8. FISH HABITAT OFFSETTING PLAN

LNG Canada is committed to offsetting project-related effects to fish and fish habitats that contribute to the sustainability and ongoing productivity of CRA fisheries. It proposes to do so by implementing a fisheries offsetting plan that maintains or increases the availability and quality of rearing, migratory, and overwintering habitats for the local salmon, trout, and char populations most directly affected by construction and operation of the Supporting Infrastructure. The sections below describe LNG Canada's approach to offsetting and provide details about the offset plan and associated monitoring.

8.1. LNG Canada's Approach to Offsetting

LNG Canada's approach to offsetting is consistent with DFO policy and local fisheries management objectives and restoration priorities. LNG Canada has taken an ecosystem approach by targeting factors limiting fish production, while recognizing the inter-connectivity of existing estuarine habitats. LNG Canada also acknowledges the inherent uncertainty and time lags involved in implementing habitat offsets.

8.1.1. Consistency with Fisheries and Oceans Canada Policy

LNG Canada has developed an offset plan that is consistent with DFO's Fisheries Protection Policy Statement (DFO 2013a) and DFO's Fisheries Productivity Investment Policy: A Proponents Guide to Offsetting (2013b). This has been achieved by:

- Selecting offsets that are consistent with provincial, federal, and Haisla Nation fisheries management objectives
- Including offsets that support local habitat restoration priorities such as the Lower Kitimat Watershed Planning Initiative
- Choosing offsets that can be reasonably expected to counterbalance the loss of fish habitat and fisheries productivity over the long-term
- Including offsets that restore or enhance existing habitats or create new habitats in areas that were previously terrestrial in nature
- Including offsets that specifically address the factors most likely limiting local fish production within and adjacent to the LNG Canada Export Terminal footprint and its Supporting Infrastructure

- Prioritizing inclusion of “in-kind” offsets (i.e., those that replace the type, quantity, and quality of habitat lost or altered for the local fish populations most directly affected by the Project)
- Including sufficient offsets to address the time lag until newly created or enhanced habitats become fully functional and to address the inherent uncertainty associated with successfully replacing lost production of CRA fisheries through enhancement or restoration of existing fish habitat and creation of new fish habitat

8.1.2. Consistency with Local Fisheries Management Objectives and Restoration Priorities

LNG Canada has met with Haisla Nation, DFO, and MFLNRO throughout the development of its offset plan to identify the federal, provincial, and Haisla Nation fisheries management objectives necessary to align its offset plan. Objectives that relate directly to the Kitimat River and its estuary include:

- Rebuilding weak wild runs of north coast chum salmon, while providing opportunities to harvest surplus stock (DFO 2015)
- Preventing or minimizing impacts of development activities on fish populations and fish habitat (Kalum Land and Resource Management Plan [LRMP] 2002)
- Managing existing populations of vulnerable and/or distinct fish stocks and species for their healthy perpetuation (Kalum LRMP 2002)
- Rehabilitating fish populations and/or habitat where degraded and, where appropriate, undertaking enhancement projects (Kalum LRMP 2002)
- Providing a range of opportunities for consumptive and non-consumptive use of fish (Kalum LRMP 2002)
- Managing resource development activities to minimize negative impacts to surface and groundwater quality (Kalum LRMP 2002)
- Managing human activities to maintain or enhance water quality and minimize water pollution (Kalum LRMP 2002)
- Managing human activities to maintain hydrological stability (Kalum LRMP 2002)
- Supporting Kitimat River eulachon restoration as eulachon is the priority for Haisla Nation (M. Jacobs, Haisla Fisheries Commission, Lower Kitimat Watershed Planning Meeting [LKWPM] 2013)

Consultations with local stakeholders and regulators have also provided the opportunity to understand habitat restoration priorities in the lower Kitimat River and its estuary. These priorities have been articulated in results of the LKWPM, held January 10, 2013 in Terrace, British Columbia.

8.1.3. Targeting Factors Limiting Fish Production

In the development of this fish habitat offsetting plan, LNG Canada has assumed that the quantity and quality of summer rearing and overwintering habitats are the factors most likely limiting the freshwater production of coho salmon, the most abundant salmon species in the lower Kitimat River estuary. This assumption is based on the following lines of evidence:

- Coho salmon have an extended freshwater juvenile life-stage in the estuary, whereas newly emerged fry of eulachon, pink salmon, and chum salmon migrate or passively drift to the estuary immediately after hatching
- The depth of most ponds, pools, and wetlands in Beaver Creek, Anderson Creek, and Moore Creek watersheds in winter are generally less than 0.5 m, thereby limiting the space and dissolved oxygen concentrations needed by juvenile coho salmon to survive the winter
- The number and spatial extent of ponds, pools, and wetlands preferred by juvenile coho salmon for rearing significantly diminishes in summer when flows are lowest

Based on these assumptions, offset projects included in this plan focus on the creation or enhancement of summer rearing and overwintering habitat for juvenile coho salmon.

8.1.4. Acknowledging the Inter-connectivity of Existing Estuarine Habitats

LNG Canada has taken an ecosystem approach to offsetting because of the inter-connectivity of the Kitimat River estuary. This means the offset projects included in this offset plan complement those provided in LNG Canada's previous applications for *Fisheries Act* authorizations (for the WAC [file no. 15-HPAC-00918] and LNG facility [file no. 16-HPAC-00220]). Taken together, they provide a mix of migratory, spawning, rearing and overwintering habitats focused in the Beaver, Anderson, and Moore Creek watersheds. The intent of this approach is to maintain the overall integrity of the Kitimat River estuary ecosystem and its ability to produce the eulachon and salmon species valued by the people of Kitimat and Haisla Nation.

8.1.5. Acknowledging Uncertainty and Time Lags

LNG Canada acknowledges that successful offsetting of lost fish production due to alteration or destruction of fish habitat has inherent uncertainties. These uncertainties come from three main sources:

- Difficulty understanding the relationships between fish production and physical habitat
- Time lags between when habitat creation, restoration, or enhancement efforts are complete, and when habitat becomes fully functional
- Assumption that we fully understand and can replicate the physical habitat features that fish actively select for their different life stages (e.g., spawning, rearing, overwintering)

LNG Canada has taken the following approach in its offset plan to address uncertainty and time lags:

- Building offsets in the same local watersheds, and for the associated local fish populations, most directly affected by the Project
- Building offset projects at the same time or as soon after construction of the Supporting Infrastructure as possible
- Building offsets that improve the temporal availability of habitat to fish
- Building offsets that provide a mix of rearing and overwintering habitat similar to that lost during construction of the Supporting Infrastructure
- Building offsets that provide more direct, instream habitat than will be lost or altered by the Supporting Infrastructure (i.e., gain-to-loss ratios greater than 1:1)

LNG Canada proposes the following offset-to-impact ratios to address some of the uncertainty and time lags associated with offsetting unavoidable *serious harm to fish* and the associated reduction in fisheries productivity:

- 2:1 for mainstem watercourses that provide spawning, overwintering, migratory, and/or rearing habitats for salmonids
- 2:1 for off-channel wetlands/ponds that provide rearing and overwintering habitats for salmonids
- 2:1 for estuarine habitats
- 1:1 for off-channel watercourses and wetlands that provide rearing, feeding, and refuge habitat for salmonids only during high water periods in spring and fall (i.e., areas that do not provide summer rearing or overwintering habitat)

For riparian areas permanently altered or destroyed, LNG Canada proposes to offset the reduction in riparian area with instream fish habitat at a 0.33:1 aquatic offset-to-riparian impact ratio. This offset ratio has been developed with the objective of providing a 2:1 riparian offset-to-impact ratio and the understanding that the average watercourse in the vicinity of the LNG

Canada Export Terminal has a 10 m wide channel and a 30 m wide riparian area on either side. As an example, if 3,000 m^2 of riparian area is lost, then restoration or enhancement of a 100 m long section of a 10 m wide watercourse (1,000 m^2 of direct aquatic habitat gain) would be required to provide 6,000 m^2 of associated riparian area.

These ratios, combined with LNG Canada's commitment to build offset projects during or shortly after *serious harm to fish* occurs during construction of the Supporting Infrastructure, increase the certainty that the offsetting plan will meet its goal of maintaining or increasing fisheries productivity in the lower Kitimat River estuary.

8.2. Offset Options Identification and Screening

8.2.1. Options Identification

Offset options were compiled from two main sources: the LKWPM held January 10, 2013 and attended by members of the Haisla Fisheries team, DFO, and MFLNRORD; and baseline surveys, desk-top reviews, and offsetting-specific site visits conducted between 2013 and 2015. Options identified by the LKWPM and LNG Canada's freshwater fisheries team are the result of knowledge of the existing freshwater and estuarine habitats and their utilization by fish in Beaver, Anderson, and Moore creeks and in the greater lower Kitimat River watershed.

During the LKWPM, 38 separate projects were identified. The spatial distribution of these projects ranged from the Kitamaat Village, including Wathl Creek, to the powerline crossing the Kitimat River just north of the Cable Car Subdivision (LKWPM 2013), a location approximately 15 km upstream of the Kitimat River estuary. These 38 projects can be roughly divided into three categories:

- Habitat enhancement projects (i.e., projects that augment natural fish production through improvement of existing fish habitat)
- Habitat restoration projects (i.e., projects that repair degraded habitat)
- Improved information/research/pre-assessment projects (i.e., projects that increase the likelihood of successfully restoring, augmenting, or managing local fish stocks)

Another 34 potential offset projects were identified from the work conducted by LNG Canada's fisheries team during baseline surveys and offsetting-specific site visits or by Mitch Drewes, a local consultant who has conducted fisheries work for Haisla Nation and was part of the LKWPM. The spatial distribution of these projects ranged from Jesse Falls on Douglas Channel in the south to Lone Wolf Creek in the north. Together, these 72 potential projects are identified in Appendix 8 (Freshwater Fish Habitat Offsetting Options Compilation and Screening) and have been the

principle source for offset projects for the previously submitted offset plans for the WAC (file no. 15-HPAC-00918) and LNG facility (file no. 16-HPAC-00220).

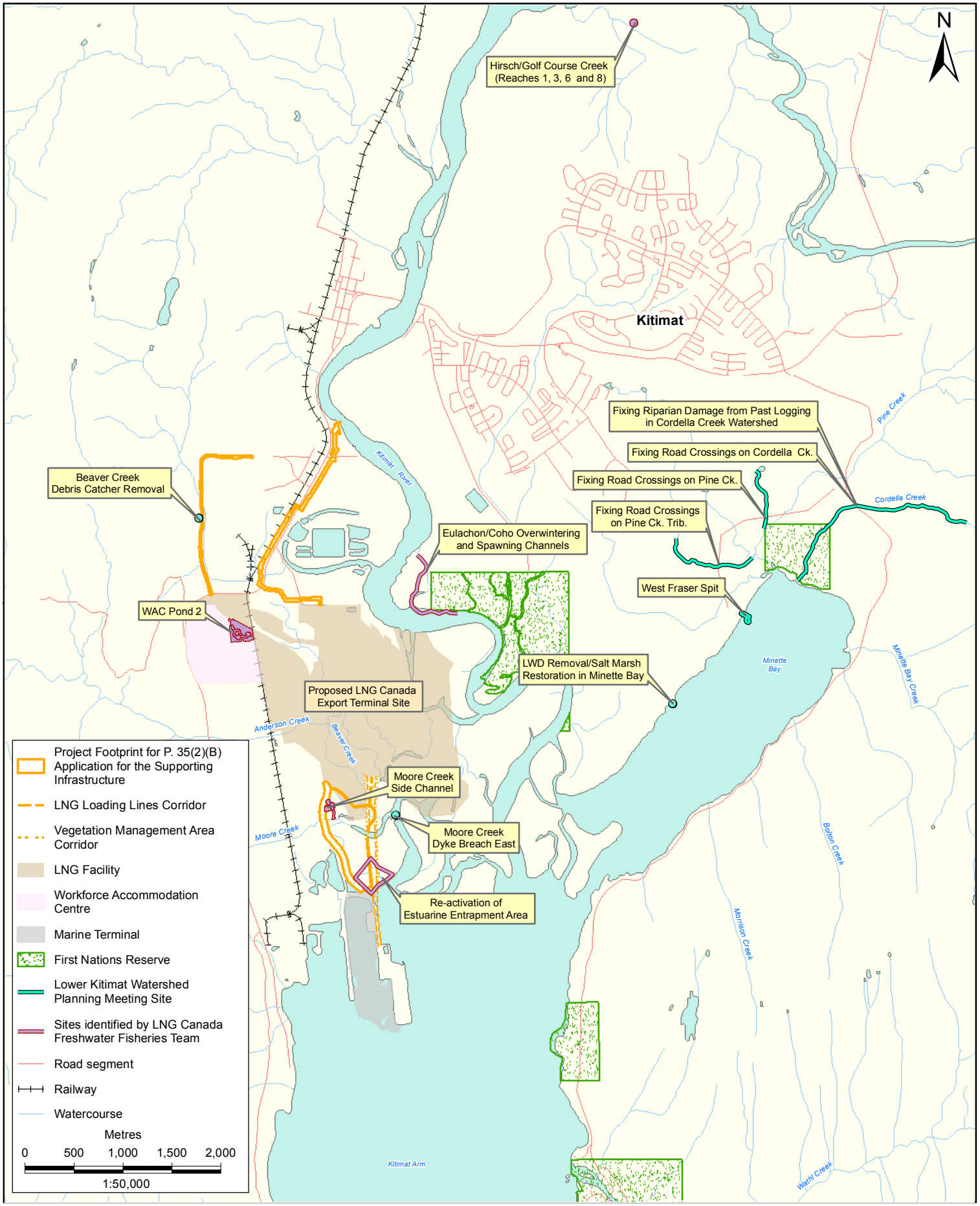
8.2.2. Options Screening

A smaller subset of these 72 projects was evaluated for inclusion in this offset plan for the Supporting Infrastructure. This was because: some projects from the larger set of options have already been included in the previous two offset plans; several potential projects had been previously rejected for logistical, technical, and land-ownership reasons; and, some options were felt to be too far-field to likely benefit the fish populations most directly affected by the Supporting Infrastructure.

The Hirsch Creek side-channel project proposed in the original offset plan submitted to DFO for the paragraph 35(2)(b) *Fisheries Act* authorization for the Supporting Infrastructure has been removed from this plan based on feedback from DFO, as well as challenges with access to construct the offset habitat. Excluding the Hirsch Creek side-channel project, 12 other potential offset projects were evaluated for inclusion in this offset plan (Figure 8-1). Each project was qualitatively screened for its biological relevance, technical feasibility, consistency with federal and provincial policies, compatibility with the LNG Canada project footprint and water management plans, and potential land ownership conflicts. Options in obvious conflict with federal and provincial policies (e.g., removal of natural barriers to fish passage) or with the constructability of the LNG facility were dropped from further consideration. Options located on private land were carefully considered. Options provided by the LKWPM were considered to be acceptable to DFO and Haisla Nation, given their participation in the LKWPM workshop.

Those options passing this initial screening were prioritized based on their:

- Contribution to offset unavoidable habitat losses associated with the Supporting Infrastructure
- Proximity to affected habitats and the local fish populations they support
- Opportunity to provide long-term benefits to fish
- Ability to benefit multiple fish species and life stages
- Ability to provide similar types of habitat as those lost or altered by the Supporting Infrastructure
- Ability to augment utilization or suitability of projects already included in the offsets plans for the WAC and LNG facility
- Long-term maintenance requirements
- Access requirements



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LNG CANADA EXPORT TERMINAL: APPLICATION FOR PARAGRAPH 35(2)(B) FISHERIES ACT AUTHORIZATION FOR SUPPORTING INFRASTRUCTURE

LOCATIONS OF EVALUATED OFFSET OPTIONS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

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Important considerations during this screening and prioritization process were the proximity and similarity of the offset habitat that would be created or enhanced to the habitat lost or altered by the Supporting Infrastructure. This was because similar offset habitats located as near to the Project as possible (i.e., "in-kind" offsets) have the greatest potential to benefit the fish species and populations most directly affected. Different offset habitats located further away (i.e., "out-of-kind" offsets) have greater uncertainty about whether they will directly benefit the fish populations most directly affected by the Project. As a result, "in-kind" offsets were given higher priority than "out-of-kind" offsets.

8.2.3. Options Selection

Two of the 13 offset projects shown in Figure 8-1 have been selected for inclusion in the offset plan for the Supporting Infrastructure:

- Moore Creek side channel realignment
- WAC Pond 2

The Moore Creek side channel realignment was selected because it will reconnect the remaining portions of the Moore Creek side channel that would otherwise be disconnected by expansion of the haul road to construction the module haul road and utility corridor. It will also maintain connection to wetland habitats on the west side of the module haul road that would otherwise be isolated and inaccessible to fish on the east side of the module haul road. This offset project will provide new habitat and will enhance existing habitat for juvenile coho salmon rearing and overwintering. It will also provide fish passage between habitats on either side of the module haul road. The location of the Moore Creek side channel realignment project is shown in Figure 8-2.

The WAC Pond 2 project was selected because it will provide rearing and overwintering habitat for juvenile coho salmon in the Beaver Creek watershed. This pond and associated channels will be connected hydraulically to WAC Pond #1 and WAC Pond #3 creating a large wetland/pond complex in the upper Beaver Creek watershed. Other reasons for its selection are that groundwater monitoring in the area provides a high degree of confidence in maintaining water levels in the ponds and wetland during summer, it is located near existing roads for ease of construction and monitoring, and it has low maintenance requirements given the low energy nature of the project. The location of the WAC Pond 2 offset project is shown on Figure 8-3.

The two selected offsetting projects will support the sustainability, diversity, and ongoing productivity of affected CRA fisheries in the Kitimat region, will provide the key ecosystem functions of the existing habitat being affected by the LNG facility and the Supporting Infrastructure, and will provide benefits to fish that are expected to outlive project effects. These new and enhanced habitats represent appropriate options for offsetting project-related *serious*

harm to fish because they are technically feasible, complement the existing environment by providing a variety of habitat types to support the different life stages of local fish populations, and expand the temporal availability of habitat for use by juvenile coho salmon.

Reasons for excluding the remaining 11 projects from further consideration are presented below:

- Cordella Creek logging impacts—diffuse impacts requiring watershed restoration
- Cordella Creek road crossing—little benefit without restoration of logging impacts
- Pine Creek road crossing—already addressed by Haisla Nation
- Pine Creek tributary road crossing—already addressed by Haisla Nation
- West Fraser Spit—benefits largely in marine environment
- Salt Marsh Restoration in Minette Bay—benefits largely in marine environment
- Eurocan Dyke Side channel restoration—land ownership and existing infrastructure issues
- Reactivation of estuarine entrapment area—potential contamination issues
- Beaver Creek Debris Catcher Removal—currently used by Kitimat LNG and its removal could have impacts to existing infrastructure
- Moore Creek dyke breach—retained by Rio Tinto
- Hirsch Creek side-channel—concerns expressed by DFO and construction access

While these projects are not being carried forward in this offset plan, some may be potential contingencies should any of the proposed offset projects be found to be physically unstable, require long-term maintenance, or not provide the anticipated benefits to fish. These contingency options are described in greater detail in Section 6.4 (Contingency Measures).

8.3. Design Approach

The overall approach to the design of the selected offset projects is to provide habitats that meet the characteristics of "good quality" salmonid habitat identified in Table 5 (Diagnostics of salmonid habitat condition at the reach level) of the Fish Habitat Assessment Procedure (Johnston and Slaney 1996). Some of the parameters characteristic of good quality salmonid habitat identified in Johnston and Slaney (1996) include:

- More than two pieces of LWD per bankfull width
- More than 20% LWD cover in pools
- Percent pool by area greater than 55%
- Gravel- and cobble-dominated substrates with sand or small gravel rarely subdominant

The exception is the criteria for placement of more than two pieces of LWD per bankfull width in the Moore Creek side channel. Due to its small channel width this would result in too much instream LWD. In this case, sufficient LWD will be provided to achieve more than 20% cover in the watercourse, as well as the pools.

The following sections provide details of the design approach used for off-channel habitat enhancement, habitat complexing, and riparian restoration incorporated into the Moore Creek side-channel and WAC Pond 2 projects.

8.3.1. Off-Channel Habitat Enhancements

Natural channel design principles have been used to inform the off-channel habitat enhancement designs for the Moore Creek side channel. Natural channel design uses geomorphic and engineering principles to design channels that work in the environment in which they are constructed. Natural templates of the existing Moore Creek side channel and other side channel habitats in the Kitimat River estuary were used to inform the design. This included using the site-specific conditions currently present in the side channel, following the existing channel meander pattern wherever possible to reduce impacts to riparian areas, and mimicking the channel morphology and repeating pattern of different habitat types present.

Many off-channel wetlands and ponds in the Beaver, Anderson, and Moore creek watersheds are shrub swamps that do not provide year-round habitat for fish because they are generally less than 0.5 m deep during summer and winter low flow conditions and are isolated from mainstem habitats. This limits the space available, can lower dissolved oxygen concentrations to stressful levels, and restricts the ability of fish to move out of these wetlands and ponds when conditions become unsuitable. For this reason, off-channel wetlands and ponds included in the Moore Creek side channel and WAC Pond 2 projects have been designed with a depth of 1 m or greater. This design increases the volume and depth of water present, increases the likelihood and volume of groundwater inflows because the bottoms of the ponds are below the water table, and increases the likelihood that water temperatures and dissolved oxygen concentrations are suitable for juvenile coho salmon for longer durations than most existing off-channel wetlands and ponds in the lower Kitimat River estuary.

8.3.2. Habitat Complexing

Habitat complexing is incorporated into offset designs to stabilize banks and riparian areas and to provide cover for fish. This complexing includes large woody debris (LWD) structures, parallel log jams, root-wads, and woody debris toe protection.

The benefits of habitat complexing in habitat restoration programs has been demonstrated by Keeley et al. (1996), who completed a literature review of habitat restoration programs that

reported fish abundance information as part of a study funded by the provincial Watershed Restoration Program. For rearing habitat enhancements that included habitat complexing, the study found:

- 77% increase in coho salmon young-of-year densities
- 52% increase in steelhead young-of-year densities
- 130% increase in steelhead parr densities
- 50% increase in stream-resident juvenile salmonid densities

Similar results were found by other researchers. Whiteway et al. (2010) performed a meta-analysis using data from 211 stream restoration projects and found that 73% of projects using instream structures resulted in increased local salmonid densities (average effect size of 0.51 [167%]) and 87% of projects using instream structures resulted in increased fish biomass (average effect size of 0.48 [162%]). Roni et al. (2010) found that stream restoration projects that included instream structures resulted in an increase of 0.37 coho smolts per square metre. Ogston et al. (2014) found that the density of coho smolts at individual complexed sites in the Chilliwack River (smolt density ranging from 0.17 to 0.75 smolts/m^2) was consistent with Whiteway et al. (2010).

Each wood structure will fulfill specific design functions depending on local site-conditions such as water depth, water velocity, bank height, channel slope, and substrate composition. Functions of the wood structures will include:

- Controlling flow direction
- Maintaining pool features
- Dissipating flow energy
- Providing channel stability
- Providing velocity refugia for fish
- Providing cover for fish

Materials will be sourced on-site wherever possible. The final placement, arrangement, and quantity of in-channel habitat structures will be optimized during detailed design or during construction when they can be “field-fit” without altering the overall habitat objectives. However, general criteria for the wood structures include, but are not necessary limited to, the following:

- LWD not providing a structural function in the design will consist of logs and rootwads that are a minimum of 0.3 m in diameter
- Rootwads will have a length of at least 3 m

- Logs will have a minimum length of 6 m
- Cedar, spruce, hemlock, or other coniferous tree species will be selected and set aside during clearing to be used as LWD
- LWD will be positioned so a portion is submerged and functional at low flows
- LWD will be anchored by ballasts (boulders and/or other logs) and/or buried within the channel or pond bank to prevent movement of the log structure

8.3.3. Riparian Restoration

Effort will be made to avoid disturbing existing riparian vegetation during construction of the offset projects. Where disturbance of riparian vegetation occurs and topsoil has been removed or compacted by construction vehicles, a staged approach to restoration will be taken:

- Immediately following construction, 300 mm to 450 mm of salvaged or imported topsoil will be placed over all disturbed areas
- Areas of moderate to higher erosion risk will be seeded with an appropriate seed mix to stabilize the soils. The seed mix will meet MFLRNORD standards, and seeding may include hydroseeding
- Wetland areas will be planted and stream banks will be live-staked with appropriately wet tolerant species as soon as seasonal conditions allow

In all other areas, natural recovery will be allowed for up to one growing season.

Following one growing season, in-fill planting will occur, as required, around naturally generating vegetation to bring the plant spacing within the riparian areas up to the average on-centre spacing targets identified in Table 8-1. Based on site conditions around the offset projects, five planting zones have been identified:

- Zone A—Low Bench Riparian: Areas with prolonged periods of flooding in fall and spring and high water table. Zone A also applies to areas with restrictions on vegetation height
- Zone B—Mid Bench Riparian: Areas with occasional flooding during freshet or following storm events and high water table
- Zone C—High Bench Riparian: Areas not subject to flooding but with occasional high water table
- Zone W1—Freshwater marsh: Water depths from saturated soils to 400 mm standing freshwater (typically located around the perimeter of deeper overwintering habitats)
- Zone W2—Estuarine marsh: Flooded at high tide and dewaters at low tide

The plant species and planting density targets for each zone are identified in Table 8-1.

Immature trees, shrubs and emergent marsh plants may be salvaged from areas within the LNG Canada Export Terminal footprint and used in the riparian restoration effort. The contractor will assess the opportunity to reuse salvaged plants prior to ordering nursery grown plants. All container grown plants will be from stock originating within the Kalum Forest District.

Table 8-1 Native Species Identified for Replanting by Planting Zone

Planting Zone	Species		Minimum Size	Avg. On-Centre Spacing (m)	Approximate Percentage
	Common Name	Scientific Name			
Zone A	Sitka willow	*Salix sitchensis*	Live stake[1]	0.75	30
	Red-osier dogwood	*Cornus stolonifera*	Live stake	0.75	30
	Hardhack	*Spirea douglasii*	No. 1 pot[2]	1.25	20
	Salmonberry	*Rubus spectabilis*	No. 1 pot	1.25	20
Zone B	Hardhack	*Spirea douglasii*	No. 1 pot	1.25	40
	Salmonberry	*Rubus spectabilis*	No. 1 pot	1.25	35
	Black twinberry	*Lonicera involucrata*	No. 1 pot	1.25	20
	Western redcedar	*Thuja plicata*	No. 2 pot[3]	3.5[4]	1
	Western hemlock	*Tsuga heterophylla*	No. 2 pot	3.5	2
	Black cottonwood	*Populus trichocarpa*	Live stake[1]	3.5	2
Zone C[5]	Salal	*Gaultheria shallon*	No. 1 pot	1.25	10
	Sitka spruce	*Picea sitchensis*	No. 2 pot	3.5	15
	Western red cedar	*Thuja plicata*	No. 2 pot	3.5	15
	Western hemlock	*Tsuga heterophylla*	No. 2 pot	3.5	15
	Black cottonwood	*Populus trichocarpa*	Live stake	3.5	10
Zone W1	Broadleaf cattail	*Typha latifolia*	Bare root	0.5	50
	Small-flowered bulrush	*Scirpus microcarpus*	Plug	0.5	20
	Beaked sedge	*Carex rostrata*	Plug	0.5	15
	Sitka sedge	*Carex sitchensis*	Plug	0.5	15
Zone W2	Lynby's sedge	*Carex lyngbyei*	Plug	0.5	100

NOTES:

[1] Live stakes to be minimum 1 m in length, have 5 nodes, with 65% to 70% of live stake to be covered by topsoil when planted. Can be replaced with No. 1 pot.

[2] No. 1 pot = 1 gallon container

[3] No. 2 pot = 2 gallon container

[4] Trees to be planted in groups of 2-5 at designated spacing. Sufficient spacing to be provided between groups to allow for development of a shrub layer.

[5] Zone C planting percentage less than 100% to account for natural recruitment.

8.3.4. Verification of Designed Water Levels

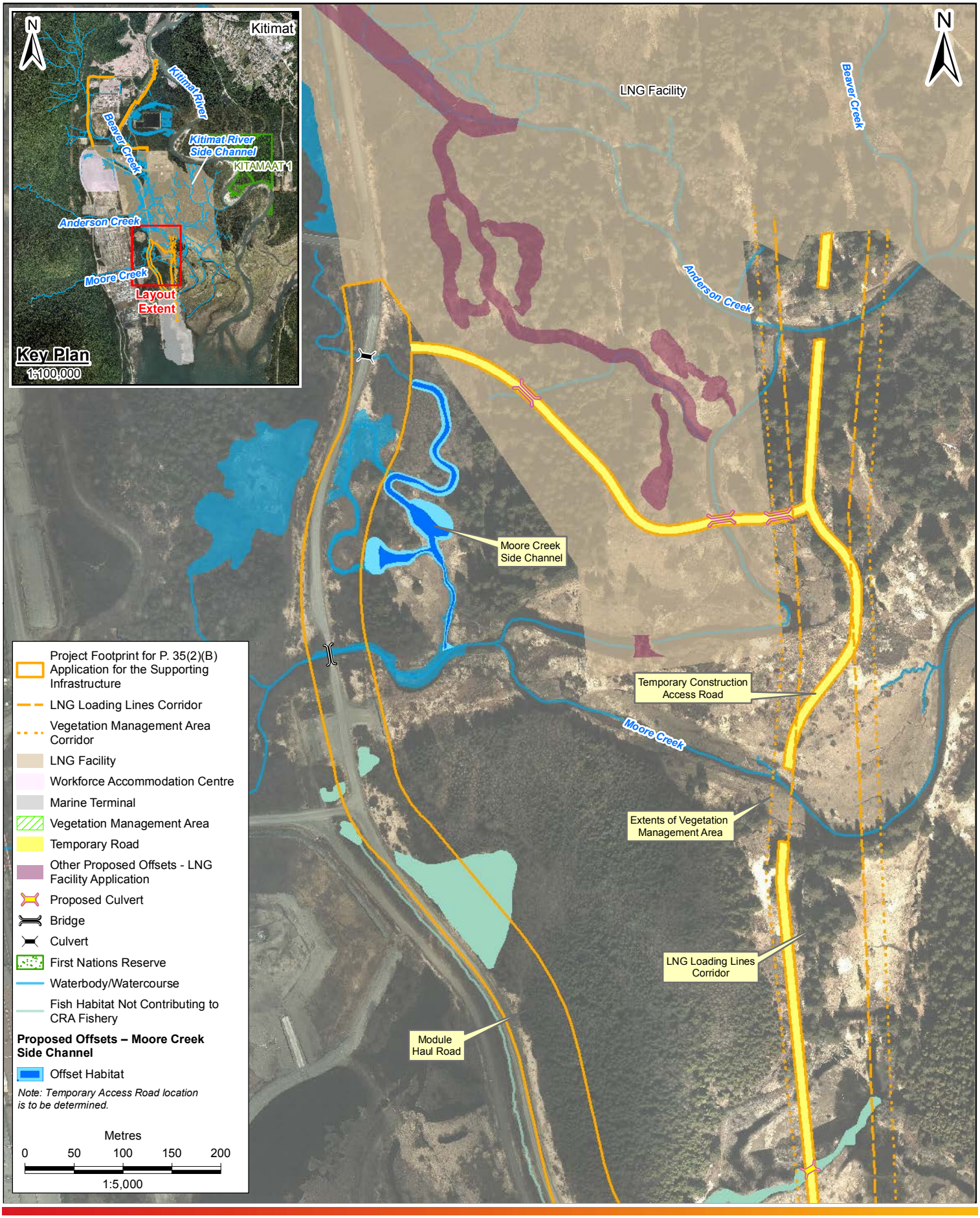
A low-flow assessment was conducted for the Moore Creek Side-channel design (Appendix 9). To do this, weekly stream flow in the Moore Creek side-channel was simulated by scaling a model predicting weekly flows in Beaver Creek. The model included as inputs 10 years of daily rainfall data from rain gauges in the immediate area, and groundwater recharge data collected from 55 slug tests and water levels measured at 72 observation wells across the LNG Canada Project site during geotechnical investigations. The model was calibrated to stream gauge data from Beaver Creek collected between November 2014 and October 2016 by adjusting groundwater recharge and baseflow attenuation rates until a suitable fit with the measured data was achieved.

A three-dimensional groundwater model was used to predict baseflows and water table elevations during summer and winter periods for the Moore Creek Side-channel design and for the WAC Pond 2 design. The model was calibrated using the observation well data. The calibrated model was used to set pond depths below the predicted water table, and determine the width and depth of connector channels based on predicted base flow volumes. Details of the groundwater model are provided in Appendix 9.

8.4. Moore Creek Side Channel

8.4.1. Background

The existing Moore Creek side channel is a tributary of Moore Creek that originates on the west side of the module haul road. The side channel flows under the haul road from west to east through a partially collapsed 1.5 m diameter corrugated steel pipe culvert located approximately 340 m north of the Moore Creek bridge. The side channel enters Moore Creek east of the haul road, approximately 100 m downstream of the Moore Creek Bridge (Figure 8-2).



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LNG CANADA EXPORT TERMINAL: APPLICATION FOR PARAGRAPH 35(2)(B) FISHERIES ACT AUTHORIZATION FOR SUPPORTING INFRASTRUCTURE

PROPOSED MOORE CREEK SIDE CHANNEL OFFSET PROJECT

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

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The Moore Creek side channel offset will connect off-channel and wetland habitats that would otherwise be disconnected from fish access by loss of habitat resulting from construction of the module haul road and utilities corridor. It will also create perennial ponds to replace the seasonal wetland areas lost under the module haul road and utility corridor footprints. These habitats will provide year-round rearing and overwintering habitat and maintain access to existing off-channel habitat on the east and west sides of the module haul road.

8.4.2. Offset Design and Benefits to Fish

The objectives of the Moore Creek side channel offset are to: 1) provide rearing and overwintering habitat for juvenile coho salmon; and 2) provide uninterrupted access to habitats on the east and west sides of the module haul road.

The design utilizes the new culvert installed under the module haul road and utility corridor. From this culvert, water will flow for approximately 240 m within the existing channel. Between 0 + 240 and 0 + 280, a new channel will be constructed to turn the flow of water east away from the utility corridor and into a newly constructed pond. This pond will then drain into Moore Creek via the existing Moore Creek side channel. A second pond will be built in the old Moore Creek side channel in an area that currently drains a seasonal wetland within the utility corridor footprint. This second pond will be the only component of this offset project to affect existing habitat in the Moore Creek side channel.

Engineering design drawings, including plan, profiles, sections, and specifications for the Moore Creek side channel are provided in Appendix 9 (Hydrology Report and Hydrogeology Data); the hydrology assessment for low flow conditions in the side channel is provided in Appendix 9. Design criteria used in development of the Moore Creek side channel include the following:

- Maximum water depth of ponds will be 4 m to provide sufficient depth for overwintering
- Pond bank slopes will be 5H:1V
- Off-channel watercourse habitat will have an average width of 5 m and average water depth of 1 m
- Off-channel watercourse bank slopes will be 2H:1V or less
- Pond edges and banks will be planted with emergent wetland vegetation
- LWD will be placed in the ponds and the off-channel habitat for complexity
- Channel edges will be planted with native trees and shrubs through the low, mid, and high-bench floodplains or estuarine marsh vegetation (Zone W2) where appropriate

When completed, the Moore Creek side channel will provide new rearing and overwintering habitat for juvenile coho salmon and maintain access to existing off-channel habitat on the east and west side of the module haul road.

8.4.3. Contribution to Habitat Balance

The Moore Creek side channel will have a designed surface area of 3,751 m^2, not including a section of existing channel to be retained. This will include 569 m^2 of new off-channel watercourse and 2,737 m^2 of new intertidal wetland habitat. An additional 455 m^2 of existing off-channel watercourse will be enhanced with the placement of LWD. A net area of 3,751 m^2 of off-channel habitat will be created or enhanced by the Moore Creek side channel offset project (Table 8-2). During low flow conditions, the offset project will create 1,583 m^3 of rearing and overwintering off-channel watercourse and pond habitats (Table 8-2).

Table 8-2 Habitat Area Created or Enhanced by the Moore Creek Side Channel

Habitat Type	Habitat Use	High Flow Habitat Area (m^2)	Low Flow Habitat Area (m^2)
Off-channel Watercourse: perennial	• Rearing • Overwintering	569	324
Off-channel Watercourse: perennial (enhanced)	• Rearing • Overwintering	445	204
Wetland: intertidal	• Rearing • Overwintering	2,737	1,055
Total		**3,751**	**1,583**

8.5. Workforce Accommodation Centre Pond 2

8.5.1. Background

The WAC Pond 2 offset project is intended to provide additional rearing habitat for juvenile coho and improve connectivity between the existing wetland (B3-5-2-1-1 wetland) northeast of the WAC and the offset habitat created for the WAC (DFO file no. 15-HPAC-00918). It will do this by increasing water levels in the existing B3-5-2-1-1 wetland (by setting the culvert elevation higher than it is currently), and flooding adjacent terrestrial areas to create the new Pond 2. In addition, new channels and ponds will be excavated adjacent to Pond 2 that connect with the WAC offsets to the west (channel 1) and east (channel 3).

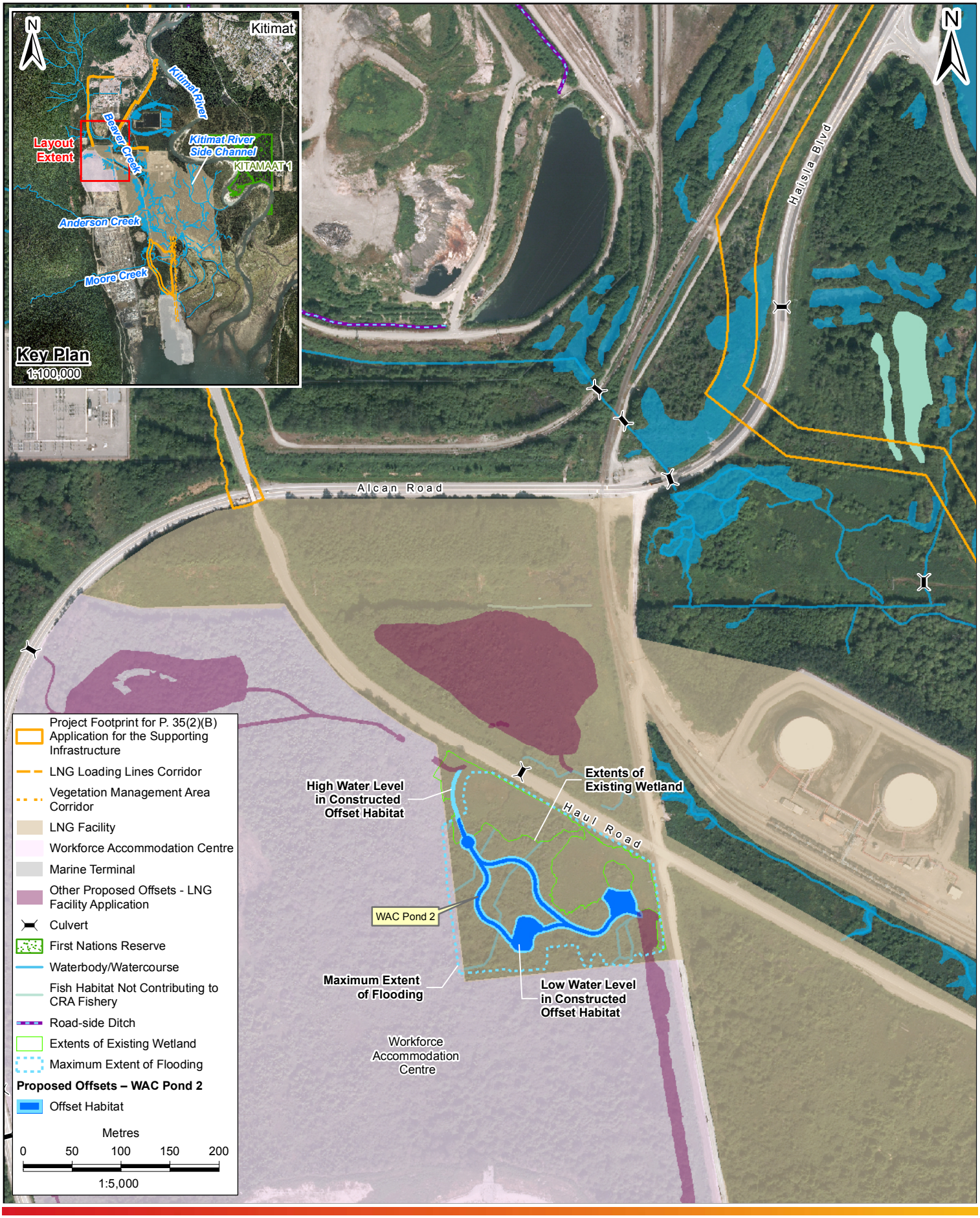
The WAC Pond 2 offset project is bounded by the haul road to the north, the Rio Tinto rail line to the east, and the WAC to the west and south (Figure 8-3). The existing wetland in this area is presently a mixed sedge and shrub (hardhack) wetland with swamp forest around its perimeter. During high flow conditions in spring and fall, there are sufficient water depths to allow fish access to the wetland; juvenile coho salmon and threespine stickleback have been captured during fall high waters. There are no well-defined channels or large sections of open water in the existing wetland. During low flow periods in the summer and winter, fish habitat values were rated as poor, given the lack of deep pools, absence of flowing water, and poor hydraulic connection to downstream fish habitat.

Currently, flow from WAC offset channel 3 enters the existing wetland southwest of the haul road crossing of the Rio Tinto rail line. Water from channel 3 seeps through the existing wetland before being directed north under the haul road and ultimately entering Beaver Creek tributary B3-5. During summer months and low flow conditions in winter months, the perennial habitat in channel 3 is isolated from the perennial habitat patch in the existing B3-5-2-1-1 wetland. In fall and spring there is fish access to channel 3 but it through the shrub swamp and access is poor.

8.5.2. Offset Design and Benefits to Fish

The objectives of the WAC Pond 2 offset habitat are to: create perennial rearing habitat; extend the period of the year that the existing B3-5-2-1-1 wetland provides suitable fish habitat to juvenile coho salmon; improve fish access to/from this wetland and WAC offset channel 3; and, create additional seasonal habitat. The scope of the offset project involves:

- Raising water levels in the existing B3-5-2-1-1 wetland and across the offset habitat area to 8.2 m geodetic- by setting the invert of the outlet channel at the 8.2 m elevation, thereby creating the expanded Pond 2 area. This will provide greater water depths, a longer period of flooding, and create seasonal wetland habitat around the new pools and channels.
- Creating a 50 m long seasonal outlet channel to connect the new offset habitat to the WAC offset channel 1
- Creating approximately 435 m of new perennial channel habitat that provides connectivity between WAC pond 1 (via channel 1), Pond 2, and WAC offset channel 3
- Creating three new perennial pools, mostly in an area of terrestrial habitat, that are on-line with the new perennial channels



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LNG CANADA EXPORT TERMINAL: APPLICATION FOR PARAGRAPH 35(2)(B) FISHERIES ACT AUTHORIZATION FOR SUPPORTING INFRASTRUCTURE

PROPOSED WAC POND 2 OFFSET PROJECT

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	BH
DATE	FIGURE NO.
12-SEP-17	**8-3**

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These works will create new perennial habitat within the new channels and new on-line ponds. In addition, raising the water level in the Pond 2 area by 0.3 m and construction of the outlet channel, will create new seasonal off-channel wetland habitat and seasonal channel habitat. The increased water depth in this area will also flood the existing wetland to a greater depth extend the period that the wetland provides functional habitat for juvenile coho salmon rearing. Under average climate conditions, connectivity between the proposed WAC Pond 2 and Beaver Creek is expected in fall and spring; in winter and summer months, the habitats will be isolated but able to support fish.

The channels and ponds will be excavated to a depth of 1.75 m and 2 m, respectively, to provide overwintering and perennial rearing habitat for fish. The channels will have one side graded at 1H:1V side slopes to promote greater over stream cover from riparian vegetation; the other side will be graded at 1H:2V for constructability and safety reasons (i.e., to allow someone who falls in to be able to get out of the channel). The ponds will be graded at 1H:4V below the water line and 1H:1V above the water line. The 1H:4V side slopes are expected to allow colonization by emergent wetland vegetation, while allowing safer access and egress, as well as easier construction. Habitat complexing will be achieved through placement of root wads and other LWD.

Engineering design drawings for the WAC Pond 2, including plan, profiles, sections, and specifications, are provided in Appendix 1.

8.5.3. Contribution to Habitat Balance

Table 8-3 describes the areas of habitat created through the construction of the offset program and associated increases in water levels. During high flow conditions, when flooding is at its maximum, 37,495 m^2 of new habitat will be created for use by juvenile coho salmon and threespine stickleback. This will include 4,145 m^2 of perennial channel and pond habitats and 21,945 m^2 of seasonal wetland and watercourse habitats. During low flow conditions in summer, a total of 2,847 m^2 of four-season perennial habitat will be created by the WAC Pond 2 offset project. Available overwintering habitat areas will be between these two areas.

Table 8-3 Habitat Area Created or Enhanced by the WAC Pond 2 Offset

Habitat Type	Habitat Use	High Flow Habitat Area (m^2)	Low Flow Habitat Area (m^2)
Off-channel watercourse: perennial	• Rearing • Overwintering	2,270	1,384
Off-channel watercourse: seasonal	• Rearing	350	0
Off-channel pond: perennial	• Rearing • Overwintering	1,875	1,463
Wetland: seasonal	• Rearing	21,595	0

Habitat Type	Habitat Use	High Flow Habitat Area (m^2)	Low Flow Habitat Area (m^2)
Wetland: seasonal (enhanced)	• Rearing	11,405	0
Total		**37,495**	**2,847**

8.6. Summary of Habitat Contributions from the Offset Projects

Together, the Moore Creek side channel and WAC Pond 2 offsets will create or enhance a gross total of 41,246 m^2 of fish habitat under high flow conditions and 4,430 m^2 of fish habitat under low flow conditions (Table 8-5). For high flow conditions, this includes 29,046 m^2 of perennial and seasonal habitat that will be constructed or created by flooding terrestrial areas, and another 11,850 m^2 of habitat that will be enhanced by increased complexing or raising water levels and the period of flooding.

The existing Moore Creek side channel outlet (between the constructed offset habitats and Moore Creek mainstem) will be enhanced by placement of LWD to provide more than 20% of instream cover to improve the complexity of the channel. This will increase the juvenile coho salmon densities of the habitat by a minimum of 50% as per Section 8.3.2 (Habitat Complexing). As such, the area of complexed habitat is discounted by 50% to reflect the increased productivity (i.e., the contribution from this project have been reduced from 445 m^2 to 223 m^2 for high flow conditions and from 204 m^2 to 102 m^2 for low flow conditions).

Contributions from the WAC Pond 2 seasonal outlet channel and new seasonal wetland created by raising the water level in the area to 8.2 m geodetic has been discounted by 50% to allow the net offset habitat contributions of perennial and seasonal habitats to be weighted equally. The enhancement of the existing B3-5-2-1-1 wetland by the increased flooding (depth and duration) is not considered in the habitat balance, but will benefit juvenile coho salmon.

After accounting for the percentage contribution for seasonal and enhanced habitats, these two offsets will contribute a net gain of 18,647 m^2 towards counterbalancing the *serious harm to fish* created by the Supporting Infrastructure.

Table 8-4 Gross and Net Habitat Areas Created or Enhanced by the Offset Projects

Offset Project	Habitat Type	Habitat Use	Gross Habitat Area (m^2)		Contribution to Offset (%)	Net Offset Area (m^2)	
			High Flow	Low Flow		High Flow	Low Flow
Moore Creek Side Channel	Off-channel watercourse: perennial	• Rearing • Overwintering	569	324	+100%	569	324
	Wetland/Pond: intertidal	• Rearing • Overwintering	2,737	1,055	+100%	2,737	1,055
	Enhanced off-channel watercourse: perennial	• Rearing • Overwintering	445	204	+50%[1]	223	102
WAC Pond 2	Off-channel watercourse: perennial	• Rearing • Overwintering	2,270	1,384	+100%	2,270	1,384
	Off-channel watercourse: seasonal	• Rearing	350	0	+50% [2]	175	0
	Off-channel pond: perennial	• Rearing • Overwintering	1,875	1,463	+100%	1,875	1,463
	Wetland: seasonal	• Rearing	21,595	0	+50%	10,798	0
	Wetland: seasonal (enhanced)	• Rearing	11,405	0	0% [3]	0	0
Total			**41,246**	**4,430**		**18,647**	**4,328**

Notes:

[1] Enhanced by placement of LWD to improve the complexity of the channel. This will increase the utilization and densities of the habitat by a minimum of 50% as per Section 8.3.2 (Habitat Complexing).

[2] Seasonal offset habitat discounted by 50% to allow net contributions to be in perennial habitat equivalents

[3] No net habitat gain from temporal increase in water depth or period of hydraulic connectivity between the B3-5-2-1-1 wetland and Beaver Creek tributary B3-5 is claimed in the habitat balance

During low flow conditions, the offsets will provide a net (i.e., discounted) contribution of 1,708 m^2 of perennial off-channel watercourse, and 2,518 m^2 of perennial and intertidal pond/wetland, (Table 8-5). Another 102 m^2 of low flow habitat gains will be achieved through enhancement of perennial off-channel watercourse. During low flow conditions, the offsets will provide a combined net (i.e., discounted) contribution of 4,328 m^2.

Table 8-5 Summary of Habitat Contributions by Habitat Type

Habitat Type	Gross Habitat Areas (m^2)		Net Habitat Areas (m^2)	
	High Flow	Low Flow	High Flow	Low Flow
Off-channel Watercourse: perennial	2,839	1,708	2,839	1,708
Off-channel Watercourse: seasonal	350	0	175	0
Off-channel Pond/Wetland: perennial/intertidal	4,612	2,518	4,612	2,518
Off-channel Wetland: seasonal	21,595	0	10,798	0
Enhanced Off-channel Watercourse: perennial	445	204	223	102
Enhanced Off-channel Wetland: seasonal	11,405	0	0	0
Total	**41,246**	**4,430**	**18,647**	**4,328**

8.7. Confidence in Offset Effectiveness

LNG Canada has high confidence that the habitat offsets described in Sections 8.4 (Moore Creek Side Channel) and 8.5 (Workforce Accommodation Centre Pond 2) will effectively counterbalance the *serious harm to fish* created by construction of the Supporting Infrastructure and associated offsets. This confidence is supported by the following lines of evidence:

- The Moore Creek side channel offset project is located in a small, meandering, low gradient tributary of Moore Creek; it requires a relatively simple re-connection of two isolated channel segments with a short section of channel and a new in-line pond. Site conditions reduce the probability of bank instability and limit the hydraulic conditions that would result in excessive erosion and sedimentation.
- The two ponds that will be built as part of the Moore Creek side channel offset provide most of the offset area. These types of off-channel ponds are known to be used extensively throughout the Kitimat River estuary by juvenile coho salmon for rearing and overwintering.
- The WAC Pond 2 habitat complex has been designed to utilize the groundwater in this area of the site. Groundwater monitoring wells provided a strong understanding of the groundwater regime.

- Fish sampling has shown these areas to be utilized by juvenile coho salmon and threespine stickleback. The designs provide improved access, deeper habitats, and high instream complexity—these features are intended to provide high quality habitat.
- Off-channel habitats, such as those proposed in this offset plan, are known to increase fish production and provide direct benefits to salmonids in similar freshwater environments throughout BC (Lister et al. 1980; Envirowest Environmental Consultants 1990; Nickelson et al. 1992; Keeley et al. 1996; Whyte et al. 1997; Blackwell et al. 1999; Morley et al. 2005; Cooperman et al. 2006; Rosenfeld et al. 2008).

8.8. Implementation and Monitoring

8.8.1. Implementation Schedule

Following receipt of regulatory approvals and a positive financial investment decision, LNG Canada will start site preparation and construction of the Project, including the Supporting Infrastructure, as per the schedule identified in Section 4.4 (Schedule and Sequencing) and Figure 4-8.

The WAC Pond 2 offset project will be built in Q2 and Q3 of Year 2 of the LNG Canada Export Terminal construction schedule. The Moore Creek side channel will be built during or immediately after construction of the module haul road and utility corridor. Construction of the Moore Creek side channel is anticipated to start during in the second half of Year 3 and is expected to take eight months, extending into Q1 of Year 4. As mentioned above, the timing relative to the module haul road construction is necessary to manage water flowing through the culvert under the module haul road and to maintain connectivity with the Moore Creek mainstem downstream.

Construction of both offset projects will be completed within 1.5 years of the start of construction of the proposed works causing *serious harm to fish*. Construction of WAC Pond 2 will be complete before most activities causing serious harm to fish and construction of the Moore Creek side channel will occur concurrently with the module haul road work. This timing results in no temporal delays between the benefits of the offset projects being realized and the *serious harm to fish* occurring.

Riparian restoration planting for each offset project will be completed approximately one year after completion of the aquatic habitats. This timing is intended to allow natural re-colonization from the existing seed-bank to start before in-fill planting is completed.

8.8.2. Monitoring and Reporting

Two types of monitoring will be conducted as part of the offset plan:

- Assurance monitoring to evaluate whether the offsets have been constructed as designed, and confirm that the environmental protection measures have been implemented as required
- Habitat effectiveness monitoring to assess whether the offsets are functioning as intended, or whether remedial or contingency measures are necessary

Assessing adherence to the conditions of the *Fisheries Act* authorization will be a key feature of these monitoring components. The proposed monitoring programs, the roles and responsibilities of participants, and the reporting procedures are described in detail in the sections below.

8.8.2.1. Assurance Monitoring

An environmental monitor (EM) will oversee construction of the offsets and guide implementation of site-specific environmental best practices, guidance, and mitigation measures. The EM will work under the supervision of a QEP, and will be responsible to document environmental effects resulting from offset construction, and confirm that contractors are compliant with regulatory requirements, including any construction-specific conditions of the *Fisheries Act* authorization. BMPs include delineation of project site boundaries and sensitive areas; appropriate upkeep and maintenance of equipment; erosion and sediment control; management of any hazardous materials; and spill prevention and emergency response planning.

The EM will maintain monitoring documentation. Observations, construction activities, and weather conditions will be documented. Reports will be retained on-site and be available to DFO on request. It will include:

- Offset area being monitored
- Name(s) of EM(s) on-site during the period
- Period covered by the report
- General weather conditions
- Report on construction activities by area, including a description, documentation of sequence of events, photos and status
- Environmental incidents
- Outstanding environmental issues and/or non-compliances including corrective actions
- Water sampling data (if applicable)

- Changes in the designs necessary to adapt to unanticipated conditions
- Confirmation offsetting components conform to design requirements
- Confirmation terms and conditions of the *Fisheries Act* authorization are met

Any anticipated major changes to the design of offsetting features will be submitted to DFO in writing prior to implementation.

At the conclusion of construction of the offsetting features, a completion report will be prepared summarizing the information from the available reports, for distribution to DFO and Haisla Nation. The report will include record drawings, and a description of any modifications that were implemented during construction. This report will be submitted to DFO within 90 days of completion of construction of offsetting features. With this completion report, LNG Canada may request the return of the offset construction component of the letter of credit.

A summary of the effectiveness monitoring program for construction is provided in Appendix 11.

8.8.2.2. Offset Habitat Effectiveness Monitoring

A description of the effectiveness monitoring program for offset habitats is provided in Appendix 12 (Effectiveness Monitoring Program for Offsetting Habitats). The objective of effectiveness monitoring is to confirm that the offset habitats are functioning as intended and are meeting conditions of the *Fisheries Act* authorization.

Specific parameters and criteria have been identified to gauge the success of the offsets. These include:

- Physical (structural) stability of the offset works and the habitat complexing structures to determine if they are stable and functioning as intended
- Hydraulic connectivity to confirm fish are able to access the habitats as intended
- Areas of habitat that provide the physical requirements for salmon spawning (e.g., substrate size, water depth, and water velocity)
- Water quality (e.g., DO, temperature)
- Riparian vegetation establishment
- Fish use (presence and density) in the variety of offset habitats created

Specific measurable parameters, monitoring methods, and success criteria have been tailored to these offsetting features.

Effectiveness monitoring of the offset habitats and riparian vegetation will be completed following the same timeline as the effectiveness monitoring program for the LNG facility offsets and will extend for 10 years. Monitoring of the aquatic habitat functions will occur in Years 1, 2, 3, 5, 7, and 10. Riparian vegetation monitoring will occur in Years 2, 3, 5, 7, and 10 as in-fill planting will not occur until one year after completion of the offset construction work. Construction of the WAC Pond 2 offset project will be completed in the same general timeframe as construction of the Anderson Creek and Beaver Creek realignments for the LNG facility offset program. The Moore Creek side channel offset habitat construction will be undertaken a year later. As the LNG facility offset effectiveness monitoring program will start before the Moore Creek side channel offset construction is complete, the WAC Pond 2 offset will be monitored for ten years and the Moore Creek side channel offset will be monitored for nine years.

If remedial measures are necessary for either offset project at any time during the first 10 years after its construction, effectiveness monitoring will be extended to provide more time for the habitat effectiveness criteria to be met (assuming an overall positive trend has been observed).

8.8.2.3. Habitat Effectiveness Reporting

A Habitat Effectiveness Monitoring Report will be submitted to DFO by January 31 following the end of each monitoring year, and will include the following:

- Summary of physical habitat, stability, and hydraulic connectivity
- Summary of water quality
- Summary of riparian and salt marsh vegetation establishment
- Summary of fish sampling and spawner escapement survey(s)
- Recommendations for maintenance and management, if any

These reports will also be provided to Haisla Nation and local stakeholders. After Year 10 of the habitat effectiveness monitoring program, a summary report will be issued with findings based on the overall success of the offset habitats.

8.9. Remedial Measures

If, during the 10-year monitoring program, the assurance or effectiveness monitoring programs identify deficiencies in the stability or function of the physical components of the offsets, LNG Canada will conduct additional effort, use additional materials, and/or re-design the offsets to rectify the deficiency. These remedial measures may include, but are not limited to:

- Increasing erosion protection
- Increasing or modifying riparian planting

- Deepening pond/wetland complexes
- Re-designing pond/wetland connector channels
- Re-designing channel meander pattern and bend radius, channel widths, and thalweg depth and direction
- Adjusting gradient controls
- Increasing or decreasing bank armouring
- Modifying flow diversions and intakes
- Modifying or replacing stream crossings
- Installing or removing sediment traps
- Increasing or decreasing instream cover and habitat complexity
- Modifying substrate composition

Any measures conducted to remedy deficiencies identified with any of the offset projects will be vetted with DFO and Haisla Nation prior to implementation. Approved remedial measures will be used to update record drawings, as necessary.

8.10. Contingency Measures

Contingency measures are additional actions or offset projects that would be implemented if any of the following circumstances occur during Supporting Infrastructure construction and/or during construction and subsequent monitoring of the offset projects:

- Fish salvages are required during periods when active and passive fish capture techniques are relatively ineffective and, therefore, construction activities result in the unavoidable mortality of fish
- Fish cannot be successfully excluded from habitats that will be permanently altered prior to spawning and, therefore, construction activities will result in the unavoidable mortality of fish eggs
- Failure of any mitigation measures designed to avoid fish mortality or permanent alteration or destruction of fish habitat
- Failure of any offsets to be implemented as intended
- Failure of any of the offsets to remain physically stable and provide the intended habitat for the intended life stages of fish (e.g., overwintering)

- Failure of the offsets to meet the effectiveness criteria based on results from the post-construction 10 year habitat effectiveness monitoring program

If habitat effectiveness monitoring indicates that any offset project is not functioning as intended, has been destroyed or altered beyond repair by remedial measures, or does not meet the habitat effectiveness criteria in the stated timeline (or another mutually agreeable timeline extension granted to follow positive trends), LNG Canada will work with DFO to determine if additional offsetting will be required. It is expected that any deficiencies would not exceed the surplus habitat gain identified in Section 9 (Habitat Balance).

As noted in Section 8.2.1 (Options Identification), there are offsetting opportunities in the Kitimat River valley, floodplain, and estuary, including options identified during the LKWPM attended by DFO, MFLNRORD, and members of the Haisla Nation. Many of these options have technical, biological, and legal constraints; however, some are anticipated to pass most, if not all, of the screening criteria listed in Section 8.2.2 (Options Screening) following collection of additional field data (e.g., topographical surveys, groundwater testing, fish presence/absence and species and life stage composition surveys, hydrological, hydraulic and geomorphological surveys) and/or landowner consultation.

In the event that any contingency offset projects are required, LNG Canada will work with DFO and Haisla Nation to identify a list of high priority contingency offsets that will be further investigated for technical feasibility, biological relevance, and long-term stability. The specific contingency offset project(s) carried forward for construction will be determined after analysis of field data and in consultation with DFO and Haisla Nation.

8.11. Cost Estimate

The estimated cost for implementation of the offsetting measures and monitoring program proposed in this Fish Habitat Offsetting Plan is $1,882,500. A breakdown of the construction and monitoring costs is provided in Table 8-6. LNG Canada has provided a letter of credit for the total estimated cost to DFO.

Table 8-6 Cost Estimate for Implementation of Fish Habitat Offsetting Plan

Item	Estimated Cost
Construction of Moore Creek side channel	$407,500
WAC Pond 2 Offset	$550,000
Construction and Compliance Monitoring	$175,000
Effectiveness Monitoring	$750,000
Total	$1,882,500

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