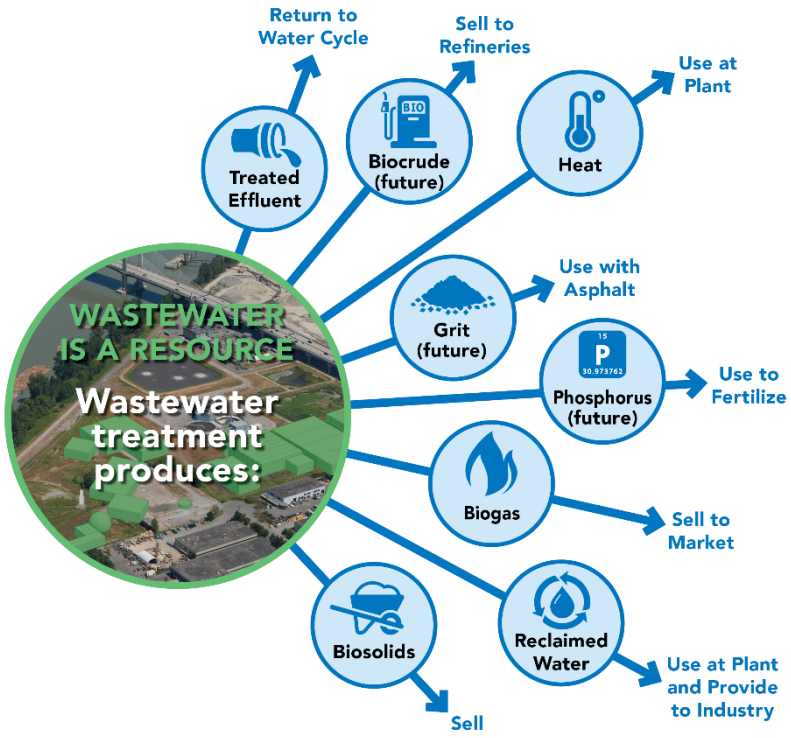
Introduction

The Northwest Langley Wastewater Treatment Plant (NLWWTP), which currently serves 30,000 people in the Township of Langley, will be expanded on the same site to serve 230,000 people, including residents and businesses in Maple Ridge and Pitt Meadows, across the Fraser River. The existing NLWWTP provides secondary treatment; the new plant will produce a higher quality effluent using advanced secondary treatment and tertiary filtration.

This indicative design report focuses on the plant expansion and new outfall. It establishes a design basis and advances the design of the required infrastructure sufficiently to be able to develop cost estimates, so Metro Vancouver can subsequently proceed with the detailed design engineering phases in 2019. The Indicative Design included in this report was developed to fulfill Metro Vancouver's four project objectives:

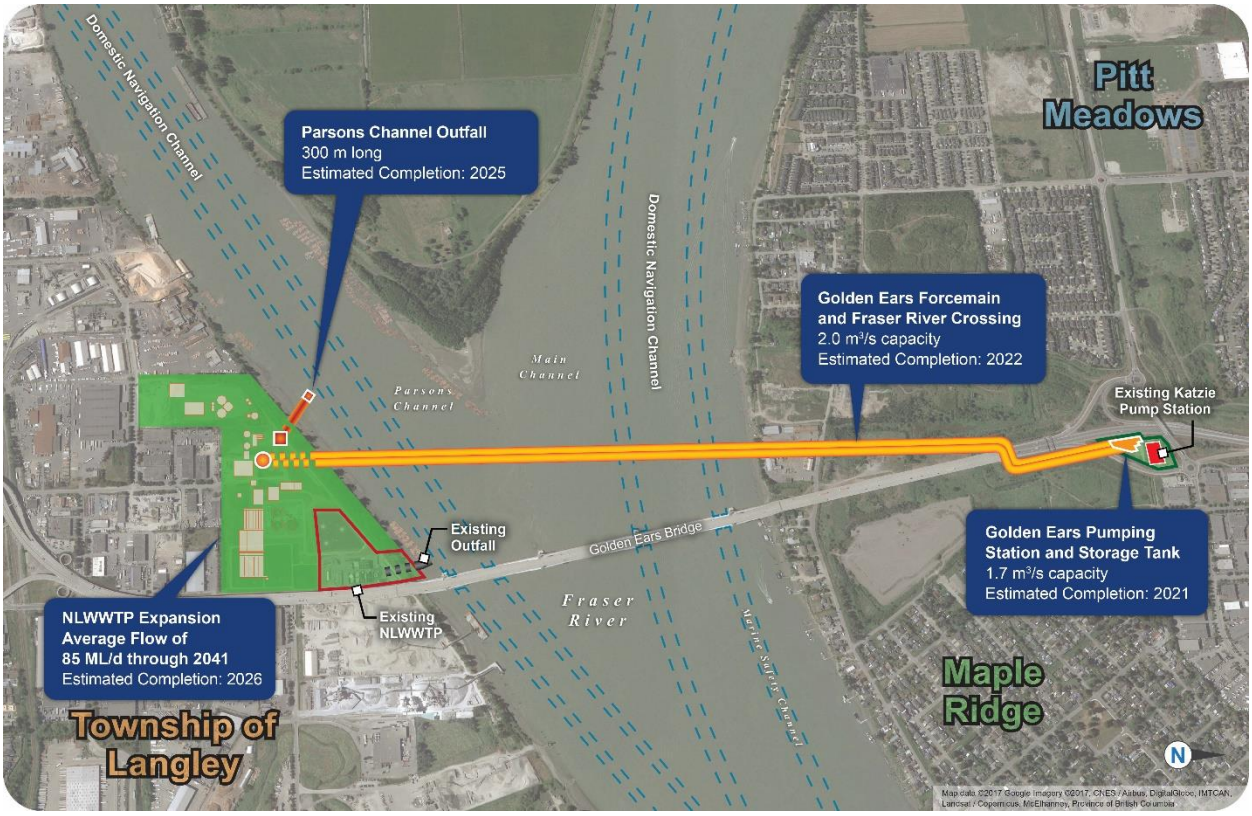


1. **The provision of robust wastewater treatment that meets both federal and provincial regulatory requirements, protects the Fraser River, and can be readily expanded in the future with similar or more advanced treatment technologies to accommodate more stringent discharge criteria**
2. **The inclusion of an odour control strategy that will reduce plant-generated odour**
3. **The implementation of an integrated resource recovery strategy**
4. **The design of a treatment plant that provides community enhancement opportunities**

This Indicative Design Summary Report provides an overview of the project. It describes the project components, design criteria, treatment technologies, cost estimate, and community enhancement opportunities available for the plant expansion.

Project Background

The NLWWTP, which currently serves 30,000 people in the Township of Langley, will be expanded on the same site to serve 230,000 people by 2041, including residents and businesses across the Fraser River in Maple Ridge and Pitt Meadows. Several other projects will support the plant improvements. Untreated wastewater from Maple Ridge and Pitt Meadows currently flows to the Annacis Island Wastewater Treatment Plant. To divert these flows to the NLWWTP, a new pump station is required north of the Fraser River, along with two large diameter pipes under the Fraser River connecting the pump station in Maple Ridge to the NLWWTP. A new storage tank, sited with the pump station, will help to reduce overflows in the area.



Project Drivers

Metro Vancouver is expanding the plant to accommodate population growth in the Fraser Sewerage Area. In 2016, Metro Vancouver completed a study to evaluate options for upgrading the Fraser Sewerage Area wastewater infrastructure to service the growing population. It evaluated long term costs, environmental protection, and adaptability to future regulatory changes and technological advances.

The preferred option was to expand the plant to become a regional facility by redirecting wastewater to the NLWWTP. This option offered environmental and social benefits and a potential cost savings of approximately $300 million (2016 dollars) over the 85-year analysis period.

Ultimately, the plant will accommodate diverted flows from additional catchment areas, specifically the 104 Avenue section of the North Surrey Interceptor, the entire Township of Langley, the City of Langley, and the Cloverdale area in Surrey. The plant is projected to have an ultimate build-out service population of 700,000 people by 2101.

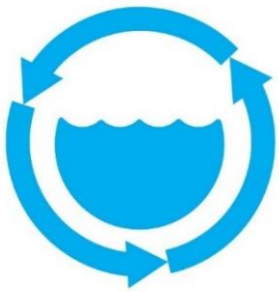
Project Objectives

Metro Vancouver has four main objectives that need to be achieved with the expanded plant.

Provide Robust Wastewater Treatment

The plant will provide **robust treatment** to protect human health and the environment, including the Fraser River. The plant will:

- meet or exceed both federal and provincial regulatory requirements.
- produce Class A biosolids.
- allow for future expansion with similar or more advanced treatment technologies.



Provide Advanced Odour Control Strategies

The **odour control system** will reduce the plant-generated odours to barely detectable levels (1 odour unit per cubic metre) at the property fence line, as follows:

- The plant will provide double containment of odorous process units.
- The air from odorous sources will undergo two-stage treatment.

Develop Integrated Resource Recovery Opportunities

Integrated Resource Recovery opportunities that are being incorporated into the plant include the following:

- Biogas reuse for onsite process heating
- Excess biogas purified to biomethane and sold to third parties
- Use of treated effluent heat recovery for building and process heat
- Reclaimed water use
- Footprint allocation for future phosphorus recovery

Include Community Enhancement Opportunities with the Expanded Plant

Several community enhancement opportunities are planned around the plant:

- An Operations and Maintenance building that will accommodate visitors, school tours, and staff from municipalities across Metro Vancouver
- A foreshore park along the Fraser River
- Connections to the Trans-Canada Trail and the local bike network

Level of Treatment

The treated effluent must meet the following:

- Federal *Canada-wide Strategy for the Management of Municipal Wastewater Effluent* (2014)
- Federal *Wastewater Systems Effluent Regulations* (2015)
- An amended Operational Certificate issued by the BC Ministry of Environment and Climate Change Strategy

The Utilities Committee and Metro Vancouver Board selected a level of treatment for the plant that includes a **biological nutrient removal** process (advanced secondary treatment) and **tertiary filtration**. Combined, these technologies result in a significantly higher quality effluent than a conventional secondary wastewater treatment plant. This level of treatment meets or surpasses regulatory requirements with lower concentrations of ammonia, suspended solids, and other contaminants discharged to the river.

Community and First Nation Engagement Feedback

Through open houses, workshops, meetings, and other outreach activities with municipalities and First Nations, the following themes emerged:

- **Protect** or improve water quality in the Fraser River.
- **Minimize** the impact of the projects on fish (salmon, eulachon, and sturgeon), fish habitat, and fishing activities.
- **Eliminate** or reduce long-standing odour issues in communities near the plant.
- **Provide** a pipe crossing under the river that is resistant to earthquakes and verify that it is monitored and maintained.

The design team has worked with the Metro Vancouver project team to confirm that these themes are addressed in the indicative design of the plant expansion.

Sustainability Objectives

The design team looked for commonalities among the following key documents that highlight Metro Vancouver's policy priorities: the Board Strategic Plan (2015-2018), the Ecological Health Action Plan (2011), and the Sustainability Framework (2010). Three areas of impact were identified through review of these documents:

1. **Addressing climate change through the reduction of greenhouse gas emissions**
2. **Incorporating resource recovery opportunities**
3. **Reducing the contaminants being discharged to the environment**

Design Criteria

Design Horizon

The design horizon for the plant expansion is 15 years. The ultimate buildout for the plant is 85 years, which will involve two or three major expansions between 2041 and 2101.

Population Projections and Design Populations

The following table provides a summary of the design horizons, service areas, and design populations for the plant expansion and ultimate buildout.

Summary of NLWWTP Design Horizons; Service Areas; and Design Populations, Flow, and Loads

	Plant Expansion	Ultimate Buildout
Design Horizon	15 years (Year 2027 to Year 2041)	85 years (to Year 2101)
Service Areas	Northwest Langley, Maple Ridge, and Pitt Meadows	Township of Langley, City of Langley, Maple Ridge, Pitt Meadows, and parts of Surrey
Design Serviced Population	230,000	700,000
Average Annual Flow	85 ML/d	221 ML/d
Peak Wet Weather Flow	247 ML/d	582 ML/d
Average Annual Influent TSS Load	20,700 kg/d	63,000 kg/d
Average Annual Influent BOD Load	19,550 kg/d	59,500 kg/d

Notes:
BOD = biochemical oxygen demand
kg/d = kilogram per day
ML/d = megalitre per day
TSS = total suspended solids

Biosolids Reuse Criteria

Metro Vancouver has been using the biosolids generated from its plants for mine and gravel pit reclamation, agricultural land application, parks use, and other beneficial uses. The new plant will be designed to produce biosolids that meet the **Class A biosolids** requirements, which will allow land application.

Odour Criteria

Odour criteria were based on industry best practices and odour design criteria used at other plants in western Canada. The proposed odour criterion is **1 odour unit per m^3 at the property line** and on the deck of the Golden Ears Bridge, based on 99.5 percent compliance and a 10-minute averaging period.

Resiliency Criteria

The plant is designed to withstand extreme events with minimal damage and functionality disruptions during an event; and the ability to rapidly recover full functionality after the event. This includes resiliency to earthquakes, flooding, climate change, and power disruptions.

Seismic Events

Geotechnical considerations are an important element of this project, as the Fraser River fine sand layer underlying the site is susceptible to liquefaction during a major earthquake. As part of the project definition, the design team has completed extensive geotechnical investigations in support of the design of ground improvements, so that the new plant can withstand a 1 in 2,475-year seismic event, per the National Building Code of Canada (2015). Ground improvements began at the site in 2018 and will continue through 2023.

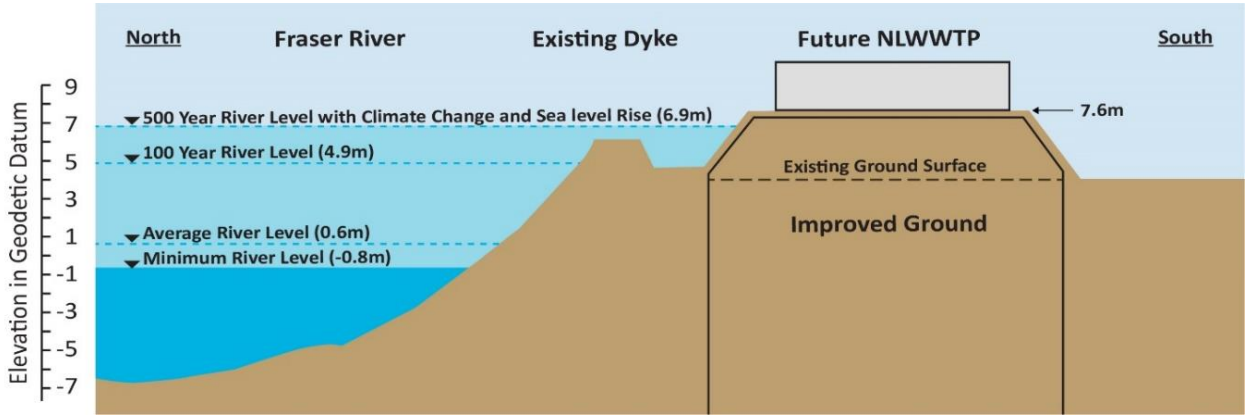
Climate Change and Flooding

The plant site is located adjacent to the Fraser River and is vulnerable to river flooding. While the site is partially protected from flooding by an existing dyke, it does not provide sufficient protection from flood events that consider increased peak river flows and sea level rise, driven by climate change. The recommended design flood elevation includes the following:

- 1 in 500-year freshet river flow under a moderate climate change scenario
- 1 metre sea level rise by the year 2100

The new plant will be constructed above the design flood elevation through the placement of fill material, to a flood construction level of **7.6 m Geodetic Datum,** which satisfies municipal requirements and provides climate change resiliency.

The ground improvements will limit the extent of settlement and lateral displacement of the plant during an earthquake and sufficient flood protection should be maintained after the event.



Power Disruptions

The plant site is susceptible to BC Hydro power supply interruptions. The plant expansion requires a continuous standby power supply, so the plant continues to operate and so that effluent discharge limits are maintained at all times. Standby diesel generators will be used to satisfy the requirements of a post-disaster facility. In the event of a disaster, such as an earthquake, standby power will be supplied to the following control systems:

- Critical life safety systems
- Influent pumping and preliminary treatment
- Primary treatment, including chemically enhanced primary treatment for wet weather flows
- Primary sludge pumping
- Secondary treatment and disinfection
- Effluent pumping
- Plant drainage system

Site Characterization

Land Use and Zoning

The current zoning for the plant site is heavy industrial. The Township of Langley Official Community Plan (2016) suggests that the area around the plant site will remain zoned for industrial use for the foreseeable future.

Archaeological Considerations

The project is located within the respective territories of the Coast Salish First Nations and the Consultative Areas of 15 First Nations and tribal councils. Metro Vancouver has undertaken an archaeological overview assessment for the plant site and surrounding area. The potential for encountering archaeological sites is low, with no major archaeological findings or risk expected.

Ecological Context

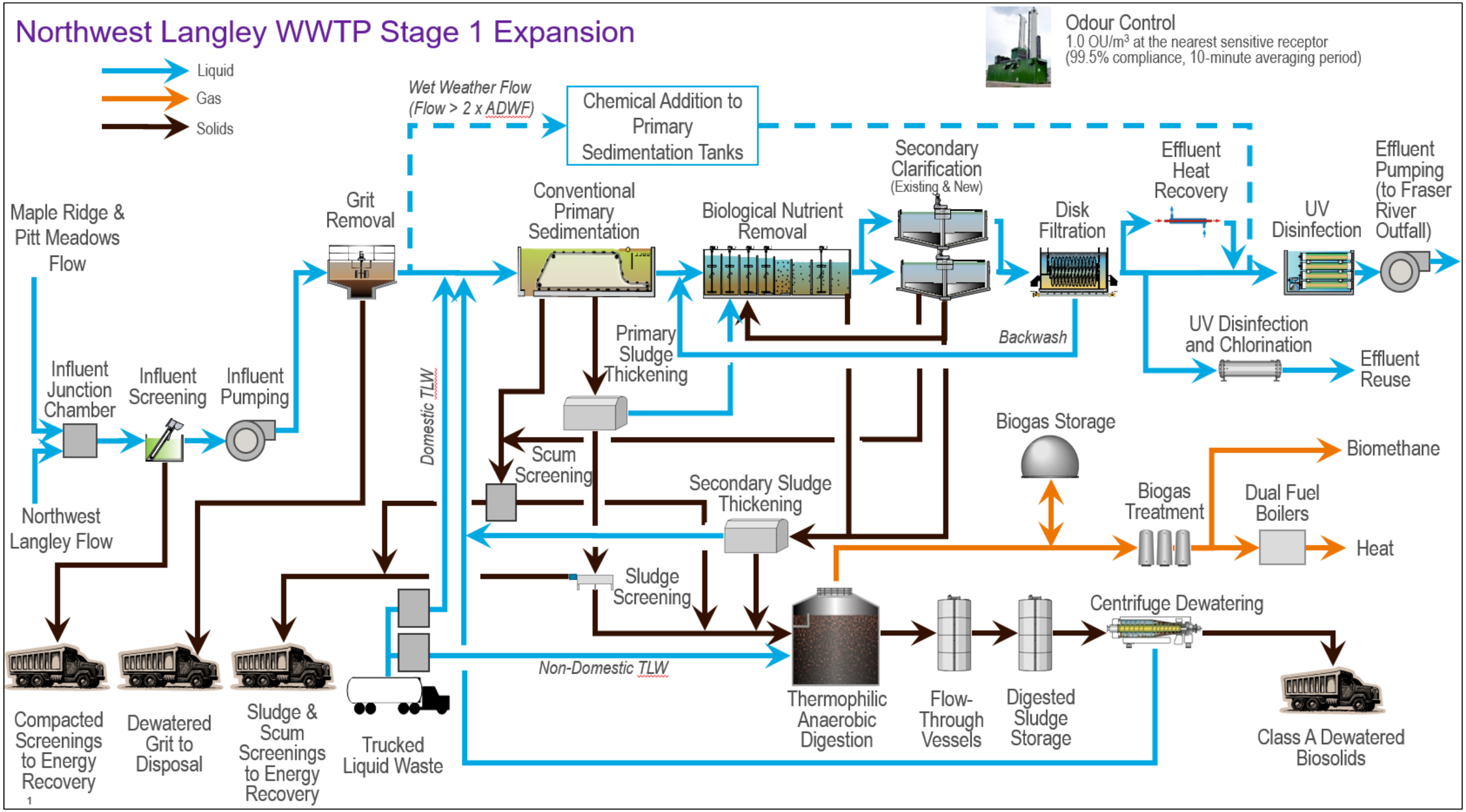
Ecological values of the plant site have been reduced over time from urban development and industrial land use. Much of the area is covered in asphalt or gravel, while certain areas are sparsely vegetated. The existing artificial ditches and the plant lagoons provide some habitat for birds and other wildlife, and future site enhancements will seek to replace habitat values that are lost during construction of the plant.

The Fraser River provides habitat for several fish species of commercial, recreational, and aboriginal importance, notably white sturgeon, salmon, and eulachon. Aquatic environment values are being closely considered during advancement of project design, including in the Environmental Impact Study, which focuses on operation of the outfall and its construction.

NLWWTP Stage 1 Expansion Indicative Design Summary

Liquid Treatment, Solids Management, and Odour Control

The proposed NLWWTP expansion liquid and solids treatment trains are summarized on this process flow diagram and on the site plan on the following page.



Site Layout


BARNSTON ISLAND
FRASER RIVER
RIVERFRONT PARK
Lookout Mound
Multi-Use Pathway
MEADOW
Effluent Pumping
UV Disinfection
Disk Filtration
Odour Control
Existing Secondary Clarification
Blower Building and Electrical Room
Odour Control
TRAIL CONNECTION
Trans Canada Trail
102b Ave
Golden Ears Way/201 St
Eagle Tree
Constructed Treatment Wetlands
Off-Channel Habitat
Wharf
O&M
Odour Control
Effluent Heat Recovery and Dual Fuel Boilers
Biogas Storage
Biogas Treatment
Flow Through Vessels and Digested Sludge Storage Tank
Centrifuge Dewatering
Trucked Liquid Waste
Electrical Building
101 Ave
Influent Junction Chamber
Primary and Secondary Sludge Thickening
Influent Screening
Electrical Substation
Influent Pumping
Thermophilic Anaerobic Digestion
199b St
Grit Removal
Sludge Screening
Primary Sedimentation
Biological Nutrient Removal
Secondary Clarification
102 Ave
TRUCK ACCESS
STAFF AND VISITOR ACCESS
TRUCK ACCESS

Liquid Treatment

Influent junction chamber, screening, and influent pumping (headworks)

- An influent junction chamber is centrally located at the plant to receive gravity flow from Northwest Langley and pumped flow from Maple Ridge and Pitt Meadows.
- Influent screens with 12-mm bar spacing remove large debris from the incoming wastewater and protect downstream equipment.
- Influent pumps lift wastewater up to the headworks, where wastewater flows through downstream treatment processes by gravity.

Stacked tray grit removal, primary sedimentation, and chemically enhanced primary treatment for wet weather flow management

- Heavier particles, such as grit and sand, settle and are removed from the wastewater in the stacked tray grit removal units.
- Primary treatment tanks physically remove suspended solids from the wastewater by sedimentation.
- Chemicals will be added to part of the primary treatment tanks to enhance the removal of suspended solids during wet weather periods.
- The portion of flow that receives enhanced primary treatment will bypass secondary and tertiary treatment.

Biological nutrient removal (BNR) and secondary clarification

- BNR is an advanced secondary treatment process that breaks down organic matter using microorganisms that naturally exist in the wastewater. These microorganisms grow in a controlled environment provided by the BNR process and facilitate the removal of contaminants from the wastewater. The reduced concentration of nutrients in the effluent also protects the receiving environment from the potential adverse impacts caused by ammonia.
- Four new secondary clarifiers will be added to the three existing secondary clarifiers that were constructed in 2015.

Tertiary filtration

- Tertiary filters, consisting of cloth media disks, remove fine particles that remain in the wastewater after secondary treatment and further improve the quality of effluent discharged to the receiving water.

Ultraviolet (UV) disinfection

- The effluent will be disinfected using UV lamps that kill or inactivate bacteria and pathogens without the use of chemicals.

Effluent pumping

- Under normal conditions, effluent will be discharged to the Fraser River by gravity via a new outfall. During high river levels or periods of high effluent flows, effluent pumps will be operated as needed.

Solids Management

Sludge thickening

- Sludge from the primary and secondary treatment processes is thickened to reduce the required capacity and costs of downstream sludge handling equipment.

Sludge screening

- Sludge screens remove finer inorganic materials from the thickened primary sludge to improve the quality of the biosolids.

Thermophilic anaerobic digestion

- Sludge digestion will utilize a thermophilic anaerobic process to stabilize sludge to a non-pathogenic and non-odorous level to recover energy and produce Class A biosolids.

Centrifuge dewatering

- Centrifuges reduce the volume of digested sludge by separating water from the sludge, which lowers the volume and cost of hauling biosolids offsite.

Trucked liquid waste receiving

- Trucked liquid waste receiving facilities will be included to receive domestic waste (septage) and non-domestic waste (fats, oils, and grease).
- The inclusion of liquid waste receiving facilities will increase the plant's biogas production.

Odour Control

Odour containment

- Fitted and retractable covers are provided on tanks where odorous air is present. Odorous air under the covers will be captured and treated.
- Odorous air from buildings housing process equipment will be captured and treated.

Odour treatment

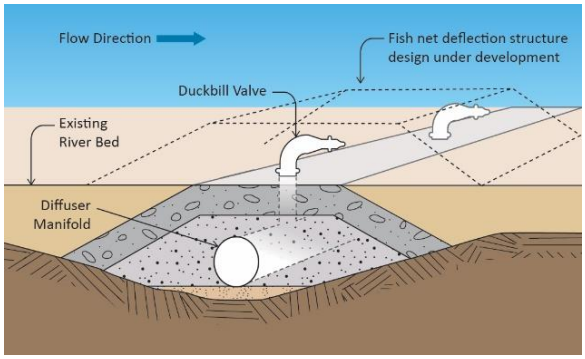
- Odorous air from the liquid treatment areas will be treated with a two-stage treatment process, consisting of multi-stage bio-trickling filters followed by activated carbon polishing.
- Odorous air from the solids treatment areas will be treated with a two-stage treatment process, consisting of biofilters with engineered media followed by activated carbon polishing.

Dispersion stacks

- Two stacks are required for the dispersion of treated air to meet the odour criterion.

Fraser River Outfall

After reviewing several outfall locations, the outfall will be located in the Parsons Channel to meet environmental regulations and mitigate construction and seismic risks.



The outfall tunnel will be approximately 300 m long, extending from the plant site to a diffuser manifold. The diffuser manifold will disperse the treated effluent through six ports that are spaced at 8-m intervals and positioned to maximize dilution perpendicular to the river flow. To mitigate potential snagging of fish nets and to protect these ports from damage, the diffuser design will include a structure to deflect objects over the risers.

Environmental Impact Study

As part of amending the Operational Certificate, the Municipal Wastewater Regulation requires the preparation of an Environmental Impact Study (EIS) to confirm whether the plant's effluent will substantially alter or impair the usefulness of the environment or adversely affect human or ecological health. The EIS is being conducted in two stages and will be completed in 2019.

Stage 1 findings indicate that the predicted effluent quality meets or, in some cases, surpasses the regulatory wastewater discharge criteria. Stage 2 includes a detailed analysis of the receiving environment, which will serve to confirm Stage 1 results using additional field-collected data.

Integrated Resource Recovery Opportunities

Effluent Heat Recovery

- Heat-pumps **recover heat from the effluent** to provide building and process heat.
- Effluent heat recovery allows for more biogas to be refined and sold.

Biogas Utilization

- Biogas produced from the anaerobic digestion process will be collected and used as a fuel source to supplement building and process heat.
- Excess biogas will be refined to **biomethane and sold.**

Reclaimed Water

- A small portion of the effluent will be **reclaimed**.
  - Onsite reclaimed water usage offsets the use of potable water for process demands.
  - A truck loading station for offsite bulk reclaimed water use will be included.

Nutrient Recovery

- Nutrients, such as **phosphorus and nitrogen,** are retained in the biosolids and used for land application.
- Nutrients can be selectively recovered and made into a commercial fertilizer. The business case for fertilizer products is not currently favourable. Space has been allocated for potential phosphorus-harvesting equipment to be installed in the future.

Greenhouse Gas Reduction

The design of the plant considers ways to minimize greenhouse gas emissions:

- **Use biogas** generated onsite to reduce the dependence on natural gas (fossil fuel).
- **Recover heat** from thermophilic digestion to reduce heating loads to the digesters.
- **Recover heat** from the effluent and use the heat onsite.
- **Use reclaimed water** for onsite demands, such as washdown stations and truck washing.

Future Proofing

Future proofing the plant includes consideration of changing regulations and treatment technologies. Future regulations may include Emerging Substances of Concern (ESOCs). ESOCs include pharmaceutical organic contaminants, personal care products, endocrine-disrupting compounds, surfactants, pesticides, flame retardants, and industrial additives that may be harmful to the environment. A three-pronged approach to future proofing and treatment of ESOCs has been considered in the plant design:

Source control

Metro Vancouver's existing and future amendments to the Sewer Use Bylaw will be used, where appropriate, to reduce ESOCs and other contaminants from the sanitary sewer system. Pollution Prevention Plans (PPPs)

are being developed to target specific industries and facilities. Currently, PPPs are being considered for hospitals and health care facilities. Public Education Programs (such as medicine return programs) reduce the quantity of ESOCs and other contaminants disposed of into the sanitary sewer system.

Technology selection

The advanced secondary and tertiary treatment processes selected provide flexibility to adapt to future changes. Additional treatment can be added to the end of the treatment train for further ESOC removal if required.

Outfall design

The outfall is designed to meet current regulations and provide capacity to satisfy future water quality regulations and guidelines.

Community Enhancement Opportunities

Along the edges of the plant site, opportunities for community enhancement have been identified. These opportunities will be considered during the detailed design phase of the project. Potential enhancements provide the opportunity for viewing the plant, the Fraser River, and the riparian restoration zone. These areas can also be used for public education.

Sustainable Design Opportunities

In accordance with Metro Vancouver's current Sustainable Infrastructure and Buildings draft policy, and consistent with the design team's recommendations, the project will be designed to **LEED Gold for the Operations and Maintenance Building** and **Envision Gold for plant process infrastructure** standards, but will not be accredited.

Operations and Maintenance Building

The O&M Building will be in a central area of the plant. Working within the site constraints, the building will be configured as a 3-storey building with a basement, which will connect to the plant's below-ground gallery network. A 3-storey building serves to reduce the footprint of the building and maximize the amount of available site area for development of treatment facilities.

Landscape Architecture Opportunities

The 60-m setback of facility infrastructure provides space to design a restorative environment. A multi-use path could meander through this portion of the site, accommodating cyclists and pedestrians. Other opportunities include lookout, treatment marsh, multi-use path, connection to the Trans-Canada Trail, and public education.

Cost Estimates

The following table presents a summary of the preliminary design cost estimates for the four projects that make up the NLWWT Program. Costs are shown in 2018 dollars and escalated to the mid-point of construction for the respective projects. Estimates include contingencies, engineering fees, and owner's fees. Based on industry experience, costs shown here may vary by minus 20 percent to plus 30 percent.

Total Costs Across all Northwest Langley Wastewater Treatment Projects

Project Components	Total Costs (2018 dollars)	Total Escalated Costs (through to mid-point of construction of each project)
Golden Ears Pump Station and Storage Tank	$ 75 million	$ 83 million
Fraser River Forcemain Crossing	$ 74 million	$ 81 million
NLWWTP Expansion	$ 860 million	$ 965 million
NLWWTP Outfall	$ 145 million	$ 165 million
Total Cost	**$ 1,155 million**	**$ 1,295 million**

The NLWWTP Expansion and Outfall costs are further broken down in the following table, based on the proposed contracting strategy developed by the design team.

Cost Estimates for the Plant Expansion and Outfall

Project Components	Total Costs (2018 dollars)	Total Escalated Costs (through to mid-point of construction of each project)
Ground Improvements	$ 80 million	$ 85 million
Liquid Treatment	$ 430 million	$ 480 million
Solids Treatment	$ 320 million	$ 365 million
O&M Building	$ 30 million	$ 35 million
NLWWTP Outfall	$ 145 million	$ 165 million
Total Cost	**$ 1,005 million**	**$ 1,130 million**

Project Schedule

The project definition and indicative design will be completed in the fall of 2018. The completed work will include a design package sufficiently advanced to allow the project to proceed to detailed design phase in 2019. Based on this schedule, the NLWWTP expansion will be completed in 2027. Once the new NLWWTP is operational, the existing facility will be decommissioned.