East Clayton area.

Table 1: Clayton and Cloverdale Pressure Zone Population Projections

	Clayton	Cloverdale	Total
2003	14,700	18,700	33,400
2004	15,500	19,800	35,300
2005	18,100	20,800	38,900
2006	20,300	21,800	42,100
2007	22,200	22,600	44,800
2008	24,300	23,200	47,500
2009	26,500	23,700	50,200
2010	28,900	24,000	52,900
2011	31,600	24,300	55,900
2012	34,300	24,500	58,800
2013	36,900	24,600	61,500
2014	39,900	24,800	64,700
2015	42,500	25,000	67,500

Figure 2: Population Projections



4.3 Per Capita Water Consumption

The City of Surrey Design Criteria Manual provides Average Day, Maximum Day and Peak Hour demand per capita. This has been compared to the GVWD 2002 Water Consumption Statistics for the City of Surrey and is provided in ***Table 2*** below.

Table 2: ADD, MDD, and PHD Design Values

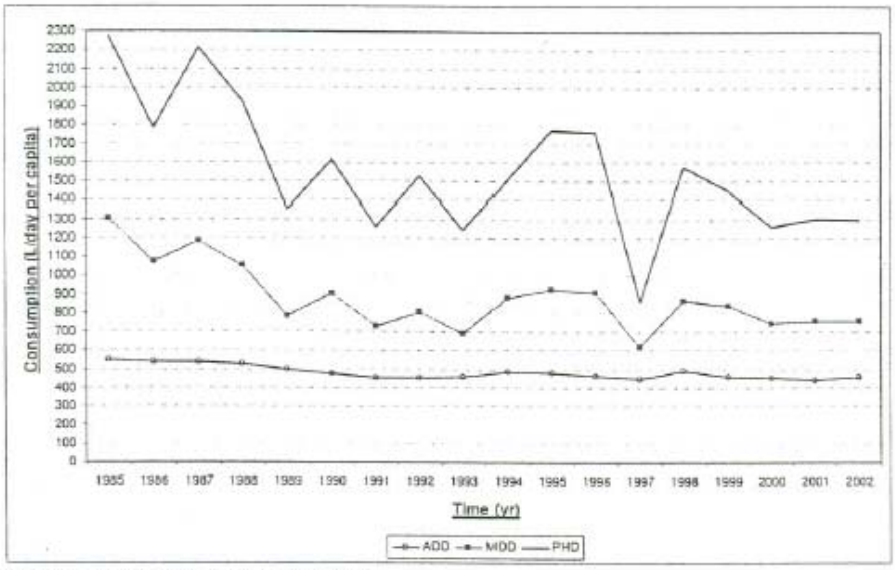
Demand Type	City of Surrey Design Criteria Manual (L/day per capita)	GVWD 2002 Water Consumption Statistics – City Wide* (L/day per capita)	Calculated 2003 Clayton Records** (L/day per capita)
Average Day Demand (ADD)	500	460	593**
Maximum Day Demand (MDD)	1,000	756*	1,306**
Peak Hour Demand (PHD)	2,000	1,298*	2,120**

*The GVWD maximum day and peak hour are taken to coincide with the day of peak flow from the sources. This day may be different from Surrey's peak day.

**These values are based on the flow measurements at Clayton Pump Station and GVWD PRV provided by the City and includes the water that flows from the higher pressure Clayton zone to the lower pressure Cloverdale zone via the 15 smaller PRVs.

The GVWD data for ADD, MDD and the PHD for entire City of Surrey for the period from 1985 - 2002 has been plotted in ***Figure 3*** for comparison purposes.

Figure 3: City of Surrey Per Capita Consumptions



* Source: 2002 GVRD Water Consumption Data

Although there is a difference in the above values, for the purposes of this assessment, the decision to use City Design Criteria for the determination of projected residential water demands was made in consultation with City Staff.

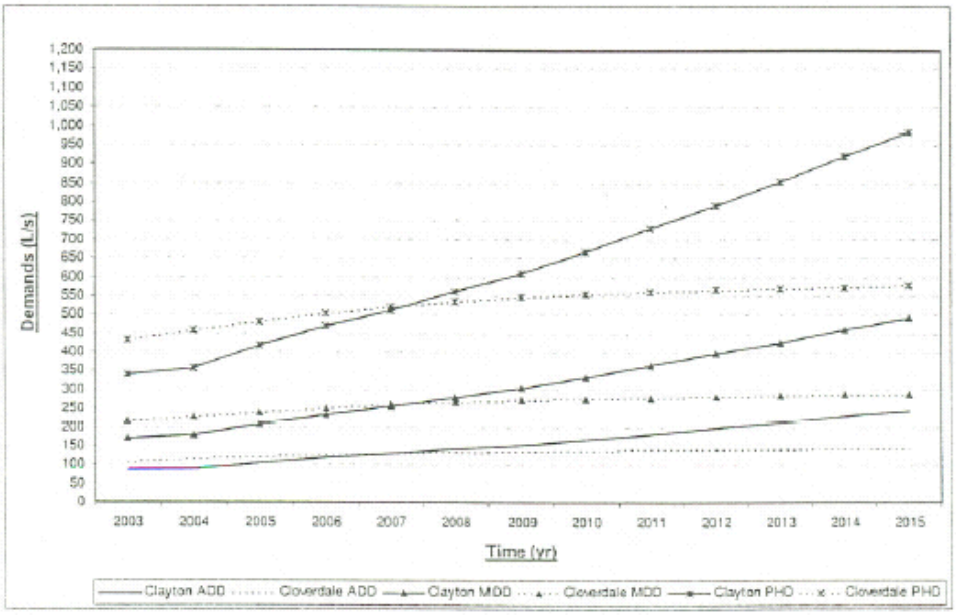
4.4 Residential Water Demands (2003-2015)

The population data obtained from the City's Planning Department and the City of Surrey Design Criteria for per capita consumption were used to calculate the residential demands for East Clayton, Clayton and Cloverdale areas. The projected demands from 2003 to 2015 are summarized in ***Table 3*** for Clayton and Cloverdale and they are both illustrated in ***Figure 4***.

Table 3: Projected Residential Demands

Year	Clayton Demands (L/s)			Cloverdale Demands (L/s)		
	ADD	MDD	PHD	ADD	MDD	PHD
2003	85	170	340	108	216	431
2004	90	179	358	115	229	458
2005	105	209	417	121	241	481
2006	117	234	468	126	252	504
2007	129	257	514	131	261	522
2008	141	281	561	134	268	536
2009	153	306	612	137	274	547
2010	167	334	668	139	278	555
2011	183	365	730	141	281	561
2012	199	397	793	142	283	566
2013	214	427	854	143	285	570
2014	231	461	922	144	287	574
2015	246	492	984	145	289	578

Figure 4: Projected Residential Demands



4.5 Existing Non-residential Water Demands

The existing non-residential water demands were determined using land use areas from the land use file provided by the City of Surrey GIS Department and the respective "equivalent populations" from the Surrey Design Criteria Manual. *Tables 4A* and *4B* summarize the calculated existing non-residential demands from Clayton (including East Clayton) and Cloverdale respectively. Agricultural Land use is the largest non-residential demand for both the Clayton and Cloverdale zones. The Light Industrial and the golf course water demands are the other significant water users in the Cloverdale zone. Based on the land use projections the long-term non-residential demand is not expected to increase significantly beyond be the existing condition.

Table 4A: Clayton Non-Residential Demands

Land Use	Description	Gross Density (people/ha)	Gross Density (people/m2)	Total Area in Clayton Zone (m2)	Clayton Zone Equivalent Population	Clayton Zone ADD Demand (L/s)	Clayton Zone MDD Demand (L/s)	Clayton Zone PHD Demand (L/s)
A-1	General Agriculture	10	0.001	1,587,700	1,588	9.2	18.4	36.8
A-2	Intensive Agriculture	10	0.001	10,550	11	0.1	0.1	0.2
C-15	Town Centre Commercial	90	0.009	0	0	0.0	0.0	0.0
C-4	Local Commercial	60	0.006	14,000	84	0.5	1.0	1.9
C-5	Neighbourhood Commercial	60	0.006	0	0	0.0	0.0	0.0
C-8	Community Commercial	60	0.006	0	0	0.0	0.0	0.0
CCR	Child Care	50	0.005	5,800	29	0.2	0.3	0.7
CPG	Golf Course	50	0.005	0	0	0.0	0.0	0.0
IB	Business Park	90	0.009	0	0	0.0	0.0	0.0
IH	High Impact Industrial	90	0.009	0	0	0.0	0.0	0.0
IL	Light Impact Industrial	90	0.009	5,100	46	0.3	0.5	1.1
RMS-1	Special Care Housing 1	50	0.005	1,500	8	0.0	0.1	0.2
RMS-1A	Special Care Housing 1	50	0.005	0	0	0.0	0.0	0.0
RMS-2	Special Care Housing 2	50	0.005	0	0	0.0	0.0	0.0
			Total	1,624,650	1,765	10.2	20.4	40.8

Table 4B: Cloverdale Non-Residential Demands

Land Use	Description	Gross Density (people/ha)	Gross Density (people/m2)	Total Area in Cloverdale Zone (m2)	Cloverdale Zone Equivalent Population	Cloverdale Zone ADD Demand (L/s)	Cloverdale Zone MDD Demand (L/s)	Cloverdale Zone PHD Demand (L/s)
A-1	General Agriculture	10	0.001	13,715,700	19,716	114.1	228.2	456.4
A-2	Intensive Agriculture	10	0.001	67,450	67	0.4	0.8	1.6
C-15	Town Centre Commercial	90	0.009	125,200	1,127	6.5	13.0	26.1
C-4	Local Commercial	60	0.006	10,800	65	0.4	0.8	1.5
C-5	Neighbourhood Commercial	60	0.006	0	0	0.0	0.0	0.0
C-8	Community Commercial	60	0.006	161,700	970	5.6	11.2	22.5
CCR	Child Care	50	0.005	0	0	0.0	0.0	0.0
CPG	Golf Course	50	0.005	1,947,900	9,740	56.4	112.7	225.5
IB	Business Park	90	0.009	268,200	2,414	14.0	27.9	55.9
IH	High Impact Industrial	90	0.009	460,200	4,142	24.0	47.9	95.9
IL	Light Impact Industrial	90	0.009	1,897,200	17,075	98.8	197.5	395.3
RMS-1	Special Care Housing 1	50	0.005	0	0	0.0	0.0	0.0
RMS-1A	Special Care Housing 1	50	0.005	4,300	22	0.1	0.2	0.5
RMS-2	Special Care Housing 2	50	0.005	0	0	0.0	0.0	0.0
			Total	24,658,650	55,336	320.2	640.5	1,280.9

4.6 East Clayton Area

There have been a large number of development applications made in the East Clayton neighborhood. The City of Surrey Planning and Development Department provided a list of built-out sites, sites currently under construction and sites under development application. Nearly all of these developments are residential and based on this information, the immediate effect of the associated increase in population was determined. The non-residential "equivalent" population was also determined using the City of Surrey Design Criteria.

Table 5 shows the East Clayton Residential Demand Projections. The number of units is based on the information provided by the Planning Department. The number of people per unit is based on the City of Surrey Design Criteria and this was used to calculate the overall increase in population. The City of Surrey Engineering Department has advised that the Design Criteria for the various types of residential land use will be changing in the future and this will allow for further increases in population. It is noted that the East Clayton area population is approximately 37% of the total population (2003) of the Clayton Pressure Zone. ***Table 6*** and ***Table 7*** indicate the East Clayton demand projections for the commercial and total areas respectively.

Table 5: East Clayton Area: Projected Residential Demands

	Residential Land Use							
	RF-9	RF-9C	RF-9S	RF-12	RF-12C	TH	APT	Total
Number of Units	123	459	53	143	301	962	226	
People per unit*	3.0	3.0	3.0	3.0	3.0	1.9	1.9	
Population	369	1377	159	429	903	1828	429	5,494
Total ADD (L/s)	2.1	8.0	0.9	2.5	5.2	10.6	2.5	31.8
Total MDD (L/s)	4.3	15.9	1.8	5.0	10.5	21.2	5.0	63.6
Total PHD (L/s)	8.5	31.9	3.7	9.9	20.9	42.3	9.9	127.2

*The City of Surrey is currently in the process of revising its design criteria (increasing density).

Table 6: East Clayton Area Commercial Demand Projections

	Commercial Land Use
Area (m^2)	11,880
People per m^2	0.009
ADD (L/s/capita)	0.006
MDD (L/s/capita)	0.012
PHD (L/s/capita)	0.023

Table 7: East Clayton Area: Total Demand Projections

Demand Type	Demand (L/s)		
	ADD	MDD	PHD
East Clayton Area Residential	31.8	63.6	127.2
East Clayton Area Commercial	0.6	1.2	2.5
Total East Clayton Area	32.4	64.8	129.7

4.7 Total Demand Projections

The total projected water demands were obtained adding the residential and non-residential water demands obtained above for the Cloverdale and the Clayton (inclusive of East Clayton) Zones and they are summarized below in *Tables 8A* and *8B*.

Table 8A: Clayton Area: Total Demand Projections

Year	Residential ADD	Non-Residential ADD*	Total ADD	Total MDD	Total PHD
2003	84.9	10.8	95.7	191.4	382.9
2004	89.3	10.8	100.1	200.3	400.6
2005	104.2	10.8	115.0	230.0	460.0
2006	117.0	10.8	127.8	255.6	511.1
2007	128.4	10.8	139.2	278.3	556.7
2008	140.2	10.8	151.1	302.1	604.3
2009	152.9	10.8	163.7	327.4	654.8
2010	166.9	10.8	177.7	355.4	710.9
2011	182.4	10.8	193.2	386.5	772.9
2012	198.2	10.8	209.0	418.0	836.0
2013	213.3	10.8	224.2	448.3	896.6
2014	230.4	10.8	241.2	482.4	964.8
2015	245.8	10.8	256.6	513.1	1,026.3

* All non-residential demands have been assumed to be fully developed and will remain constant.

Table 8B: Cloverdale Area: Total Demand Projections

Year	Residential ADD	Non-Residential ADD*	Total ADD	Total MDD	Total PHD
2003	107.7	320.2	427.9	855.8	1,711.5
2004	114.3	320.2	434.5	869.1	1,738.1
2005	120.1	320.2	440.3	880.7	1,761.4
2006	125.8	320.2	446.0	892.1	1,784.2
2007	130.4	320.2	450.6	901.1	1,802.2
2008	133.8	320.2	454.0	907.9	1,815.8
2009	136.7	320.2	456.9	913.8	1,827.5
2010	138.6	320.2	458.8	917.6	1,835.2
2011	140.2	320.2	460.4	920.8	1,841.7
2012	141.4	320.2	461.6	923.2	1,846.3
2013	142.3	320.2	462.5	924.9	1,849.9
2014	143.3	320.2	463.5	927.0	1,854.0
2015	144.5	320.2	464.7	929.3	1,858.7

* All non-residential demands have been assumed to be fully developed and will remain constant.

5.0 PRV SETTINGS:

The City of Surrey's Operations Department provided the existing pressure settings of the PRV's serving both zones. The PRV's are all located at approximately the 50m contour elevation and the field settings, existing ground elevations (obtained from the 5m contour map) and calculated hydraulic grade line for each of the 15 PRV's is shown in *Table 9*.

Apart from the flow records for GVWD PRV located near Clayton Reservoir, flow data was not available for any of the other PRV locations.

Table 9: Clayton and Cloverdale PRV HGLs

PRV ID	Location	Elevation (m)	U/S Pressure Setting (m)	D/S Pressure Setting (m)	HGL (m)	Pressure Zone Boundary (m)
1	72 Ave. and 184 St.	55	82	66	121	115
2	68 Ave. and 181 St.	37	77	55	92	90
3	18200 - 67A Ave.	53	70	46	99	90
4	66 Ave. and 181 St.	50	77	40	90	90
5	60 Ave. and 182 St.	56	56	38	94	90
6	58 Ave. and 184 St.	57	53	35	92	90
7	5760 - 184 St.	55	77	38	93	90
8	56 Ave. and 187A St.	47	56	42	89	90
9	57 Ave. and 188 St.	57	56	35	92	90
10	58 Ave. and 189A St.	50	64	36	86	90
11	18925 - 59A Ave.	53	63	37	90	90
12	64 Ave. and 192 St.	55	99	42	97	90
13	64 Ave. and Fraser Hwy	57	30	30	87	90
14	Clayton Station	81	varies	37	118	115
15	80 Ave. and 192 St.	36	81	55	91	90
16	65A Ave. and 176 St.	16	140	70	86	90
17	68A Ave. and 176 St (GVRD)	10	154	91	101	90
18	54 Ave. and 192 St (GVRD)	10	144	80	90	90

6.0 TRANSFER OF WATER FROM CLAYTON TO CLOVERDALE PRESSURE ZONE VIA EXISTING PRVS

In order to estimate how much water enters the lower pressure Cloverdale zone from the higher pressure Clayton zone via the existing PRVs the average Clayton pumping rates and PRV flow data obtained from the City of Surrey Operations Department was used (see ***Figure 5***).

The amount of water entering the Cloverdale zone through the 15 minor PRVs in the Clayton zone was approximated using the design demands from ***Table 2***, the flow data from both the Clayton Pump Station and the GVWD PRV flow data shown in ***Figure 5***. This information was entered into the following flow balance equations (see ***Figure 6*** for a schematic representation):

Figure 5: Clayton Pump Station: Pump Station and PRV Flow Data

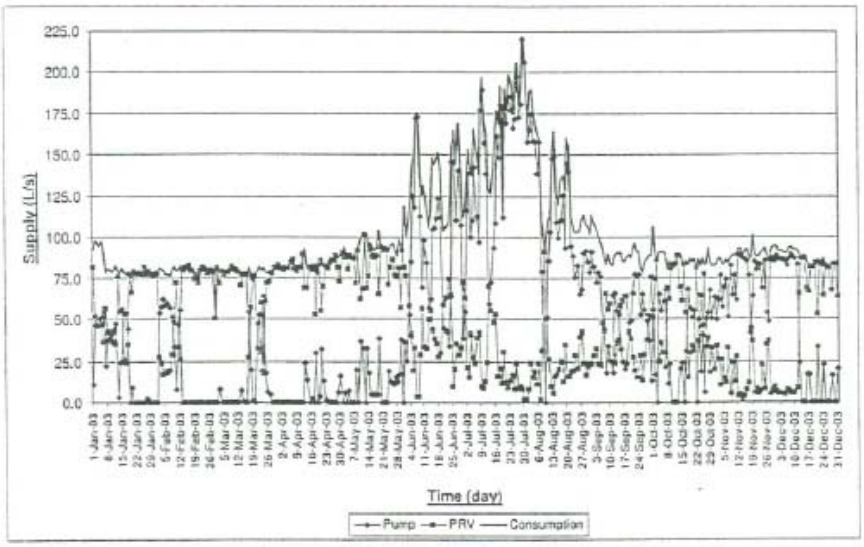
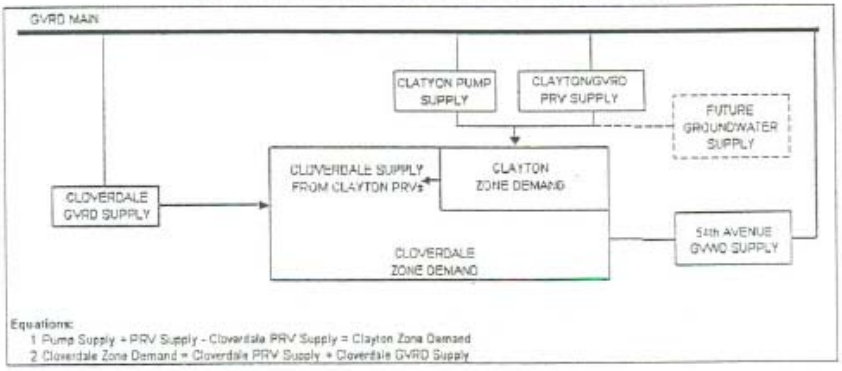


Figure 6: Schematic of Clayton and Cloverdale Supply



Equation 1

CLAYTON PUMP SUPPLY + FUTURE GROUNDWATER SUPPLY + CLAYTON/GVRD PRV SUPPLY – CLAYTON ZONE DEMAND = CLOVERDALE SUPPLY FROM CLAYTON PRVs

Equation 2

CLOVERDALE ZONE DEMAND = COLVERDALE SUPPLY FROM CLAYTON PRVs+ CLOVERDALE GVRD SUPPLY + 54TH AVENUE GVWD SUPPLY

The calculated demand projections were used as inputs to the above equations to estimate the quantity of water that currently flows from the 115m Clayton Pressure Zone to the 90m Cloverdale Pressure Zone (under the various demand scenarios).

Using the calculated demand assumptions for the various demand scenarios, it is estimated that up to 15% of the total volume of water that is being pumped into the Clayton pressure zone flows into the lower pressure zone via the 15 existing minor PRVs.

Table 10: Transfer of Water to Lower Zone: Calculation

	Based On Design Demands		
Demand Projections:	ADD (500Lcpd)	MDD (1000Lcpd)	PHD (2000Lcpd)
Clayton Zone Residential (L/s)	84.9	169.8	339.6
Clayton Zone Non-Residential (L/s)	10.2	20.4	40.8
A) Total Clayton Zone Demand (L/s)	95.1	190.2	380.4
Cloverdale Zone Residential (L/s)	107.7	215.4	430.7
Cloverdale Zone Non-Residential (L/s)	320.2	640.5	1280.9
B) Total Cloverdale Zone Demand (L/s)	427.9	855.8	1711.7
Clayton Supply (provided by City)			
Pump Supply (L/s)	50.8	220.1	358.8
GVRD PRV Supply (L/s)	49.8	1.7	0.0
C) Total Supply to Clayton Zone (L/s)	100.6	221.8	358.8
Therefore:			
D) Cloverdale Supply from Clayton PRVs (L/s) (C-A)	5.5	31.6	0.0
Cloverdale GVRD Supply (L/s) (B-D)	422.4	824.3	1733.3
% of water supplied to Clayton transferred to Cloverdale	5.5%	14.2%	0% *

* The above calculations are based on theoretical assumptions. A more accurate assessment will be able to be completed following calibration of the existing WaterCAD system model.

7.0 WATER SUPPLY

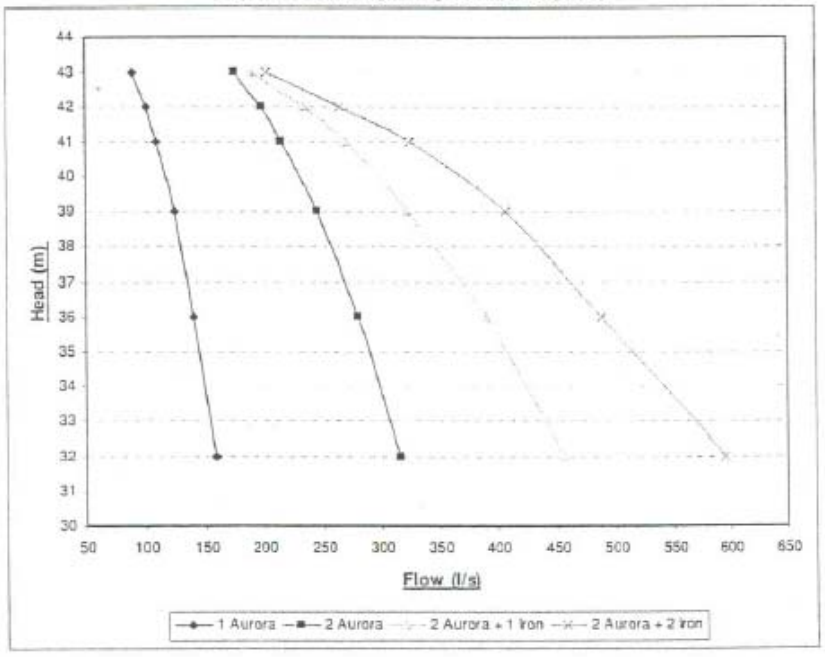
7.1 Existing Pumping Station Capacity

The existing Clayton pumping station houses four 75hp pumps (2 Aurora and 2 Iron Pumps) supplying 106 L/s each. The City's current practice is to have one pump available as a standby. The "standby" status rotates through each of the pumps every 4 cycles. ***Figure 7*** illustrates the combined available flow from the four pumps. During peak hour demand (PHD) periods in the summer of 2003, all four pumps had to run leaving the City with no standby capacity in the existing station.

The City of Surrey had originally indicated they would consider installing larger pumps in the existing station if the existing electrical service could accommodate the larger pumps without a significant upgrade as the existing station is slated for replacement.

The existing Clayton Pumping station has a 300kVA service transformer power supply and currently feeds four 75hp pumps. At pump starts, the power requirements are significantly higher and the station will not be able to handle the power requirements of larger pumps without a major upgrade to the main power supply consequently, an upgrade to accommodate larger pumps was not considered.

Figure 7: Existing Pump Station Capacity



The current pump station capacity can not meet the calculated peak hour demands with three pumps operating and as previously mentioned in the summer of 2003, the fourth (standby) pump had to be used during peak hour conditions. Because the existing station cannot accommodate an increase in pump size without a major electrical upgrade the purchase of a 75hp pump shelf spare

will provide some redundancy in the event that one of the existing pumps has to be removed for repairs.

In evaluating the capacity of the existing pump station we have considered the following two scenarios:

1. 3 Pump Configuration: Three 106 L/s duty pumps = 318 L/s total installed capacity with 106 L/s standby capacity.

2. 4 Pump Configuration: Four 106 L/s duty pumps = 424 L/s total installed capacity with one 106 L/s shelf spare to be used for emergency replacements.

7.2 Ground Water Supply:

The City of Surrey has just completed the initial testing of two ground water wells that have been drilled close to the existing Clayton Pump Station. The expected yield from these two wells will be limited to a maximum of 75 L/s.

The preliminary results of the well testing indicate a high degree of uncertainty on the long-term yield of the wells. Based on the information provided, it has been assumed that ground water will not be available to supplement the supply to the Clayton Pressure Zone within the next two years.

7.3 54th Avenue Supply to the Cloverdale Zone:

The City of Surrey has recently completed the construction of a new 600mm diameter watermain along 54th Avenue. This became operational in June 2004 and the new supply line provides the lower pressure Cloverdale zone with a second source of supply. This additional source of supply to the low pressure zone means that the City can modify the existing PRV settings at the zone boundary between the Clayton and Cloverdale pressure zones to maximize the retention of water in the higher pressure zone. The remaining service life of the existing Clayton pump station will be maximized because under normal circumstances the Clayton pump station may only be used to supply the higher pressure Clayton zone.

7.4 Proposed Pumping Station

The City has a design for a new Clayton Pumping station "on the shelf". This station has a proposed interim capacity of 625 L/s (four 208 L/s pumps with one standby) and ultimate capacity of 2,083 L/s (six 416 L/s pumps with one installed spare). Based on the population projections and the calculated demands we estimate that the interim capacity of the proposed pumping station will be reached in 2008 as shown on ***Figure 8***.

If the construction of the new pump station started near the end of 2004 and assuming that it would take approximately one year to complete, the new pump station would be operational by the end of 2005 or early 2006. Using the same population projections and the calculated demands as noted above, it appears that the interim capacity of the new pumping station would be reached two (2) years after construction. For this reason, the recommended capacities of the proposed pumps for both the interim and ultimate stage should be reviewed during the detail design of the new pumping station.

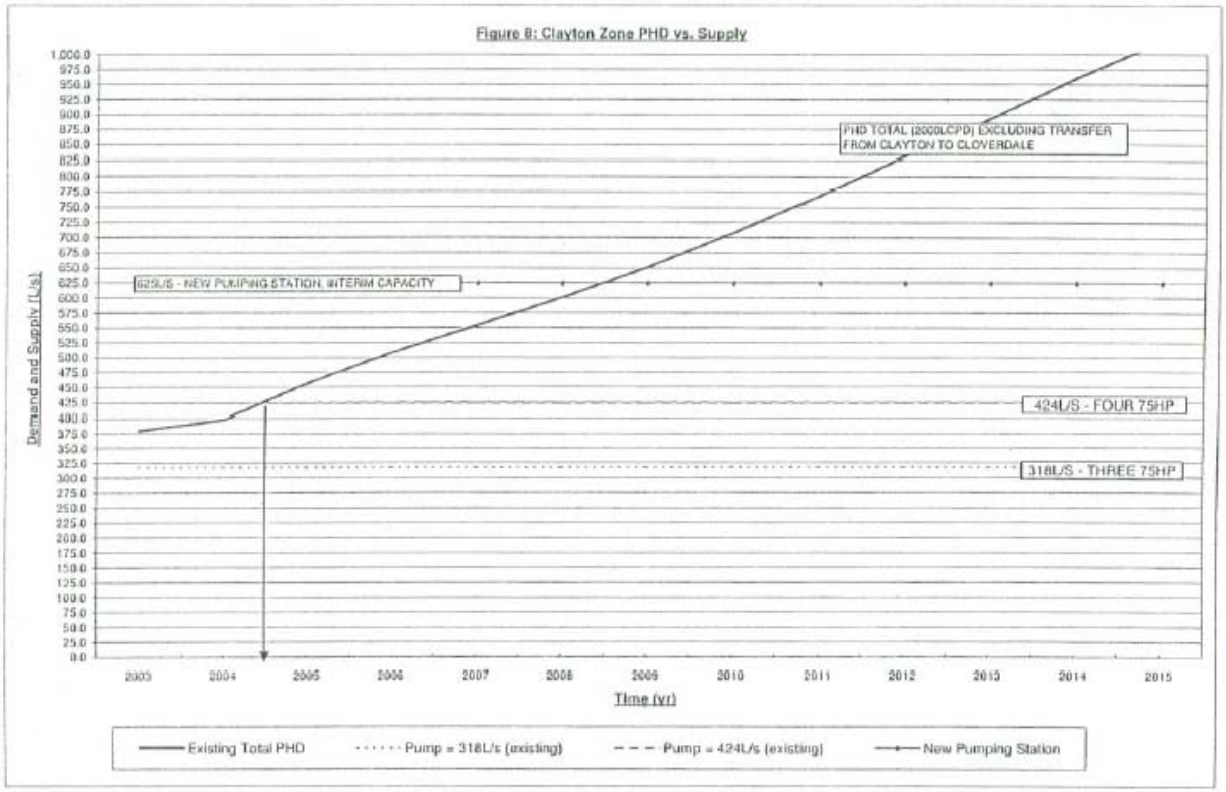


Figure 8: Clayton Zone PHD vs. Supply
Demand and Supply (L/s)
Time (yr)
PHD TOTAL (2000L/CPD) EXCLUDING TRANSFER FROM CLAYTON TO CLOVERDALE
625L/S - NEW PUMPING STATION, INTERIM CAPACITY
424L/S - FOUR 75HP
318L/S - THREE 75HP
Existing Total PHD
Pump = 318L/s (existing)
Pump = 424L/s (existing)
New Pumping Station

8.0 DEMAND VERSUS SUPPLY PROJECTIONS

8.1 Pumping Station Capacity

Table 11 indicates the pump station configurations that were evaluated as part of our analysis. The various capacities of the pump station were plotted against the demands and are shown in *Figure 8* for Peak Hour. The existing pumping station is at or very near it's predicted service life, given the projected population growth and water demand. The service lives of the various pump station configurations is as follows:

Table 11: Pump Station Capacities

Pumping Station Capacity (L/s)	Description	Capacity Limit till=
318	Existing: 3 - 75hp with one 75hp standby	end 2004
424	Existing: 4 - 75hp with one 75hp "shelf" spare	mid 2005
625	New Pumping Station –Interim capacity	mid 2008

8.2 Hydraulic Modelling Results

The City's existing uncalibrated WaterCAD model was used to evaluate the three (3) different flow scenarios indicated in ***Table 12*** and the resulting flow through each of the PRVs and Clayton pumps are summarized in *Table 13*.

The optimal solution was determined to be Scenario 3 with the PRVs between the 115m Clayton and 90m Cloverdale pressure zones set to an HGL of 85m. Under this scenario, all flow from the Clayton to Cloverdale zone via the 15 minor PRVs is eliminated and the volume of water that is pumped by the existing Clayton pump station is reduced approximately 47% compared to existing conditions.

Table 12: Model Simulation Descriptions

PRV Label	Scenario 1.0	Scenario 2.0	Scenario 3.0
54th PRV Setting	Existing	95m HGL	Existing
176th PRV Setting	Existing	95m HGL	Existing
All PRV Settings Between 115m and 90m Zone	Existing	Existing	85m HGL

Table 13: Model Simulation Results (Peak Hour Flow, L/s)

PRV Label	Scenario 1.0	Scenario 2.0	Scenario 3.0
54th PRV Setting	Existing	95m HGL	Existing
176th PRV Setting	Existing	95m HGL	Existing
All PRVs Between 115m and 90m Zones	Existing	Existing	85m HGL
Supply to 115m Zone	**483.1**	**346.1**	**268.8**
PCV-Clayton#1 (Pump # 1)	56.8	37.5	28.5
PCV-Clayton#2 (Pump # 2)	111.7	73.8	56.1
PCV-Clayton#3 (Pump # 3)	185.0	136.9	104.1
PCV-Clayton#4 (Pump # 4)	0.0	0.0	0.0
PRV-Clayton#1	0.0	0.0	0.0
PRV-ClaytonStation#1	21.6	16.6	13.8
PRV-ClaytonStation#2	28.5	21.9	18.1
PRV-72_184#1	24.6	18.4	14.9
PRV-72_184#2	54.9	41.0	33.3
PRV-56_187A	-12.8	0.0	0.0
PRV-57_188#1	-3.4	0.0	0.0
PRV-57_188#2	-56.9	0.0	0.0
PRV-58_184	-4.7	0.0	0.0
PRV-58_189A	0.0	0.0	0.0
PRV-60_182	-54.0	-33.8	0.0
PRV-66_181#1	0.0	0.0	0.0
PRV-66_181#2	-3.8	0.0	0.0
PRV-68_181#1	-0.1	0.0	0.0
PRV-68_181#2	-1.5	0.0	0.0
PRV-5760_184#1	-15.4	-1.3	0.0
PRV-5760_184#2	-40.2	-34.1	0.0
PRV-18200_67A	-21.5	-8.0	0.0
PRV-18925_59A	0.0	0.0	0.0
	268.9	268.9	268.8
Supply to 90m Zone	**220.0**	**370.2**	**433.8**
PRV-3 (54th Avenue)	28.3	98.9	113.5
PRV-4 (54th Avenue)	22.9	80.2	92.0
PRV-5 (54th Avenue)	2.1	7.5	8.6
PRV-68A_176#1	117.4	7.0	114.1
PRV-68A_176#2	49.3	54.7	32.7
PRV-68A_176#3	0.0	122.0	72.9
PRV-64_Fraser#1	0.0	0.0	0.0
PRV-64_Fraser#2	0.0	0.0	0.0
PRV-56_187A	12.8	0.0	0.0
PRV-57_188#1	3.4	0.0	0.0
PRV-57_188#2	56.9	0.0	0.0
PRV-58_184	4.7	0.0	0.0
PRV-58_189A	0.0	0.0	0.0
PRV-60_182	54.0	33.8	0.0
PRV-64_192#1	39.0	25.8	39.4
PRV-64_192#2	0.0	0.0	0.0
PRV-66_181#1	0.0	0.0	0.0
PRV-66_181#2	3.8	0.0	0.0
PRV-68_181#1	0.1	0.0	0.0
PRV-68_181#2	1.5	0.0	0.0
PRV-5760_184#1	15.4	1.3	0.0
PRV-5760_184#2	40.2	34.1	0.0
PRV-18200_67A	21.5	8.0	0.0
PRV-18925_59A	0.0	0.0	0.0
	473.2	473.2	473.2

8.3 Fire Flow Analysis

The City of Surrey Design Criteria requires their water distribution system to be able to provide an operating pressure of 280 kPa during peak hour flow and 140 kPa during maximum day plus fire flow. Clayton Pressure Zone Maximum Day plus fire flow conditions were simulated under Scenario 3. For all areas, a fire flow of 75 L/s was used based on discussion with City Staff.

The recommended modification of the PRV setting greatly increases the quantity of flow from the Clayton pump station that is available for fire fighting purposes. Regardless, when only 3 pumps are running, the existing Clayton pump station will not be able to meet the fire flow criteria for multi-family, commercial and industrial areas in the Clayton zone. When 4 pumps are running, only the industrial fire flow requirement cannot be met. The commercial, industrial and multi-family areas for the Cloverdale and Clayton zones are shown in the attached ***Figure 9***.

Table 14: Available Fire Flow

Clayton Pump Station Capacity	Clayton MDD	Leakage to Lower Zone	Available Flow for Fire Fighting
3 pumps (318 L/s)	220 L/s*	0 L/s	98 L/s
4 pumps (424 L/s)	220 L/s*	0 L/s	204 L/s

*MDD is based on information provided by the City (see Table 10) and also confirmed by the Total demand projections (see Table 8A).

Figure 10 illustrates nodes that are unable to satisfy the City's fire flow and residual pressure criteria in the Clayton and Cloverdale pressure zones under Scenario 3. While at first glance it might appear that there are a multitude of deficient nodes, this is related to deficiencies in pipe sizes, dead ends in cul-de-sacs, etc. and not as a result of modifying the PRV settings. This is further verified by comparison to ***Figure 11*** representing the existing condition.

Figure 10: Critical Fire Nodes Experienced Under MDD Plus Fire Flow = 75l/s, After PRV Changes Made

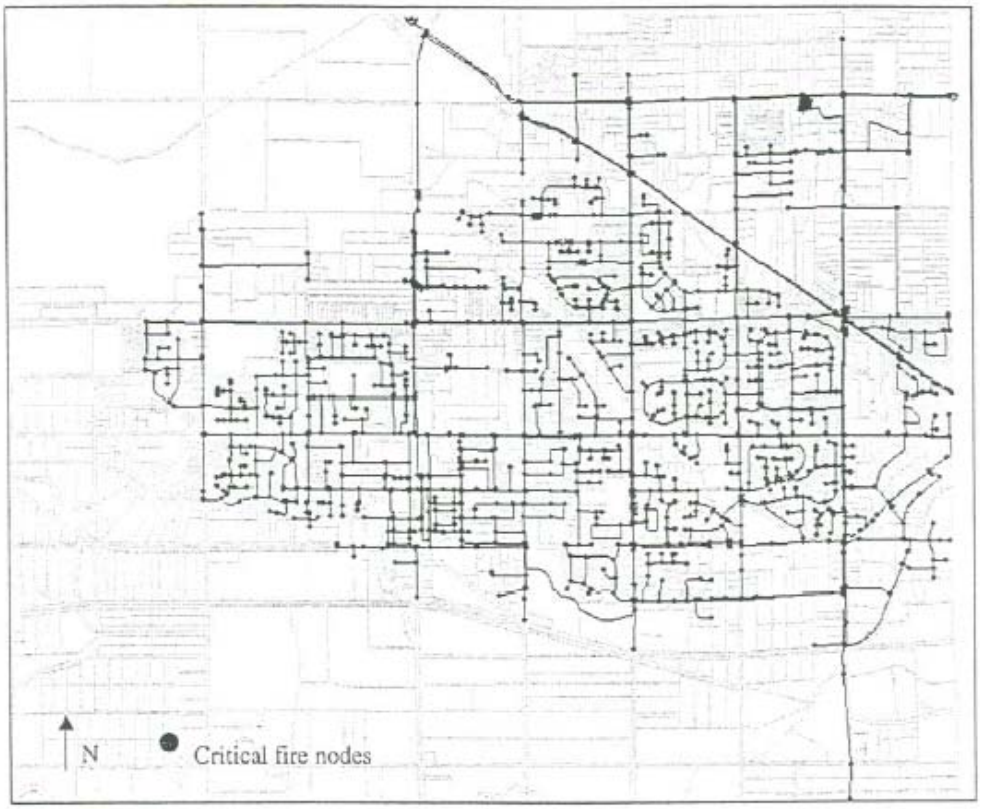
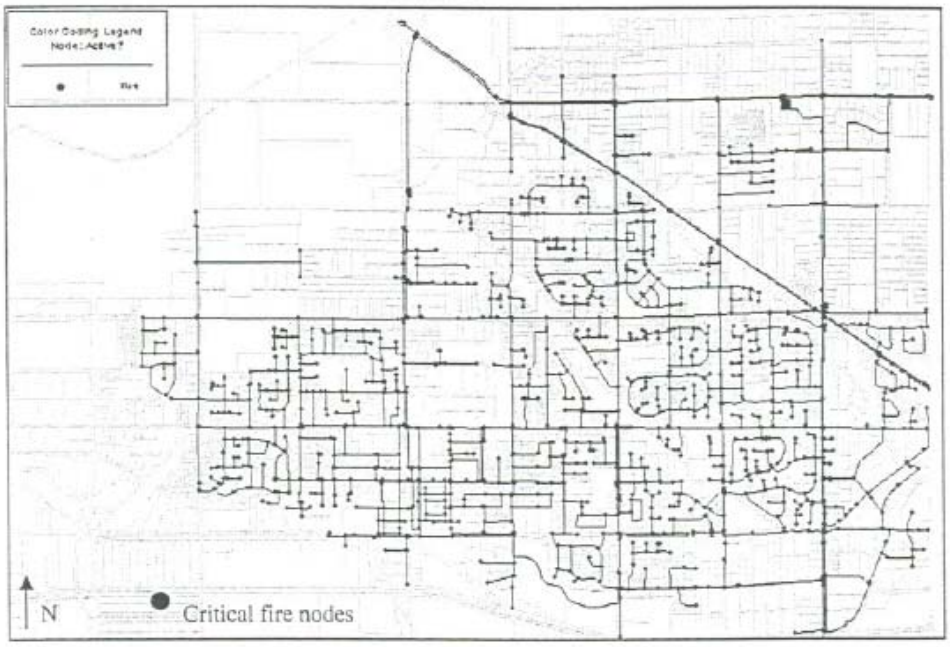


Figure 11: Critical Fire Nodes Experienced Under MDD Plus Fire Flow = 75l/s, Existing Conditions



9.0 RECOMMENDATIONS

On the basis of the analysis undertaken to date, we make the following recommendations:

9.1 Change the settings on the 15 minor PRV's to an HGL of 85m to maximize the retention of water in the Clayton pressure zone. Based on the results of the model simulations, this will result in approximately 50% reduction in the amount of water being pumped from the Clayton pump station under Peak Hour Demand conditions.

The 54th Avenue PRV became operational in June 2004. The settings of the PRVs were modified by the City's Operations Department in July 2004 during an extended dry spell and although the settings were not precisely set, during that time the existing Clayton pump station operated without requiring all four (4) pumps to be in operation at the same time. However, it is noted that the four (4) pumps can only provide the required flows till

mid 2005 (see Table 11).

9.2 Accurately field set the PRVs to the recommended settings, checking the pressures on both the upstream and downstream side of the PRVs.

9.3 In order to maximize the service life of the existing pump station consider using all four (4) existing pumps as duty pumps and purchase an additional pump as a "shelf spare " for use in the event of a failure of any one of the pumps during a high demand period.

9.4 Consider installing temporary flow meters on selected PRVs during a high demand period to measure flows, and ensure that there is no or minimal flow between the high and low pressure zones under normal operating conditions.

9.5 Review the interim and final capacity of the proposed new Clayton pumping station to ensure an adequate period of time (5-10 years) between the interim and ultimate development phases.

9.6 Initiate updating the design of the new pump station as soon as practical so that the new pump station can be operational by the summer of 2006.

The above report completes our assignment. If you have any questions concerning the information contained in this letter report, please do not hesitate to contact us.

Yours truly,

EARTH TECH (CANADA) INC.

Per:

Anwar Sheikh, P. Eng.

Encl.

APPENDIX A

CLAYTON PUMPING STATION UPGRADE –STUDY
PROJECT UNDERSTANDING, CITY'S STATED OBJECTIVES, WORK TASKS AND PROJECT SCHEDULE

PROJECT UNDERSTANDING

The level of development in the Cloverdale area is increasing and the City needs to examine the best strategy to service the Cloverdale area in the immediate short-term as well as confirm plans for phased upgrading and construction of the new Clayton pumping station. In an ideal situation, the City would like to extend the life of the existing pumping station for as long as possible provided that they can still meet the service requirements of the developing neighbourhood.

All four pumps in the Clayton pump station currently operate during peak hour conditions (summer months during lawn sprinklering). The 4th pump doesn't run at full speed yet but in absence of an upgrading it's only a matter of time before the 4th pump is running at full speed. At that time the station will be operating at full capacity with no backup or redundancy. The station is supposed to operate so that 3 pumps running simultaneously will meet the peak hour demand leaving the 4th pump as a standby (33% standby capacity).

The service area has two pressure zones: the 115m Clayton Pressure Zone and the 90m Cloverdale Pressure Zone. The City has indicated that they do not presently know how much water flows from the Clayton zone to the Cloverdale zone through the existing PRVs during peak demands and one possibility would be to modify the settings on the existing PRVs to "hold" more water in the Clayton zone so that the existing pumps are not supplying the Cloverdale zone during peak demand periods except during emergency conditions (i.e. during a fire). This was one of the recommendations for the water supply improvements that were contained in our Clayton NCP and confirmation of the validity of this recommendation should be a first priority for this project.

The City is currently installing a new 600mm diameter main along 54th Avenue. This will be operational by May 2004. The City would like to determine the impact of providing a new connection off this main to supply the lower zone in conjunction with modifications of the existing PRV settings.

The City already has a design for a new Clayton pumping station "on the shelf", however they were not anticipating that it would be necessary to construct the new pumping station for a number

of years. The City would prefer to delay the construction of the new pumping station if demands can be met by making modifications to the existing system.

A change in the alignment of a proposed roadway around the west and south side of the existing reservoir has put the current "as designed" location of the new Clayton pump station in the middle of the road. The ultimate location is still to be determined however the City has indicated that it would be preferable, if possible, to revise the Clayton pump station location so that it can be consolidated with the City's proposed groundwater pumping station. This location will be determined by the City Engineering Department in consultation with the GVWD and other City Departments.

As mentioned above, the City is currently pursuing the development of a groundwater pumping station adjacent to the existing reservoir site. The anticipated capacity of the well will be somewhere between 20L/s and 75L/s. Ideally the City would like to consolidate the groundwater pumping station with the new Clayton pumping station and with this in mind, the scope of this assignment is expected to consider the following:

Determination of impact that a new groundwater supply will have on extending the life of the existing pumping station or modifying the required capacity of the new pump station. Our initial observation is that a single groundwater well producing 25-50L/s will be insufficient to allow only 3 of the existing pumps to operate during a peak demand condition.

Consolidation of the controls for the proposed groundwater well with the new pump station in a single room. In this regard, the City would like to consolidate the controls and electrical systems for both the proposed booster pumping station and the new groundwater well in the same building.

Incorporation of the well head into the proposed "wet" side of the groundwater pump station and physical separation of the "wet" area of the groundwater pump station from the electrical/control room.

City's Stated Objectives:

Determine if and what temporary measure(s) are required in the immediate short-term to provide adequate service to the Cloverdale area.

1. Determine if the current planned pumping capacity is required to satisfy the latest projected

population.

2. Confirm the necessary schedule of the replacement of the existing pumping station and construction of the new pumping station.

3. Coordinate the design and construction of groundwater supply

Work Tasks – Planning and Review

1. We will review the existing pump run times and peak demand flows.

2. We will review current development applications and population projections based on information provided by the City's Planning and Land Development Departments to allow us to develop short (near) term demand projections for the Cloverdale service area.

3. We will review the existing PRV settings and recommend modified settings in order to reduce the transfer of water from the upper zone to the lower zone.

4. We will determine the effect that the development of a new groundwater well with a capacity in the range of 20-75L/s will have on any of the proposed upgrading scenarios.

5. Depending on the results of the above, and as part of a short-term solution prior to completion of the new pumping station, we will determine the need for the City to purchase a spare pump so that they can have a replacement pump "on the shelf" in the event of failure of one of the existing pumps. We will also review the pumping capacity of existing pumps, and potential capacity for upgrading existing facilities to facilitate the purchase and installation of a larger capacity pump(s). The City has noted that the existing station is due to be replaced in a few years and they will only consider installing a larger pump if the existing electrical equipment will handle the larger pump.

6. The recommended timing for construction of the new Clayton pump station based on the outcome of Items 4, 5 and 6.

7. Using the City's working water model which will be available in mid-April, we will;

   - evaluate the performance of the existing system under the updated demand scenarios for MDD, MDD plus fire flow, PHD using the modified PRV settings. The PRV settings will be such that the system will retain more water in the Clayton Pressure Zone in

accordance with the recommendation contained in the Clayton NCP.

- determine the impact of an additional connection from the new 600mm diameter main along 54th Avenue

8. We will confirm the future development plans and population projections based on information provided by the City's Planning Department in order to develop long-term demand projections for the Cloverdale service area.

9. We will determine if the near term/ultimate "as-designed" pumping capacity of the Clayton pump station that the City has "on the shelf" will be adequate to meet the updated population growth and demand projections.

Work Tasks – Design and Construction

If necessary according to Task 5 (above) we will prepare the technical specifications to allow the City to tender and purchase an "on the shelf" standby pump for the existing Clayton pump station. Similarly, if our review of the existing facilities indicates that it is possible to install a larger pump in the existing pump station, we will develop the technical specifications to allow the City to tender and purchase an "on the shelf" standby pump that will be usable in the future pump station.

PROJECT SCHEDULE

We will provide initial assessment of the capacities within four weeks of receiving the notice to proceed. We will confirm our initial assessment and complete the work outlined above within three weeks of receiving the working model.

Appendix V – Drainage Servicing

1. Drainage

1.1 Background

Surface drainage from East Clayton NCP area flows to two major catchment areas.

- Catchment A is the eastern and southern area and comprises approximately 190 hectares of land. The catchment slopes southeasterly, while partially draining into McLellan Creek (with an outfall across 64 Avenue) and partially to the east into the Township of Langley storm sewer system (through culverts across 196 Street).

- Catchment B is the western area and comprises approximately 85 hectares of land. The catchment slopes in a westerly direction and drains to North Cloverdale Creek, that outfalls west across 188 Street at 68 Avenue.

Both of the above catchments form part of the Nicomekl-Serpentine river system. Flows from the East Clayton NCP area and the subject NCP area must be managed in an environmentally sustainable and economical manner involving infiltration, volume controls and other sustainable engineering strategies. The requirement for infiltration systems is outlined in the "*Green Infrastructure Performance Standards and Guidelines*" in section 4.0 of the East Clayton NCP.

The proposed study area is located within the East Clayton NCP, Catchment B, as shown on Figure 10 (prepared by Earth Tech Canada Inc., Figure 7.5.1).

In addition to the above, the NCP servicing strategy is to convey stormwater runoff via storm sewers to a series of five (5) detention ponds, four (4), of which, are located within the NCP area and Pond E that is located within the study area

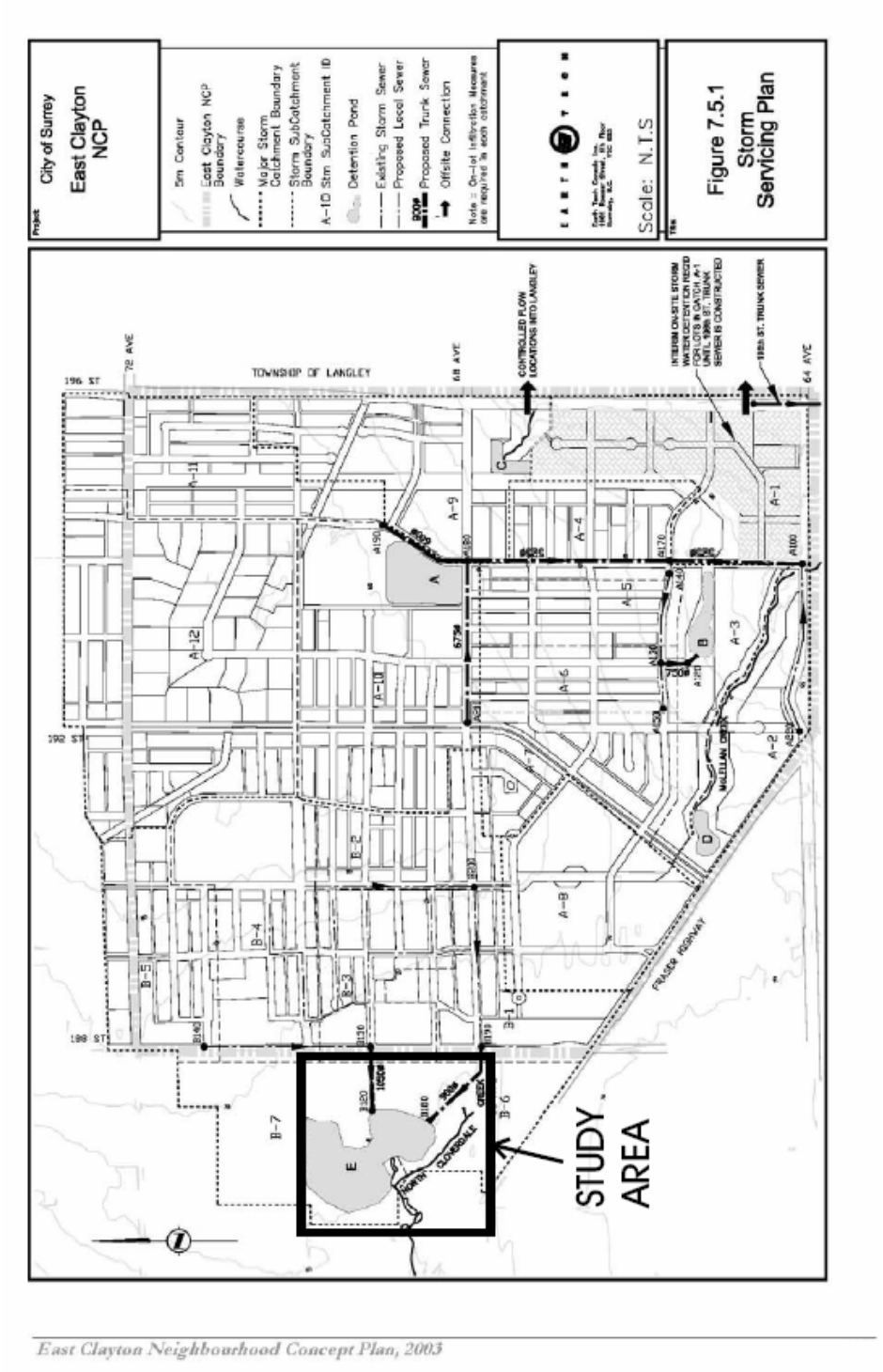


Figure 10 – Storm Sewer, Catchment B

but outside the NCP area. The purpose of these detention ponds is to control the post-development 100-year flows to pre-development levels. It should be noted that the City of Surrey has purchased the property for Pond E and Stage 1 construction of the detention pond was constructed in 2003 together with a 1050 mm diameter trunk sewer that was installed along the south property line of Clayton Heights Secondary School. Pond E was originally designed to accommodate flows from the study area, assuming full development (associated construction costs were accounted for in the East Clayton NCP).

1.2 Design

The proposed layout and sizing of the storm sewer infrastructure surrounding the proposed study area have already been constructed or are in the process of being constructed by adjacent developments located west of 188 Street. Drainage works under construction include the installation of 1200 mm diameter trunk sewer graded at 0.10% along 68 Avenue, west from 188 Street that conveys post-development 100-year flows to Pond E. It should be noted that the original East Clayton NCP sized the proposed trunk sewer as a 900 mm diameter pipe graded at a slope of 1.50 %.

The City of Surrey intends to complete the ultimate construction of Pond E in 2005. In the event that the pond is not constructed to the ultimate design, then the developers will be the responsible for completing the works unless they elect to provide interim individual on-site detention.

Developers have expressed a desire to develop dwellings with finished basements. In order to permit finished basements, the 1:100 year hydraulic grade line must be below the proposed minimum basement elevation in accordance with the City design criteria.

Minimum basement elevations for development within the study area in the vicinity of Pond E will require consideration of the impact of the pond on the

surrounding hydraulic grade lines for the major flows and basement construction may be limited.

1.3 Watercourses

In addition to the above, North Creek is currently located within the study area and approximately 100 meters of the existing creek is located within the ultimate 68 Avenue road dedication and will require in-filling to accommodate the construction of a collector road complete with sidewalks and boulevard landscaping. The developer of the lands fronting this section of North Creek that is to be in-filled will be required to meet the requirements of the environmental agencies including the Ministry of Land Water and Air Protection and the Department of Fisheries and Oceans Canada. Mitigation for loss of riparian habitat on private lands may include the use of City lands subject to the approval of the City and may involve monetary compensation.

All development will meet the required land development guideline for water quality preservation through the use of appropriate Best Management Practices through all stages of the development.

1.4 Sustainable Engineering

This East Clayton West Extension NCP will implement the "*Green Infrastructure Performance Standards and Guidelines*" as described in the East Clayton NCP for maintaining and enhancing the natural drainage systems in East Clayton.

The objectives to preserve the natural environment and promote natural drainage systems for the study area will include the following:

- Re-use all existing topsoil from the development areas to increase topsoil depth around building clusters to promote soil absorption.
- Provide a minimum 450 mm thick layer of topsoil (free draining and non-packed) over all pervious areas within the study area.

- Provide double row tree canopy along the west side of 188 Street and on-site landscaping to facilitate evapo-transpiration.

- Provide infiltration trenches as per East Clayton NCP Sustainability Features Figure 11 (prepared by Earth Tech Canada Inc., Figure 7.2.10).

Future building sites are also required to implement Infiltration Best Management Practices, as described in Section 4.1.1 of the East Clayton NCP.

1.5 Impact of Study Area on East Clayton Stormwater Drainage

The East Clayton NCP engineering servicing plan has already taken into account the impact of the study area on the stormwater drainage due to the fact that Pond E and the trunk storm sewers for East Clayton, Catchment B are located within the study area and are an integral part of the drainage system.

1.6 Financing

Developers will be eligible for drainage DCC rebates in the event that they construct the ultimate construction of Pond E.

It is estimated that the drainage DCC revenues generated by the study area will be approximately $450,000, not including DCC's from future school expansion.

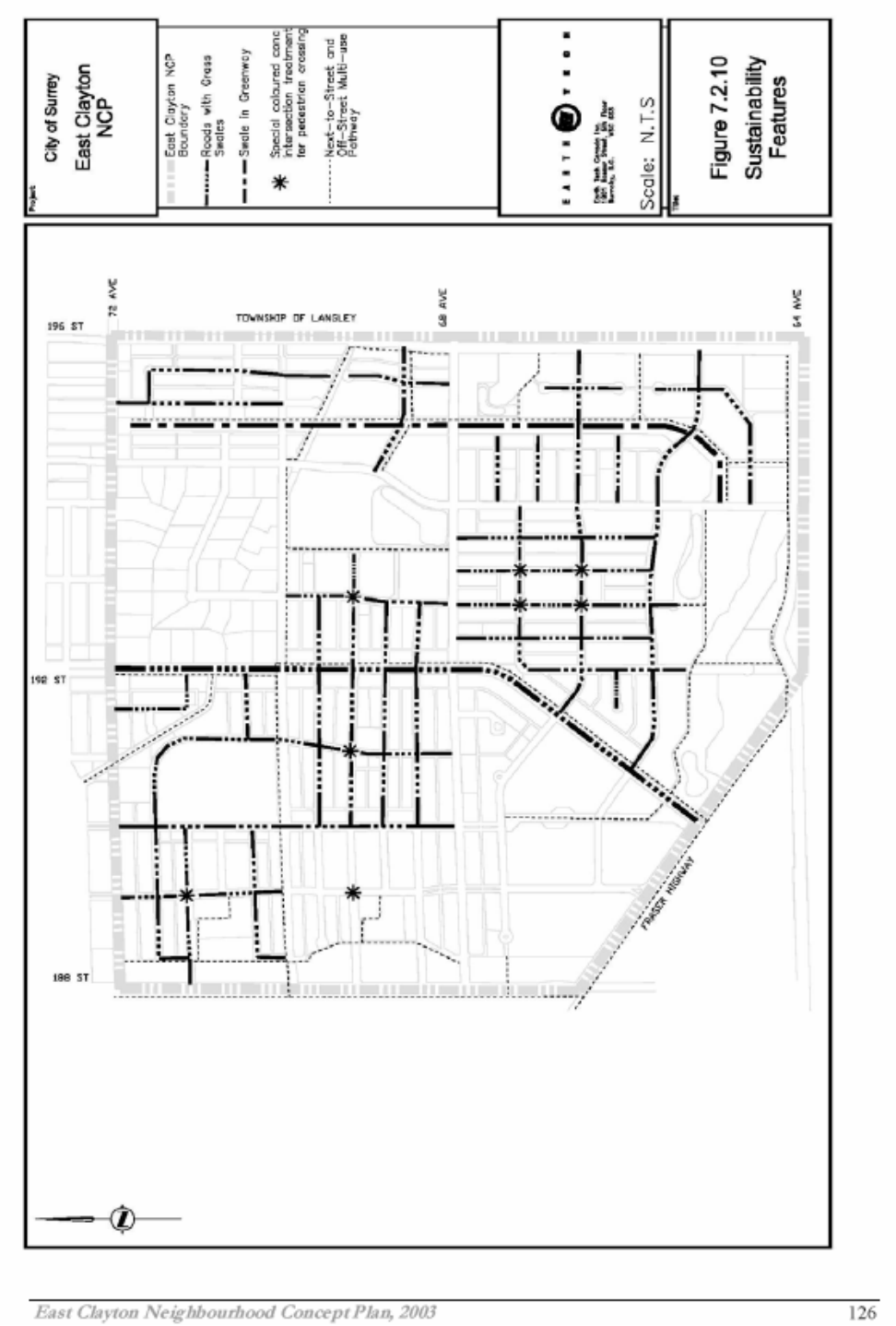


Figure 11 – Sustainable Features

Appendix VI – Water Servicing

1. Water

1.1 Background

The water supply system in the Clayton/Cloverdale area is separated into two pressure zones along the approximate 50 m geodetic contour. The upper or "Clayton" pressure zone currently operates at 115 m static head. The lower or "Cloverdale" pressure zone operates at a 90 m static head. Water supply to the overall area is provided by the GVWD's Whalley/Clayton 900 mm diameter watermain, which feeds the Clayton Reservoir at 72 Avenue and 190 Street. During lower demand winter months the GVWD's Whalley/Clayton main operates between 125 m and 139 m static head and the 115m Clayton pressure zone is fed directly from the GVWD main via PRV stations at 72 Avenue and 184 Street and at the Clayton Reservoir. During the higher demand periods throughout the summer, the HGL in the Whalley/Clayton main drops below 115 m static head and all water supply to the Clayton zone must be pumped from the Clayton Pump Station, which is located immediately adjacent to the reservoir. The Cloverdale pressure zone is fed directly from the GVWD supply system through PRV's at two locations (176 Street north of 66A Avenue and 54 Avenue at 192 Street). The Cloverdale pressure zone is fed indirectly through fifteen (15) minor PRV's at the zone boundary between the Clayton and Cloverdale pressure zones. The City of Surrey has recently completed the construction of a new 600 mm diameter water supply main along 54 Avenue to augment the existing supply to the Cloverdale pressure zone.

A water study, report and network model was prepared by Earth Tech Canada Inc. to determine the ultimate grid and feeder pipe network to service the East Clayton NCP service area. The ultimate system was analyzed for both maximum day plus fire flow and peak hourly flows. The results of the network model were

used to confirm that the proposed grid and feeder system meet the City of Surrey design criteria. Figure 12 (prepared by Earth Tech Canada Inc., Figure 7.4.1), prepared by Earth Tech Canada Inc., shows the major feeder and grid mains for the ultimate system. In addition, Earth Tech Canada Inc. completed a review of the existing pump station to determine a schedule for the proposed staged upgrading to accommodate the development of East Clayton and eventual replacement of the existing Clayton Pump Station with a new pump station.

In April, 2004, the City of Surrey engaged the services of Earth Tech Canada Inc. to prepare an additional report to examine and develop the best strategy to service the Clayton and Cloverdale areas with water supply to serve immediate short term requirements, confirm timing for phased upgrading of the East Clayton Pump Station and a review of the existing PRV station settings that control flows between the two pressure zones. The request by the City to undertake this additional work was due to an increased level of build-out in these NCP areas. This additional report was completed by Earth Tech Canada Inc. and submitted to the City of Surrey on 29 October, 2004. A copy of this report is included in Appendix IV. In summary the report prepared by Earth Tech Canada Inc. made the following recommendations:

- Change the settings on the 15 minor PRV's to an HGL of 85 m to maximize the retention of water in the Clayton pressure zone.

- Consider using all four (4) existing pumps as duty pumps and the immediate purchase of an additional pump as a "shelf spare".

- Consider installing temporary flow meters on selected PRVs to ensure no or minimal flows during high demand periods.

- Initiate design and construction of the new pump station for operation by the summer of 2006.

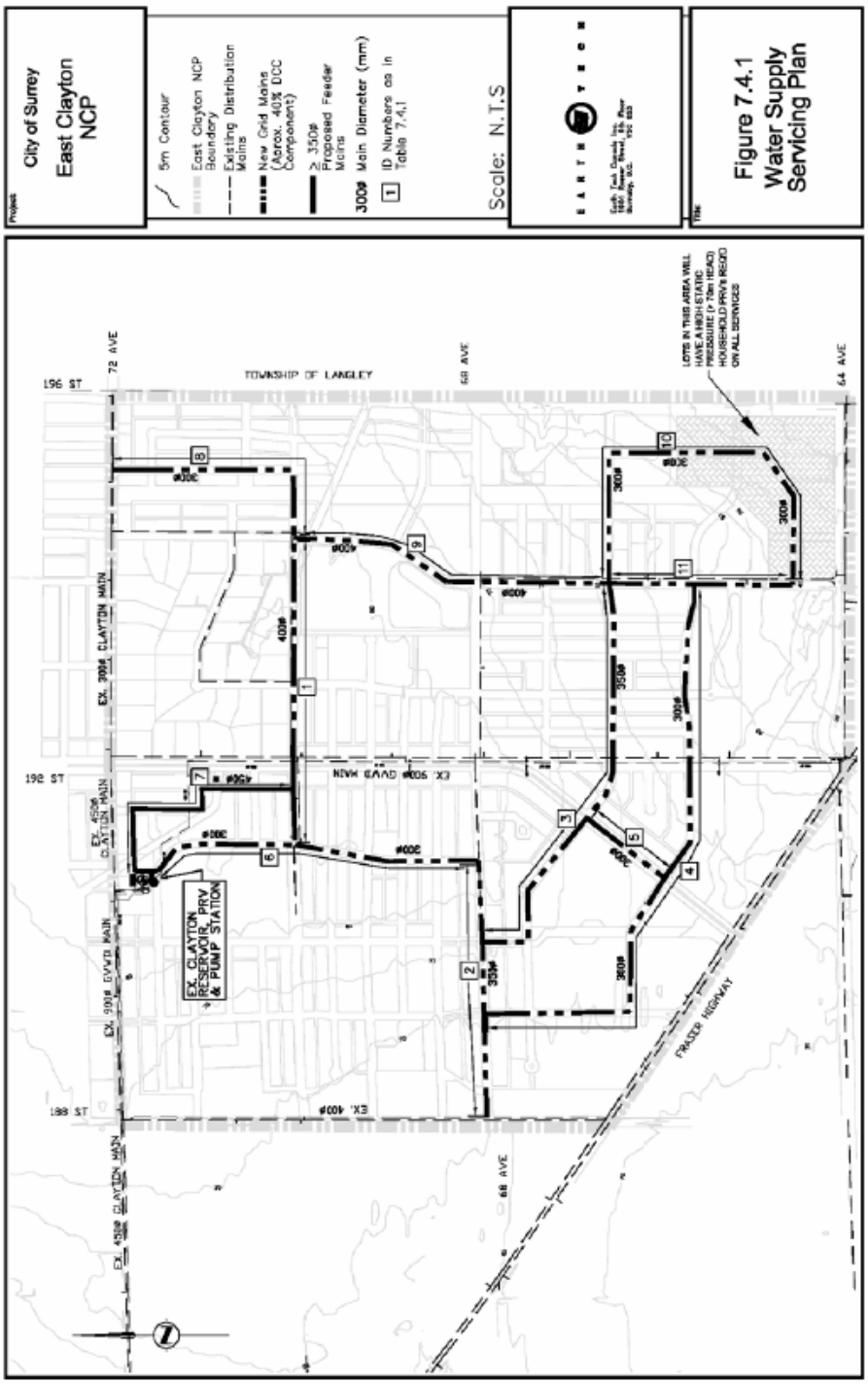


Figure 12 – Water Supply Servicing Plan

1.2 Design

The study area is located in the “Clayton” pressure zone and is fed by an existing 400 mm diameter grid main on 188 Street from the existing GVRD’s Whalley/Clayton 900 mm diameter watermain on 72 Avenue and the Clayton Reservoir and Pump Station located at 72 Avenue and 190 Street. It should be noted that Clayton Heights Secondary School is located within the study area and is already connected to the existing 400 mm diameter grid watermain located on 188 Street.

The water demand for the residential areas within the study area have been calculated based upon an average daily allowance of 500 l/capita/day, a maximum day allowance of 1,000 l/capita/day plus fire flow and a peak hour demand of 2,000 l/capita/day, in accordance with the City’s design criteria.

For all other land uses (i.e. commercial, institutional, etc.) the City of Surrey Design Criteria Manual was used as a guide.

The water demands for the study area are as follows:

Table 7 – Study Area Water Demands

Area #	Zoning	MDD (l/s)	PHD (l/s)	ADD (l/s)
15	School	124.7	9.3	1.21
14	15-45 upa	127.5	15.07	3.77
201	Institutional	122.0	3.35	0.99

It is recommended that the additional water demands be added to the City’s network model to confirm the capacity of the existing 400mm diameter feeder watermain on 188 Street and proposed 350mm diameter watermain on 68 Avenue, east of 188 Street.

In addition to the water demand calculations, an analysis of the distribution network was completed, in order to determine sizing for a proposed watermain on 68 Avenue, west of 188 Street to Fraser Highway and on 68A Avenue cul-de-sac road, west of 188 Street. In order to provide fire flow requirements for the study area, it was determined that a 250 mm diameter watermain was required on 68A Avenue and a 300 mm diameter watermain was required on 68 Avenue. A copy of the water calculations is included in Appendix V.

1.3 Impact on East Clayton NCP Water Supply System

Based upon the East Clayton NCP engineering servicing report and pump station upgrade recommendations identified additional report prepared by Earth Tech Canada Inc., the addition of the proposed study area will not adversely impact the East Clayton water supply system, assuming that the new pump station is operational by the summer of 2006, subject to confirmation of watermain sizing by water main modeling.

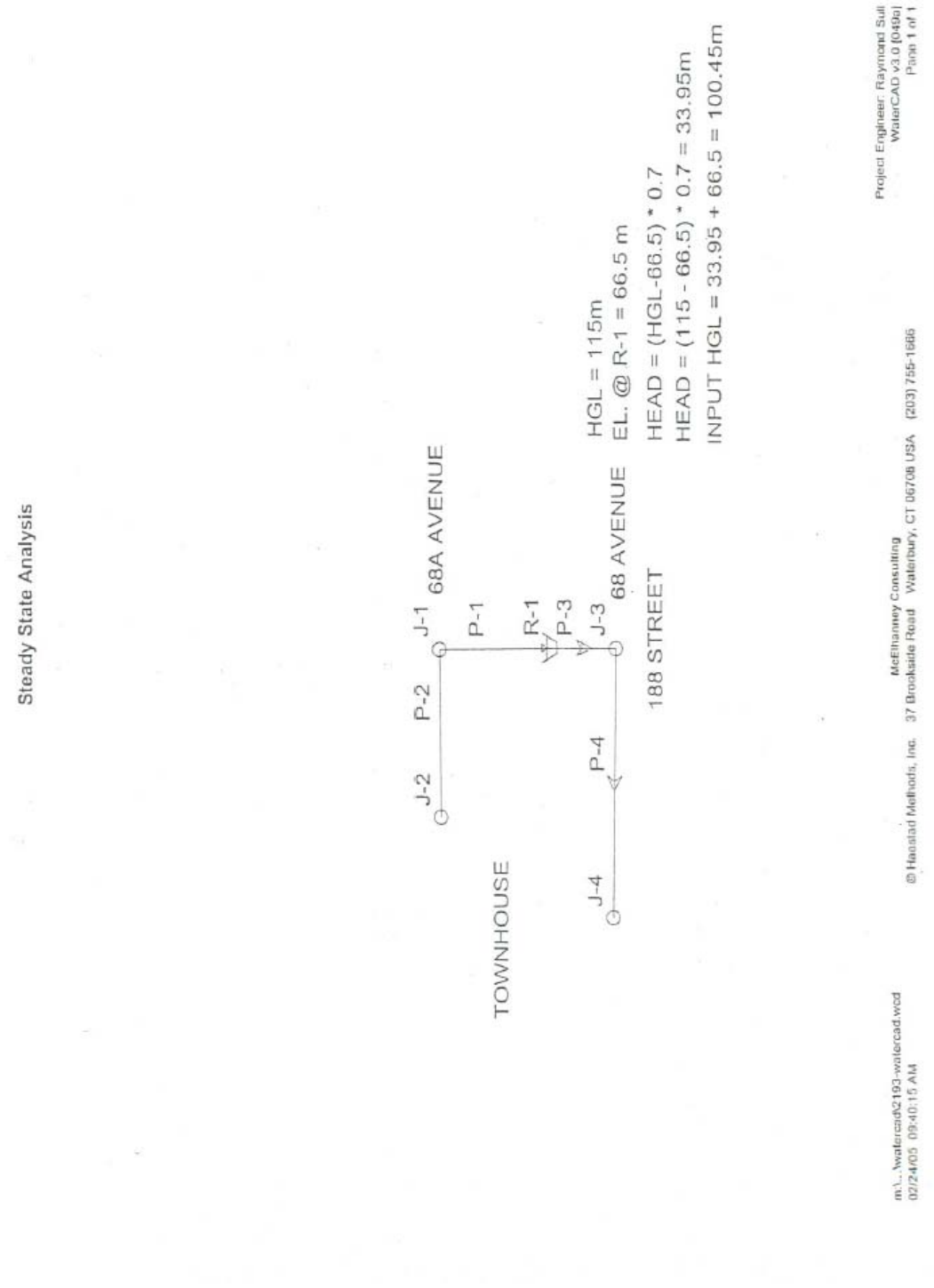
It is recommended that the water demands for the proposed NCP extension be added to water network model to confirm the capacity of the existing 400mm diameter watermain on 188 Street and the proposed 350mm diameter watermain on 68 Avenue, east of 188 Street.

1.4 Financing

There are no DCC eligible infrastructure elements required for construction in the study area except for water distribution construction, which are to be installed at the Developer's cost.

It is estimated that the water DCC revenues generated by the study area will be approximately $224,000, not including DCCs from future school expansion.

Appendix VII –Water Calculations



Steady State Analysis
Junction Report

Node Label	Elevation (m)	Demand Type	Demand (l/s)	Demand Pattern	Calculated Demand (l/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-1	66.50	Demand	0.0	Fixed	0.0	100.45	33.864
J-2	65.88	Demand	0.0	Fixed	0.0	100.45	34.483
J-3	66.20	Demand	0.0	Fixed	0.0	100.21	33.924
J-4	0.00	Demand	120.0	Fixed	120.0	97.06	96.815

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Project Engineer: Raymond Sull
WaterCAD v3.0 [049a]
Page 1 of 1

Steady State Analysis
Pipe Report

Link Label	Start Node	End Node	Diameter (mm)	Length (m)	Material	Roughness	Minor Loss	Initial Status	Current Status	Discharge (l/s)	Start Hydraulic Grade (m)	End Hydraulic Grade (m)	Headloss (m)	Friction Slope (m/km)	Velocity (m/s)	End Pressure (m H2O)
P-1	R-1	J-1	400	20.00	PVC	125.0	0.00	Open	Open	-0.3e-4	100.45	100.45	0.00	0.00	0.24e-6	33.864
P-3	R-1	J-3	400	100.00	PVC	125.0	0.00	Open	Open	120.0	100.45	100.21	0.24	2.40	0.95	33.924
P-2	J-1	J-2	300	75.00	PVC	125.0	0.00	Open	Open	0.0	100.45	100.45	0.00	0.00	0.00	34.483
P-4	J-3	J-4	300	300.00	PVC	120.0	0.00	Open	Open	120.0	100.21	97.06	3.15	10.50	1.70	96.815

Steady State Analysis
J-1
68A AVENUE
P-1
R-1
P-3
J-3
68 AVENUE
P-2
J-2
P-4
J-4
TOWNHOUSE
188 STREET
HGL = 115m
EL. @ R-1 = 66.5 m
HEAD = (HGL-66.5) * 0.7
HEAD = (115 - 66.5) * 0.7 = 33.95m
INPUT HGL = 33.95 + 66.5 = 100.45m
Project Engineer: Raymond Sull
WaterCAD v3.0 [049a]
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Steady State Analysis
Junction Report

Node Label	Elevation (m)	Demand Type	Demand (l/s)	Demand Pattern	Calculated Demand (l/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-1	66.50	Demand	0.0	Fixed	0.0	100.40	33.817
J-2	65.88	Demand	120.0	Fixed	120.0	99.67	33.707
J-3	66.20	Demand	0.0	Fixed	0.0	100.45	34.164
J-4	0.00	Demand	0.0	Fixed	0.0	100.45	100.197

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Project Engineer: Raymond Sull
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Steady State Analysis
Pipe Report

Link Label	Start Node	End Node	Diameter (mm)	Length (m)	Material	Roughness	Minor Loss	Initial Status	Current Status	Discharge (l/s)	Start Hydraulic Grade (m)	End Hydraulic Grade (m)	Headloss (m)	Friction Slope (m/km)	Velocity (m/s)	End Pressure (m H2O)
P-1	R-1	J-1	400	20.00	PVC	125.0	0.00	Open	Open	120.0	100.45	100.40	0.05	2.40	0.95	33.817
P-3	R-1	J-3	400	100.00	PVC	125.0	0.00	Open	Open	-0.3e-4	100.45	100.45	0.00	0.00	0.24e-6	34.164
P-2	J-1	J-2	300	75.00	PVC	125.0	0.00	Open	Open	120.0	100.40	99.67	0.73	9.74	1.70	33.707
P-4	J-3	J-4	300	300.00	PVC	120.0	0.00	Open	Open	0.0	100.45	100.45	0.00	0.00	0.00	100.197

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Appendix VIII – Traffic Analysis

1. Transportation

1.1 Analysis Objectives

Further to the Terms of Reference prepared by the City in August 2004, and discussions with the City's Engineering Department, the traffic analysis is to focus on the following impacts and access provisions:

- Impact at the Fraser Highway/188 Street, Fraser Highway/68 Avenue, and 188 Street/68 Avenue intersections with and without the extension of 72 Avenue to Fraser Highway; and

- Provide guidance on access locations on 68 Avenue and 188 Street considering need and access for currently approved developments

Analysis is to be undertaken for the weekday AM and PM peak hours on opening day (assumed to be 2006) and the 10 year horizon (2016). Sunday morning analysis will be required only to examine left turn needs on 68 Avenue into the church site.

The impact of extending 72 Avenue to Fraser Highway was evaluated for the 2016 horizon only. The 72 Avenue extension would consist of a four lane section west of 192 Street.

1.2 Background Traffic

Projected weekday PM peak hour background traffic volumes were derived from various sources:

- Clayton Crossing Traffic Impact Update, McElhanney Consulting Services Ltd., 27 October 2004;

- Clayton Crossing Traffic Impact Study, Ward Consulting Group, 9 January 2001; and,

- Results from the East Clayton NCP traffic analysis (including the East Clayton North NCP Extension).

Traffic volumes for 2006 were generally based on findings from the Clayton Crossing Traffic Impact Update, which incorporated traffic projections from the Ward report. Background PM traffic projections for 2016 were obtained from results in the East Clayton NCP. The East Clayton NCP was assumed to be built-out before 2016. The traffic impact from Clayton Crossing (and the Hillcrest Commercial development) were added to the East Clayton NCP traffic volumes to generate the background volumes.

Background traffic volumes for the weekday AM peak hour were derived by reversing the PM intersection volumes and multiplying by a factor of 0.8. Similarly, Sunday traffic volumes were derived for the Sunday late-morning period, coinciding with the church peak period, by factoring weekday AM volumes by 0.67.

Figure 13 shows background traffic volumes for 2016 with and without 72 Avenue extension, assuming a four-lane facility on Fraser Highway, extension of 68 Avenue from Fraser Highway to east of 188 Street, and including development trips from the Clayton Crossing and Hillcrest commercial developments.

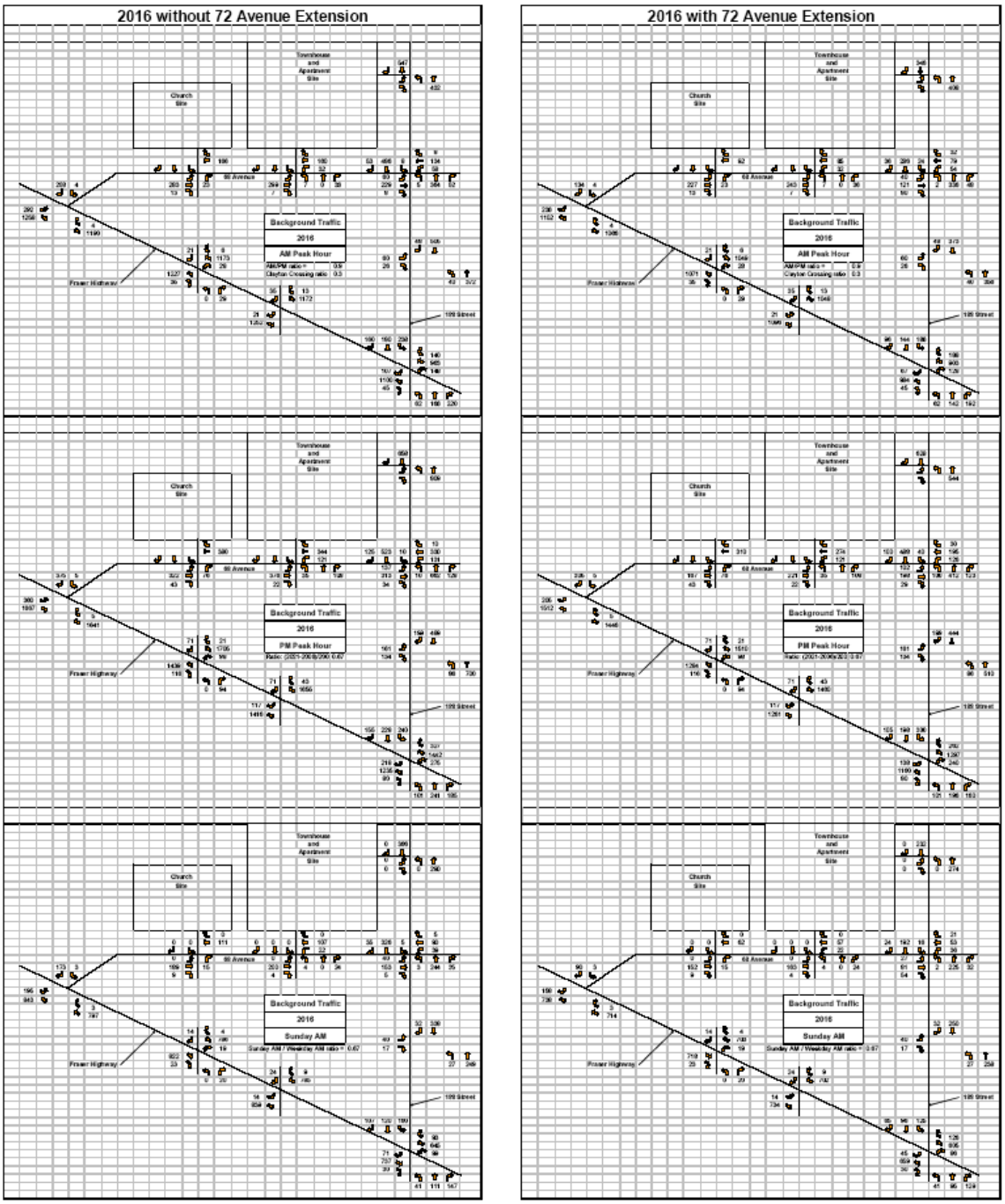


Figure 13 – 2016 Background Traffic Volumes

1.3 Trip Generation

Using the assumed land uses within the West Clayton Expansion area, the number of development trips was calculated and added to the existing background and the projected background trips generated by the original East Clayton development area. The Institute of Transportation Engineer's (ITE) Trip Generation Manual was used to determine the number of development trips for the weekday AM/PM and the Sunday morning peak hours. Tables 8, 9 and 10 summarize the results. Because the institutional site (assumed to be a regional-scale church) will have an assembly hall component, an assumption was made that the assembly hall would consist of ¼ the building area (16,250 ft^2), and the remaining building area (48,750 ft^2) would function as a church facility. Thus, trip generation for the church site was broken down into church and assembly hall uses. It should be noted that the assumed size of the church plus assembly hall is quite large, and will most likely be smaller.

Table 8 - Weekday AM Peak Hour Development Trips

Use	Size (ft2)		ITE Code	ITE Method	ITE Trip Rate	AM Trips	% Inbound	Site Trips In	Site Trips Out
Church	48,750	ft^2	560	Average rate	1.28 trips/1000ft^2	62	50%	31	31
Assembly hall	16,250	ft^2	-	Estimated	1.28 trips/1000ft^2	21	75%	16	5
Apartments	96	Du's	221	Average rate	0.46 trips/du	44	21%	9	35
Townhouse	194	Du's	230	Average rate	0.44 trips/du	85	17%	15	71
					Total	213		71	142

Table 9 – Weekday PM Peak Hour Development Trips

Use	Size (ft2)		ITE Code	ITE Method	ITE Trip Rate	PM Trips	% Inbound	Site Trips In	Site Trips Out
Church	48,750	ft^2	560	Fitted curve eqn	1.21 trips/1000ft^2	59	59%	35	24
Assembly hall	16,250	ft^2	-	Estimated	8.00 trips/1000ft^2	130	75%	98	33
Apartments	96	du's	221	Average rate	0.58 trips/du	56	65%	36	19
Townhouse	194	du's	230	Average rate	0.52 trips/du	101	67%	68	33
					Total	346		236	109

Table 10 – Sunday (AM) Peak Hour Development Trips

Use	Size (ft2)		ITE Code	ITE Method	ITE Trip Rate	PM Trips	% Inbound	Site Trips In	Site Trips Out
Church	48,750	ft^2	560	Average rate	11.76 trips/1000ft^2	573	52%	298	275
Assembly hall	16,250	ft^2	-	Estimated	5.00 trips/1000ft^2	81	52%	42	39
Apartments	96	du's	221	Estimated	0.28 trips/du	27	35%	9	17
Townhouse	194	du's	230	Estimated	0.24 trips/du	47	35%	16	30
					Total	728		366	362

The residential/church developments will generate in the order of 213 and 346 trips during the weekday AM and PM peak hours, respectively. As expected, the church site will generate a significant number of trips on Sundays, typically peaking in the morning. For apartment and townhouse uses, the ITE manual only provides Sunday trip rates for the 'peak hour of generator', which generally occurs around early to mid-afternoon. The Sunday morning trip rates for apartments/townhouses shown in Table 10 were estimated to be half the peak hour of generator.

1.4 Trip Distribution and Assignment

Development trips were distributed onto the road network assuming the same directional distribution adopted in the Clayton Crossing Traffic Impact Update Study.

Table 11 – Trip Directional Distribution

Origin/Destination		Distribution
Fraser Highway	West	30%
	East	16%
188 Street	North	22%
	South	5%
69 Avenue	East	27%
Total		100%

About half of the residential trips were assigned to each of the driveways on 188 Street and 68 Avenue. Figure 14 shows the distribution of Church and residential development trips. Note that the church may have a second right-in, right-out access on Fraser Highway.

1.5 Combined Traffic

Combined traffic volumes (background plus development trips) for 2006 and 2016 are shown on Figure 15. The impact of development trips at the key intersections, in terms of the proportion of development trips, is described in Table 12.

Table 12 – Proportion of Development Trips

Inter-section	Without 72 Avenue Extension						With 72 Avenue Extension		
	2006			2016			2016		
	AM	PM	Sun	AM	PM	Sun	AM	PM	Sun
Fraser/ 68 Av	3%	4%	16%	2%	2%	11%	2%	3%	13%
Fraser/ 188 St	1%	2%	9%	1%	1%	6%	1%	1%	7%
188 St /68 Av	10%	12%	41%	6%	6%	30%	9%	8%	37%

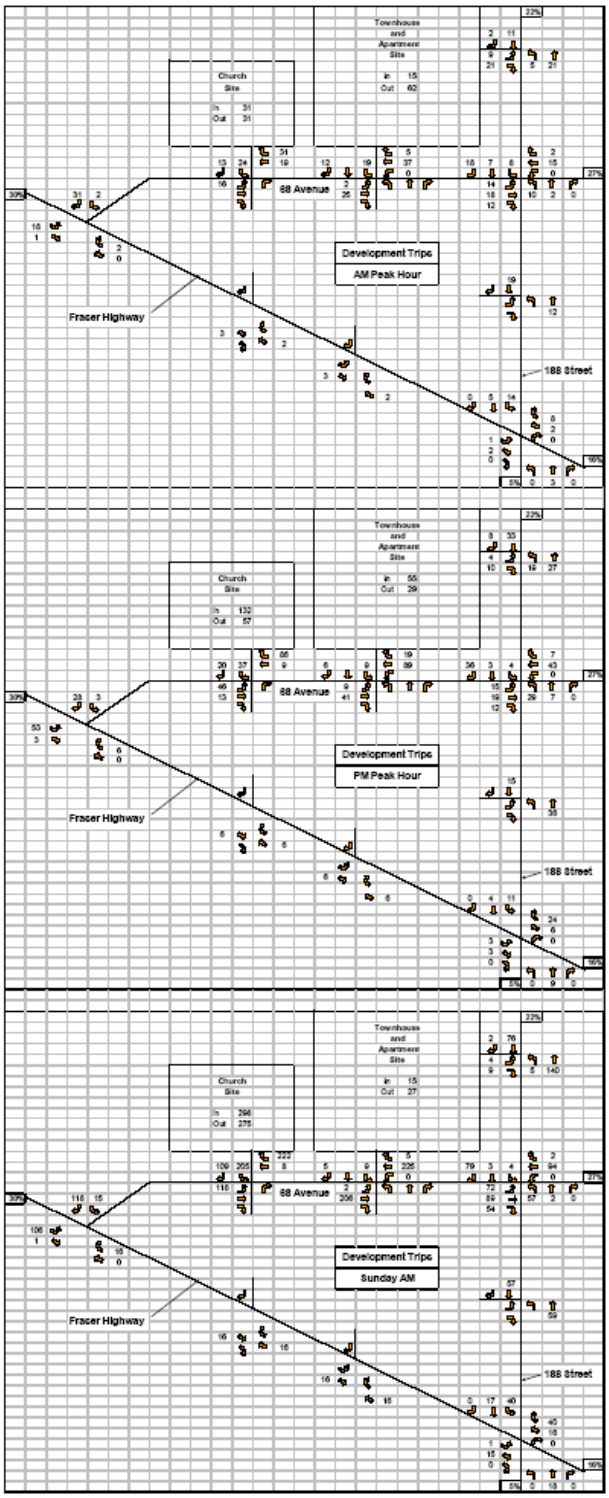


Figure 14 – Development Trips

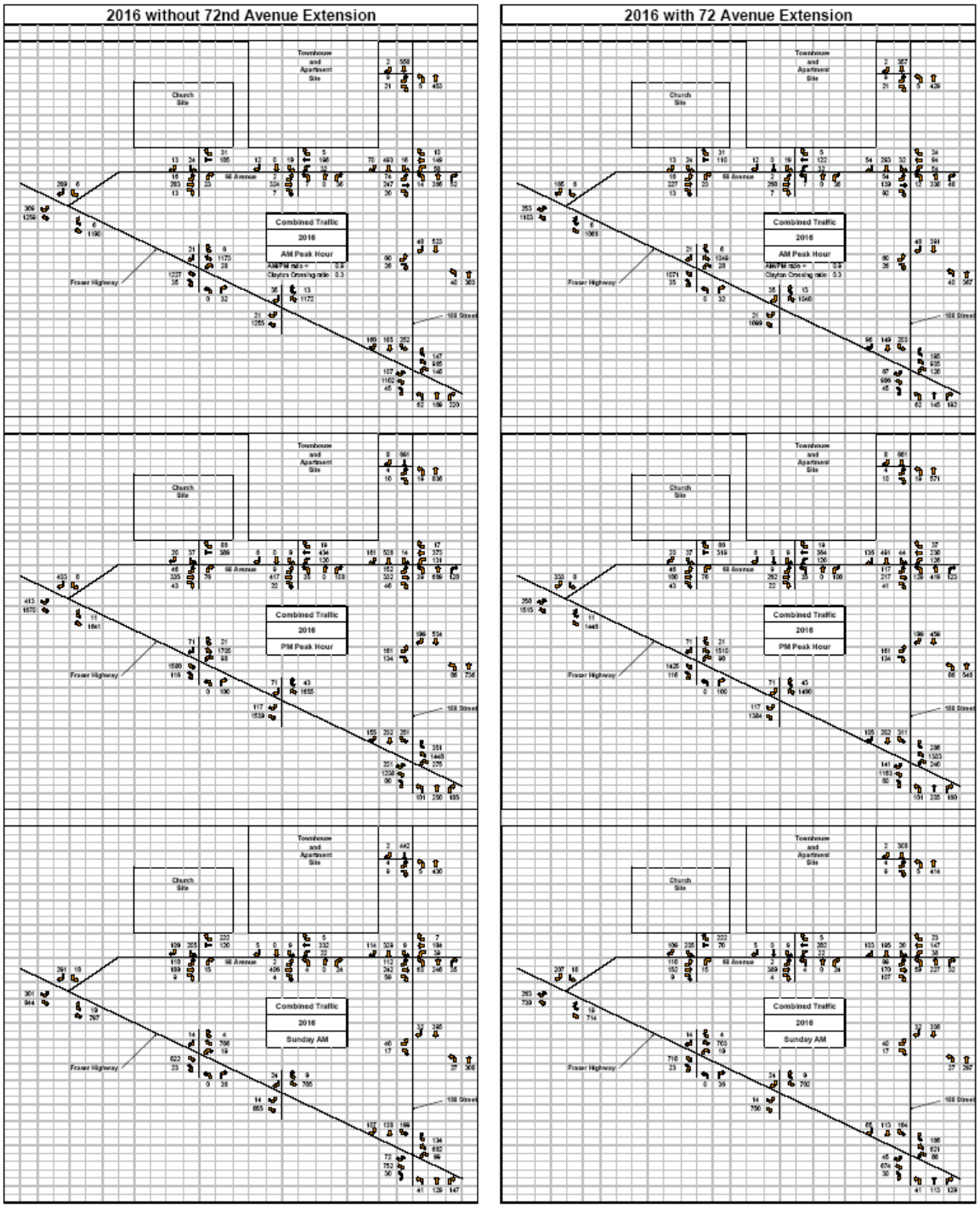


Figure 15 – 2016 Combined Traffic Volumes

The developments will only significantly impact the 188 St/68 Ave intersection on Sundays (mostly church trips), when background traffic volumes are relatively low.

1.6 Capacity Analysis

Capacity analysis for 2006, 2016 without the extension of 72 Avenue and 2016 with 72 Avenue extension traffic simulations were modelled. Level of Service (LOS) calculations were performed using Synchro. In the East Clayton NCP, it was assumed that the intersection of 68 Avenue and 188 Street would be controlled by a signal. However, in consideration of the proximity of one existing signal at 188 Street /Fraser Highway and the planned signal at 68 Avenue/Fraser Highway as well as possible access restrictions on both 188 Street and 68 Avenue, a roundabout was considered for the control at the 188 Street/68 Avenue intersection. Roundabouts analysis was modelled using AASidra, Rodel, and VISSIM.

Proposed 2006 and 2016 Roadway Laning without 72 Avenue Extension

Level of Service (LOS) calculations were performed using Synchro software assuming the following road network and site driveway base case conditions:

- 4 lanes on Fraser Highway
- Fraser Highway / 188 Street intersection laning as follows:

  EB (L, T, TR)

  WB (L, T, T, R)

  NB (L, TR)

  SB (L, T, R)

- 188 Street / 68 Avenue unsignalized with priority to 188 Street traffic

- Fraser Highway / 68 Street unsignalized
- Left turn lane on 68 Avenue into the church site, plus two exit lanes
- No left turn lanes on 68 Avenue nor 188 Street at the residential driveways

Synchro results for key intersections and critical left turn movements are shown in Tables 13 and 14.

Table 13 – 2006 Capacity Analysis Without the Extension of 72nd Avenue – Base Case

Intersection	Control	Background			With Development		
		AM	PM	Sunday	AM	PM	Sunday
Fraser/68	Unsig	E	F	C	E	F	D
Fraser/188	Signal	C	C	B	C	C	C
188/68	Unsig	D	F	C	F	F	F
188/ Residential driveway	Unsig	-	-	-	B	B	B
68/Residential driveway	Unsig	-	-	-	B	C	B
68/Church driveway	Unsig	-	-	-	B	B	C

Table 14 – 2016 Capacity Analysis Without the Extension of 72nd Avenue – Base Case

Intersection	Control	Background			With Development		
		AM	PM	Sunday	AM	PM	Sunday
Fraser/68	Unsig	F	F	F	F	F	F
Fraser/188	Signal	D	F	C	D	F	C
188/68	Unsig	F	F	D	F	F	F
188/ Residential driveway	Unsig	-	-	-	C	D	B
68/Residential driveway	Unsig	-	-	-	B	E	C
68/Church driveway	Unsig	-	-	-	B	C	F

Fraser Highway/68 Avenue – The poor LOS in 2006 is attributed to the SB left turn from 68 Avenue, which consists of a low volume and does not warrant

signals, as this traffic has the option to access Fraser Highway via signals at 188 Street. The EB left turn from Fraser Highway will operate at LOS C in 2006, and LOS F by 2016, with or without development. As the EB left turn will consist of a relatively high volume, signals are recommended in the short term. A signal at this location also has the advantage of alleviating the EB left turn on Fraser Highway at 188 Street.

Assuming a signal and permitted/protected EB left turn operation, an additional (3rd?) WB through lane on Fraser Highway would be required to achieve an acceptable LOS in 2016 PM. Also the EB left turn would require 160m of storage to accommodate peak traffic demand. A minimum 25 meter left turn lane will satisfy 2016 storage needs for the SB left turn.

Fraser Highway/188 Street – The poor performance at this intersection in 2016 PM is attributed to background traffic, as development trips will only contribute about 1% to the total intersection volume. Improvements to this intersection to achieve an acceptable LOS are as follows:

- 6 lanes on Fraser Highway, plus a separate WB right turn lane
- 2 through lanes NB and SB on 188 Street
- Dual SB left turn lanes on 188 Street (35m storage per lane)

Because the above cross-section on 188 Street would require additional right-of-way to accommodate dual SB left turn lanes, a split north/south phasing option was analysed. With split phasing, this intersection will operate at an acceptable LOS in 2016 PM with the following laning:

- 6 lanes on Fraser Highway, plus a separate WB right turn lane
- NB (L, T, TR)
- SB (L, TL, TR)

Due to the intersection skew, right turn channelization is suggested for NB and SB right turns on 188 Street.

188 Street / 68 Avenue – As traffic volumes from the East Clayton NCP increase along the 68 Avenue corridor, the LOS for minor road traffic on 68 Avenue at 188 Street will decrease rapidly. Even in 2006, without development trips, minor road (68 Ave) movements will experience LOS F. This intersection would initially operate well with either a roundabout or signal configuration, but a one-lane roundabout will operate poorly in the PM by 2016, even with NB and SB right turn slip lanes, therefore, a signal is recommended.

Signal operation will require one through lane and separate left turn lanes on each approach; E-W permitted/protected left turn phasing is suggested in the long term to reduce left turn storage needs. A NB right turn lane is also required. A SB right turn lane is not required, but should be considered due to the relatively high proportion of right turns.

188 Street / Residential Driveway(s) – Two accesses are on 188 Street – one to the apartment site and one to the townhouse site. Northbound through movements on 188 Street will continue to experience LOS A with little or no delay until 2016 without left turn lanes at either location. At the north driveway location (to the 2.5 acre multiple townhouse site), because the offset from 69 Avenue to a driveway at the 2.5 acre site will not result in overlapping left turn movements, and traffic volumes from both the driveway and 69 Avenue are relatively low, the intersection offset is not critical. However, a minimum 25m offset is recommended (measured between nearside curb or property lines) to allow for pedestrians crossing on the south leg of 188 Street at 69 Avenue, and a 35m offset is preferred.

68 Avenue / Residential Driveway – this driveway is currently proposed to be located within the transition taper to the EB left turn lane at 188 Street. As a result, this driveway should be restricted to right-in/right-out.

68 Avenue / Church Driveway – The concern at this location is in regard to left turn storage into the site, given the short spacing on 68 Avenue to the SB left turn at Fraser Highway.

A Peak Hour Factor (PHF) of 0.5 was applied to Sunday church traffic at the church driveway. Synchro results indicate that 2016 left turn storage into the church site will be minimal, even during the Sunday arrival peak, since opposing traffic is relatively low during this period – a 25m left turn storage lane will suffice. Similarly, the SB left turn storage need on 68 Avenue at Fraser Highway is not anticipated to be significant due to the low left turn traffic demand - less than 25m of left turn storage is required. Conversely, the heavier SB right turn volume at Fraser Highway will queue to about 50m.

Assuming the church driveway can be located as close as possible to its east property line, the distance on 68 Avenue between the SB stop line at Fraser Highway and the entrance to the church driveway is about 105m. Assuming 10m between the driveway centreline and the beginning of a left turn lane, this distance (95m) could accommodate two back-to-back left turn lanes, consisting of a 25m SB left turn lane at Fraser Highway, a standard 35m taper transition and a 35m left turn lane into the church site. Also, this location will not conflict with a proposed driveway to Clayton Crossing located on 68 Avenue approximately 60m to the east.

Proposed 2016 Roadway Laning with 72 Avenue Extension

The purpose of evaluating an extension of 72 Avenue to Fraser Highway was to determine if a four-lane basic cross-section could be maintained along Fraser Highway while still achieving acceptable levels of service. It is recommended that the City plan to construct 72 Avenue because of the significant relief it provides at all subject intersections. The following proposed 2016 roadway laning has been included in the main body of this report.

Level of Service (LOS) and queue calculations were performed using Synchro, Rodel, AAsidra, and VISSIM software assuming the following road network and site driveway base case conditions:

- 4 lanes on Fraser Highway
- Fraser Highway / 188 Street intersection laning as follows:

  EB (L, T, TR)

  WB (L, T, T, R)

  NB (L, T, R)

  SB (2L, T, R)

- 188 Street / 68 Avenue unsignalized with priority to 188 Street traffic or 188 Street / 68 Avenue single lane roundabout with single lane approaches
- Fraser Highway / 68 Street unsignalized
- Left turn lane on 68 Avenue into the church site, plus two exit lanes
- No left turn lanes on 68 Avenue nor 188 Street at the residential driveways

Table 15 - 2016 Capacity Analysis With the Extension of 72 Avenue – Base Case

Intersection	Control	Background			With Development		
		AM	PM	Sunday	AM	PM	Sunday
Fraser/68	Signal	A	B	A	B	C	A
Fraser/188	Signal	D	E	C	D	C	C
188/68	Unsig/Rndabt	F/A	F/B	C/A	F/A	F/B	F/A
188/ Residential driveway	Unsig	-	-	-	B	C	B
68/Residential driveway	Unsig	-	-	-	B	D	C
68/Church driveway	Unsig	-	-	-	B	C	F

Fraser Highway / 68 Avenue – The installations at a signal at this intersection improves the level of service for the southbound left turn movement. Consequently, the LOS for the entire intersection improves, and the EB left turn storage requirement decreases to 60m (compared to 160m without extension of 72 Avenue).

Fraser Highway / 188 Street – Traffic volumes at this intersection decrease with the extension of 72 Avenue in 2016. However, even with the 72 Avenue extension, the lane configurations could not support peak hours volumes. To accommodate peak hour volumes, the proposed improved configuration, SB (2L, T, R) and NB (L, T, R) with right turn channelized movements for the north and southbound right turns, could be used to achieve acceptable levels of service. High volume to capacity ratios are exhibited in the eastbound through movement, along with queues in the east and west through approaches.

For this case, the SB dual lefts would require 90 metres of total storage (45 metres per left turn lane).

188 Street / 68 Avenue – Increased traffic volumes for this intersection, if unsignalized, will yield a failing level of service. When 72 Avenue is extended to

Fraser Highway, the volumes at this intersection can be managed with a roundabout and signalization of this intersection can be avoided. The introduction of a single lane roundabout with single lane approaches on each leg will yield levels of service B or better. Queue lengths produced with the roundabout are acceptable and will not impede traffic moving into and out of roadways nearby.

The proposed roundabout was modelled using AASidra, Rodel, and Vissim. This analysis was performed for the PM peak hour as the PM peak hour has the highest volumes for this intersection among all scenarios. The results of the anticipated queues are shown in Table 16 below.

Table 16 – 2016 188/68 Roundabout PM Peak Hour Maximum Queues

Intersection: 188 St/68 Av	Roundabout PM Peak Hour Maximum Queue (Vehs)				LOS
	North Approach	West Approach	South Approach	East Approach	
Rodel	5	2	3	3	B
AASidra	10	6	6	7	B
VISSIM*	9	4	8	5	A

*Vehicle queue length calculations are based on the assumption that each vehicle = 7.8m.

The range of queue lengths is based on a variety of factors. Most notably is the difference in the method of calculations. The Rodel software utilizes empirical data and formulas as its basis of analysis while AASidra utilizes a theoretical approach. Using the two methods, we can find a range of anticipated future queue lengths with the proposed volumes. VISSIM was used to further verify the outcome.

188 Street / Residential Driveway(s) – – Lane configurations are the same as the 2006 scenario with an overall LOS C for the PM peak hour. The north and southbound through traffic continues to operate at a level of service A. Since the offset from 69 Ave to a driveway at the 2½ acre site will not result in

overlapping left turn movements, and traffic volumes from both the driveway and 69 Avenue are relatively low, the intersection offset is not critical. However, a minimum 25m offset is recommended (nearside curb line to nearside curb line) to allow for pedestrians crossing on the south leg of 188 Street at 69 Avenue, and a 35m offset is preferred. In addition, the installation of corner bulbs and midblock narrowings should be used as traffic calming devices. The narrowings also allow for a much shorter distance of travel for pedestrians when crossing 188 Street

68 Avenue / Residential Driveway – The City plans to extend the proposed splitter island (raised median at the roundabout approach) on 68 Avenue from 188 Street to the Clayton Crossing commercial driveway, thus, restricting access to the commercial driveway and to the proposed multiple family property to right-in, right-out. The location of the proposed multiple family property's access should be no closer than 20m from the property line at 188 Street. At this spacing, proper queuing distance within this access must be employed to ensure that the operation of the roundabout is not impacted by the access.

68 Avenue / Church Driveway – As noted above, this intersection yields small queues (approximately 7m) for the eastbound left turn movement. The 68 Avenue / Fraser Highway signalized intersection yields a queue of approximately 4m. Although the two intersections are in close proximity to the 68 / Fraser Highway intersection, the previously suggested 35m left turn storage for the southbound left turn lane on 68 / Fraser Highway intersection and 25m left turn storage lane for the eastbound left turn lane for the 68 Avenue / Church driveway intersection will be more than sufficient for the projected traffic volumes.

Conceptual cross-sections of 188 Street and 68 Avenue fronting multiple residential sites are shown in Appendix IV.

1.7 Conclusions

Without a 72 Avenue extension to Fraser Highway, a six lane basic cross-section is required on Fraser Highway to achieve acceptable Levels of Service at

intersections. With an extension of 72 Avenue to Fraser Highway, the east west demand to and from Fraser Highway can be spread evenly over several intersections and acceptable Levels of Service at each intersection within the study area can be achieved while maintaining a four lane basic cross-section on Fraser Highway. As a four-lane scenario with ultimate widening for transit lanes is preferred for Fraser Highway, extension of 72 Avenue is recommended by 2016. 72 Avenue would also be a four-lane facility west of 192 Street.

Therefore, the following conclusions can be made regarding the analysis, assuming extension of 72 Avenue to Fraser Highway:

- A signal at Fraser Highway / 68 Avenue is required in the short term to accommodate EB left turn traffic. The SB left turn from 68 Avenue should be constructed with a 40m storage bay, but the EB left turn from Fraser Highway will require 60m of storage. As there are low volumes for the southbound left turn movement, the green time for each cycle could be lower than the minimum requirement assuming there are few pedestrian movements. A single lane roundabout is recommended at the 188 Street / 68 Avenue intersection.

- A single lane roundabout is recommended at the 188 Street / 68 Avenue intersection with wider flares, a 30m inscribed diameter, splitter islands. Corner cuts of 5x5 must be provided at each of the four corners in order to construct the roundabout and fit in the sidewalks.

- The Fraser Highway / 188 Street intersection will experience a poor Level of Service by 2016 due to background traffic alone. To accommodate 2016 PM traffic volumes, this intersection will require the following improvements:

    - Separate WB right turn lane from Fraser Highway

    - NB laning consisting of L, T & R

  - SB laning consisting of 2L, T, R (with 45 metre storage per SB left turn lane)

  - Channelized N-S right turns

- A northbound left turn lane on 188 Street to the proposed 68A Avenue extension west of 188 Street is not warranted.

- A minimum 25m offset between 69 Avenue and the proposed townhouse driveway on 188 Street.

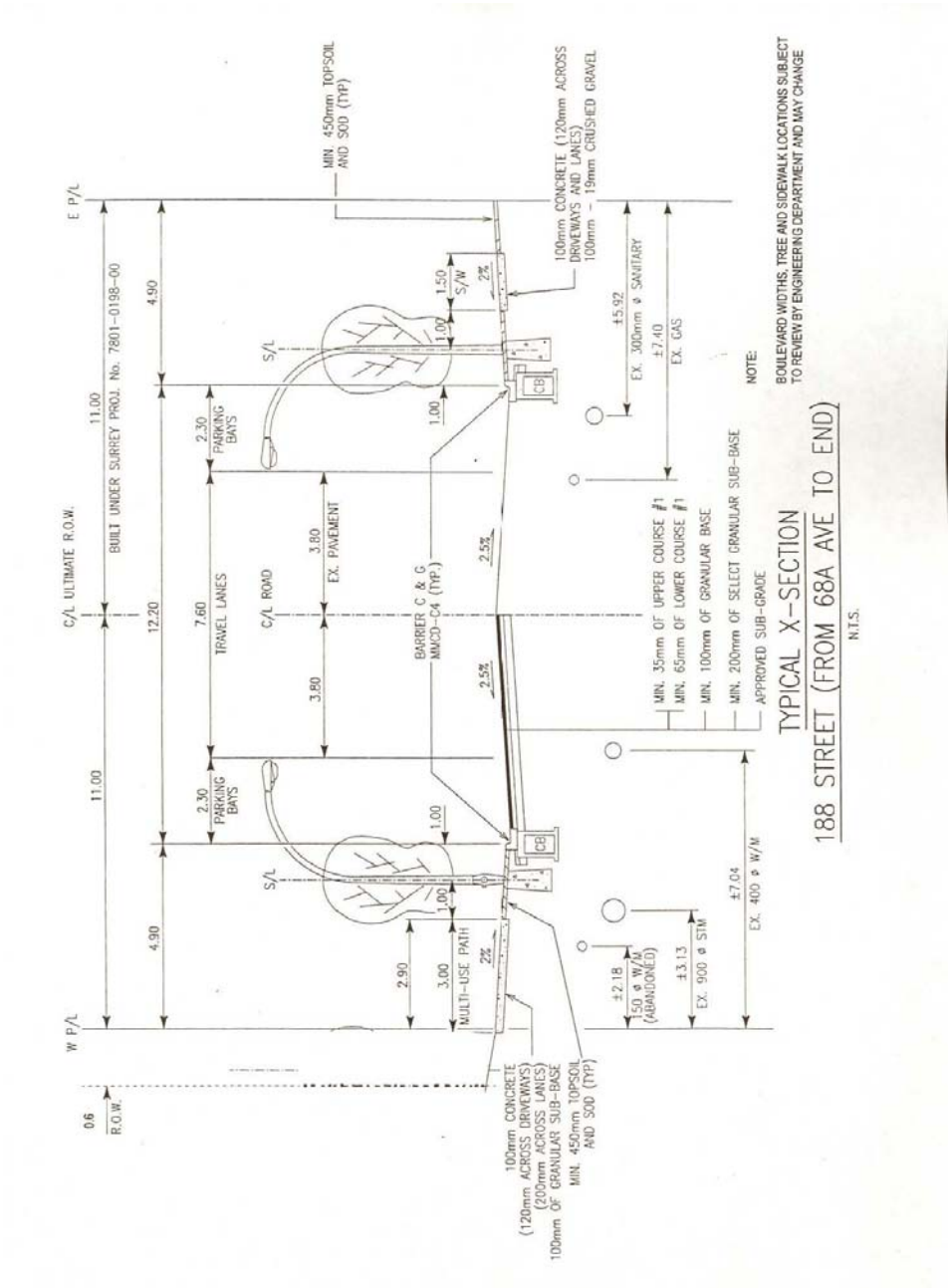
- The City plans to extend a raised median on 68 Avenue from the proposed roundabout at 188 Street to the Clayton Crossing commercial driveway, thus restricting the proposed multiple family residential driveway to right-in, right-out. The residential driveway on 68 Avenue should be located no closer than 20m from the N-S property line at 188 Street. To ensure proper operation of the roundabout, the appropriate queuing distance within the access must be maintained.

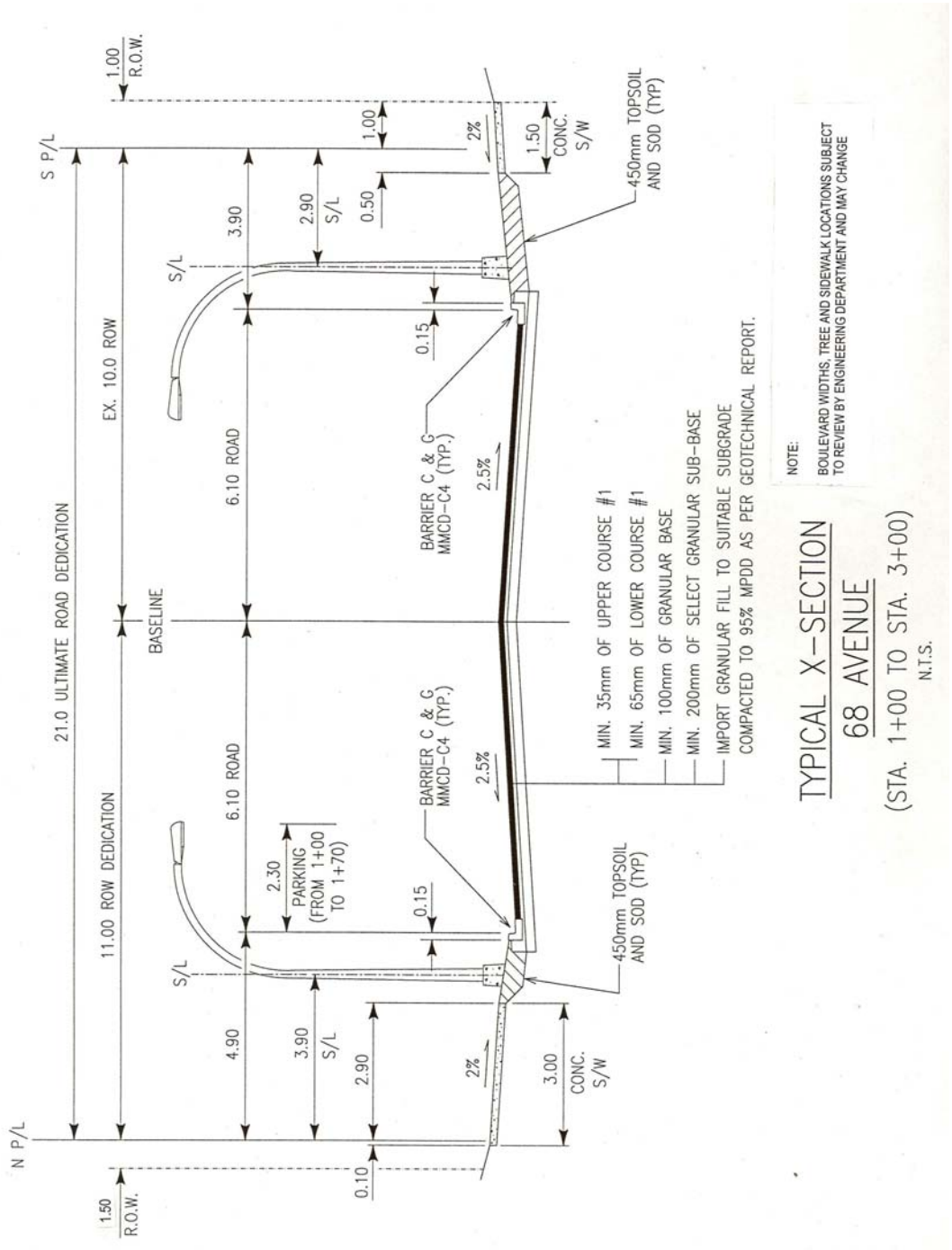
- Maximum 2016 queues on 68 Avenue, at the SB left turn lane to Fraser Highway and the left turn lane into the church site, will not exceed 25m for any of the analyzed time periods (Weekday AM/PM & Sunday AM).

- The distance on 68 Avenue, between the SB stop line at Fraser Highway and the church driveway, will accommodate two back-to-back left turn lanes, consisting of a 40m SB left turn lane at Fraser Highway, a sub-standard 25m taper transition and a 20m left turn lane into the church site. Anticipated upgrades will not affect the anticipated DCC expenditures for the East Clayton NCP.

- It is estimated that the Arterial and Major Collector Road DCC revenues generated by the study area will be approximately $1,116,500.

Appendix IX –188 Street and 68 Avenue Cross Sections




1.00
R.O.W.
S P/L
21.0 ULTIMATE ROAD DEDICATION
11.00 ROW DEDICATION
EX. 10.0 ROW
BASELINE
1.00
2%
1.50
CONC.
S/W
450mm TOPSOIL
AND SOD (TYP)
2.90
S/L
0.50
3.90
S/L
0.15
6.10 ROAD
BARRIER C & G
MMCD-C4 (TYP.)
2.5%
MIN. 35mm OF UPPER COURSE #1
MIN. 65mm OF LOWER COURSE #1
MIN. 100mm OF GRANULAR BASE
MIN. 200mm OF SELECT GRANULAR SUB-BASE
IMPORT GRANULAR FILL TO SUITABLE SUBGRADE
COMPACTED TO 95% MPDD AS PER GEOTECHNICAL REPORT.
6.10 ROAD
BARRIER C & G
MMCD-C4 (TYP.)
2.5%
2.30
PARKING
(FROM 1+00
TO 1+70)
0.15
S/L
450mm TOPSOIL
AND SOD (TYP)
4.90
3.90
S/L
2.90
2%
3.00
CONC.
S/W
N P/L
0.10
1.50
R.O.W.
NOTE:
BOULEVARD WIDTHS, TREE AND SIDEWALK LOCATIONS SUBJECT
TO REVIEW BY ENGINEERING DEPARTMENT AND MAY CHANGE
TYPICAL X-SECTION
68 AVENUE
(STA. 1+00 TO STA. 3+00)
N.T.S.