Final Report

CITY OF LANGLEY

Integrated Stormwater Management Plan

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EXECUTIVE SUMMARY

The recent trend towards integrated stormwater management represents an evolution in the way that watershed health and development impacts are viewed. An integrated stormwater management plan (ISMP) not only links stormwater with land use planning and environmental factors but also examines the hydrological characteristics of the watershed by considering broader aspects of the hydrological regime in pre-development conditions and tailoring a plan for development which aims to keep that regime intact to the greatest extent possible. As a member municipality of Metro Vancouver, City of Langley is committed to develop a Liquid Waste Management Plan (LWMP) that requires development of an integrated stormwater management plan (ISMP). Aside from its commitment under the LWMP, heightened redevelopment interest, particularly north of the Nicomekl River, as well as an aging infrastructure, are strong drivers for looking at the watersheds needs through an ISMP. The City of Langley has retained Urban Systems Ltd. to develop an Integrated Stormwater Management Plan (ISMP) tailored to suit the City's needs and conditions. For environmental assessment, Urban Systems has retained Jacques Whitford AXYS Ltd. This particular ISMP is limited in scope relative to the GVRD ISMP template due to a limited budget available to conduct the study. Upon embarking on this assignment, the City recognized the limitations of the investigation and accepted that further study may be required for some particular aspects. However, given that the City's environmental and stormwater systems had never been looked at in a holistic manner before, this study was an important first step to take stock of current issues, identify constraints and opportunities, and set direction for optimum management of these systems moving forward.

The City of Langley is located in the Fraser Valley, bordering the Township of Langley to the north, south and east and the City of Surrey to the west. The City encompasses approximately 1013 ha of land. Most of the City has residential and urban land use, with few remaining areas of undisturbed natural vegetation. There are a number of unique aspects for the City that shaped this study, including growth pattern of the City consisting mostly re-development and densification of existing developments, aging drainage infrastructures, and limitation of City resources. Considering these aspects, the ISMP has been tailored to meet the following key objectives:

- Identify habitat and environmental values, opportunities and constraints;
- Complete a general assessment of aquatic health and stormwater quality;
- Review infrastructure from the perspective of Asset Management and Capital Planning.
- Recommend initiatives that promote better understanding of the drainage condition and influence land use planning, redevelopment and capital investment.

Urban Systems Ltd. retained Jacques Whitford AXYS Ltd. to assess aquatic and terrestrial habitat in the City of Langley. This assessment focused on existing aquatic habitat values that should be protected and

identified stream enhancement opportunities on several streams in the City. The 21 watercourses (total length of 16.9 km of streams) in the City include 5 km of Nicomekl River, 9.4 km of other Class A streams (salmonid or potentially fish bearing) and 2.5 km of Class B streams (significant food and nutrient value, no fish present). In addition to a review of available literature, a fish habitat survey was conducted along 7.4 km of City streams, including Muckle, Pleasantdale, Brydon, Baldi and Langley creeks, their tributaries and portions of the Nicomekl River. Information about Logan Creek and Jeffries Brook, obtained in 2007 field investigations for the City and Urban Systems Ltd. was also reviewed. As a result, the majority of Class A streams have been surveyed and fish habitat quality documented.

There are reports of coho salmon, cutthroat trout and steelhead in the five surveyed streams. Habitat quality for the various salmonid life stages ranges from poor to good, with no critical or excellent habitat identified; however, all the streams surveyed contain habitat for all life stages of salmonids. There are no substantial impassable barriers restricting salmonid movement in the streams. Although spawning habitat is present in these streams, several have predominantly soft sediments, with limited amounts of gravel substrates. Riparian habitat varies in quality, with many areas containing predominantly invasive Himalayan blackberry with little native tree or shrub growth. Riparian areas have also been encroached upon by residential and commercial developments. Within the City, there is potential for several wildlife species of conservation concern to be present, mainly in stream corridors that include red legged frog, western toad, Pacific water shrew, Trowbridge's shrew, Band-tailed Pigeon and Western Screech Owl.

Fish habitat restoration options were identified for the five streams surveyed. Options range from removal of invasive plants and garbage, to planting with native species, adding spawning gravel, removing artificial banks and substrates and improving fish passage through culverts. Additional biophysical information gaps required for an ISMP have also been identified that include a review of hydrogeology for assessment of stormwater infiltration potential and watershed health assessments (benthic invertebrate surveys, calculation of percent riparian coverage and impervious cover).

During the ISMP process, the stewardship groups expressed their concerns regarding the stormwater quality in the City. Sediment deposits were the predominant concern reported, particularly in the Nicomekl River. Further to anecdotal reports, Urban Systems conducted a desk top pollutant loading assessment based on land use. This included typical pollutants such as total suspended solids (TSS), phosphorus, nitrogen, fecal coliforms, oil and grease, zinc and copper. Other site specific water quality issues raised by different stakeholder groups were also investigated.

For the pollutant loading estimation, the City was divided into seven (7) land use categories and impervious cover was estimated for each category, by catchment for both existing and future development conditions. Annual loading for the seven selected pollutants were estimated. For most of the catchments, given the built nature of the City, predicted future loadings are similar to those of current conditions. The catchments were reviewed based on relative pollutant concentrations as well as total loading. In general, that catchments located north (mostly commercial, industrial and high density

residential) of the Nicomekl River generate significantly more TSS and oil and grease to the Nicomekl River than catchments in the south (single family residential). As such, development north of the Nicomekl River is the most urgent candidate for the application of Best Management Practices to management pollutants.

Water quality conditions directly within the streams was assessed at a cursory level, as limited budget prevented the sampling of characterization of the water quality samples. The Ministry of Environment's 2003 report 'Status of Water Quality Conditions in the Little Campbell, Serpentine and Nicomekl Rivers from 1971 to 2002' presents an overall picture about the water quality in the Nicomekl and its tributaries, but do not reflect the complete water quality condition specific to the City of Langley. Jacques Whitford conducted an in-situ water quality testing at different locations of the selected five streams (Muckle, Pleasantdale, Brydon, Baldi and Langley creeks). A hand held multi-meter (YSI 85) was used to measure temperature, DO, pH, and conductivity. The results met applicable water quality guidelines and seem to support test results reported earlier (MOE, 2003). In all the creeks that were examined, minor to moderate erosion was observed created through a combination of reduced riparian vegetation and increased runoff from impervious surfaces. In some areas, bank erosion on the edge of properties were observed. However, no evidence of major bank failures was observed, as most stream banks are low and vegetated. An assessment of stormwater infrastructure was mostly based on review of past infrastructure studies and interviews with the Public Works staff. UMA Engineering Ltd. [AECOM] completed a comprehensive stormwater drainage system assessment in 2005, which provides a solid foundation of information. This study completed a capacity assessment of the stormwater drainage system both for existing and future conditions, identified opportunities for improvement, and recommended remedial measures. At the time of initiating this ISMP study, no recommendations from the UMA [AECOM] report had been implemented by the City. Based on discussions with the City staff, it is understood that the City is comfortable with the findings of the UMA report. Urban Systems did conduct a cursory review of the UMA [AECOM] study recommendations relative to the objectives of this ISMP, and did not feel there were any areas of conflict.

It is also understood that the UMA study was limited to a capacity assessment and did not consider the operational or conditional aspect of the system. As part of this ISMP study, City Public Works staff were interviewed for information about infrastructure records, system condition, operational challenges (i.e. surcharging, flooding, debris accumulation, clogging, etc.), and maintenance protocols. In general, infrastructure records of the City's drainage systems are somewhat limited, and there is no comprehensive, proactive operation and maintenance program currently in place, however development of such a program is in early stages. The City has recently initiated a process to develop an inventory of infrastructure assets, which will then be used to develop a comprehensive Asset Management Program, the details of which have not yet been defined.

This ISMP study identifies key issues and makes prioritized recommendations, which included the following:

- Proceed with implementation of infrastructure upgrades as previously recommended by UMA [AECOM].
- Undertake a feasibility study to identify the optimum strategy for combating runoff water quality issues, particularly north of the Nicomekl River.
- Proceed with a stream condition assessment study to investigate potential erosion risks from a geomorphologic and fisheries perspective and identify appropriate solutions.
- Initiate design and implementation process for stream restoration works based on the stormwater quality feasibility study and the stream condition assessment study recommendations.
- Establish a base flow water quality monitoring program for the Brydon Creek and the Baldi Creek that receive runoff from the commercial and industrial areas to track changes in water quality over time and to evaluate the effectiveness of established water quality improvement measures.
- Implement a public education program to educate the public about the City's effort to effectively manage stormwater and protect stream health.
- Proceed with establishment of riparian area setback limits for species of conservation concern and amendment of development permit guidelines within the OCP to accommodate the new setback limits.
- Undertake a hydrogeological assessment program for areas to the south of the Nicomekl River (with common aquifer between the City and the Township of Langley) to assess the condition of the rock pits, and their impacts on groundwater and to identify opportunities and constraints to developing a groundwater protection strategy.
- Continue developing the comprehensive asset management program for stormwater infrastructure that includes preparing inventory of the stormwater infrastructures, assessing their conditions, and developing a plan for eventual replacement of aging stormwater infrastructures.
- Undertake a stormwater utility feasibility study to assess the feasibility of establishing a stormwater utility charge.

1.0 INTRODUCTION

1.1 Project Background

As a member municipality of Metro Vancouver, City of Langley is committed to develop a Liquid Waste Management Plan (LWMP) that requires development of an integrated stormwater management plan (ISMP). The aim of an ISMP is to develop an integrated understanding of existing functions and values within the City's watersheds and to develop strategies and action plans that cause the watersheds to be managed appropriately. Aside from its commitment under the LWMP, redevelopment pressures and an aging infrastructure are strong factors that drive the need to look at the watersheds needs comprehensively through an ISMP.

The City of Langley has been proactive in establishing land use planning strategies that are easily linked with stormwater management planning. The Official Community Plan (OCP) adopted in 2006 reflects City's vision towards a sustainable community. In 2007, a Downtown Master Plan (MP) was developed that also shows City's ongoing commitment towards sustainability and protection of environmental values. These two plans would play significant roles in development of an ISMP that fosters an integrated approach to stormwater management through protecting public and environment and encouraging efficient land use.

The City of Langley has retained Urban Systems Ltd. to develop an Integrated Stormwater Management Plan (ISMP) tailored to suit the City's needs and conditions. For environmental assessment, Urban Systems has retained Jacques Whitford AXYS Ltd.

1.2 Study Scope and Objectives

An ISMP establishes a framework that links land use with appropriate management solutions and policies that maintain, restore and enhance the watershed. Involvement of the policy makers, community members and other interested groups is beneficial for the success of the ISMP process. As such, input was sought from the City of Langley, Nicomekl Enhancement Society (NES) and the Langley Field Naturalists (LFN) to discuss City and community expectations and considerations for an ISMP. Concerns about water quality and aquatic habitat conditions due to siltation in the Nicomekl River and its tributaries were raised as significant issues.

The ISMP template prepared by Metro Vancouver (then, GVRD) outlines a significant number of topics with suggested scope of study. Using it as a guide, each community conducting an ISMP then considers the status of its watershed(s) in concert with the needs and resources of the community, ultimately tailoring the scope of the ISMP study. There are a number of unique aspects for the City that shaped this study, including:

- City growth is not driven by newly expanding urban development, but modest re-development and densification of existing urban areas.
- Most areas of the City have a long history, thereby raising the importance of infrastructure operation, maintenance and renewal issues.
- There are a number of historic documents that provide significant input with respect to land use, flood protection, and infrastructure capacity assessment.
- The City's resources are limited at this point in time, and therefore, may require an incremental approach to implementation.

Given the above, the ISMP has been tailored to meet the following key objectives:

- Identify habitat and environmental values, opportunities and constraints.
- Complete a general assessment of aquatic health and water quality.
- Review infrastructure from the perspective of Asset Management and Capital Planning.
- Based on the above three items, make recommendations with respect to guidelines that influence land use planning, redevelopment and capital investment.

With a limited budget for development of the study, the scope has focused on identifying issues, setting priorities, assessing current aquatic and terrestrial habitat conditions, and devising a program for future actions to respond to priorities, with little emphasis on analysis.

A summary of the report content is provided in Table 1.1, and then divided into the following sections: General Study Area Description (Section 2), Evaluation of Existing Conditions (Section 3), Aquatic and Terrestrial Habitat Assessment (Section 4 referring to Appendix C), Drainage Infrastructure Assessment (Section 5), Stormwater Management Strategies (Section 6) and Recommendations (Section 7).

Table 1.1
Report Summary

ISMP DELIVERABLE	PROCESS	SCOPE OF DELIVERABLE
An overall understanding of existing drainage systems and environmental values	Screening Evaluation/Limited Field Survey/Background Reports	▪ Water quality problems ▪ Flooding and erosion related problems ▪ Aquatic and terrestrial habitat ▪ Stormwater Infrastructure deficiency
Identified areas of concern and recommended future initiatives to accommodate development/redevelopment in sustainable manner	Discussion with the City and stakeholder groups, consultation with other existing studies and plans	▪ Recommendations to improve water quality condition ▪ Recommendations for stream enhancement ▪ Recommendations for drainage improvement ▪ Recommendations to bring regulatory changes
Implementation Strategy		▪ Potential projects ▪ Community Education ▪ Maintenance Activities, standards and schedules ▪ Performance Monitoring ▪ Priority Ranking

2.0 STUDY AREA DESCRIPTION

2.1 City Of Langley: General Overview

The City of Langley is located in the Fraser Valley, bordering the Township of Langley to the north, south and east and the City of Surrey to the west. The Nicomekl River, which flows through the Township and City of Langley and the City of Surrey, flows into Boundary Bay before entering the Strait of Georgia. A map of the City is provided in Figure 2.1.

2.1.1 Land Use

The City encompasses approximately 1013 ha of land. Most of the City has residential and urban land use, with few remaining areas of undisturbed natural vegetation. According to the Official Community Plan (OCP, 2005; amended in 2007), areas south of the Nicomekl River are designated as urban residential whereas areas north of the Nicomekl River have a combination of commercial, industrial, downtown commercial and high density residential type landuse. The City has approximately 16 parks that range in size from small city parks (mostly flowers and grass) to larger parks bordering the Nicomekl River (Portage Park) to a large off-leash dog park (Appendix C: Figure 1). Most of these have landscaped, as opposed to natural, vegetation. Pleasantdale Creek ravine and Muckle Creek ravine (from the BC Hydro right-of-way north to Grade Crescent) are the main naturally vegetated ravine areas in the City. Figures 2.2 and 2.3 show the current and future land uses according to the OCP.

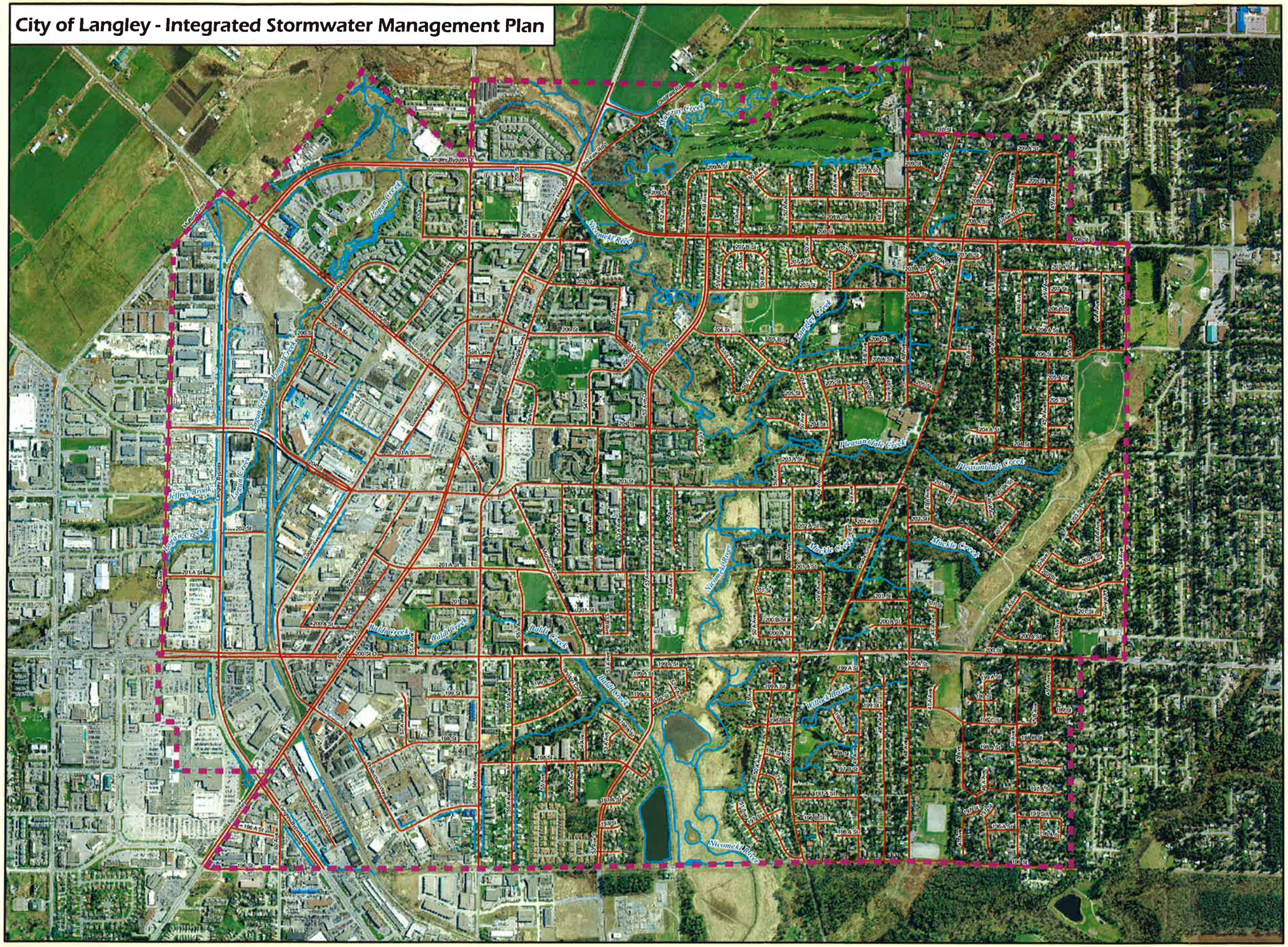
2.1.2 Soils

According to the Upper Nicomekl Flood Control Strategy Technical Memorandum (UMA 2003), soils in the City can be classified into four groups:

- Class A: high infiltration rate, predominantly deep, well drained sands and gravels with no silt or clay.
- Class B: Moderate infiltration rate, moderately deep, well-drained sands and gravels with silt.
- Class C: Slow infiltration rate, well-drained soils with a high proportion of silt.
- Class D: Very low infiltration rate, permanently high water table or shallow soils over an impervious layer, mainly clay soils.

Appendix A include the map from the UMA study (2005) showing the distribution of soils within the City. As shown in the map, significant portion of the City consists of Class B soils, whereas areas in the northwest are predominantly Class D soils. Soil condition is one of the important factors to consider while recommending stormwater management strategies.

City of Langley - Integrated Stormwater Management Plan



CITY OF LANGLEY

Legend

- City Boundary
- Watercourses
- Roads

City of Langley Base Map

Figure 2-1

URBANSYSTEMS.

0 250 500 1,000

Meters

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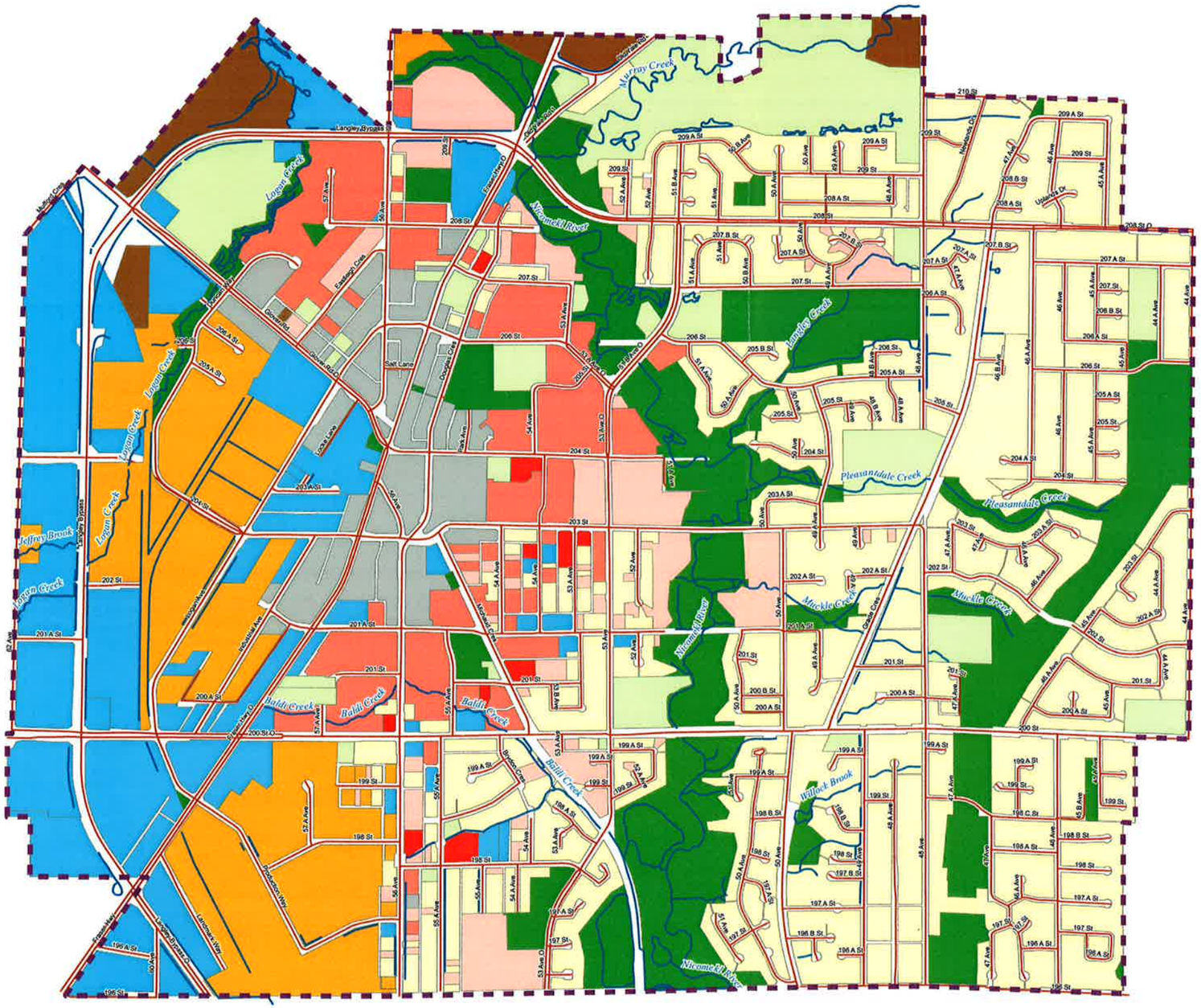
City of Langley - Integrated Stormwater Management Plan



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Landuse Type

- Urban Residential (RS1/RS2)
- Residential - Low Density (RM1)
- Residential - Medium Density (RM2)
- Residential - High Density (RM3)
- Downtown Commercial (C1)
- Service Commercial (C2/C3/CD/Bylaw 950 Zone)
- Industrial (I1/I2/I3)
- Agriculture (A1)
- Institutional (P2)
- Green Institutional (P1)
- Watercourses
- Roads
- City Boundary

Current Landuse

0 250 500 1,000

Meters

Figure 2-2

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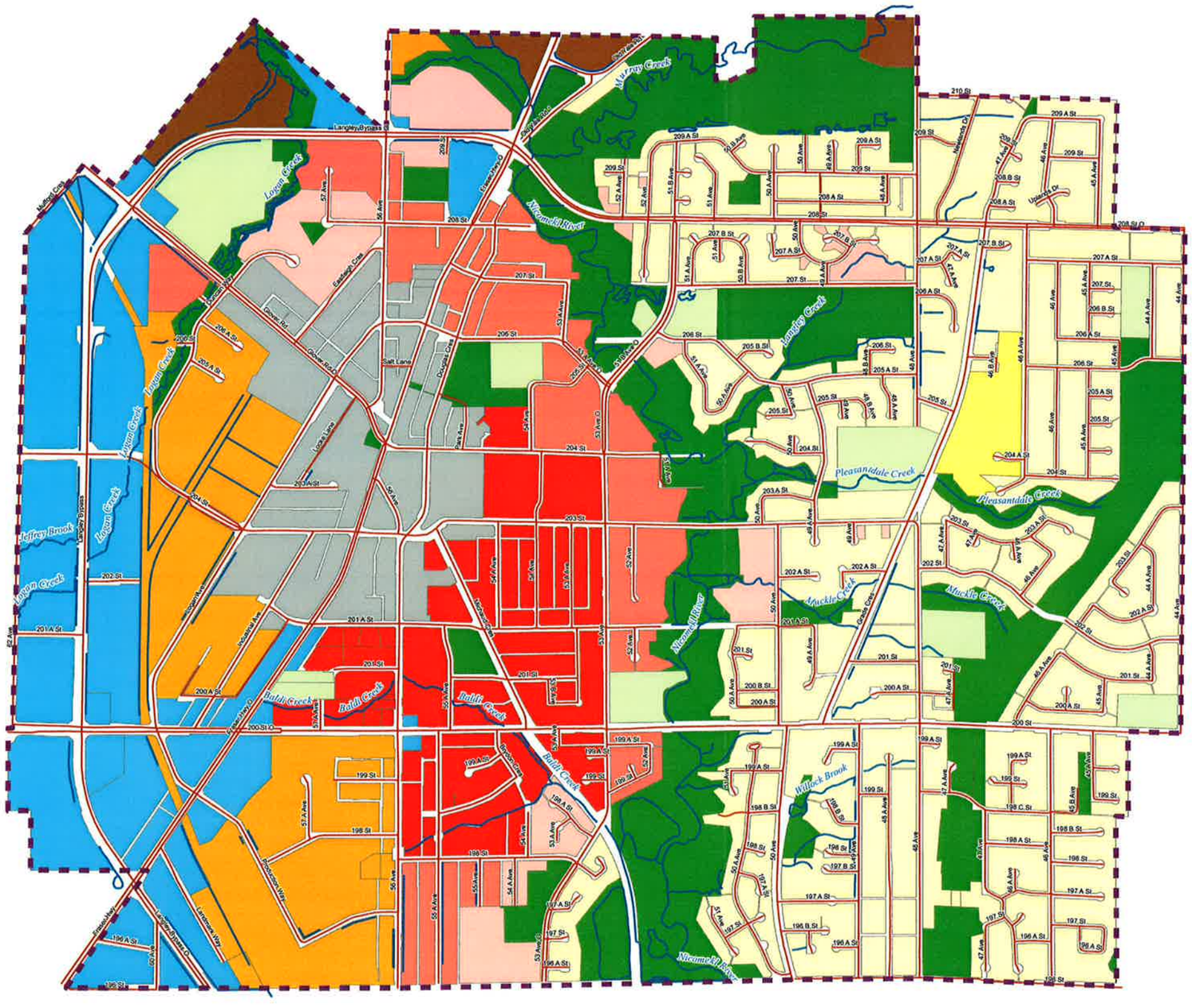
City of Langley - Integrated Stormwater Management Plan



CITY OF LANGLEY

Legend

Landuse Type

- Estate Residential (1)
- Urban Residential (2)
- Low-Density Residential (3)
- Medium-Density Residential (4)
- High-Density Residential (5)
- Downtown Commercial (6)
- Service Commercial (7)
- Industrial (8)
- Agricultural (9)
- Institutional (10)
- Green Institutional (11)
- City Boundary
- Watercourses
- Roads

Future Landuse

0 250 500 1,000

Meters

Figure 2-3

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2.1.3 Drainage Overview

A broad area bordering the Nicomekl River has been zoned as floodplain, with restricted, limited, or no development potential. In general, overland drainage of Langley is towards the Nicomekl River, which runs east to west through the central part of the City. Areas south of the Nicomekl River drain towards north to the Nicomekl River, except for a small area within the Newlands Golf Course that drains eastward to Murray Creek, then to the Nicomekl River. Areas north of the Nicomekl River, but south of the Fraser Highway drain to the Nicomekl River and areas north of the Fraser Highway drain to Logan Creek, then to the Nicomekl River. In the northwest, the Willowbrook Stormwater Management Facility collects runoff from a 40.9 ha area in the Township of Langley and discharges into the City's system at the intersection of Fraser Highway and Langley By-pass. Figure 2.4 shows the natural drainage pattern within the City.

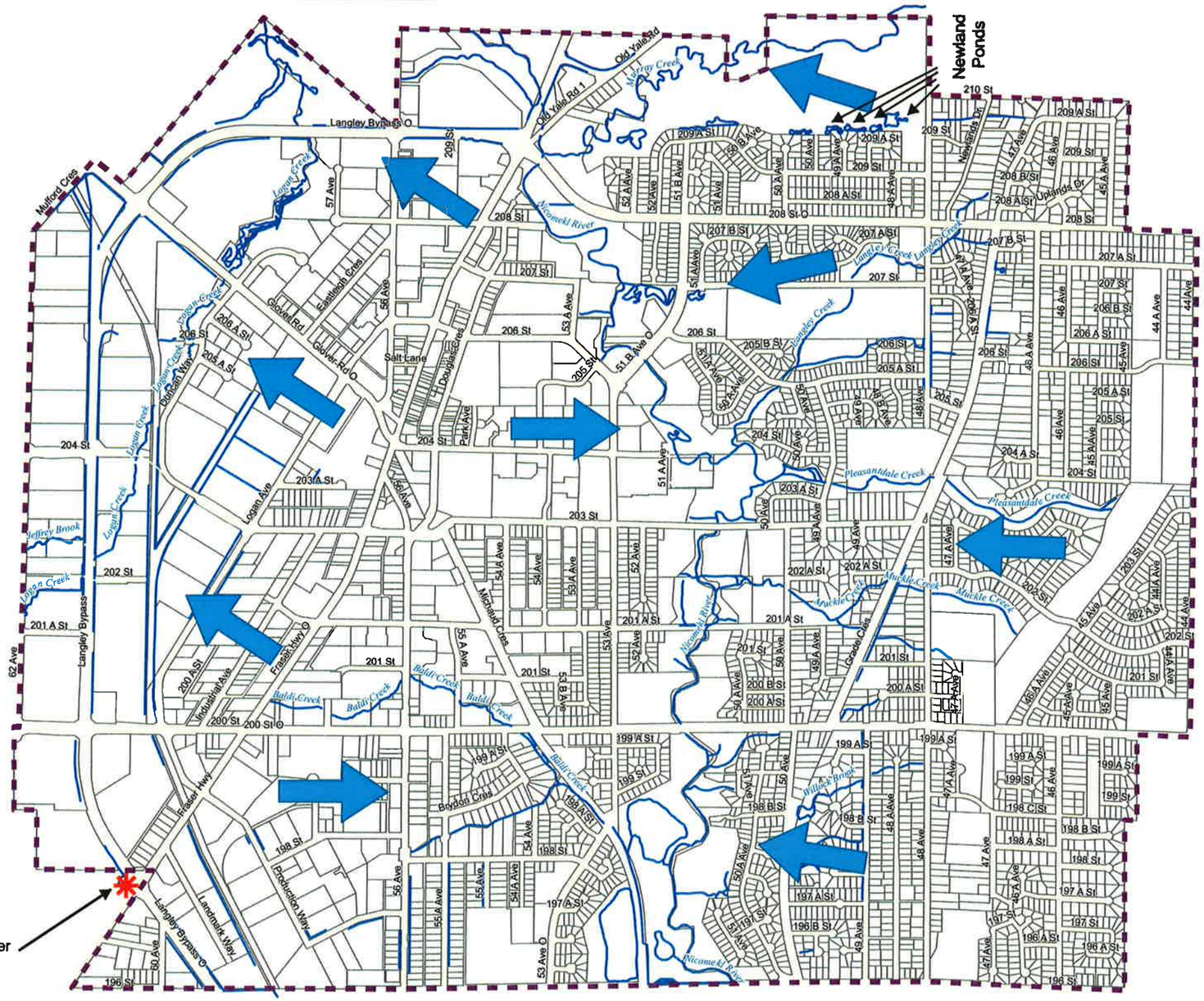
There are several smaller watercourses in the City that are tributary to the Nicomekl River. South of the Nicomekl River, the stormwater drainage systems are interconnected through overland flow routes, and streams. The major tributaries to the Nicomekl River in the south are Muckle Creek, Pleasantdale Creek, Langley Creek, and Murray Creek. In the northeast, most of the runoff is conveyed through the enclosed minor system whereas in the northwest, the stormwater drainage systems are interconnected through either Baldi Creek or Brydon Creek (UMA, 2005), the two major tributaries in the north of the Nicomekl River. Several residential areas north of the Nicomekl River do not have storm sewer systems and runoff is routed overland through ditches into these creeks (UMA, 2005).

2.1.4 Identified Issues

A review of existing documents and consultation with the City and local stewardship groups identified several issues, including flooding, siltation and other water quality concerns, and the importance of raising community awareness about their role in protecting the streams and other habitat. The following documents were reviewed for developing the current ISMP:

- City of Langley Official Community Plan (2005, amended in 2007)
- City of Langley Downtown Master Plan (2007)
- Stormwater Drainage System Assessment by UMA (2005)
- City of Langley's Stormwater Management Policy and Design Manual
- Status of Water Quality Conditions in the Little Campbell, Serpentine, and Nicomekl Rivers from 1971 to 2002 (2003)
- Phase 1 Water Resources Management Strategy Township of Langley (1999)
- Upper Nicomekl Flood Control Strategy (UMA, 2004)

City of Langley - Integrated Stormwater Management Plan



Legend

- City Boundary
- Water courses
- Drainage Flows

Drainage Pattern

0 250 500 1,000
Meters

Figure 2-4

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Flooding

Flooding in lowland areas of the City is a long standing challenge and has been studied in three previous initiatives, including:

- 'Upper Nicomekl Flood Control Strategy (UMA, 2004)',
- 'Langley Floodplain Bylaw Analysis (USL, 2008)', and
- 'Logan Creek Conveyance Improvement (USL, 2007)'.

These past initiatives have resulted in the delineation of floodplain boundaries for the Nicomekl River and Logan Creek, as well as defined capital improvements to mitigate flooding impacts.

Consultation with LFN and NES

Concerns about increased siltation in the Nicomekl River, particularly following a rainfall event, and the need for a long term solution were strongly described by the LFN and NES. They also reported there to be some watercourse erosion problems. Sediments are of concern in this system because they settle and smother fish habitat, including spawning areas and benthic macro-invertebrate communities (MOE, 2002). Sediments can also be associated with other contaminants such as metals and polycyclic aromatic hydrocarbons (PAH), which pose a threat to aquatic life. The stewardship groups also expressed concerns regarding conditions in Brydon Lagoon and its previous use as a sewage treatment lagoon. The need for increased community awareness about preservation of the natural resources and adoption of stormwater Best Management Practices (BMPs) to address the water quality issues was also raised by the stakeholders.

Stormwater Infrastructure

The 'Stormwater Drainage System Assessment' by UMA (2005) reported existing drainage problems and recommended future stormwater management initiatives. They indicated an inadequate level of service by stormwater management systems along Douglas Crescent from 204th to 207th Street, along 57A Avenue from 198th Street to 200th Street, along Landmark Way and west of 200th Street and north of Production Way (UMA, 2005). Further details on infrastructure needs are discussed in Section 6.2.

Infrastructure operation and maintenance issues were discussed with the City's Public Works Department. Aside from the broad floodplain issues, City staff identified some site specific flooding issues that need to be addressed, including:

- Logan Creek area (currently being dealt with through the Logan Creek Conveyance Improvements initiative),
- 208th Causeway south of Fraser Highway,
- Willowbrook Mall,
- Areas south of Nicomekl River, and
- East of 208th Street.

The City is only recently initiated the development of comprehensive infrastructure database and Asset Management program. In addition, operation and maintenance procedures have been done "on demand", rather than through a routine, proactive O & M program. Both of these issues are recognized challenges by Public Works staff. Efforts are underway to alleviate these challenges, however there will be significant resource commitments and additional efforts to implement them.

3.0 EVALUATION OF EXISTING CONDITIONS

According to the City's current landuse map, areas south of the Nikomekl River are residential and public spaces, areas north of the Fraser Highway are mostly industrial and commercial, and areas between Fraser Highway and the Nicomekl River are a combination of low, medium and high density residential, service commercial, downtown commercial and few parks spaces (Figure 2.2). In 2005, the City adopted an Official Community Plan (OCP) where major changes are recommended in the areas between the Fraser Highway and the Nicomekl River (Figure 2.3). In these areas, most of the low and medium density residential areas have been designated as high density residential and some service commercial located north of the downtown have been designated as downtown commercial. In an urban setting, changes in land use can have a significant effect on the hydrology. Increase of paved surfaces decreases available area for infiltration, reduces the moisture retention capacity of the surficial soils to sustain base flows during dry seasons and thus, increases the peak flows to the creek systems. Urbanization can also affect the quality of stormwater runoff and thus, the water quality of receiving streams, as urban runoff is a potential source of total suspended solids (TSS), oil and grease, lead, zinc, fecal coliforms and PAH contamination. In the Fraser-Delta area, agricultural and urban runoff are known to influence water quality in the Nicomekl River and other neighbouring rivers (MOE, 2002). For the City of Langley, concerns about water quality were raised by the stewardship groups.

As part of this ISMP assignment, an evaluation of existing conditions has been conducted in three general areas: stormwater runoff quality, habitat, and infrastructure.

3.1 Stormwater Quality

The assessment of stormwater runoff quality in the City of Langley included a desktop estimation of pollutant loading by stormwater runoff based on land use. This includes typical pollutants such as total suspended solid (TSS), phosphorus, nitrogen, fecal coliforms, oil and grease, zinc and copper. Specific water quality issues commented on by NES and LFN relating to a closed landfill near Pleasantdale Creek and Brydon Lagoon were also explored. However, the runoff from the landfill has been intercepted and flows into the GVS&DD sanitary line.

3.1.1 Stormwater Runoff Pollutant Loading Estimation

A screening-level tool developed by the Center for Watershed Protection, a nonprofit watershed consulting organization based in the United States, was used to assess predicted pollutant loads associated with stormwater runoff and identify potentially significant areas within the City for possible remedial treatment and/or future application of treatment practices. The tool[1], or

[1] Schueller, Tom, *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMP's*, for Metropolitan Council of Governments, Washington, D.C., 1987.

method, requires minimal data input, all of which was readily available for this preliminary water quality assessment:

- Drainage (catchment) area(s) – we divided the City into several catchments based on the drainage pattern and land use type.
- Impervious cover – Imperviousness of surface cover was estimated based on City's stormwater management guidelines.
- Annual precipitation – We used the Surrey Kwantlen Park Rain gauge from the Water Survey Canada database to estimate the annual precipitation.
- Pollutant concentrations – Event Mean concentrations are based on data collated by researchers in the U.S.; we focused on a few pollutants, as representative of the spectrum of potential contaminants in runoff: TSS; total nitrogen; dissolved phosphorus; total copper; total zinc; and bacteria (specifically, fecal coliforms).

To determine predictive annual pollutant loadings, seven basic land use categories were assigned to each catchment, and then pollutant concentrations associated with those land use categories were applied. This method was applied to both existing and future conditions. The basic results are presented in graphs and maps and include:

- Estimates of annual loadings for runoff pollutants, by catchment area for existing and future conditions.
- Pollutant loading per unit area for existing and future conditions.
- A map showing "hot spot" or target catchments for possible remedial runoff treatment and for future application of best management practices.

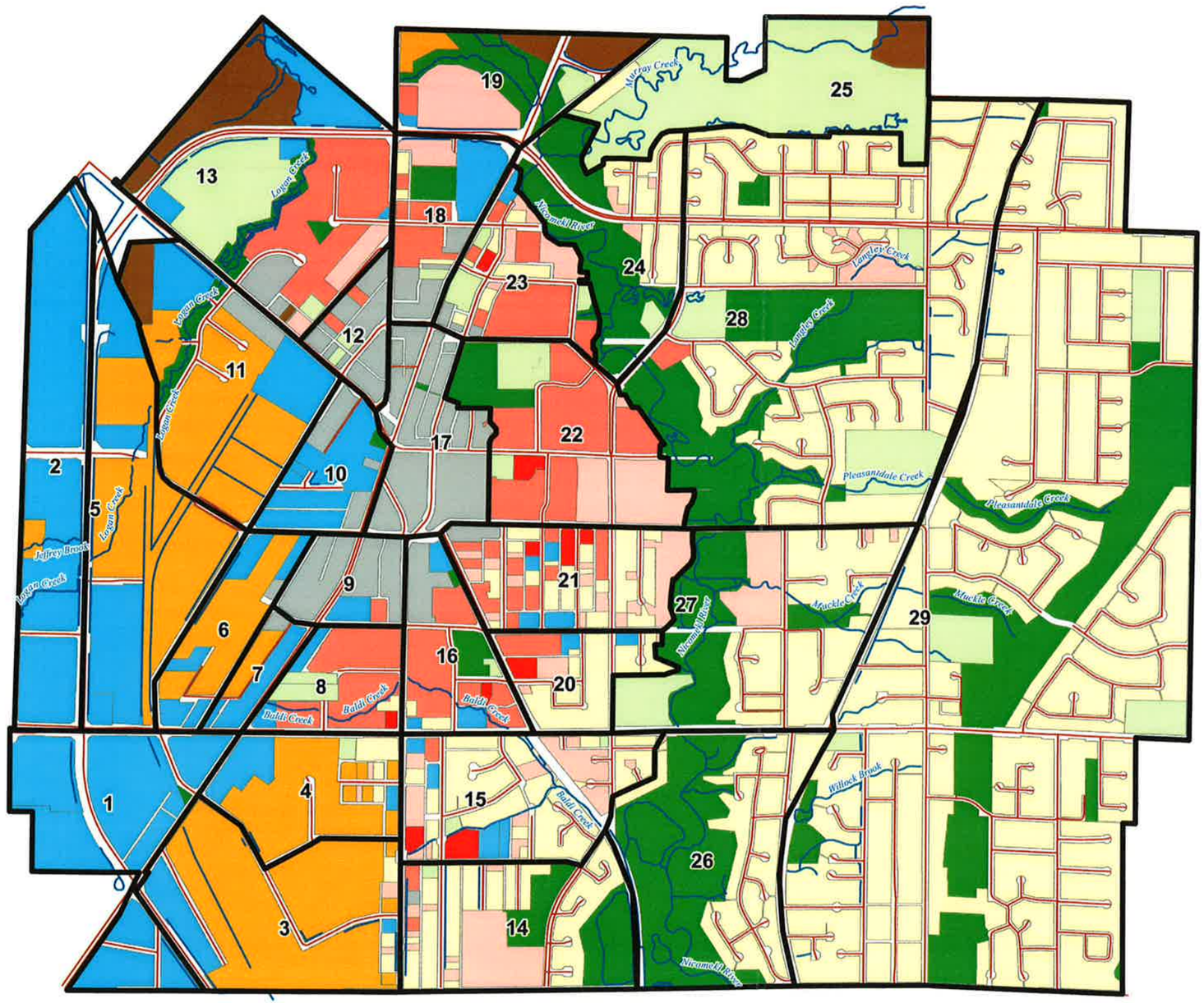
3.1.2 Model Development

As noted, this analysis uses a simple spreadsheet-based model that accounts for local rainfall, land use and typical runoff pollutant concentrations to estimate annual loads. The various components and input parameters for the model are described in this section.

Catchments

Twenty nine catchments were identified covering a total area of 1013 hectares. Figure 3.1 shows the catchment areas.

City of Langley - Integrated Stormwater Management Plan



CITY OF LANGLEY

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Landuse Type

- Agriculture (A1)
- Downtown Commercial (C1)
- Green Institutional (P1)
- Industrial (I1/I2/I3)
- Institutional (P2)
- Residential - High Density (RM3)
- Residential - Medium Density (RM2)
- Residential - Low Density (RM1)
- Service Commercial (C2/C3/CD/Bylaw 950 Zone)
- Urban Residential (RS1/RS2)
- Watercourses
- Roads
- 10 Catchments and ID's

Catchment Areas With Existing Landuse

0 250 500 1,000
Meters

Figure 3-1

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Impervious Area

The City was divided into a set of seven (7) land use categories and impervious cover was estimated for each category, by catchment. The categories, based on groups of similar zoning categories, are shown in Table 3.1 and include: single family residential; multi-family residential; commercial; industrial; institutional; roads; and open space (parks and agricultural). Two additional residential categories are used in the City: urban residential and estate residential. The 'urban' residential zoning was treated as 'single family' residential and the 'estate' residential zoning was treated as 'multi-family' residential. Under the 'commercial' category, the 'downtown commercial' and 'service commercial' as described in the City zoning map were combined. The 'Institutional' category included all private institutions and recreation zones (P2 in City zoning map). The public institutions (P1 in City zoning map) and agricultural lands were considered under the Open space (parks) category as most of these were parks and open spaces.

For existing conditions, impervious coverage for each catchment was computed using orthophotos and reference values of % imperviousness given in the City of Langley storm sewer design manual. For future conditions, impervious coverage was estimated based on the Official Community Plan (developed in 2005; amended in 2007) and the City of Langley storm sewer design manual. Table 3.1 lists impervious coverage for each land use type as given in the City of Langley Storm sewer design manual.

Table 3.1
Land Use Categories and Corresponding Impervious Surface Coverage

Land Use Category	Average Impervious Cover (%)
Single Family Residential	Low density 40%, Medium density 65% High density 78%
Multi-Family Residential	Low density 40%, Medium density 65% High density 78%
Industrial	90
Commercial	90
Institutional	80
Roads (ROW)	100
Open Space (Parks) and Agricultural	20

Precipitation

Based on climate data for the City of Langley (Surrey Kwantlen Park Station), the City receives an average of 1496 mm of rain per year[2]. For our analysis, we assumed a 90% rate of runoff production, which is generally assumed for urban runoff. This means that 10% of the total annual rainfall produces no runoff at all (and thus no pollutant washoff).

Pollutant Loading Functions

Research in the U.S. over the past 30 years has shown that on a broad scale, median concentrations for the common pollutants found in urban runoff are relatively similar across the continent. That is, despite its highly variable nature, within a small group of broad land use types, a preliminary estimate of pollutant concentrations in urban runoff can be made with reasonable confidence using median values tabulated from nationwide studies. The Center for Watershed Protection assessment method is based on pollutant concentrations derived from extensive sampling done in the early 1980s across the U.S. More recent data collected and published over the last 10 years was used, which included data from the Metro Vancouver area. Table 3.2 shows the pollutant event mean concentrations as determined by the recent study[3]; dissolved fractions are shown for information only and were not used in the analysis.

[2] Environment Canada, "Canadian Daily Climate Data (for Western Canada)," CDCD V1.02,2002.

[3] Pitt, R.E., A. Maestre, and R. Marquecho, "The National Stormwater Quality Database (NSQD, Version 1.1)," February 16, 2004 (http://unix.eng.ua.edu/~rpitt/Research/ms4/Paper/Mainms4paper.html, accessed July 30, 2007).

Table 3.2
Pollutant Event Mean Concentrations by Land Use Category

Pollutant	Residential	Commercial	Industrial	Highway	Open Space	Notes
TSS (mg/L)	49.0	42.0	78.0	99.0	48.5	
P (mg/L)	0.17	0.11	0.11	0.20	0.13	Filtered (i.e., dissolved)
N (mg/L)	0.92	1.10	1.23	1.35	0.77	NH3 + (NO2 + NO3)
Bacteria (mpn/100 mL)	8345	4300	2500	1700	7200	Fecal Coliform
Oil & Grease (mg/L)	3.90	4.70	5.00	8.00	1.30	
Zn (µg/L	73	150	210	200	40	Total
	43%	39%	53%	26%	NA	Dissolved fraction*
Cu (µg/L)	12	17	22	34.7	10	Total
	58%	45%	36%	31%	NA	Dissolved fraction*

* Listed for information only; not used in model

3.1.3 Annual Pollutant Load Computations

Two spreadsheet models were set up, one existing conditions and a second for future conditions. Each spreadsheet contained separate worksheets for each catchment and a summary worksheet with total values for all catchments. Annual loads (kilograms per year; colonies per year for bacteria) and annual loading rates (kilograms per hectare per year; colonies per hectare per year for bacteria) of the various pollutants were computed for each land use category then summed for each catchment. Sample spreadsheet models are included in Appendix B.

3.2 Results and Analysis

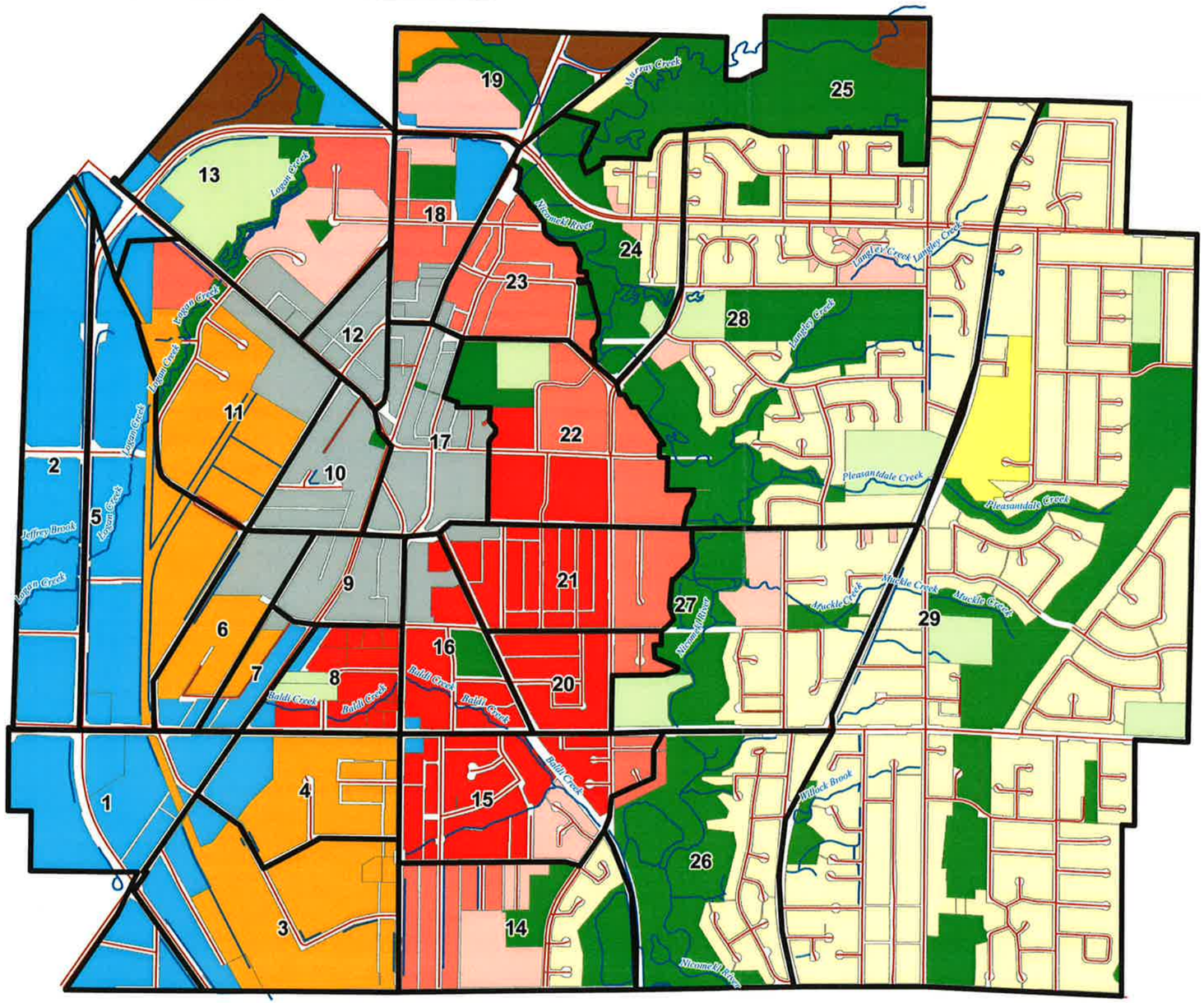
3.2.1 Baseline Conditions

Annual loads for the seven selected pollutants for the different catchments were estimated, with results for TSS and oil and grease discussed here, given that they are most relevant to the built-out nature of the City and that similar trends were obtained for the other pollutants. Figures 3.3 and 3.4 show annual loadings (kg) for both existing and future conditions, for TSS and oil and

grease, respectively. Only TSS and Oils & Greases have been presented as graphs. TSS is often used as the surrogate measure of water quality. High levels of TSS can damage fish and aquatic invertebrates and degrade instream habitat where the material settles onto gravel and cobble substrates. Oil and grease is another common stormwater runoff pollutant for urban developments especially for commercial and industrial areas.

For most of the catchments, the computed future pollutant loading is very similar to those for existing conditions. This reflects the fact that the City is essentially "built out". In catchment 23, the lower future TSS loading is probably a result of proposed land use type that replaces some industrial and commercial areas with multifamily residential areas, therefore a decrease in pavement density.

City of Langley - Integrated Stormwater Management Plan



CITY OF LANGLEY

Legend

Landuse Type

- Estate Residential (1)
- Urban Residential (2)
- Low-Density Residential (3)
- Medium-Density Residential (4)
- High-Density Residential (5)
- Downtown Commercial (6)
- Service Commercial (7)
- Industrial (8)
- Agricultural (9)
- Institutional (10)
- Green Institutional (11)
- Watercourses
- Roads
- 10 Catchments and ID's

Catchment Areas With Future Landuse

URBANSYSTEMS.

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0 250 500 1,000
Meters

Figure 3-2

Figure 3.3
Annual TSS Loading from Catchments

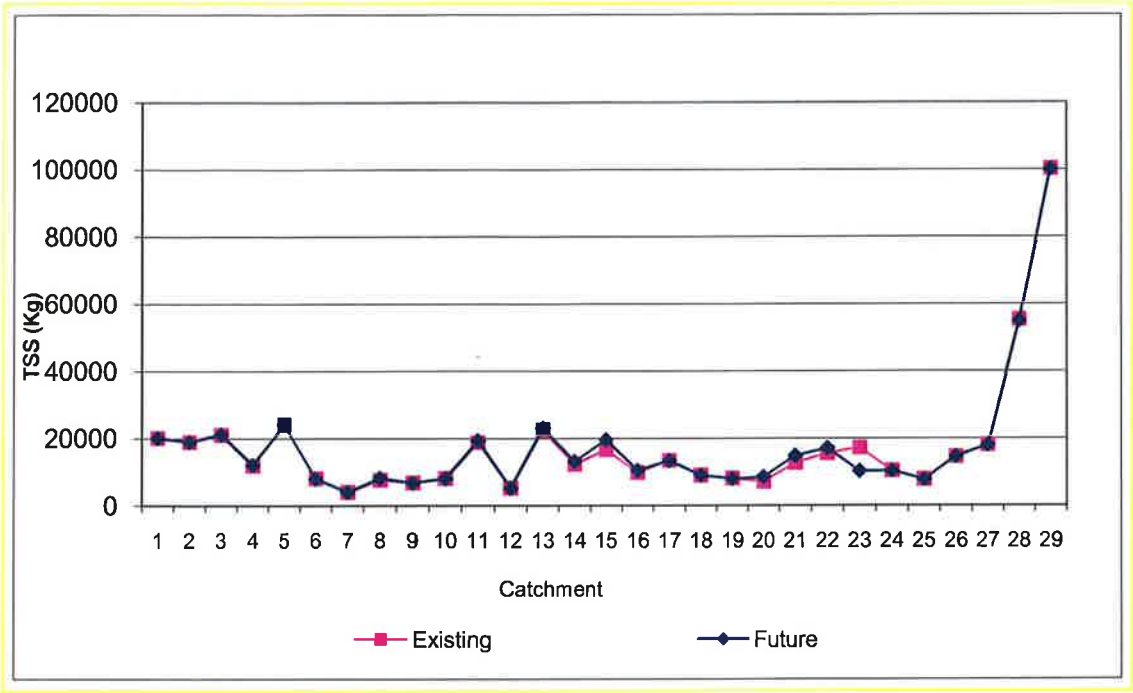
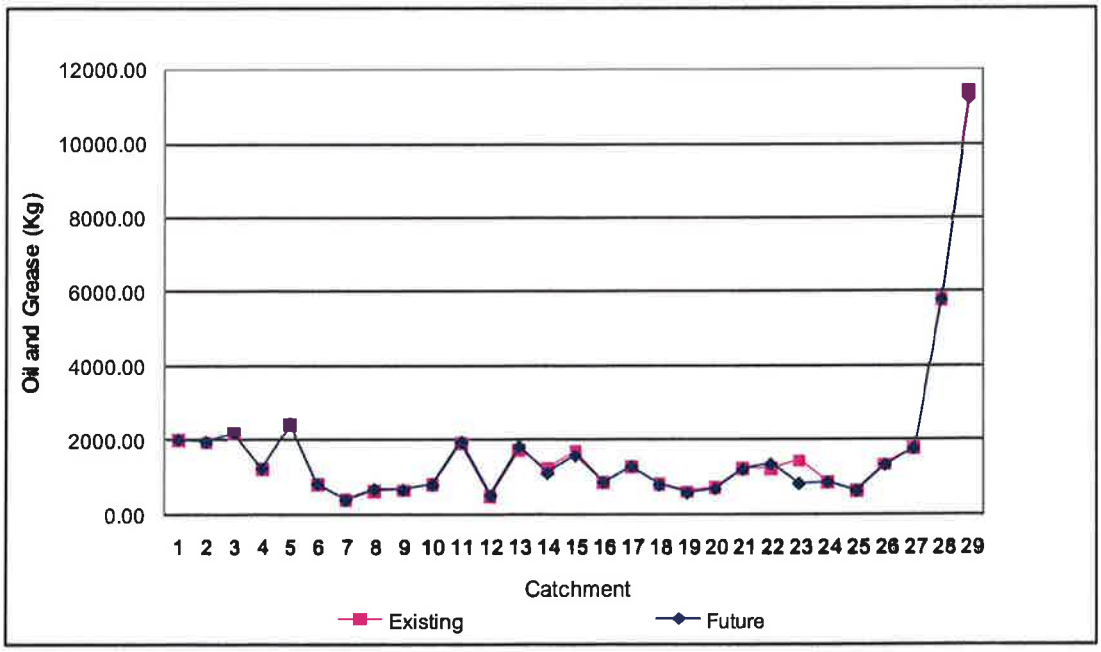


Figure 3.4
Annual Oil and Grease Loading from Catchments



Pollutant loading per unit area was estimated to identify catchments that might be smaller in size but produce higher pollutant loading per unit area (i.e. pollutant concentration). Figure 3.5 and Figure 3.6 show TSS loadings per unit area and Oil and Grease per unit area for each catchment. Other pollutants show similar trends. In general, it is observed in these graphs that catchments located north (mostly commercial, industrial and high density residential) of the Nicomekl River generate significantly more TSS and Oil and grease (kg/ha) to the Nicomekl River than catchments in the south (single family residential). This information is key to identifying priority areas that are potential candidates for water quality Best Management Practices (BMP's). Figure 3.5 and Figure 3.6 also illustrate that some catchments show relatively significant increases in TSS/Oil and grease loading from existing to future conditions. This result would be important in determining the runoff quality target to maintain 'no net increase in pollutant loading' with future development. Considering the significance of TSS loading, Figure 3.7 shows how the catchments generating different TSS loadings per unit area are distributed throughout the City. TSS loading rates were categorized into four groups that demonstrate the relative differences in TSS loading per unit area.

Figure 3.5
Annual TSS Loading from Catchments (Kg/ha)

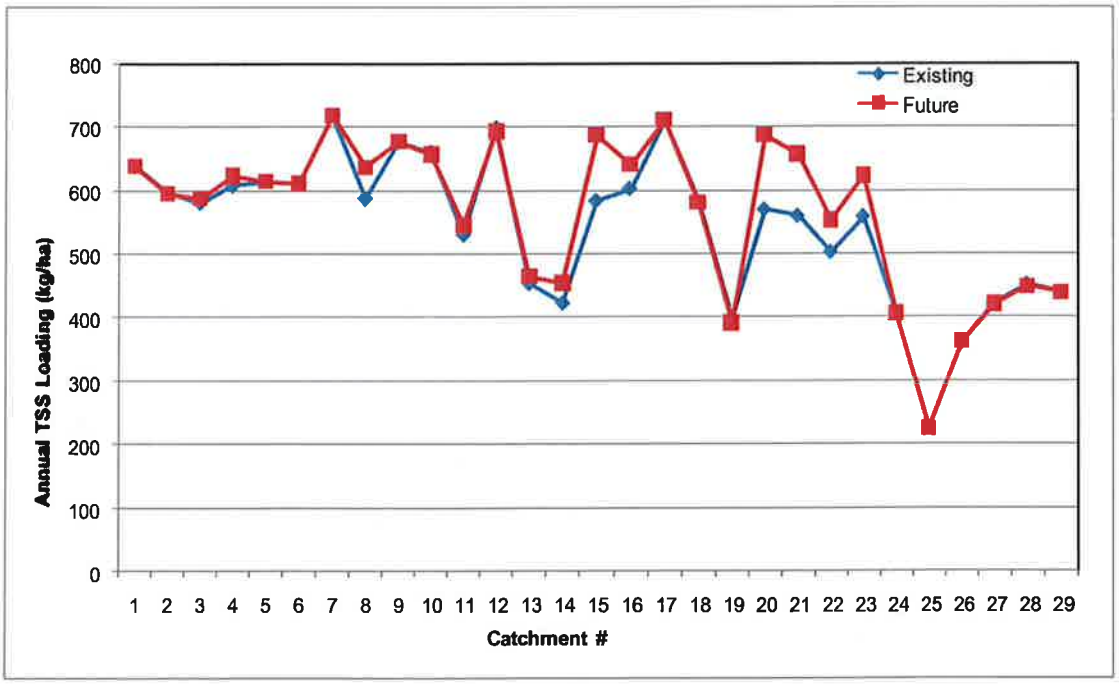
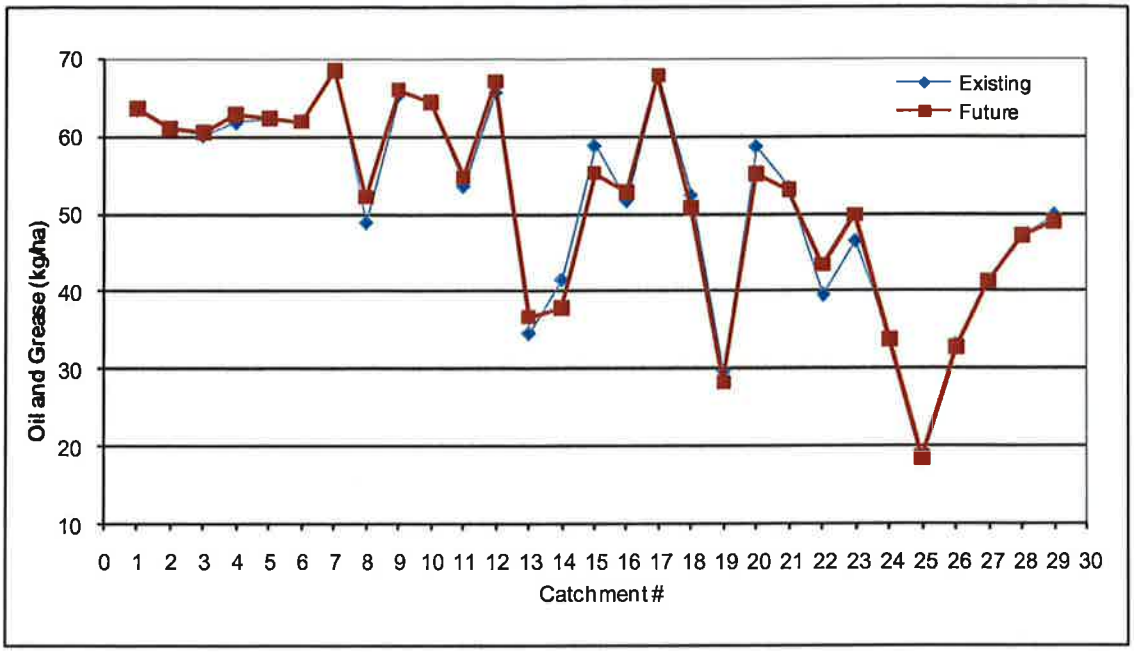


Figure 3.6
Annual Oil and Grease Loading from Catchments (Kg/ha)

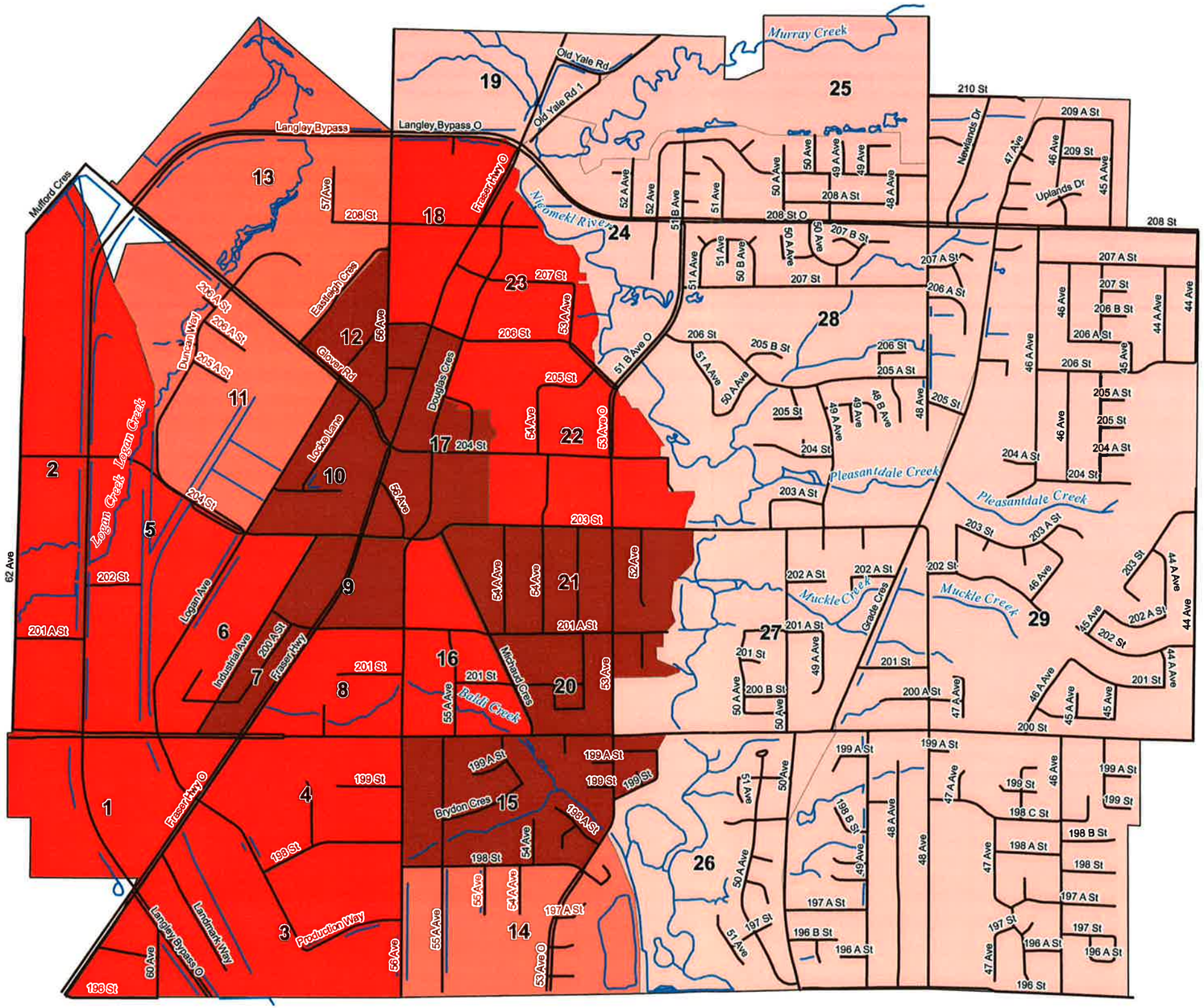


3.2.2 Limitation of Analysis

This screening assessment makes use of highly simplified approaches to estimate pollutant loads and removal of those loads. The following key limitations to the analysis apply:

- Pollutant concentrations are not specific to the City of Langley; instead median values for event mean concentrations of pollutants across North America were used. Specifically, with respect to the roads land use category, use of median values for highways likely overstate the pollutant loads from low speed, low use streets.
- While all the concentrations used in the analysis are subject to variability, bacteria (fecal coliform) data are particularly difficult to model. As such, these results should be considered to have a very wide band of variability.
- The computations do not account for any dynamic processes among the pollutants affecting pollutant loads and concentrations.
- The computations used an annual average rainfall depth, not a series of discrete storms over time, which would yield a better accounting of actual pollutant wash-off.

City of Langley - Integrated Stormwater Management Plan



CITY OF LANGLEY

Legend

TSS: kg/ha

- 227 - 450
- 451 - 550
- 551 - 650
- 651 - 718
- Watercourses
- Roads

Total Suspended Solids Loading for Future Condition

Figure 3-7

URBANSYSTEMS.

0 250 500 1,000

Meters

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Two specific classes of pollutants not addressed in the analysis are pesticides and herbicides, both of which can be significant contaminants from lawns (in residential and some commercial areas) and from open space used for sports-type recreation (e.g., golf courses and sports fields). Bacteria counts from residential areas can be quite high as well, particularly in areas with high concentrations of family pets (i.e., dogs). Despite these limitations, the screening level assessment provides a reasonable "first cut" for the purposes of assessing the significance of pollutant loading issues, and to create a framework for developing an action plan, where warranted.

3.3 Water Quality In Streams

Among the several watercourses within the City of Langley, some have their headwaters within the Township of Langley and the City of Surrey. In 2003, the Ministry of Environment published a report on the 'Status of Water Quality Conditions in the Little Campbell, Serpentine and Nicomekl Rivers from 1971 to 2002'. The study focused on the main stem Nicomekl River and its two tributaries Murray Creek and Anderson Creek. Murray Creek originates in the Township of Langley and flows westward to join the Nicomekl River in the City of Langley. Results of water quality monitoring undertaken in 2002 were presented in the report in relation to Boundary Bay tributary water quality objectives set in 1988. The test locations are shown in Appendix A. The water quality index was calculated using the index developed by Canadian Council of Ministers of the Environment (CCME, 2001).

In general, objectives for fecal coliforms, E. coli, ammonia, nitrite, and suspended solids, and pH were met in the Nicomekl River and its tributaries, with a few exceptions. Objectives for dissolved oxygen (DO) were not met in the main stem Nicomekl River and tributaries, and the provincial *E.coli* criterion was not met at the midstream Nicomekl River location (0300061). Objectives for fecal coliforms, suspended solids, DO and pH have not been met in previous attainment monitoring, while objectives for fecal coliforms and suspended solids have not been met in Murray Creek. However, these results do not reflect the complete water quality condition in the Nicomekl River and its tributaries within the City of Langley boundary. These watercourses have no water quality monitoring program and no knowledge of water quality data for Langley Creek, Baldi Creek, Muckle Creek, Brydon Creek, and Pleasantdale Creek were found.

3.3.1 In Situ Water Quality Testing

As part of the October 2008 field survey of some of the selected City streams, Jacques Whitford AXYS measured *in situ* water quality on one date. A hand held multi-meter (YSI 85) was used to measure temperature, DO, pH, and conductivity. *In situ* water quality data surveyed are provided in Table 3-3. The values met applicable water quality guidelines and seem to support test results reported earlier (MOE, 2003). DO levels were lowest in two locations (7.7 mg/L and 7.6 mg/L), but higher than the BC Ministry of Environment instantaneous minimum of 5 mg/L

(MOE 2006). These measurements were taken from Brydon Creek and near Brydon Lagoon, where abundant instream vegetation was growing in shallow water. There are no provincial water quality guidelines for conductivity, which provides a general indication of ionic strength of the water.

Table 3.3
***In Situ* Water Quality in Langley Watercourses, October 16-17, 2008**

Creek	Location on Creek	Temperature (°C)	pH	Conductivity (µs)	Dissolved Oxygen (mg/L)
Baldi Creek	near Fraser Highway	13.4	6.5	175	9.4
Brydon Creek and Brydon Lagoon	at 55A Avenue	13.5	6.7	340	7.7
	at 53 Avenue	11.8	6.6	242	7.6
Pleasantdale Creek	Headwaters near BC Hydro RoW	10.8	6.5	260	8.0
Tributary of Pleasantdale Creek	Headwaters near BC Hydro RoW	11.2	7.0	85	11.1
	at Grade Crescent	9.8	7.4	290	10.5
Muckle Creek	at 50 Avenue	9.3	7.3	261	11.4
Tributary to Muckle Creek	at Grade Crescent	10.6	7.2	300	9.2
Langley Creek	at Grade Crescent	12.5	6.6	NA	9.3
	at 48 Avenue	12.2	6.8	240	10.8
	at 205A Street	12.7	5.8	282	9.3
Tributary to Langley Creek	4850 206 Street (creosote barrier)	12.4	6.7	NA	11.3

3.3.2 Pleasantdale Creek Water Quality

The 2003 MOE report identified the historic City of Langley Landfill located close to Pleasantdale Creek as a potential source of contamination. The site received residential, commercial and industrial refuse until it was closed in 1983. To protect the waters of Pleasantdale Creek, the City of Langley installed a leachate collection system. The MOE report noted that although a leachate collection system was installed, site inspections in the 1990s suggested the creek was still receiving some landfill leachate flow. To verify this information, the City also installed a leachate

monitoring system. Monitoring reports are published quarterly showing the current status of the leachate and to date, there has been no indication of any potential threat to the stream waters.

3.3.3 Brydon Lagoon

Concern was raised by the Nicomekl Enhancement Society (NES) and Langley Field Naturalists (LFN) groups regarding the function and features of the lagoon. It was stated that the Lagoon was originally designed as a 'settling basin' for a sewage system (GVS&DD) that is no longer used, and that the Lagoon is now a habitat feature. Sediment accumulation has decreased the depth of the lagoon significantly which might affect the water quality. The groups recommended dredging to improve function. However, the City has informed us that the water quality in the lagoon is tested occasionally in response to residents' complaints and there has been no indication of deterioration of water quality. Further in-depth investigation is necessary to assess the sediment accumulation, the water quality and overall functionality of the lagoon as a habitat feature.

4.0 AQUATIC AND TERRESTRIAL HABITAT ASSESSMENT

Jacques Whitford AXYS Ltd. (JWA) was retained by Urban Systems Ltd. to assess freshwater and terrestrial habitat and assist the City of Langley in developing an appropriate information base for an ISMP. This study documents existing habitat values that should be protected and identifies enhancement opportunities in general and for five streams that are tributary to the Nicomekl River (Pleasantdale, Langley, Muckle, Baldi and Brydon creeks). Most of the streams in the City are considered to provide salmonid habitat, as they are linked directly with the Nicomekl River and there are few barriers to fish passage on the tributaries (Appendix C: Figure 1). Please see attached Appendix C for detail aquatic and terrestrial habitat assessment by Jacques Whitford.

5.0 DRAINAGE INFRASTRUCTURE ASSESSMENT

With limited budget for this ISMP study, analysis and condition assessment of the municipal drainage infrastructures could not be completed. At this time, the assessment has been limited to a review of past infrastructure studies and interviews with Public Works staff.

5.1 Infrastructure Capacity

UMA Engineering Ltd. completed a comprehensive stormwater drainage system assessment in 2005, which provides a solid foundation of information. This study completed a capacity assessment of the stormwater drainage system both for existing and future conditions, identified opportunities for improvement, recommended remedial measures (Appendix A: Figure 4.4 and Figure 5.3) and provided an implementation plan. Building on that solid foundation, the following questions were raised to ensure that the content of that past study is well aligned with the ISMP initiative.

- Is the City satisfied with the findings of UMA study?
- Did the study use the most current OCP land use information for the future condition? If not, does it make a significant difference to the findings?
- Does the City feel there is anything of significance absent in the UMA study?
- Following the completion of the UMA study, has the City started to implement its recommendations?

Based on discussions with the City staff, it is understood that the City is comfortable with the findings of the UMA report; however, the study recommendations have not yet been integrated into the City capital program.

The UMA study identified deficiencies in the existing storm sewer system for both the existing and future condition based on the 1999 OCP. The 2005 (amended in 2007) and 1999 OCP were compared and found to not have significant differences in landuse that would warrant re-assessment. In addition, the findings of the UMA report were reviewed in the context of the ISMP objectives. The study is comprehensive and the findings are consistent with the drainage problems mentioned by the City Operation and Maintenance staff. However, the study focused on conveyance infrastructure alone and did not explore issues pertaining to environmental or water quality protection. As such, it is suggested that the content of the UMA be adopted, however the following sections of this ISMP report are supplementary and offer commentary to satisfy a broader set of objectives.

5.2 Operation and Maintenance

It is also understood that the UMA study was limited to a capacity assessment and did not consider the operational or conditional aspect of the system. As part of this ISMP study, City Public Works staff were interviewed for information about infrastructure records, system condition, operational challenges (i.e. surcharging, flooding, debris accumulation, clogging, etc.), and maintenance protocols. Following are some of the key findings from that exploration:

- There are three areas of noted flooding: 208th St south of Fraser Highway, the Willowbrook Mall at Fraser Highway, and Logan Creek at the Langley Bypass. According to the UMA report, the Willowbrook Mall Stormwater Management Facility receives runoff from areas (approximately 40 ha) located in the Township and discharges into the City's system. City staff identified this as a potential cause of flooding.
- There is isolated flooding east of 208th Street as reported by the City Staff.
- In the areas south of the Nicomekl River, there exists numerous historic rock pits servicing the residential areas. The City does not have full knowledge of the location and the condition of these rock pits.
- Operational and maintenance efforts take place mostly in response to complaints from the residents.
- There is no routine or comprehensive storm sewer video inspection program. Storm sewers are videoed where problems arise, or to coincide with road improvements projects. The City does proactively investigate and replace underground utilities with the road rehab program.
- The City has an annual clean-up program for catch basins.

In general, infrastructure records of the City's drainage systems are somewhat limited, and there is currently no comprehensive, proactive operation and maintenance program in place. Both are objectives of current staff, given the importance of managing aging infrastructure in the most cost effective manner. Development of such programs are in early stages. Most significantly, the City has recently initiated a process to develop an inventory of infrastructure assets. This will provide critical information in the development of a comprehensive Asset Management Program, which has not yet been defined.

6.0 STORMWATER MANAGEMENT AND HABITAT PROTECTION STRATEGIES

Based on the preceding information, the final sections of the report explore stormwater management strategies to address a number of objectives. The following list summarizes the issues and opportunities identified.

1. The issues of infrastructure conveyance and flood protection have been adequately addressed through other recent initiatives. Future actions are to implement prior recommendations.
2. The current status of land use and habitat conditions does not warrant revisiting future land use planning, but does suggest an opportunity to revisit development standards such that redevelopment is conducted in a way that reduces or minimizes environmental impact.
3. Pollutant loadings, particularly in the northern half of the City, are significant and contribute to the sedimentation and water quality challenges observed in the Nicomekl River.
4. The City has an aging infrastructure; therefore development of a comprehensive Asset Management Program would be essential.
5. There have been significant encroachments in the riparian areas, with loss of natural vegetation that would otherwise provide additional benefits of stormwater management and bank stability. A City program to improve riparian habitat quality on public land and to promote the values of retaining natural vegetation on private land would be most useful.
6. All the streams within the City have well documented fish habitat and there exists few barriers to fish passage.
7. The riparian areas provide the majority of habitat for species of conservation concern such as red legged frog and Pacific water shrew, which depend on a relatively large depth of high quality riparian vegetation (30 to 100 m setbacks from a stream).

6.1 Water Quality Improvement

Several treatment strategies can be utilized to improve the stormwater runoff quality. Considering that most areas of the City are already developed, the potential for implementing a wide range of structural/non-structural BMPs in these areas is limited. Following are some measures that can potentially be applied in the existing development areas. However, for infiltration-based measures, assessment of infiltration potential is necessary prior to recommendation.

- Basic Treatment – End-of-pipe sediment-removal structures, typically able to remove approximately 50% of TSS, plus oil and grease, and particulate fractions of trace metals; Contech's "Vortechs" and the "StormCeptor" systems are examples; basic treatment could be

considered on par with pre-treatment and primary treatment technologies for municipal wastewater.

- Basic Treatment Plus Filter System – End-of-pipe combined sediment removal and filtration systems, typically able to remove approximately 90% of TSS, along with oil and grease, trace metals and some nutrients; Contech's "StormFilter" system is one example; specific pollutants can be targeted for removal by varying the filter media type.
- Street Cleaning – High performance, vacuum-based street sweepers are able to remove more than 80% of TSS from the pavement and other hard surfaces; applied to roads only although in theory could also be used to clean parking lots and other open, paved surfaces. However, as we understand, street cleaning is currently included in City's operation and maintenance program.
- Roadside Bioswales – Low Impact Development (LID) method using swales specifically designed to capture and treat runoff from small areas through settling, contact with soils and biological processes; typical TSS removal rates of more than 60% can be achieved.
- Rain Gardens – Low Impact Development (LID) method using bioretention on residential and commercial sites; as with bioswales, designed to capture and treat runoff from small areas such as residences and commercial sites; can be expected to remove 75% or more of TSS.
- Roof Leader Disconnection – Low Impact Development (LID) method that reduces the total runoff from residential areas by redirecting roof runoff to lawns rather conveying it to local storm drains; since there is no surface runoff after disconnection, pollutant removal is 100%.

The desktop analysis of surface runoff quality indicates that the commercial and industrial areas near the downtown area are the highest producers of TSS and some other pollutants. This indicates that these areas should be considered as candidate areas for implementing water quality improvement measures. The City has recently completed the 'Downtown Master Plan' (City of Langley, 2007), which is an initiative to revitalize its historic downtown core. The vision of that Plan provides significant opportunities to address stormwater quality and environmental issues, as follows:

- Streetscaping, green roofs, porous pavements, and roadside gardens are enhancement opportunities recommended in the Master Plan. These measures can be considered in conjunction with the treatment methodologies noted above in reducing the pollutant loading and, thus, improving the stormwater runoff quality. The City's development and building standards would need to be reviewed and adopted accordingly.
- A stormwater canal / water feature is proposed within the Festival Park to the north side of Fraser Highway. This falls within catchments that demonstrated high TSS production (and some other pollutants). With sufficient planning and design, the proposed feature may provide a significant opportunity to offer meaningful environmental benefit, in addition to

being a community feature. A feasibility study is required to confirm the viability and effectiveness of the opportunity.

- According to the Master Plan, there are five major street corridors in the downtown area that should be revitalized over the short to medium term. These corridors include West, Central and East Fraser Highway; Douglas Crescent; Glover Road/204th Street; 203rd Street; and Logan Avenue. The plan is to improve these corridors for walking with a marked difference to surrounding street sections. There are strong potential opportunities to incorporate low impact design techniques into these projects. Therefore, it is recommended that each of these corridors undergo a concept planning exercise to evaluate such opportunities.

6.2 Stormwater Infrastructure

The current status of the City's stormwater infrastructure and existing operation and maintenance programs was discussed in Section 5.0. Stormwater infrastructure related initiatives can be placed into three major divisions:

- Structural Upgrade
- Improvement in Inspection/Maintenance program
- Development of Asset Management Program

6.2.1 Structural Upgrade

In the 2005 UMA 'Drainage Assessment' report, the following recommendations were made for improvement of existing stormwater system within the City, and are still supported (Appendix A: Figure 4.4):

- Increase sewer capacity along Landmark Way (205 m), west of 200th Street and north of Production Way (272 m), and along 57A Avenue from 198th Street to 200th Street (220 m).
- Alterative drainage improvements along 203rd Street from Fraser Highway to Nicomekl River Outfall and Imperial Avenue that include increased sewer capacity through replacement or diversions, and stormwater detention using underground storage tank at the upstream end of the system along 203rd Street.
- Alternative drainage improvements along Douglas Crescent from 204th Street to 207th Street. Designs include increased sewer capacity through replacement, and stormwater detention in a dry stormwater management facility.

Considering future development (based on the OCP), the UMA study has shown that if the existing drainage improvements are implemented, the majority of the future stormwater drainage systems, with the exception of Douglas Crescent, have minimal increases in surcharge levels and capacity utilization and meet the design criterion. Increases in sewer capacity are recommended for stormwater drainage system along 205th Street and 206th Street, south of Douglas Crescent

(Appendix A: Figure 5.3). Cost estimates for the different recommendations have been provided in the UMA study. However, since these cost estimates were done in 2005, the City has requested Urban Systems provide updated cost estimates to reflect 2009 prices. As agreed by the City, this update was limited to applying an incremental factor to the costs previously reported in the 2005 study. This update did not include a review of the unit rates or quantities previously developed by UMA. Based on market condition changes since 2005, it is recommended that the total costs previously compiled by UMA be increased by approximately 25%-30%, depending on the nature of the recommendation (whether it is a storm pipe or detention facility). This factor was chosen based on observed increases in tender prices for similar works over the 2005 to 2009 time period. The updated costs are included in Appendix D. These costs are intended for long range budgeting only. It is recommended that each individual project be reviewed in greater detail prior to securing funds for the calendar year in which they are to be implemented.

6.2.2 Inspection and Maintenance Program

This program should include routine video inspections and sewer flushing, a standard reporting system for structural deficiency or failure, and a structural performance guide. The following tasks are recommended for the City's Stormwater Maintenance and Operation program:

- Regular inspection and assessment of stormwater infrastructures, and removal of debris. Evolve it from the current "on demand" approach into a City wide routine program.
- Community education programs (flyers, community newspaper info-articles) to raise awareness to environment / water quality issues within the City and communicate actions the public can take to help manage them.

6.2.3 Development of Asset Management Program

The City is currently in the process of developing an asset management plan to improve planning and decision-making related to managing its infrastructure assets. The plan will help the City:

- ensure sustainable infrastructure funding;
- optimize capital investment; and
- comply with new accounting requirements (PSAB 3150 requires local governments to account for the depreciation of tangible capital assets).

As part of the development of the plan, the City will need to inventory all of its infrastructure assets, including its stormwater management system. This inventory will include information on the age and condition of each component of the stormwater system. The plan will incorporate information from this inventory along with information on desired levels of service and risk management to identify optimal maintenance and replacement programs for the City's

stormwater infrastructure. As part of the plan, the City will also develop financing approaches to ensure that adequate funding is secured to support its routine maintenance program, and importantly, to support the eventual replacement of aging infrastructure.

After discussion with City staff, it is recommended that rock pits be included in this inventory list. Given the number of rock pits that appear to exist south of the Nicomekl River, their existence and performance is expected to be significant to the overall drainage and hydrologic functions in the area. Having a solid understanding of the rock pits will be important for long range infrastructure management and rehabilitation plans.

6.3 Habitat Protection And Stream Enhancement

Various City policies, and provincial and federal legislation, provide for protection of aquatic and terrestrial habitat. A well designed ISMP, signed off by Fisheries and Oceans Canada, indicates the commitment of the City to comply with the federal *Fisheries Act* while it manages urban development. The provincial Riparian Area Regulations under the *Fish Protection Act* are in place to guide development along streams. The province also provides guidelines to protect various species of conservation concern, which, in the City, include red legged frogs and Pacific water shrew, among others. The City provides direction to planning staff, residents and potential developers through the Official Community Plan, which includes an Environmentally Sensitive Areas Map and the use of Development Permits for certain areas. Details are provided below.

6.3.1 Habitat Protection

The main areas of environmental sensitivity in the City of Langley are the Nicomekl River and its floodplain and streams and their riparian areas. These areas provide important habitat for both fish and wildlife.

Various City of Langley policies provide guidance on environmental protection in the Official Community Plan (OCP) last updated in 2005 (City of Langley 2005). These are outlined in Section 9 of OCP Bylaw, 2005, No. 2600 and include the following policies relevant to habitat protection:

- protection of areas identified in the Environmentally Sensitive Areas Map.
- requirement of Development Permits for properties affected by environmentally sensitive areas.
- cooperation with other jurisdictions (DFO, MOE, adjacent municipalities, Metro Vancouver) on environmental protection and research initiatives.
- review of streamside development applications in accordance with the "Riparian Areas Regulation of the Fish Protection Act.

- encouragement of stormwater management practices to mitigate flooding and destruction of habitat and farmland, and consistent with the GVRD Liquid Waste Management Plan and Integrated Stormwater Management Planning.
- partnering with conservation groups and government agencies on habitat enhancement projects.

Development Permit Areas are described in Section 15.0 of the OCP for protection of the natural environment (documented in their Environmentally Sensitive Areas Map, Appendix C: Figure 2) and for intensive land uses (commercial, industrial, multifamily residential, Estate Residential). The Environmentally Sensitive Areas (ESA) Map was based on the 1997 Coast River Environmental Services report for the City (Fisheries Watercourse Classification Project and Environmentally Sensitive Areas Overview), updated in 2002 in consultation with Fisheries and Oceans Canada. The ESA Map provides base information for the fish habitat map (Appendix C: Figure 1) and identifies the following types of areas:

- ravines and watercourses (setbacks that would be determined through RAR)
- Nicomekl River floodplain and wetlands
- forested areas, trees and snags
- BC Hydro Right (s)-of-way
- watercourses and their classifications (Class A, A(O), B, C)

Guidance for development within the ESAs includes the following (Section 15.8 of OCP Bylaw):

- avoiding ESAs, where possible
- establishing watercourse setbacks in accordance with the Riparian Areas Regulation
- in some cases, providing detailed environmental inventory or environmental impact assessment in accordance with MOE requirements
- review of applications in consultation with MOE and DFO, where applicable
- use of restrictive covenants, where applicable

Exemptions for Development Permits are available for construction or alteration of single family dwellings and duplexes, and for single family subdivisions (Estate Residential parcels still require a Development Permit). As a result, some residential lots that include land within the ESA may not require a development permit but the developments will still need to comply with the Riparian Areas Regulation.

6.3.2 Stream Classification

The stream classification system used by the City of Langley is similar to that used by other municipalities, with minor differences. The City defines four types of streams, designated by letter and colour:

- Class A (red) – permanent (wetted year round) and deemed to contain, or potentially contain fish habitat and fish presence.
- Class A(O) (red-dashed) – contain fish habitat and presence, but may not be permanent, and thus are seasonal or intermittent.
- Class B (yellow) – generally permanent, but can also be seasonal or non-permanent; generally do not contain fish habitat, but contribute nutrients, food or cooler water to downstream fish habitat (e.g., roadside ditches that lead into streams).
- Class C (green) – generally have no fish habitat or presence, do not contribute nutrients or food downstream and are not connected directly to fish bearing streams (e.g., storm sewers and isolated drainage ditches).

Most of the City streams are considered Class A because they are directly connected to the Nicomekl River, have permanent flows and few passage restrictions.

6.3.3 Stream Setbacks

The Riparian Area Regulation (RAR) under the provincial *Fish Protection Act* will provide the main regulatory tool for protecting stream habitat in the City of Langley. The RAR came into effect on March 31, 2006. A proponent hires a qualified environmental professional to conduct a simple or a detailed assessment to establish watercourse setbacks. Fish habitat values within a 30 metre assessment area along Class A, AO or B watercourses are assessed and the appropriate setbacks are established (MoE 2008). Setbacks range from 5 m to 30 m; they are widest for permanent, fish-bearing streams (Class A) with at least a 15 m width of existing or potential riparian vegetation, and smallest for non-permanent, non fish-bearing streams (Class B) with minimal riparian vegetation. The RAR assessment also considers slopes and ravine areas, where wider setbacks are typically required to protect slope stability.

According to the RAR, areas within the setbacks are to be maintained as Streamside Protection and Enhancement Areas. Proposed stormwater detention facilities and recreational facilities are to be situated outside the riparian area and access restricted to minimize disturbance and discourage encroachment by auxiliary structures (e.g. sheds, fencing, landscaping, swimming pools, garages).

The setbacks defined under RAR (15 or 30 m) were established to protect fish habitat and are not wide enough to protect habitat for some species of conservation concern. On some

properties, the City may wish to require wider setbacks that those provided by RAR. For the red-listed Pacific water shrew, setbacks recommended for protection of critical preferred habitat are currently 100 m (Ministry of Environment 2005). For the blue-listed red-legged frog and other amphibians (which prefer slow flowing, marsh, wetland and pool habitat), recommended setbacks are at least 30 m on each side of a stream or wetland, with adequate connectivity with other habitat areas (Ministry of Environment 2004).

7.0 RECOMMENDATIONS

The Metro Vancouver (GVRD) template for an ISMP covers a wide range of topics. Due to limited budget, through discussions with the City and other stakeholders and based on our preliminary assessment, we have identified some key components of an ISMP that the City should address on a priority basis. It is apparent from the discussion in previous sections that water quality is one of the most significant issues; the other being stormwater infrastructure renewal. With respect to water quality, it is recommended that the ISMP incorporates the following tasks:

- Perform more detailed modeling of non-point source pollutant generation and wash-off followed by modeling of potential prevention and treatment options;
- Establish which pollutants should be targeted for prevention and/or treatment;
- Explore means to encourage or require the use of site adaptive BMPs during development or redevelopment; and
- Formulate and evaluate alternative strategies to prevent and/or treat non-point source pollution, including various combinations of public and private solutions, as well as combinations of source, structural and non-structural measures; the evaluation should include an explicit means for determining a cost effective combination of solutions.

The use of site adaptive BMPs will require a thorough review of the City's current land use, City's development bylaws, standards and guidelines and a good understanding of the groundwater condition. The purpose is to evaluate the feasibility of the BMPs and to identify development-related policies, procedures and practices that can more effectively lead to better stormwater management practices. The study should also determine which pollutants should be targeted for prevention or removal and to what level to protect the existing watercourses. This will involve an assessment of the risks and consequences of not preventing runoff pollution from entering receiving waters and will likely require significant consultation with senior environmental agencies as well as other stakeholders. With respect to the evaluation of alternative stormwater management strategies, the cost effectiveness analysis should take into account capital costs as well as long term operation and maintenance costs. This review should be combined with infrastructure renewal and redevelopment strategies.

In summary, the table below presents the proposed initiatives, suggested budget, estimated duration, and the rationale behind the recommendations. The suggested budget is only preliminary for approximate budgetary purposes and will need to be revisited through the development of a refined work program.

Table 7.1 Proposed Initiatives

PROJECT NO.	PROPOSED INITIATIVE	SUGGESTED BUDGET	ESTIMATED DURATION	RATIONALE
1	**<u>Feasibility Study for Stormwater Quality Improvement</u>** Conduct a feasibility study of various stormwater quality improvement approaches. The feasibility study should: • Refine water quality goals and performance targets • focus on the industrial/commercial areas north of the Nicomekl River, which are found to be the most significant sources of stormwater pollutants in the City • consider the applicability of source and non-source controls, including: o water quality ponds/wetlands o filtering practices (e.g., sand filters) o infiltration measures (e.g., porous pavement, infiltration trench) o bioswales o basic stormwater improvement practices (e.g., high performance, vacuum based street sweeping, roof leader disconnects, stormwater treatment units, oil-grit separators) • consider public and private solutions • evaluate each option in terms of various factors, such as: o cost-effectiveness o ability to implement given land ownership and available public spaces. o implementation steps o lifecycle costs o O&M requirements o regulatory/enforcement issues • identify suitable locations and implementation strategy for stormwater quality improvement measures (with specific consideration of how BMPs could be incorporated into the Downtown Master Plan). The Feasibility Study will further explore and develop an effective strategy that will allow the City to formulate a capital program for public works, and implement bylaws and policies for works to be practically implemented by private development.	$30,000-$40,000	6 – 8 months	Given the land use distribution within the City, managing water quality within the northern part of the City is a significant opportunity. As the City is largely built-out, the greatest opportunity to implement change is through infrastructure renewal and redevelopment initiative. Many techniques may be applied to meet water quality goals, both within private lands and public lands. Changes will be implemented gradually over time.

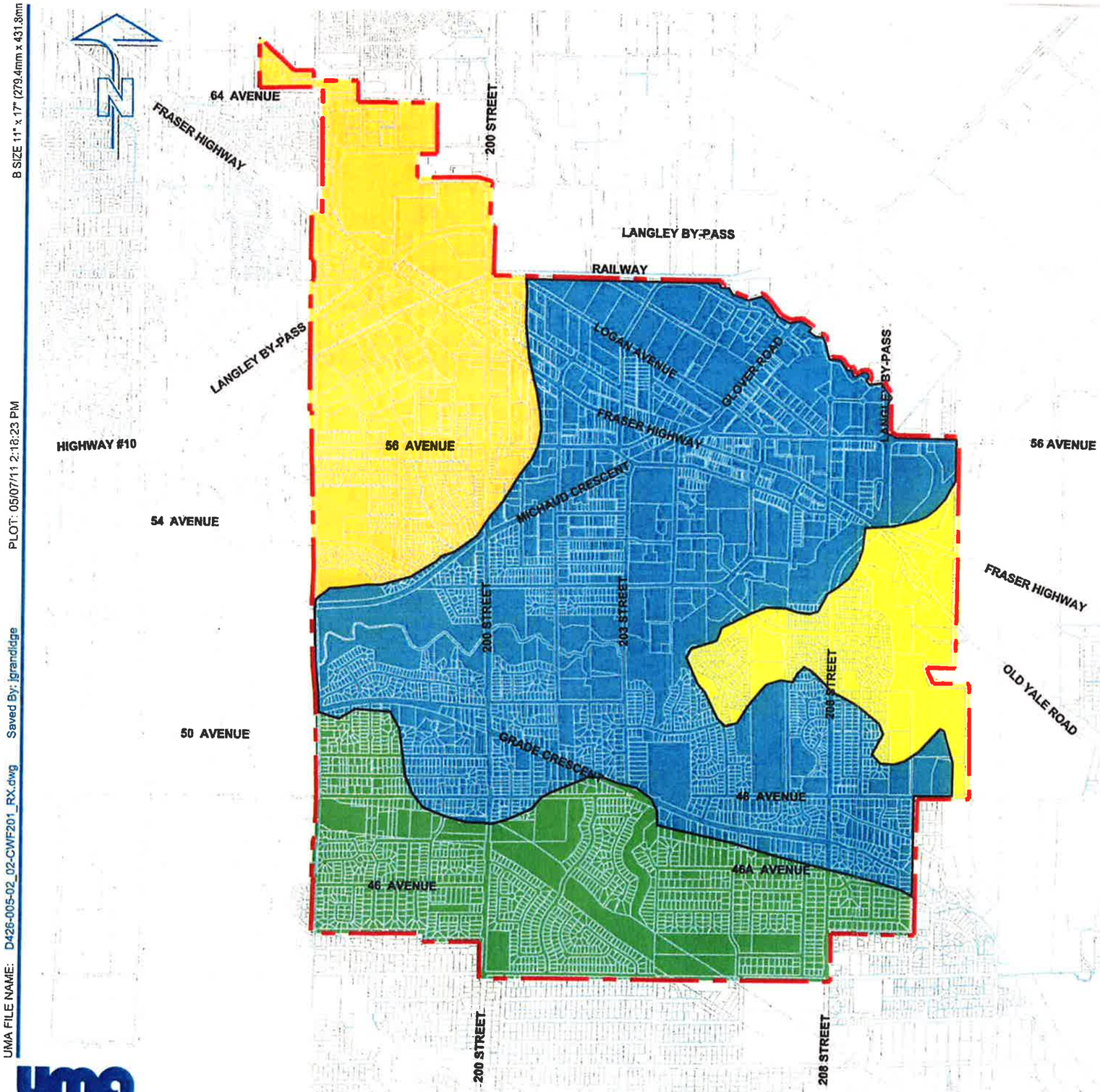
PROJECT NO.	PROPOSED INITIATIVE	SUGGESTED BUDGET	ESTIMATED DURATION	RATIONALE
2	**Stream Condition Assessment Study: Phase I (Screening Study)** Conduct a study to assess potential erosion risks from a geomorphologic and fisheries perspective. The study should: • Investigate the annual flow regime of the water courses. • conduct comprehensive assessment of erosion. • consider the state and cause of erosion relative to development conditions to identify current and future risk. • evaluate if and how the infrastructure upgrades recommended by UMA (2005) will affect the flow conditions in the streams. • identify appropriate and practical actions to manage risk and enhance habitat conditions. • define the habitat functions and comment on the restoration opportunities and constraints to ensure environmental approval is achieved for proposed solutions.	$25,000; Depends on number of systems investigated	6 months- 1 year	In order to identify the need and priority level for appropriate stream restoration works, it is necessary to understand the flow and erosion conditions. Our current study recognized creek erosion as an issue; however, their cause, current state, and future risk has not been assessed.
3	**Stream Condition Assessment Study: Phase II (Design and Implementation)** Based on the information generated through the stormwater quality feasibility study and the Phase I stream condition assessment, develop prescriptions for recommended stream restoration works at specific locations and proceed with implementation process.	Depends on findings of Phase I Study		Specific solutions are to be developed following the initial screening from the Phase I assessment. Since most of the watercourses within the City are fish bearing or assumed to be fish bearing, stream restoration works are to both manage risk and meet environmental habitat objectives.
4	**Stormwater Infrastructure Improvements Capital Program Update** In the 2005 'Drainage Assessment' report by UMA, several options and recommendations were made to improve the City's existing drainage infrastructure. It is suggested that the options, priority ranking and cost estimates be updated to reflect changes in the industry / economy and reflective of when the works are expected to be implemented.	$3,000	1 month	The cost of construction has changed significantly over the past few years and has now become volatile with changed economic conditions. This initiative would review the options and costs previously identified in the 2005 study to reaffirm recommendations, priority ranking of each projects, and update budgetary values tied to the City's broader capital program.

PROJECT NO.	PROPOSED INITIATIVE	SUGGESTED BUDGET	ESTIMATED DURATION	RATIONALE

5	**Base Flow Water Quality Monitoring Program**
	
	• A basic, long-term base flow water quality monitoring program should be established in the vicinity of the creeks (Brydon Creek, Baldi Creek) that receive runoff from the commercial and industrial areas. Testing should be conducted for at least the following parameters:
	  • TSS
	  • Copper (dissolved)
	  • Zinc (dissolved)
	  • Oil and grease
	  • Total Phosphorus, Ortho Phosphorus
	  • NO3, NH3
	Testing locations and frequency of testing will be determined as part of the program.
	• In accordance with the GVRD ISMP template, benthic invertebrate sampling program can be added with the base flow water quality monitoring program. This gives indication of long term changes in the creek system.
		$5000/year
		(Costs are based on assuming 3 testing sites per creek system, twice per year in the low flow period, 3 days per year sampling and reporting.)
		
		$5000/year
		(Not required every year; 1 year baseline and 1, 3 and 5 years after stormwater improvement measures are implemented.)
			Ongoing	Long-term base flow water quality testing will allow the City to:
				-track changes in water quality over time
				-evaluate the effectiveness of established water quality improvement measures (Adaptive Management)
				-indicate the adequacy of existing measures or the need for new measures to improve water quality
				
				Benthic Invertebrate Sampling helps to understand the long term stream health condition.

PROJECT NO.	PROPOSED INITIATIVE	SUGGESTED BUDGET	ESTIMATED DURATION	RATIONALE
6	**Public Education Program** Implement a communications program to educate the public about the City's efforts to effectively manage stormwater and protect stream health. The education program should: • identify target audiences (e.g., residents, commercial/industrial property owners, local streamkeeper/environmental groups, school children) • identify key messages to be communicated to each of these groups – for example, communication material could: o explain the connection between stormwater and the environment o identify the City's stormwater management initiatives o generally communicate how the public can contribute to protecting the environment and why it is important. o educate landowners about the use of pesticides, herbicides, and other potential pollutants o encourage landowners to implement and maintain BMPs/LID measures on private property or within the boulevard (information would specifically target techniques ultimately supported by the City). o discuss the status of key features known by the public, such as Brydon Lagoon. • use a variety of communication methods, such as: o flyers (within local newspapers or bundled with utility/tax bills) o information advertisements in local newspapers o brochures provided to new properties owners entering the City and as part of the subdivision / development process o postings on the City's website o presentations through public school system o public information meetings	$20,000/year	Ongoing	The City does not currently have a formal public communications process regarding stormwater management and protecting the environment. A public education program can be an effective way to: - promote and build public support for stormwater management and environment protection initiatives - encourage public participation in stormwater management and environment protection - contribute to changing behaviors
7	**Establish Riparian Area Setbacks** • Establish adequate riparian setbacks for species of conservation concern following the provincial guidelines. Based on existing riparian habitat quality, Muckle and Pleasantdale Creeks and the Nicomekl River floodplain are the most likely areas supporting red legged frog, Pacific water shrew and Trowbridge's shrew. • Development permit guidelines within the OCP will need to be amended to implement new setback requirements. Considering the built out nature of the City, it is recommended that during redevelopment process, the required riparian setbacks are maintained.	$5,000- $10,000 (Cost estimate depends on the amount of public consultation and additional field work required. The cost does not include preparing new policies or bylaw documents)	3 months	There has been significant encroachment in the past on many of the water courses that would not meet current regulations. With consideration for current development conditions, redevelopment processes, and habitat conditions, this investigation is to further assess current policies, bylaws and processes and assist the City with developing appropriate tools to enforce suitable setbacks in the future.

PROJECT NO.	PROPOSED INITIATIVE	SUGGESTED BUDGET	ESTIMATED DURATION	RATIONALE
8	**Investigation of Surface water / Ground water Interactions South of the Nicomekl River** The south, upland portion of the City contains soils with high infiltration capacity and the aquifer underneath is common between the City and the Township of Langley. To protect groundwater quality and further investigate infiltration capabilities, the City should: • evaluate the Township of Langley's Draft Water Management Plan (May, 2008), which contains recommendations to promote sustainable use and protection of groundwater • identify opportunities from the Township's Draft Water Management Plan (May, 2008) that are relevant to the City and determine if they can be adopted by the City • As part of developing a long term infrastructure renewal strategy for the area, conduct a hydrogeological assessment to determine: o the depth of the water table o infiltration capabilities o inventory and broader condition assessment of the rock pits and their influence on groundwater systems • Provide the City with further direction on long term infrastructure renewal and investment in the area.	$20,000-$30,000	3 months	Hydrogeological information is required to make recommendations regarding the use of stormwater BMPs/LID and to protect the health of the aquifer, which is a source of drinking water for the Township of Langley. Significant information may exist from the Townships past studies, but will be supplemented as needed to ensure relevancy to the City.
9	**Comprehensive Asset Management Program for Stormwater Infrastructure** Continue with asset management program. The City is currently in the process of developing a comprehensive asset management program, which will include stormwater infrastructure. This study will: • inventory all stormwater infrastructure • assess the condition of all stormwater infrastructure • develop a plan for the eventual replacement of aging stormwater infrastructure	$20,000 for the baseline report and implementation in the first year; $50,000/year for implementation in the next 3 years.	Ongoing	An asset management program will help the City manage risk (of infrastructure failure) and ensure financial sustainability of its services.
10	**Stormwater Utility Feasibility Study** Conduct a study to assess the feasibility of establishing a stormwater utility charge. The study should consider: • required revenue for stormwater initiatives • fee design options (e.g., basing the fee on impervious area, lot size, land use) • implementation steps and issues	$12,000 - $15,000	2 months	A stormwater utility would provide the City with a stable source of funding to proactively address stormwater issues. Stormwater utilities also provide a more equitable way (compared to the use of general revenues) of generating required revenues.



LEGEND:

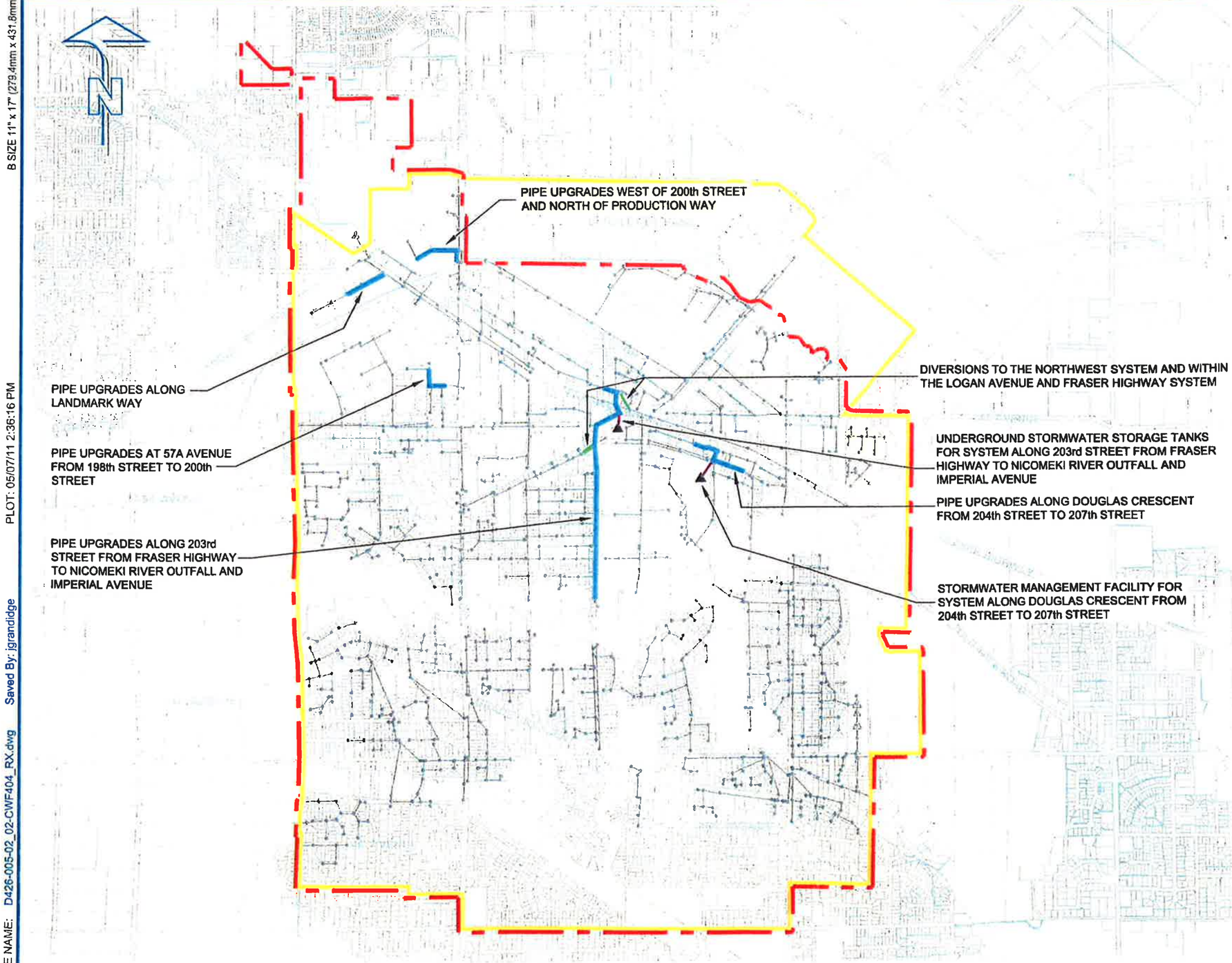
- STUDY AREA BOUNDARY
- SOIL TYPE A
- SOIL TYPE B
- SOIL TYPE C
- SOIL TYPE D

m
0 200 400 600
SCALE 1:20000

City of Langley
Stormwater Drainage System Assessment

Soil Distribution

Figure - 2.1



LEGEND:

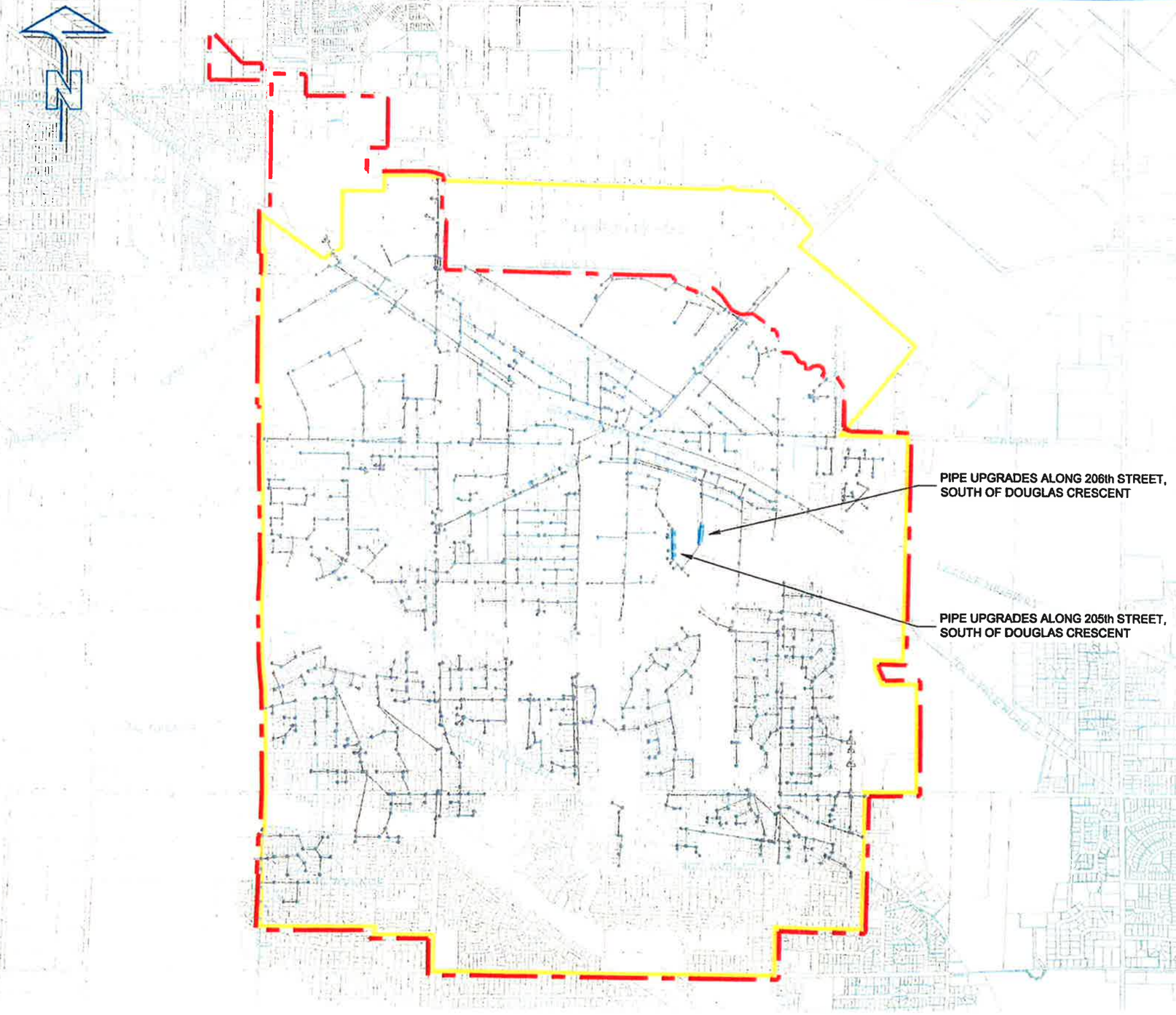
- STUDY AREA BOUNDARY
- CITY OF LANGLEY BOUNDARY
- EXISING SYSTEM
- PIPE UPGRADES
- DIVERSION
- STORAGE
- ▲ STORMWATER MANAGEMENT FACILITY

0 200 400 600 m SCALE 1:20000

City of Langley
Stormwater Drainage System Assessment

Existing System Improvements

Figure - 4.4



City of Langley
Stormwater Drainage System Assessment

Future System Improvements

Figure - 5.3

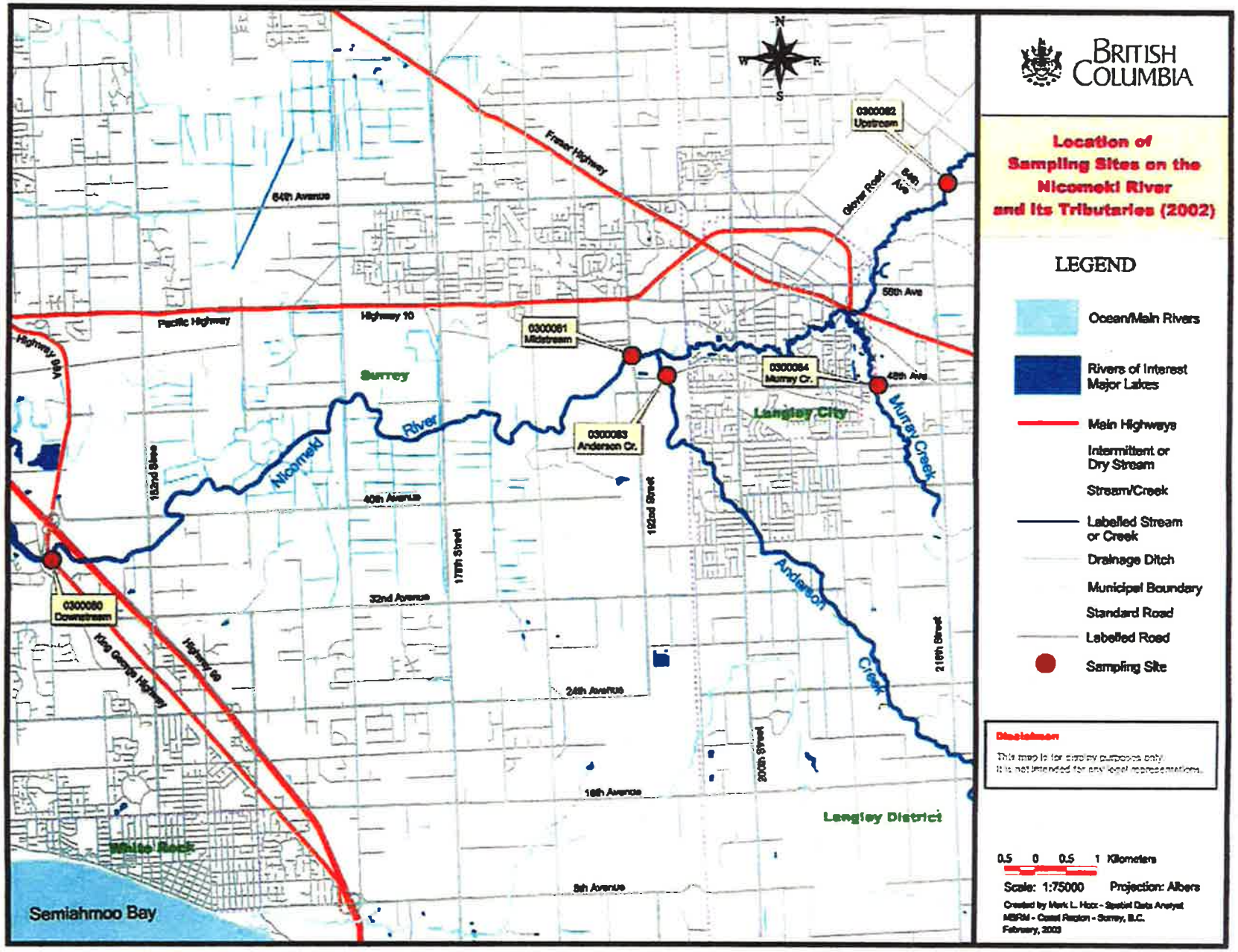


Figure 5 Location of sampling sites on the Nicomekl River and its tributaries- 2002

Project Description: City of Langley, Water Quality Screening Study
Project Number: 1125 0023 01

By: NN
Date: Sept 19,08

USE WITH CAUTION: Results based on EMC averages across North America

INPUT

P 1496.4 mm (annual average rainfall)
Pj 90 % (fraction of rainfall that produces runoff)

EXISTING CONDITION

Catchment 10						Estimated Potential Pollutant Load																			
Land Use	Area (Ha)	I%	Rv	R (mm)	Pollutant Land Use Category	TSS		COD		Phosphorus		Nitrogen		Fecal Coliform		Oil & Grease		Zinc		Lead		Copper		Chromium		Cadmium		Arsenic	
						(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(10^12 Colonies)	(10^12 Colonies/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)
Single family Residential-low/meddensity/urban	0.000	40	0.410	552.2	Res	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multi-Family Residential-high density	0.000	78	0.752	1012.8	Res	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	0.000	90	0.860	1158.2	Com	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	9.400	90	0.860	1158.2	Com	4560	485	6515	693	11.94	1.27	119.44	12.71	4.69	0.499	510.32	54.29	16.29	1.73	1.95	0.21	1.85	0.20	0.65	0.07	0.10	0.01	0.26	0.03
Institutional	0.000	80	0.770	1037.0	Res	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Roads	2.820	100	0.950	1279.4	Highway	3562	1263	3598	1276	7.20	2.55	48.58	17.23	0.61	0.218	287.86	102.08	7.20	2.55	0.90	0.32	1.25	0.44	0.30	0.11	0.04	0.01	0.09	0.03
Recreation	0.000	40	0.410	552.2	Com	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Space (Parks)	0.180	60	0.590	794.6	Open	69	384	60	334	0.19	1.03	1.10	6.10	0.10	0.573	1.85	10.30	0.06	0.32	0.01	0.08	0.01	0.08	0.01	0.04	0.00	0.00	0.01	0.03
Total	12.400	91.8				8192	661	10173	820	19.33	1.56	169.11	13.64	5.41	0.436	800.03	64.52	23.54	1.90	2.87	0.23	3.11	0.25	0.96	0.08	0.13	0.01	0.35	0.03

Project Description: City of Langley, Water Quality Screening Study
Project Number: 1125 0023 01

By: NN
Date: Sept 19,06

USE WITH CAUTION: Results based on EMC averages across North America

INPUT

P 1496.4 mm (annual average rainfall)
Pj 90 % (fraction of rainfall that produces runoff)

FUTURE CONDITION

Catchment 10						Estimated Potential Pollutant Load																			
						TSS		COD		Phosphorus		Nitrogen		Fecal Coliform		Oil & Grease		Zinc		Lead		Copper		Chromium		Cadmium		Arsenic	
Land Use	Area (Ha)	I%	Rv	R (mm)	Pollutant Land Use Category	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(10^12 Colonies)	(10^12 Colonies/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)
Single family Residential-low/meddensity/urban!	0.000	40	0.410	552.2	Res	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multi-Family Residential-high density	0.000	78	0.752	1012.8	Res	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	0.000	90	0.860	1158.2	Com	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	9.384	90	0.860	1158.2	Com	4553	485	6504	693	11.92	1.27	119.23	12.71	4.68	0.499	509.45	54.29	16.26	1.73	1.95	0.21	1.84	0.20	0.65	0.07	0.10	0.01	0.26	0.03
Institutional	0.000	80	0.770	1037.0	Res	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Roads	2.820	100	0.950	1279.4	Highway	3562	1263	3598	1276	7.20	2.55	48.58	17.23	0.61	0.218	287.86	102.08	7.20	2.55	0.90	0.32	1.25	0.44	0.30	0.11	0.04	0.01	0.09	0.03
Recreation	0.000	40	0.410	552.2	Com	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open Space (Parks)	0.185	20	0.230	309.8	Open	28	150	24	130	0.07	0.40	0.44	2.38	0.04	0.223	0.74	4.02	0.02	0.12	0.01	0.03	0.01	0.03	0.00	0.02	0.00	0.00	0.00	0.01
Total	12.389	91.2				8143	657	10126	817	19.19	1.55	168.25	13.58	5.34	0.431	798.05	64.42	23.48	1.90	2.86	0.23	3.10	0.25	0.95	0.08	0.13	0.01	0.35	0.03

APPENDIX C

Aquatic and Terrestrial Habitat Assessment (Jacques Whitford AXYS)

Jacques Whitford AXYS

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Stream and Terrestrial Habitat Assessment

CITY OF LANGLEY

Prepared for:
Urban Systems Ltd.
Richmond, BC

Prepared by:
Jacques Whitford Stantec AXYS Limited
Burnaby, BC

February 2009

PROJECT NO. 1044309

Jacques Whitford

An Environment of Exceptional Solutions

PROJECT NO.	**1044309**
REPORT TO:	**Urban Systems Ltd.** #2353 - 13353 Commerce Parkway Richmond, BC V6V 3A1 Attention: Nazmun Nahar
FOR:	**Stream and Terrestrial Habitat Assessment**
ON:	**The City of Langley**

February 16, 2009

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Table of Contents

1 Introduction

Jacques Whitford AXYS Ltd. (JWA) was retained by Urban Systems Ltd. to assess freshwater and terrestrial habitat and assist the City of Langley (the City) in developing an appropriate information base for an Integrated Stormwater Management Plan (ISMP). This study documents existing habitat values that should be protected and identifies general enhancement opportunities for the City and specific opportunities for five tributaries of the Nicomekl River (Pleasantdale, Langley, Muckle, Baldi and Brydon creeks). Metro Vancouver has developed a template for ISMPs, which many municipalities follow. Alternatively, with a more compact jurisdiction, and with all streams (and stormwater) draining into the Nikomekl River, the Metro Vancouver template can be modified to be specific to Langley.

The current status of aquatic and terrestrial habitat was assessed through a review of existing documents and a field survey, conducted on October 16 and 17, 2008. Results are presented below for freshwater habitat (Section 2) and terrestrial habitat (Section 3). Recommendations for an approach to stormwater management planning are made (Section 4) and existing habitat protection measures are discussed (Section 5).

1.1 General Overview of the City of Langley Streams

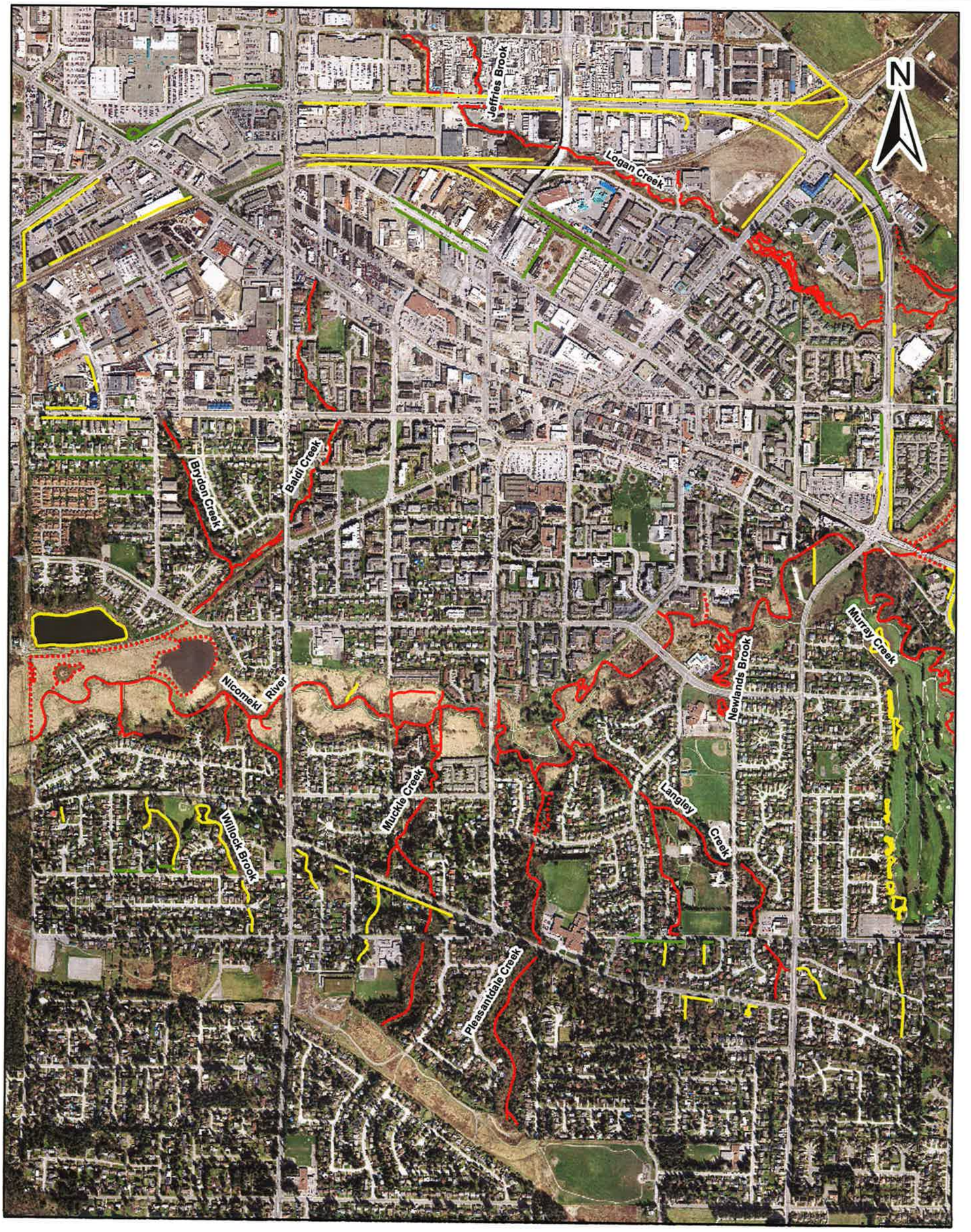
The City of Langley is located in the Fraser Valley, bordered the Township of Langley to the north, south and east and the City of Surrey to the west. The Nicomekl River, which flows through the Township and City of Langley and the City of Surrey, flows into Boundary Bay before entering the Strait of Georgia.

The City encompasses 10.2 square kilometres (City of Langley 2008), 32.4 ha (or 3.2 %) of which is dedicated park area (City of Langley 2008a). Figure 1 provides an overview of current City land cover and streams. The City's 16 parks include small parks (mostly flowers and grass), larger parks bordering the Nicomekl River (Portage Park) and a large off-leash dog park at the location of the former landfill. Most of these have landscaped, as opposed to natural, vegetation. The majority of the City is urban, with a mix of residential and commercial property. Pleasantdale Creek ravine and Muckle Creek ravine (from the BC Hydro right-of-way north to Grade Crescent) are the main naturally vegetated ravine areas in the City.

The Nicomekl River and its floodplain provide valuable habitat for fish and wildlife, hosting migratory and resident birds, and providing habitat for salmonids and other aquatic species. The riparian area also provides highly valued recreational opportunities, with associated economic benefits. The City developed an Environmentally Sensitive Areas map (adopted April 2006) that identifies ravines and watercourses, floodplain and wetland habitat, forested areas, trees and snags, BC Hydro right-of-way and stream classifications.

All 21 streams identified in the City and the Nicomekl River have been classified as either fish bearing or assumed to be fish bearing for most of their length. The five surveyed streams (Pleasantdale, Langley, Muckle, Baldi and Brydon creeks), and their tributaries, contain freshwater fish habitat through the majority of their lengths.

As is common in most municipalities, stormwater enters the creeks through municipal storm sewer infrastructure draining the roads and through small diameter PVC pipes draining buildings, residential lots and park or playground areas. Large diameter storm pipes commonly drain into the stream at bridges or within culverts spanning roadways, although these were difficult to observe in most areas due to access limitations, blackberry cover or water levels within the culverts. It is likely that the majority of the stormwater entering the watercourses in Langley is from the larger drainage pipes.



Legend

Watercourse Classification

- Class A
- Class A(O)
- Class B
- Class C

0 100 200 300 400 500 Meters

Notes:

Class A: Inhabited by salmonids year round, or potentially inhabited year round.

Class A(O): Inhabited by salmonids primarily during the overwintering period or potentially inhabited during the overwintering period with access enhancement

Class B: Significant food / nutrient value, no fish present

Class C: Insignificant food / nutrient value, no fish present

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CITY OF LANGLEY

OVERVIEW OF CITY OF LANGLEY AND WATERCOURSES

PROJECTION	DRAWN BY
UTM - ZONE 10	NP
DATUM	CHECKED BY
NAD 83	
DATE	FIGURE NO.
21-Nov-08	1

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2 Freshwater Habitat

This section describes fish habitat within the City and existing habitat values that should be protected.

2.1 Available Background Information and Data

Available information about fish presence and stream habitat within the City of Langley was reviewed prior to a field assessment October 16 & 17, 2008. Fish Wizard (2008), Fisheries Information Summary System (FISS 2008) and the City of Langley (aerial photographs) provided background information. The field survey was designed to assess conditions and types of aquatic habitat in areas of interest and did not include fish sampling, as the background data provided sufficient information about fish presence.

The 21 streams and Nicomekl River in the City of Langley, as identified by Fish Wizard, are listed in Table 2-1 and shown in Figures 1 and 2. The combined stream length of approximately 16.9 km includes:

- 5 km of Nicomekl River (Class A - inhabited by salmonids or potentially inhabited by salmonids year round)
- 9.4 km of Class A streams and tributaries
- 2.5 km of Class B streams (significant food and nutrient value, no fish present)

Table 2-1: Watercourses within the City of Langley Boundaries (Fish Wizard, 2008)

Watercourse Name (CODE)	Watershed Code	Fish Species[1]
Nicomekl River	900-004300	coho, chinook, chum, cutthroat trout, Dolly Varden, steelhead, threespine stickleback, more
Murray Creek	900-004300-66600	coho, chinook, chum, cutthroat trout, Dolly Varden, steelhead, threespine stickleback, more
Matheson Creek (*near Logan Creek*)	900-004300-70100	coho, cutthroat trout, steelhead, threespine stickleback
Logan Creek	900-004300-70100-65800	coho, cutthroat trout, steelhead, threespine stickleback
Jefferies Brook	900-004300-70100-41500	coho, cutthroat trout, steelhead, threespine stickleback
Baldi Creek	900-004300-55500	coho, cutthroat trout, steelhead
Brydon Creek	900-004300-55500-44300	coho, cutthroat trout, steelhead
Brydon Lagoon	900-004300-55500-13000	unknown
Willock Brook	900-004300-57900	coho
Muckle Creek	900-004300-60000	coho, cutthroat trout, steelhead
Pleasantdale Creek	900-004300-61500	no records available – likely at least coho, cutthroat trout, steelhead
Unnamed watercourse (Pleasantdale headwater trib.)	900-004300-61500-61500	unknown
Langley Creek	900-004300-61900	no records available – likely at least coho, cutthroat trout, steelhead
Newlands Brook	900-004300-64500	coho, cutthroat trout, steelhead

Watercourse Name (CODE)	Watershed Code	Fish Species[1]
Unnamed watercourse (*Newlands trib.*)	900-004300-64500-10400	unknown
Unnamed watercourse (between Newlands Brook & Langley Creek)	900-004300-63200	unknown, probably: coho, cutthroat trout, steelhead, threespine stickleback
MacDonald Brook	900-004300-55600	coho
Unnamed watercourse (*MacDonald tributary*)	900-004300-55600-52300	unknown
Unnamed watercourse (north side of Nicomekl near Murray Creek)	900-004300-67700	coho, cutthroat trout, steelhead, threespine stickleback
Fraser Creek (east edge of city)	900-004300-66700	coho, cutthroat trout, steelhead, threespine stickleback
Glover Creek (northeast edge of city)	900-004300-70400	unknown, probably coho, cutthroat trout, steelhead, threespine stickleback

Note: Grey shading indicates watercourses surveyed in 2007 or 2008 by JWA

Of the 16.9 km of watercourses in the City, including the Nicomekl, JWA conducted a field assessment on approximately 7.4 km (44% of the total length of watercourses in the City) in October 2008. Additional studies conducted by JWA within the City include a survey of Logan Creek and Jeffries Brook, for Urban Systems, in 2007. As a result, the majority of Class A streams have been surveyed and fish habitat quality documented. The information on Logan Creek and Jeffries Brook has been added to this report and can be found in the 2007 Letter of Advice Application to DFO for Logan Creek Drainage Improvement Works (JWA 2007).

2.1.1 Fish Species

The majority of watercourses within City boundaries are fish bearing or assumed to be fish bearing (FISS 2008, Fish Wizard 2008). More than 30 species of fish have been recorded in the Nicomekl River and its tributaries (Table 2-1). This includes three salmon species (coho, chum, and chinook), other salmonids (steelhead, rainbow trout, coastal cutthroat trout and westslope cutthroat trout), sculpins, catfish, forage fish (minnows, sticklebacks, chubs, redsided shiners), lamprey and others.

The only known fish species of conservation concern within City streams is the westslope cutthroat trout (*Oncorhynchus clarkii lewisi*), listed under the *Species at Risk Act* (SARA 2008) and known to occur in the Nicomekl River and its tributaries. Important habitat for this species is small streams with gravel bottoms and relatively gentle gradients (FishBase 2008).

Legend

Environmentally Sensitive Areas

- BC Hydro ROW
- Forested Area / Trees / Snags
- Floodplain & Wetland
- Ravine & Watercourse
- Culverts
- Potential Barrier
- Water Quality Sample Locations

Watercourse Classification

- Class A
- Class A(O)
- Class B
- Class C
- Parks
- City Boundary
- Surveyed Area

0 140 280 420 560 700 Meters

Notes:

Class A: Inhabited by salmonids year round, or potentially inhabited year round.

Class A(O): Inhabited by salmonids primarily during the overwintering period or potentially inhabited during the overwintering period with access enhancement

Class B: Significant food / nutrient value, no fish present

Class C: Insignificant food / nutrient value, no fish present

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CITY OF LANGLEY

FISHERIES FIELD ASSESSMENT FOR CITY OF LANGLEY STREAMS OCTOBER 2009

PROJECTION: UTM - ZONE 10	DRAWN BY: NP
DATUM: NAD 83	CHECKED BY:
DATE: 25-Nov-08	FIGURE NO.: 2

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2.2 Aquatic Habitat Characteristics

The Nicomekl River is the major watercourse within City boundaries. The headwaters are in the Township of Langley and the river continues westward for almost 36 km through the City of Langley and Surrey to Boundary Bay. All identified streams in the City are tributaries of the Nicomekl River, and are accessible to salmon and other fish. These creeks have the potential to contain suitable salmonid habitat, as no steep gradients or impassable culverts restricting fish movement are known to occur.

Five creeks within the City, and portions of the Nicomekl River, were surveyed October 16 and 17, 2008, during a period of extended precipitation. Pleasantdale, Muckle and Langley creeks, on the south bank of the Nicomekl River, and Baldi and Brydon creeks and Brydon Lagoon on the north bank were surveyed, along with City Park (adjacent to Langley Creek) and parts of the Nicomekl floodplain. The entire length of the five creeks was walked (a total of 7.4 km), except in areas of limited access, and assessed for fish habitat quality, *in situ* water quality and riparian area conditions.

Data collection methods generally followed the Resource Inventory Standards Committee methodologies described in *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures* (RIC 2001) and the *Forest Practices Code Guidebooks Fish-Stream Identification Guidebook* (MOF 1998), *Fish-Stream Crossing Guidebook* (MOF 2002) and *Riparian Management Area Guidebook* (MOF 1995). The assessment focussed on parks, ravines, flood plains, wetlands, areas bordered by residential and commercial development and areas of substantial vegetation.

Water quality was assessed at each site using a hand held multi-meter (YSI 85) to measure temperature, dissolved oxygen, pH, and conductivity. *In situ* water quality data surveyed are provided in Table 2-2. The values met applicable water quality guidelines. Dissolved oxygen levels were lowest in two locations (7.7 mg/L and 7.6 mg/L), but higher than the BC Ministry of Environment instantaneous minimum of 5 mg/L (MOE 2006). These measurements were taken from Brydon Creek and near Brydon Lagoon, where abundant instream vegetation was growing in shallow water.

Table 2-2: *In Situ* Water Quality in Langley Watercourses, October 16-17, 2008

Location	Location on Creek	Temperature (° C)	pH	Conductivity (µs)	Dissolved Oxygen (mg/L)
Baldi Creek	near Fraser Highway	13.4	6.5	175	9.4
Brydon Creek and Brydon Lagoon	at 55A Avenue	13.5	6.7	340	7.7
	at 53 Avenue	11.8	6.6	242	7.6
Pleasantdale Creek	Headwaters near BC Hydro RoW	10.8	6.5	260	8.0
	at Grade Crescent	9.8	7.4	290	10.5
Pleasantdale Creek Tributary	Headwaters near BC Hydro RoW	11.2	7.0	85	11.1
Muckle Creek	at 50 Avenue	9.3	7.3	261	11.4
Muckle Creek Tributary	at Grade Crescent	10.6	7.2	300	9.2
Langley Creek	at Grade Crescent	12.5	6.6	N/A	9.3
	at 48 Avenue	12.2	6.8	240	10.8
	at 205A Street	12.7	5.8	282	9.3
Langley Creek Tributary	4850 206 Street (creosote barrier)	12.4	6.7	N/A	11.3

The majority of stream areas surveyed contain habitat suitable for fish. Habitat for all freshwater life stages of salmonids was identified in each stream, although a given area surveyed would not necessarily contain all habitat types. A thorough assessment of all natural and park areas within the City may be necessary to determine if any watercourses contributing to the Nicomekl River provide critical fish habitat that may need attention. Additionally, an extended assessment of downstream reaches of the Nicomekl should be conducted to determine if the drainage inputs to the Nicomekl, within the City, are affecting downstream fish habitat or water quality. Many assessed areas are immediately adjacent to residential or commercial developments and others are adjacent to city parks or playgrounds.

2.2.1 Baldi Creek

Baldi Creek flows south into the Nicomekl River from headwaters near the Fraser Highway, just east of 200th Street, a distance of 2.2 km. It converges with Brydon Creek near 53rd Avenue, then flows into the Nicomekl River approximately 750 m downstream of the confluence. Baldi Creek is culverted under 57A Avenue, 56 Avenue, 55A Avenue, 200th Street and 53 Avenue, and is spanned by a few small bridges and driveways. The watercourse has permanent flows and obvious signs of flooding in some areas, likely due to runoff from surrounding impervious surfaces. The upper section of the stream has residential and commercial development on the banks that limit the amount of riparian vegetation. Baldi Creek is discussed separately for the upper section (Fraser Highway south to the 200th Street culvert) and lower section (200th Street to Nicomekl River).

2.2.1.1 Upper Section of Baldi Creek

The upper section of Baldi Creek, from the Fraser Highway to the 200th Street crossing, has dense residential and commercial development on both stream banks (Photos 1 and 2). There is riparian vegetation through most of the upper section, although limited or lacking in some areas (e.g., just north of 55A Avenue). Much of the riparian area has been disturbed by development and contains mainly the non-native, invasive Himalayan blackberry (*Rubus armeniacus*). Shrubs, grasses and small patches of mixed forest remain, but do not provide substantial amounts of overhead cover along this length of creek.

Temperature, pH, turbidity and dissolved oxygen levels in Baldi Creek near the Fraser Highway met water quality guidelines (MOE 2006) at the time of the survey (Table 2-2). In addition to large stormwater pipes from the road, numerous small (<200 mm diameter) PVC pipes along the banks contribute runoff to Baldi Creek. The pipes are near buildings or park areas.

In general, upper Baldi Creek is a meandering, low gradient stream with shallow banks, culverts, flood areas and minor erosion issues (likely caused during storm events). Salmonid habitat quality was ranked poor for spawning, moderate to good for rearing, moderate for overwintering and poor to moderate for migration (Table 2-3). Overall, there is instream habitat for all fish species; while excellent habitat for salmonids was not identified, Baldi Creek does provide habitat that would support forage fish and rearing for some salmonids. It is likely the entire watercourse is fish bearing, given the lack of permanent barriers.

Table 2-3: Fish Habitat in Upper Baldi Creek, October 2008 Survey

Habitat Type	Description
General Habitat	▪ channel width 1.5 to 3 m ▪ bank height 0.5 m to 1.5 m (top-of-bank height > 4 m in some areas) ▪ low gradient, shallow banks ▪ flood areas and minor erosion issues (likely caused during storm events) ▪ constrained because of development, but unconstrained within the bank-to-bank area
Spawning	▪ poor (mostly fines, as well as areas of debris, several culverts)
Rearing	▪ moderate to good (pool areas, moderate cover, minimal instream complexing)
Overwintering	▪ moderate (pool areas)
Migration	▪ poor to moderate (no physical barriers present, but several culverts may restrict movement of some species, some instream debris) ▪ three culverts greater than 20 m long (under 57A Avenue, 56 Avenue and 55A Avenue)

Examples of modified channel were noted: rock filled gabion baskets on banks on the north side of 57A Avenue (Photo 3) and a concrete channel and banks on the north side of 55A Avenue (Photo 4). There is minimal riparian habitat for 100 m upstream of 55A Avenue, as the creek flows between two apartment buildings.

Habitat restoration opportunities in upper Baldi Creek may be limited by current residential and commercial development. Potential restoration options include:

- removing garbage and debris
- adding natural woody debris
- adding spawning gravel
- replacing corrugated steel pipe culverts (CSP) with open-bottom arch culverts
- restoring and stabilizing banks to a natural state.

Restoring and stabilizing banks would be a major undertaking and would include removal of concrete from banks and streambed, creation of riffles, terracing of banks, planting of shrubs and daylighting portions of the stream. The area immediately north of 55A Avenue would require the most effort to restore.

2.2.1.2 Lower Section of Baldi Creek

Lower Baldi Creek, from 200th Street to the Nicomekl River, flows through residential developments on both banks. Riparian habitat is predominantly Himalayan blackberry, with a mix of tree species on the upper edges of the banks. The creek adjacent to the gravel pedestrian pathway, between 200th Street and 53rd Avenue, appears to be a low-lying flood area (Photo 5), with shrubs, grasses and mixed forest on the top of bank, but no substantial overhead cover. Sections of lower Baldi Creek had water which had grey discolouration, but no noticeable odour; likely a result of stormwater runoff.

Overall, there is instream habitat for all fish species. While no areas of excellent habitat for salmonid species were identified, habitat that would support forage fish and rearing for some salmonid species was noted. It is likely that the entire watercourse is fish bearing, given the lack of permanent barriers. Fish habitat quality in lower Baldi Creek was ranked as poor for spawning, moderate to good for rearing, moderate for overwintering and poor to moderate for migration, as described in Table 2-4.

Table 2-4: Fish Habitat in Lower Baldi Creek, October 2008 Survey

Habitat Type	Description
General Habitat	▪ channel width 2 to 3 m ▪ bank height 0.5 m to 1.0 m (top of bank maximum 2.5 m) ▪ low gradient, shallow banks, sections with riffle-pool habitat ▪ constrained because of development, but unconstrained within the bank-to-bank area
Spawning	▪ poor (mostly fines, as well as areas of debris, shallow areas with instream vegetation)
Rearing	▪ moderate to good (pool areas, moderate cover)
Overwintering	▪ moderate (pool areas)
Migration	▪ poor to moderate (no physical or gradient barriers present, but several culverts may restrict movement of some species)

Habitat restoration opportunities in lower Baldi Creek may be limited by the current amount of residential development, and limited riparian areas. Potential restoration options include:

- removing garbage and debris
- addition of natural woody debris
- improving instream habitat in areas, including adding spawning gravel
- removing blackberry from the riparian area and replanting with native plant species.

2.2.2 Brydon Creek

Brydon Creek begins near 55A Avenue and 198th Street and flows into Baldi Creek near 198A Street (northeast of the intersection of 198A Street and 53A Avenue). Brydon Creek appears to have year-round flows, although the channel is less defined in the upper sections. There is instream vegetation in lower portions of the creek. Riparian habitat is limited by residential development through the length of the creek. The riparian vegetation consists of blackberry and grasses in low lying areas close to the creek, and trees providing high overhead cover further up the banks (Photo 6).

Temperature, pH, turbidity and dissolved oxygen levels in Brydon Creek met water quality guidelines (MOE 2006) at the time of survey (Table 2-2), although dissolved oxygen levels were lower than in other streams surveyed. No odours or signs of discolouration were present in any of the assessed sections.

Brydon Creek is a low gradient stream, 0.8 km in length, with riffle-pool habitat. Fish habitat quality was ranked as poor to moderate for spawning, and moderate for rearing, overwintering and migration, as described in Table 2-5. The 55A Avenue road crossing appears to have been recently upgraded or altered and may be a barrier to fish passage, as the culverts appear to be undersized, perched and may be partially blocked (Photo 7).

Table 2-5: Fish Habitat in Brydon Creek, October 2008 Survey

Habitat Type	Description
General Habitat	▪ channel width 1 to 2.5 m ▪ bank height 0.2 m to 1.0 m (top of bank maximum 2.5 m) ▪ low gradient, flood areas, shallow vegetated banks, riffle-pool habitat ▪ constrained because of development, but unconstrained within the bank-to-bank area
Spawning	▪ poor to moderate (small stream, shallow areas, some gravels, low flows, instream vegetation)

Habitat Type	Description
Rearing	▪ moderate (some gravels, shallow, some pools, moderate overhead cover)
Overwintering	▪ moderate (pool areas)
Migration	▪ moderate (culverts, no physical or gradient barriers present, connectivity to downstream sections), potential barrier at 55A Avenue culvert (undersized, perched, maybe partially blocked)

Habitat restoration opportunities in Brydon Creek are limited by the current amount of residential and commercial development. Potential restoration options include:

- improving the culvert under 55A Avenue
- removing instream debris
- adding spawning gravel.

2.2.3 Brydon Lagoon

Brydon Lagoon is a shallow water body, approximately 25,000 m^2 in area, on the north edge of a large wetland complex near 53 Avenue and 198A Street. The lagoon appears to connect to Baldi Creek before it enters the Nicomekl River; however, no above ground connection was observed. The Nicomekl River runs through the middle of the wetland area and Brydon Creek/Baldi Creek enter the wetland on the north side of the complex, south of Brydon lagoon (Photo 8).

Waterfowl and other birds use Bryon Lagoon, and fish habitat may be present. The riparian area is mostly grasses and shrubs, including invasive plant species such as blackberry. There is a trail around the lagoon, connecting with a path that continues along the Nicomekl River.

A potential restoration option for Brydon Lagoon would be improvement of connectivity of the lagoon to the nearby Nicomekl River, to provide fish habitat. Depending on oxygen and sediment levels, initial mixing of Bryon Lagoon water might have a localized and short-term negative effect on water quality of the Nicomekl River.

2.2.4 Muckle Creek

Muckle Creek flows northward through residential areas into the Nicomekl River, a distance of 1.0 km. It is a permanent stream with low gradient, gravel and cobble substrate, scour, and small amounts of vascular plant growth within the channel in some areas (Photo 9). The headwaters are at the BC Hydro right-of-way, and Muckle Creek flows into a ravine with dense riparian vegetation on both banks. There are large culvert crossings at Grade Crescent and 50 Avenue, both of which are passable to fish, and numerous culverts, small bridges and constructed channel diversions. Riparian habitat becomes limited near the confluence with the Nicomekl River. The main channel and one tributary were surveyed.

Temperature, pH, turbidity and dissolved oxygen levels in Muckle Creek (Table 2-2) met water quality guidelines (MOE 2006) at the time of the survey. No odours or signs of discolouration were present in any of the assessed sections. Several drainage pipes (generally < 200 mm diameter PVC pipes) protruding from the stream bank near buildings or park areas, along with the stormwater infrastructure, contributed runoff to Muckle Creek.

Fish habitat quality in Muckle Creek was ranked as moderate for spawning, overwintering and migration and moderate to good for rearing, as described in Table 2-6. Fish habitat is likely present throughout the

creek, given the lack of barriers. The banks are mostly vegetated, although one location on private property had minimal to no riparian habitat.

Table 2-6: Fish Habitat in Muckle Creek, October 2008 Survey

Habitat Type	Description
General Habitat	▪ channel width 2 to 3 m ▪ bank height 0.1 m to 1.0 m (top of bank height at least 10 m in ravine area) ▪ low gradient, flood areas, riffle-pool habitat ▪ constrained because of development, but unconstrained within the bank-to-bank area
Spawning	▪ moderate (sections with good gravel substrate, shallow, instream vegetation)
Rearing	▪ moderate to good (some pools, overhead cover, some undercut banks, areas of low flow)
Overwintering	▪ moderate (some pool areas, mostly shallow pools, overhead cover)
Migration	▪ moderate (no physical or gradient barriers present, few culverts, direct connection to Nicomekl)

Habitat restoration opportunities for Muckle Creek are limited by the current amount of residential and commercial development. Potential restoration options include:

- improving riparian habitat on Muckle Creek and its tributary and removal of invasive plants
- creating instream riffle-pool complexing
- adding woody debris
- enlarging culverts
- reducing the number of culverts on the tributary to Muckle Creek
- restoring the creek and riparian area above 48 Avenue, adjacent to Simonds Elementary School
- removing instream debris

2.2.5 Pleasantdale Creek

Pleasantdale Creek flows through residential areas before reaching the Nicomekl River. It flows north from its headwaters just below the BC Hydro right-of-way to the Nicomekl River (Photo 10), a distance of 1.9 km. The headwaters are within a vegetated ravine and adjacent to another small tributary which starts to the east and connects with Pleasantdale Creek less than 50 m downstream. The tributary appears to be fed by runoff from the adjacent ravine bank. Houses line the top of bank on each side of the ravine.

The former Langley landfill is located in the headwater area, near 206th Street and 44th Avenue on the edge of the BC Hydro RoW. The City Dog Park is now located at this site, the western edge of which is approximately 100 m from the headwaters of Pleasantdale Creek. It is possible that the rust coloured flocculent observed at the culvert in the headwaters of Pleasantdale Creek (Photo 11) is related to historic landfill activities, as water was leaching from around the older concrete headwall of the culvert into the creek. However, temperature, pH and dissolved oxygen levels in Pleasantdale Creek (Table 2-2) met applicable water quality guidelines (MOE 2006) at the time of the survey.

In addition to municipal stormwater infrastructure and property drainage pipes, two pipes contributed runoff to Pleasantdale Creek adjacent to the downstream end of the Grade Crescent culvert (Photo 12).

Pleasantdale Creek is primarily a shallow, low gradient riffle-pool stream, with man-made paths alongside and crossing it in many areas (Photo 13). Upper reaches have small sections with increased gradients,

but not likely enough to inhibit fish passage. Fish habitat quality in Pleasantdale Creek was ranked as poor to moderate for spawning, good for rearing, moderate to good for overwintering and moderate for migration, as described in Table 2.7. While the entire creek is considered fish-bearing, no critical habitat was documented. Riparian habitat through the creek still contains diverse vegetation.

Table 2-7: Fish Habitat in Pleasantdale Creek, October 2008 Survey

Habitat Type	Description
General Habitat	▪ channel width 2 to 3 m ▪ bank height 0.2 m to 0.8 m (top of bank height at least 10 m in ravine area) ▪ low gradient, low banks, flood areas near Nicomekl River, riffle-pool habitat
Spawning	▪ poor to moderate (some gravels, shallow areas, areas of low flows)
Rearing	▪ good (pool areas, good overhead cover, undercut banks)
Overwintering	▪ moderate to good (some pool areas, connectivity with Nicomekl, cover)
Migration	▪ moderate (no physical barriers present, but several culverts, including under Grade Crescent, may restrict movement of some species)

Pleasantdale Creek passes through culverts at Grade Crescent and 49A Avenue, and has several bridges spanning the lower 500 m of the stream. The Grade Crescent culvert is 30 m long, with a steeper gradient than the rest of the creek. The lower sections show areas of erosion, bank modification and generally less riparian habitat than upstream. Upstream of the 49A Avenue culvert, approximately 100 m of bank has been modified and flows redirected by property owners, who have installed wooden timbers along the banks (Photo 14). A side channel, possibly the creek's natural path, joins the main channel just before flowing through the culvert under 49A Avenue.

Restoration or improvement options within Pleasantdale Creek are limited by the current amount of development throughout the creek. Potential restoration options include bank restoration in lower Pleasantdale Creek:

- removing timbers on creek banks
- enlarging culverts
- moving existing pathways away from the creek
- adding spawning gravel
- adding riparian planting.

2.2.6 Langley Creek

Langley Creek flows north through residential areas into the Nicomekl River a distance of 1.1 km, from headwaters on the west side of 208 Street near Grade Crescent. The creek is a low gradient, riffle-pool stream with riparian vegetation. There are two headwater tributaries and the mainstem. Langley Creek passes through four road culverts (208 Street, 48 Avenue, 55A Avenue, 205A Street) and three smaller culverts, while the tributaries pass through a total of two culverts. All culverts have low gradients and do not appear to present a barrier to fish passage.

Temperature, pH and dissolved oxygen levels (Table 2-2) in Langley Creek met applicable water quality guidelines (MOE 2006) at the time of the survey.

Fish habitat quality in Langley Creek was ranked as poor to moderate for spawning, moderate to good for rearing, moderate for overwintering and poor for migration (Table 2-8). There is minimal riparian vegetation in the upper section (mainly grasses with some mixed forest). Between 207 Street and 205A

Street there are several bridge crossings, obvious signs of flooding and erosion, and dense vegetation along most of the banks. Riparian vegetation consists mainly of grasses and Himalayan blackberry established after disturbance from development of residential or park areas, with some remaining shrubs and small patches of mixed forest that do not provide substantial overhead cover. Instream vegetation may limit fish movement, but provides good rearing habitat in this section.

Table 2-8: Fish Habitat in Langley Creek, October 2008 Survey

Habitat Type	Description
General Habitat	▪ channel width 1.5 to 3 m ▪ bank height 0.1 m to 1.0 m (top of bank ranges from 1 to 3 m) ▪ low gradient, low banks, flood areas, riffle-pool habitat, some instream vegetation ▪ constrained because of development, but unconstrained within the bank-to-bank area
Spawning	▪ poor to moderate (areas of abundant instream vegetation, few gravels, shallow areas, several culverts in lower section of creek)
Rearing	▪ moderate to good (pool areas, good cover, instream vegetation and cover)
Overwintering	▪ moderate (some pool areas)
Migration	▪ poor (physical barriers present in tributary, several culverts may restrict movement of some species, instream debris and vegetation)

One headwater tributary joins Langley Creek approximately 20 m downstream of the 208 Street culvert crossing. Immediately downstream of Grade Crescent, property owners have confined the channel with bricks lining the banks (Photo 15).

A second tributary joins Langley Creek just upstream of the 205A Street culvert crossing and runs at the back of residences on 206 Street and 205A Street (Photo 16). This is a small, partially vegetated stream, generally 1 to 1.5 m wide, with banks 0.1 to 0.5 m high, and top-of-bank height more than 2 m. There is riffle-pool habitat, some areas of debris blockage, and various overland and drainage pipe inputs, including an overland side channel from the adjacent playing field. The side channel has evidence of scour, but no gravel or other bed materials; a cascade 1.5 m high and shallow water levels would prevent fish access to this channel. There is a major barrier on the tributary at 4850 206 Street (Photo 17), a creosote timber structure with the creek buried in an approximately 20 m long culvert. This structure redirects the stream and constrains it within constructed banks. The property owner indicated the structure had been in place for an unknown period of time, potentially years. They are new owners and have inquired of the City how to go about removing the structure.

Habitat restoration opportunities in Langley Creek may be limited by the current amount of residential development, as described for the other creeks in Langley. Potential restoration opportunities include:

- improving riparian habitat just upstream of the Nicomekl River, where there is limited vegetation (mostly grasses), a multi-use paved pathway adjacent to the creek, and several culverts along the path (Photo 18)
- removing the instream modifications on the tributary at 4850 206 Street (removing the creosote timber structure and culvert and increasing habitat complexity); this would be a major undertaking and would likely involve loss of some property to the current home owner
- adding spawning gravel.

2.2.7 Logan Creek and Jefferies Brook

Logan Creek is approximately 4 km long. It originates in the Township of Langley and flows southwest through the City from north of 64th Avenue to southeast Glover Road before joining the Nicomekl River. The watershed contains mainly residential developments in the upper reaches and commercial developments in the lower reaches. There are numerous road crossings, including a large box culvert under 201st Street and large diameter (>1,500 mm) corrugated steel pipes along and under the Langley Bypass, other sections, the SRBC railway, 206 Street and 206A Street. The lower area is low gradient floodplain and storm events cause flooding some of these areas. In situ water quality data are not available.

Most of Logan Creek is fish bearing, as reported in FISS (2008) and Fish Wizard (2008). There are no permanent fish barriers within Logan Creek that would limit the passage of fish between the Nicomekl River, Glover Road and 62nd Avenue. Although fish habitat quality in Logan Creek was not assessed in 2008, based on available information the habitat would most likely be ranked as moderate for spawning, moderate to good for rearing, moderate for overwintering and moderate for migration (Table 2-9). There are large, passable culverts in lower Logan Creek, with adequate base flows. Riparian vegetation in the upper section (mainly grasses with some mixed forest) provides areas of moderate overhead cover and shade. Between 204th Street and 206A Street there are obvious signs of flooding and dense vegetation along most of the banks. Riparian vegetation consists mainly of grasses and Himalayan blackberry established after disturbance from development of residential or park areas, with some remaining shrubs and small patches of mixed forest that do not provide substantial overhead cover. Undercut banks and some instream vegetation provide the majority of cover in the lower creek. Instream vegetation may limit fish movement in some areas, but provides good rearing habitat in this section.

Table 2-9: Fish Habitat in Logan Creek, 2007 Survey

Habitat Type	Description
General Habitat	▪ channel width 1.8 to 3 m ▪ bank height 0.5 m to 2.0 m (top of bank ranges from 1 m to 3 m) ▪ low gradient, flood areas, riffle-pool habitat, evidence of beaver dams, some instream vegetation ▪ constrained because of development, but unconstrained within the bank-to-bank area
Spawning	▪ moderate (areas of abundant instream vegetation, some gravels, shallow areas, several culverts in lower creek)
Rearing	▪ moderate to good (pool areas, good cover, instream vegetation and cover)
Overwintering	▪ moderate (some pool areas)
Migration	▪ moderate (several culverts may restrict movement of some species, instream debris and vegetation)

Jefferies Brook joins Logan Creek at the Langley Bypass, and has been restored in upstream areas to flow around commercial and residential structures and through multiple culverts. The creek likely contains fish habitat for forage species, and some salmonids, but less than that available in Logan Creek.

Restoration activities within Logan Creek are being completed in association with drainage improvement works. The City, along with Urban Systems, has been upgrading sections of Logan Creek to convey increased flows since 2007. The drainage improvement works have improved fish passage and habitat by using arched culverts with gravel and cobble substrates.

Habitat restoration opportunities in Logan Creek may be limited by the current amount of commercial development, as described for other City creeks. Potential restoration opportunities include:

- improving riparian habitat near the Langley Bypass and downstream to Glover Road, where there is limited vegetation (mostly grasses)
- Continuing to improve habitat and fish passage within Logan Creek as part of continuing drainage improvements (ideally, removing non-essential culverts where possible, and creating habitat in areas where improvement works are being conducted).

2.2.8 Nicomekl River

The Nicomekl River runs east-west through the City in a wetland/floodplain area. The Nicomekl River has a total length of approximately 36 km and is a fourth order stream. All watercourses in the City of Langley drain into the Nicomekl River. The riparian area between 208 Street and Brydon Lagoon is mainly grasses, shrubs, mixed trees and landscaped areas (Photo 19). Urban pathways criss-cross the riparian area and a number of bridges cross the river. The area provides good habitat for numerous bird and mammal species. Homeless people are currently using the bushes and densely vegetated areas for sleeping. Removing some of the dense shrub vegetation may increase safety, at a loss to riparian habitat.

Substrate composition within the Nicomekl was not observed due to water colour and depth; however, the river is known to have a large amount of mud and sediment in lower sections. The Nicomekl does contain a number of fish species (including coho salmon and steelhead trout) and fish habitat within the Nicomekl River is likely good to excellent for all categories, except for salmonid spawning.

2.3 General Observations on Erosion and Stormwater Runoff

Runoff from roads and other paved areas enters the creeks through municipal stormwater infrastructure. Runoff from parks, sports fields and residential properties also enters creeks and ravines in numerous areas through small drainage pipes. Banks in the upper reaches of Pleasantdale Creek have steep slopes, making control of runoff from adjacent properties difficult and unpredictable. All streams examined have areas of minor to moderate erosion created through a combination of reduced riparian vegetation and increased runoff from of impervious surfaces. No evidence of major bank failures was observed, as most stream banks were low and vegetated, although bank erosion on the edge of properties was evident in several areas.

The orange flocculent at the headwaters to Pleasantdale Creek may be iron-laden runoff associated with the former landfill which was located approximately 100 m east of the creek. The former landfill is now an off-leash dog part and is located within the current BC Hydro RoW. *In situ* water quality in the area of the flocculent was similar to downstream areas and to other City Creeks (Table 2-1) and there was no obvious odour associated with the runoff. The City tests water quality at two locations in the system regularly.

Historic and ongoing development has resulted in additional loads of sediment to the streams of Langley as for other municipalities, as direct runoff in stormwater from roads and construction sites and as surface runoff from less vegetated riparian areas. Most of the City streams assessed have reduced riparian area and vegetation, associated with residential or commercial development. The addition of sediment to the creeks reduces habitat complexity and quality of salmon spawning habitat.

The Nicomekl River transports large amount of sediment downstream to Boundary Bay. Continued erosion in areas of Langley is likely to increase the sediment transportation load, leading to decreases water quality for aquatic life and area residents.

An Integrated Stormwater Management Plan and protection of riparian areas will help address erosion and sedimentation issues during development and protect salmonid habitat in the City.

3 Terrestrial Habitat and Wildlife

This section describes terrestrial habitat and wildlife within the City and identifies habitat values that should be protected, including habitat for species of conservation concern (species listed under the federal Species at Risk Act, red or blue listed species).

3.1 Available Background Information and Data

There are limited data and literature concerning wildlife and terrestrial habitat conditions within the City of Langley. Professional knowledge of the natural landscape in the Lower Mainland, a review of information available from the BC Conservation Data Centre, and the City of Langley (policies, aerial photographs) provide the basis for this section. Information about water and park features obtained in the fish habitat field survey was also incorporated.

3.2 Terrestrial Habitat

The City of Langley is located within the Coastal Western Hemlock Zone (CWH biogeoclimatic zone), which spans the coastal region of British Columbia between Washington and Alaska and continues inland through the Coast Mountains through major river valleys. The CWH zone occurs primarily in very wet regions from sea level up to 1000 metres elevation, with moisture levels varying with proximity to the coast (Egan 1999). Typical undisturbed forests within the CWH zone primarily contain western hemlock (*Tsuga heterophylla)*, often coexisting with pacific silver fir (*Abies amabilis*), western red cedar (*Thuja plicata*) and Douglas fir (*Pseudotsuga menziesii var. Menziesii*). The understory is dominated by salal (*Gaultheria shallon*) and various species of huckleberry (*Vaccinium*).

Urban and rural developments have altered the natural forest and wetland habitat. The City of Langley contains a combination of residential, urban, and commercial areas. Several municipal parks, shown in Figures 1 and 2, primarily provide active space uses, with little natural vegetation. The Nicomekl Floodplain Park lies between 196th and 208th Streets adjacent to 53rd Avenue, consists mainly of wetland habitat around the river and contains nature paths linking to Portage, Hi-Knoll and Langley City parks. Riparian areas, including ravines, provide some areas of relatively undisturbed vegetation.

The Environmentally Strategic Areas map, prepared for the 2005 Official Community Plan (Schedule D) describes floodplain and wetland areas, watercourses and ravines, forested areas, trees and snags, and the BC Hydro ROW as areas to be considered and protected during development.

Several invasive animal and plant species occur in the City (Langley Environmental Partners 2008). Animal species include the American bullfrog (*Rana catesbeiana*), eastern cottontail (*Sylvilagus floridanus*), eastern grey squirrel (*Sciurus carolinensis*), European starling (*Sturnus vulgaris*) and European house sparrow (*Passer domesticus*). Plant species include English ivy (*Hedera* spp.), Japanese knotweed (*Polygonum cuspidatum*), scotch broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*), purple loosestrife (*Lythrum salicaria*), English holly (*Ilex aquifolium*) and deadnettle, also known as yellow archangel (*Lamiastrum* or *Lamium*). Growth of invasive plant species has increased greatly in recent years, particularly in disturbed areas, and is recognized as a significant management issue for many municipalities in Metro Vancouver. As noted for individual streams surveyed for this report, invasive plants are abundant in riparian areas. Invasive species can pose a threat to indigenous species by eliminating native populations or altering the functional role of the ecosystem.

3.3 Wildlife

Wildlife species within the City are likely to include small mammals (e.g., mice, voles, shrews), skunks, racoons, opossums, coyotes and a wide range of birds. Amphibians such as tree frog, red-legged frog, western toad, long-toed salamander, northwestern salamander, western red-backed salamander, rough-skinned newt and reptiles such as garter snake, western painted turtle and northern alligator lizard, are also likely to inhabit some natural areas in the City. Anticipated use of existing natural habitat includes nesting by songbirds and hunting, foraging, shelter and migratory stopovers by other animals. Typical bird species likely to be found in the City include Black-capped Chickadee, Northwestern Crow, American Robin, Spotted Towhee, Dark-eyed Junco and Song Sparrow. Raptorial species such as Red-tailed Hawk, Bald Eagle and Northern Harrier are also likely to be present.

Areas of natural habitat are small and fragmented, limiting the ability to support mammals with large home ranges while supporting tolerant species such as raccoon and coyote. Existing patches provide habitat for smaller mammals such as voles, shrews, rodents and songbirds, although small patch size leads to a high proportion of edge habitat, typically inhabited by nest predators (e.g., crows and jays) or opportunists (e.g., starlings), further limiting suitability of the area for native, more desirable songbirds.

Wildlife corridors provide important linkages for animals to migrate between natural areas. Corridor use depends on the extent of connectivity to natural areas, corridor width and level of human disturbance and urbanization in or adjacent to the area. Given the extent of urbanization in the City and the isolation of most of the parks, there are limited wildlife linkages connecting undeveloped areas. However, the Nicomekl River Floodplain provides important natural habitat for species using the area for hunting, foraging, shelter, and migratory stopovers.

Mud Bay to the west of the City is linked to the Nicomekl River and is close to the Serpentine Fen Nature Reserve and Wildlife Area. Mud Bay and the Serpentine Fen are known to support high numbers of waterfowl, geese and other migrating avian species, including species of conservation concern (Great Blue Herons and Double Crested Cormorants). Due to its close proximity to such an important ecosystem for birds, City parks and the Nicomekl River floodplain provide valuable upland habitat for species using the area for foraging, resting or shelter during migration.

3.4 Species of Conservation Concern

Some plant and animal species, or their habitat, are of conservation concern, and are listed by the BC Conservation Data Centre (BCCDC) as either blue-listed (ecological communities, and indigenous species and subspecies of special concern), or red-listed (ecological communities, and indigenous species and subspecies that are extirpated, endangered or threatened). The federal *Species at Risk Act* also has requirements for protection of certain species. Protection of these species, or their habitat, will be necessary during any type of land development.

3.4.1 Regulatory Requirements and Guidance

The Province of British Columbia will change the British Columbia *Wildlife Act* in the future to include greater protection to species at risk. The *Wildlife Amendment Act*, 2004 received third reading and Royal Assent in May 2004 and changes will be brought into force through regulation. Changes that may affect land development include prohibitions respecting species at risk and specific legislation stating that no compensation is to be paid for reduced land values or damages/losses resulting from the new legislation. Upcoming changes encompassed in the *Wildlife Amendment Act* that may affect potentially developable lands are:

"6.1 (1) *A person must not do any of the following:*

a) kill, harm, harass, capture or take a species individual of a species at risk, except as authorized by regulation or by a permit or agreement under this section;

(b) damage or destroy a species residence of a species at risk, except as authorized by regulation or by a permit or agreement under this section;"

Under the amendments, "*species residence*" is defined as:

"a place or area in, or a natural feature of, the habitat of the species at risk, or a class of such a place, area or natural feature that is habitually occupied or used as a dwelling place by one or more species individuals of the species at risk".

In effect, lands occupied by rare, threatened or endangered species on a regular basis will be protected from development under these provisions.

To track the status of species at risk, the BCCDC maintains a database of rare vertebrates for each Forest District in British Columbia. Species or populations at high risk of extinction or extirpation are placed on the red list, and are candidates for formal Endangered Species status. Species or subspecies considered to be of Special Concern are placed on the blue list. The yellow list includes all remaining wildlife species. Yellow-listed species are not considered "at risk." However, the BCCDC maintains a "watch list" of Yellow-listed taxa that have a small range or low abundance in the province, have shown provincial declines, or are susceptible to perceived long-term threats.

COSEWIC is the federal equivalent of the BCCDC. This committee of experts assesses and designates wild species in some danger of disappearing from Canada. COSEWIC ratings for species are defined as:

- **Extinct:** a species that no longer exists
- **Extirpated:** a species that no longer exists in the wild in Canada, but occurs elsewhere (for example, in captivity or in the wild in the United States)
- **Endangered:** a species facing imminent extirpation or extinction
- **Threatened:** a species likely to become endangered if limiting factors are not reversed
- **Special Concern:** a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events
- **Not at Risk:** a species that has been evaluated and found to be not at risk
- **Data Deficient:** a species for which there is insufficient scientific information to support status designation.

A COSEWIC designation of Extirpated, Endangered, Threatened or Special Concern makes a species potentially eligible for listing on Schedule 1 of the *Species at Risk Act* (*SARA*). The *SARA* provides special protection for Extirpated, Endangered and Threatened species and their critical habitats, and mandates the development of management plans for species of Special Concern. When *SARA* received royal assent in December 2002, Schedule 1 contained 233 plant and animal species. Currently, the SARA Registry lists 564 species as Extirpated, Endangered, Threatened or of Special Concern in Canada.

3.4.2 Species of Conservation Concern in the City of Langley

The BCCDC (2008) has records for blue-listed or red-listed species for four animals and two plants within approximately 10 km of the City of Langley. The most recent record was 2003:

- 1985 to 1989 reports of one to two American Bitterns (*Botaurus lentiginosus*) at the east end of Serpentine Fen

- 2003 record of four adult red-legged (*Rana aurora*) frogs east of the Nicomekl River in various locations
- 1961 and 1996 records of one and two Pacific water shrews *(Sorex bendirii*) observed hunting at Trinity/Cattail pond on the Trinity Western Campus
- 1992 and 2001 reports of Trowbridge's shrews (*Sorex trowbridgii*) caught in pitfall traps along Salmon River, Anderson and Latimer Creeks (15 in 1992 and 8 in 2001)
- 1986 to 1990 records of a few small plants of false-pimpernel (*Lindernia dubia* var. *Anagallidea*) in an old gravel pit 400 m south of Latimer Pond
- 1975 report of one specimen of California tea (*Rupertia physodes*) growing secondarily from a Douglas fir on 176th Street and 32nd Avenue.

Local records for endangered species were also reviewed (Langley Environmental Partners 2008a).

Based on species distribution maps and known habitat requirements, there is habitat suitable or potentially suitable in the City for ten species of conservation concern (provincially or federally-listed wildlife and plant species). Table 3-1 summarizes these species, their preferred habitat, potential habitat sites, and likeliness to occur in the City of Langley.

Potential habitat for species of conservation concern was identified based on the amount of relatively undisturbed native vegetation in a park or riparian area. On this basis, only the Nicomekl River floodplain and riparian areas of Muckle and Pleasantdale creeks were considered likely to provide such habitat, as riparian areas of the other City creeks are more heavily affected by residential development.

Table 3-1: Potential Wildlife Species of Conservation Concern in the City of Langley

Species	Preferred Habitat	Potential Habitat in the City of Langley	Potential to Occur in City of Langley
BIRDS			
American Bittern (*Botaurus lentiginosus)* Blue-listed (BC CDC 2005)	Nests throughout most of BC's interior, in freshwater or brackish wetlands with tall vegetation. Feeds along shores on mammals, fish, crustaceans, insects, amphibians. Overwinters on the coast.	Floodplain regions of Nicomekl River for feeding or migration	Medium
Band-tailed Pigeon (*Columba fasciata*) Blue-listed (BC CDC 2006)	In coastal BC, from southern Vancouver Island and Lower Mainland to Queen Charlotte Islands from sea level to 1,830 m elevation. Frequents a range of habitats, including railway yards, farmland, coniferous and deciduous forests, residential, mineral springs and intertidal flats and golf courses.	May occur throughout the City and within any City parks. Also at the east end, towards the Newlands Gold and Country Club	Medium
Western Screech Owl (*Megascops kennicottii kennicottii*) Special Concern (SARA, Sched. 1, 2001) Blue-listed (BC CDC 2006)	Occurs along BC coast, including Vancouver Island (not Queen Charlotte Islands). Found at lower elevations generally in wooded habitat, often in riparian zones. Also found in treed urban and suburban environments and at the edge of forested habitats close to open wetlands or fields.	Most likely to occur close to riparian areas of Pleasantdale and Muckle creeks	Medium to Low
REPTILES AND AMPHIBIANS			
Oregon Spotted Frog (*Rana pretiosa)* Endangered (SARA, Sched. 1, 2000) Red-listed (BC CDC 2007)	BC populations exist only in Fraser Valley, found in floodplain wetlands near permanent bodies of water. Known populations include Campbell Valley Regional Park and Aldergrove. Breed in early spring; females lay egg masses in warm, shallow waters along marsh edges.	Potential habitat along the Nicomekl Floodplain	Low
Red-legged Frog (*Rana aurora*) Special Concern (SARA, Sched. 1, 2004) Blue-listed (BC CDC 2006)	Occurs in southwest BC, in moist forests and treed wetlands. Adults can occur away from water in damp weather or if logs or other debris are available for shelter. Breeds in ponds or slow moving streams during late winter or early spring; females lay eggs in large jelly-like masses attached to stems just below the water surface. In winter, build small burrows for aestivation in moist vegetation and leaf litter close to the water.	Riparian areas within Pleasantdale and Muckle creeks. May breed in Brydon Lagoon	High
Western Painted Turtle (*Chrysemys picta, bellii* subspecies*)* Pacific Coast Population: Endangered (SARA, Sched. 1, 2006) Red-listed (BC CDC 2008)	Common in interior valley systems of BC, and less common near the coast, populations in the Fraser Valley from Vancouver to Hope. Inhabit shallow ponds that warm in summer and have a muddy bed to support vegetation growth. Food includes frogs, insects, larvae, plant matter, and carrion. Females nest in June in sandy or lose soil locations, often within 150m of water.	Ponds in the Nicomekl floodplain as well as Brydon Lagoon	Low

Species	Preferred Habitat	Potential Habitat in the City of Langley	Potential to Occur in City of Langley
MAMMALS			
Pacific Water Shrew (*Sorex bendirii*) Endangered (SARA, Sched. 1, 2006); Red-listed (BC CDC 2006)	Limited to lowland riparian forests and marshes (usually below 600 m); prefers habitat with a moderate amount of ferns, mosses and rocks, a low amount of grass and exposed soil and a high percentage of fine litter. Heavily dependent on freshwater organisms for food; most individuals have been caught within 25 m of a stream.	Riparian areas within Pleasantdale and Muckle creeks	Medium
Trowbridge's shrew (*Sorex trowbridgii*) Blue-listed (BC CDC 2006)	Occurs in BC in the Lower Mainland and Fraser corridor to Boston Bar. This is the most abundant shrew in the lower Fraser Valley, found in low elevation coastal areas (0 to 1820 m), preferring riparian fringe habitat, ravines, or swampy woods and feeding on insects, worms, centipedes and vegetation.	Forested regions of Ponder Park or along Pleasantdale and Muckle creeks	Medium to High
PLANTS			
California Tea (*Rupertia physodes*) (Blue-listed BC CDC 2006)	Grows at elevations below 2500 m along the west coast of North America. A small perennial bush that prefers brush and wooded areas.	Forested regions surrounding Muckle and Pleasantdale creeks	Low
False-pimpernel (*Lindernia dubia* var. *Anagallidea*) Blue-listed (BC CDC 2002)	Occurs throughout southwestern BC. Grows in summer in moist soils in woodlands or around ponds and streams. Typically occurs in areas that are wet and prone to flooding. Provides important cover for frogs and turtles.	Suitable habitat along Pleasantdale and Muckle creeks, and ponds or damp forest edges of the Nicomekl floodplain	Low

4 Recommendations for an ISMP Approach in the City of Langley

An important aim of an ISMP is to develop an integrated understanding of existing environmental values and functions of the watersheds and to identify management processes that the City of Langley can use to guide land development to maintain a healthy and safe watershed from an environmental and hydrological perspective. Table 4-1 provides a summary of key components of an ISMP and the status of information currently available. The current report provides much of the information needed for the terrestrial and aquatic habitat components of an ISMP.

Table 4-1: Key Components of an ISMP for City of Langley, Status of Information

ISMP Component	Information Status	Further ISMP Needs
Water quality	In situ water quality (October 2008) – met provincial guidelines at time	Additional information on base flow water chemistry
Fish and fish habitat quality	2007 survey of Logan Creek and Jeffries Brook 2008 stream surveys of Baldi, Brydon, Langley, Pleasantdale and Muckle creek ▪ moderate quality fish habitat ▪ fish habitat throughout streams ▪ connections to Nicomekl River ▪ a number of stormwater outfalls to streams Recommendations for protection of habitat	Full assessment of all streams to determine areas of critical habitat for protection
Terrestrial Environment	2008 review of terrestrial habitat in the City: ▪ review of historic records of species of conservation concern in general area ▪ survey of riparian habitat, including Baldi, Brydon, Langley, Pleasantdale and Muckle creeks as well as Nicomekl River ▪ identification of potential habitat for species of conservation concern) Recommendations for protection of habitat	Best management practices for development adjacent to streams
Watershed Health	NA	Percent impervious cover Percent riparian vegetation Benthic invertebrate community
Groundwater	Not reviewed	Include in ISMP (applicable to discussions of infiltration of stormwater, links between groundwater and stormwater).
Land Use	Not reviewed:	Liaise with Planning department, identify links between ISMP and planning initiatives
Hydrology	Urban Systems	?
Stormwater Infrastructure	Urban Systems	?

5 Existing Habitat Protection Measures in the City of Langley

Various City policies and provincial and federal legislation provide for protection of aquatic and terrestrial habitat. A well designed ISMP, signed off by Fisheries and Oceans Canada, indicates the commitment of the City to comply with the federal Fisheries Act while it manages urban development. The provincial Riparian Area Regulations under the Fish Protection Act are in place to guide development along streams. The province also provides guidelines to protect various species of conservation concern, which, in the City, include red legged frogs and Pacific water shrew, among others. The City provides direction to planning staff,

residents and potential developers through the Official Community Plan, which includes an Environmentally Sensitive Areas Map and the use of Development Permits for certain areas. Details are provided below.

5.1 Habitat protection

The main areas of environmental sensitivity in the City of Langley are the Nicomekl River and its floodplain and streams and their riparian areas. These areas provide important habitat for both fish and wildlife.

Various City of Langley policies provide guidance on environmental protection in the Official Community Plan (OCP) last updated in 2005 (City of Langley 2005). These are outlined in Section 9 of OCP Bylaw, 2005, No. 2600 and include the following policies relevant to habitat protection:

- protection of areas identified in the Environmentally Sensitive Areas Map
- requirement of Development Permits for properties affected by environmentally sensitive areas
- cooperation with other jurisdictions (DFO, MOE, adjacent municipalities, Metro Vancouver) on environmental protection and research initiatives
- review of streamside development applications in accordance with the "Riparian Areas Regulation of the Fish Protection Act
- encouragement of stormwater management practices to mitigate flooding and destruction of habitat and farmland, and consistent with the GVRD Liquid Waste Management Plan and Integrated Stormwater Management Planning
- partnering with conservation groups and government agencies on habitat enhancement projects.

Development Permit Areas are described in Section 15.0 of the OCP for protection of the natural environment (documented in their Environmentally Sensitive Areas Map, Figure 2) and for intensive land uses (commercial, industrial, multifamily residential, Estate Residential).

The Environmentally Sensitive Areas (ESA) Map was based on the 1997 Coast River Environmental Services report for the City (Fisheries Watercourse Classification Project and Environmentally Sensitive Areas Overview), updated in 2002 in consultation with Fisheries and Oceans Canada. The ESA Map provides base information for the fish habitat map (Figure 1) and identifies the following types of areas:

- ravines and watercourses (setbacks that would be determined through RAR)
- Nicomekl River floodplain and wetlands
- forested areas, trees and snags
- BC Hydro right-of-way
- watercourses and their classifications (Class A, A(O), B, C)

Guidance for development within the ESAs includes the following (Section 15.8 of OCP Bylaw):

- avoiding ESAs, where possible
- establishing watercourse setbacks in accordance with the Riparian Areas Regulation
- in some cases, providing detailed environmental inventory or environmental impact assessment in accordance with MOE requirements
- review of applications in consultation with MOE and DFO, where applicable
- use of restrictive covenants, where applicable

Exemptions for Development Permits are available for construction or alteration of single family dwellings and duplexes, and for single family subdivisions (Estate Residential parcels still require a Development

Permit). As a result, some residential lots that include land within the ESA may not require a permit but the developments will still need to comply with the Riparian Areas Regulation.

5.2 Stream Classification

The stream classification system used by the City of Langley is similar to that used by other municipalities, with minor differences. The City defines four types of streams, designated by letter and colour:

- **Class A** (red) – permanent (wetted year round) and deemed to contain, or potentially contain fish habitat and fish presence
- **Class A(O)** (red-dashed) – contain fish habitat and presence, but may not be permanent, and thus are seasonal or intermittent
- **Class B** (yellow) – generally permanent, but can also be seasonal or non-permanent; generally do not contain fish habitat, but contribute nutrients, food or cooler water to downstream fish habitat (e.g., roadside ditches that lead into streams)
- **Class C** (green) – generally have no fish habitat or presence, do not contribute nutrients or food downstream and are not connected directly to fish bearing streams (e.g., storm sewers and isolated drainage ditches)..

Most of the City streams are considered Class A because they are directly connected to the Nicomekl River, have permanent flows and few passage restrictions.

5.3 Stream Setbacks

The Riparian Area Regulation (RAR) under the provincial Fish Protection Act will provide the main regulatory tool for protecting stream habitat in the City of Langley. The RAR came into effect on March 31, 2006. A proponent hires a qualified environmental professional to conduct a simple or a detailed assessment to establish watercourse setbacks. Fish habitat values within a 30 metre assessment area along Class A, AO or B watercourses are assessed and the appropriate setback established (MoE 2008). Setbacks range from 5 m to 30 m; they are widest for permanent, fish-bearing streams (Class A) with at least a 15 m width of existing or potential riparian vegetation, and smallest for non-permanent, non fish-bearing streams (Class B) with minimal riparian vegetation. The RAR assessment also considers slopes and ravine areas, where wider setbacks are typically required to protect slope stability.

According to the RAR, areas within the setbacks are to be maintained as Streamside Protection and Enhancement Areas. Proposed stormwater detention facilities and recreational facilities are to be situated outside the riparian area and access restricted to minimize disturbance and discourage encroachment by auxiliary structures (e.g. sheds, fencing, landscaping, swimming pools, garages).

The setbacks defined under RAR were established to protect fish habitat and at up to 15 or 30 m, are not wide enough to protect habitat for some species of conservation concern. On some properties, the City may wish to require wider setbacks than those provided by RAR. For the red-listed Pacific water shrew, setbacks recommended for protection of critical preferred habitat are currently 100 m (Ministry of Environment 2005). For the blue-listed red-legged frog and other amphibians (which prefer slow flowing, marsh, wetland and pool habitat), recommended setbacks are at least 30 m on each side of a stream or wetland, with adequate connectivity with other habitat areas (Ministry of Environment 2004).

5.4 Water Quality and Best Management Practices

All efforts to maintain water quality in City watercourses as part of the ISMP will help protect fish and wildlife resources. The main Urban Systems report discusses stormwater management strategies recommended for specific areas and land uses in the City. These, along with Best Management Practices and Low Impact Development Strategies to increase infiltration of stormwater, will be particularly helpful in maintaining stream conditions suitable for salmonids.

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7 Closure

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Appendix A
Photographs

Photo 1: Baldi Creek at 55A Avenue. Downstream view of concrete in creek

Photo 2: Baldi Creek downstream of 57A Avenue

Photo 3: Baldi Creek, upstream of 57A Avenue. View of gabions with rock in stream bank

Photo 4: **Baldi** Creek, concrete lined section upstream of 55A Avenue

Photo 5: Baldi Creek, downstream view from 200 Street

Photo 6: Brydon Creek, downstream view from 55A Street of riparian vegetation

Photo 7: Brydon Creek. Culverts on downstream side of 55A Avenue. Location of reduced fish passage

Photo 8: Brydon Lagoon Area

Photo 9: Muckle Creek. Downstream of 50 Avenue, just upstream of convergence with Nicomekl River. Gravels and cobble substrates in this section of creek

Photo 10: Pleasantdale Creek. Ravine near headwaters

Photo 11: Pleasantdale Creek. Headwater area with evidence of rust coloured flocculent in stream

Photo 12: Pleasantdale Creek at Grade Crescent. Drainage pipes entering creek on downstream side of road

Photo 13: Pleasantdale Creek. Pathway and bridge adjacent to and crossing the creek, upstream of convergence with Nicomekl River

Photo 14: Pleasantdale Creek. Modified instream habitat upstream of 49A Avenue

Photo 15: Tributary to Langley Creek. Headwaters, near Grade Crescent, with modified instream habitat

Photo 16: Tributary to Nicomekl River, upstream of convergence with Langley Creek. Flowing adjacent to residential properties

Photo 17: Tributary to Nicomekl River; upstream of convergence with Langley Creek. Creosote barrier structure at 4850 206 Street

Photo 18: Langley Creek, pathway next to creek near Nicomekl River

Photo 19: Nicomekl River riparian area with walkway

Updated Cost Estimates for Alternatives Recommended in the Stormwater Drainage Assessment Report by UMA Engineering (2005)

EXISTING SYSTEM

			Minor System				SWMF			
			Replacement Cost		Twinning Cost		10 year Storage Cost	100 year Storage Cost	10 year Storage Cost	100 year Storage Cost
System	Description	Pipe Length (m)	2005 Estimate	2009 Estimate	2005 Estimate	2009 Estimate	2005 Estimate	2005 Estimate	2009 Estimate	2009 Estimate
Willowbrook	**Landmark way**	**204**	**$192,600.00**	**$240,750.00**	**$160,900.00**	**$201,125.00**				
	West of 200th Street and North of Production Way	272	$245,500.00	$306,875.00	$210,100.00	$262,625.00				
Northwest	**57a Avenure from** 198th Street to 200th Street	220	$248,400.00	$310,500.00	$214,300.00	$267,875.00				
Logan Avenue and Fraser Highway	**203rd Street from** Fraser Hwy to Nicomekl River Outfall and imperial Avenue	1239	$2,863,000.00	$3,578,750.00	$737,800.00	$922,250.00	$1,195,680.00	$2,158,800.00	$1,554,384.00	$2,806,440.00
Douglas Crescent	**Douglas Crescent** from 204th to 207th Street	335	$297,400.00	$371,750.00	$167,200.00	$209,000.00	$203,740.00	$445,570.00	$264,862.00	$579,241.00

NOTES:

This update was limited to applying an incremental factor to the costs previously reported in the 2005 study. This update did not include a review of the unit rates or quantities previously developed by UMA. Based on market condition changes since 2005, it is recommended that the total costs previously compiled by UMA be increased by approximately 25%-30%, depending on the nature of the recommendation (whether it is a storm pipe or detention facility). This factor was chosen based on observed increases in tender prices for similar works over the 2005 to 2009 time period. These costs are intended for long range budgeting only. It is recommended that each individual project be reviewed in greater detail prior to securing funds for the calendar year in which they are to be implemented.

Updated Cost Estimates for Alternatives Recommended in the Stormwater Drainage Assessment Report by UMA Engineering (2005)

FUTURE SYSTEM

			Replacement Cost		Twinning Cost	
System	Description	Pipe Length (m)	2005 Estimate	2009 Estimate	2005 Estimate	2009 Estimate
Douglas Crescent	205th Street South of Douglas Crescent	179	$154,300.00	$192,875.00	$138,600.00	$173,250.00
	206th Street South of Douglas Crescent	107	$89,400.00	$111,750.00	$84,600.00	$105,750.00

NOTES:

This update was limited to applying an incremental factor to the costs previously reported in the 2005 study. This update did not include a review of the unit rates or quantities previously developed by UMA. Based on market condition changes since 2005, it is recommended that the total costs previously compiled by UMA be increased by approximately 25%-30%, depending on the nature of the recommendation (whether it is a storm pipe or detention facility). This factor was chosen based on observed increases in tender prices for similar works over the 2005 to 2009 time period. These costs are intended for long range budgeting only. It is recommended that each individual project be reviewed in greater detail prior to securing funds for the calendar year in which they are to be implemented.