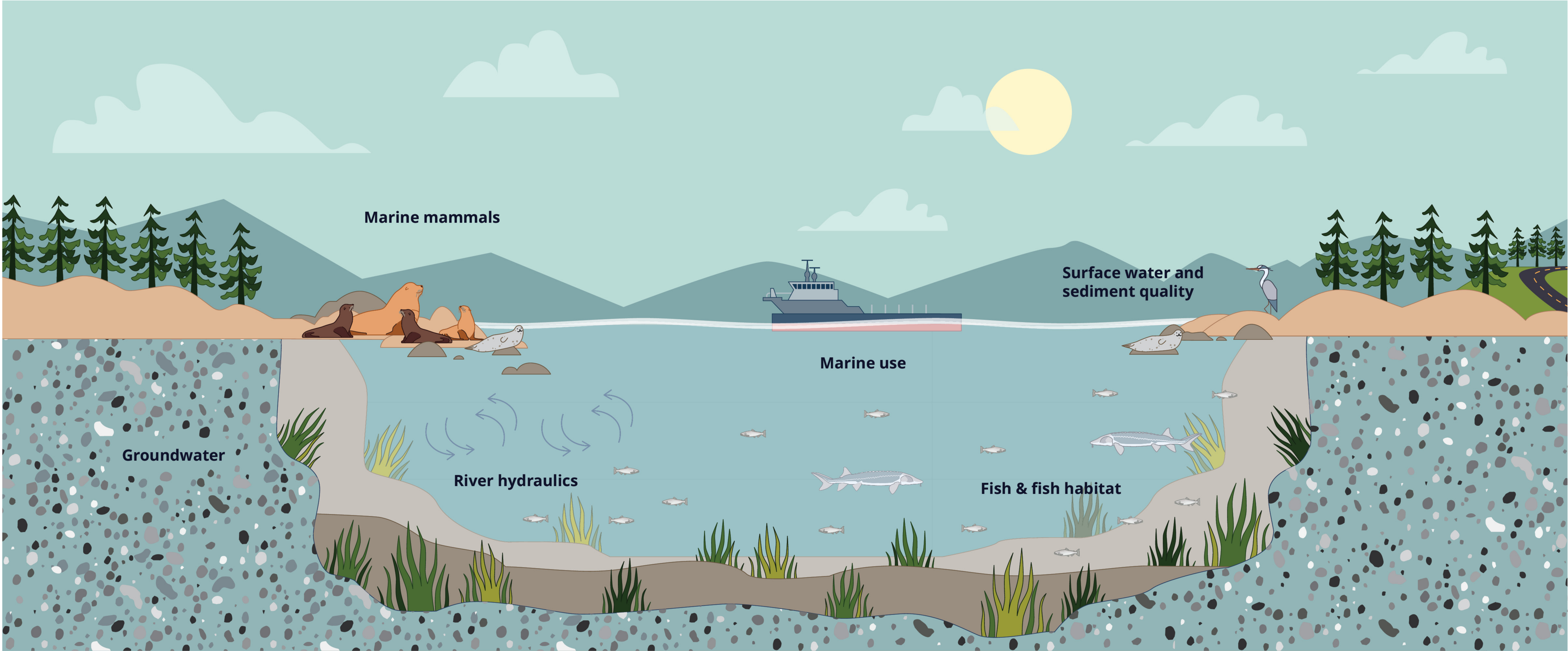


Aquatic Environment



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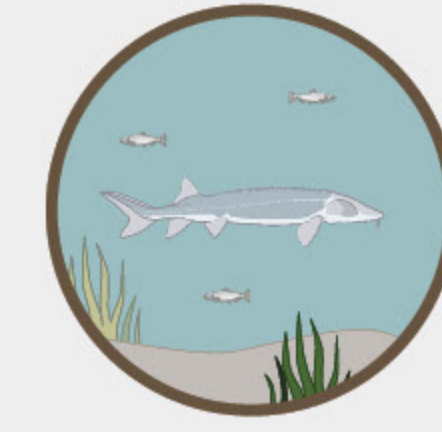


Aquatic Environment



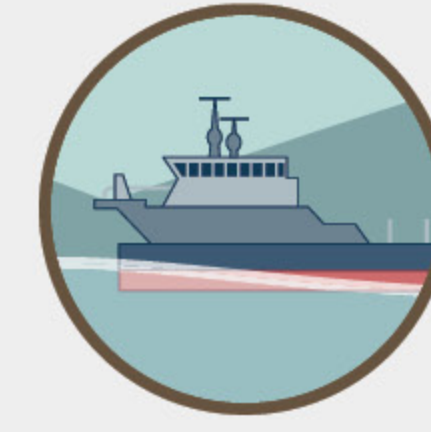
Marine mammals

Marine mammals have the potential to occur near the Project footprint and may include harbour porpoise, humpback whales, grey whales, California sea lions, Stellar sea lions and harbour seals.



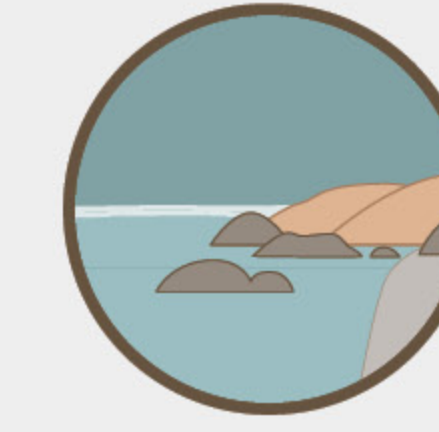
Fish and fish habitat

Fish and fish habitat play vital roles in aquatic ecosystems. Fish species include salmon, sturgeon, eulachon, trout, char and others in traditional use.



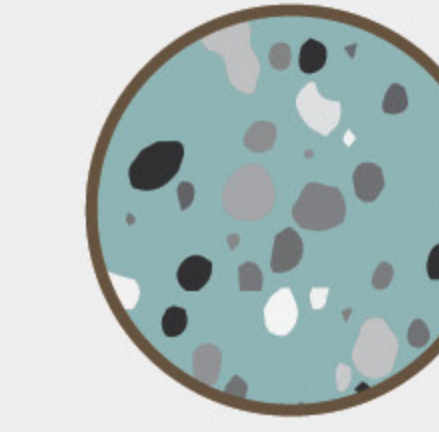
Marine use

In-river work could potentially affect marine access and area use, Indigenous interests and marine recreation. This includes commercial transportation; commercial, recreational and Aboriginal fisheries; marine tourism and recreation; and other Indigenous marine use.



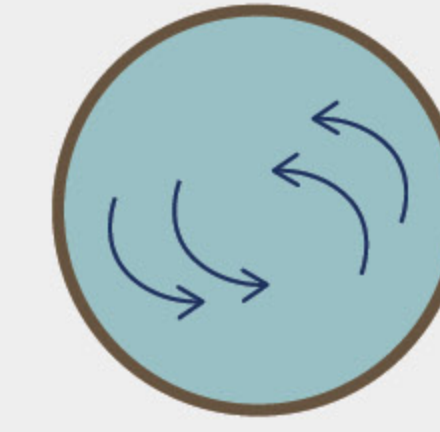
Surface water and sediment quality

Project works could affect the surface water and sediment quality, including in rivers and streams.



Groundwater

Construction activities could potentially affect groundwater, which has important local uses, including drinking water, irrigation and industrial use.



River hydraulics and morphology

In-river construction, including dredging and tunnel immersion, may result in changes to river hydraulics and morphology.

Project activities that interact with Valued Components

- Materials transportation in river
- Construction activity in river
- Dredging, moorage/floating/immersion of tunnel elements

- River dredging and changes to river flows
- Pre-construction activity, including hydrotechnical surveys
- Trestle installation across Deas Slough and Deas Slough Bridge replacement
- Towing materials
- Tunnel and interior materials installation
- Maintenance dredging
- Addressing existing tunnel

- Construction materials and workers transportation on water routes
- Materials delivery by barge
- Trestle installation across Deas Slough
- In-river pile installation
- Dredging and shipping material between Project and disposal sites
- Potential tunnel fabrication and elements transport and storage
- Temporary flood protection installation

- Excavate sites to create ditches and install stormwater management facility
- Ground improvements on both sides of river
- Construction materials and equipment transportation
- In-river pile installation and in-river dredging
- Excavated material management

- Site excavation, clearing, grubbing and grading gravel in construction areas
- In-river pile driving and pile posts installation
- Dredging
- Casting basin excavation and dewatering
- Tunnel installation
- Excavated material management
- Flood protection systems construction
- Existing dikes re-construction within Ministry right-of-way

- Riverbed changes may result in changes to water levels, flow condition and erosion/deposition patterns
- Potential tunnel element fabrication
- Tunnel elements towing and moorage
- River dredging and new tunnel elements installation
- Portal excavation on Deas Island
- Deas Slough Bridge construction
- Addressing existing tunnel

What we learned from the Existing Conditions Program and engagement

- Marine mammals sensitive to underwater noise
- Seals and sea lions can be found near Project footprint (haul out/resting sites nearby)
- Marine mammals listed under federal *Species at Risk Act* and protected under *Fisheries Act*

- Habitat compensation could be required
- Impacts to insects and microbes should be reviewed
- Consider cumulative effects from Project and others in proximity

- Marine use is of vital importance to Indigenous nations, regulatory agencies, commercial fish harvesters and local governments that have direct connection to Fraser River

- Recent studies outline sensitivity of marine mammals to potential contaminant exposure

- Project has potential to impact groundwater transport of contaminants to surface water receptors that are of regulatory importance and important to Indigenous nations and stakeholders

- Changes to timing and extent of saltwater wedge that could affect agricultural intakes are not anticipated as result of Project
- New in-river piles have potential to impact river hydraulics and morphology

What we're doing

- Studying under- and above-water noise and effects from construction activities
- Studying effects on food sources for marine mammals
- Considering interactions between marine mammals and Project vessels
- Monitoring vessel traffic activity

- Studying effects on fish and fish habitat, with a specific focus on salmon, sturgeon, eulachon and trout
- Preparing Construction Environmental Management Plan (CEMP)
- Reviewing all relevant federal and provincial permitting requirements

- Studying potential impacts to marine and foreshore area access and use
- Studying potential impacts to Indigenous, commercial and recreational marine resources
- Studying potential impacts to marine commercial navigation and recreational environmental setting
- Preparing dredge materials management framework

- Studying potential stormwater runoff, erosion or spills and temporary redistribution of riverbed sediments
- Addressing impacts to water and soil that could cause potential economic impacts
- Assessing emerging contaminant 6PPD-Quinone
- Conducting sediment dispersion modelling

- Groundwater assessment to inform potential Project effects on geotechnical conditions that could affect structural integrity of existing flood protection infrastructure

- Studying changes to river hydraulics during construction and to permanent infrastructure during operations
- Assessing impacts to river levels and/or flooding risk as part of River Hydraulics and Morphology Valued Components assessment

Linkages to other Valued Components

Fish and fish habitat Marine use Acoustic

Marine mammals Surface water and sediment quality

Marine use River hydraulics and morphology Vegetation

Wildlife and wildlife habitat Human health

Employment and economy

Fish and fish habitat River hydraulics and morphology

Marine mammals Visual quality Employment and economy

Community health and well-being Acoustic Air quality

Wildlife and wildlife habitat

Groundwater River hydraulics and morphology Vegetation

Fish and fish habitat Wildlife and wildlife habitat

Land and resource use Human health

Surface water and sediment quality Vegetation

River hydraulics and morphology Soil

Fish and fish habitat Surface water and sediment quality

Marine use Archaeological and heritage resources

Wildlife and wildlife habitat Vegetation

Infrastructure, services and transportation

Legend

- Aquatic Environment
- Terrestrial Environment
- Human Environment



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Terrestrial Environment



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Terrestrial Environment



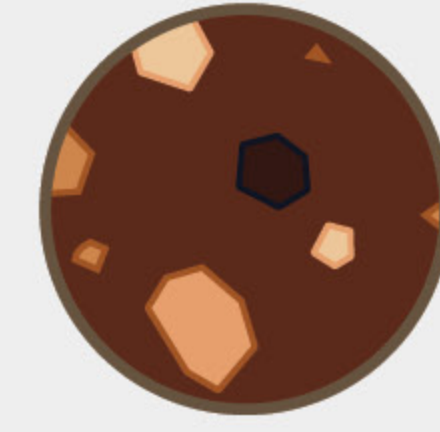
Wildlife and wildlife habitat

Wildlife in the Project area can include a variety of bird species, bats, small mammals, river otters and reptiles.



Vegetation

Vegetation plays a fundamental role in the ecosystem. A variety of plant species and types are present in the Project area.



Soil

Construction activities could affect soil quality and quantity, including through dredging, excavation, ground improvements and dike infrastructure.



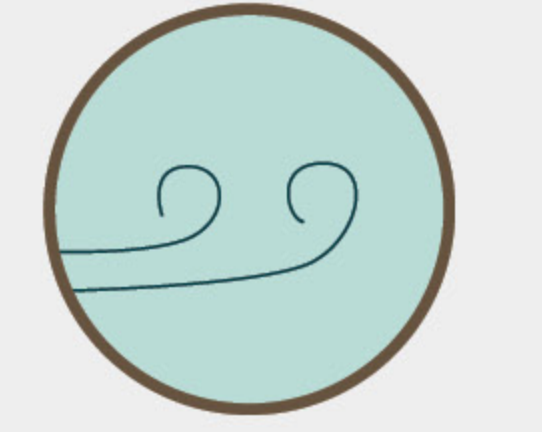
Land and resource use

Project activities may affect land and resource use, including access, availability and productivity.



Archaeological and heritage resources

The Project has the potential to affect archaeological and historical heritage resources during construction, including artifacts and sites.



Air quality

Air emissions during construction has the potential to affect air quality in the Project area. Air quality is determined by concentration of various pollutants and airborne particles present in atmosphere. Monitoring and assessing air quality is crucial for human health, environmental protection and public safety.

Project activities that interact with Valued Components

- Materials transportation in river
- Site area excavation and clearing
- Construction activity on land and in river
- Potential tunnel components fabrication
- Construction of north and south tunnel approaches
- Management of excavated material
- Long-term tunnel operations

- Utility locations and installation
- Site drainage excavation and new stormwater systems installation
- Site area excavation and clearing
- Temporary roads construction
- River dredging and new tunnel elements installation
- Reconstruction of existing dikes

- Site excavation to create ditches and install stormwater management facility
- Stormwater and flood protection systems installation
- Piling and grading on both sides of river
- Tunnel approaches construction
- Portal excavation on Deas Island
- Deas Slough Bridge construction
- Excavated material management
- Addressing existing tunnel

- Construction materials and worker transportation
- Temporary roads construction
- Project components fabrication and storage
- Dikes and flood protection installation in Richmond
- Temporary closures of Fraser River to install tunnel elements
- Long-term tunnel operations

- Site area excavation and clearing
- Piling and grading on both sides of river
- Portal excavation on Deas Island
- Deas Slough Bridge construction
- In-river dredging and towing materials
- Walls installation along tunnel portals
- Tunnel elements construction
- Flood protection systems construction

- Construction materials and worker transportation
- Site clearing and excavation, movement of soil
- Concrete batching and pouring
- Potential tunnel element fabrication
- River dredging and new tunnel elements installation
- Emissions from construction material transport on roads and waterway
- Addressing existing tunnel

What we learned from the Existing Conditions Program and engagement

- Deas Island is home to a variety of bird species. These birds, their eggs and their nests are protected from hunting, trafficking and commercialization under the *Migratory Birds Convention Act*
- Federal/provincial at-risk bird and mammal species observed in vicinity of Project
- Several culturally important Indigenous bird and mammal species identified in Project area
- Deas Island is home to largest colony of bats in B.C.

- Two plant species identified under *Species at Risk Act*
- 28 invasive plant species identified within Project area
- Culturally important traditional use plant species located within Project area
- Importance of Indigenous rights to harvest vegetation resources
- Importance of conserving health practices that include use of medicinal plants

- Large-scale excavation removes old soil and introduces new materials
- Potential for contaminated soil as Project is located within industrial and commercial lands
- Management of contaminated soil and proper disposal required

- Land use is important to Indigenous nations and regional governments
- Project may affect nearby residential and public facility access and use
- Construction may affect nearby commercial, retail and industrial land access and use
- Project may affect agricultural land and farming operations adjacent to Highway 99 corridor

- Palaeontological, archaeological and historical heritage resources are protected under *BC Heritage Conservation Act*
- Project is unlikely to affect palaeontological resources in Fraser River, but this will be monitored and mitigated as required
- Project is unlikely to affect archaeological resources during construction and will be managed to meet regulatory requirements
- Project may affect historical heritage record and will be managed to meet regulatory requirements

- Air emissions during construction and vehicle emissions during operations have potential to change air quality in Project area
- Air quality is important to human health and can lead to increased internal contaminants

What we're doing

- Studying changes in habitat quality and quantity
- Studying changes in wildlife mortality
- Studying changes in wildlife movement/relocation

- Studying changes to habitat availability
- Studying changes to habitat distribution
- Studying changes in vegetation abundance

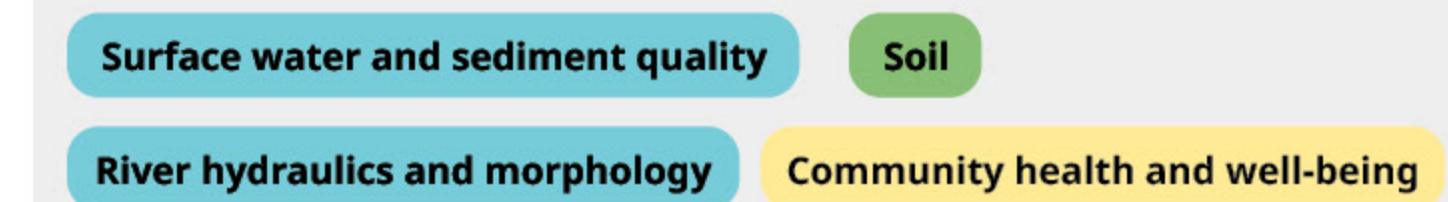
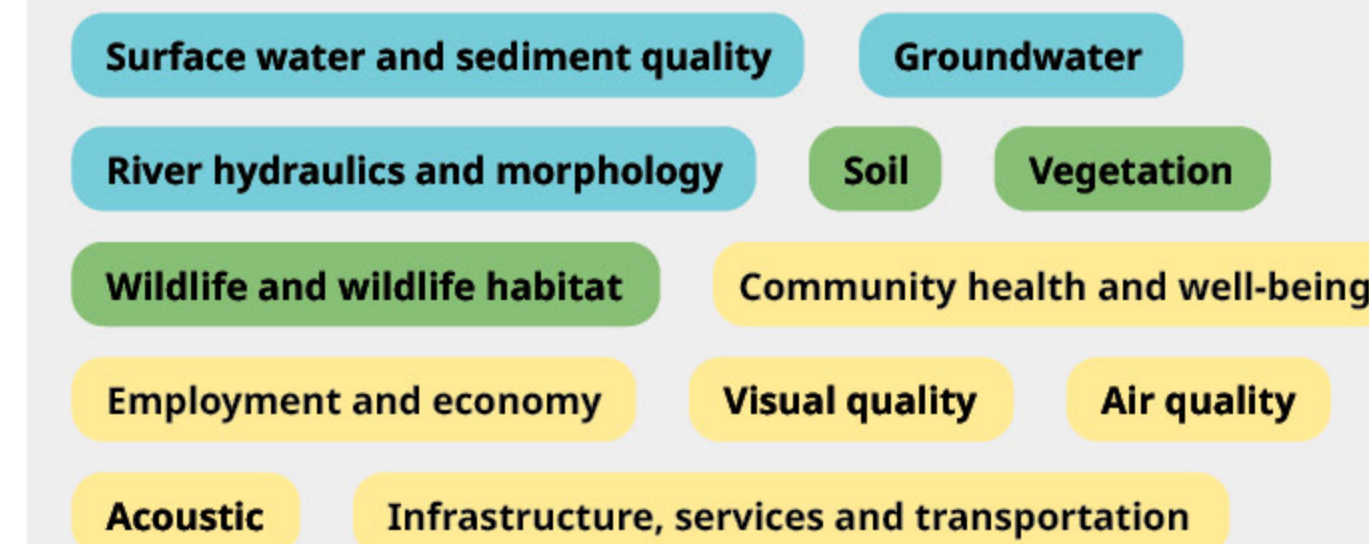
- Monitoring changes in soil quantity and distribution
- Monitoring changes in soil chemistry due to introduction or removal of contaminants
- Monitoring changes in soil quality, especially within water areas

- Assessing land use plans, policies, land use designations and zonings
- Assessing agricultural land availability and nearby farming operations and infrastructure
- Monitoring noise, vibration and air/visual quality conditions and potential effects to resident and public facilities
- Studying location and use of parks, protected areas, trails and other recreational infrastructure

- Documenting volume/integrity of:
 - Potential palaeontological resources
 - 'Spirit of place' of archaeological resources
 - 'Spirit of place' of registered historical sites

- Making changes in Project criteria for air contaminants, including particulates and dust
- Making changes in Project criteria for volatile organic compounds and identifying sources of air emissions

Linkages to other Valued Components



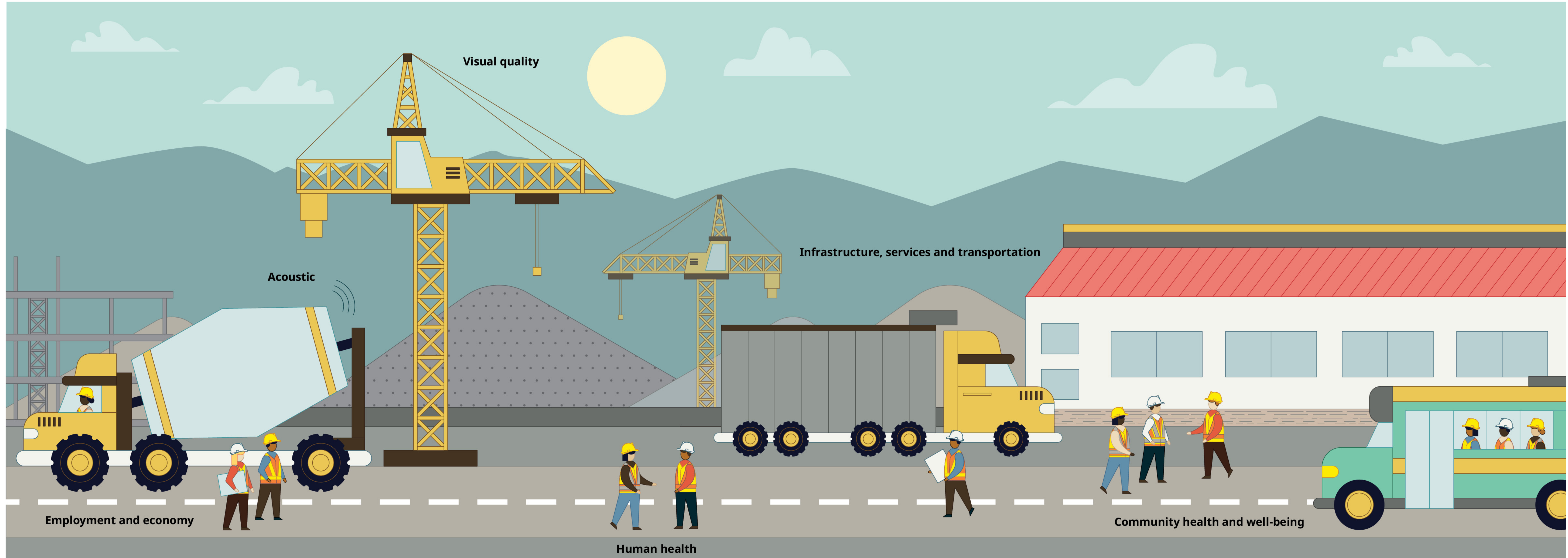
Legend ● Aquatic Environment ● Terrestrial Environment ● Human Environment



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Human Environment



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Highway 99
Tunnel Program
FRASER RIVER TUNNEL

Human Environment



Acoustic

The Project has the potential to increase noise and vibration levels during construction, which can have adverse effects on human and animal health.



Visual quality

Project construction may temporarily affect the visual appeal and visual experience of the landscape.



Employment and economy

The Project is expected to contribute to economic output and regional economic development.



Infrastructure, services and transportation

The Project may affect existing infrastructure as well as regional services to support the Project workforce.



Human health

Project activities that result in a change to environmental quality may affect human health.



Community health and well-being

Construction activities may temporarily affect the health and well-being of nearby communities, including dust and noise from construction, recreational, traditional and other land uses.

Project activities that interact with Valued Components

- In-river pile driving and pile posts installation
- Piling and grading on both sides of river
- In-river dredging and new tunnel elements installation
- Portal excavation on Deas Island
- Deas Slough Bridge construction
- Refilling excavated areas in the river

- Site excavation and preparations
- Construction crew mobilization and equipment storage
- Site circulation and temporary roads construction
- Piling and grading on both sides of river
- Potential on-site tunnel fabrication and tunnel elements towing
- Deas Slough Bridge construction
- CN railway bridge removal
- Existing Rice Mill Road overpass removal
- Long-term tunnel operations

- Labour, goods and services procurement
- Construction materials and workers transport on water routes
- Temporary roads construction
- Dredging and dredged material shipping
- Tunnel elements temporary moorage outside navigation tunnel
- Tunnel elements labour and construction
- Labour, goods and services during long-term operations and maintenance

- Labour, goods and services procurement
- Construction materials and worker transportation
- Portal excavation on Deas Island and Deas Slough Bridge construction
- Construction of flood protection systems
- Re-construction of existing dikes within Ministry right-of-way
- Commissioning of new tunnel and tie-in to Highway 99

- Utility locations and installation
- Construction activity on land and in river
- Potential tunnel fabrication and installation
- Excavated material management
- Refilling excavated areas in the river
- Long-term operations

- Labour, goods and services procurement
- Construction materials and worker transportation
- Ground preparation, geotechnical and archaeological assessments
- Riverbed changes may result in changes to water levels, flow condition and erosion/deposition patterns
- In-river dredging and material shipping between project and disposal sites
- Portal excavation on Deas Island
- Deas Slough Bridge construction
- Addressing existing tunnel

What we learned from the Existing Conditions Program and engagement

- Project may increase noise levels at nearby receptors during construction, operations and decommissioning
- Project may increase vibration levels at nearby receptors during construction

- Construction activities will have a visual impact, including use of lights at nighttime
- Visual qualities and context of places are associated with Indigenous oral history and culture in both daytime and nighttime settings
- Deas Island Regional Park holds high visual importance for recreational and tourism purposes

- Transportation infrastructure is an important component of regional economic development
- Fishing, agriculture, water-based tourism and industrial uses within Project area could be affected
- International and domestic vessel operators and marine terminal operators may be affected by in-river works
- Components are important to all levels of government and Indigenous nations

- There are existing utilities and some infrastructure in the area
- Project may overlap with other nearby ongoing infrastructure and transportation projects
- Project has potential to affect accessibility of emergency and health services
- Project may affect accessibility of labour, increasing pressure on local housing cost and availability

- Project activities that result in changes to environmental quality (e.g., soil, groundwater, sediment, surface water and air quality) will affect human health

- Community health and well-being is important to all levels of government and health authorities
- Health and well-being key concern raised by Indigenous nations

What we're doing

- Monitoring noise levels at noise-sensitive receptors
- Monitoring changes to ground vibration at vibration-sensitive receptors
- Following the Ministry of Transportation and Infrastructure and Health Canada noise guidelines

- Assessing changes in viewing conditions in relation to existing landscape and environment
- Assessing changes in light levels created by the Project

- Assessing Project's potential economic effects
- Assessing changes in government revenues and expenditures
- Aligning with regional economic development and planning
- Assessing changes in employment and labour incomes
- Assessing changes in contracting opportunities and revenues
- Examining labour market for training and skills opportunities
- Assessing changes to nearby businesses such as foreshore works, fisheries and land and marine-based recreation and tourism

- Assessing change in infrastructure and utilities, including water, waste, power and determining capacity and supply needs
- Changing flood protection infrastructure as part of Project construction
- Assessing emergency and health service supply and demands
- Assessing housing and temporary accommodation demand and availability due to temporary migration of workers

- Monitoring changes in air emission contaminants
- Monitoring changes in water surface quality and sediment quality
- Monitoring changes in soil and conducting testing
- Monitoring changes in vegetation due to water or air quality changes

- Refining criteria for healthy built and physical environments
- Refining criteria for community, emergency and public transit services
- Refining criteria for sustainable livelihoods such as access to employment and income levels
- Refining criteria that contribute to healthy lifestyles such as recreational/traditional land use, supportive housing and personal health status/practices

Linkages to other Valued Components

- Marine mammals
- Community health and well-being
- Land and resource use
- Wildlife and wildlife habitat

- Fish and fish habitat
- Marine use
- Land and resource use
- Community health and well-being
- Wildlife and wildlife habitat

- Marine use
- Infrastructure, services and transportation
- Land and resource use
- Community health and well-being

- River hydraulics and morphology
- Land and resource use
- Community health and well-being
- Employment and economy

- Surface water and sediment quality
- Vegetation
- Soil
- Community health and well-being
- Air quality

- Marine use
- Land and resource use
- Acoustic
- Human health
- Air quality
- Employment and economy
- Infrastructure, services and transportation
- Visual quality

Legend ● Aquatic Environment ● Terrestrial Environment ● Human Environment



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