



Environmentally Sensitive Areas Mapping Study

January 26, 2016



Produced by:





Acknowledgements

The City of Langley thanks all consultants, City of Langley staff, Metro Vancouver, stakeholders, and members of the general public for their contributions to this Environmentally Sensitive Areas Mapping Study. Specifically, we would like to thank the project team, which includes:

- Diamond Head Consulting Ltd. (Jimmy Allen, Camille Lefrancois, Michael Coulthard, Jeanette Elmore) – lead consultant;
- Zoetica Wildlife Research Services (Dr. Heather Bears) – sub-consultant.

This document would not have been possible without guidance from City of Langley staff, in particular:

- Roy Beddow, Deputy Director, Development Services & Economic Development Department;
- Kara Jefford, Manager of Engineering Services; and,
- Andrew Brown, Mapping Technician.



Executive Summary

The City of Langley initiated an Environmentally Sensitive Areas (ESA) Mapping Study in 2015. Up to this point, planning and mapping of natural and semi-natural areas in the City of Langley were based on ESA and fisheries information collected in 1997 and 2002. Since this time, there have been significant changes in land use and development, best practices and tools, available data, and the regulatory environment. For example, the Official Community Plan (2005) and Sustainability Framework (2010) provide direction to protect ESAs and envision an ecological network that supports ecological values, biodiversity, and recreation (e.g. trail networks).

Public consultation and stakeholder engagement were an important component of the project and will continue to be as it moves forward. Stakeholders were contacted early in the process to provide input, as the City recognized their valuable experience pertaining to natural areas and their management. Stakeholders involved included the Langley Environmental Partners Society, Nicomekl Enhancement Society, and Langley Field Naturalists. A public open house was also conducted to provide information on the project and gather additional feedback that was incorporated into the ESA Mapping Study.

The first phase of the project determined what natural areas and features exist in the City of Langley. Examples include riparian areas, wetlands, forest patches, oldfields, ecological corridors, floodplains, and semi-natural areas. The basis for the inventory was Metro Vancouver's Sensitive Ecosystem Inventory (SEI), which was ground-truthed and adapted to map out different habitat types in the City at a much finer resolution. Use of this baseline SEI data facilitates a "common language" for regional planning, while also reflecting City-specific needs and conditions.

A science-based approach was used to determine the value of different inventory components, which allows for more informed decision-making. Natural areas were ranked according to various factors including ecosystem rarity, occurrence of Species of Conservation Concern (SCC), condition, level of disturbance, risk (e.g. floodplain interval), connectivity, and fish presence. A cumulative ranking was then developed to provide an overall picture of value based on all factors assessed.

Thirty-eight prioritized management recommendations are included in the ESA Mapping Study. These recommendations direct action for the protection, restoration and enhancement of natural areas and features. They reflect existing ecological conditions (i.e. inventory and value assessment), land use, opportunities and constraints, regulatory environment, and municipal capacity. Recommendations are also organized by category: Planning and Development (implementation and management of ecosystem components), Species of Conservation Concern, Climate Change, and Community Stewardship, Education and Awareness.

A monitoring framework with objectives, indicators, and targets is an integral component of the ESA Mapping Study. The framework is linked to the management recommendations, and will be used to measure changes in ecological health over time, in addition to management performance. This will be a living document; regular updates to the ESA Mapping Study will be required to ensure all information, including mapping, is current. Goals and objectives may need to be adapted based on future conditions and evaluation of management performance. This will ensure that the City of Langley continues to protect important environmental values that support a livable community and region.



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1.0 Introducing the ESA Mapping Study

1.1. Project Overview

The City of Langley (City) is a dynamic, vibrant urban center located around the Nicomekl River. Established in 1955, the City was envisioned as the downtown core to a larger surrounding area (the Township of Langley). Much of the region's early European history centred on forestry, agriculture, and fisheries, due in large part to the rich natural resources that typified the region. First Nations, of course, had long subsisted in the area through hunting, fishing, and trade. Over time, population growth and development significantly altered the natural landscape. Although some natural areas remain, most of these exist in a fragmented, altered state.

Today, development pressures continue alongside new threats to sensitive ecosystems such as climate change. The City recognizes that natural areas provide tremendous value and benefits to urban centres, and is developing new and updated policies and strategies to protect, maintain, and enhance them. This Environmentally Sensitive Areas (ESA) Mapping Study provides a foundation for future management of natural areas in the City of Langley.

1.2. What is an Environmentally Sensitive Area?

Environmentally Sensitive Areas are land or water areas that are managed to meet one or more objectives including:

- Conservation and/or protection of natural and semi-natural areas and features and ecosystem functions that have biological, physical, or social value;
- Supporting sustainable development and green infrastructure;
- Risk management; and,
- Environmental education.

Natural areas provide a diversity of benefits and that are often not fully appreciated. Many of the ecological services they provide are 'free' and cannot be replicated. Some examples include:

- **Stormwater and flood protection:** wetlands and trees intercept, absorb, and store runoff;
- **Carbon sequestration:** trees and vegetation store carbon and help mitigate climate change;
- **Water and air quality:** forests and wetlands can filter pollutants;
- **Habitat:** natural areas provide an abundance of habitat for fish, wildlife and other organisms;
- **Recreation:** natural areas provide opportunities for both passive and active recreation;
- **Human health:** proximity and access to nature provides health benefits for people;
- **Food production:** pollinators such as bees are essential for many crops, while trees and plants can be important sources of local food.

1.3. Management Challenges for ESAs

The value of protecting and enhancing the City's remaining ESAs has been demonstrated through its policies and plans. Policies such as the Official Community Plan (OCP; 2005) have firmly established the City's goal of being a positive steward for the environment. However, there will continue to be

management challenges as the City seeks to balance future population growth and urban development while protecting environmental values:

- **Population Growth:** The City's population is expected to grow to 38,000 people by 2041, with an increase of ~7,000 dwelling units;
- **Urbanization:** Many of the landscape changes over the past 150 years have affected natural areas. Clearing of land for forestry, agricultural activity in floodplains, infilling of watercourses, and habitat fragmentation have reduced the amount and quality of natural areas.
- **New Threats:** Beyond management of growth and focusing on sustainable development, strategies must now also consider new threats to ecological integrity including invasive species and climate change. Invasive species, such as reed canarygrass and Himalayan blackberry, have established over large areas. Changing climate is also having impacts. For example, 2015 was one of the driest years on record, resulting in early dry-up of many marshes.

The City of Langley needs to understand what natural areas remain, and what the existing and potential threats to those natural areas are, to ensure they can be protected and maintained for the benefit of all residents. Considering both the benefits and challenges associated with managing natural areas, new strategies are needed to protect, maintain and restore their ecological functions. For example, the City's Brownfield Redevelopment Strategy recognizes existing land constraints and offers opportunities to improve the quality of the environment. This ESA Mapping Study provides an updated management framework that will support and inform City policy pertaining to Environmentally Sensitive Areas in the years to come.

1.4. Process and Objectives

The City initiated an ESA Mapping Study in May, 2015 to build on and update the City's earlier ecological inventories conducted in 1997 and 2002. An updated ESA mapping study was also needed for the City's enactment of environmental policy through its OCP, parks plans, and bylaws. This updated inventory and related guidelines and regulations for the protection of natural features and sensitive ecosystems will reflect changes in the regulatory environment, land use, knowledge, programs, tools, and best practices. Ultimately, the ESA Mapping Study will inform many decisions regarding how and where development should occur, which will shape the city for years to come.



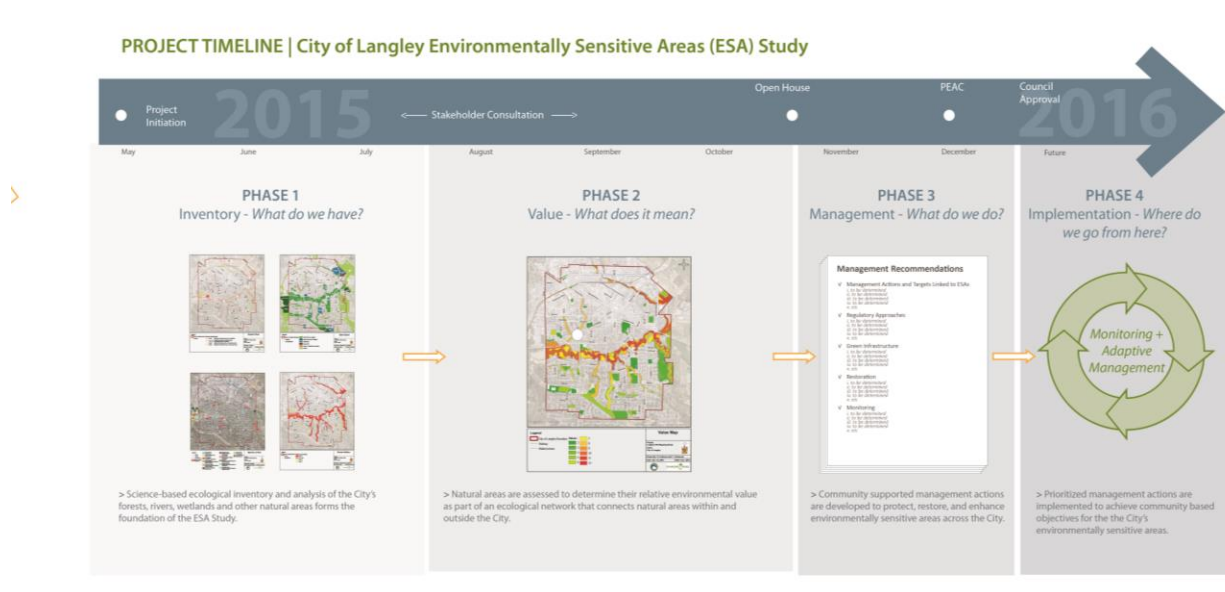


Figure 1. City of Langley ESA Mapping Study project timeline

This ESA Mapping Study is a science-based inventory and assessment that raises awareness of existing natural features and their relative values throughout the City. Innovative strategies to manage natural areas and features in the urban environment are included. These strategies consider community sustainability objectives, a changing regulatory environment, and future unknowns (e.g. climate change).

Specific objectives of this project included:

- Creating an up-to-date inventory of natural areas and features including: riparian areas, wetlands, vegetation and forest cover, wildlife habitat, wildlife corridors, floodplains, and outstanding natural landscapes;
- Assessing natural areas and features based on ecological value, sensitivity, risk and condition;
- Recommending policies, guidelines and management procedures for the protection, restoration and enhancement of ecosystems and natural features; and
- Monitoring and assessing changes in ecological health over time.



Photo Credit: Cos van Wermeskerken



Photo Credit: Cos van Wermeskerken



2.0 Public Consultation

Public consultation was an important component of the ESA Mapping Study. The consultation process included direct stakeholder engagement and a public open house. Consultation was conducted via two primary methods:

- 1) a survey/questionnaire to local stakeholder groups known to have relevant expert knowledge in the area; and
- 2) a public open house, which included a written feedback component to gather information from the general public.

2.1. Survey/Questionnaire to Experts

A survey/questionnaire was sent to three environmental stakeholder groups active in the community: Langley Environmental Partners Society (LEPS), the Langley Field Naturalists (LFN), and the Nicomekl Enhancement Society (NES). These stakeholder groups advocate for the protection and restoration of Langley's natural areas and wildlife and engage in important stewardship activities (i.e. invasive plant control, natural areas restoration). The individuals who volunteer for these organizations have considerable knowledge, experience, and technical expertise, and are considered to be integral to the success of the ESA mapping study. Responses from these surveys were used to guide certain aspects of subsequent field work.

2.2. Open House

A public open house was held on November 3, 2015. The purpose of the open house was to formally introduce the project to the general public and interested stakeholder groups, and to gather feedback on existing mapping and environmental values. This valuable information was then used to help adjust existing ESA mapping, where relevant. Information gathered at the open house also informed management recommendations.

Open house participants were asked to respond to 25 statements pertaining to management of the City's ESAs. Statements were categorized according to five themes: sensitive ecosystems, watercourses and riparian areas, species of conservation concern, open space, and ESA mapping and management. Respondents were asked how strongly they agreed with various statements within each category on a scale of 1 to 5 (strongly disagree, disagree, unsure/do not know, agree, and strongly agree).

While responses showed some level of agreement for management of environmental values, the strongest public support pertained to statements concerning restoration of natural areas and managing invasive species:

- The City should focus its management efforts on protection and restoration of its rarest habitat types;
- The City should encourage restoration of natural habitat as a condition of development, where feasible;
- The City should prioritize restoration of natural areas within the Nicomekl River floodplain;

- The City should work to enhance riparian areas by planting native vegetation and removing invasive species, where possible and practical; and,
- As many of the native amphibians in the City are vulnerable to local extinction due to invasive species like the American Bullfrog, the City should work to eradicate this species from ponds and waterways known to host them.

Generally, stakeholders and members of the public identified the following areas to be of particular management importance and/or concern:

- Nicomekl River floodplain and associated tributaries (Logan Creek, Pleasantdale Creek, Murray Creek, etc.);
- Brydon Lagoon;
- Brydon Pond;
- Newlands Golf course ponds; and,
- Oldfield habitat associated with agricultural land, and upland properties with high tree cover.

Although many of these areas are City owned as park, some of them are privately owned. Interestingly, respondents at the public open house generally agreed that the City has not protected a sufficient amount of land as ESAs. While a variety of protective mechanisms were supported, use of community amenity charges (paid for by developers), application of restrictive covenants and easements, and implementation of Environmental Development Permit Areas were slightly more favoured than acquisition of new land for protection purposes.

Specific issues that were raised as risks to ESAs include development pressure, pollution and discharge of harmful substances through urban run-off, invasive species (e.g. purple loosestrife, Japanese knotweed), climate change, garbage dumping, homeless camps, and off-leash dogs.

Responses gathered from the stakeholder surveys and the public open house are summarized in Appendix B.



3.0 Inventory and Assessment

The inventory and assessment component for this ESA mapping study (2015) was based on Sensitive Ecosystem Inventory (SEI) mapping data provided by Metro Vancouver. This SEI data was used as baseline information, which was updated following summer field surveys. Unique habitat polygons were delineated in the City of Langley, and each was assessed to determine its relative value. Base value maps were created for four distinctive ecosystem components: Sensitive Ecosystems, Watercourses and Riparian Areas, Floodplains, and Species of Conservation Concern. A final ESA map was developed, which combined the four base maps using a cumulative value ranking system.

The following sections summarize inventory and assessment information for each ecosystem component and the final ESA map. Detailed methods and value maps for each ecosystem component are provided in the Appendices.

3.1 Sensitive Ecosystems

Prior to European settlement, the lowland floodplains and adjacent uplands that characterize the City of Langley and surrounding area hosted a variety of natural habitats including rivers, ponds, swamps, marshes, and forests. Today, most of these natural areas have been lost or altered. However, the City still retains a variety of natural habitats, in addition to parks, gardens, and other open space. There is a need to understand the ecosystem values that remain in these largely modified natural areas within the City for future planning and conservation initiatives.

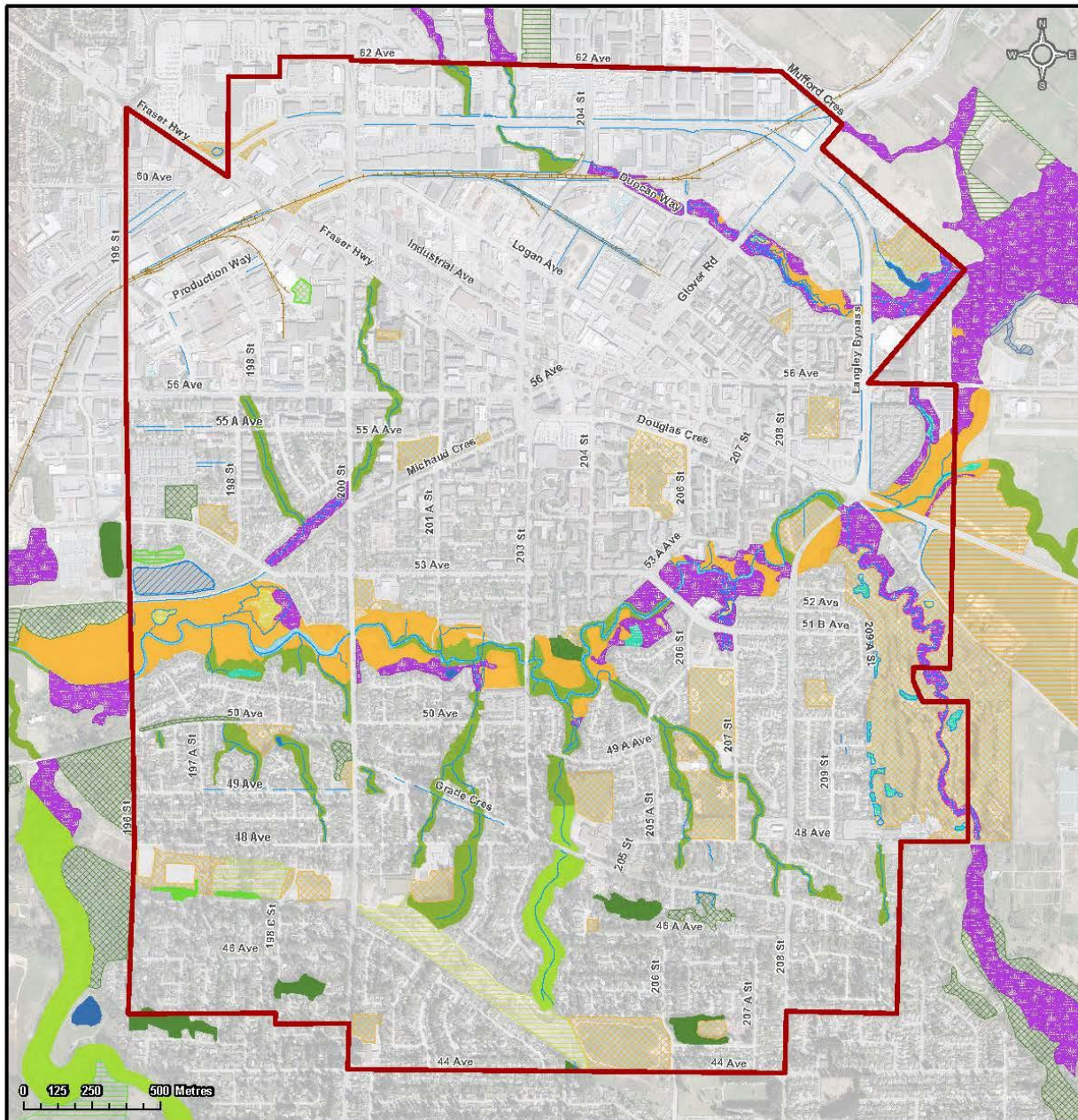
A Sensitive Ecosystems Inventory (SEI) mapping project was conducted by Metro Vancouver in 2014. This information was used as the basis for mapping natural areas in the city; however, some refinements were:

- Updated mapping for the City was produced at a greater resolution (minimum polygon size of 100 m²) than the Metro Vancouver SEI (variable polygon size up to a minimum of 5 hectares);
- Addition of some habitat types representing modified ecosystems including reed Canarygrass and turf; and,
- Metro Vancouver SEI mapped polygons that contained more than one habitat type were remapped to distinguish individual habitat types in the City of Langley ESA mapping study.

A Sensitive Ecosystem Value ranking was conducted for different habitat types using a measure of ecosystem rarity. A detailed methodology used for this assessment is contained in Appendix C. Refer to Appendix D for the value map.



City of Langley Environmentally Sensitive Areas Mapping Study



Legend

City of Langley Boundary	Modified Ecosystem (agriculture)	Wetland (marsh)
Watercourses	Old field	Wetland (swamp)
Railway	Mature Forest (coniferous)	Wetland (shallow water)
Freshwater (pond)	Mature Forest (mixed)	Young Forest (broadleaf)
Freshwater (reservoir)	Riparian (fringe)	Young Forest (coniferous)
Modified Ecosystem (reed canary)	Riparian (gully)	Young Forest (mixed)
Modified Ecosystem (turf)	Riparian (river)	

Sensitive Ecosystem Inventory

Project:
Langley ESA Mapping Study
Client:
City of Langley



Drawn By: D. Lishman and C. Lefrancois
Date: Oct. 29, 2015 Ortho Year: 2014



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3.2 Watercourses and Riparian Areas

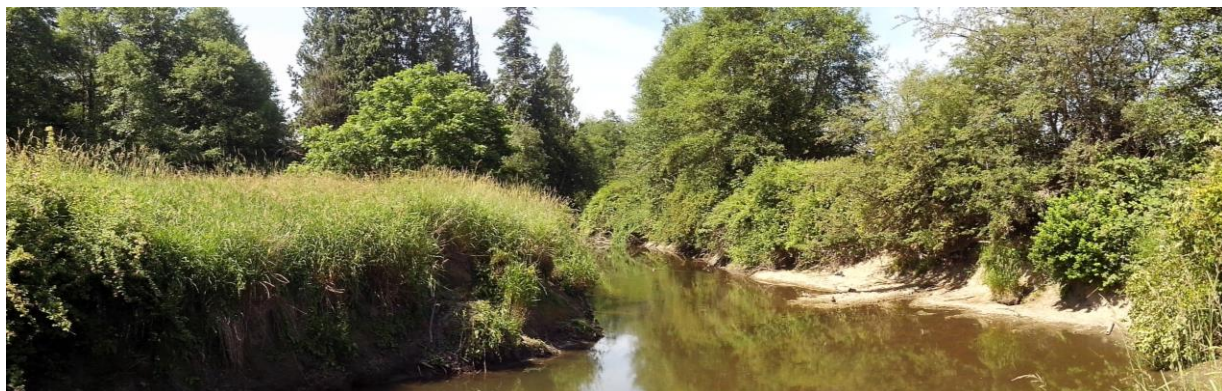
The City of Langley has over 40 km of watercourses (rivers, creeks) & numerous ponds and reservoirs within its borders. Examples include the Nicomekl River and its tributaries, and Brydon Lagoon. The adjacent land associated with these watercourses is known as riparian habitat. These waterbodies and riparian habitats support important fish and wildlife species, some of which are classified as Species of Conservation Concern or are important for commercial/recreational fisheries. Together, riparian-watercourse complexes make up a significant part of the city's green infrastructure, defined as the natural areas and features that provide benefits and services for both people and wildlife. For example, in addition to providing habitat, watercourses help convey and contain water and act as valuable recreational amenities, forming the backbone of the City's park and trail system.

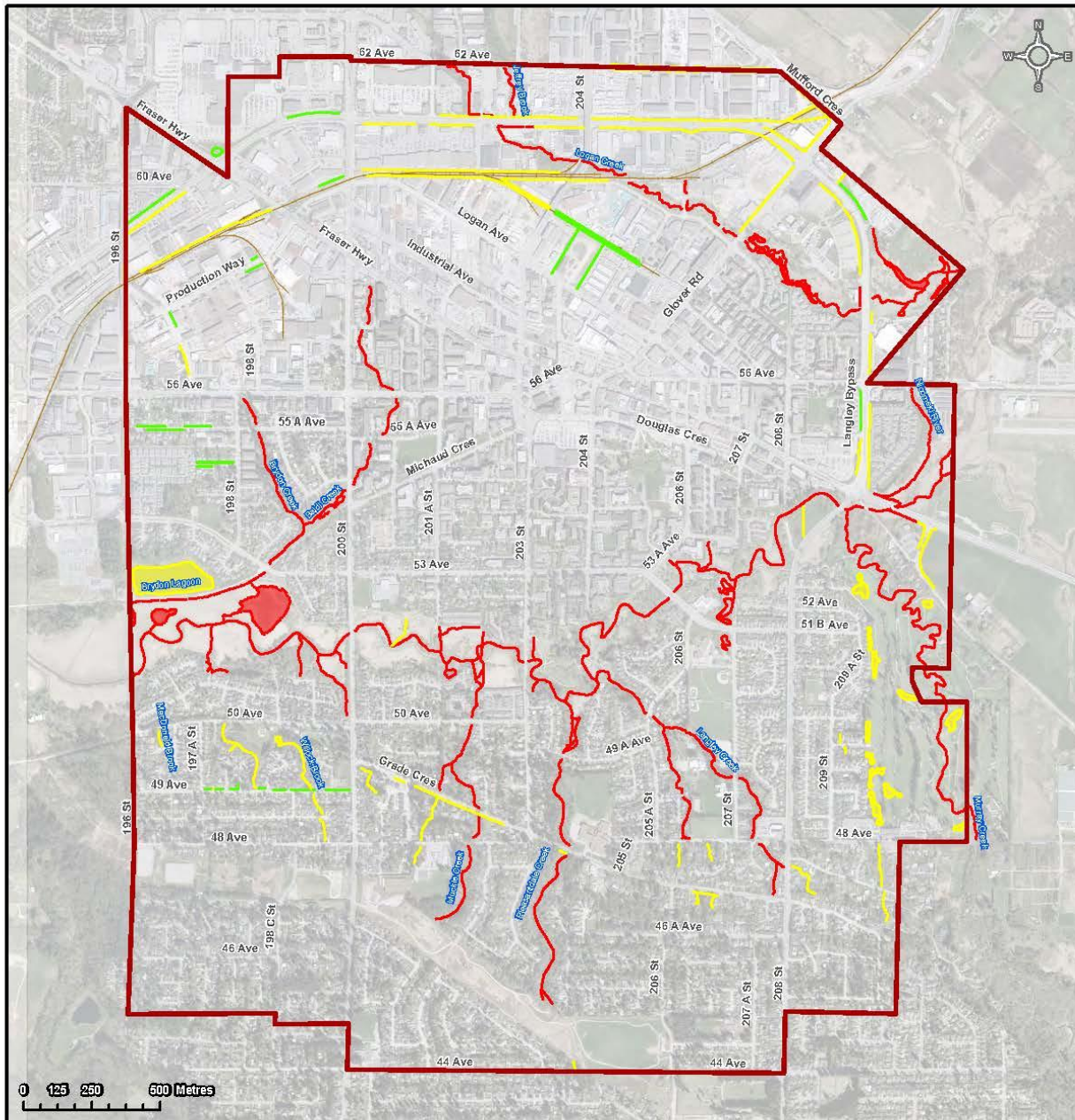
Issues:

Watercourses and riparian areas in urban areas are susceptible to a number of negative effects due to the nature and intensity of development. These influences can reduce the ecological integrity of watercourses and their value to fish, wildlife and humans. Examples of watercourse and riparian area vulnerabilities include:

- **Pollution:** Pollution and introduction of harmful substances from overland flow, stormwater discharge, and erosion.
- **Channel Modification:** Channel modification and infilling can reduce habitat value and alter hydrology.
- **Land Clearing:** Clearing of riparian vegetation reduces the capacity for these systems to moderate water temperature, input nutrients, stabilize slopes, and protect against erosion and sedimentation.
- A Sensitive Ecosystem Value ranking was conducted for different habitat types using a measure of ecosystem rarity. A detailed methodology used for this assessment is contained in Appendix C. Refer to Appendix D for the value map.

A Watercourses and Riparian Areas Value ranking was conducted for streams and other watercourses using a measure of classification based on fish presence. A detailed methodology used for this assessment is contained in Appendix C. Refer to Appendix E for the value map.





Legend



City of Langley Boundary



Railway

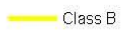
Watercourse Classification



Class A Inhabited by fish* year round, or potentially.



Class A(O) Inhabited by fish* primarily during the overwintering period, or potentially.



Class B Significant food/nutrient value, no fish* present.



Class C Insignificant food/nutrient value, no fish* present.

* Under the Provincial Riparian Areas Regulation, fish means all life stages of salmonids, game fish, and regionally significant fish.

Watercourse Classification

Project:
Langley ESA Mapping Study
Client:
City of Langley



Drawn By: A. Needoba and C. Lefrancois

Date: Oct. 29, 2015

Air Photo Year: 2014



DIAMOND HEAD

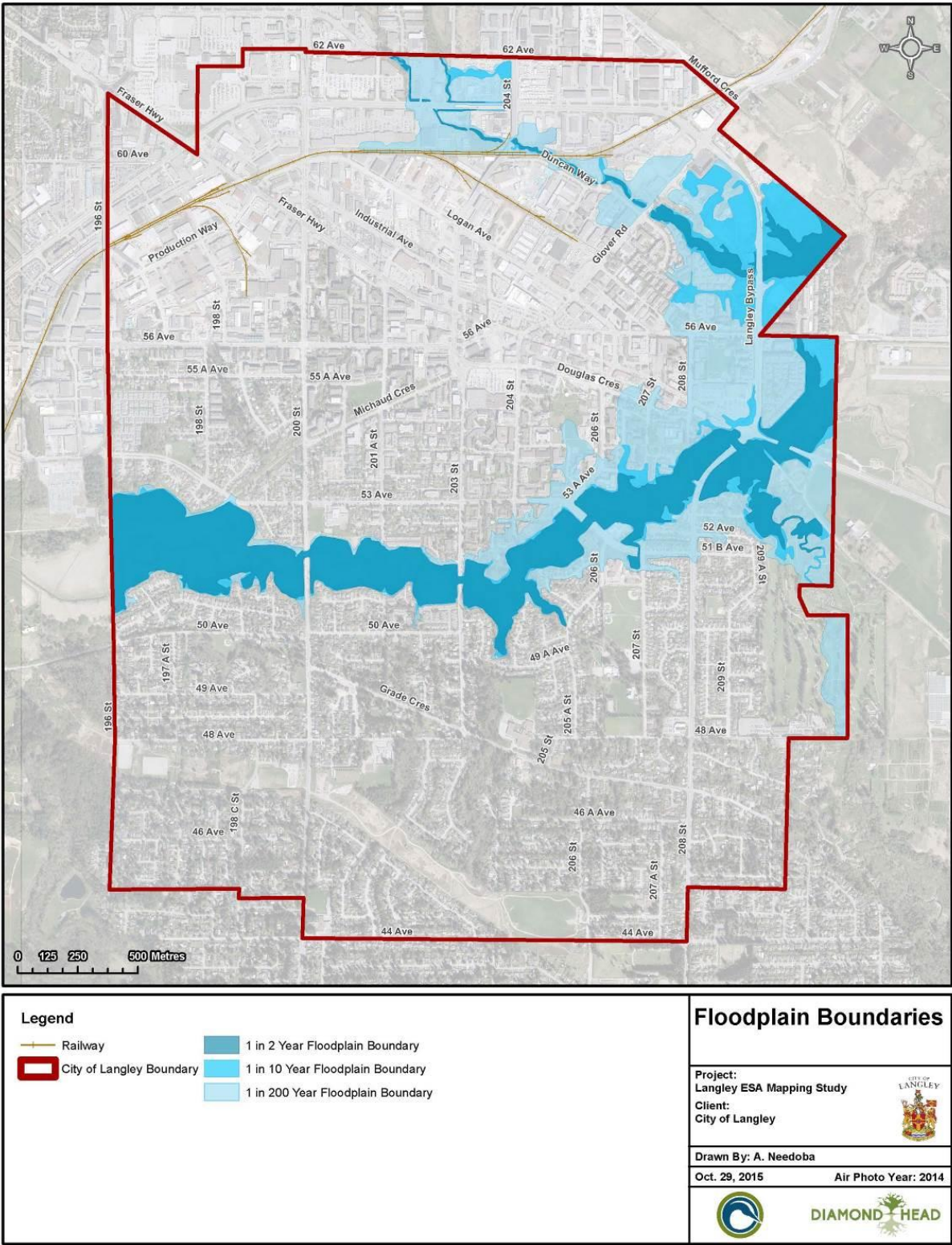
3.3 Floodplains

The Nicomekl River has an active floodplain that essentially bisects the City from east to west. Agriculture and development have occurred within the floodplain in the past; however, these activities are now controlled. Most of the Nicomekl floodplain (1 in 2 year flood interval), including its tributaries, is now used for parks and recreation. Flood protection structures such as levees, dykes and dams have not been constructed in this area, and winter flooding sometimes affects trail use and other infrastructure. Some residential, commercial, and industrial development has been permitted in wider floodplain areas (e.g., 1 in 10 year, 1 in 200 year flood intervals). These varying sensitivities have been considered in floodplain mapping for the City.

A Floodplains Value ranking was conducted based on different floodplain intervals. A detailed methodology used for this assessment is contained in Appendix C. Refer to Appendix F for the value map.



Photo Credit: Shon Troelstrup



3.4 Species of Conservation Concern

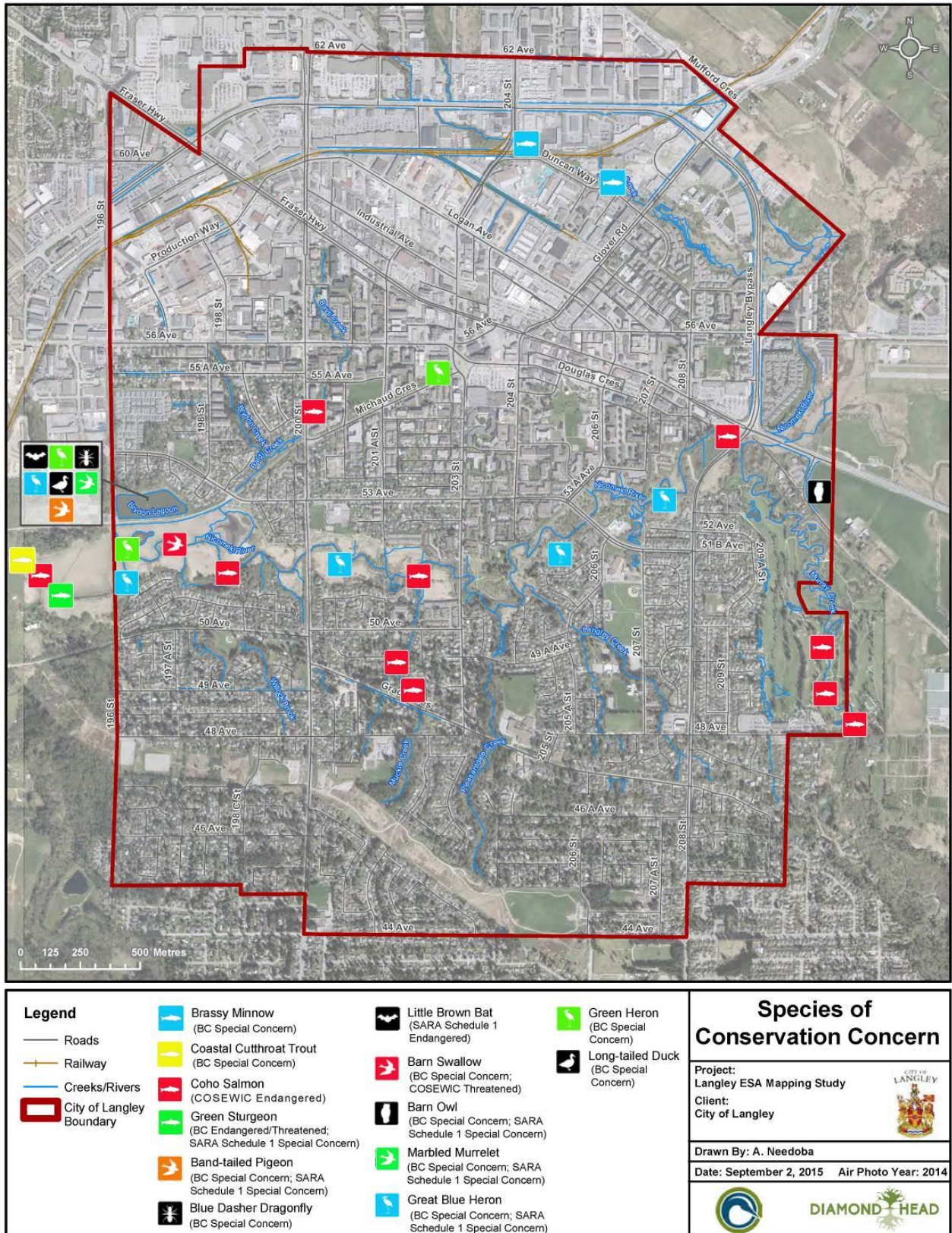
Species of Conservation Concern (SCC) are species that are scarce, or infrequently encountered. Such species and critical elements of their habitat are also legally protected under Provincial and Federal Acts. Some species of conservation concern are recognized as rare at a provincial level, and may be protected under certain provincial Acts (e.g., Wildlife Act of B.C), while others may be federally listed as Species at Risk (SAR), and are protected under the *Species at Risk Act*. Examples of SCC include the Great Blue Heron (provincial and federal), Brassy Minnow (provincial), and Barn Swallow (provincial). Presence of these species often signals something rare and uniquely valuable ecologically about the area that they inhabit.

Issues:

Management of SCC can be challenging due to the variety of issues that can be encountered. Some of the most significant issues for consideration include:

- **Habitat Requirements:** Many species rely on a variety of habitats to meet their life-history needs (e.g., nesting, migrating, feeding, shelter). As species often need to move between various locations to meet the needs of each seasonally specific life history stage, greater landscape connectivity may help these species meet their seasonal needs;
- **Available Knowledge:** There is often little to no local knowledge on the presence, abundance, and habits of SCC. Some species migrate long distances and may only be present in the City of Langley for part of the year. Often this period coincides with critically important times in their life cycles (e.g. bird breeding season). A lack of knowledge about what species use various habitats within Langley, when, and for what, severely hinders the ability to make sound management decisions; and
- **Multi-agency cooperation:** The City of Langley covers only a small land area (10 km²). Range requirements for some species are often much larger than can be provided in any one jurisdiction. Wildlife and other organisms that depend on these habitats do not recognize political boundaries. Management efforts may be ineffectual if the same protections are not offered in neighbouring jurisdictions. Cooperation amongst a variety of partners is required for conservation efforts to be effective.

Due to these challenges, long term conservation approaches may be required that focus not just on the species, but also on its habitat. An SCC value ranking was conducted based on species associations with different habitat types and other measures including size, condition of the habitat. A detailed methodology used for this assessment is contained in Appendix C. Refer to Appendix G for the value map.



4.0 Management Framework

4.1 Environmentally Sensitive Areas Mapping

Natural areas and features have many benefits beyond their intrinsic value. The Environmentally Sensitive Areas mapping provides an awareness of what exists and what condition it is in. Once understood, this information can be used by the City of Langley to meet many other sustainability objectives, for example:

- Developing a green infrastructure network;
- Reducing flood risk and improving stormwater management (e.g., permeable surfaces, rainwater collection/infiltration);
- Improving biodiversity (e.g., significant habitat, landscape connectivity, etc.);
- Offering new and/or improved recreational opportunities (e.g., greenways, parks, trails);
- Supporting community health (e.g., access to/views of nature);
- Increasing food production (e.g., natural pollinators, fruit trees, etc.); and,
- Adapting to climate change (e.g., carbon sequestration, combating urban heat island effect).

The final ESA Value map is a cumulative ranking of values from four base maps: Ecosystem Rarity, Species of Conservation Concern, Floodplain Mapping, and Watercourse and Riparian. Detailed methodology for this assessment is contained in Appendix C.



Photo Credit: Cos van Wermeskerken

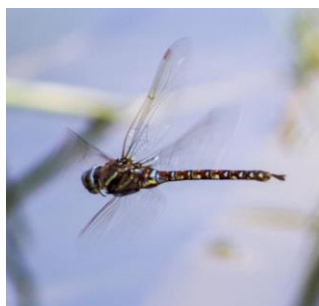


Photo Credit: Shon Troelstrup

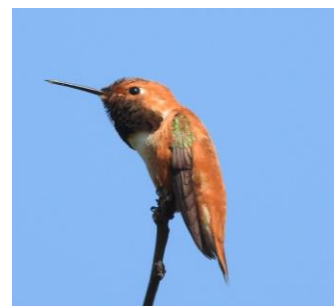
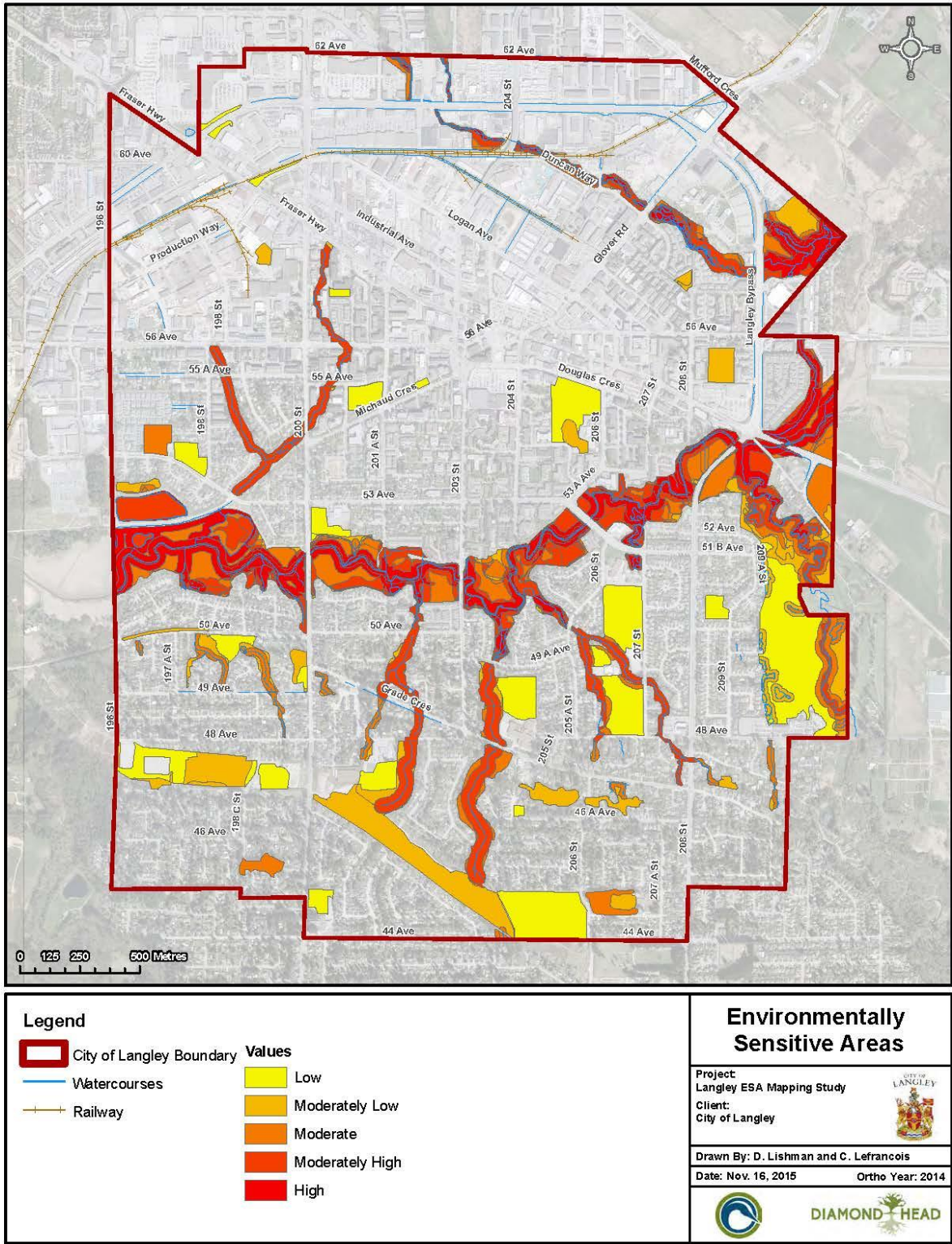


Photo Credit: Cos van Wermeskerken



4.2 Open Space

Urban areas pose unique challenges for management of natural areas. This is particularly true in the Lower Mainland. Some of these challenges include:

- **Demand for Land:** Rising land costs and a growing population are placing high demand on the existing land base. Remaining natural areas are often a target for development;
- **Development Intensity:** The type and intensity of development will influence the kind of opportunities available to manage natural areas;
- **Ownership:** Managing what land owners can do on private land is particularly challenging, with a need to balance the rights of property owners with the public good. The City of Langley is approximately 10 km² in size; almost 205 hectares of which is classified as environmentally sensitive. These natural areas extend across political boundaries, including both public and private land.

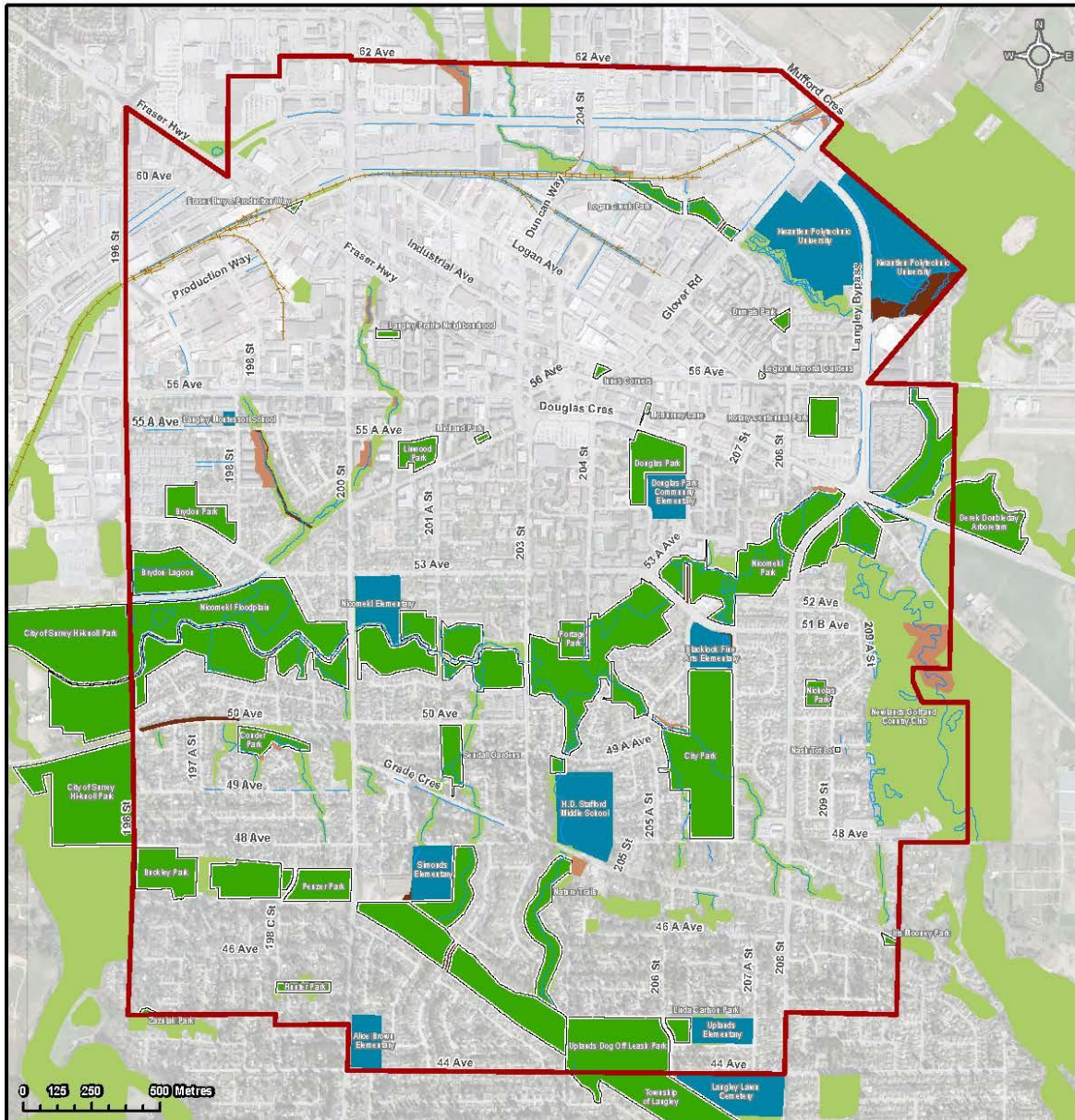
Land Use/Ownership	Area (hectares)	Percentage of city by area
Parks	133	13.1
Other City owned properties	4	0.4
Institutions	39	3.8*
Private natural area	76	7.4
Private natural area with restrictive covenant	6	0.6
TOTAL**	252	24.7

* including buildings/infrastructure

** not including private natural area protected with restrictive covenant

- **Unequal Application of Regulations:** A variety of policies and regulations, from all levels of government, are in place to manage and protect natural features and ecosystem values (see Appendix A). However, they do not always apply equally across public and private land, and for all jurisdictions. Changes or inadequacies in existing legislation may also influence how certain values are managed (or not managed). Likewise, management capacity may affect the ability to enforce existing legislation or to implement new measures and best practices, reducing overall effectiveness. The City's policies and bylaws may need to be updated to respond effectively to changing regulatory conditions, anticipated future challenges (e.g. climate change), and to balance objectives of community development and environmental protection or enhancement/restoration.

Due to these factors, a variety of policy and regulatory tools are necessary to effectively manage environmentally sensitive areas.



Legend

- | | |
|--------------------------|---------------------------------|
| City of Langley Boundary | Parks |
| Railway | Institutional |
| Creeks/Rivers | City-owned |
| | Private - Restrictive covenants |
| | Private |

Open Space Ownership (tenure)

Project:
Langley ESA Mapping Study

Client:
City of Langley



Drawn By: A. Needoba and C. Lefrancois

Date: Oct. 29, 2015

Air Photo Year: 2014



DIAMOND HEAD

4.3 Management Recommendations

The management recommendations in this section reflect the City's unique ecological conditions, risks, opportunities and constraints, land use, and regulatory environment. Successful implementation will require that strategies are proven, cost-effective and support other City plans and initiatives such as parks plans and stormwater management plans.

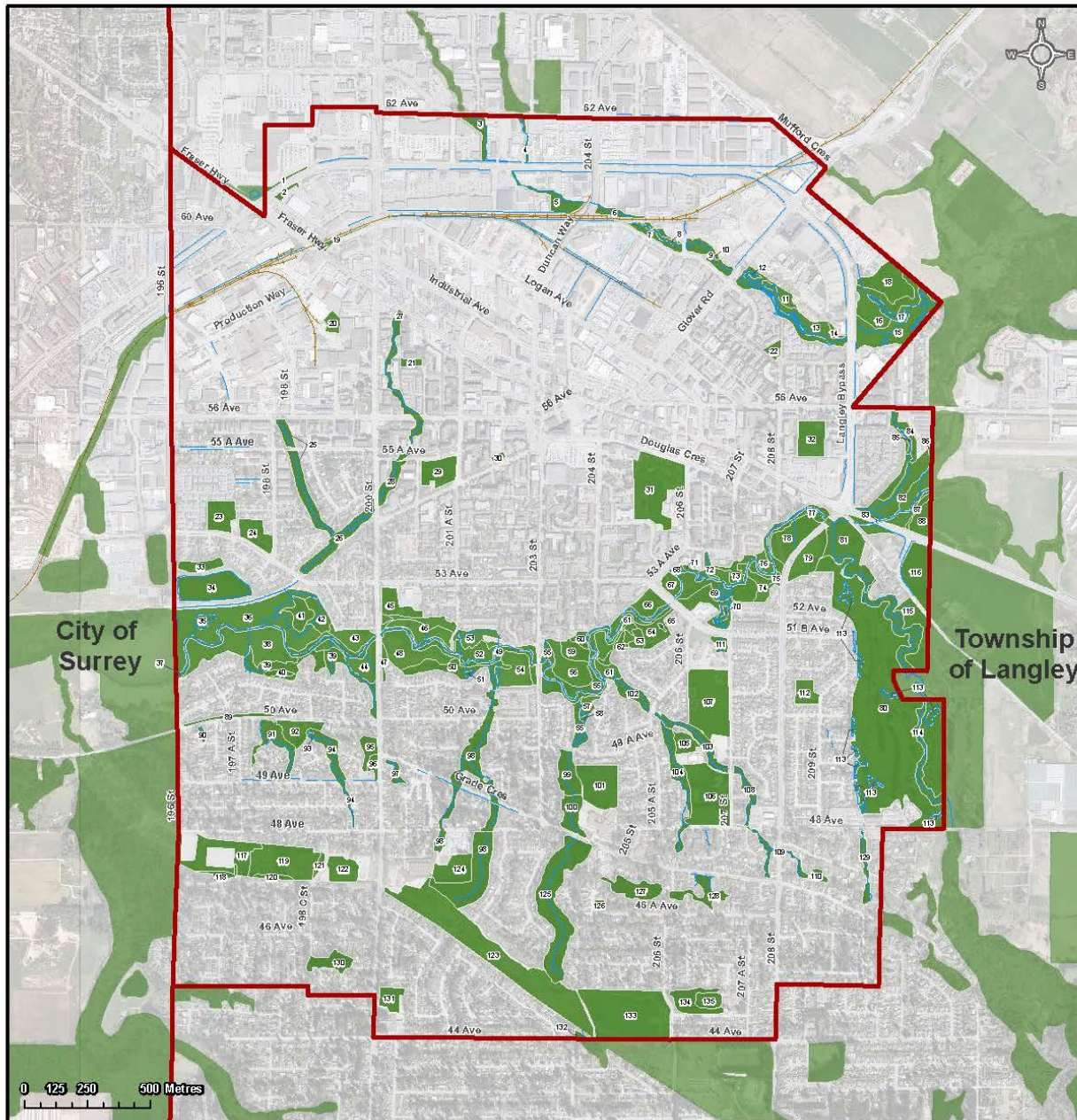


Photo Credit: Shon Troelstrup






The Environmentally Sensitive Areas map that follows represents a **Green Infrastructure Network (GIN)**, which is defined as the “interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife.”¹ Each number represents the individual ecosystem polygons derived from Metro Vancouver’s Sensitive Ecosystem Inventory and further refined as part of this study. When connected, these ecosystems form a whole greater than the sum of its parts. The City of Langley’s natural areas are also integral as part of a regional framework, exemplified by the natural connections to terrestrial and aquatic habitat in neighbouring municipalities. Natural ecosystems do not typically follow political boundaries; therefore, it is important that ecological management take a more holistic view to be successful.

Management recommendations in this section are organized by category. Where relevant, recommendations are linked to specific ecosystem polygons to guide specific actions.

¹ Benedict, M. and McMahon, E. 2006. Green Infrastructure: linking landscapes and communities. The Conservation Fund.



Legend

-  Municipal Boundaries
-  Watercourses
-  Railway
-  Environmentally Sensitive Areas
-  Sensitive Ecosystem Inventory (Metro Vancouver)

Environmentally Sensitive Areas

Project:
Langley ESA Mapping Study
Client:
City of Langley



Drawn By: D. Lishman and C. LeFrancois

Date: Oct. 29, 2015

Ortho Year: 2014



DIAMOND HEAD



A. Planning and Development

Objective: Integrate Environmentally Sensitive Areas (ESAs) into the City of Langley's planning and development framework

A.1 ESA Implementation

#	Management Recommendation	Priority H: < 2 yrs; M: 2-5 yrs; L: >5 yrs	SEI Polygon #
A.1.1	Incorporate recommendations from ESA Mapping Study into relevant City policies.	H	n/a
A.1.2	Review and update ESA mapping every 10 years to ensure most up to date information is considered in City planning.	L	n/a
A.1.3	Maintain ESA mapping outside of the OCP to permit greater flexibility to update as required.	ongoing	n/a
A.1.4	Provide sufficient resources and staffing to support ESA implementation and management.	M	n/a
A.1.5	Ensure interdepartmental and interagency cooperation to manage ESAs.	ongoing	n/a
A.1.6	Amend zoning bylaw to include designated riparian area setbacks (see A.3.1. for additional detail).	H	n/a
A.1.7	<p>Update Development Permit Area Guidelines to support ESA management and ensure future development recognizes and is compatible with ESA values:</p> <ul style="list-style-type: none"> • Create a single Environmental Development Permit Area designation to manage all ESAs. The Environmental DPA shall include all ESAs. Properties either wholly or partly within an ESA should be required to follow DPA provisions and/or guidelines where relevant; • Prohibit development in all ESAs ranked as moderate to high value; • Place strict development controls for ESAs ranked moderately low to low value, with focus on maintaining and/or improving ecological connectivity and function where possible; • Locate and design development in DPAs to protect, complement and enhance ESA values, including natural areas, landforms, and hydrological function; • Locate development away from sensitive habitat and features; • Require habitat compensation at 2:1 replacement levels, or implement a cash-in-lieu mechanism, for any development affecting ESAs; • Require appropriate reports or environmental impact studies (e.g. environmental assessment, arborist report, slope stability report, Riparian Areas Report, etc.) submitted by a Qualified Environmental Professional (QEP) for all development within an Environmental DPA. 	H	n/a
A.1.8	Investigate implementation of stormwater usage fees to encourage reductions in impermeable surfaces.	M	n/a



A.1.9	Investigate funding opportunities for the protection and enhancement of Environmentally Sensitive Areas.	M	n/a
A.1.10	Encourage development of green infrastructure (e.g., bioswales, artificial stormwater wetlands, green roofs) to complement the ESA network and Integrated Storm Water Management Plan (ISWMP).	M	n/a
A.1.11	Formally recognize the City's ESAs as an integral component of the City's green infrastructure network. Implement measures (e.g. acquisition, easements, green infrastructure) to improve ecological connectivity throughout the City, particularly north of the Nicomekl River.	ongoing	n/a
A.1.12	Develop an Urban Forest Management Plan to enhance ESAs and improve environmental values in the urban matrix (defined as those areas outside of ESAs).	M	n/a
A.1.13	Develop an Invasive Species Management Plan to manage reed canarygrass, Japanese knotweed, purple loosestrife, Himalayan blackberry, American Bullfrog and other invasive plants, animals and insects that are degrading ESAs.	M	n/a
A.1.14	Improve and expand City trail system to support ESA network.	ongoing	13,26,27, 28, 34

A.2. ESA Management – Sensitive Ecosystems

#	Management Recommendation	Priority (L, M, H)	SEI Polygon #
A.2.1	Identify and acquire priority high value ESAs that are not currently within the parks and open space system, where feasible.	ongoing	5,6,26,27, 28,72,98
A.2.2	Prioritize restoration and enhancement of the highest value ESAs.	ongoing	13,41,55, 57,58,98,55, 99, 100, 125
A.2.3	Use passive and active strategies to encourage natural succession and restore reed canarygrass dominated landscapes within floodplain ecosystems.	ongoing	8,10,13,36, 43,54,57
A.2.4	Continue to work in partnership with private developers to protect ESAs through application of land use controls such as restrictive covenants and easements.	ongoing	25,26,27, 28
A.2.5	Encourage naturalization of landscaped City parks in low use areas (where possible) to support ecological function and connectivity.	L	103,106,117, 119,123
A.2.6	Develop a strategy to increase green space and natural areas in industrial and commercial areas north of the Nicomekl River. Potential strategies include decreasing impermeable surfaces, tree planting on parking lots and boulevards, encouraging green infrastructure (green roofs, bioswales, etc.) and restoring and enhancing existing natural areas. Consider integration of environmental values and ESAs as part of the Brownfield Redevelopment Strategy.	M	n/a



A.3. ESA Management – Watercourses and Riparian Areas

#	Management Recommendation	Priority (L, M, H)	SEI Polygon #
A.3.1	<p>Amend zoning bylaw to include minimum Streamside Protection and Enhancement Areas next to watercourses:</p> <ul style="list-style-type: none"> Minimum setbacks, corresponding to fish classifications, should be established that meet minimum Riparian Areas Regulation Simple Assessment methods. Minimum setbacks of 5 metres for Class C, 15 metres for Class B, and 30 metres for Class A watercourses should be implemented; A net-gain approach for riparian areas should be supported to meet restoration objectives. Incentives (e.g. increased housing density) and flexibility (e.g. development variances linked to setback averaging) should be permitted to encourage buy-in from developers; Grandfathering provisions for existing structures within SPEAs (i.e. non-conforming uses) should be included, with ultimate goal to re-establish riparian corridors through future re-development; In cases where the prescribed minimum setbacks are not accepted, riparian setbacks should be determined by a Qualified Environmental Professional (QEP) in accordance with the Riparian Areas Regulation. Wider setbacks may be required if QEP determines geotechnical, windthrow, flooding, or other environmental concerns warrant expansion. 	H	n/a
A.3.2	Work with landowners to restore riparian setbacks through incentives when re-development opportunities arise.	ongoing	n/a
A.3.3	Prioritize development of restoration and enhancement plans for Nicomekl River, Brydon Pond, Logan Creek, Muckle Creek, lower Pleasantdale Creek, and Baldi Creek, to improve water quality and fish habitat.	ongoing	n/a
A.3.4	Recognize Brydon Lagoon as a locally important biodiversity hub and continue management actions to protect and enhance ecological values.	H	34
A.3.5	Investigate an open drainage and daylighting policy for City watercourses.	M	n/a



B. ESA Management - Species of Conservation Concern

Objective: Manage Species of Concern, other native wildlife and their habitat in the City of Langley to ensure their persistence over the long-term.

#	Management Recommendation	Priority (L, M, H)	SEI Polygon #
B.1	Develop indicators to monitor ecological health and changes to Environmentally Sensitive Areas (ESAs) over time (see Appendix H).	M	n/a
B.2	Prioritize the reconnection of high value ESA and open space in the City of Langley and neighbouring municipalities and implement measures to improve connectivity and facilitate seasonal and daily movements of wildlife in and out of the area while reducing risk of wildlife mortality.	ongoing	3,4,5,15, 81,82,84 122,123, 133,
B.3	Consider expanding species re-introduction programs as habitat becomes restored to a suitability level such that it can support that species.	L	n/a

C. Climate Change

Objective: Incorporate adaptive management to improve ecosystem resilience to projected future climate changes.

#	Management Recommendation	Priority (L, M, H)	SEI Polygon #
C.1	Preserve and restore environmentally sensitive areas (particularly floodplain ecosystems) to mitigate and adapt to future climate change scenarios.	ongoing	n/a
C.2	Develop landscaping and planting guidelines to ensure trees and vegetation can adapt to projected climate change.	M	n/a
C.3	Partner with other agencies to identify risks to riparian habitat from rising temperatures. Prioritize protecting those areas by planting streamside and riverside vegetation that enhances shading, and will provide microhabitat refuge in the future.	M	37 & fish-bearing creeks.



D. Community Stewardship, Education and Awareness

Objective: Increase public awareness of the City's Environmentally Sensitive Areas and support community stewardship initiatives to improve ecological condition.

#	Management Recommendation	Priority (L, M, H)	SEI Polygon #
D.1	Engage the public through Citizen Science programs, whereby members of the public can report rare or interesting species in their backyards or in public space, and submit those findings to the City.	M	n/a
D.2	Continue to pursue and support watercourse and riparian areas restoration and enhancement projects in partnership with local stewardship groups.	ongoing	n/a
D.3	Increase education, signage, and enforcement to protect sensitive ecosystems and wildlife from disturbance including off-leash dogs and cats.	M	n/a
D.4	Enhance nature and wildlife viewing opportunities as part of parks planning. Options include providing public bird blinds, towers, nature trails, elevated boardwalks that would not be subject to flooding, and interpretive/interactive signage (e.g. QR Code app or sign-directed informative walk).	ongoing	34, 37
D.5	Work with local schools to encourage nature awareness and education in the City's Environmentally Sensitive Areas.	M	n/a
D.6	Celebrate and promote Environmentally Sensitive Areas and biodiversity in partnership with local stewardship groups and the general public through locally, nationally, and internationally recognized events (e.g. World Migratory Bird Day).	M	n/a
D.7	Increase public education on City and provincial regulations associated with dumping or polluting the City's watercourses and riparian areas, including potential fines.	M	n/a

5.0 Monitoring

Effective management of natural areas requires a long-term approach wherein changes observed in the natural or built environment can trigger adaptive management. Adaptive management, which incorporates a continual feedback loop to measure, assess, and adapt as a means to better improve performance, is a valuable tool to ensure objectives are being met or are realigned appropriately to respond to unknown conditions in the future. Adaptive management involves collecting new knowledge through monitoring data. Monitoring data will, in turn, influence best practices, and changes in development and land use.

The ESA Mapping Study includes measures to monitor and assess the City of Langley's progress towards meeting its management objectives. The monitoring measures and performance benchmarks in this ESA mapping study support and direct management action for achieving City-specific objectives such as natural areas acquisition, public education, or for ensuring an effective policy framework is in place. Some are based on measures used in the United Nations' City Biodiversity Index.*

*The *City Biodiversity Index* (CBI) was initiated in 2008 under the auspices of the UN Convention on Biological Diversity (CBD). The intent of the CBI is to provide an international standard to help cities benchmark their biodiversity conservation efforts, which can be used as a proxy for ESA management in the City of Langley. The CBI was designed to measure three distinct components:

- native biodiversity in the city;
- ecosystem services provided by biodiversity in the city; and
- governance and management of biodiversity in the city.

As of 2015, testing of the CBI is still being undertaken by numerous cities around the world.



Photo Credit: Cos van Wermeskerken

5.1 ESA Management Objectives, Assessment Criteria and Performance Indicators

Management objectives, assessment criteria and performance indicators are provided below.

Key Objectives	Assessment Criteria	Performance Indicators			
		Low	Moderate	Good	Optimal
Encourage retention of Langley's natural areas	Proportion of natural areas in City retained*	<10% of land base is retained as natural area	10-20% of land base is retained as natural area	20-30% of land base is retained as natural area	>30% of land base is retained as natural area
Establish ESA (green Infrastructure) network	Proportion of ESA network established	<30% of ESA network is established	30-60% of ESA network is established	60-90% of ESA network is established	>90% of ESA network is established
Preserve representative ecosystems and habitat types	Preservation of representative ecosystems and habitat types in parks	<30% of representative ecosystems and habitat types are adequately represented	30-60% of representative ecosystems and habitat types are adequately represented	60-90% of representative ecosystems and habitat types are adequately represented	>90% of representative ecosystems and habitat types are adequately represented
Identify and protect critical habitat	Identification and protection of critical habitat	<30% of priority habitat areas incorporated into ESA network or protected	30-60% of priority habitat areas incorporated into ESA or protected	60-90% of priority habitat areas incorporated into ESA or protected	>90% of priority habitat areas incorporated into ESA or protected
Encourage connectivity of City of Langley's natural areas	Proportion of natural areas that are connected in ESA*	Little to no connectivity (>75% of patches isolated)	Some connectivity (50-75% of patches isolated)	Significant linkages established (25-50% of patches isolated)	Extensive linkages established (<25% of habitat patches isolated)
Increase biodiversity in built-up areas	Population of native bird species in built-up areas*	Population of native bird species at or below baseline (to be defined at later date)	Population of native bird species <10% above baseline	Population of native bird species 10-20% above baseline	Population of native bird species >20% above baseline
Enhance and restore degraded natural areas	Development and implementation of habitat enhancement and restoration plans for priority areas in ESA network	Habitat and enhancement plans implemented for <30% of priority natural areas in ESA	Habitat and enhancement plans implemented for 30-60% of priority natural areas in ESA	Habitat and enhancement plans implemented for 60-90% of priority natural areas in ESA	Habitat and enhancement plans implemented for >90% of priority natural areas in ESA
Develop species inventory and monitor changes in biodiversity	Change in number of indicator species	Inventory and monitoring protocol developed and implemented for <25% of indicator species	Inventory and monitoring protocol developed and implemented for 25-50% of indicator species	Inventory and monitoring protocol developed and implemented for 50-75% of indicator species	Inventory and monitoring protocol developed and implemented for >75% of indicator species
Manage alien invasive species in natural areas	Proportion of invasive alien plant species compared to native plant species*	Proportion of alien plant species is >0.21	Proportion of alien plant species is 0.11-0.20	Proportion of alien plant species is 0.01-0.10	Proportion of alien plant species is <0.01
Reduce impermeable surface to regulate quantity of water	Proportion of permeable surface in City's terrestrial land*	City has <25% permeable surface (excluding agricultural land)	City has 25-50% permeable surface (excluding agricultural land)	City has 50-75% of permeable surface (excluding agricultural land)	City has >75% permeable surface (excluding agricultural land)



Key Objectives	Assessment Criteria	Performance Indicators			
		Low	Moderate	Good	Optimal
Increase tree canopy for climate regulation and provision of other ecosystem services	Proportion of tree canopy cover compared to North American average of 34%*	City has <10% tree canopy cover (excluding agricultural land)	City has 10-20% tree canopy cover (excluding agricultural land) compared to North American average of 34%	City has 20-30% tree canopy cover (excluding agricultural land)	City has >30% tree canopy cover (excluding agricultural land)
Increase education and awareness of ESA issues in youth	Number of formal educational visits to natural park areas per child (<16 a) per year*	1 visit or less per year	2 visits per year	3 visits per year	4 visits per year
Increase education and awareness of ESA issues in youth	Inclusion of ESA/biodiversity related programs in educational institutions*	No programs exist or are being considered	Programs are being planned	Programs are being implemented	Programs exists
Increase public awareness of value of ESAs and biodiversity	Implementation of outreach events/programs and public awareness*	<5 events per year; little to no public awareness of issues	5-10 events per year; some local awareness of issues and management actions	11-15 events per year; local awareness of issues and management actions	>15 events per year; neighbourhood awareness of issues and management actions in natural areas
Increase budget allocation for ESA related projects and administration	Number of ESA-related projects implemented annually by City*	No ESA-related projects initiated	1-5 ESA-related projects initiated	6-10 ESA-related projects initiated	>10 ESA-related projects initiated
Implement ESA management plan	Implementation of ESA management plan*	No ESA management plan	ESA management plan developed	ESA management plan reviewed and updated semi-regularly to reflect conditions, goals and BMPs	ESA management plan regularly reviewed and updated to reflect conditions, goals and BMPs
Develop and implement an acquisition strategy for priority ESAs	Enactment of ESA acquisition strategy	No Acquisition strategy/Acquisition strategy developed with <30% of priority areas acquired	Acquisition strategy developed; 30-60% of priority areas acquired	Acquisition strategy developed; 60-90% of priority areas acquired	Acquisition strategy developed; >90% of priority areas acquired
Employ adequate staff to deliver comprehensive ESA management program	Ability of staff to deliver comprehensive program	No staff or staff unable to deliver <30% of comprehensive program	Staff able to deliver 30-60% of comprehensive program	Staff able to deliver 60-90% of comprehensive program	Staff able to deliver >90% of comprehensive program
Develop and implement appropriate regulatory and enforcement mechanisms to support ESA management objectives	Implementation and enforcement of policy and bylaws	No policies or bylaws to manage ESAs	Policies developed, with voluntary implementation, to manage ESAs	Policies and bylaws implemented to support ESA management objectives	Regulatory and enforcement programs in place to support ESA management objectives



Key Objectives	Assessment Criteria	Performance Indicators			
		Low	Moderate	Good	Optimal
Improve interagency and regional cooperation for ESA management	Number of interagency and regional partnerships established*	No interagency or regional partnerships established	1 – 5 interagency or regional partnerships established	6 – 10 interagency or regional partnerships established	>10 interagency or regional partnerships established
Improve institutional capacity and cooperation for ESA management	Involvement of City and local government agencies in ESA management*	No cooperation in City administration to achieve common goals and objectives	Common goals and objectives are identified; minimal cooperation	Cooperation to achieve priority goals and objectives	Efficient management structure in place to coordinate to achieve common goals and objectives
Improve interagency and regional cooperation for biodiversity management	Regional cooperation with adjacent municipalities and Metro Vancouver	No integration or participation with regional ESA/biodiversity initiatives	Some participation in regional ESA/biodiversity initiatives	Cooperation with adjacent municipalities and Metro Vancouver to integrate regional biodiversity/ESA management initiatives	Full integration with regional ESA/ biodiversity initiatives

* Criteria adopted from City Biodiversity Index

Appendix A – Environmental Policies and Regulations

Federal

Federal involvement in municipal affairs is limited due to constitutional provisions that give provinces jurisdiction over most matters. Some relevant exceptions include regulation of fisheries, species at risk, and migratory birds:

- **Fisheries Act, 1985.** Lists regulatory requirements that focus on fish protection for aboriginal, commercial and recreational fisheries;
- **Species at Risk Act, 2002 (SARA).** Includes provisions to help protect and manage threatened and endangered species and their critical habitat. The federal government's jurisdiction is limited to federally owned lands; however, provisions in the Act require that provinces protect listed species to the standards of SARA;
- **Migratory Birds Convention Act, 1994 (MBCA).** Enacted to implement the *Migratory Birds Convention*, a treaty signed with the United States to protect *listed* bird species. The federal government has jurisdiction wherever listed birds occur;
- **Canadian Biodiversity Strategy (1995).** Canada's response to the Convention on Biological Diversity. Canada was an original signatory at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro.

Provincial

The Province grants municipalities the authority to govern its own affairs and pass by-laws relating to its environmental, social and economic well-being. However, the province does maintain jurisdiction in some areas:

- **Local Government Act, 1996.** This Act outlines the powers and responsibilities of local governments. This includes implementation of land use regulations, development requirements, provisions for park land acquisition and designation of environmentally sensitive areas;
- **Fish Protection Act, 1997** and attendant **Riparian Areas Regulation, 2004 (RAR).** RAR was enacted to protect riparian habitat and maintain stream health and productivity. It requires municipalities to enact streamside protection provisions during development, using a meet-or-beat approach;
- **Wildlife Act, 1996.** Provides for the protection and management of wildlife in British Columbia, including endangered and threatened species.
- **Water Sustainability Act, 2015.** Replaces the Water Act with intent to manage both surface and groundwater water (which was not previously regulated) in the province.
- **British Columbia Biodiversity Strategy.** A framework is currently being developed to prepare a Biodiversity Strategy for the province. This framework includes a report on the Status of Biodiversity (2008), a Biodiversity Atlas (2009) and other supporting material. Component reports address impacts to biodiversity, climate change, key and special elements, genetic diversity and First Nations.

Regional/Municipality

Municipalities are granted authority by the Province to enact by-laws to address issues of local or regional importance. Many of these relate to land use planning, development and environmental sensitivity:

- **Metro Vancouver Regional Growth Strategy, 2011.** Provides direction for regional growth to 2040. Sustainability goals include environmental protection and climate change adaptation. The Strategy identifies key Conservation and Recreation areas and outlines regional, municipal, and provincial roles and actions necessary to achieve objectives;
- **Metro Vancouver Regional Parks and Greenways Strategy, 2011.** A key regional sustainability plan that focuses on protection of the natural environment, supporting public health, wellness and recreation and developing partnerships to acquire park land and operate regional parks;
- **Metro Vancouver Ecological Health Action Plan, 2011.** Emphasizes benefits of ecological services provided by intact, natural ecosystems. Key opportunities to improve regional ecological health were identified, including development of green infrastructure, supporting salmon in urban areas, supplementing ecosystem services and reducing toxins;
- **Metro Vancouver Biodiversity Conservation Strategy.** This Partnership is developing an action plan to conserve biodiversity in the Region. The Plan will identify biodiversity “hotspots” and develop strategies towards a framework of corridors/greenways in Greater Vancouver. Work will guide and complement municipal initiatives to conserve biodiversity;
- **City of Langley Official Community Plan Bylaw, 2005, No. 2600.** The OCP provides general objectives, policies and guidance for future planning and development in the City. It provides direction to protect environmentally sensitive areas (Section 9.0), including Development Permit Area Guidelines (17.9);
- **City of Langley Sustainability Framework, 2010.** Expresses the City’s commitment to sustainability and creates a structure to align the City’s policies, plans and actions towards these goals. The Sustainability Framework envisions a connected system of green spaces, greenways, and natural areas that support local ecology, biodiversity, and recreation;
- **City of Langley Brownfield Redevelopment Strategy, 2012.** Investigates opportunities, strategies and planning tools to redevelop brownfield sites in the City’s industrial and commercial lands;
- **City of Langley Watercourse Protection Bylaw, No. 2518.** Prohibits discharge of harmful or deleterious substances into the City’s drainages and Environmentally Sensitive Areas;
- **City of Langley Floodplain Elevation Bylaw, No. 2768.** Reduces exposure risk for new development by reducing the potential for damage to structures and property due to flooding;



- **Pond Management Strategies, 2013.** Recommends policies and strategies to support the operations and maintenance of three ponds: Brydon Lagoon, Seniors Recreation & Resource Centre Pond, and Sendall Gardens Pond.

Appendix B – Public Open House Responses

Question	Score*
<i>Sensitive Ecosystems</i>	
1. The City should focus its management efforts on protection and restoration of its rarest habitat types.	4.7
2. The City should work to improve or restore habitat values by controlling invasive species (e.g. reed canarygrass, Himalayan blackberry, and Japanese knotweed) and restoring habitat to its native condition.	4.2
3. In order to remove invasive species, the City should consider mowing and planting, or shading out techniques when appropriate (e.g., Himalayan blackberry, reed canarygrass).	3.7
4. In order to remove invasive species, the City should consider herbicide use when necessary (e.g., control of Japanese knotweed).	4.0
5. The City should work with Metro Vancouver, Surrey, and the Township of Langley to support protection and enhancement of important regional connections for natural areas.	4.5
<i>Additional comments:</i> <ul style="list-style-type: none"> No specific mention about Purple Loosestrife which LFN attacked with <i>Calerula kalmariensis</i> beetles in the Brydon Pond area and other small infested areas in both the City and Township of Langley. LEPS have current breeding experience with this beetle; Wetlands should be considered very high value ecosystems; Invasive species fish could also be included (i.e. Brydon Lagoon); Cannot be successful on an isolated basis [working with other municipal and regional governments to protect and enhance regional connections for natural areas]. 	
<i>Watercourses and Riparian Areas</i>	
1. The City should acquire riparian areas that are not currently within the parks and open space system where feasible.	4.3
2. The City should continue to pursue and support enhanced watercourse and riparian areas projects in partnership with local stewardship groups.	4.5
3. The City should allocate more resources to cleaning up riparian habitat and watercourses in the City (e.g. removing garbage)	4.5
4. The City should work to enhance riparian areas by planting native vegetation and removing invasive species, where possible and practical.	4.8
5. The City should designate default minimum Streamside Protection and Enhancement Area (SPEA) widths around fisheries watercourses (currently SPEA's are determined by Qualified Environmental Professionals on a case by case basis).	4.5
<i>Additional comments:</i> <ul style="list-style-type: none"> Need to support [watercourse and riparian areas projects] with true costs that go above invasive removals. Should incorporate a large degree of stream bank stabilization and stabilization through floodplain, and removal of invasives such as blackberry in riparian along banks of Nicomekl River; Need to support with true costs that go above invasive removals. Should incorporate a large degree of stream bank stabilization and stabilization through floodplain, and removal of invasives such as blackberry in riparian along banks of Nicomekl River; Enhancement of boulevards in industrial areas to help offer corridors for birds and other wildlife. 	

Species of Conservation Concern	
1. As many habitats function best when they are connected to other habitats as corridors, the City should focus on reconnecting previously disconnected habitat corridors, to allow for wildlife to move among habitats more easily.	4.5
2. As many of the native amphibians in the City are vulnerable to local extinction due to invasive species like the American Bullfrog, the City should work to eradicate this species from ponds and waterways known to host them.	4.7
3. As many of the Species of Conservation Concern (SCC) in the City are vulnerable to off-leash dogs and cats, the City should do more to educate the public and to enforce off leash dog bylaws.	4.2
4. The City should work to enhance nature and wildlife viewing opportunities by providing public bird blinds/towers or nature boardwalks and signs.	3.7
5. The City should engage the public through Citizen Science programs, whereby members of the public can report rare or interesting species in their backyards or in public space, and submit those findings to the City.	4.2
Additional comments: <ul style="list-style-type: none"> • Cosmetic pesticide bylaw has been a great way to limit impacts on amphibian species, too! Great work implementing; • Elimination is never going to happen to bullfrogs as they move so easily; areas should be enhanced to limit habitat features bullfrogs prefer; • Pleasantdale creek pollution due to former city dump (i.e. water quality); • Lower end of Brydon Lagoon channel needs to be established for salmon enhancement; • Reporting rare/interesting bird species already in operation on a regional basis. The city's small area may not be enough for meaningful feedback. 	
Overall ESA Map and ESA Management	
1. The City should prioritize restoration of natural areas within the Nicomekl River floodplain.	4.8
2. The City should apply policies, guidelines and regulations to protect and manage Environmentally Sensitive Areas (ESAs) according to their sensitivity values.	4.3
3. The City should encourage restoration of natural habitat as a condition of development, where feasible.	4.8
4. The City should increase the amount of natural habitat in landscaped parks.	4.0
5. The City should develop indicators to monitor ecological health and changes to Environmentally Sensitive Areas over time.	4.5
6. The City should include more detailed guidance and requirements for developing within existing Environmental Development Permit Areas.	4.5
Additional comments: <ul style="list-style-type: none"> • Floodplain area has potential to be a real jewel; major enhancement could occur; massive removal of invasive species and planting of diverse vegetation; • Concern about natural areas in landscaped parks offering areas for homeless; • Since our defined environmentally sensitive areas are already so small, why not just ban development in such areas [Environmental DPAs]? • Small area of city would make this [increasing natural habitat in landscaped parks] difficult. 	
Open Space Map	
1. The City has put aside a sufficient amount of land for protection (environmentally sensitive areas).	2.3
2. The City should use Community Amenity Charges (paid by developers) to fund the protection and enhancement of Environmentally Sensitive Areas (ESA's).	4.5

3. The City should continue to work in partnership with private land owners to protect ESAs through application of land use controls such as restrictive covenants and easements.	4.3
4. Where feasible, the City should acquire ESAs that are not currently within the parks and open space system.	4.2
<p><i>Additional comments:</i></p> <ul style="list-style-type: none"> • More land should be park space in NW corner industrial area, boulevards for corridors and enhance fore area so it looks better and workers benefit; • Suggest that detailed review of zoning bylaws and their application should be undertaken on a periodic basis in currently defined ESAs. 	

* Average of all individual survey responses. Individual responses were ranked on a 1 to 5 scale (1 – strongly disagree, 2 – disagree, 3 – not sure or neutral, 4 – agree, 5 – strongly agree).

APPENDIX C – Assessment Methods

Updated Environmentally Sensitive Areas (ESAs) in the City of Langley were determined using a science-based value assessment of ecosystems combined with local knowledge from community members and stakeholder groups. The value assessment incorporates a cumulative ranking of four sensitive ecosystem components: *Species of Conservation Concern (SCC)*, which includes measures such as connectivity, disturbance, and context, *Ecosystem Rarity*, *Flood Risk*, and *Watercourse (Fish) Classifications*. Each component is weighted equally, using a 0 to 5 (low - high) sensitivity/risk scale, to provide a final ESA Value.

$$ESA\ Value\ (0-5) = (Ecosystem\ Rarity + SCC + Flood\ Risk + Watercourse\ Classification) \div 2.4$$

Final ESA Values were adjusted (where appropriate) based on community/stakeholder feedback. For example, where stakeholder groups have identified specific areas of conservation concern in the City of Langley.

A.1 Sensitive Ecosystem Inventory Mapping A Sensitive Ecosystem Inventory (SEI) conducted by Metro Vancouver (2014) was used as a starting point for habitat mapping in the City of Langley. SEI mapping provides standardized ecological information to support future decision making. Generally, SEI mapping followed Provincial and Metro Vancouver standards,² but was modified to meet City of Langley planning objectives where appropriate. For example, due to minimum size limits for polygons in the Metro SEI, some polygons contained multiple ecosystem units (e.g. wetland marsh, old forest coniferous, riparian fringe) and were represented as a percentage of the whole polygon (e.g.. Wetland 10%, Riparian 30%, Mature Forest 60%). A finer scale of mapping (≥ 0.1 hectares) used in the City of Langley permitted these original Metro Vancouver SEI polygons to be subdivided into distinct units representing only a single ecosystem unit. Metro SEI polygons were ground-truthed and any resulting modifications to their classification were completed in collaboration with Metro staff. Other information collected during ground-truthing included notes on condition (e.g. prevalence of invasive species) and wildlife/vegetation species observed. Additionally, some new classifications were created for the City of Langley for planning purposes. These included the addition of three Modified Ecosystems: reed canarygrass [ME(rc)], turf [ME(tu)], and agriculture [ME(ag)].

A.2 Ecosystem Rarity

A value was applied to each polygon to account for the relative rarity of that particular ecosystem (i.e. habitat type), measured as a percentage of the area of all sensitive ecosystems in the City.

² Meidinger, D., Clark, J., and Adamoski, D.. 2014. Sensitive Ecosystem Inventory for Metro Vancouver & Abbotsford 2010 – 2012 Technical Report.

Table 1. Determination of Final Value for Ecosystem Rarity

Indicator	Measure	Sensitivity/Risk Ranking
Relative rarity of ecosystem within City of Langley, measured as a % of total area of all ecosystems.	Ecosystem comprises < 11% of total area of all ecosystems	High (3)
	Ecosystem comprises 11% - 22% of total area of all ecosystems	Medium (2)
	Ecosystem comprises > 22% of total area of all ecosystems	Low (1)

A.3 Species of Conservation Concern

Species of Conservation Concern (SCC) are described as those species that are on the provincial Red (Endangered/Threatened) or Blue (Special Concern) list, and/or that are federally identified as a Species at Risk (SAR). An *SCC Value* rating was applied to each polygon (ecosystem) based on its potential to support Species of Conservation Concern (*SCC potential*) and *Permeability*. *SCC Potential* was determined by considering the habitat available and the relative number of SCC associated with that habitat type. *Permeability* is a measure used to account for typical disturbances that can affect the quality of habitat in urban areas. Considerations include *connectivity* (habitat size and degree of landscape fragmentation), *context* (adjacent disruptive land use activities), and *condition* (the amount of edge to surface area and loss of habitat function due to invasive species). *SCC Value* was ranked on a 0 to 3 scale, including decimals. More detail on how SCC potential and permeability values were determined is provided below.

$$SCC\ Value\ (0-3) = (SCC\ Potential + Permeability) \div 2$$

SCC Values were also converted to a five level ranking scale, as per Table 2 below. These rankings were not used in the final ESA value determination; however, the wider scale permits finer distinctions in habitat value across the landscape, which was used to develop management recommendations. Refer to Appendix X for SCC ranking data for all polygons.

Table 2. Determination of Final Value for SCC Potential

Indicator	Measure	Sensitivity/Risk Ranking
SCC potential and permeability.	2.5 – 3.0	Very High (5)
	2.0 - 2.4	High (4)
	1.5 – 2.0	Moderate (3)
	1.0 - 1.4	Low (2)
	0.1 - 1.0	Very Low (1)

A.3.1. Potential SCC

Potential SCC was evaluated based on the relative proportion of potentially occurring SCC within the City of Langley that can use each ecosystem type, under ideal conditions.

The potential number of SCC associated with each ecosystem type was first determined by searching the British Columbia Conservation Data Centre (BC CDC) online database for potentially occurring SCC in the City of Langley (see Table 3). The search was conducted for all plant and animal species with a Provincial (Blue or Red) or Federal (SARA, COSEWIC) conservation status. The search was constrained to only include species within the Chilliwack Forest District (DCK), the Lower Mainland MOE Region 2, the Metro Vancouver Regional District (MVRD), and the Coastal Western Hemlock (CWH) Biogeoclimatic zone. Within this restricted search area, CDC habitat units were used as search variables, including:

- Forest: Conifer Forest, Mesic
- Forest: Deciduous/Broadleaf Forest
- Forest: Mixed (Deciduous/Coniferous mix)
- Grassland/Shrub (unnatural)
- Other Unique Habitats: Vernal Pools/Seasonal Seeps
- Lakes: Pond/Open Water
- Riparian: Riparian Forest
- Stream/River
- Wetland: Marsh
- Wetland Swamp

SCC lists were generated for each CDC habitat unit (see Appendix X). Based on professional judgement, certain species were removed, as they were not considered as potentially occurring in the City of Langley due to low habitat suitability. For example, Grizzly Bear and Wolverine were excluded as these species are deterred by dense populations of humans, and require large tracts of connected, undisturbed habitat in good condition, which is not represented within the City of Langley.

Habitat types searchable on the CDC database were not identical to the Sensitive Ecosystem Inventory (SEI) classifications used for mapping in the City of Langley. Table 2 shows associations between these two classification systems based on presumption of similarity and professional judgment, in addition to listing the number of SCC potentially occurring within them.

Table 3. Potentially Occurring SCC within SEI Polygons/BC CDC Habitat Units.

Habitat Unit (BC CDC)	Ecosystem Type (SEI Classification)	Number of SCC
Forest: Conifer Forest, Mesic Forest	MF (co), YF (co)	22, 21
Forest: Deciduous/Broadleaf	MF(bd)	25
Forest: Mixed (Deciduous/Coniferous mix)	MF (mx)	26, 25
Grassland/Shrub (unnatural)	OD, ME (rc)	11,14
Other Unique Habitats: Vernal Pools/Seasonal Seeps	WN (sw)	11
Lakes: Pond/Open Water	WN (pd), WN (rs)	28, 28
Riparian: Riparian Forest	RI (ff), RI (gu)	33,33
Stream/River	RI (ri)	32
*Wetland: Marsh	WN (ms)	38
Wetland: Swamp	WN (sp)	28
Anthropogenic: Industrial	ME (tu)	3
Agriculture: Cultivated Field	ME(ag)	11

*Wetland: Marsh habitat was predicted to have the highest potential for SCC biodiversity.

The number of potentially occurring SCC for each ecosystem type was divided by the maximum number of SCC predicted within polygons comprising the City of Langley. In this case, the maximum SCC was predicted to be 38 species within wetland (marsh) habitat. SCC values were then converted to continuous values ranging from 0 to 3 by dividing by 0.3333.

$$\text{Potential SCC (0 – 3)} = (\text{Number SCC} \div \text{Max SCC}) \div 0.3333$$

A.3.2 Permeability

Permeability describes how well species are able to move through and among habitats to meet different daily or seasonal life history requisites. Permeability, as used herein, is a term that recognizes that such movement through and among habitat types is influenced by various factors including *connectivity* to adjacent natural areas, the types of activities and land use surrounding the habitat (*context*), and habitat *condition*. Combining connectivity, context, and condition into a single measure, permeability, allows for an equal rating weight with *SCC potential*. Permeability ranges in value from 0 to 3, and includes terminating decimals. This value was not rounded prior to use in the final ratings to prevent a loss of precision.

$$\text{Permeability (0 – 3)} = (\text{Connectivity} + \text{Context} + \text{Condition}) \div 3$$

Methods to derive value for *connectivity*, *context*, and *condition* are described below.

Connectivity

Connectivity describes whether ecosystem/habitat types form part of a contiguous corridor or larger natural area, or if they are isolated as smaller habitat islands. Habitat that is connected to larger green networks is considered more capable of hosting higher numbers of potential SCC. This is because connected habitat corridors allow for daily, seasonal, or annual movements between habitat types, and permits access to a much larger area to meet life requisites. Table 3 describes the criteria used to rate connectivity.

Table 4. Qualitative Evaluation Criteria for Connectivity Value

Indicator	Measure	Sensitivity/Risk Ranking
Degree of connectivity between ecosystem/habitat types	Habitat type falls within a larger green infrastructure network or corridor.	High (3)
	Habitat type is close to a larger tract or corridor, but may be somewhat disconnected. However, it could still be used for wildlife travel along the corridor, and reconnection could be possible through future land use planning and restoration/enhancement.	Medium (2)

	Habitat type is disconnected from other habitat and is unlikely to be used as a part of a larger network or corridor. Still, it may be used as a stopover or habitat 'island' by mobile species such as birds that are en route between larger tracts of habitat.	Low (1)
	Habitat is extremely isolated and within a highly industrialized area, far from other habitats. It is unlikely to be used as a stopover habitat.	Nil (0)

Context

Context is a term used to describe the amount and proximity of human activity occurring around a certain habitat. It recognizes that most wildlife species are negatively impacted to some degree by human caused disturbances (e.g. noise, activity). Typically, the more human activity (i.e. development) that exists, and the closer it occurs, the less likely that a particular habitat will be able to attract and support SCC, particularly those species that are less tolerant of human disturbance.

Table 5. Qualitative Evaluation Criteria for Context Value.

Indicator	Measure	Sensitivity/Risk Ranking
The type and proximity of human activities surrounding a habitat, which will impact the willingness and ability of wildlife to use a habitat.	Habitat contained within (or mostly contained within) other SEI units.	High (3)
	Habitat abuts some quieter human use areas like suburban housing, and also abuts other SEI units on at least 1 side.	Medium (2)
	Habitat abuts dense urban areas, industrial sites and busy roads on all sides. Heavily impacted by surrounding noise, human use, and traffic.	Low (1)
	Habitat abuts urban, suburban, roads, or industrial areas on all sides and is also undergoing active conversion to an unusable habitat type (e.g. tree clearing for housing development).	Nil (0)

Condition

Condition is a term used to describe the quality of the habitat and its capacity to buffer itself against outside influences (e.g. noise). Size and shape of habitat is considered, as habitat with larger surface area to edge ratios are generally thought to reduce outside influences on core habitat, and to host a higher diversity of species. Most SCC will be negatively impacted by small, fragmented habitats with high edge: surface area ratio. For example, these habitats often have little to no core habitat with minimal natural buffers, often resulting in higher rates of nest predation, more impacts from wind, and increased disturbance from humans and dogs.

Condition also considers the vegetation communities associated with a particular ecosystem, including invasive plant species. Invasive plants species often form monocultures that will exclude native vegetation and reduce overall habitat value.

Table 6. Qualitative Evaluation Criteria for Condition Value.

Indicator	Measure	Sensitivity/Risk Ranking
Habitat condition	Relative to other SEI units within the City of Langley, habitat retains much of its natural vegetation and function. Relatively small edge to interior ratio, or habitat edge falls within another SEI unit.	High (3)
	Impacted by modifications, some invasive species, but retains some of the functions, vertical vegetation structure, and species expected in the unmodified habitat. Moderate edge to internal habitat ratio.	Medium (2)
	Heavily modified, large or exclusive composition of non-native or invasive species, high edge to interior habitat ratio.	Low (1)
	Areas mainly consisting of impervious surfaces (developed areas), which are heavily used by humans.	Nil (0)

A.4 Floodplains

Lowland areas of the City of Langley are situated in the Nicomekl River floodplain. Healthy, functional floodplain ecosystems support a diversity of wildlife and provide benefits to people (e.g. water storage and peak flood attenuation). Development in floodplains can reduce ecological function by altering vegetation and increasing impervious surfaces, which can affect hydrology and result in more frequent and severe flood events. Homes within the Nicomekl floodplain are prone to periodic flood events, particularly since there are no existing flood control measures in this area. Flood intervals (based on elevation within the active floodplain) were used as indicators of flood risk, with a higher ranking given to more frequent flood intervals.

Table 7. Qualitative Evaluation Criteria for Floodplain Value.

Indicator	Measure	Sensitivity/Risk Ranking
Flood interval	1 in 2 year	High (3)
	1 in 10 year	Medium (2)
	1 in 200 year	Low (1)

A.5 Watercourse (Fish) Classifications

Watercourse classifications within the City of Langley follow generally accepted mapping standards for Metro Vancouver. Watercourses are categorized based on fish presence (or potential to have fish) and their relative value as fish habitat:

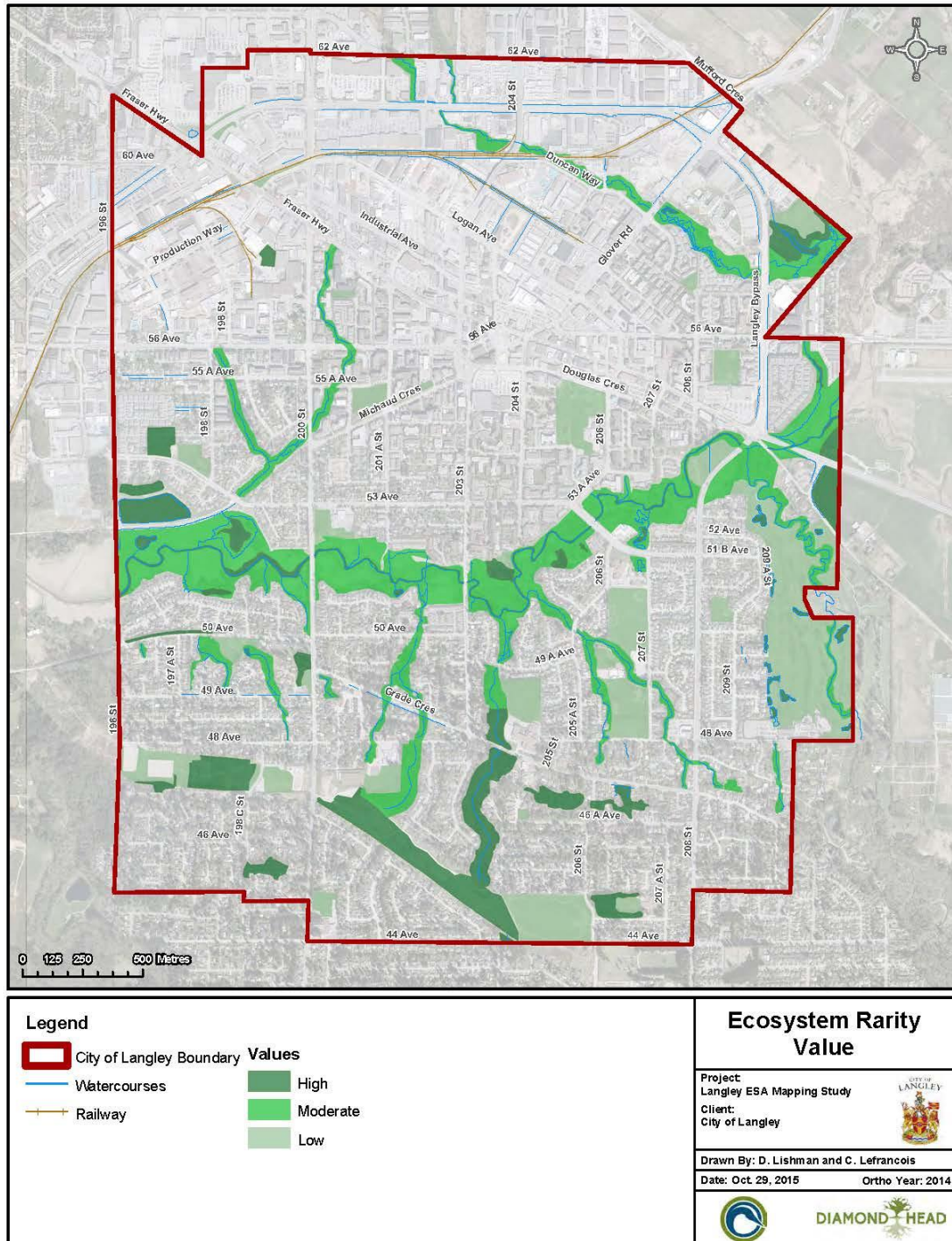
- Class A - Inhabited or potentially inhabited by salmonids year round
- Class A(O) - Inhabited or potentially inhabited by salmonids primarily during the overwintering period
- Class B - Significant food/nutrient value, no salmonids present.
- Class C - Insignificant food/nutrient value, no salmonids present.

Riparian areas were established based partly on the simple methodology used to establish Streamside Protection and Enhancement Areas (SPEA) under the provincial Riparian Areas Regulation Assessment. A maximum 30 metre buffer was applied for Class A and Class A(O) watercourses, and a maximum 15 metre buffer for Class B and C watercourses. Only natural or semi-natural areas (i.e. non-developed land) within these buffer extents were given a value ranking.

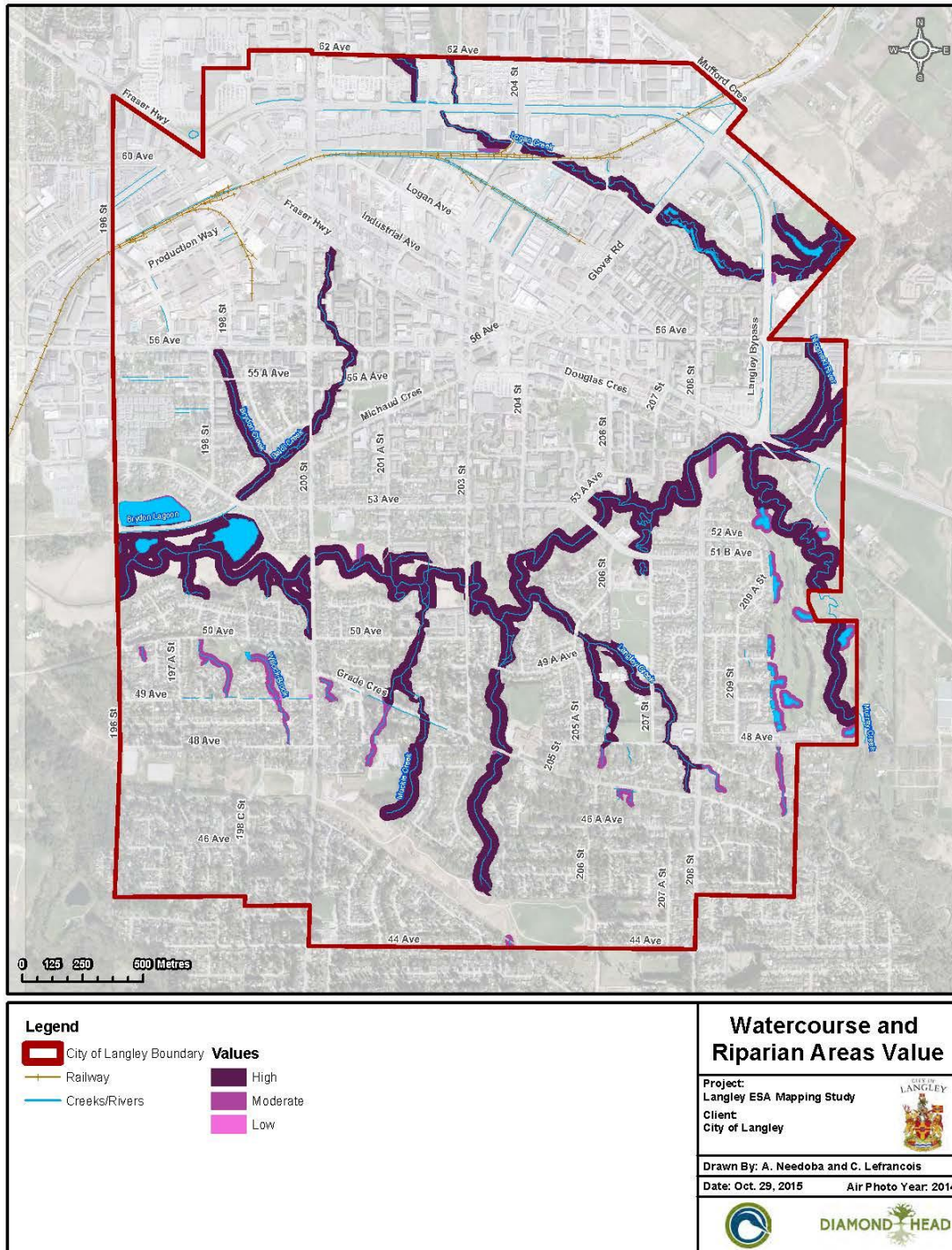
Table 8. Qualitative Evaluation Criteria for Watercourse and Riparian Area Value.

Indicator	Measure	Sensitivity/Risk Ranking
Watercourse/ fish classification	Class A, Class A(O)	High (3)
	Class B	Medium (2)
	Class C	Low (1)

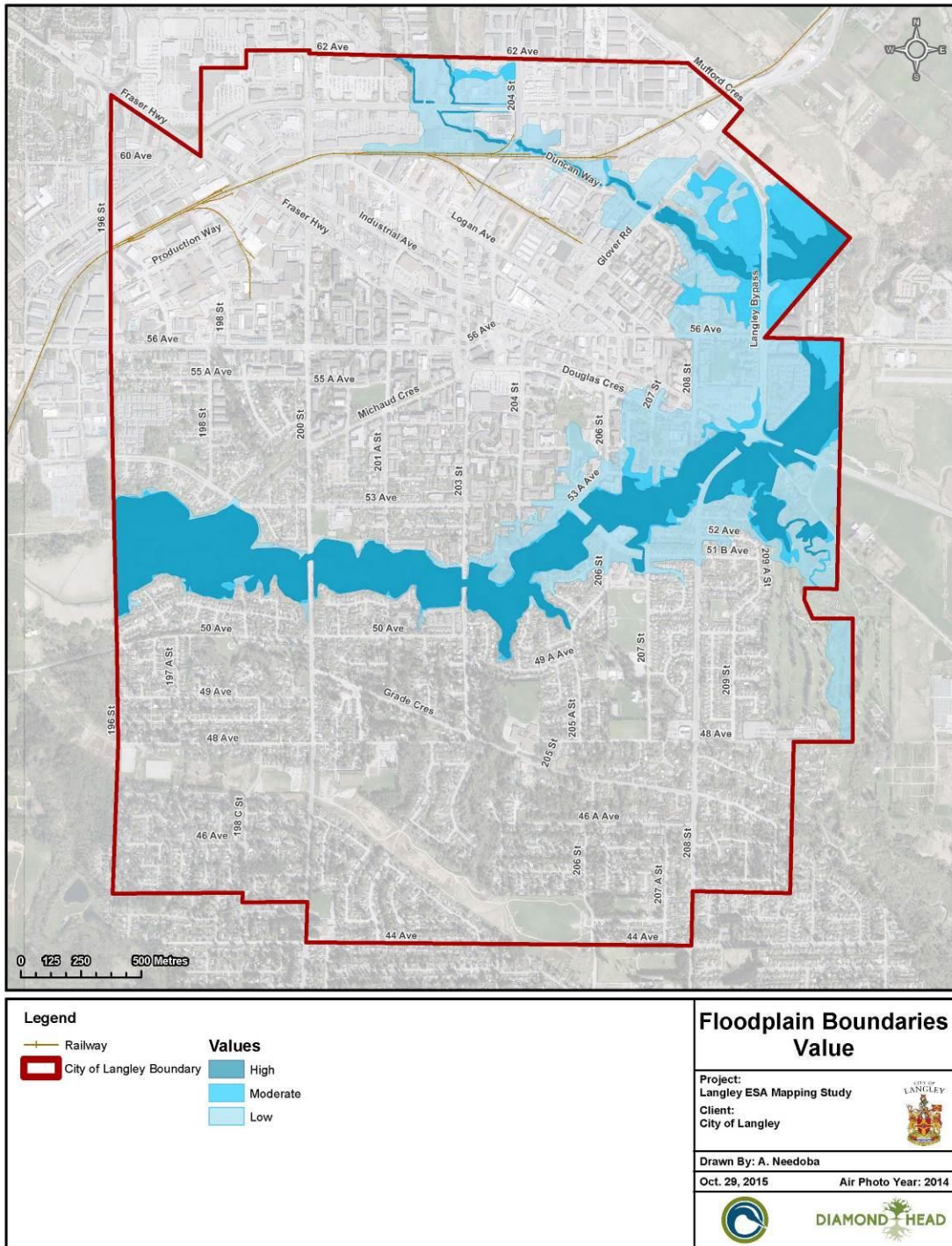
Appendix D – Ecosystem Rarity Value



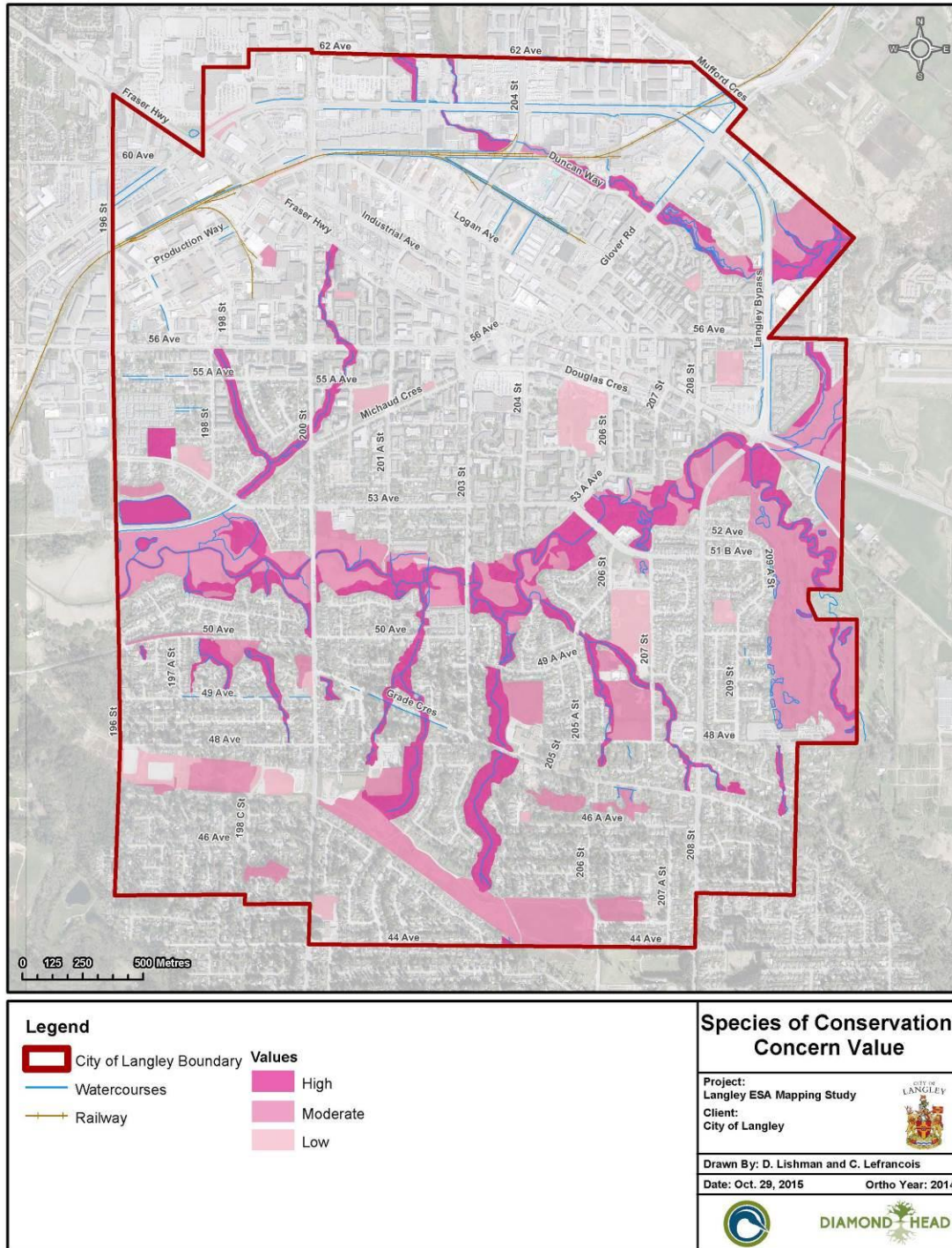
Appendix E – Watercourses and Riparian Areas Value



Appendix F – Floodplain Boundaries Value



Appendix G – Species of Conservation Concern Value



Appendix H – Potential Indicator Species for Environmental Monitoring

1. Potential Indicator Species to monitor ecological function of environmentally sensitive areas for representative habitats in the City of Langley.

Fish	Amphibians and Reptiles	Birds	Mammals	Insects	Plants
<ul style="list-style-type: none"> • Coho Salmon • Brassy Minnow • Cutthroat Trout 	<ul style="list-style-type: none"> • Pacific Chorus Frog • Common Garter Snake • Northwestern Salamander • Red-legged Frog 	<ul style="list-style-type: none"> • Great Blue Heron • Green Heron • Rufous Hummingbird • Barn Owl • Short-eared Owl • Cooper's Hawk • Red-breasted Nuthatch • Brown Creeper • Hairy Woodpecker • Downy Woodpecker • Marsh Wren • Song Sparrow • Yellow Warbler • Townsend's Warbler • Barn Swallow 	<ul style="list-style-type: none"> • Coastal Black-tailed Deer • River Otter • Southern Red-backed Vole • Townsend's Vole • Creeping Vole • Douglas Squirrel • Big Brown Bat • Mountain Beaver 	<ul style="list-style-type: none"> • Anise Swallowtail • Bumble Bee • Orchard Mason Bee • Stonefly sp. • Caddisfly sp. • Mayfly sp. • Riffle Beetle 	<ul style="list-style-type: none"> • Red huckleberry • Western flowering dogwood • Salal • Western redcedar

2. Potential indicator species to monitor disturbed ecosystems/extent of disturbance in the City of Langley.

Fish	Amphibians and Reptiles	Birds	Mammals	Plants
<ul style="list-style-type: none"> • Brown Bullhead • Largemouth Bass 	<ul style="list-style-type: none"> • American Bullfrog • Green Frog 	<ul style="list-style-type: none"> • European Starling • House Sparrow 	<ul style="list-style-type: none"> • Norway Rat • Feral Cats • Eastern Grey Squirrel 	<ul style="list-style-type: none"> • Japanese knotweed • Himalayan blackberry • Policeman's helmet • Purple loosestrife • Scotch broom • Reed canarygrass