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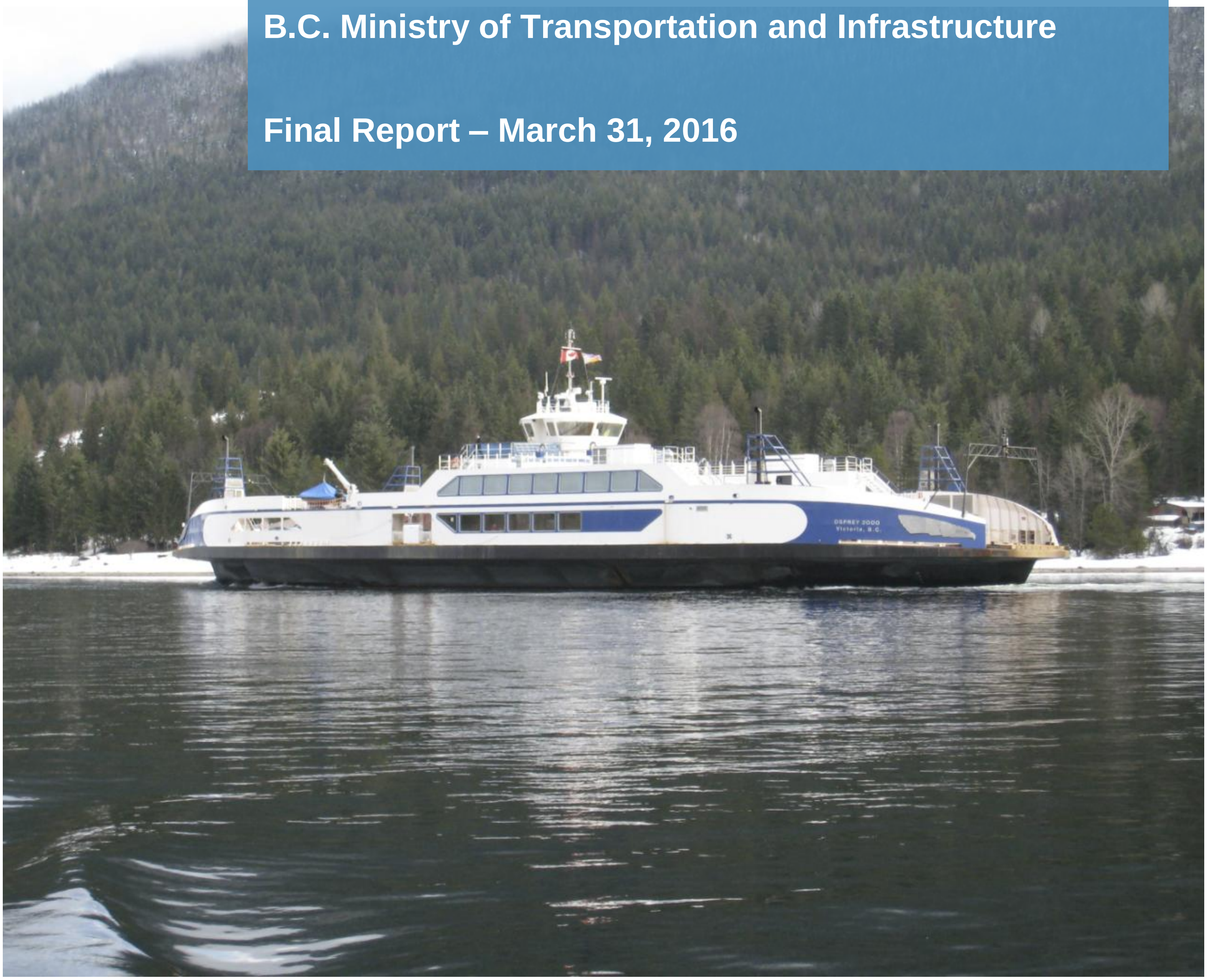
Balfour Ferry Terminal Relocation Project

B.C. Ministry of Transportation and Infrastructure

Final Report – March 31, 2016



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EXECUTIVE SUMMARY

Balfour has been the western terminus of the Kootenay Lake ferry service since 1947. The site was a satisfactory location for a vehicle holding compound and berth for many years. As vehicle traffic and the community of Balfour have grown over the years, the site has experienced increasing marine and landside issues and challenges, including the ability to maintain service levels during peak travel periods.

The feasibility of relocating the Balfour ferry terminal service has been studied a number of times over the past twenty-five years, with the intent to improve both safety and service levels. More recent concept studies[1] reviewed the merits of relocating the ferry terminal from Balfour to select locations further north in Queens Bay. The earlier studies were also conceptual in nature, and further development was required in order for MOTI to be assured all issues had been analyzed.

This technical feasibility study has expanded on the earlier studies to provide to MOTI the necessary analysis to fully understand the challenges and implications of a new ferry terminal location.

The Balfour ferry terminal was compared qualitatively with alternate terminal locations at Queens Bay South and Queens Bay North in this technical feasibility study. The results of the study indicated that the relocation of the Balfour ferry terminal to Queens Bay North was not only technically feasible, it was a superior choice when critically compared under the categories of safety, service, community / stakeholder impact, environmental impact, and financial.

Remaining at Balfour

Retaining the ferry terminal at Balfour was reviewed. Balfour in its existing state is not sustainable, and even with several improvements, many of the safety issues will not be significantly improved. In addition, the facility is currently at capacity during peak months, and this condition will worsen over time if the forecasted increase in ferry ridership materializes.

- From a marine perspective, the challenges navigating through the west arm of Kootenay Lake include:
  - Limited vessel draft during low water periods is resulting in local coating breakdown and pitting of the bottom of the MV Osprey, as well as causing propeller damage.
  - Limited vessel draft during low water periods is resulting in local coating breakdown and pitting of the bottom of the MV Osprey, as well as causing propeller damage.
  - The navigation channel through the west arm is narrow, and with the relatively strong water currents and the increase in pleasure craft activities through the years, has increased the risks for incidents, especially during the peak summer periods.

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[1] Reid Crowther & Partners Limited - Kootenay Lake Ferry Study - June, 1990
Reid Crowther & Partners Limited - Kootenay Lake Ferry System Study - September, 1996
WorleyParsons Canada - Queens Bay Concept Study - June, 2012

- Due to the narrow channel and drifting sand the navigational aid system guiding the ferries into and through the west arm are less reliable.
- Canadian Coast Guard has concerns with available water depth for the MV Osprey in the west arm.

- With the existing terminal layout, vehicles entering and exiting from the highway, especially during periods of high demand, requires major improvements to safety for the following reasons:
  - The practice of vehicle queuing on the highway shoulder during high demand periods conflicts with the highway through traffic, and in addition the queuing vehicles conflict with several access points with local residences and businesses along the highway.
  - The highway intersection with the terminal entrance is not designed for the increased ferry traffic of today. Proper exit lanes and dedicated turn-in lanes for westbound traffic are required.
  - During the unloading of the larger MV Osprey 2000 vessel, the congestion at the highway intersection has backed up the departing vehicles onto the ferry, thus causing delays to the ferry schedule.

Improving the existing facilities at Balfour to maintain the operations into the future was reviewed. This option was not recommended for the following reasons:

- Vehicle queuing on the highway will continue, and the highway cannot be widened without additional right-of-way from the several residential and commercial businesses alongside the highway. In addition, traffic control will be ongoing, even with the widening of the highway.
- The future vehicle growth forecast could not be serviced at Balfour, from the standpoint of both the terminal size and the ferry schedule.
- Dredging would be an ongoing requirement due to the constantly shifting sand and narrow channel.
- Conflicts with the pleasure crafts will still exist.
- Only limited improvements could be made to the highway intersection with the terminal to improve safety. With no approach road from the compound to the highway the off-loading traffic from the ferry will still back onto the ferry during periods of traffic congestion.
- Signals could be considered on Highway 3A when the ferry unloads to help with the unloading of the ferry traffic, but this only deals with the unloading and will negatively impact the overall efficiency of the highway system.
- Expanding the existing vehicle holding compound will require additional right-of-way from established businesses, even if the existing rest area and septic field is removed.
- The ferry system from Balfour to Kootenay Bay will still require two ferries to maintain the existing service.

Relocating to Queens Bay

The study concluded that relocating the terminal to Queens Bay North will significantly improve highway and marine safety. In addition, the service level will be significantly improved by the shorter water route reducing the current 50 minute transit time to 30 minutes. Attributes of

Queens Bay North, compared to the existing facility at Balfour or alternate locations in Queens Bay South, include:

- Safety – Highway Traffic, Highway Intersection, Queuing Area
  - Queens Bay North is furthest away from the residential / commercial businesses in the Balfour area and is in a relatively undeveloped area along the highway,
  - Queens Bay North would have the easiest transition off the highway to the vehicle holding compound.
  - Queens Bay North would have an engineered left turn exit off the highway and into the terminal.
  - The location of the highway intersection would allow for minimal road grades from the highway into the vehicle holding compound, less than 2%.
  - No vehicle queuing on the highway would be required, as there is adequate capacity with the holding compound and the access road off the highway.
  - Being furthest from Balfour and the residential area in Queens Bay South, the terminal would have the least interaction with local traffic.
- Safety – Marine Transit
  - The location away from the west arm of Kootenay Lake would minimize conflict with other marine traffic (pleasure boats, fishing, sailing).
  - Queens Bay North does not have the channel width constraints evident in the west arm of Kootenay Lake, nor vessel draft issues and propeller wear brought on by shifting lake bed elevations.
- Service – Transportation
  - The location provides a 40% savings in terms of transit time.
  - Frequency of service – hourly service year round.

The Queens Bay North location improves both highway and marine safety. The location would be able to manage future vehicle growth predictions without the requirement for highway queuing, and would enhance the service levels with one ferry, instead of requiring two ferries to achieve peak demand requirements. The distance between Queens Bay North and Kootenay Bay is approximately 5.4 km, compared to the distance between Balfour Terminal and Kootenay Bay of approximately 9 km, as shown below.

Distance to Kootenay Bay – Queens Bay North and Balfour

Vessel Capacity Analysis

Vessel capacity was reviewed using a 50-year horizon and a conservative 0.3% annual compound growth rate. The shortened transit distance from Queens Bay North to Kootenay Bay ensures that there are no issues with vessel capacity now, or during the forecast period to 2065.

Traffic Analysis

A traffic study was undertaken at the proposed highway intersection with the Queens Bay North terminal. In conclusion, there would be minimal risk of traffic growth outpacing the capacity of the intersection before the horizon year of 2065. If ferry traffic unloading peaks are allowed to dissipate gradually, then signalization of the intersection would not be required. If the desire is to dissipate that queue instantaneously, then signalization will be considered. The intersection design will incorporate cable ducting to allow for signalization at a later date if desired.

Environmental

Background information available for the proposed Queens Bay North site did not indicate critical habitat or sensitive species that would preclude relocating the terminal from Balfour. It is possible though that a detailed field investigation could identify environmental attributes that would require specific consideration or protection.

It is anticipated that a formalized habitat mitigation and offsetting plan would need to be part of the planning process to seek federal Fisheries Act authorization. Fish and aquatic habitat are protected under the Fisheries Act and, by definition, the proposed terminal footprint area would be permanent alteration of fish habitat.

Archaeological Review

An archaeological study and preliminary field reconnaissance was undertaken at the proposed Queens Bay North site. The assessment determined that the proposed development area has moderate to high potential for the presence of archaeological sites.

During the survey, five clear elevated benches / breaks in slope which were assessed as having potential for the presence of buried archaeological deposits were observed. In addition, two talus slopes which have the potential to contain prehistoric burials were also identified.

Based on the results of the review it was determined that the proposed Queens Bay North terminal and access road development should be subjected to an Archaeological Impact Assessment under a permit issued under Section 14 of the Heritage Conservation Act (1994).

Conceptual Cost Estimate

The project costs for the proposed Queens Bay North terminal have been estimated to be CAD $25 million in 2015 dollars. The project costs are expected to be accurate to +/- 25%.

Estimated Project Costs at Queens Bay North

SNC·LAVALIN	Cost Estimate - Queens Bay North (± 25%)		
Description	Roadwork & Holding Compound	Marine Structures	Total
[redacted]			
Total	[redacted]		$25,000,000

Queens Bay North Terminal Delivery Schedule

The anticipated project schedule timelines are:

Project Development – 6 months

- Stakeholder engagement
- Preliminary design and geotechnical investigation
- Archeological and environmental assessment

Design and Construction – 38 months

• Procurement the design	2 month
• Detail design & agency approvals	12 months
• Tender and Award	3 months
• Construction (2 summers)	21 months
• Total Project Schedule	38 months

Total Project Delivery Timeline 44 months

Recommendations for Future Work

The following "next steps" are recommended to compliment future phases in design at Queens Bay North:

- An anemometer to be installed in the vicinity of Queens Bay North and wind measurements be collected for a minimum of twelve (12) months,
- A formalized habitat mitigation and offsetting plan be developed in order to seek federal Fisheries Act authorization,
- In advance of the detailed engineering phase of the project an archaeological impact assessment is undertaken,
- Public / Stakeholder Engagement Plan and Schedule.

1 FERRY TERMINAL LOCATIONS – SITE EVALUATION

1.1 Overview of Project

The BC Ministry of Transportation and Infrastructure (MOTI) is the government ministry responsible for transport infrastructure in British Columbia, including inland ferry services. In the Kootenay District, MOTI provides a vehicle and passenger ferry service on Kootenay Lake. This service is toll free and provides ferry travel between Balfour and Kootenay Bay, as shown below in Figure 1. The ferry service is currently provided by two ferries owned by MOTI and operated by Western Pacific Marine under a services contract with MOTI.

Figure 1 - Balfour Terminal to Kootenay Bay Terminal Ferry Route

The Balfour Ferry Terminal has been in service at its present location since 1947. Various improvements have been undertaken over time, including the recent repairs to the approach trestle in 2012. The facility though is in need of numerous near-term capital improvements associated with an aging facility, including:

- A vehicle holding compound in need of significant reconfiguration, rehabilitation and expansion,
- A highway intersection into the terminal which becomes congested during busy periods, and requires improvements in the form of entrance / exit lanes to accommodate traffic flows,
- Environmental infrastructure work to maintain increasingly stringent sewage treatment quality levels.

In addition to these required improvements, there are a number of marine and nautical concerns which have resulted in both increased operational concerns and safety risks, including:

- Vessel draft issues brought on by shifting sand bars in the west arm can lead to grounding or damage to the ferry propeller,
- Currents in the west arm are relatively strong, and if the ferry loses power a collision or grounding is possible,
- Increased pleasure boat traffic in the mouth of the west arm of Kootenay Lake,
- The ferry wake has the potential to damage the local communities private docks,
- Seasonal traffic congestion near Balfour Terminal.

The two ferries which operate this route are named the "MV Osprey 2000" and the "MV Balfour". MV Osprey 2000 was constructed in 2000, whereas the MV Balfour was constructed in 1954, and has been in operation for over 60 years. The MV Balfour was not originally designed to meet the current federal regulatory safety requirements and given its age, it is experiencing increasing operating costs. The MV Balfour must be retired within the next few years.

The feasibility of relocating the Balfour ferry terminal service has been studied a number of times over the past twenty-five years, with the intent to improve both safety and service levels. More recent concept studies[1] reviewed the merits of relocating the ferry terminal from Balfour to select locations further north in Queens Bay. The earlier studies were also conceptual in nature, and further development was required in order for MOTI to be assured all issues had been analyzed. This technical feasibility study has expanded on the earlier studies to provide to MOTI the necessary analysis to fully understand the challenges and implications of a new ferry terminal location.

This study provides tangible go-forward recommendations, including confirmation on the technical feasibility of constructing and operating a ferry terminal, on an alternate site. The study focuses on viable site locations at the south end and the north end of Queens Bay, and

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[1] Reid Crowther & Partners Limited - Kootenay Lake Ferry Study - June, 1990
Reid Crowther & Partners Limited - Kootenay Lake Ferry System Study - September, 1996
WorleyParsons Canada - Queens Bay Concept Study - June, 2012

qualitatively compared them back to the Balfour location, both in its existing state and with possible improvements. The sites chosen will be reviewed from the perspective of the highway intersection and the transition into the terminal, the vehicle holding compound, marine navigation and transit time.

The results will be compared and rated based on:

- Safety,
- Service,
- Community / Stakeholder Impact,
- Environmental Impact,
- Financial.

1.2 Balfour

1.2.1 Existing Balfour Ferry Terminal Site

Background

Balfour has been the western terminus of the Kootenay Lake ferry service since 1947. The benefits of the site include good upland terrain, a sheltered berth location in the west arm of Kootenay Lake, and close proximity to Highway 31 for northern travel and Highway 3A for western travel and beyond.

Balfour ferry terminal has direct access to / from Highway 3A. There is a paved vehicle staging compound located between the highway and the start of the access trestle to the ferry. There is an entry lane into the terminal, an exit lane from the terminal, and six vehicle queuing lanes to provide space for approximately 110 vehicles, with some additional overflow capacity.

The Balfour ferry terminal is shown below in Figure 2.

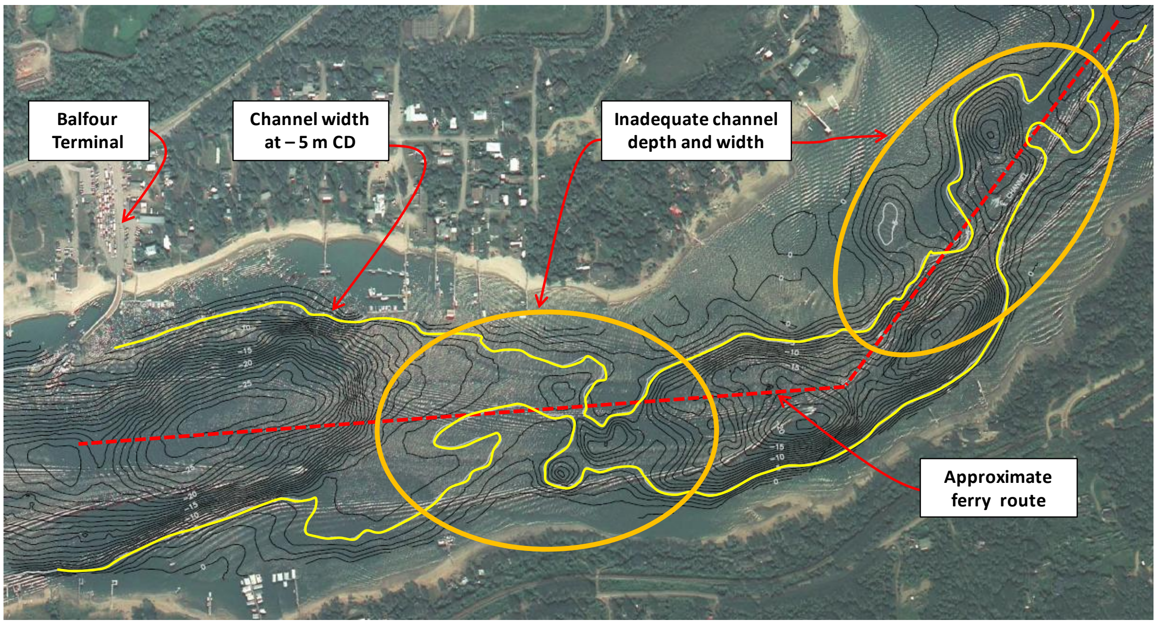
Figure 2 – Balfour Ferry Terminal

Marine Navigation

The ferry terminal at Balfour is located in the west arm of Kootenay Lake. The arm in the vicinity of the berth is approximately 350 m in width, though the draft required by the MV Osprey 2000, limits the navigable width considerably.

As part of this technical feasibility study a bathymetric survey was undertaken in the west arm. Figure 3 provides the results of the bathymetric survey, and shows the channel width in the west arm representative of the 5 m water depth contour at low water. The approximate ferry route into and out of Balfour Terminal is also shown. The MV Osprey 2000 requires approximately 5 m depth of water to prevent grounding with its propeller skeg. Figure 3 shows there are two distinct locations where the propeller clearance is severely limited and navigational safety is an issue.

Figure 3 - Ferry Route Compared to Channel Width



A recent Canadian Coast Guard bathymetric survey of the west arm of Kootenay Lake confirms the findings shown.

A summary of navigation challenges to / from Balfour include:

- Balfour terminal is located in the west arm of Kootenay Lake, which is a relatively narrow and congested channel. This requires the ferries to slow while navigating through the channel.
- Congestion from pleasure crafts in the area poses a significant safety risk during peak summer periods,
- Water currents at the Balfour berth site are relatively strong, increasing the possibility of collision or grounding should the vessel lose power,
- Limited vessel draft during low water periods in the west arm increases the risk of propeller damage and grounding (Figure 3),
- Ferry vessel wake impacts private docks in the vicinity of the terminal.

Transit Time

Transit time from Balfour Terminal to Kootenay Bay is indicated below in Table 1. The return trip time of 100 minutes equates to a one-way transit of 50 minutes.

Table 1 - Transit Time Segment Durations - Balfour to Kootenay Bay

Segment	Description	Duration	Notes
1	Load at Balfour	10	
2	Navigate the channel entrance out of Balfour	10	
3	Crossing Kootenay Lake (Balfour to Kootenay Bay)	25	
4	Offload at Kootenay Bay	5	
5	Load at Kootenay Bay	10	
6	Crossing Kootenay Lake (Kootenay Bay to Balfour)	25	
7	Navigate the channel entrance in to Balfour	10	
8	Offload at Balfour	5	
		100	(50 min per leg)

Vehicle Holding Compound and Highway Access

The holding compound within the terminal accommodates approximately 110 vehicles. This is sufficient space to handle the MV Osprey 2000 (80 AEU), and allows approximately 30 additional vehicles to remain in the holding compound after the MV Osprey 2000 is filled to capacity.

The vehicle staging compound has become somewhat integrated with the services and amenities that are adjacent to it. The community of Balfour has grown up around the terminal, and local services and amenities now exist on both sides of the vehicle compound.

The services and amenities include a restaurant on both sides of the compound, a park (rest area), parking lots for services, bus drop off access for the ferry and area, a bakery, a gift shop and gas outlet, and a marina all within a confined area. During peak demand periods the area is also congested with cars waiting for the ferry.

It is not unusual for vehicle occupants to leave their vehicles and spend their wait time utilizing the services in the area, and to return to their vehicle when the ferry is boarding. Similarly, local residences are able to frequent the services on either side of the vehicle compound simply by walking through the vehicle compound. Individuals who frequent the services on the eastern side of the compound must cross over the ferry vehicle exit lane to get back to their waiting vehicle.

There are periods when the vehicle holding compound is insufficient for the demand. Several times per year, (i.e. during the peak August holiday season, long weekends, when special events are held in the region, etc.) vehicle demand exceeds the capacity within the compound and gridlock occurs. During these periods the excess vehicles were required to queue on the highway.

When ferry traffic is blocked from exiting the terminal due to obstructions at the highway intersection, the line of traffic can back up to the ferry ramp, thus impacting the ability to load and unload the ferry efficiently and on time. In such circumstances, if the ferry schedule is to be maintained, the ferry loadings could be incomplete. Alternatively if ferry departure is held until the vessel is fully loaded, the ferry schedule will be impacted. Both options have the net effect of reducing the route’s capacity during peak times when it is needed most.

Vehicles access the terminal from Highway 3A or Highway 31. As the holding compound fills up, a queue of eastbound vehicles forms along Highway 3A. When Highway 31 westbound traffic attempts to turn left into the terminal the intersection becomes gridlocked, potentially blocking eastbound highway traffic and blocking ferry traffic exiting the terminal. As ferry traffic increases over time, congestion at the highway intersection will also increase.

To maintain order at the intersection and to prevent gridlock, the ferry Operator[1] dispatches traffic control personal during such times. The traffic control personal maintain order by:

- Directing the ferry-bound Highway 3A traffic to queue along the eastbound shoulder of Highway 3A,
- Directing the ferry-bound Highway 31 traffic to turn around near Old Wharf Road and join the tail of the queue along the eastbound shoulder of Highway 3A.

Queuing along Highway 3A is made more difficult because of the number of residences and businesses along the highway which have the possibility of being blocked by queuing vehicles. To avoid blocking access, the vehicle queue is drawn out further and must be managed by the traffic control personal.

Managing and attending to ferry-bound traffic on the highway because the terminal is full is a high risk activity and lead to safety issues. Highway queuing should be mitigated for the following reasons:

- The increase in vehicular movement interacting with and impeding through traffic,
- The conflict with residential and business access,
- The requirement for the traffic control personal to manage the vehicle traffic while standing on the highway centerline.

Figure 4 indicates the extent of highway queuing which can occur during peak summer ferry travel.

[1] Western Pacific Marine is the current ferry operator at Balfour Terminal

Figure 4 - Balfour Highway Overflow Queue

1.2.2 Improvements Required at the Existing Balfour Terminal

The study considered what improvements would be required to mitigate existing concerns and shortfalls in order to maintain the level of service and improve safety at the existing Balfour location.

Safety

There are a number of significant safety aspects of the existing terminal which would need to be addressed to remain at Balfour:

- Highway Queuing – Highway 3A would need to be widened in order to accommodate vehicle queuing on the highway. Widening of the highway would be difficult to achieve due to the numerous residential and commercial establishments along the highway in that area. Accommodating the widening will require additional right-of-way, and the costs will be in the $1 million range, and safety would only marginally improve.
- Vehicle Holding Compound – There is little opportunity for improvement within the terminal area, as the queuing space available is limited. Reconfiguration of the overall compound within the existing space is not feasible, as the area in general also services the bus lane, parking, and access to the adjacent park and businesses. A possibility exists to remove the park area to the west of the terminal (beside the restaurant), however by doing so the existing septic field would need to be removed and the travelling public would be without a rest area. Cost will be in the $2 million range for the compound expansion, but without a resolution for the washroom / septic field.
- Marine Transit – The entrance to the west arm of Kootenay Lake is shallow compared to the draft requirements for the M.V. Osprey, and the lake bed depth tends to shift with seasonal deposition of sand. In addition, there are areas within the west arm where rock outcrops exist. A recent bathymetry survey of the west arm indicated that there is no straight alignment from the through the west arm to the berth, and the ferry captains must be extremely vigil when transiting through the channel. To mitigate the shallow areas within the west arm the channel would need to be dredged and widened. The estimated cost for this improvement is $3 million, and would be reoccurring.

Service

- The MV Balfour was not originally designed to meet the current federal regulatory safety requirements and, given its age, it is experiencing increasing operating costs. The MV Balfour must be retired in the next few years. If the MV Balfour is not replaced, the level of service would be compromised as the vessel operates during summer when demand is higher, and without the second vessel, the MV Osprey 2000 is unable to meet the current peak demands. If the forecasted vehicle growth is realized (0.3% annual compound growth) the pressures on service levels will increase accordingly. The capital cost to replace the ferry is estimated in the range of $30 million.

Environmental Impact

- Sewage – The existing septic system at Balfour is not enough to serve future growth or meet changing environmental regulation requirements. The estimated cost of an appropriate sewage treatment facility is in the $500,000 range.

Financial

- The costs for upgrading the existing terminal are estimated in the $36 million to $40 million, inclusive of dredging, terminal upgrades and a replacement for the MV Balfour. As well, dredging would not be just a one-time project. It would have to be ongoing and there would be environmental considerations. With this option, the Ministry would incur significantly higher operating costs.

1.3 Queens Bay South

For the purposes of this study, Queens Bay South generally describes the area immediately north-east of Balfour. This area is comprised of established homes, cabins and at least one motel. The residential neighborhoods are reached by smaller unpaved roads which wind through the neighborhood.

1.3.1 Potential Site Locations in Queens Bay South

The 2012 WorleyParsons concept study referenced in Section 1.1 considered two locations in the southern region of Queens Bay as possible terminal sites. These locations are shown below in Figure 5.

Figure 5 - Queens Bay South – Potential Site Locations

1.3.2 Queens Bay South – Site Location 1

Location

Site Location 1 (shown in Figure 5) is comprised of a large privately owned potential land area. The terminal area would be accessed from Busk Road, which ties into Highway 31 immediately north of the existing Balfour Terminal site.

Marine Navigation

The ferry berth location at Site Location 1, being located out of the west arm of Kootenay Lake, would address concerns with respect to boat congestion and vessel draft evident at Balfour Terminal. The location is immediately south of the water intake for the Balfour community and the Balfour Beach Regional Park.

Transit Time

The proposed ferry terminal location at Site Location 1 would result in a reduction in transit time to and from Kootenay Bay, as the location is not in the congested west arm of Kootenay Lake. It is estimated that the return trip time would be approximately 80 minutes, equating to a one-way transit of 40 minutes.

From the perspective of transit time savings alone, the proposed terminal location would not materially change the travel time to Kootenay Bay. These issues will be further explored and compared with alternative berth locations in the site assessment evaluation described in Section 1.5.1.

Vehicle Holding Compound

Site Location 1 is approximately 5.3 Ha in area, and is sufficiently large enough to accommodate a vehicle holding compound of 160 AEU. A considerable portion of the site is understood to be low lying and, in the spring period, is potentially submerged. Substantial fill volumes would be required to raise the site and cover the wetlands to avoid flooding. The environmental impact of filling these wetlands is considered an issue.

Highway Access

A terminal in Site Location 1 would require the vehicle traffic to enter the site, likely via Busk Road. Vehicles would travel along Busk Road for a distance of approximately 500 m before they would enter onto the vehicle holding compound, as shown in Figure 6. The order of magnitude cost estimate for development of the 3-lane roadway access on Busk Road is $1 million, plus right-of-way costs. Assuming $1 million for right-of-way costs, the cost estimate for the “roadway and compound” for Queens Bay South, Site Location 1 is approximately $10 million.

Figure 6 - Busk Road Access to Queens Bay South Site Location 1

An alternate access point off Highway 31 to Site Location 1 is shown below in Figure 7. Access from this location would require development of approximately 870 m of access road.

Figure 7 - Alternate Highway Access to Site Location 1

The order of magnitude cost estimate for development of the 3-lane roadway access from this highway exit is $3 million, plus right-of-way costs. Assuming $1 million for right-of-way costs, the cost estimate for the "roadway and compound" for Queens Bay South, Site Location 1 would be $12 million.

The elevation change from the highway to the terminal site using this access road is approximately 40 m. In the proximity of the terminal compound the approach road grade averages 12%. The increased distance to the terminal compound from the highway, along with the steeper grade for vehicle and trucks exiting the ferry makes this option for access to the proposed terminal impractical.

Property Impacts

If access to Site Location 1 were from Busk Road, it is noted that this is also the main road in to many of the residential houses and business in the Balfour area. An increase in vehicle traffic to access a terminal at Site Location 1 would significantly impact the local community. In this location, traffic would travel through the residential neighborhood 365 days of the year. To facilitate the exiting two-lane ferry traffic, Busk Road would require widening, and traffic speeds would rise to accommodate the flow of traffic off the ferry.

1.3.3 Queens Bay South – Site Location 2

Location

Queens Bay South - Site Location 2 (shown in Figure 8), contemplated using the Crown owned aggregate pit area for the vehicle holding compound.

Figure 8 – Queens Bay South - Site Location 2

Marine Navigation

The berth location at Site Location 2, being located out of the west arm of Kootenay Lake, would address concerns with respect to boat congestion and vessel draft which are evident at Balfour terminal.

Transit Time

Similar to Queens Bay South – Site Location 1, the proposed terminal location would not materially change the travel time to Kootenay Bay. It is estimated that the return trip time would be approximately 80 minutes, equating to a one-way transit of 40 minutes.

Vehicle Holding Compound

The space available in the aggregate pit area would be sufficient to provide a vehicle holding compound containing 160 AEU. The location though is not immediately adjacent to the berth area, and as such vehicles would need to travel from the holding compound approximately 400 m down to the ferry landing.

Roadway grades in excess of 20% which lead from this location down to the berth site makes this option not feasible.

Highway Access

Highway access would be off of Highway 31. Vehicles would turn off the highway and turn to wait in the vehicle compound for the arriving ferry. After the ferry arrives and has cleared the vehicles on board, the vehicles in the holding compound would transfer to the ferry.

Property Impacts

The berth site is adjacent to numerous private properties immediately to the north. It appears that an easement through the northern limit of Balfour Beach Regional Park would be required to reach the proposed berth location.

Furthermore, it is understood that there is a First Nations treaty land parcel being considered for the former gravel pit site where the vehicle holding compound is proposed for Site Location 2.

Queens Bay South - Site Location 2 was eliminated from further review due to roadway grades in excess of 20% which lead from the holding compound down to the berth site, along with property impacts due to the Balfour Beach Regional Park and First Nation treaty.

1.4 Queens Bay North – Possible Site Locations

Two locations were considered in the northern region of Queens Bay as possible terminal sites. These locations are shown below in Figure 9.

Figure 9 - Queens Bay North – Possible Site Locations

1.4.1 Queens Bay North – Site Location 1

Location

Site Location 1 was purportedly a berth site used by paddle wheel vessels on Kootenay Lake years ago. It is tucked into the bay east of McEwen Point at the end of "Wharf Road", as shown in Figure 9.

Marine Navigation

The ferry berth location at Site Location 1, being located out of the west arm of Kootenay Lake, would address concerns with respect to boat congestion and vessel draft. The location benefits due to its proximity to McEwen Point, which shelters the berth from northerly winds. The location is not sheltered from southerly winds.

Transit Time

Transit time to Kootenay Bay from this site is superior to any location in Queens Bay South and Balfour. There is nothing impeding vessel movement in this area. It is estimated that the return trip time to Kootenay Bay would be within one (1) hour, and would provide hourly sailings with one vessel, the MV Osprey 2000

Vehicle Holding Compound

The area available for vehicle queuing at this site is insufficient.

Highway Access

The site is accessed directly from Highway 31 via Old Wharf Road. Old Wharf Road is an unpaved road with grades in excess of 15% leading down to the lake shore.

Property Impacts

The berth site is adjacent to two private properties immediately to the west.

Queens Bay North - Site location 1 was eliminated from further review due to insufficient space for the vehicle holding compound and road grades in excess of 15% leading down to the lake shore.

1.4.2 Queens Bay North – Site Location 2

Location

Queens Bay North, Site Location 2 (shown in Figure 9) is an undeveloped site located on Crown land south-west of Site Location 1 and the two adjacent properties. The location has many attributes that are more favorable to any of the alternative locations reviewed.

Marine Navigation

The berth at Site Location 2, being located out of the west arm of Kootenay Lake, would address concerns with respect to boat congestion and vessel draft which are evident at Balfour terminal. The location is sheltered from northerly winds by its proximity to McEwen Point. Similar to Site Location 1, the location is not sheltered from southerly winds.

Transit Time

Another positive attribute of this location (similar to Queens Bay North – Site Location 1) is that the reduction in transit time for the ferry to cross over to Kootenay Bay is substantial and that a marked increase in capacity could be achieved. It is estimated that the return trip time to Kootenay Bay would be approximately 60 minutes, equating to a one-way transit of 30 minutes and would provide hourly sailings with one vessel, the MV Osprey 2000.

Vehicle Holding Compound

The vehicle holding compound area allows for the design 160 AEU to be accommodated. A 300 m length of access road between the highway intersection and the vehicle holding compound can accommodate 60 additional AEU's in the event of a holding compound overflow.

Highway Access

Road access from Highway 31 into Site Location 2 vehicle holding compound runs parallel to Highway 31 and the shoreline. The elevation of the highway at the location of the proposed intersection is relatively low. As such the road grade into the terminal would be less than 2%.

Property Impacts

The proposed terminal site, including the access road and vehicle holding compound are located on Crown Land.

There are fewer properties in the north end of Queen's Bay than in the south. There are two residences along the shoreline to the northeast of the proposed terminal site. The Ministry would need to consider potential impacts to these properties in the design development phase.

The residences to the southwest along the highway of the proposed site are further away from the proposed highway exit.

1.5 Terminal Sites Selected for Further Evaluation

In the previous section, two sites were eliminated from further evaluation:

- Queens Bay South - Site Location 2,
- Queens Bay North - Site Location 1.

A comparative evaluation was undertaken for the following sites:

- The existing Balfour Terminal with improvements,
- Queens Bay South - Site Location 1,
- Queens Bay North - Site Location 2.

The evaluation was undertaken to critically review the attributes and shortcomings of each location and determine which would be best suited for the terminal location.

1.5.1 Site Evaluation Process

To evaluate and compare the sites an evaluation matrix was developed. This allowed an assessment of the sites against a set of defined criteria based on the main project objectives. The information gathered and analysis performed at each site was compared qualitatively according to the defined criteria.

1.5.2 Criteria Used for the Site Evaluation Matrix

The criteria used for the site evaluation matrix was based on a number of parameters, including the main objectives of improving operational safety (on water and on land), and to improve the level of service across Kootenay Lake. The sites were evaluated and ranked according to the following criteria:

- Safety, subdivided into the following subsets:
    - Highway traffic, highway intersection and holding compound,
    - Marine transit.
- Service
- Community / Stakeholder Impact
- Environmental Impact, subdivided into the following subsets:
    - Highway traffic, highway intersection and holding compound,
    - Marine transit,
    - Sewage.
- Financial

1.5.3 Weighting Factors Used for the Site Evaluation Matrix

Each of the criteria indicated in Section 1.5.2 were weighted according to the relative importance of each in the comparison process. This led to the weighting factors indicated in Table 2.

Table 2 - Weighting Factor Used in Site Evaluation Matrix

Criteria	Weighting Factor
Safety	40%
Service	15%
Community / Stakeholder Impact	15%
Environmental Impact	15%
Financial	15%

In completing the site evaluation matrix a number of relevant aspects at each site were carefully compared. Table 3 below shows the specific aspects discussed and compared for each site location.

Table 3 – Specific Assessment Aspects Discussed at each Site Location

Safety (WF 40%)	**Community / Stakeholder Impact** (WF 15%)
Highway Traffic and Highway Intersection and Queuing Area	**Highway Traffic and Highway Intersection and Queuing Area, Marine**
Safe transition off highway into vehicle queuing area:	Proximity to existing communities or developments
Site distances, horizontal & vertical clearances, gradient	Impact on local economy (businesses- café, bakery, etc.)
Southbound left turn lane across highway - truck & automobile traffic	Vessel wake (damage to adjacent facilities)
Requirement to queue on highway	Noise and light affect on community
Interaction with local traffic accessing the highway	**Environmental Impact** (WF 15%)
Safety of traffic control attendants	**Highway Traffic and Highway Intersection and Queuing Area**
Conflicts between vehicles and passengers (foot traffic)	Air quality, noise
Adequate capacity without spilling onto highway	Archaeological concerns or limitations - First Nations
Marine Transit	Environmental terrestrial impacts
Navigational complexity (narrow channel - draft concerns - nav aids)	**Marine Transit**
Navigational complexity (visibility - fog - radar interference)	Air quality, noise, water quality
Conflict with other marine traffic (pleasure boats, fishing and sailing)	Vessel wake (damage to adjacent facilities)
Berthing (wind and wave severity)	**Sewage**
	Sewage considerations on land and in lake
Service (WF 15%)	**Financial** (WF 15%)
Transportation (Intersection, queuing area, marine transit)	**Transportation (Intersection, queuing area, marine transit)**
Travel time savings, frequency of service	Capital cost
Reliability of service (1 vessel versus 2 vessels)	Operating cost
Throughput capacity (vehicles/h)	
Efficiency of transportation system	

1.5.4 Qualitative Review

General findings for each category and location were:

- Safety - Highway traffic, highway intersection and holding compound
  - Improved Balfour Terminal
    - Highway 3A would need to be widened in order to accommodate vehicle queuing on the highway,
    - Vehicle holding compound in need of significant reconfiguration and rehabilitation and expansion in order to be viable,
    - Widening of the highway would be difficult to achieve due to the numerous residential and commercial establishments along the highway in that area,
    - Traffic control will be ongoing, even with the widening of the highway,
  - Queens Bay South – Site Location 1
    - Vehicle conflicts with Upper Balfour Road and Busk Road intersection legs at the terminal would require intersection improvements in an already topographically challenged area,
    - An increase in vehicle traffic along Busk Road to access a terminal at Site Location 1 would significantly impact the local community.
  - Queens Bay North – Site Location 2
    - The highway intersection is away from residential property,
    - The road grade into the terminal would be less than 2%, which is ideal for vehicle movements, both within the holding compound and the ferry vehicle departure lane,
    - Vehicle holding compound and access road provide sufficient leading to no queuing on the highway.

- Safety - Marine transit
  - Improved Balfour Terminal
    - The entrance to the West Arm of Kootenay Lake is shallow compared to the draft requirements for the M.V. Osprey,
    - The lake bed depth tends to shift with seasonal deposition of sand,
    - Canadian Coast Guard has concerns with available water depth for the MV Osprey in the West Arm of Kootenay Lake. Their navigation aids are at the end of their service life and are being replaced and reconfigured.
    - Dredging would be an ongoing requirement,
    - Local boat traffic and congestion will only increase over time.
  - Queens Bay South – Site Location 1
    - Marine transit from this location is outside the west arm of Kootenay Lake,
    - Ferry landing would be in proximity to local community in Queens Bay South,
    - Less boat congestion better than Balfour location.

- Queens Bay North – Site Location 2
  - Proximity to McEwen Point, shelters the berth from northerly winds,
  - Unsheltered from southerly winds,
  - Boat congestion issues minimized due to location,
  - Marine transit from this location is well outside the west arm of Kootenay Lake.

- Service

  - Improved Balfour Terminal
    - The MV Balfour must be retired in the next few years. If the vessel is not replaced the remaining MV Osprey 2000 will be unable to meet the current peak demands and service will be compromised.
    - Ferry travel time is longest at Balfour (50 minutes).
  - Queens Bay South – Site Location 1
    - Ferry travel time is better than at Balfour (40 minutes),
    - To maintain existing level of service will still require two ferries.
  - Queens Bay North – Site Location 2
    - Shortest travel time (30 minute crossing, versus 50 minutes from Balfour),
    - Route can be serviced with one vessel,
    - A 36% (340 AEU) increase in daily vehicle capacity during the summer, and 60% (480 AEU) during the rest of the year,
    - No issues with vessel capacity now, or during the forecast period to 2065,
    - There will be no expected sailing waits and no queuing onto the highway.

- Community / Stakeholder Impact

  - Improved Balfour Terminal
    - Depending upon perspective, the local community either appreciates the proximity of the ferry terminal, or does not.
    - Some stakeholders (businesses) would be impacted if the Balfour Terminal was relocated. Some stakeholders would be less impacted.
  - Queens Bay South – Site Location 1
    - The community impact would be substantial if vehicular traffic moved along Busk Road,
    - A ferry berth in Queens Bay South would impact residential properties.
  - Queens Bay North – Site Location 2
    - Residences from Queens Bay South would experience an increase in highway traffic levels from eastbound vehicles, and a decrease in highway traffic levels from westbound traffic going to the ferry.

- Environmental Impact

  - Improved Balfour Terminal
    - Possible paving over of the rest area to accommodate more vehicles,
    - Initial and on-going dredging of West Arm channel.
  - Queens Bay South – Site Location 1

        - Proposed vehicle compound area would require fill – possible reduction in wet lands.
    - Queens Bay North – Site Location 2
        - The access road and vehicle compound would require fill as this area fronts the lakeshore,
        - One-time dredging required for placement of berth.

- Financial

    - Improved Balfour Terminal
        - The estimated project cost for improving Balfour Terminal, replacing the MV Balfour, and dredging the west arm of Kootenay Lake, in the $36 million to $40 million range.
        - As well, dredging would not be just a one-time project. It would have to be ongoing and there would be environmental considerations.
        - With this option, the Ministry would incur significantly higher operating costs.
    - Queens Bay South – Site Location 1
        - The estimated project cost for a new facility at Queens Bay South, along with replacement of the MV Balfour, exceeds $50 million.
    - Queens Bay North – Site Location 2
        - The estimated project cost for a new facility at Queens Bay North is approximately $25 million.
        - The operating costs would be least at this location.

1.5.5 Results of Qualitative Review

The results of the qualitative review are provided in Appendix G. The results indicate that the highest rated location for the ferry terminal, when considering the various criteria indicated in Section 1.5.2 is the undeveloped Queen Bay North – Site Location 2.

Queens Bay North achieved the highest overall ranking. The areas that Queens Bay North ranked the highest on were:

- Safety – Highway Traffic, Highway Intersection, Queuing Area
    - Queens Bay North would have the easiest transition off the highway to the vehicle holding compound,
    - Queens Bay North would be engineered for all vehicle movements, including the left turn exit off the highway into the terminal,
    - The location of the highway intersection would allow for minimal road grades from the highway into the vehicle holding compound, less than 2%,
    - No queuing on the highway would be required, as there is adequate capacity with the holding compound and the approach road off the highway,
    - Being furthest from Balfour and the residential area in Queens Bay South, the location would have the least interaction with local traffic,
    - Queens Bay North is the location best able to provide the physical space to build the terminal.
- Safety – Marine Transit

  - The location being away from the west arm of Kootenay Lake would minimize conflict with other marine traffic (pleasure boats, fishing boats, sailing boats),
  - The location is not subject to siltation and moving sand bars as are areas within the west arm of Kootenay Lake, and potential grounding of the ferry due to inadequate draft is eliminated.
- Service – Transportation
  - The location provides substantial savings in terms of ferry transit time, and allows for an increase in the level of service,
  - The reduction in transit time improves vehicle capacity,
  - Frequency of service – hourly year round.
- Financial
  - Least capital cost for developing terminal and berth,
  - Least annual operating cost, given the route can be serviced by a single vessel due to the shorter distance to Kootenay Bay.

1.5.6 Site Evaluation Workshop in Nelson, B.C.

Following completion of the site evaluation matrix, a workshop was held whereby SNC-Lavalin reviewed the matrix and the results obtained with MOTI District staff, Marine Branch, and the ferry Operator, Western Pacific Marine. The group discussed and compared each location based on the site evaluation matrix to ensure that all aspects of each site were considered.

1.5.7 Recommendation

The results of the site evaluation matrix clearly showed that Queens Bay North was the preferred location to relocate the existing terminal.

The Queens Bay North location would:

- Improve highway safety, as the requirement for highway queuing would be eliminated,
- Improve marine safety, as the restricted nature of the west arm of Kootenay Lake would be eliminated, and the ferry would have minimal interaction with the recreational marine traffic.
- Address future vehicle growth predictions within the vehicle holding compound,
- Substantially reduce the crossing time, increase capacity, and allow for MOTI to increase the level of service.

The remainder of this report will identify the basis of design and the steps necessary for further development of the terminal at Queens Bay North.

2 DESIGN BASIS

2.1 Introduction

The onshore and marine infrastructure for the proposed Queens Bay North facilities will be designed in detail and constructed in later phases of the project. This design basis document has been developed as a guideline for the design of the new terminal. As design progresses and more detailed information becomes known (i.e. geotechnical conditions, environmental sensitivities) aspects of this design basis document will be revised. This design basis document will thus evolve and from it, a more detailed and specific design criteria document will be developed.

This design basis will consider the following characteristics:

- Critical facilities (loading ramps, floating leads, draft requirements, etc) will have a design safety margin appropriate for the perceived risk,
- Design and construction methods will consider safety implications (i.e. proximity of retaining wall from existing highways, highway intersection design, adequate terminal area to prevent highway queuing),
- Design will use proven methods and materials, and will be similar to existing inland ferry structures which have a proven track record,
- Facilities will be designed to be easily maintainable.

2.1.1 Codes, Standards and Regulations

The design and construction of the infrastructure will be based on the applicable sections (and latest revisions) from the following codes, standards and regulations, or their approved equivalents:

- MOTI Design Standards for Roads and Bridges,
- BC Supplement to TAC,
- OSHA British Columbia Building Code, BCBC,
- CAN / CSA-S6 Canadian Highway Bridge Design Code,
- CAN / CSA-S826 Series-01 (R2011) : Ferry Boarding Facilities,
- BS 6349 British Standard Code of Practice for Maritime Structures,
- PIANC Permanent International Association of Navigation Congresses, Guidelines for the Design of Fender Systems.

2.1.2 Coordinate System and Elevation Datum used in Study

LIDAR

LIDAR topography, including cadastral mapping and high resolution overlays, was received from MOTI. UTM horizontal coordinates were converted to ground by scaling around origin point 0,0, with a scaling factor of 0.99951875.

Elevations are based on geoid model HTv2.0.

Bathymetry

Bathymetry survey was undertaken by Kootenay Technical Services Inc. between March 2, 2015 and March 6, 2015. Equipment included a SPS 852 Base Station, a SPS 882 Rover, an Ohmex Sonar M8 depth sounder, and a Thunderjet Envoy aluminum boat.

The base station was setup and calibrated horizontally to monument 897006 and vertically to monument 1524J. Data was processed using a Trimble Terramodel.

UTM horizontal coordinates were converted to ground by scaling around origin point 0,0, with a scaling factor of 0.99951875.

Elevations are to CGVD28. Conversion of land elevations to CHS Nautical Chart #3050 1999 edition Sheet 6 datum (Queens Bay area) subtract 529.742 m.

2.1.3 Design Vehicular Forecast

For the purposes of this study, vehicular growth is assumed to follow population growth, as discussed in Section 4.2. The design vehicular forecast is conservative, and will be used to analyze highway congestion at the intersection to the proposed terminal, the possible need for a traffic light at the intersection, the capacity of the terminal holding compound, and the throughput capacity of the design vessel(s). The Kootenay vehicular traffic is assumed to increase at a 0.3% compound annual growth rate over the period, as shown in Table 4 below.

Table 4 - Design Vehicular Forecast

Description	Base	2065
Ferry Traffic Crossing to Kootenay Bay (daily maximum – one way)	826 AEU [(1)]	977 AEU
Eastbound thru Traffic (design peak hour)	60	72
Westbound thru Traffic (design peak hour)	64	76

Note [(1)] – Peak daily ridership – August, 2009. Refer to Section 3.1.5

2.2 Marine Infrastructure

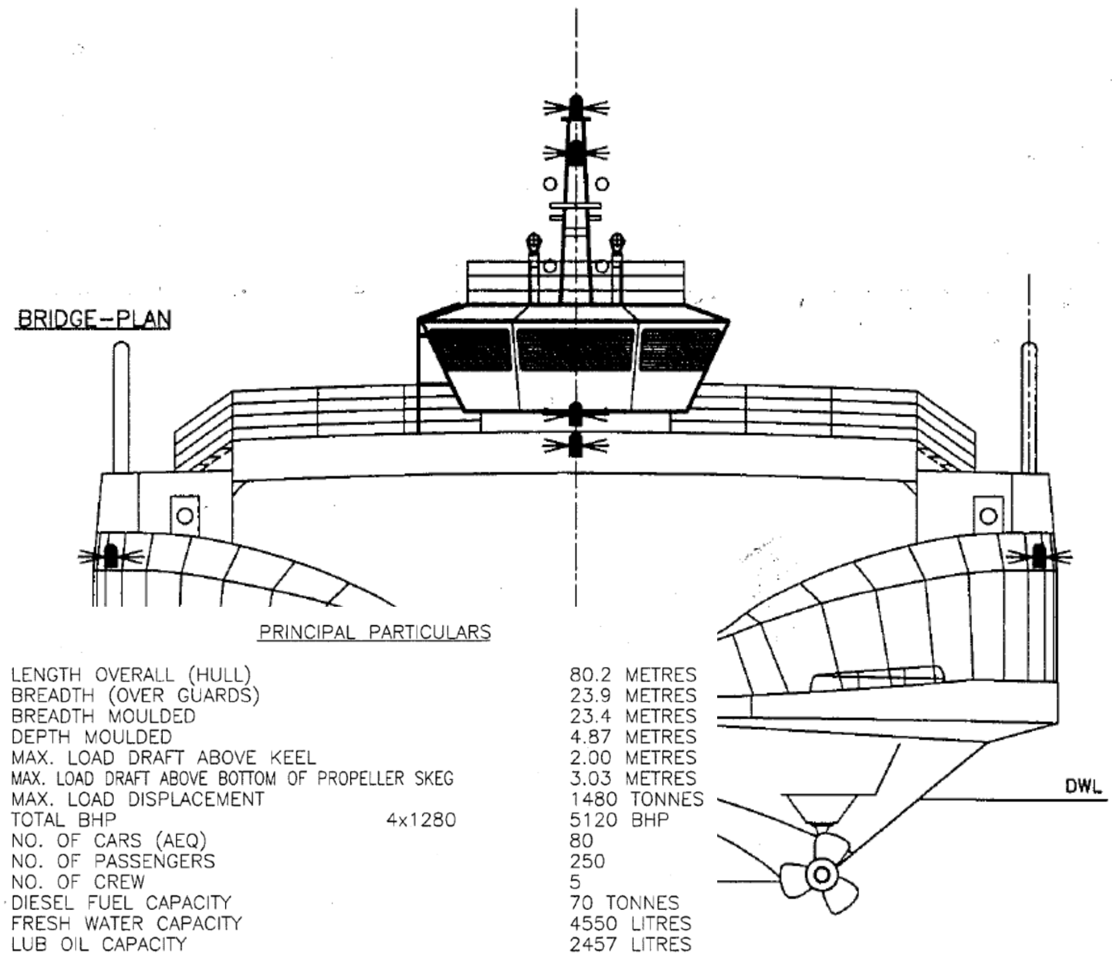
2.2.1 Design Life

- The design life of the infrastructure is to be not less than 50 years.

2.2.2 Design Vessel

The design vessel will be the MV Osprey 2000. The MV Osprey 2000 has the characteristics indicated below in Figure 10.

Figure 10 - Design Characteristics of the MV Osprey 2000



The proposed terminal, in particular the berth configuration and the transition from the deck of the vessel to the shore ramp, must be optimized to best accommodate the MV Osprey 2000. In addition, a tie-up berth will be provided for MV Balfour or equivalent.

2.2.3 Design Wind Speed

Wind data will be confirmed following the availability of physical data collected on site. Further information on wind speed is provided in Section 5.1.2.

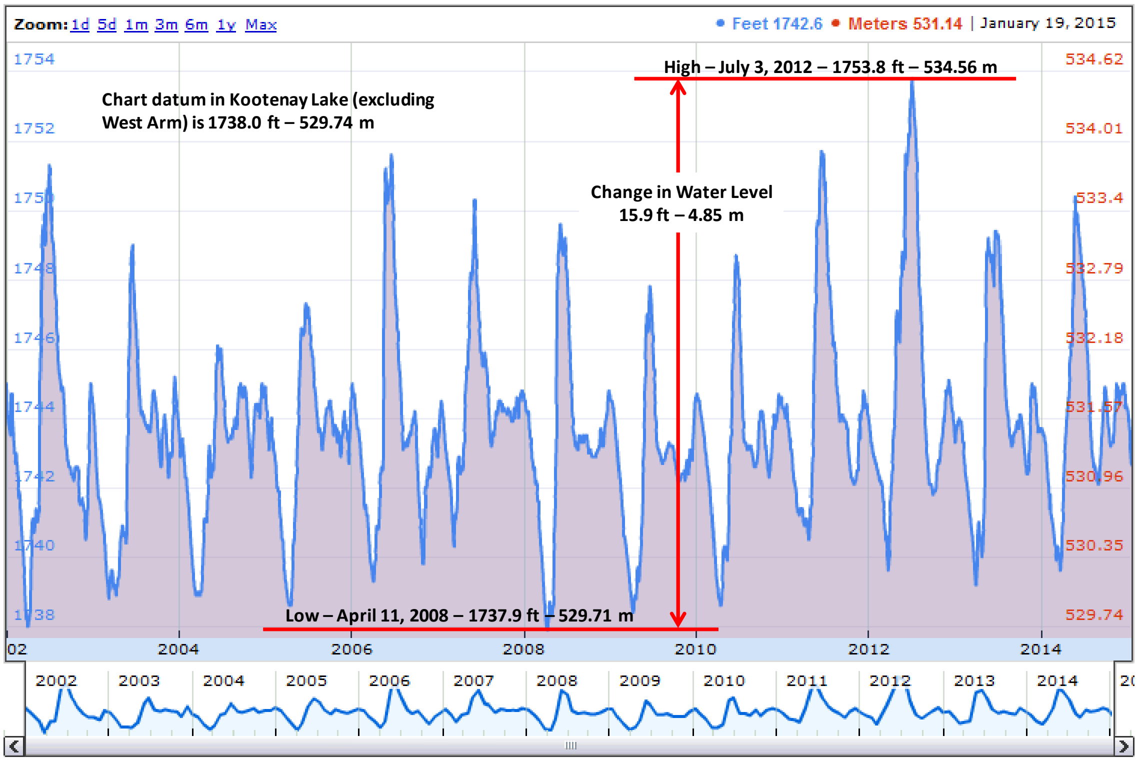
2.2.4 Design Wave Height

Wave data will be confirmed following the availability of physical data collected on site (likely analysis of site-specific wind data). Further information on wind speed is provided in Section 5.1.3.

2.2.5 Design Water Elevations

Water level elevations come from a recorded FortisBC water level gage in Queens Bay located immediately north-east of the proposed berth location at McEwen Point. Water levels at this gage location over the past several years are indicated below in Figure 11.

Figure 11 - Kootenay Lake Levels - 2002 through 2014 (geodetic)



http://webapp.fortisbc.com/lakelevel/lakes.jsp

During September 1 and March 31 maximum water levels in Kootenay Lake are governed by the 1938 International Joint Commission Order between Canada and the United States. During this period water levels are not to exceed a maximum of 532.0 m.

During the high summer runoff period, there is a restriction getting water out of Kootenay Lake because of Grohman Narrows. Grohman Narrows is a natural hydraulic constriction on the west arm of Kootenay Lake, approximately 3 km downstream of Nelson.

Typically water levels in Kootenay Lake do not exceed 534 m, but as indicated in Figure 11, reached 534.5 m in July, 2012, the highest level since 1974. Without the dams upstream of Kootenay Lake, the peak water level would likely have been higher.

For the purposes of design, the vehicle holding compound lowest elevation will be set 1.5 m higher than the peak reached in 2012, namely at 536.0 m. This will minimize the possibility of wave run-up onto the vehicle holding compound during freshet storm periods. Table 5 references the minimum elevation of the vehicle holding compound with respect to relevant design water levels.

Table 5 - Design Water Levels

Description	Elevation (geodetic)	Elevation (above Chart Datum)
Minimum elevation of vehicle holding compound	536.0 m	+ 6.2 m
Design high water level (July, 2012)	534.5 m	+4.7 m
Design low water level (April, 2008)	529.7 m	0 m
MV Osprey - bottom of propeller skeg at maximum loaded draft during design low water	526.7 m	- 3.0 m
Minimum design seabed level at loading ramp	524.7 m	- 5.0 m

2.3 Terminal Holding Compound

2.3.1 Design Capacity of Vehicle Holding Compound

Based on the historic ferry traffic demand and assessment by the Ferry Operational staff, the vehicle holding compound will have a design capacity of two times the capacity of MV Osprey 2000 (160 AEU).

2.3.2 Design Roadways and Ramps

Roadways and loading ramp will be designed based at a minimum on CAN/CSA S826 Series-01: Ferry Boarding Facilities.

2.4 Highway

2.4.1 Highway Design Intersection

- One (1) through lane in each direction on the highway,
- One (1) left turn lane from the highway into the ferry terminal,
- Right turn from highway to the ferry terminal, accommodated by a direct taper design and delta island,
- Separate left and right turn lanes exiting the ferry terminal.

2.5 Concept Sketches for Proposed Terminal at Queens Bay North

Conceptual sketches of the proposed terminal and ferry berth at Queens Bay North are provided in Appendix A. The proposed design incorporates the design basis described above.

3 FERRY OPERATIONS ANALYSIS

3.1 Existing Ferry Operations at Balfour

3.1.1 Ferry Vessels

Existing ferry service from Balfour to Kootenay Bay is provided by two vessels operated by Western Pacific Marine under a services contract with MOTI. The newer and larger of the two vessels, the MV Osprey 2000, operates daily service year round. MV Balfour, a smaller and older vessel, operates during the peak summer travel season to reduce capacity constraints. The MV Balfour is also operated during periods when maintenance of the MV Osprey 2000 is required.

3.1.2 Ferry Vehicle Capacity

Table 6 indicates the vehicle capacity of the vessels operating on Kootenay Lake.

Table 6 - Kootenay Lake Ferry Capacity

Vessel	Vehicles (AEU)	Passengers
MV Osprey 2000	80	250
MV Balfour	28	150

3.1.3 Ferry Transit Time

The sailing distance between Balfour and Kootenay Bay is 8.8 km, and the total crossing time to navigate the west arm and the main body of the lake is approximately 35 minutes. 15 minutes is taken to load and unload the vehicles, making the total time for a one-way trip equal to 50 minutes. A round trip is one hour and 40 minutes. A breakdown of typical segment durations for a return trip is shown below in Table 7.

Table 7 - Transit Time Durations – Return Trip - Balfour to Kootenay Bay

Segment	Description	Duration	Notes
1	Load at Balfour	10	
2	Navigate the channel entrance out of Balfour	10	
3	Crossing Kootenay Lake (Balfour to Kootenay Bay)	25	
4	Offload at Kootenay Bay	5	
5	Load at Kootenay Bay	10	
6	Crossing Kootenay Lake (Kootenay Bay to Balfour)	25	
7	Navigate the channel entrance in to Balfour	10	
8	Offload at Balfour	5	
		100	(50 min per leg)

3.1.4 Ferry Summer Schedule

During the summer months ferry service is provided by regular sailings of both the MV Osprey 2000 and the MV Balfour.

The current summer period ferry schedule is shown below in Table 8 for sailings from Balfour to Kootenay Bay, operating approximately 15 hours / day.

Table 8 - Typical Summer Ferry Schedule (Balfour to Kootenay Bay)

Time of Day	Vessel	AEU Capacity	Aggregate AEU
06:30	Osprey 2000	80	80
08:10	Osprey 2000	80	160
09:50	Osprey 2000	80	240
10:40	Balfour	28	268
11:30	Osprey 2000	80	348
12:20	Balfour	28	376
13:10	Osprey 2000	80	456
14:00	Balfour	28	484
14:50	Osprey 2000	80	564
15:40	Balfour	28	592
16:30	Osprey 2000	80	672
17:20	Balfour	28	700
18:10	Osprey 2000	80	780
19:50	Osprey 2000	80	860
21:40	Osprey 2000	80	**940**

3.1.5 Maximum Daily Ridership from Balfour to Kootenay Bay

The theoretical maximum daily car-carrying capacity from Balfour to Kootenay Bay is 940 AEU as shown in Table 8. This would only occur if every sailing was completely full, which in fact is never the case.

Actual ridership on the ferry from Balfour tends to start off slow, and increase progressively throughout the day, peaking around 12:00 h (noon). A review of actual ridership was undertaken for the two highest years where traffic volume was available (August, 2008 and August, 2009). These months were chosen in order to understand the challenges placed on the terminal during busy periods, when sailing waits occurred, and the vehicle compound overfilled requiring cars to queue on the highway.[1]

During these two summer months actual daily ridership from Balfour to Kootenay Bay never achieved the theoretical maximum capacity of 940 AEU. The maximum actual daily ridership for the peak August day[2] in 2008 and 2009 were 818 AEU and 826 AEU respectively, approximately 88% of the theoretical maximum capacity.

3.1.6 Vehicle Arrival Rates at Balfour

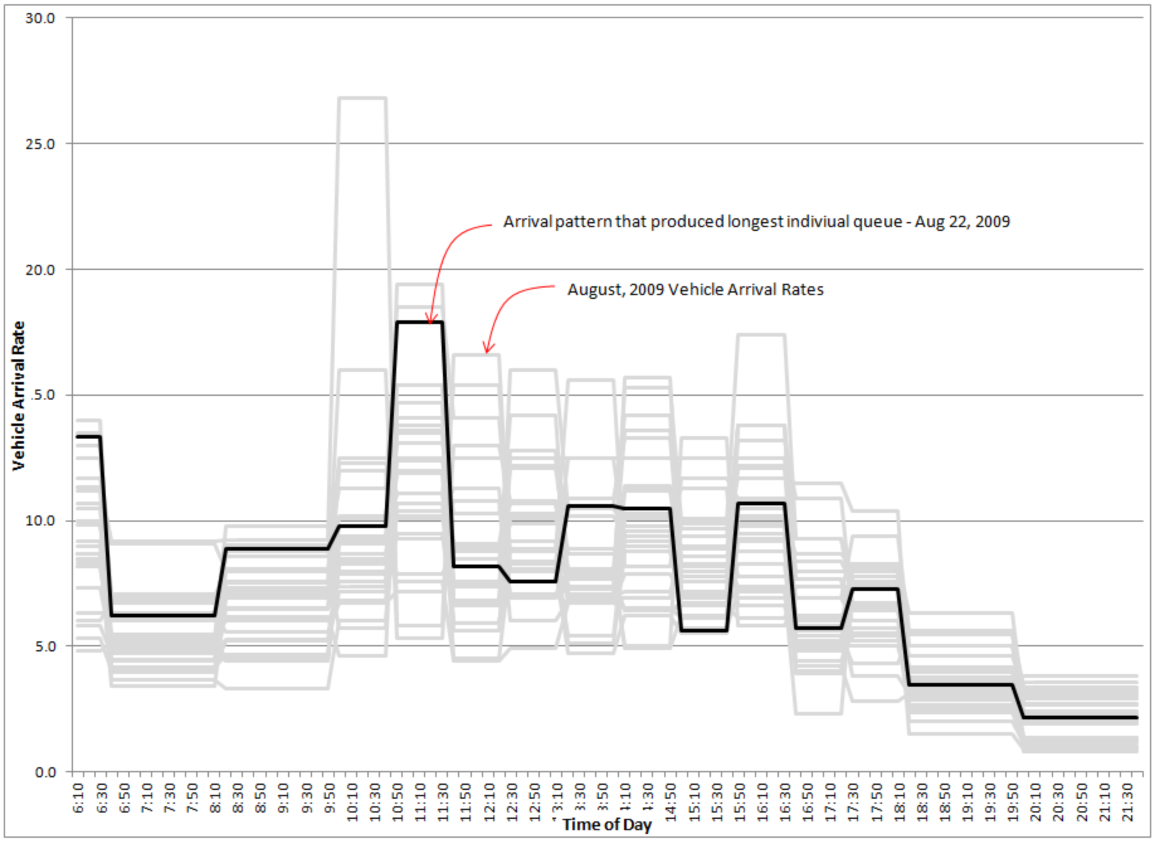
Vehicles arrive at Balfour irregularly throughout the day. Traffic patterns indicate that there is a progressive build up in vehicle activity as the day progresses, peaking around 12:00 h. As the evening sailings continue, the flow of vehicles arriving subsides. This pattern is clearly indicated in Figure 12 which shows the daily arrival pattern at Balfour during the high traffic volume period of August, 2009.

A significant issue with the existing Balfour Terminal becomes evident when reviewing the non-uniform vehicle arrival rate throughout the day, in conjunction with the size of the vehicle holding compound and the vehicle take-away capacity of the ferries. When vehicle arrivals between sailing periods exceed the take-away capacity of the ferry, the surplus vehicles begin to queue and sailing waits occur.

[1] Detailed statistical information was available from MOTI commencing in 2008. Not all years experienced the same high demands during the same period, however individual periods within each year also had busy times during long weekends, highway disruptions, or other planned and non-planned events, and as such a review of the terminal operations during these high use times is appropriate. It also allows for a design basis to calculate appropriate compound size if redesign is considered, particularly if growth forecasts are realized.

[2] Achieved on August 5th, 2008 and on August 3rd, 2009

Figure 12 – Daily Vehicle Arrival Rates at Balfour Terminal[1]



3.1.7 Sailing Waits and Vehicle Holding Compound at Balfour

During the peak summer months, a one sailing wait is common at Balfour, as demand for ferry service exceeds capacity during periods of the day. Table 9 below shows sailing demand versus vessel capacity for the first week of August, 2009. Periods shown in pink[2] indicate periods where demand exceeds capacity and vehicles are forced to wait for the next sailing. For the week shown, it is estimated that there was at least a one-sailing wait for 59 of the 105 sailings.

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[1] Based on highest traffic volume period over last 10 years (August, 2009)

[2] The table indicates in some cases that vehicles waited even though the vessel capacity was not attained. This can occur when the weight carrying capacity of a vessel is reached before the deck space capacity.

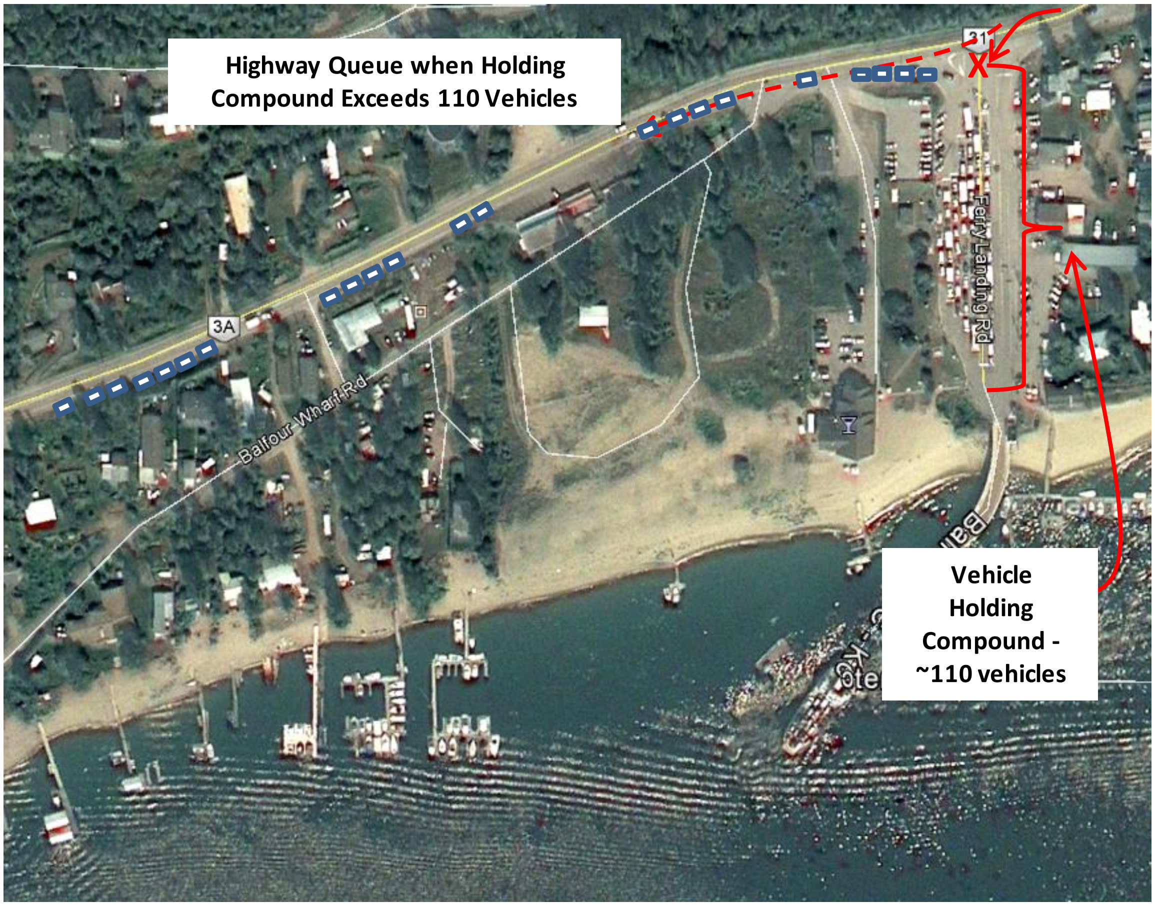
Table 9 - Sailing Demand versus Capacity - August, 2009 at Balfour Terminal

Sailng	Vessel	Capacity	Friday 1	Sat 2	Sun 3	Mon 4	Tue 5	Wed 6	Thur 7
06:30	Osprey 2000	80	16	19	34	34	25	26	15
08:10	Osprey 2000	80	41	63	92	60	52	48	51
09:50	Osprey 2000	80	72	88	98	91	45	44	74
10:40	Balfour	28	62	57	147	49	47	42	42
11:30	Osprey 2000	80	82	121	149	88	85	60	111
12:20	Balfour	28	48	101	143	46	47	57	58
13:10	Osprey 2000	80	76	114	160	92	68	53	107
14:00	Balfour	28	53	104	111	45	55	37	69
14:50	Osprey 2000	80	89	116	110	93	88	80	81
15:40	Balfour	28	39	90	102	50	44	50	52
16:30	Osprey 2000	80	61	115	99	91	61	101	80
17:20	Balfour	28	26	57	48	61	44	69	58
18:10	Osprey 2000	80	41	61	62	60	52	68	85
19:50	Osprey 2000	80	34	36	56	42	50	46	39
21:40	Osprey 2000	80	42	40	23	23	26	35	30

The Balfour vehicle holding compound is capable of accommodating approximately 110 AEU. In periods when demand is high, and the number of vehicles waiting for the next ferry sailing exceeds this number, the vehicle holding compound becomes full and all additional vehicles are forced to queue on the shoulder of north-east Highway 3A. For the week shown in Table 9, it is estimated that highway queuing occurred for 10 sailing waits, as depicted on Figure 13. Vehicle queuing is managed by the ferry Operator traffic control attendees.

A review was undertaken for the years where ferry vehicle data at Balfour was available. Periods where the vehicle holding compound exceeded 110 AEU was calculated. The months of July and August are the most likely to incur highway queuing.

Figure 13 - Highway Queuing when Terminal Exceeds 110 Vehicles



Vehicle queuing on the highway is undesirable. South-west travelling vehicles are prevented from entering into the holding compound and must continue south-west until it is possible to turn around and form part of the queue line. Vehicles travelling north-east to take the ferry are directed by traffic attendants to queue up instead. This phenomena of highway queuing will continue to occur, as the vehicle holding compound is restricted in its physical size, and the take-away capability of the ferry operation at Balfour is insufficient during peak periods.

Highway queuing will worsen in the future if the estimated vehicle growth (0.3% annual compound growth) continues as indicated in Section 4.2. At the end of the forecast period (2065) it is predicated that the majority of the peak month sailings will encounter sailing waits and that highway queuing will be extensive and a regular occurrence.

3.2 Proposed Ferry Operations at Queens Bay North

3.2.1 Ferry Vessel

If the ferry service is relocated to Queens Bay North, the service could be operated by a single vessel, and due to the reduced crossing time the maximum daily car carrying capacity to

Kootenay Bay would significantly increase by 36% to 1,280 AEU[1]. During off-peak periods of the year this increases by 60%[2].

3.2.2 Ferry Transit Time

The sailing distance between Queens Bay North and Kootenay Bay is 5.4 km and the crossing time is shortened to approximately 17 minutes. A new facility at Queens Bay North would be designed with a two-lane ramp for vehicle loading and unloading. With a two-lane ramp the anticipated offload time would be 3 minutes and the load time would be 8 minutes, making the total time for a one-way ferry trip equal to 30 minutes. A round trip would be approximately one hour, as indicated in Table 10 below. This is a significant reduction in travel time compared to the existing transit time from Balfour. Travel distance is commensurately shorter as shown in Figure 14.

Table 10 - Transit Time Segment Durations - Queens Bay North to Kootenay Bay

Segment	Description	Duration	Notes
1	Load at Queens Bay North	8	
2	Crossing Kootenay Lake (QBN to Kootenay Bay)	17	
3	Offload at Kootenay Bay	5	
4	Load at Kootenay Bay	10	
5	Crossing Kootenay Lake (Kootenay Bay to QBN)	17	
6	Offload at Queens Bay North	3	
		60	(30 min per leg)

[1] Summer maximum car carrying capacity at Balfour is 960 AEU with two ferries in operation.
[2] Winter maximum car carrying capacity at Balfour is 800 AEU with one ferry in operation.

Figure 14 - Travel Distances to Kootenay Bay

3.2.3 Ferry Vessel Schedule

A hypothetical ferry schedule, using a 30 minute transit time, is shown below in Table 8 for sailings from Queens Bay North to Kootenay Bay.

Table 11 - Typical Ferry Schedule (Queens Bay North to Kootenay Bay Only)

Time of Day	Vessel	AEU Capacity	Aggregate AEU
06:30	Osprey 2000	80	80
07:30	Osprey 2000	80	160
08:30	Osprey 2000	80	240
09:30	Osprey 2000	80	320

Time of Day	Vessel	AEU Capacity	Aggregate AEU
10:30	Osprey 2000	80	400
11:30	Osprey 2000	80	480
12:30	Osprey 2000	80	560
13:30	Osprey 2000	80	640
14:30	Osprey 2000	80	720
15:30	Osprey 2000	80	800
16:30	Osprey 2000	80	880
17:30	Osprey 2000	80	960
18:30	Osprey 2000	80	1,040
19:30	Osprey 2000	80	1,120
20:30	Osprey 2000	80	1,200
21:30	Osprey 2000	80	**1,280**

3.2.4 Vehicle Arrival Rates at Queens Bay North

Table 11 above indicates a design maximum daily capacity of 1,280 AEU for ferry travel between Queens Bay North and Kootenay Bay, utilizing only the MV Osprey 2000. This reflects a 36% increase in capacity relative to ferry transit from Balfour during the summer and 60% during the rest of the year when the MV Balfour is not in service.

Traffic patterns indicate that there is a progressive build up in summer vehicle activity throughout the day, peaking around 12:00 h. As a result, the take-away capability of the ferry system needs to be analyzed on a time-specific basis throughout the day to better understand the relationship between vehicle arrival patterns, the take-away capability of the ferry service, and the inevitable vehicle queuing which will occur if arrivals exceed the take-away capability. If an imbalance occurs, the vehicle holding compound needs to be of sufficient size to retain the surplus vehicles long enough into the day until the point when demand reduces. Ideally the size of the vehicle holding compound will be such that highway queuing is entirely avoided.

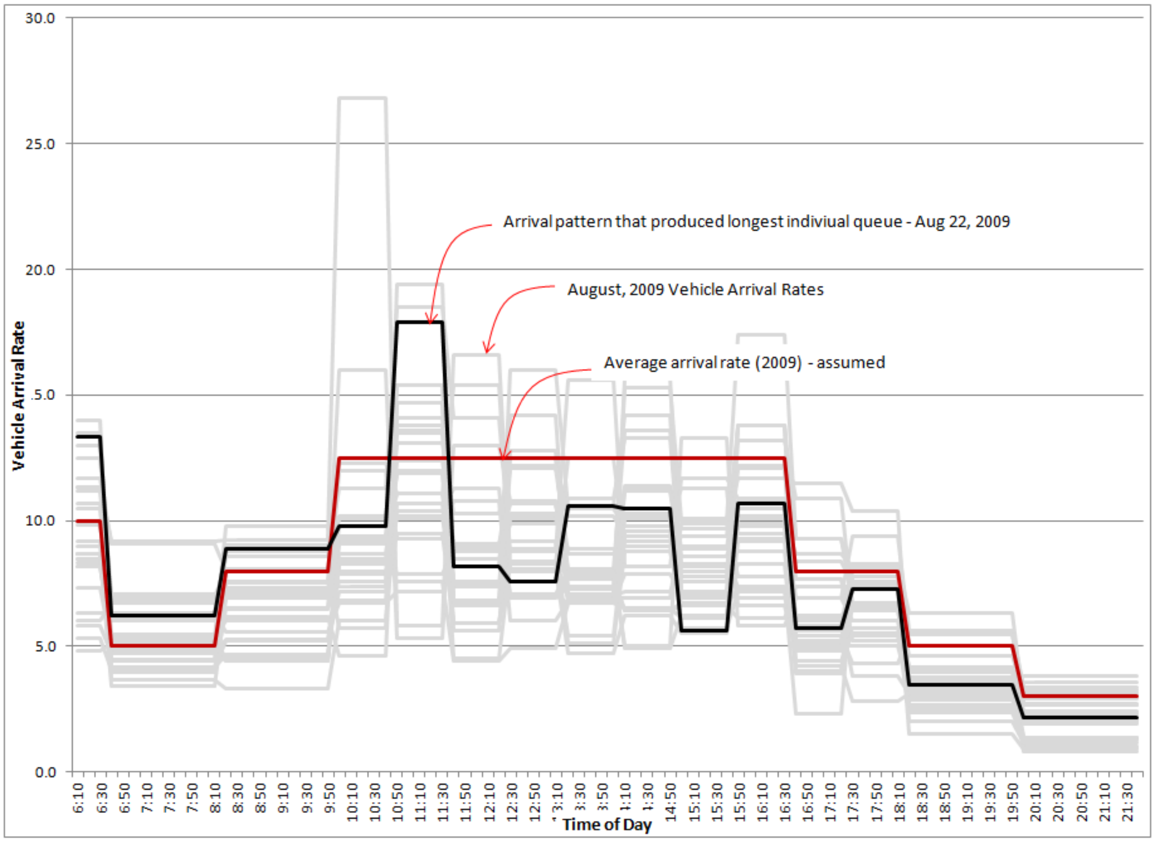
An approximation of vehicle arrival rates throughout the day at Queens Bay North was estimated following a review of traffic patterns in August, 2009 at Balfour. This year represents the highest monthly ferry traffic flow in the years where detailed statistics were available[1].

In Figure 15, vehicle arrival rates for 2009 respectively were plotted. The "spikes" in the mid-day arrival rates generally represent the increase in traffic arriving to sail on the larger of the vessels, the MV Osprey 2000. From this representation of arrival rates, an assumed vehicle arrival pattern at Queens Bay North was developed. This location, where it is proposed that the

[1] Detailed statistical information was available from MOTI commencing in 2008.

larger MV Osprey 2000 would be the only vessel operating, would not be expected to experience the "spikes" evident at Balfour. Arrivals during the mid-day would be assumed to be relatively uniform, as shown.

Figure 15 – Assumed Vehicle Arrival Rates at Queens Bay North



3.2.5 Sailing Waits and Vehicle Holding Compound at Queens Bay North

At Queens Bay North, the reduced sailing distance to Kootenay Bay will reduce vehicle sailing waits, even if the service is provided with only the MV Osprey 2000. In addition, the new facility will be designed for an optimum size of the vehicle holding compound, which will significantly reduce the possibility of highway vehicular queuing. Compared to the sailing waits and highway queuing discussed in Section 3.1.7 at Balfour, the same volume of traffic could be easily managed at Queens Bay North. There would be no expected sailing waits because the queue of vehicles would be less than the ferry capacity. Table 12 shows the expected vessel traffic at Queens Bay North using the August, 2009 vehicle demand.

Table 12 – Assumed Sailing Demand versus Capacity - Queens Bay North

Sailing time	Vessel	AEU equivalent	Vehicles arrived since last sailing	Vehicles left behind from last sailing	Vehicles loaded on ferry	Vehicles not loaded on ferry	Maximum vehicle queue
6:30	Osprey 2000	80	30	0	30	0	30
7:30	Osprey 2000	80	30	0	30	0	30
8:30	Osprey 2000	80	36	0	36	0	36
9:30	Osprey 2000	80	48	0	48	0	48
10:30	Osprey 2000	80	66	0	66	0	66
11:30	Osprey 2000	80	75	0	75	0	75
12:30	Osprey 2000	80	75	0	75	0	75
13:30	Osprey 2000	80	75	0	75	0	75
14:30	Osprey 2000	80	75	0	75	0	75
15:30	Osprey 2000	80	75	0	75	0	75
16:30	Osprey 2000	80	75	0	75	0	75
17:30	Osprey 2000	80	48	0	48	0	48
18:30	Osprey 2000	80	42	0	42	0	42
19:30	Osprey 2000	80	30	0	30	0	30
20:30	Osprey 2000	80	22	0	22	0	22
21:30	Osprey 2000	80	18	0	18	0	18
		totals	**820**	**0**	**820**	**0**	**75**

Using the 2065 vehicle forecast developed in Section 2.1.3, the new facility at Queens Bay North should also easily handle the future vehicle load. As shown in Table 13, it is estimated that there would be a maximum vehicle queue length of 136 vehicles. These vehicle levels would be easily handled in the proposed terminal queue area[1].

[1] Note that Table 13 is based on using the MV Osprey, however by 2065 the MV Osprey would likely have been replaced.

Table 13 – Assumed Sailing Demand versus Capacity - Queens Bay North - 2065 Traffic

Sailing time	Vessel	AEU equivalent	Vehicles arrived since last sailing	Vehicles left behind from last sailing	Vehicles loaded on ferry	Vehicles not loaded on ferry	Maximum vehicle queue
6:30	Osprey 2000	80	36	0	36	0	36
7:30	Osprey 2000	80	36	0	36	0	36
8:30	Osprey 2000	80	43	0	43	0	43
9:30	Osprey 2000	80	57	0	57	0	57
10:30	Osprey 2000	80	79	0	79	0	79
11:30	Osprey 2000	80	89	0	80	9	89
12:30	Osprey 2000	80	89	9	80	18	98
13:30	Osprey 2000	80	89	19	80	28	108
14:30	Osprey 2000	80	89	28	80	37	117
15:30	Osprey 2000	80	89	37	80	47	127
16:30	Osprey 2000	80	89	47	80	56	**136**
17:30	Osprey 2000	80	57	56	80	33	113
18:30	Osprey 2000	80	50	33	80	3	83
19:30	Osprey 2000	80	36	3	39	0	39
20:30	Osprey 2000	80	26	0	26	0	26
21:30	Osprey 2000	80	21	0	21	0	21

3.2.6 Vehicle Off-Loading at Queens Bay North

At Queens Bay North the proposed two lane ramp and two-lane exit road, along with the length of the exit road, effectively allows the full MV Osprey 2000 vehicle load to clear the vessel, thus allowing the immediate commencement of ferry loading operations. No vessel capacity issues will exist that are associated with vehicle off-loading.

4 HIGHWAY INTERSECTION DESIGN ANALYSIS

4.1 Traffic Volume

The basis of design of the proposed intersection of Highway 31 and the proposed Queens Bay North terminal will use traffic data derived from the following:

- Traffic volume in the Balfour Area using 2015 traffic count information provided by MOTI on Highway 31 at Kaslo and on Highway 3A at Harrop,
- Vehicle off-loading from the MV Osprey 2000, with an assumed 80%split[1] of the vehicles turning left (westbound) and 20% of the vehicles turning right (eastbound) at the highway intersection.

The 2015 design traffic volume, based over a 15 minute peak period at the ferry terminal intersection, is listed below in Table 14.

Table 14 - Design Traffic Volume - Balfour (2015)

Peak Period	Highway 3A (eastbound)		Highway 31 (westbound)		Ferry Off-Loading	
	Thru traffic	Right turn into terminal	Thru traffic	Left turn into terminal	Left turn (80%)	Right turn (20%)
Design Traffic Volume (AEU)	15	35	16	10	64	16

4.2 Population Growth and Traffic Volumes (2065)

Traffic volumes in British Columbia have been steady, or on a slow decline since the downturn in the economy in 2008. Annual statistics of vehicles on Highway 31 at Kaslo, and on Highway 3A at Harrop (Appendix I) illustrate this trend. The one exception is in the Lower Mainland, where population growth continues to drive up traffic volumes, albeit at a slower rate than when the economy was doing well.

Economic downturns are not permanent, and it is assumed that the duration of the current downturn will not exceed the 50 year design period of this study. As an alternate to the highway traffic volumes, trends in population statistics were used as an indicator of long-term traffic growth. Population growth projections for the Kootenay region to 2065 are listed in Table 15.

[1] This assumption was based on the experience of ferry terminal Operations staff.

Table 15 – Kootenay Population Growth to 2065

Area	Year	2013	2015 (Base Year)	2040	2065	Overall Growth Factor to 2065
			50 Year Design Period			
Kootenay	Stated population (*1000)	154				1.16
	Annual compound growth rate (%)	0.30%				
	Calculated population (*1000)		155	166	179	

Source: BC Stats" "PEOPLE 2013", issue September 12, 2013

The Kootenay population is anticipated to increase 16% by year 2065, representing a 0.30% compound annual growth rate. For the purposes of analyzing the highway and intersection leading to / from the proposed terminal at Queens Bay North, a minimum 0.30 % annual growth rate will be assumed[1]. This leads to a 16% increase in traffic by 2065.

The 2065 design traffic volume, based over a 15 minute peak period at the ferry terminal intersection, is listed below in Table 16.

Table 16 - Design Traffic Volume – Queens Bay North (2065)

Peak Period	Highway 31 (eastbound)		Highway 31 (westbound)		Ferry Off-Loading	
	Thru traffic	Right turn into terminal	Thru traffic	Left turn into terminal	Left turn (80%)	Right turn (20%)
Design Traffic Volume (AEU)	18	40	19	12	64	16

4.3 Intersection Design

The highway approach to the proposed Queens Bay North site has good sight distance. In addition, the horizontal alignment is better than at the Balfour terminal.

A left turn lane is preferred for west bound traffic entering the terminal at Queens Bay North for the following reasons:

- Separation between through and left turn movements, thereby improving safety,
- Reduce delays to through vehicles who are following left turn vehicles,
- Reduce braking for through vehicles who are following left turn vehicles,
- Should the intersection become signalized, the configuration with a left turn lane will operate more efficiently and better conform to convention.

[1] The base design traffic volume was provided by MOTI and was 2015 traffic count information on Highway 31 at Kaslo and on Highway 3A at Harrop. This information inherently included tourist traffic. As forecasting tourist growth is uncertain, extrapolating 0.30 % annual growth rate for the Kootenay region off of the base 2015 traffic count information is reasonable, and likely not optimistic nor pessimistic with respect to tourist growth.

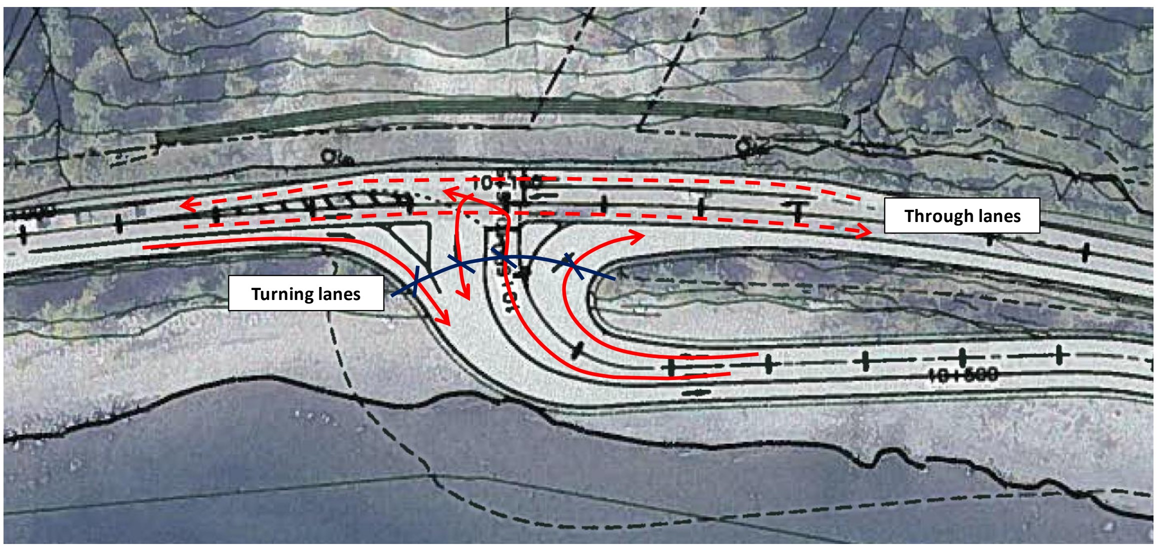
Similarly, a left and right turn lane for vehicles exiting the terminal compound is preferred. Separate turn lanes will improve the vehicle capacity exiting the terminal.

Therefore the preferred intersection configuration at Queens Bay North is:

- One (1) through lane in each direction on the highway,
- One (1) left turn lane from the highway into the ferry terminal,
- Right turn from highway to the ferry terminal, accommodated by a direct taper design and delta island,
- Separate left and right turn lanes exiting the ferry terminal.

This intersection configuration shown below in Figure 16 formed the base configuration for the traffic analysis.

Figure 16 – Queens Bay North – Proposed Intersection Configuration



4.4 Traffic Analysis Results

The proposed Queens Bay North highway intersection was analyzed using Synchro traffic planning and analysis software. The results indicate that the intersection will work without a traffic light, though departing traffic may need to briefly wait at the intersection for passing highway vehicles. This will not affect the ferry schedule though, as the ferry approach road is long enough to allow the entire design capacity of the MV Osprey 2000 to clear the vessel without delaying boarding vehicles.

The Ministry must determine the threshold of acceptable service for the unloading ferry traffic. If the Ministry wishes to dissipate the queue of vehicles more quickly, a traffic light at the intersection would be desirable. If traffic unloading peaks are allowed to dissipate gradually, then signalization is not required. The intersection design will include cable ducting to allow for future installation of a traffic light if desired.

5 METOCEAN REVIEW

5.1 Wind, Currents and Waves

5.1.1 Introduction

A desktop metocean study was performed for the proposed relocation of the ferry terminal to Queens Bay North. The review of wind, currents and waves is included in Appendix C.

5.1.2 Wind Regime on Kootenay Lake

No recorded wind data was available near the proposed site. The closest locations of wind measurement considered relevant for this review were from Akokli Creek, and Powder Creek.

For the purpose of estimating wave heights at the project site, the Akokli Creek wind station was considered to be representative of the southerly winds blowing over the southern part of the lake. When wind blows from the north, the project site is considered to be predominately sheltered from the resulting waves that are generated in the northern part of the lake propagating to the south. Hence such condition was not considered for the estimation of the wave heights at the project site.

5.1.3 Wave Climate

To estimate wave heights at Queens Bay North, a SWAN numerical model was developed using digitized bathymetry. For sake of simplicity, and to err on the conservative side, southerly wind was assumed to be blowing for a long duration (fetch limited) and in a single direction of 171° (true north) over the entire lake. This direction is an average over the axis of the lake to the south, but may not reflect the actual fetch if the near surface wind follows the actual lake alignment.

Wave simulations were performed with the wind speeds indicated in Table 17 to provide guidance on potential wave heights that could be expected at the project site if these winds were to happen.

Table 17: Sea States at Queens Bay North Predicted by the SWAN Numerical Model

Wind Speed (kts)	Significant Wave Height (H_s) (m)	Peak Wave Period (T_p) (sec)	Wave Direction (° T)
30	1.3	4.8	145
40	2.3	5.5	147
50	3.6	7.1	147

5.1.4 Conclusions from Metocean Report

The metocean analysis was able to estimate fetch-limited wave heights based upon hypothetical wind speeds only, as local wind data was unavailable.

As wave height predictions are highly sensitive to the definition of the overwater winds, the report recommended that an anemometer be installed in the vicinity of Queens Bay North and wind measurements be collected for a minimum of twelve (12) months.

For the preliminary design of the Queens Bay North location, for the purpose of navigation and safe berthing, a seastate at the proposed berth site of H_s = 2.3 m with a T_p = 5.5 sec originating from 147º T was recommended. This is commensurate with wind velocities of 40 kts.

5.2 Bathymetry

A bathymetry survey was undertaken by Kootenay Technical Services (KTS). The bathymetry survey included the Queens Bay North area, as well as Balfour Terminal area and its approaches.

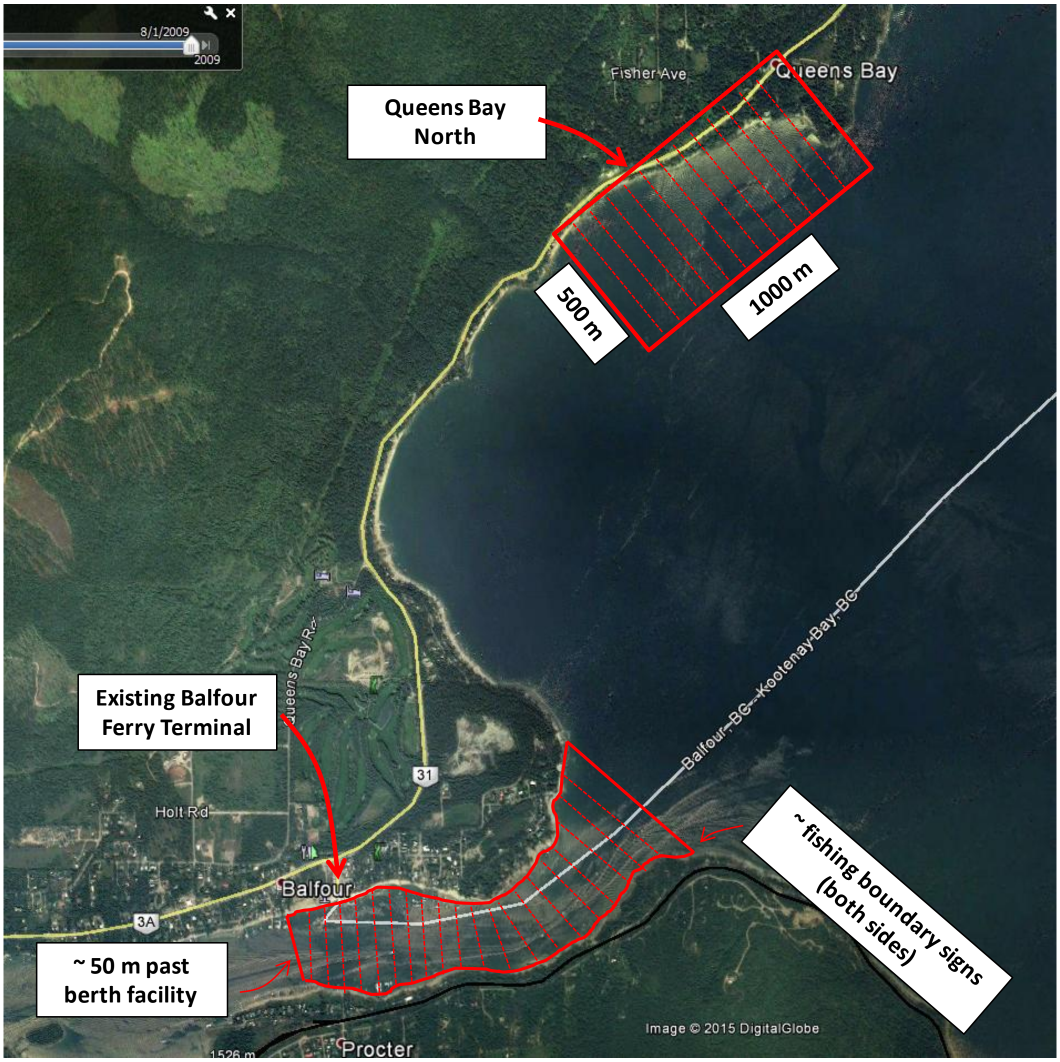
The survey areas were sounded on approximately 20 m stations, perpendicular to the shorelines. GPS was used to collect horizontal and vertical locations and the depth sounder recorded the depths on the Trimble data collector running Survey Controller. Data points were collected on 1 s intervals and a consistent speed between 5 km/h and 7 km/h was maintained. When the survey was complete, KTS re-tied in the control points. The physical extent of the bathymetry survey is indicated below in Figure 17.

The general conclusion from the bathymetry survey was that:

- A berth facility at Queens Bay North was feasible, given that the draft requirements for the design vessel could be accommodated relatively close to shore utilizing a loading ramp of similar size to the ramp at Balfour.
- The bathymetry survey in the west arm of Kootenay Lake nearing the approaches to Balfour confirmed the ferry Operators concern regarding navigational issues for both approaching and departing vessels, and that the channel does not maintain a constant depth.

Additional information with respect to the bathymetry survey is described in Section 2.1.2.

Figure 17 - Physical Extent of Bathymetry Survey



5.3 Ground Contours (Lidar)

Lidar information was provided by MOTI and used to develop the foreshore terminal assets and road transition from Highway 31. Additional information with respect to the Lidar information received is described in Section 2.1.2.

6 UTILITIES REVIEW

A utilities review of the general Balfour area extending north along Queens Bay to McEwen Point was undertaken. The review was conducted to determine whether there were any potential utilities lines (underground, overhead, underwater) at or near the Queens Bay North proposed site which could impact terminal construction and ferry operation. (i.e. water, hydro, telephone, sewer, etc.).

The following organizations were contacted:

- City of Nelson – Electrical Services,
- BC One Call – representing Regional District of Central Kootenay, FortisBC, Telus.

6.1 Nelson Hydro

Nelson Hydro is the local supplier for electrical service which transits through Balfour and extends north to the northeast boundary at Coffee Creek. At Coffee Creek Nelson Hydro connects to the FortisBC system.

Along Highway 31 in the Queens Bay area, Nelson Hydro maintains an above ground distribution network of 25 kV 3-phase. This pole-mounted distribution system drops down to a 14.4 kV 1-phase leg for subsequent distribution to property owners.

The distribution system along the highway would be impacted and would require relocation with the construction of the proposed intersection and the clear zone associated with the through lane.

6.2 BC One Call

BC One Call was contacted to determine the remaining utility suppliers servicing Balfour and further along Highway 31 to McEwan Point, further north-east of the proposed Queens Bay North location. BC One Call initiates contact with the Regional District of Central Kootenay, FortisBC and Telus, who then contact the requestor and provide information on their utilities in the area.

6.2.1 Regional District of Central Kootenay

The Regional District reported that the municipal water supply has a lake intake at the foot of Meadow Street, approximately 1 km north-east of Balfour Terminal. The distribution system does not extent north to Queens Bay North. Similarly there is no municipal sewerage system in the area, with local residences relying on home septic fields exclusively.

6.2.2 FortisBC

FortisBC provides gas service to the area around Balfour ferry terminal. Their distribution lines do not extend north on Highway 31 to the area around Queens Bay North.

6.2.3 Telus

There is no visual evidence of any telephone distribution system in the vicinity of Queens Bay North.

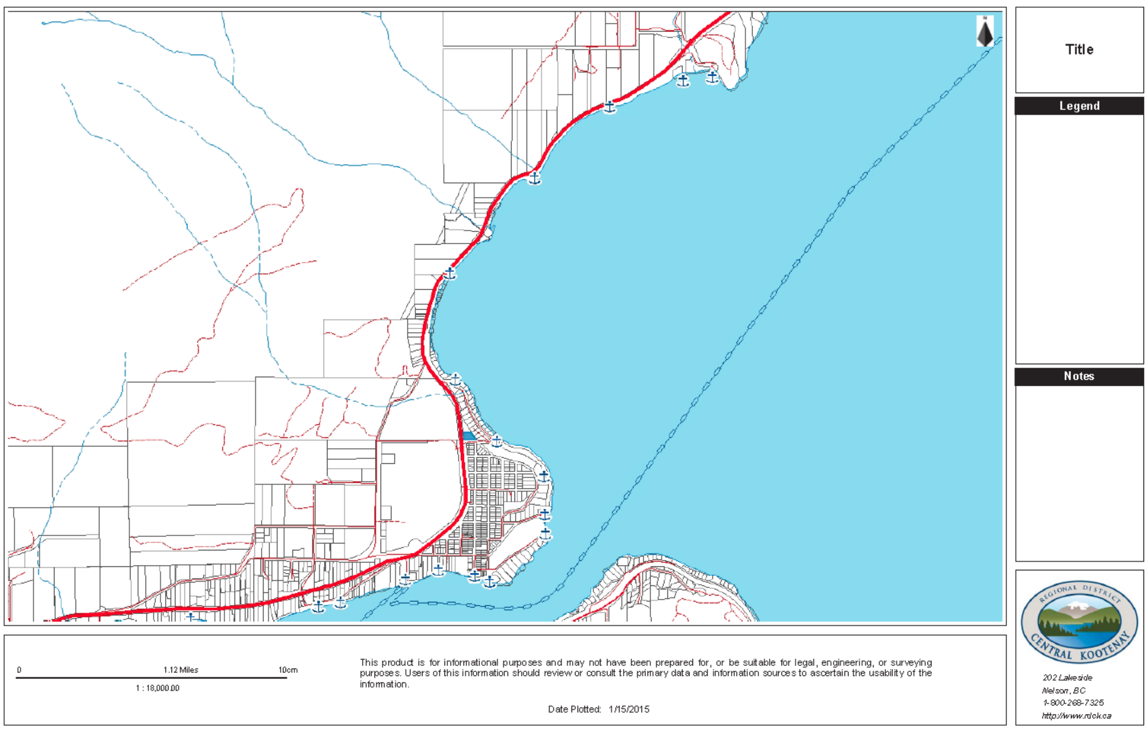
7 LAND TITLE SEARCH

7.1 Property Ownership

A land title search of properties potentially affected by the terminal relocation to Queens Bay was undertaken in January, 2015.

The title search was initiated by obtaining the property parcel identifier number and legal description of the shore side properties in Queens Bay. This information was available from the property information reports accessible from the Regional District of Central Kootenay on their Central Kootenay Web Map (see Figure 18).

Figure 18 - Regional District of Central Kootenay - Central Kootenay Web Map



The Land Title and Survey Authority of British Columbia (LTSA) administer the land title systems of British Columbia where property ownership can be determined. Using the parcel identifier obtained from the Regional District, title searches were accomplished with the web portal, “myLTSA”.

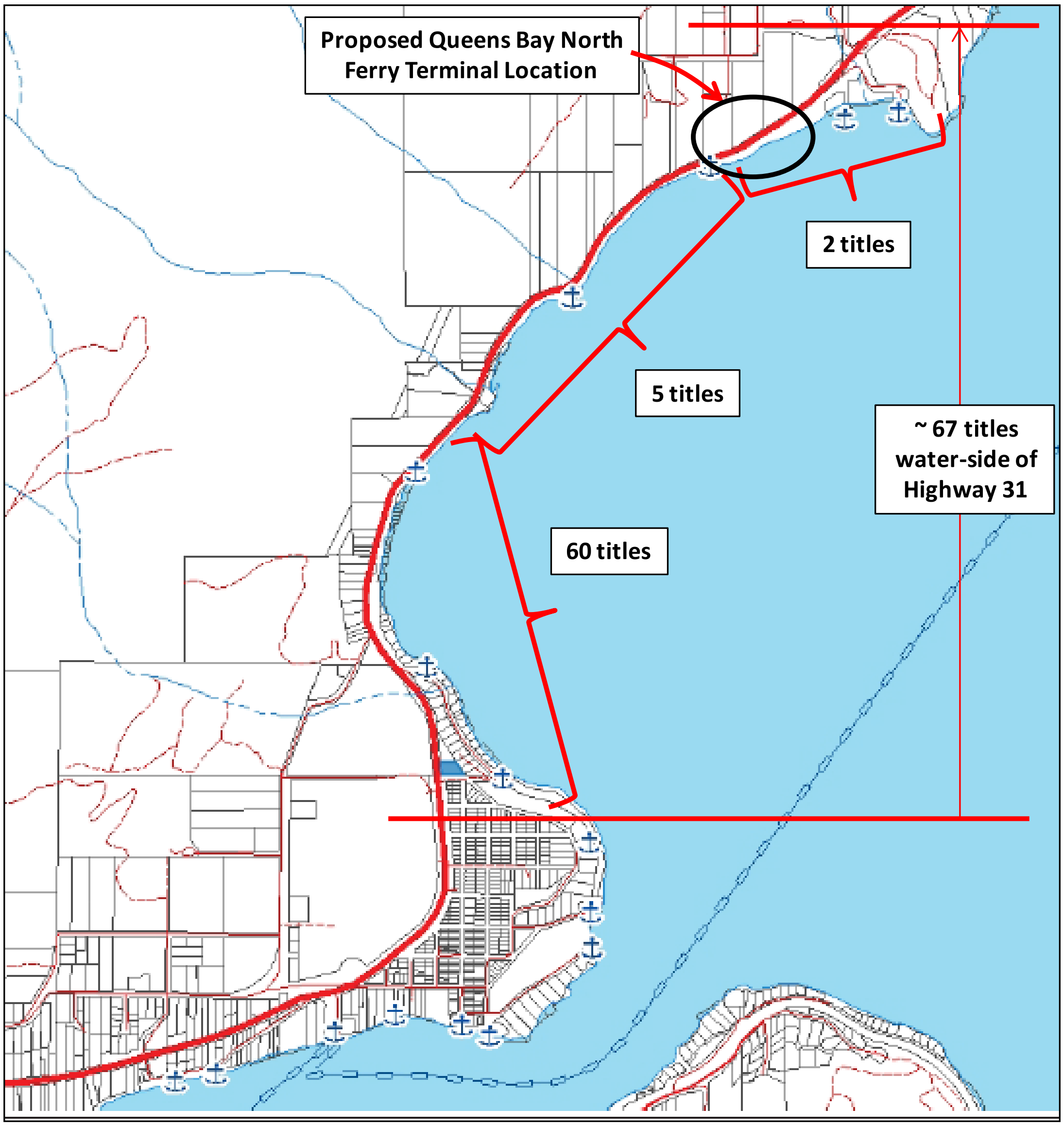
7.2 Property Assessment

The land title search for property ownership was complimented with property value information, as provided by the 2015 property assessments administered by BC Assessment.
BC Assessment produces independent and uniform property assessments on an annual basis for all properties in the province. The BC Assessment “e-valueBC” web portal was used to obtain building and land value. The assessment valuation date was as of July, 2014.

7.3 Property in Queens Bay

Figure 19 below indicate that there are approximately 67 registered properties on the water side of Highway 31 in Queens Bay around the area of the proposed ferry terminal. The property upon which the proposed Queens Bay North terminal is located is owned by the Province.

Figure 19 - Property Waterside of Highway 31 – Queens Bay



7.3.1 Queens Bay North

There are two properties along the shoreline in the Queens Bay North area that are in close proximity to the proposed terminal. The nearest property, [redacted], is approximately 100 m northeast of the proposed ferry loading platform. The next property, [redacted], is approximately 200 m away.

The Ministry would need to consider potential impacts to these properties in the design development phase.

7.3.2 Central Queens Bay

In central Queens Bay there are five properties to the southwest of the proposed terminal. The closest of these properties is approximately 600 m from the access road intersection with Highway 31. These properties are far enough away from the proposed terminal that any impact from ferry operations will be minimal.

7.3.3 Queens Bay South

In Queens Bay South there are approximately 60 properties. These properties are over 1.5 km from the proposed terminal development. Other than visual awareness of the proposed terminal, any impact from ferry operations will also be minimal.

7.3.4 Property Assessments and Land Ownership

Table 18 indicates the number of properties and the range of assessments in the Queens Bay area.

Table 18 - Property Assessment Values in Queens Bay

Area	Number of Properties	Range of Property Assessment (July, 2014)
Queens Bay North	2	[redacted]
Central Queens Bay	5	
Queens Bay South	60	

7.3.5 Conclusion

The Queens Bay North location is on Crown land, at a site that minimizes the number of potentially impacted properties.

8 ENVIRONMENTAL OVERVIEW ASSESSMENT (EOA)

8.1 Scope and Objectives

An environmental overview assessment (EOA) was performed following a site visit to Queens Bay North on February 3, 2015. The assessment was based on available federal and provincial databases, and previously collected species and habitat information in the area. The EOA report dated May 11, 2015 is provided as Appendix D to this report

The site visit provided a confirmation of the extent of the area over which the Project footprint impacts were being considered, and assessment of impact centered on those areas. The site visit also allowed a high level review of the physical habitat in the project area, overview of winter wildlife signs, incidental nest observations from the previous season (raptors and songbirds), and a general indication of potential habitat values / sensitivities.

The objectives of the desktop assessment were to describe current (baseline) environmental conditions at the site, assess the impact the Project might have on the baseline conditions and consider methods for mitigating or avoiding impacts. Information and data were collected through a desktop review of available ecological and regulatory databases and search engines including local, regional and federal government sites, as well as the site reconnaissance to observe conditions within the Project footprint and adjacent land uses that may be affected by the Project.

Specific objectives of the assessment include the following:

- Summarize fish and aquatic information for the Site and surrounding areas, including historic and anecdotal information on potential fisheries values should impacted stocks recover,
- Summarize vegetation information for the Site and surrounding areas, including indicators for rare and endangered plant species and ecosystems as well as invasive plant species,
- Summarize wildlife information for the Site and surrounding areas, including known species occurrences and indicators for wildlife species at risk,
- Identify any environmental sensitivities, including wetlands, streams, and wildlife habitats that could potentially be utilized by species at risk and/or migratory birds.

In addition to the objectives above, the potential need for permits or approvals prior to construction was identified, and environmental information was provided in support of applications for permits or approvals, where applicable.

8.2 Conclusions and Recommendations

Based on the available information, the overall environmental sensitivity of the Queens Bay North project site is moderate.

The EOA was intended only to determine the technical feasibility of the Queens Bay North site and was not intended as an environmental impact assessment. As such, detailed site specific investigations will be required during later phases in the project in order to quantify potential impacts to the environmental components identified in the EOA report (Appendix D).

Mitigation of potential effects should begin through proper project design. The Fisheries Protection Policy Statement (DFO, 2013) provides direction when considering ecosystem context and cumulative effects. A specific environmental impact assessment would quantify overall impacts, any built in mitigation strategies (i.e. project design), and any remaining / residual impacts which would require formalized compensation or offsetting measures. During construction, implementation of best management practices to minimize harmful effects on the environment should be invoked, which should also be included in a Project Construction Environmental Management Plan (CEMP).

8.3 Summary

Overall, background information available for the proposed Queens Bay North site did not indicate critical habitat or aquatic species at risk that would preclude relocating the terminal from Balfour. It is possible though that a detailed field investigation could identify environmental attributes that require specific consideration or protection.

At a minimum, the following federal and provincial environmental permits and approvals are anticipated to be required going forward:

- Fisheries Act: Section 35 Authorization. If the footprint area exceeds 25,000 m^2 it would be defined as a serious harm to fish due to a permanent alteration of fish habitat, requiring a formalized habitat mitigation and offsetting plan. The terminal will be designed to be less than 25,000 m^2.
- Navigable Waters Protection Act: Kootenay Lake is on the List of Scheduled Waters requiring project review by the Navigable Waters Protection Division,
- BC Environmental Assessment Act: The Reviewable Project Regulation requires review where a new fresh water ferry terminal entails construction of the facility by dredging, filling or other direct physical disturbance of greater than two (2) hectares of foreshore land,
- Forest and Range Practices Act: If tree clearing is necessary, a License to Cut is required before clearing can begin on Crown Land. A permit (Timber Mark) may be required to remove any merchantable timber from the site,
- Heritage Conservation Act: Permits for archaeological inspection and investigation would be required for soil excavation,
- Water Act & Water Act Regulation: Changes in and about a stream are required, therefore, a Water Act approval application will be required,
- Wildlife Act: Salvage permits for fish and wildlife as required,
- Environmental Management Act, Contaminated Sites Regulation: Contains requirements related to soil relocation and potential contamination in soil.

9 ARCHAEOLOGICAL OVERVIEW

9.1 Preliminary Field Reconnaissance

A Preliminary Field Reconnaissance (PFR), as defined by the British Columbia Archaeological Impact Assessment Guidelines (Apland and Kenny 1998), was conducted at the proposed Queens Bay North ferry terminal location. The full PFR is provided in Appendix E.

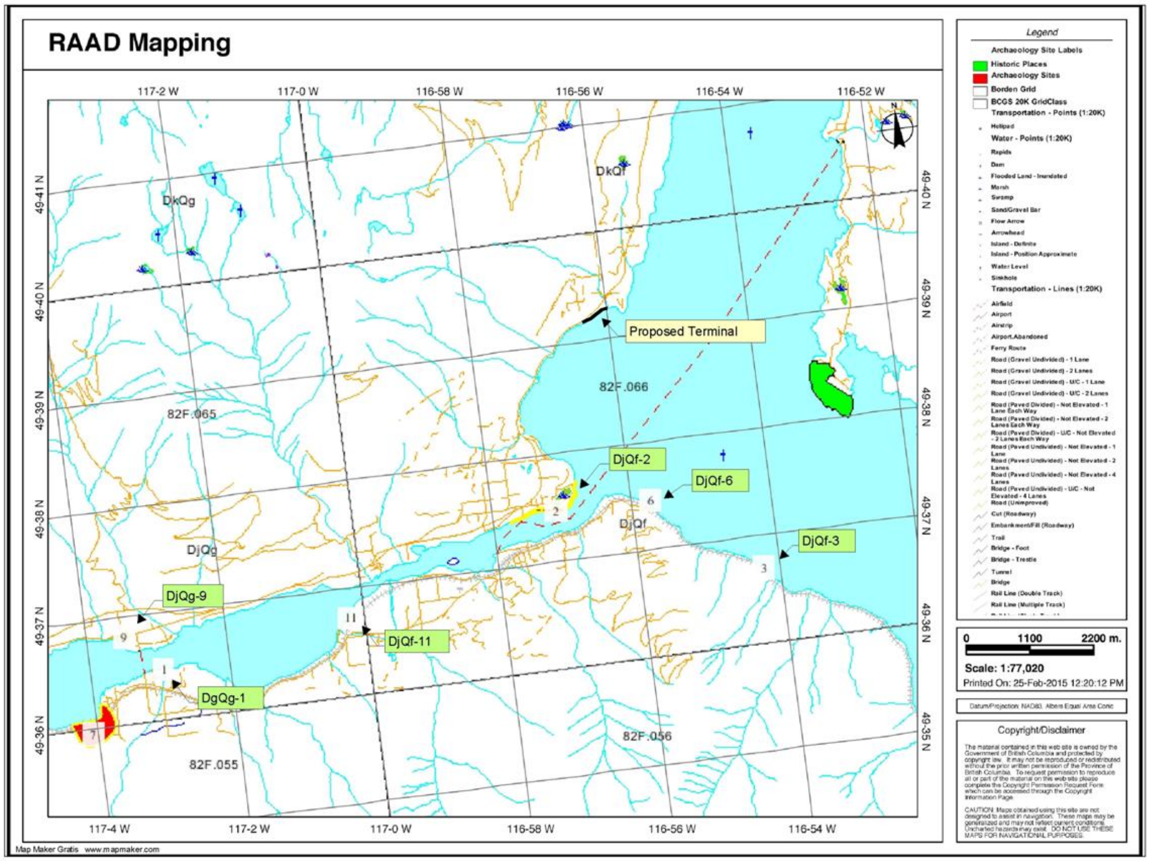
The PFR was conducted in order to assess the archaeological resource potential of the proposed development area, and to identify the need and appropriate scope of further archaeological field studies (if required). The PFR study was conducted without prejudice to First Nations treaty negotiations, aboriginal rights, or aboriginal title. According to the Provincial Consultative Area Database (CAD), the proposed development area is located within the claim area of the Secwepemc Nation, the Lower Similkameen Band, the Penticton Indian Band, the Upper Nicola Band, the Okanagan Nation Alliance, the Okanagan Indian Band, and the Ktunaxa Nation.

9.2 Desktop Review

Prior to the field assessment, an in-office review of archaeological, ethnographic, and historic materials pertinent to the proposed development area was conducted. The in-office review also included a search of the Remote Access to Archaeological Data (RAAD) system at the Archaeological Inventory and Mapping Section at the Ministry of Forests, Lands, and Natural Resource Operations for the presence of previously recorded archaeological sites located within and near the proposed development area.

The search revealed that no previously recorded archaeological sites are located within the proposed development area. However, numerous previously recorded archaeological sites have been identified in general proximity to the proposed development including the following sites DjQf-2, DjQf-3, DjQf-6, DjQg-1, DjQg-9, and DjQg-11 shown in Figure 20.

Figure 20 - RAAD Map Indicating Recorded Archaeological Sites and the Proposed Queens Bay North Ferry Terminal



9.3 Results of Archaeological Overview

Based upon the results of the literature review, the information provided in the proceeding, as well as an in-office map review conducted prior to the field assessment, the pre-field archaeological site potential assessment determined that the proposed development area has moderate to high potential for the presence of archaeological sites.

During the PFR survey, five clear elevated benches / breaks in slope which were assessed as having potential for the presence of buried archaeological deposits were observed. In addition, two talus slopes which have the potential to contain prehistoric burials were also identified.

Based on the results of the search of RAAD, the pre-field archaeological site potential assessment, the results of the Preliminary Field Reconnaissance survey, the known traditional usage of the general area, and the various areas and landforms with archaeological potential observed, it is author’s opinion that the proposed Queens Bay terminal and access road development should be subjected to an Archaeological Impact Assessment under a permit issued under Section 14 of the Heritage Conservation Act (1994).

9.4 Recommendations

It is recommended that:

- In advance of the detailed engineering phase of the project an Archaeological Impact Assessment is undertaken,
- Prior to the Archaeological Impact Assessment being conducted, all appropriate First Nations permits are applied for and received,
- The Archaeological Impact Assessment concentrate on the Areas of Concerns identified during the Preliminary Field Reconnaissance survey,
- A detailed surficial survey along the lake shoreline is undertaken,
- Subsurface testing as appropriate, based upon surficial findings, is conducted prior to any development taking place,
- The two talus slopes observed within the proposed development areas be systematically surveyed for the presence of prehistoric burials.

10 SEWAGE TREATMENT OPTIONS

A sewage treatment study was undertaken as part of this overall technical feasibility study. The sewage treatment study is provided in Appendix F.

The scope of the study involved a review of the options for the treatment of sewage generated by the ferry operations at the proposed Queens Bay North location.

10.1 Methodology

The sewage treatment study is a desktop report that primarily involves analyzing information about the ferry operation and applying current knowledge about sewage treatment options in the appropriate regulatory environment.

10.2 Options Summary

There are three (3) high-level sewage treatment options for the ferry operation listed below, and presented in detail in the report (Appendix F). Each option considers how to treat wastewater generated from both the vessel and the terminal. The options are as follows:

1. Don't treat wastewater, pump to truck for off-site disposal.
2. Treat wastewater on the vessel.
3. Treat wastewater at the terminal.

Brief consideration was given to a fourth option that involved the vessels pumping wastewater ashore and connecting the ferry terminal to the nearest municipal system. That type of solution has long-term benefits such as low operating costs, low risk to the environment, and operational reliability. However, in this case the significant distance to the nearest municipal system would result in significant capital costs that offset other potential benefits. This option was therefore not analyzed any further.

10.3 Recommendations

SNC-Lavalin recommends "Option #3 – Treat Wastewater at the Terminal". This option provides a long-term solution to the sewage treatment needs for the ferry operation, and does so with the least risk of all the options considered. In addition, the capital cost of this option is competitive with the option of treating wastewater on the vessel, and the operating cost is minimal when compared to the option of pumping wastewater to a truck.

11 CONCEPTUAL COST ESTIMATE (+/- 25%)

This capital cost estimate is for the development of Queens Bay North ferry terminal. The capital cost estimate is based on the conceptual design developed by SNC-Lavalin as presented in this report as follows:

11.1 On Shore Structures

The following on shore improvements are included in the design:

- Non-signalized intersection at Highway 31, however with underground ducting for future signalization if required,
- Three lane approach road to the 160 AEQ ferry traffic holding compound,
- Staff parking for approximately 15 vehicles,
- General public parking for 15 vehicles,
- Foot passenger drop-off and pick-up area and shelter,
- Washrooms,
- Sewage treatment plant,
- Signage, barriers, fencing & islands,
- Illumination,
- Power and water supply.

11.2 Marine Structures

The following on marine improvements were considered in the design:

- Dredging based on the assumption that dredging can be accomplished with a clam shell (not bedrock),
- Two-lane load / off-load ramp,
- Berthing structures to be a combination of fixed driven structures and floating leads,
- Tie-up (lay-over) berth.

11.3 Cost Basis

The conceptual cost estimate is based on:

- 2015 Canadian dollars, includes all applicable taxes as of 2015,
- Environmental approvals and any other approvals can be acquired with reasonable Environmental Compensation, and Stakeholder mitigation measures,
- Engineering including detailed geotechnical test holes required for the detail design is included,
- A contingency allowance is included to cover unforeseen conditions, and is based on the level of information at the time the estimate was prepared,
- No erratic market conditions, such as lack of bidders.

11.4 Exclusions

The cost estimate excludes:

- Capital financing costs,
- Property acquisitions, if necessary,

  - Please note that the conceptual design is within the existing Highway r/w.
- Removal of hazardous material, if encountered,
- Accelerated construction schedule (excess overtime premium),
- Decommissioning and / or conversion costs of the Balfour Terminal.

11.5 Project Costs (+/- 25%)

The project costs for the proposed Queens Bay North terminal have been estimated as indicated in Table 19 below. These costs are in 2015 Canadian dollars and are expected to be accurate to +/- 25%. A breakdown of these costs is provided in Appendix B.

Table 19 - Estimated Project Costs at Queens Bay North

SNC·LAVALIN Cost Estimate - Queens Bay North (± 25%)			
Description	**Roadwork & Holding Compound**	**Marine Structures**	**Total**
[redacted]			
Total	[redacted]		$25,000,000

11.6 Project Schedule

The anticipated project schedule timelines are:

Project Development – 6 months

- Stakeholder engagement
- Preliminary design and geotechnical investigation
- Archeological and environmental assessment

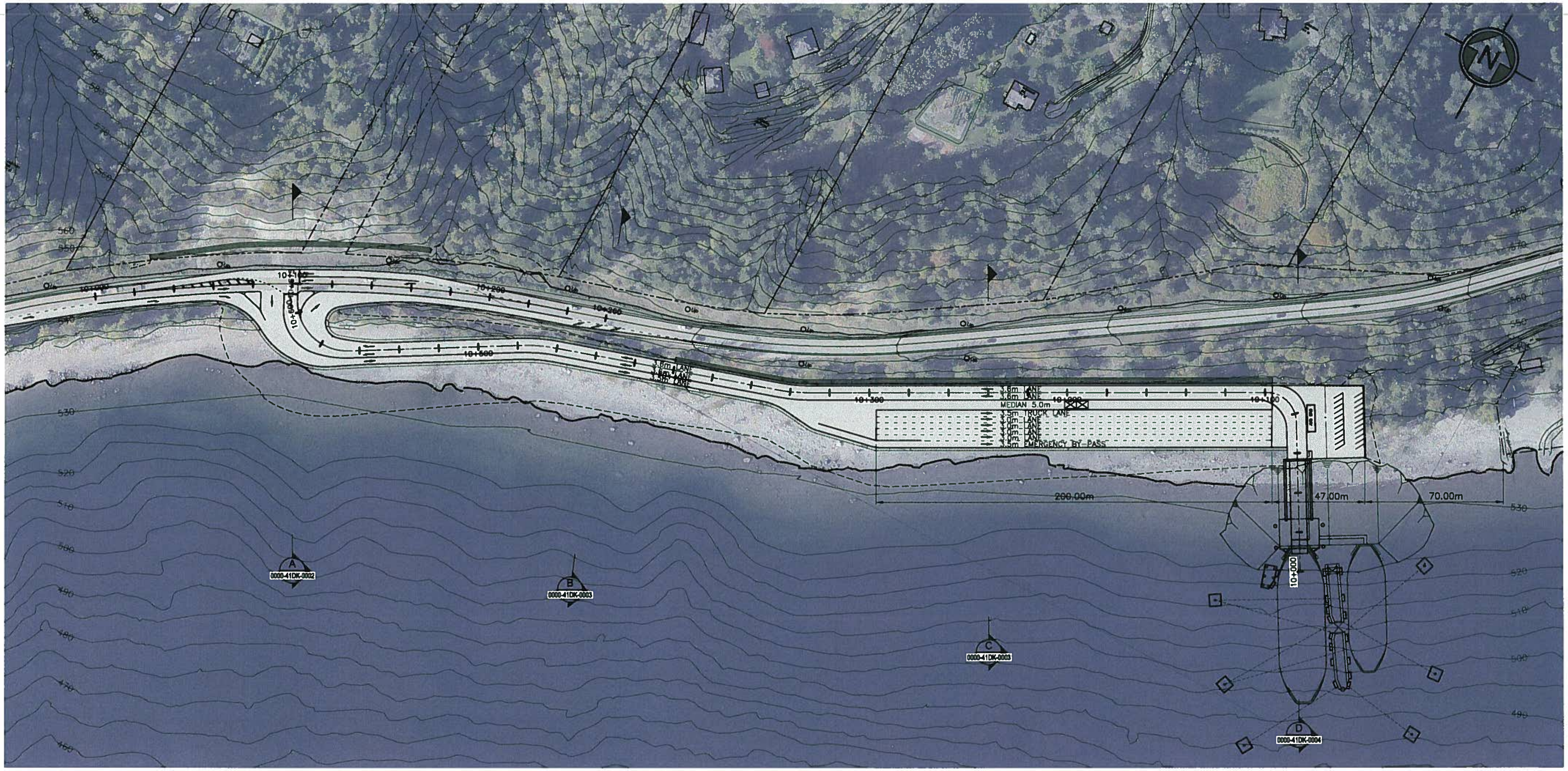
Design and Construction – 38 months

• Procurement the design	2 months
• Detail design & agency approvals	12 months
• Tender and Award	3 months
• Construction (2 summers)	21 months
• Total Project Schedule	38 months

Total Project Delivery Timeline **44 months**

DOCUMENT END

Appendix A – Preliminary Sketches



NOTES:

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2. TOPOGRAPHY IS FROM DRAWING "QueensBay_LiDARfromMOTI", RECEIVED FROM MINISTRY OF TRANSPORTATION & INFRASTRUCTURE ON FEBRUARY 13, 2015.
3. ALL DEPTHS ARE IN METRES AND ARE REFERENCED TO CVD 28. TO CONVERT TO CHS CHART 3050 1999 EDITION SHEET 6, SUBTRACT 529.742m.
4. HORIZONTAL DATUM IS GROUND LEVEL LOCAL COORDINATES. TO CONVERT FROM UTM TO GROUND LEVEL LOCAL COORDINATES, SCALE ABOUT 0,0,0 BY 0.99951875 THEN TRUNCATE NORTH BY 5,000,000.

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CHECKED: • T. TASAKA	
DATE: 2015/05/11	CLIENT
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CLIENT: BRITISH COLUMBIA — Ministry of Transportation and Infrastructure

PROJECT: BALFOUR FERRY TERMINAL RELOCATION PROJECT

TITLE: QUEENS BAY NORTH GENERAL ARRANGEMENT

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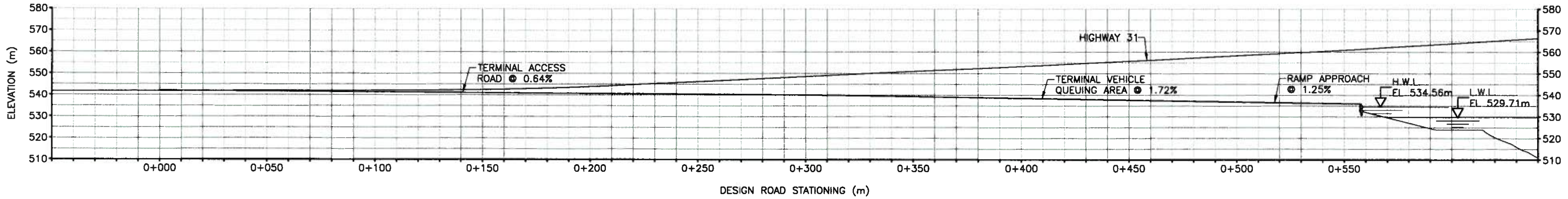

ROAD PROFILES - QUEENS BAY NORTH

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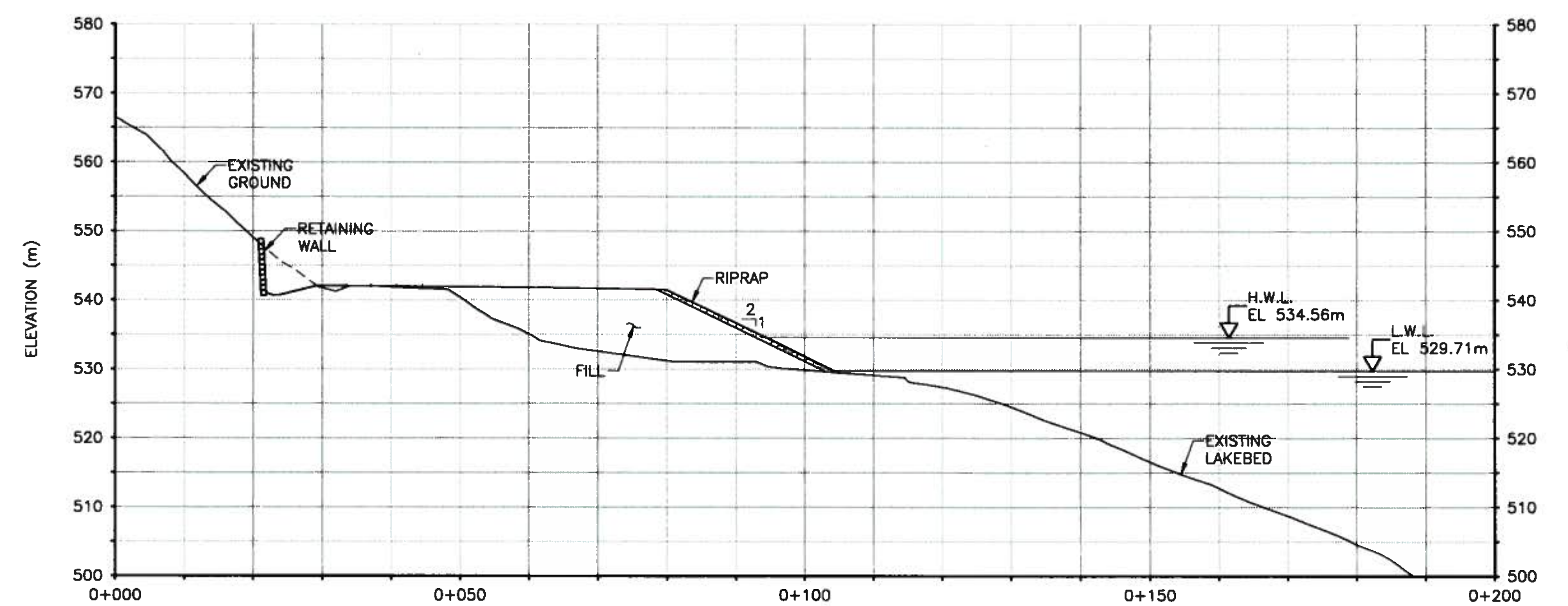

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PROJECT: BALFOUR FERRY TERMINAL RELOCATION PROJECT

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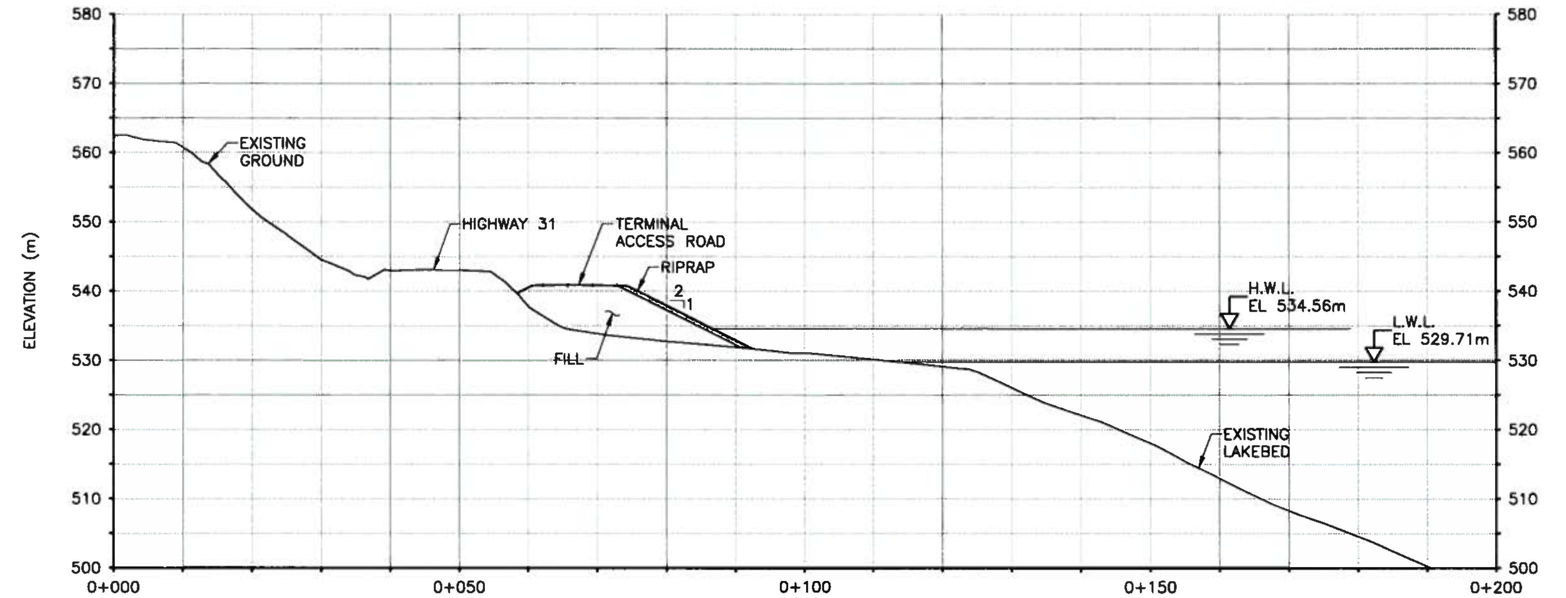

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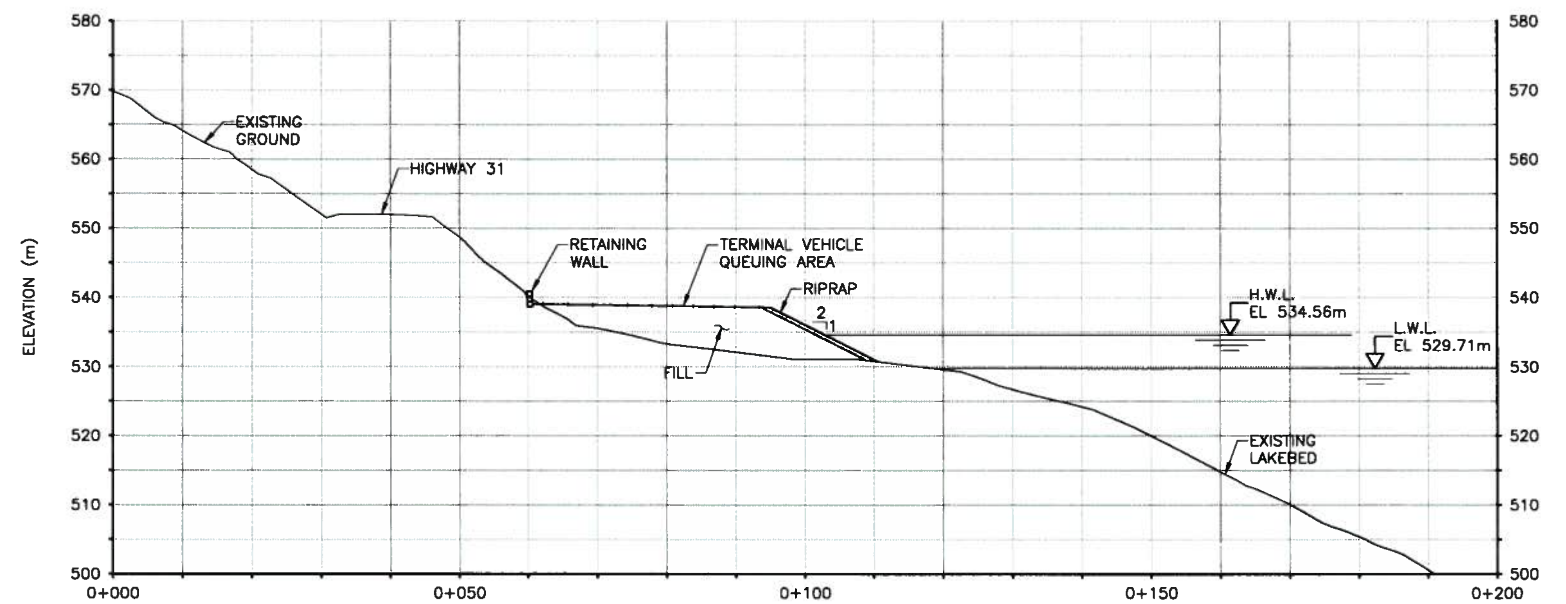

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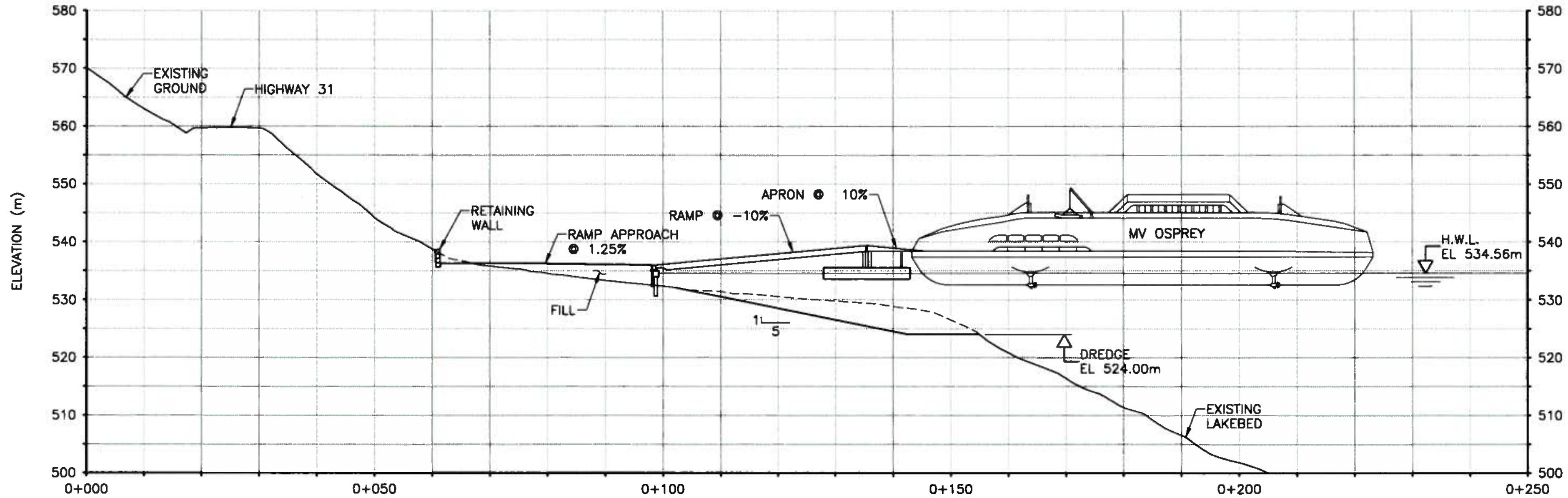

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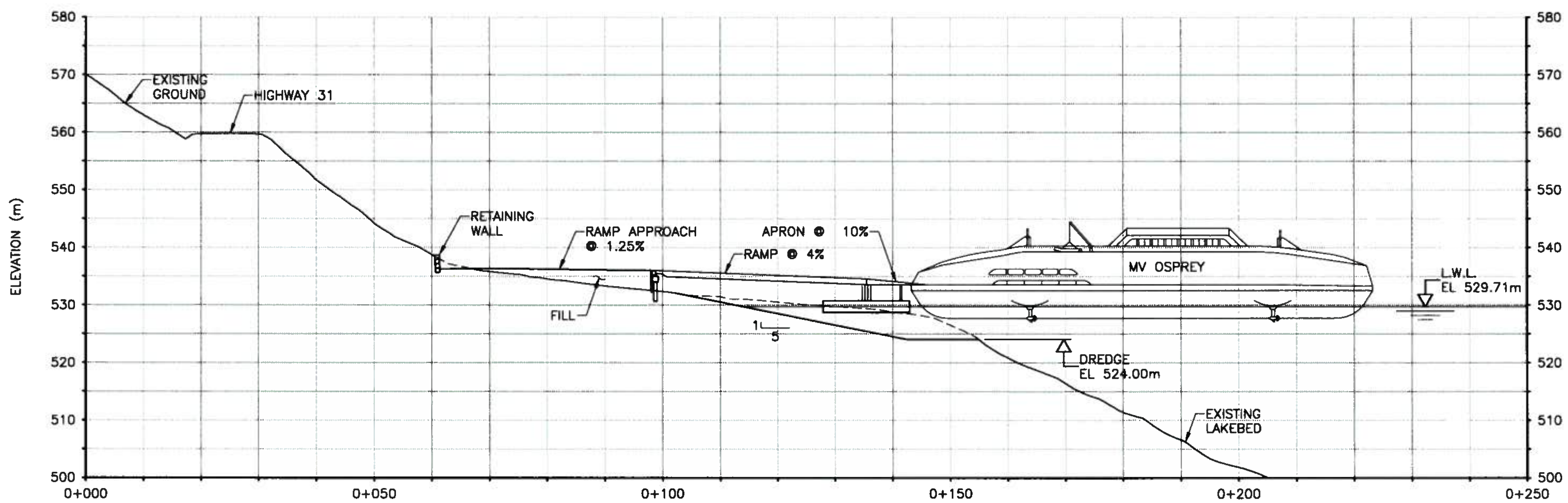

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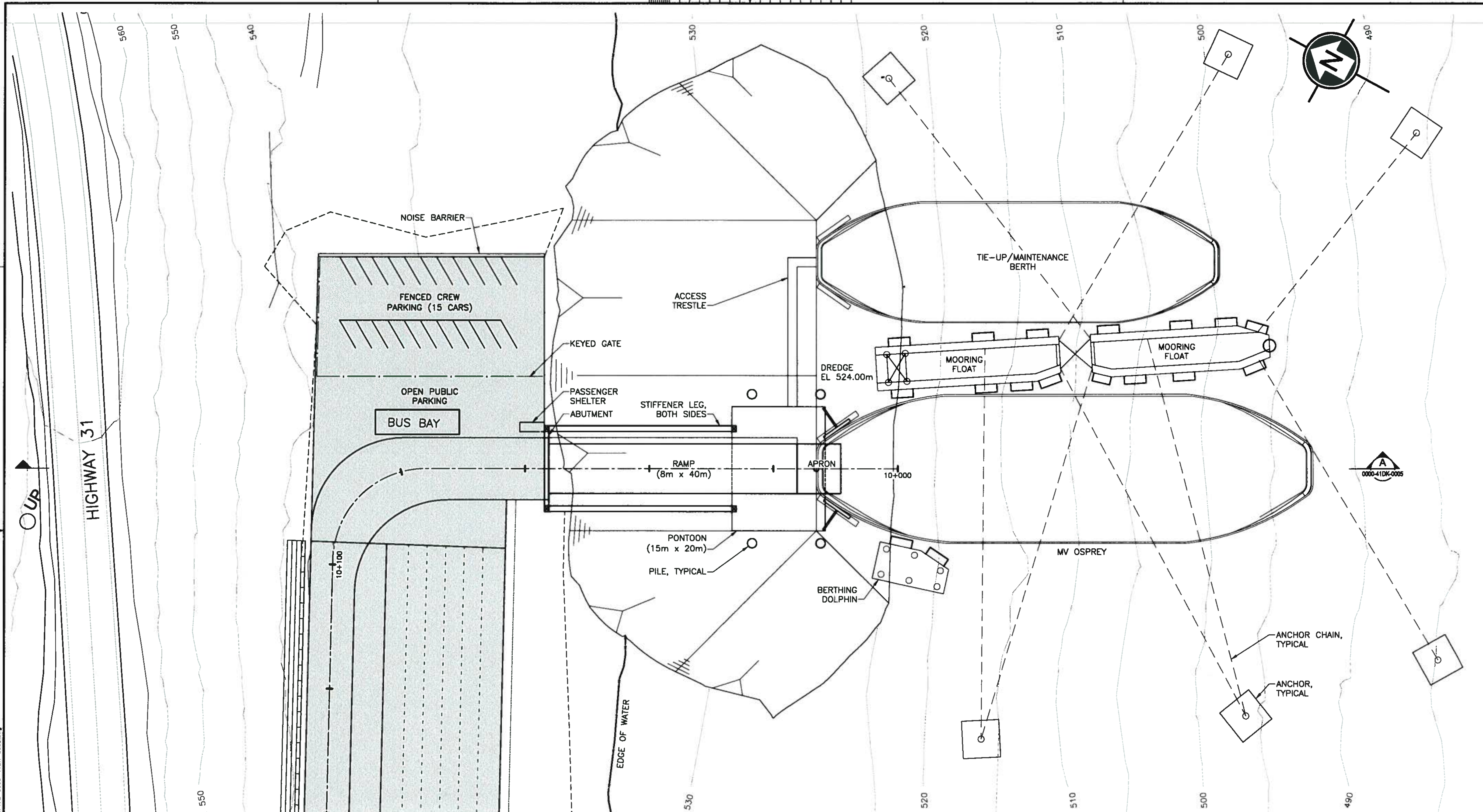

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PROJECT: BALFOUR FERRY TERMINAL RELOCATION PROJECT

TITLE: QUEENS BAY NORTH MARINE STRUCTURES GENERAL ARRANGEMENT PLAN

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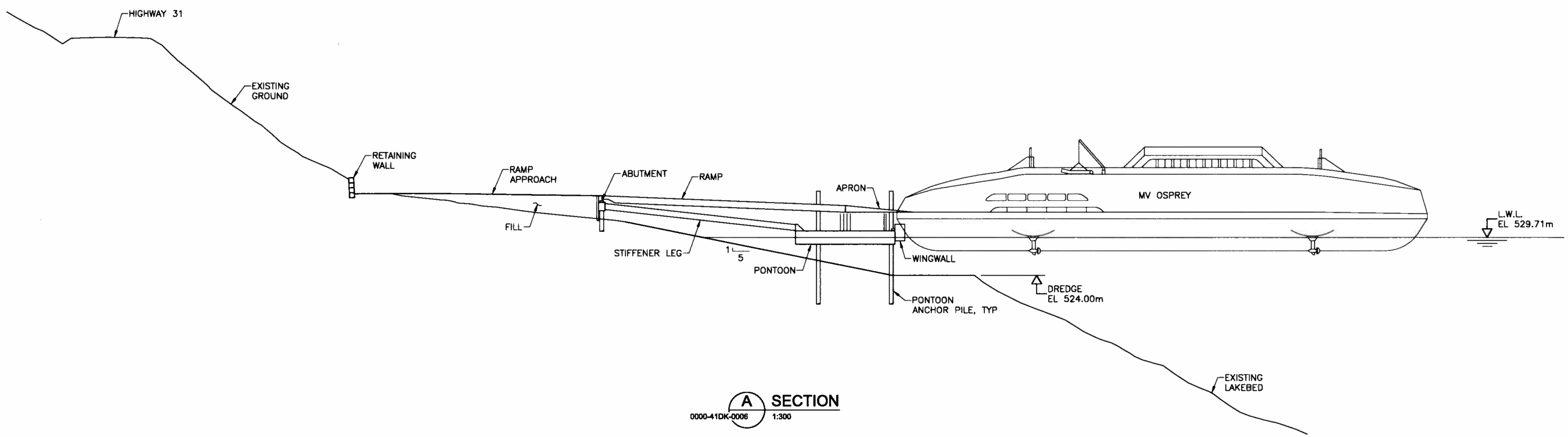

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DATE	2015/05/12	CLIENT
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CLIENT: British Columbia — Ministry of Transportation and Infrastructure

PROJECT: BALFOUR FERRY TERMINAL RELOCATION PROJECT

TITLE: QUEENS BAY NORTH MARINE STRUCTURES GENERAL ARRANGEMENT ELEVATION

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Appendix B – Conceptual Capital Cost Estimate

SNC·LAVALIN

ESTIMATE OF COST ($CAD)

627472 - Balfour Ferry Terminal Relocation Project - Queens Bay North

Ministry of Transportation and Infrastructure **DATE: June, 2015**

AREA: Summary of Costs **Queens Bay North**

		ITEM	DESCRIPTION	EST QTY	UNIT	UNIT RATE	TOTAL COST
			Summary of Cost Estimate				
							[redacted]
		1	Roadworks and Holding Compound				
		2	Marine Structures				
		3	Other Costs				

TOTAL: COST ESTIMATE:-		**25,000,000**

Cost Estimate Based On:-

- **Conceptual Study (+/- 25%)**
- **2015 Dollars**

SNC·LAVALIN

ESTIMATE OF COST ($CAD)

627472 - Balfour Ferry Terminal Relocation Project - Queens Bay North

BC Ministry of Transportation and Infrastructure **DATE: June, 2015**

AREA: Section 1 - Roadworks and Holding Compound Queens Bay North

		ITEM	DESCRIPTION	EST QTY	UNIT	UNIT RATE ($)	TOTAL COST ($)

[redacted]

SNC·LAVALIN

ESTIMATE OF COST ($CAD)

627472 - Balfour Ferry Terminal Relocation Project - Queens Bay North

BC Ministry of Transportation and Infrastructure — DATE: June, 2015

AREA: Section 1 - Roadworks and Holding Compound — Queens Bay North

		ITEM	DESCRIPTION	EST QTY	UNIT	UNIT RATE ($)	TOTAL COST ($)
		[redacted]				[redacted]	

ESTIMATE OF COST ($CAD)

SNC·LAVALIN

627472 - Balfour Ferry Terminal Relocation Project - Queens Bay North

Ministry of Transportation and Infrastructure **DATE: June, 2015**

AREA: Section 2 - Marine Structures **Queens Bay North**

		ITEM	DESCRIPTION	EST QTY	UNIT	UNIT RATE	TOTAL COST
[redacted]							

ESTIMATE OF COST ($CAD)

SNC·LAVALIN

627472 - Balfour Ferry Terminal Relocation Project - Queens Bay North

Ministry of Transportation and Infrastructure | **DATE: June, 2015**

AREA: Section 2 - Marine Structures | **Queens Bay North**

		ITEM	DESCRIPTION	EST QTY	UNIT	UNIT RATE	TOTAL COST

[redacted]

SNC·LAVALIN

ESTIMATE OF COST ($CAD)

627472 - Balfour Ferry Terminal Relocation Project - Queens Bay North

Ministry of Transportation and Infrastructure — DATE: June, 2015

AREA: Section 3 - Other Costs — Queens Bay North

		ITEM	DESCRIPTION	EST QTY	UNIT	UNIT RATE	TOTAL COST
[redacted]							

Appendix C – Metocean Report

TO:	Keith Dunbar (SLI)	**DATE:**	25/03/2015
C.C.:	John Readshaw (JSR, SLI); Grant Lamont (SLI)	**FROM:**	Philippe St-Germain
PROJECT:	625874-Balfour Berth Relocation Project	**MEMO NO:**	Rev. PA
SUBJECT:	Metocean Study – Wave Assessment	**DOCUMENT NO:**	627472-1000-41EN-0001

1. INTRODUCTION

This memorandum summarizes the results of the metocean study performed for the proposed relocation site of the Balfour Ferry Terminal on Kootenay Lake. The relocation site is referred to as Queens Bay North, and is shown in Figure 1.

Figure 1: Proposed Relocation Site of Balfour Ferry Terminal

2. VERTICAL DATUM

The Chart Datum (CD) for Kootenay Lake is the lowest recorded water level in the period of 1949 to 1959 and is 529.74 m above Geodetic Datum (CGVD28) [1]. The CD in the West Arm of the lake is different however.

3. METOCEAN ASSESSMENT

3.1 Wind

3.1.1 Available Wind Data

No wind data is available near the project site. The closest locations of wind measurement considered relevant are listed in Table 1 and are shown geographically in Figure 2. It should be noted that wind data is also available at Nelson Airport and Smallwood Creek near Taghum, located more than ~32 km west of the project site along the lake's West Arm. These two are not considered representative for the purpose of estimating wave heights at the project site.

Table 1: Summary of Kootenay Lake Wind Data Locations

Station ID	Station Name	Source	Location		Elevation Above Local Surface (m)	Time Interval	Coverage (YYYY/MM/DD)		
			Latitude (N)	Longitude (W)			Start	End	Total (yrs)
838	Akokli Creek[1]	BC Forest Service Protection Program	49.42833°	116.74417°	N/A	Hourly	2003/06/24	2015/01/23	12
380	Powder Creek[2]	BC Forest Service Protection Program	49.89361°	116.86892°	N/A	Hourly	2001/07/04	2015/01/23	14
114B1F0	Creston Campbell Scientific	Environment Canada	49.08169°	116.50068°	10	Hourly	1994/02/01	2015/01/23	21

Notes:
[1] Coordinates of Water Survey of Canada Hydrometric Station
[2] Location assumed at creek outlet

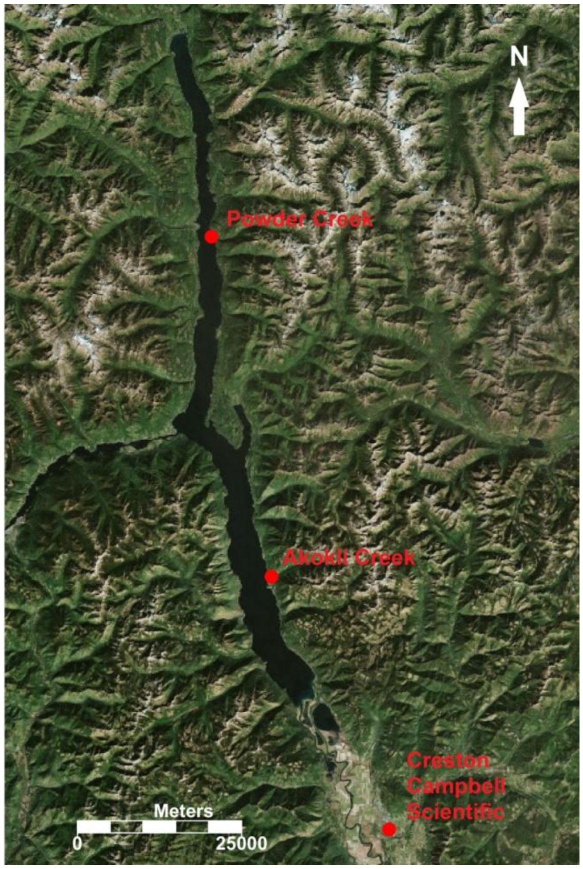

Figure 2: Location of Wind Measurements Considered for Metocean Study

3.1.2 Wind Regime on Kootnay Lake

Wind roses depicted in Figure 3 show that the stronger winds over Kootenay Lake are from southerly and northerly directions. It should be noted that overwater winds tend to be stronger than those experienced on land, on which all wind data locations considered for this study are located. The exposure of the anemometers is unknown. The exposure of an anemometer can have a larger influence on the wind measurements.

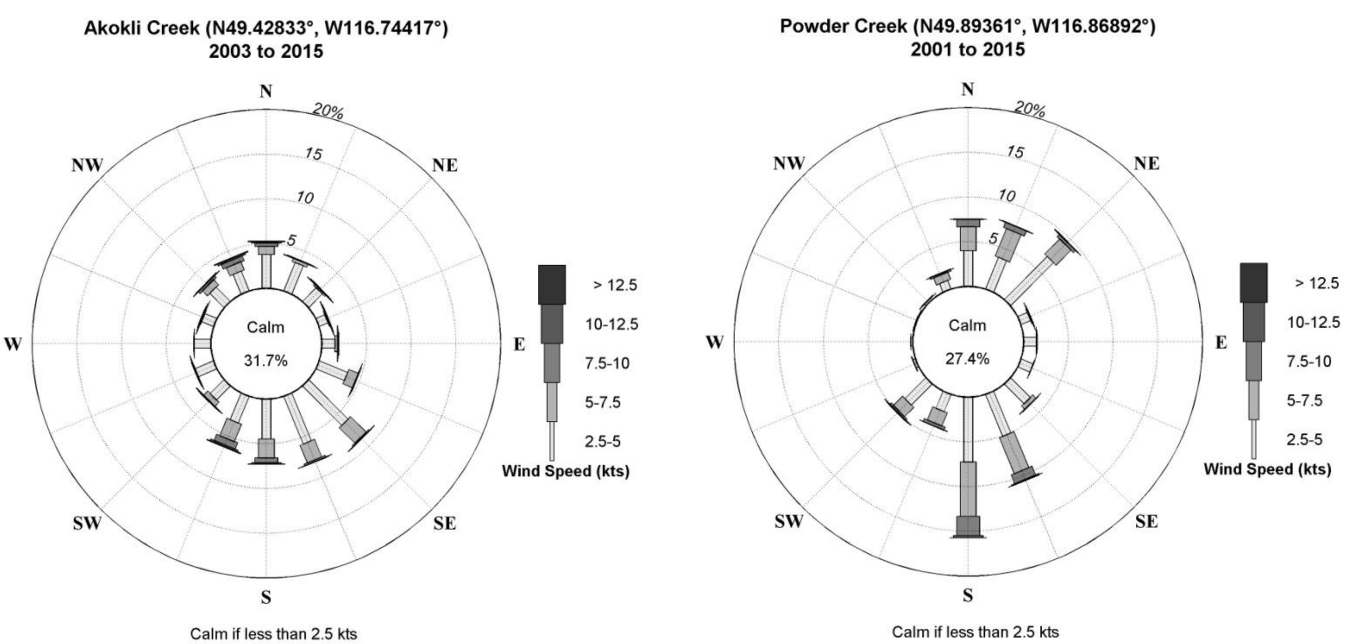

Figure 3: Wind Roses for Akokli Creek and Powder Creek

For the purpose of estimating wave heights at the project site, the Akokli Creek wind station was considered to be representative of the southerly winds blowing over the southern part of the lake. When wind blows from the north, the project site is considered to be predominately sheltered from the resulting waves that are generated in the northern part of the lake propagating to the south. Hence such condition was not considered for the estimation of the wave heights at the project site.

Statistical analysis, using "peak over threshold" methods, of the 12 years of hourly wind records at Akokli Creek was performed to determine the Average Recurrence Interval (ARI) of southerly wind events (Table 2). The ARIs were obtained by fitting the top 60 south sector wind events to a FT-1 (Gumbel) distribution as shown in Figure 4. The peak wind speed measure at the Akokli Creek wind station was 19.1 kts coming from 181° T on 26/08/2010 17h00.

Table 2: Average Recurrence Interval of Southerly Winds at Akokli Creek

ARI (yrs)	Wind Speed (kts)
1	15.7
2	16.5
5	17.5
10	18.3
20	19.1
50	20.1
100	20.8
200	21.6

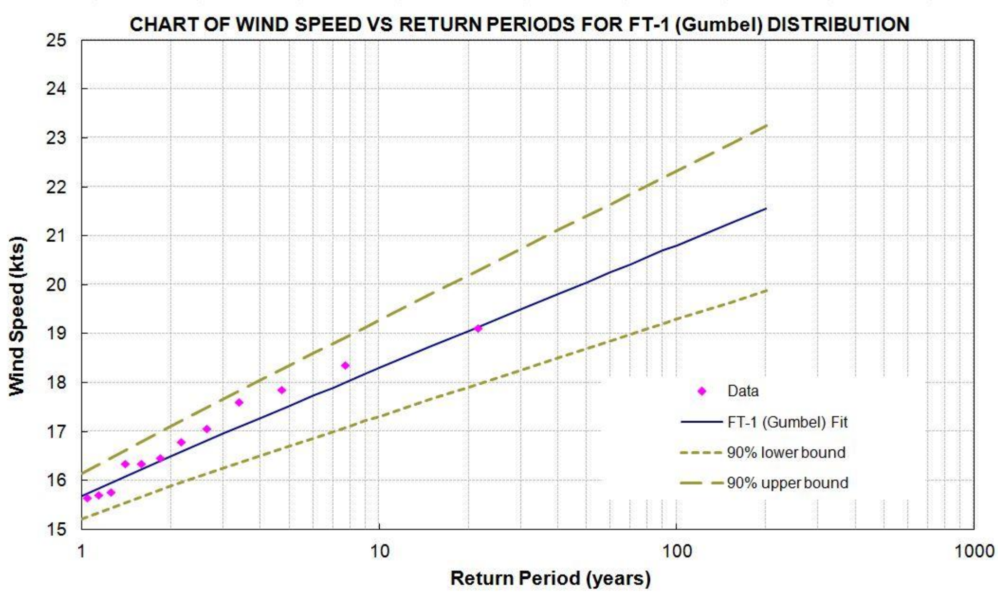

Figure 4: Fitted FT-1 (Gumbel) Distribution of Akokli Creek Winds

3.2 Water Levels

Water levels in Kootenay Lake are regulated from various dams. In Queens Bay, during the period of 1974-1994 after dam construction, maximum and minimum recorded monthly mean water levels are ~4.1m CD and ~0.3m CD, respectively [1].

More information on water levels in Kootenay Lake can be found in [1].

3.3 Currents

Wind induced surface currents could be minimally present at the Queens Bay North site but their definition is considered outside the scope of this assessment. According to [1], currents in Kootenay Lake, in particular the west arm of Kootenay Lake (where the exiting Balfour Ferry Terminal resides) can be influenced by dam operation.

3.4 Wave Climate

To estimate wave heights at Queens Bay North, a SWAN numerical model was developed using bathymetry digitized from [1]. Default SWAN modeling parameters were considered and the computational grid has a spatial resolution of 50m × 50m.

Based on the knowledge of the winds presented above, wave simulations were performed and the resulting sea states at the project site are provided in Table 3. These sea states are predicted in ~90m water depth at N49.65310° W116.92692°.

For sake of simplicity and to err on the conservative side, southerly wind was assumed to be blowing for a long duration (fetch limited) and in a single direction of 171° T over the entire lake. This direction is an average over the axis of the lake to the south, but may not reflect the actual fetch if the near surface wind follows the actual lake alignment.

Table 3: ARI Sea States at Queens Bay North Predicted by the SWAN Numerical Model

ARI	Wind Speed (kts)	Significant Wave Height- H_s (m)	Peak Wave Period – T_p (sec)	Wave Direction (° T)
2-yr	16	0.4	2.9	140
100-yr	21	0.7	3.8	141

The ARI wind speeds considered in Table 3 are believed to be low, potentially due to the Akokli wind station located on land and measuring wind speeds lower than overwater. For this reason, wave simulations were performed with higher wind speeds to provide guidance on wave heights that could be expected at the project site if these winds were to happen.

Table 4: Sea States at Queens Bay North Predicted by the SWAN Numerical Model for High Wind Speeds

Wind Speed (kts)	Significant Wave Height- H_s (m)	Peak Wave Period – T_p (sec)	Wave Direction (° T)
30	1.3	4.8	145
40	2.3	5.5	147
50	3.6	7.1	147

For the 30 kts wind speed, Figure 5 and Figure 6 show the wave field (i.e., spatial variation) predicted by the numerical model in Kootenay Lake and in the vicinity of the project site, respectively.

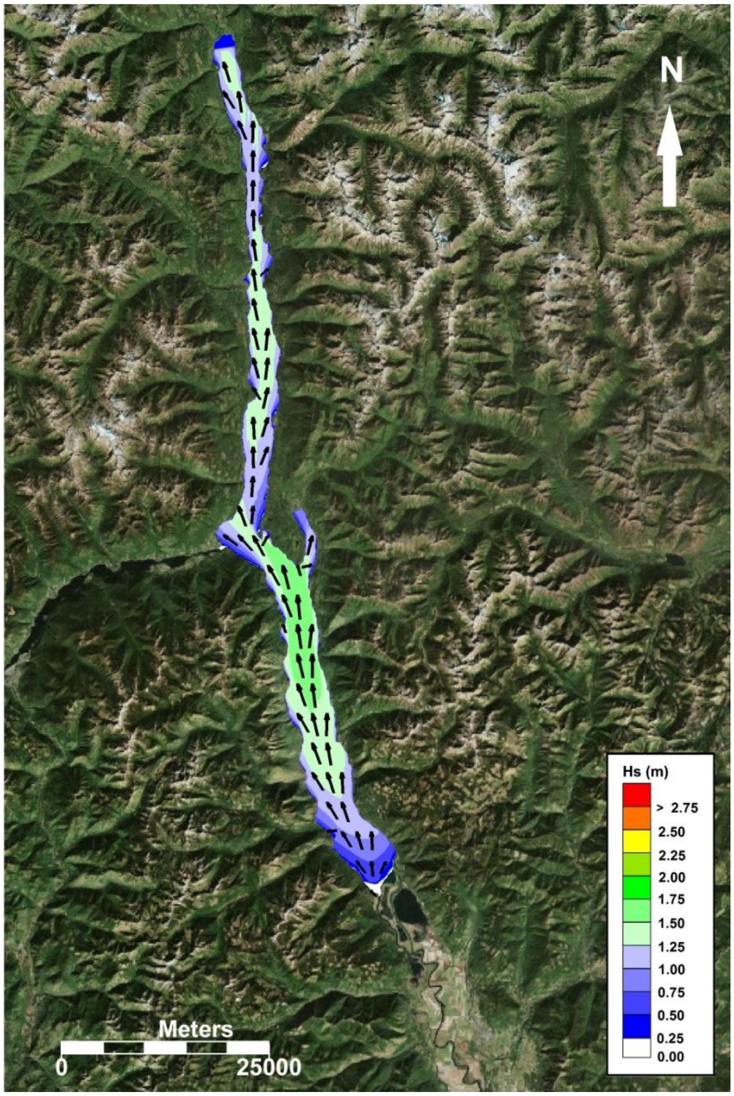

Figure 5: Wave Heights (colour contours) and Direction (black arrows) in Kootenay Lake resulting from 30 kts Southerly Winds

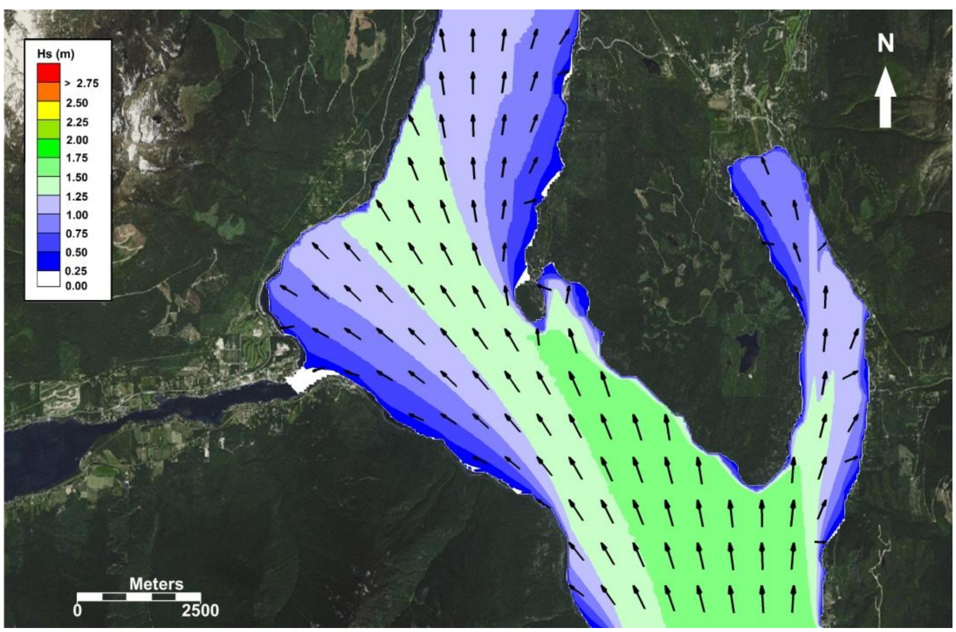

Figure 6: Wave Heights (colour contours) and Direction (black arrows) in the Vicinity of the Project Site resulting from 30 kts Southerly Winds

4. RECOMMENDATIONS

As the wave height predictions are highly sensitive to the definition of the overwater winds, is recommended that an anemometer be installed in the vicinity of Queens Bay North and wind measurements be collected for a minimum of twelve (12) months. Alternatively, more detailed orographic-based wind modeling could be performed. This data would provide for more confidence in the predicted sea states, given that the existing wind data (Akokli Creek) is approximately 25 km to the south.

Based on anecdotal evidence (personal communication between Keith Dunbar, SLI and the ferry Master) that maximum wave heights of ~2m can be observed (and common to have wave heights of 1.4 m), it is believed that winds measured at the stations considered for this assessment are under predicting overwater winds. This is likely a result of the exposure the existing anemometers and would have to be confirmed.

At this stage, for the purpose of navigation and safe berthing, a seastate at the project site of H_s = 2.3m with a T_p = 5.5 sec originating from 147º T is recommended for consideration.

5. REFERENCES

[1] Canadian Hydrographic Service (CHS), Chart 3050, *Kootenay Lake and River*, 1996 edition.

Appendix D – Environmental Report

ENVIRONMENTAL OVERVIEW ASSESSMENT

Kootenay Lake Ferry – Queens Bay Terminal

Feasibility Assessment

August 18, 2015
Project: Balfour Ferry Terminal Relocation Project – Technical Feasibility Study

Prepared For:

B.C. Ministry of Transportation and Infrastructure

SNC-LAVALIN INC.

Prepared By:

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Aquatic Biologist

Reviewed By:

Keith Dunbar, P. Eng.
Project Manager

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Drawings

- SNC-Lavalin Ports and Marine - Corridor Model
- SNC-Lavalin Ports and Marine - Queens Bay north plan dated March 31, 2015.

Site Photographs

1 INTRODUCTION

The Environment & Water business unit of SNC-Lavalin Inc. (SNC-Lavalin) was retained to conduct an Environmental Overview Assessment (EOA) to support the technical feasibility study being conducted for the Ministry of Transportation and Infrastructure (MoTI) at the Balfour, BC, Kootenay Lake inland ferry terminal. MoTI provides a vehicle and passenger ferry service on Kootenay Lake for public travel between Balfour Ferry Terminal and Kootenay Bay. The ferry service is provided by two vessels operated by Western Pacific Marine under a services contract with MoTI. The newer and larger vessel, the Osprey, operates year round, while the second provides additional capacity at times of peak usage. The travel time between Balfour to Kootenay Bay terminals, including loading a vessel, the lake crossing, and unloading is approximately 50 minutes and a round trip is one hour and 40 minutes.

The existing Balfour Ferry Terminal is located adjacent to Highway 3A near the entrance to the Kootenay Lake West Arm, along the north shore. As part of due diligence in considering capital expenditures for maintenance of the current Balfour terminal, options analysis for potential service improvements and facility upgrades are being considered. Operational considerations around the existing location include boat traffic, sediment depositional areas along the navigational corridor, inadequate vessel draft resulting in lakebed erosion and a 'sandblasting' effect on the vessel, aging infrastructure, and potential for a much reduced travel time with the terminal relocated north from Balfour to Queens Bay. (WorleyParsons, 2012) Specifically, the relocation of the western terminal from Balfour north to Queens Bay has proceeded from initial concept to the current feasibility level study being undertaken by SNC-Lavalin Inc.

2 ASSESSMENT SCOPE

This report summarizes the high level results of the desktop overview assessment following a site visit on February 3, 2015, based on available federal and provincial databases, and previously collected species and habitat information in the area. The assessment area is based on the existing concept study (WorleyParsons, 2012), with site observations influencing the current design configurations.

The site visit provided a confirmation of the extent of the area over which the Project footprint impacts were being considered, and assessment of impact centered on those areas. The site visit also allowed a high level review of the physical habitat in the project area, overview of winter wildlife signs, incidental nest observations from the previous season (e.g. raptors and songbirds), and a general indication of potential habitat values/sensitivities.

The objectives of the desktop assessment were to describe current (baseline) environmental conditions at the site, summarize high level impacts the Project might have on the baseline conditions and consider methods for mitigating or avoiding impacts. Information and data were collected through a desktop review of available ecological and regulatory databases and search engines including local, regional and federal government sites, as well as the site reconnaissance to observe conditions within the Project footprint and adjacent land uses that may be affected by the Project.

Specific objectives of the desktop assessment include the following:

- Summarize fish and aquatic information for the Site and surrounding areas, including historic and anecdotal information on potential fisheries values should impacted stocks recover.
- Summarize vegetation information for the Site and surrounding areas, including indicators for rare and endangered plant species and ecosystems as well as invasive plant species.
- Summarize wildlife information for the Site and surrounding areas, including known species occurrences and indicators for wildlife species at risk.
- Identify any environmental sensitivities, including wetlands, streams, and wildlife habitats that could potentially be utilized by species at risk and/or migratory birds.

In addition, the potential need for approvals prior to construction was considered, and environmental information was provided in support of applications for permits or approvals, where applicable.

Items **not** included in the scope of this EOA are:

- Detailed field studies including species specific surveys, plant sampling, fish sampling, fish habitat assessments or rare species investigations;
- Detailed environmental impact assessment;
- The assessment of cumulative effects of the Project;
- Consultation with First Nations, stakeholders and the public about the Project, and;

- Satisfying requirements of the *Canadian Environmental Assessment Act* (CEAA) or the *BC Environmental Assessment Act (*BCEAA*)* for environmental assessments, if applicable.

3 ASSESSMENT METHODOLOGY

The Project and its activities were evaluated to assess the potential environmental effects of the Project on the environment. The Queens Bay site is located in the Regional District of Central Kootenay (RDCK) at coordinates 116° 56' 29.8" W, 49° 38' 41.9" N. The following information was considered in the assessment:

- SNC-Lavalin Ports and Marine - Corridor Model and the Queens Bay north plan dated March 31, 2015.
- WorleyParsons (2012) document titled "Queens Bay Ferry Terminal – Concept Study", and
- Discussion during and following a February 3, 2015 site meeting.

A summary of the Project's baseline environmental setting was prepared using information from the desktop review and site visit. Environmental components included in the baseline setting include: soils and terrain; drainage, groundwater, and water quality; vegetation; wildlife and wildlife habitat; air quality; and land use and socioeconomics. The desktop EOA identifies and summarizes available information regarding the fish, wildlife and vegetation habitat occurring at the Site, with emphasis on fisheries, sensitive habitats and species at risk as defined in Schedule 1 of the federal *Species At Risk Act* (SARA) and the BC Conservation Data Centre (BC CDC). Federally listed species at risk are those species that are listed under the SARA, Schedule 1, as endangered, threatened or of special concern. Provincially listed species at risk are those species that are Red-listed (i.e., endangered or threatened) or Blue-listed (i.e., of special concern).

Baseline information and data were collected through a desktop review of available ecological and regulatory databases and search engines including local, regional and federal government sites, (e.g. iMap BC; Fish HabitatWizard; EcoCat; BC Conservation Data Centre (BC CDC); Species at Risk Public Registry (SARA); Regional District of Central Kootenay).

3.1 Regulatory Framework

Federal and provincial environmental legislation applicable to the Project is itemized in Table A below and discussed in the relevant sections of this document specific to proposed activities or impacts. It may not be an exhaustive list of all legislation which may be applicable to the Project as it is based on the concept design. Compliance with the Acts and regulations should be addressed by obtaining the required permits, licenses and approvals, through Project design and by applying mitigation and best management practices. These practices will be identified in the Construction Environmental Management Plan (CEMP) created for the Project.

Legislation governing property exchange or regarding property rights, such as BC's *Land Act*, have not been identified or described in this EOA.

TABLE A: Federal and Provincial Environmental Legislation Applicable to the Project

Regulatory Agency	Legislation or Regulation	Details of the Legislation or Regulation	Status
Federal			
Canadian Environmental Assessment Agency	*Canadian Environmental Assessment Act (CEAA 2012)*	*Regulations Designating Physical Activities* - Identifies the types of activities that are considered "designated projects" subject to the CEAA 2012 and the federal authority responsible for conducting environmental assessment.	The Project is not expected to meet definitions of *Designating Physical Activities*. The Osprey is well below the ship deadweight threshold value specified in CEAA 2012.
Fisheries and Oceans Canada (DFO)	*Fisheries Act*	Fisheries Protection And Pollution Prevention.	Serious Harm to Fish is anticipated requiring formal authorization and offsetting.
Environment Canada	*Species at Risk Act (SARA)*	*Sections 32 and 33* – For the protection of species listed in Schedule 1 of SARA as endangered, threatened or extirpated and their residences. To prevent wildlife species from becoming extinct and securing the necessary actions for their recovery.	Fish and wildlife species at risk occur in the regional Project area and may occur within the Project site. On private land and Crown Land the prohibitions of SARA apply only to aquatic species (listed as endangered, threatened or extirpated in Schedule 1 of SARA) and migratory birds (listed in the *Migratory Birds Convention Act* and Schedule 1). BC Best Management Practices also recommend that a rare plant and wildlife survey of the Project footprint be completed prior to construction, to identify, if present, any species at risk.
Environment Canada	*Canadian Environmental Protection Act (CEPA)*	Pollution prevention and the protection of the environment and human health in order to contribute to sustainable development.	All activities should adhere to the requirements of *CEPA*, including reporting requirements for environmental emergencies (i.e., accidental release of a substance). Applicable requirements should be addressed in a CEMP.

TABLE A (Cont'd): Federal and Provincial Environmental Legislation Applicable to the Project

Regulatory Agency	Legislation or Regulation	Details of the Legislation or Regulation	Status
Federal (cont'd)			
Environment Canada	*Migratory Bird Convention Act (MBCA) & Migratory Birds Regulations (MBR)*	*MBCA* Section 5.1 (1, 2) – prohibits the deposit of harmful substances into areas frequented by migratory birds. *MBR* Section 6(a) – Prohibits disturbing, destroying or taking a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird, or (b) have in possessing a live migratory bird, or its carcass, skin, nest or egg.	If tree and/or shrub clearing is required, a general bird nesting survey is required to confirm the absence of nests and nesting birds, particularly if clearing occurs during the migratory bird nesting period Proper containment and disposal of materials used on site should be addressed in a CEMP.
Transport Canada	*Transport of Dangerous Goods Act*	Governs handling or transportation of dangerous goods.	Requirements must be followed if substances listed in Schedule A of the Act are transported to/from the Site.
Transport Canada (Navigable Waters Protection Division)	*Navigable Waters Protection Act*	If a waterbody that will be affected is considered navigable, MoT must apply to TC NWPD for approval to undertake the project.	The Project impacts navigation of navigable waters or navigable waters themselves. Kootenay Lake is on the List of Scheduled Waters.
Provincial			
BC Environmental Assessment Office	*BC Environmental Assessment Act* (BCEAA) S.B.C. 2002 c. 43	*Reviewable Project Regulation* Part 8 defines reviewable transportation projects.	Review under the BCEAA is required where a new fresh water ferry terminal entails construction of the facility by dredging, filling or other direct physical disturbance of ≥ 2 hectares of foreshore or submerged land, or a combination of foreshore and submerged land, below the natural boundary of a water body.
Ministry of Forests, Lands and Natural Resource Operations	*Forest and Range Practices Act*	Division 2, Section 52(1) – A person must not cut, damage or destroy Crown timber unless authorized to do so.	Timber removal on Crown Land may be required for this Project. If tree clearing is necessary, a Licence to Cut is required before clearing can begin on Crown Land. All forestry (i.e., tree cutting) operations must comply with the *Forest and Range Practices Act*. A permit (Timber Mark) to remove any merchantable timber from the site would also be required.

TABLE A (Cont'd): Federal and Provincial Environmental Legislation Applicable to the Project

Regulatory Agency	Legislation or Regulation	Details of the Legislation or Regulation	Status
Provincial (cont'd)			
Ministry of Forests, Lands and Natural Resource Operations	*Forest and Range Practices Act*	Governs forestry related activities. A permit is required to burn timber and slash.	Not anticipated. If burning and slashing is planned, a permit (burning #) will need to be obtained.
Ministry of Forests, Lands and Natural Resource Operations	*Wildfire Act*	Section 3 - Prohibits starting a fire on, or within 1 km of, forest land or grass land, except in accordance with applicable legislation and regulation.	The CEMP should include measures to prevent uncontrolled burning.
Ministry of Forests, Lands and Natural Resource Operations	*Heritage Conservation Act (HCA)*	Section 13 - Protects heritage resources. Section14 - Permits for archaeological inspection and investigation.	Excavation work is planned as part of the Project; therefore an Archaeological Overview Assessment (AOA) would be required.
Ministry of Environment	*Water Act & Water Act Regulation*	Approval under Section 9 of the *Water Act* & Notification under Part 7 of the Regulation, both relating to changes in or about a stream.	Changes in and about a stream are required; therefore, a Water Act approval application will be required.
Ministry of Environment	*Wildlife Act*	Section 26 (1) - Prohibitions against hunting, taking, trapping, wounding or killing wildlife. Section 34 - Protects nests occupied by a bird, its eggs or its young. Subsection 34(b) protects the nests of selected raptor species year-round, regardless of whether they are occupied.	Construction personnel are prohibited from harming or taking wildlife as defined in Section 26 (1) and bird nests defined in Section 34. If vegetation clearing is required, a general bird nesting survey is required to confirm the absence of nests and nesting birds, particularly if clearing occurs during the migratory bird nesting period. BC Best Management Practices recommend minimum breeding season quiet buffer distances for active nests during the breeding season.

TABLE A (Cont'd): Federal and Provincial Environmental Legislation Applicable to the Project

Regulatory Agency	Legislation or Regulation	Details of the Legislation or Regulation	Status
Provincial (cont'd)			
Ministry of Environment	*Environmental Management Act*	Waste management, Hazardous Waste, storage and disposal.	Applicable requirements should be addressed in a CEMP.
Ministry of Environment	*Environmental Management Act, Contaminated Sites Regulation*	Contains requirements related to potential contamination in soil, groundwater or surface water at a property.	A Phase I Site Assessment has not been requested as part of the Project.
Ministry of Agriculture	*B.C. Weed Control Act*	Prevention of spread of noxious weeds as per Schedule A of the Weed Control Regulation.	Applicable requirements should be addressed in a CEMP.

4 SITE DESCRIPTION

General information about the Project site is summarized in Table B:

Table B: Summary of General Information

Item	Description
Property Description	
Owner:	Crown land.
Area:	The project footprint will be approximately 25,000 m^2 in a greenfield site. Queens Bay, Kootenay Lake.
Latitude & Longitude:	116° 56' 29.8" W, 49° 38' 41.9" N
Surface Cover:	Lake, foreshore and riparian.
Topography	
Project Surface Grade:	The Project area is the west shore and steep bank slopes of Kootenay Lake.
Elevation:	531 m above sea level[1].
Bedrock Geology:	Milford sedimentary limestone, slate, siltstone and argallite (iMap BC, 2015).
Nearest Surface Water:	Kootenay Lake (Watershed Code: 340) fish bearing; Unnamed stream crossing, unknown fish-bearing status, Ross Creek (Watershed Code: 340-212700) located north of the site, unknown fish-bearing status; Bridalveil Creek, (Watershed Code: 340-212600) located south of the site, unknown fish-bearing status (HabitatWizard, 2015).
Regional Groundwater Flow:	The regional groundwater is inferred to flow southeast based on topography and surface water patterns (BC Water Resources Atlas, 2015).
Groundwater Wells:	The MoE water well database indicates three drinking water wells located within 500 m of the Project area, two upslope at Ross Creek and one at Bridalveil Creek (iMap BC, 2015).
Terrestrial	
Biogeoclimatic Zone:	Interior Cedar Hemlock dry warm – West Kootenay Variant (ICHdw1). (CDC, 2015)

[1] http://webapp.fortisbc.com/lakelevel/lakes.jsp

5 BASELINE CONDITIONS AND EFFECTS ASSESSMENT

5.1 Soils and Terrain

5.1.1 Baseline Conditions

General information on bedrock geology is provided in Table B, Section 4.

The proposed Queens Bay North site is located on vacant Crown land between Highway 31 and Kootenay Lake. The majority of the site consists of low gradient shoreline at the toe of the slope at the edge of Kootenay Lake. The shoreline of Kootenay Lake Main Arm generally consists of narrow, rocky beach and rocky bluff shoreline, with moderate to steep sloping habitat accounting for 86% of the shoreline (Ecoscape, 2011). Approximately 80% of the Kootenay Lake Main Arm is considered to be in natural condition (Ecoscape, 2011).

Additional watercourse features within the project site included a small stream and seepage/wetland area. The bank between Highway 31 and the beach may have had previous influence of grading, cut and fill during historic road construction. The riparian/upland area between the road and shoreline was vegetated with young mixed forest, with vegetation mowing apparent along the upper bank slope. No signs of instability were observed downslope of Highway 31; however, evidence of upslope instability was observed consisting of ravelling and possible shallow slumping.

5.1.2 Project Effects on Soils and Terrain

Impacts to soil and terrain from the proposed terminal relocation construction are related to extensive fill area ranging between approximately 30 m to 50 m width over a distance of approximately 570 m along the foreshore. The new location would also require limited vegetation clearing, one watercourse crossing, installation of pilings, and dredging of the lake bottom to allow the vessel to access closer to shore. Combined footprint area of the project is anticipated to be at least 25,000 m^2. This would add to the total existing substrate modifications from all transportation land uses accounting for 15% of the Kootenay Lake shoreline (Ecoscape, 2011).

Additional impacts to soils and terrain could occur during construction related to direct surface disturbance, increased erosion potential, compaction and rutting of the land surface, and the development of instability features. Potential effects on soils and terrain include the potential for increased soil erosion as a result of site clearing and soil exposure. Excavations will further expose soil to precipitation and wind, both of which can accelerate surface erosion.

Soil disturbance near the watercourse crossing and the lake shore can increase the risk of sediment entering into fish bearing habitat. Erosion leads to an increase in the sediment load of surface water, which in turn degrades water quality and downstream fish habitat. The introduction of sediment into a watercourse providing fish habitat or nutrients to fish habitat is a contravention of the federal *Fisheries Act*.

An accidental spill during or after construction (e.g., release of vehicle fluids: gasoline, diesel, oil) associated with machinery, equipment and traffic has the potential to impact soils and terrain, and ultimately wildlife and vegetation. Spills and leaks during construction are most likely to occur from poorly maintained machinery and equipment. Once the ferry terminal is in operation, there is potential for fluid leaks from parked vehicles causing contamination impacts to soil in the terminal. Road runoff and potential impacts to soils from erosion or pollutants carried off the impervious area drainage will need to be addressed in planning.

Sanitary and septic requirements and potential impacts to soil and groundwater are being considered in a separate document.

5.1.3 Mitigation Measures

Potential effects during construction can be minimized by mitigation measures and best management practices (BMPs). Site isolation, timing the construction works during low lake level, and the implementation of appropriate erosion and sediment control measures should be effective in mitigating risk of sedimentation of fish bearing waters adjacent to the works. Due to the location and the majority of fill being placed into seasonally wetted fish habitat, a comprehensive CEMP will be required and should be considered as part of the environmental approvals information requirements. With soil removal and import fill, there will need to be compliance with the *Environment Management Act,* and Contaminated Sites Regulation pertaining to the import/export of fill.

The effect of spills and leaks on soils and terrain can be avoided or mitigated by good site management and spill prevention programs during all stages of the Project. These programs will help prevent any accidental release of pollutants (garbage, concrete product, lubricant and fuel spills) or siltation from erosion run-off.

5.2 Aquatic Habitat, Drainage, Groundwater and Water Quality

5.2.1 Baseline Conditions

<u>Kootenay Lake</u>

Kootenay Lake lies in the lower Kootenay River drainage system between the Selkirk and Purcell Mountain ranges near the confluence with Columbia River. The main lake is 107 km long, approximately 4 km wide with a mean depth of 94 m and a maximum depth of 154 m (Daley et al. 1981). The lake is referenced as three sections, the North Arm fed by the Lardeau and Duncan River systems, the South Arm fed by the Kootenay River, and West Arm at the outlet of the main lake, near the community of Balfour. The West Arm is about 40 km long with a mean depth of 13 m, and is separated by a distinct boundary from the main lake by a sill that lies at a depth of approximately 8 m (Andrusak and Andrusak, 2011). It is physically and limnologically different from the main lake, comprised of a series of shallow basins interconnected by narrow riverine sections flowing westerly and becoming the lower Kootenay River (Andrusak and Andrusak, 2011).

The South Arm of the lake receives 56% of the entire inflow to the lake via the Kootenay River drainage, and represents over 60% of the entire lake surface and volume. The remainder enters the lake directly from smaller tributaries, and the Lardeau/Duncan River systems which contribute 21% of inflow (Daley et al. 1981, Binsted and Ashley 2006 in Andrusak and Andrusak 2011).

The Kootenay River drainage originates on the western slopes of the Rocky Mountains in eastern BC and flows southwest to Canal Flats, BC, where it enters the Rocky Mountain trench and flows south into Montana. Downstream of the Libby Dam in Montana there is a natural waterfall (Kootenai Falls) that represents a barrier to all upstream fish movement. Below the falls the river flows west through Northern Idaho to Bonners Ferry where it turns north to flow into the South Arm of the lake near Creston, BC (Andrusak and Andrusak, 2011). The river drops in elevation from 2,200 m at the headwaters to 532 m at the confluence of Kootenay Lake. Downstream of the West Arm there is a natural barrier at Bonnington Falls, in addition to a series of four dams isolate fish in Kootenay Lake from other populations in the Columbia River basin.

Kootenay Lake has been subject to significant recent ecological changes from upstream hydroelectric developments during the 1960s and 1970s, unregulated discharge of phosphorus and other impacts from mining developments (Andrusak and Andrusak 2011). These impacts caused changes to fish populations that have been well documented (Northcote 1973; Daley et al. 1981; Ashley et al. 1997; Schindler et al. 2011; Utzig and Schmidt 2011; Andrusak and Andrusak 2011). Lake fertilization commenced to address upstream reservoirs that retained nutrients which had adversely impacted lake productivity which impacted fish populations (Ashley et al. 1997; Schindler et al. 2011).

Queens Bay is an approximately 3 km wide bay situated on the west shore of Kootenay Lake between McEwen Point and the entrance to the West Arm of Kootenay Lake.

Impacts to Kootenay Lake aquatic and foreshore habitat from the proposed terminal relocation construction are primarily displaced habitat due to extensive fill area ranging between approximately 30 m to 50 m width over a distance of approximately 570 m along the foreshore. The new terminal location would also require limited vegetation clearing, one watercourse crossing, installation of pilings and dredging of the lake bottom to allow the vessel to access closer to shore. Combined footprint area of the project is anticipated to be at least 25,000 m^2.

Unnamed Stream Crossing in Queens Bay North

Several small, steep gradient watercourses enter Queens Bay from the upslope hillside. The proposed access location to the terminal would require crossing a small unnamed stream. No previous information was found in online fisheries data or mapping for the watercourse.

Observations from the site reconnaissance indicate that the 5% gradient braided channels flowing across the gravel beach would be accessible to fish. The culvert crossing under Highway 31 was observed to be perched with minimal plunge pool, and would be an obstacle that would be potentially only passable at certain combinations of flow and lake levels.

Upstream of Highway 31, the channel appeared to be less than 20% gradient where roadside ditches entered the channel from the north and south. Topographic data indicates the gradient increases to over 20% approximately 60 m upstream of the highway, though there are low gradient reaches indicated farther upstream.

The extent of fish habitation is unknown at this time, but within at least the footprint area of the proposed access road, the stream is fish bearing. While cover habitat was observed to be lacking where the stream flows across the beach, there is potential the watercourse provides suitable habitat (e.g. juvenile rearing, upstream migration, very limited spawning potential) to some of the assemblage of fish species recorded for Kootenay Lake.

The Project scope has not yet indicated stream crossing design to indicate anticipated footprint impacts, but at very least the low gradient braided channels through the gravel beach will be enclosed in a crossing structure. Widening of Highway 31 to accommodate a southbound left turning lane may require encroachment and possible lengthening of the culvert on the upstream side of the highway crossing.

Bridalveil Creek

This stream flows into Queens Bay south of the proposed area for the terminal structures. No previous information was found in online fisheries data for the watercourse. Topographic data indicates channel gradients average 18% from the lake edge upstream for approximately 230 m before increasing to a sustained >20% gradient (RDCK mapping). There are no apparent low gradient reaches farther upstream. The Fish Stream Identification Guidebook (BC MoF, 1998) suggest 20% gradient as a cutoff when assuming fish presence. Based simply on gradient, there is potential salmonids could inhabit the lower reach of Bridalveil Creek for at least 230 m upstream of the lake.

Ross Creek

This stream flows into Queens Bay north of the proposed area for the terminal structures at McEwen Point, and is crossed by the existing Queens Bay Wharf Road. No previous information was found in online fisheries data for the watercourse. Topographic data indicates the channel gradients averages 23% from the lake edge upstream for approximately over 200 m before decreasing on a bench area upslope of the highway (RDCK mapping). With low gradient reaches upstream of the Highway 31 crossing, presence of salmonids would be assumed in Ross Creek until a sufficient sampling program was undertaken to indicate otherwise.

Other Water Resources

No subsurface drainage structures or water wells were identified at the proposed terminal location; however, there were three water wells located within 500 m of the Project area (iMapBC, 2015). The two licensed wells on Ross Creek (Ross Creek and Bashford Spring) are at the approximate 500 m limit and upgradient of the Project site. The one remaining water licence is a domestic point of diversion on Bridalveil Creek, within 500 m. The regional groundwater is inferred to flow southeast based on topography and surface water patterns (iMapBC, 2015). Given the locations and topography, it is unlikely that the Project would have an impact on the adjacent water licences.

5.2.2 Project Effects on Aquatic Habitat, Drainage, Groundwater and Water Quality

Direct impacts to water quality, groundwater and surface water habitat quantity and quality will need to be quantified for appropriate mitigation/offsetting planning.

Impacts to Kootenay Lake aquatic and foreshore habitat from the proposed terminal construction in Queens Bay North are primarily associated with displaced habitat due to the extensive fill area ranging between approximately 30 m to 50 m width over a distance of approximately 570 m along the foreshore. The new terminal location would also require limited vegetation clearing, one watercourse crossing, installation of pilings, and dredging of the lake bottom to allow the vessel to access closer to shore. The combined footprint area of the project is anticipated to be at least 25,000 m^2. This level of impact will require a robust mitigation and probable formal offsetting plan, with Authorization under the federal *Fisheries Act* as well as Approval under the provincial *Water Act*. Communication with Fisheries and Oceans Canada (DFO) and provincial biologists should be initiated early in the planning process for discussion of potential mitigation and offsetting options if the project proceeds to design stage.

Impacts to available habitat and fish access will need to be considered at the unnamed stream crossing.

Construction of the Project could alter the function of the seepage area wetting and drying cycles. The greatest potential impacts to water quality relate to surface water flow from construction activities. Exposing soils to erosional forces (i.e. from excavations, road/crossing construction, etc.) can increase the sediment introduced into the surrounding surface water, which can have a potentially detrimental impact to water quality. Also, the presence of heavy equipment during construction increases the possibility of introducing lubricants and fuel onto soils or into surface overland flow that could impact downstream fish habitat. In addition, there is the potential to be working in a wetted stream for the construction of the access road and installation of the culvert, which could impact downstream fish habitat.

Overall, the Project impacts on local and regional drainage patterns are anticipated to be moderate to low, based on the footprint area encroachment and if mitigation measures and BMPs are implemented. Project sanitary and septic requirements and potential impacts to ground or surface water are being considered in a separate document.

5.2.3 Mitigation Measures

The CEMP will provide appropriate mitigation measures to avoid or mitigate potentially adverse construction effects on drainage patterns and water quality. Impacts to habitat will require a habitat offsetting plan and DFO project review.

The following categories of measures to mitigate potential construction effects on drainage and water quality will need to be considered in the CEMP:

- Planning centered on impact avoidance where possible, mitigation or offsetting impacts where it is not possible;
- Planning for staging and timing to minimize the adverse effects of weather, lake levels and species timing windows;
- Working from land or barge to minimize equipment tracking in aquatic or riparian habitat;
- Preparing and implementing a Spill Prevention and Emergency Response Plan (SPERP);
- Applying appropriate erosion and sediment control techniques (e.g., site isolation, covering exposed soil, installing silt fences, etc.);
- Retaining riparian habitat or salvaging topsoil and riparian vegetation for use in riparian habitat restoration of disturbed or exposed soils; and
- Habitat construction and enhancement.

Adopting good site management and pollution prevention programs during all construction stages of the project will avoid impacting soils, and in turn groundwater or surface water, by preventing accidental release of pollutants (e.g., concrete, lubricant and fuel spills).

A riprap armoured bank at a stable slope has been proposed for the infill area. The footprint area could be reduced with different retaining wall techniques; however, doing so would reduce the suitability for habitat value to fish and wildlife passing the terminal along the shoreline at most lake levels. A rock armoured bank below high water mark is analogous to the rocky banks observed at headland areas along the lake shore. Void spaces allow some level of hiding and resting cover to fish and wildlife. Topsoil grouting and revegetation above high water mark (i.e. vegetated rip rap) would be possible. Adding rock spurs and shallow water benches for constructed habitat features would be potential impact mitigation techniques, though there would be a need for additional encroachment into the wetted area of the lake. The value of the habitat at the seepage area will need to be considered with further field assessment, which will determine the type and level of mitigation/offsetting required.

The impact from crossing of the unnamed watercourse could be reduced with a suitably sized open bottomed structure. Planned accordingly, the crossing could also serve to allow wildlife crossing and maintain connectivity along the riparian habitat of the lake. Fish passage to cross Highway 31 could be enhanced by construction works to eliminate the jump height of the perched culvert.

5.3 Fisheries

5.3.1 Baseline Conditions

Online fisheries data indicates that Kootenay Lake contains 22 species of fin fish, and reportedly at least one shellfish, a freshwater mussel (HabitatWizard, 2015; Moore and Machial, 2007). The BC CDC lists data for fish species at risk, which were assessed as a desktop exercise, cross referencing each species life requisite with the Project area's habitat quality.

Fish habitat within the vicinity of the Project area consists primarily of littoral zone rock and cobble dominant beach on the North Arm of Kootenay Lake, riparian and seepage interface area during high water, and a deep open water lake. There is also the small unnamed stream which is considered fish-bearing within the Project footprint area. Different varieties and life stages of fish utilize the above mentioned habitat types. Generally, the site would be considered to function as rearing habitat, though there is also limited potential for spawning habitat. The unnamed stream within the Project site could contain Bull Trout, Rainbow Trout, or Cutthroat Trout above the Highway 31 crossing. The culvert would likely be an obstacle to upstream fish migration to the other fish potentially inhabiting Kootenay Lake.

Recreational Fishery Species

Within the Kootenay Lake North Arm the recreational fishery species would primarily consist of the salmonid species: Kokanee (*Oncorhynchus nerka*), Bull Trout (*Salvelinus confluentus*), Rainbow Trout (*O. mykiss*), in addition to other salmonids such as Cutthroat Trout (*O. clarki*). These fish in the North Arm would be considered adfluvial, with fish leaving the lake for stream spawning, occurring either in the spring or fall, depending on the species life history. However, there are a total of eight species or subspecies of salmonids documented, four cyprinids (minnows), three cottids (sculpin), two catostomids (suckers), and several other introduced fish (HabitatWizard, 2015).

Kokanee are a key species in to the Kootenay Lake fishery both directly and indirectly. The piscivorous species of fish in Kootenay Lake are highly dependent on Kokanee as their primary food source. The impacts from hydro-electric impoundment have had significant negative consequences to Kokanee stocks on Kootenay Lake over the past few decades (Ashley et al. 1997;Schindler et al. 2011) resulting in a cascading effect on the piscivorous populations (Andrusak and Andrusak, 2011).

In Kootenay Lake, at least three separate races of Kokanee exist in different parts of the lake[2] (MoE, 2015), with work being conducted to determine distinct shore spawners in the West Arm. Decreasing abundance of Kokanee by the early 1990s led to the large scale nutrient restoration program in Kootenay Lake North Arm (Schindler et al. 2011). With initial success the program was expanded to include the South Arm in 2005. The recovery of the Kokanee stocks have benefited piscivorous fish, such as Bull Trout and Gerrard Rainbow Trout[3].

The area at the mouth of the West Arm has exceptionally high fisheries value, especially as a rearing area for Kokanee due to the riverine effects of entrained food swept into the narrow arm. The West Arm populations of Kokanee include both stream and lake spawners. While there are documented shore spawning locations in seepage/upwelling sites, including near the existing Balfour terminal at Proctor, there does not appear to be shore spawning of the North Arm population or at Queens Bay specifically.

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[2] http://www.env.gov.bc.ca/wld/documents/fishfacts/kokanee.pdf

[3] https://www.bchydro.com/news/conservation/2011/highest_count_of_spawning_gerrards.html

Kootenay Lake and many of its tributaries provide a substantial area of potentially suitable spawning and rearing habitat for Bull Trout and Rainbow Trout. The lake itself provides lacustrine habitat in which a large portion of the adult population resides for the majority of their life history (Andrusak and Andrusak, 2011). Bull Trout are a provincially blue-listed at risk species; however, Andrusak and Andrusak (2011) indicated the Bull Trout population in Kootenay Lake was 'very high', and estimated the relative lake wide annual spawner abundance could potentially exceed 7,000 fish. They also indicated data from the 2011 sport fishery which suggested annual Bull Trout harvest is estimated to average approximately 12,000 caught annually in Kootenay Lake (Redfish Consulting 2007). The nearest confirmed Bull Trout spawning stream to the Project site is Coffee Creek.

Gerrard Rainbow Trout are piscivorous fish that are dependent on Kokanee as their primary prey. The Kootenay Lake Gerrard Rainbow Trout population spawns primarily in Lardeau River at the outlet of Trout Lake, with young-of-year (YOY) and juvenile trout rearing in the streams before migrating into the lake. Gerrard Rainbow Trout abundance responded to Kokanee abundance following the lake fertilization program, with peak runs recorded over 1000 spawners at the outlet of Trout Lake in 2011 and 2012. However, the population ranges and 2015 spawner counts peaked at less than 200 fish[4]. The Project area within Queens Bay would contain Rainbow Trout, but it is not an area of key importance to carrying out critical life history stages. Much of the fish value at Queens Bay appears to be from its proximity to the main lake outlet/entrance of the West Arm. Similar general adfluvial life history can be considered for Cutthroat Trout in Kootenay Lake, which anecdotal information from fishing reports indicate are higher in abundance in areas of the South Arm.

Of the other fish species that may spawn in the lake, there is a limited potential there could be spawning where that small unnamed creek enters the lake, or for trout spawning in the stream itself upstream of the Highway 31 crossing. Juvenile fish likely use the site for rearing in the waters where the unnamed creek enters, and also at the seepage area (at higher water) that is within the proposed parking area near the ramp.

Fish Species at Risk

A search of the BC CDC was conducted, using BC Species and Ecosystems Explorer (BC CDC, 2015), to assess the status of fish species-at-risk in the Project area. There are four species at risk with potential to occur within or adjacent to the Project site. Of those, two are red-listed populations (White Sturgeon and Burbot), and two blue-listed species (Bull Trout and Cutthroat Trout *lewisi* subspecies).

- Red-listed: Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in BC. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed.
- Blue: Includes any indigenous species or subspecies considered to be of Special Concern (formerly Vulnerable) in BC because of characteristics that make them particularly sensitive to human activities or natural events (BC CDC, 2015).

[4] http://www.env.gov.bc.ca/kootenay/fsh/main/mainfish.htm

White Sturgeon

Wild White Sturgeon (*Acipenser transmontanus*) populations (non-hatchery) in the Columbia and Kootenay rivers are mainly comprised of older individuals and their populations are in decline because of the lack of recruitment of juveniles since the mid-1980's and mid-1960's respectively (Utzig and Schmidt, 2011). The 2002 population was estimated at approximately 760 individuals, with 752 of those being adults with >70cm fork length (COSEWIC 2003). In general, habitat quality, egg/fry survival and access to feeding areas (and reduced food fish populations) have been noted as negatively influenced by dam creation; Duncan dam in 1967 and Libby Dam in 1973 (Utzig and Schmidt, 2011).

Downstream of the West Arm there is a natural barrier at Bonnington Falls which has isolated sturgeon in Kootenay River from the downstream Columbia River population for approximately 10,000 years (Northcote 1973). The Kootenai Falls upstream of Kootenay Lake but downstream of the Libby Dam in Montana represents an upstream barrier. The Kootenay sub-population, a transboundary group, occurs in the mainstem only. Individuals within the population move freely from Kootenay Lake to Kootenai Falls. A population of sturgeon is also interpreted to have utilized the Duncan River system prior to dam construction, with low numbers of individuals remaining present in the system[5].

The species at risk public registry indicates in the White Sturgeon recovery strategy[6] three areas of Kootenay Lake as critical habitat (Creston Delta, Duncan Delta, Crawford Bay), the nearest to the Project site is Crawford Bay.). Habitat in the Queens Bay area is not identified as critical habitat.

Burbot

Burbot (*Lota lota*) typically inhabit the bottoms of deep, cool areas of lakes and rivers (MoE, 2015). Burbot broadcast spawn at night in mid-winter when water temperatures range from 0° to 4°C, typically from January through March, in lakes over shallow flats adjacent to steep drop-offs and in rivers side channels behind deposition bars (McPhail, 1997; Roberge et al., 2002; MoE 2015). Juvenile Burbot remain inshore in relatively shallow water and feed and grow throughout the winter, and are known to feed heavily on mysid shrimp (Scott and Crossman 1973, cited by Roberge, 2002). Subadult Burbot occupy similar habitat as YOY: shallow littoral environments with rocks, weeds or debris as cover (McPhail and Paragamian 2000 as cited in Roberge et al. 2002). With increased size burbot move to deeper water of lakes and recruit to the adult population at about the time of sexual maturity (McPhail, 1997; Roberge et al, 2002).

Burbot were historically abundant in Kootenay Lake, supporting many years of commercial and recreational food fisheries. Overfishing and habitat changes led to a collapse in the fish stocks, where the species was nearly extirpated. Efforts in Kootenay River have continued to attempt to rebuild the stock. A hatchery facility in Idaho produces and releases Burbot to the Kootenay River system.

There may have historically been Burbot spawning in Queens Bay (MoTI, pers. comm.), but with the population collapse there are very few remaining in the lake. Queens Bay is currently not substantially used

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[5] http://a100.gov.bc.ca/pub/eswp/esr.do?id=18621

[6] http://www.sararegistry.gc.ca/default.asp?lang=En&n=54C6A1BE-1&offset=6&toc=show

by Burbot. However, if Burbot numbers do recover, there could be future Burbot occupying similar areas to historic, at which time Queens Bay could again be suitable spawning and rearing habitat.

5.3.2 Project Effects on Fisheries

Potential construction effects on fisheries, including species at risk, include:

- Loss or alteration of fish habitat resulting from fill encroachment, riparian disturbance or other activity (e.g., alteration or destruction of rearing or spawning habitat, effects on water quality);
- Fragmentation of habitat, creating permanent or temporary barriers to daily movement or seasonal migration;
- Accidental mortality and injury to individual animals (e.g., hydrocarbon or concrete spills to water, hydroacoustic impacts from pile driving); and
- Impacts to fishing due to terminal relocation.

5.3.3 Mitigation Measures

Operational and space constraints of the site require a substantial encroachment into foreshore and lake bottom fish habitat of at least 25,000 m^2. Localized impacts to fish productive capacity from reduced habitat availability may occur, but are unlikely to have a significant impact on Kootenay Lake fisheries. However, site specific field surveys of fish or fish habitat for final Project design may be required for adequate Project impact assessment to fisheries.

The CEMP will provide measures to avoid or mitigate potential direct risk of effects to fish during construction following standard BMPs and site specific considerations with adjacent habitat values, construction techniques and impact avoidance planning.

5.4 Vegetation

5.4.1 Baseline Conditions

The site is located within the administrative boundaries of the Kootenay Lake Forest District, the Kootenay region, and the Regional District of Central Kootenay. A desktop review of the project area indicates the site is within the Interior Cedar Hemlock biogeoclimatic (BGC) zone, West Kootenay dry warm variant (ICHdw1) (large geographic areas with broadly homogeneous macroclimates), with subzones (smaller areas within a BGC zone that possess similar zonal plant associations on climatic climax ecosystems) and variants (reflecting local geographic variation within the subzones) that will need to be determined upon further investigation (iMap, 2015).

The proposed site is located on a segment of forested Crown land in Queens Bay below Highway 31 between areas of rural residential and recreation lakeshore properties. The following observations were made from a desktop search, as well as a site visit:

- Existing riparian impacts exist due to private land development at Queens Bay south, as well in a localized area north of the proposed site near McEwen Point.
- A narrow strip of young mixed forest occurs between the highway corridor and the lake shore; and
- The vegetation is predominantly continuous coniferous forest upslope of the site.

The Project site has been previously disturbed, and the natural forest ecosystem has been altered by road construction for the highway corridor.

<u>Vegetation Species at Risk</u>

A search of the BC CDC, using BC Species and Ecosystems Explorer (BC CDC, 2015) was conducted to determine the potential presence of federally and provincially listed plant species occurring within the Project site and surrounding area.

Based on the BC CDC plant species search using the BGC zone and riparian or lake parameters, there are six provincially red-listed (Tall Beggarticks, Beardless Wildrye, Colorado Rush, Sweet-marsh Butterweed, Alkali-marsh Butterweed, Prairie Wedgegrass) and nine blue-listed species at risk (American Sweet-flag, Crested Wood Fern, Ussurian Water-milfoil, Giant Helleborine, Wild Licorice, Spurless Touch-me-not, Blunt-sepaled Starwort, Nuttall's Waterweed, Water Marigold) with the potential to occur at the Project site or in the surrounding area. Of those, there is record of one of the blue-listed plant species, Wild Licorice (*Glycyrrhiza lepidota*), observed at Queens Bay. The remaining potential species have been either been recorded in the immediate region, with the majority of occurrences recorded at the south end of Kootenay Lake, or are possible/predicted for the search parameters for the region. Additional species are indicated for riparian areas within the region, but would be expected at higher elevations or have only been recorded in the East Kootenays; therefore, would have a low probability of being observed at the project site.

Within the project footprint impact area, there will be impacts to riparian vegetation including young upland forest and also a localized seepage area. The timing of the site visit could not preclude the noted vegetation presence within the site, thus there is a potential for impacts to plant species at risk that requires further field investigation.

<u>Vegetation Communities at Risk</u>

A search of the BC CDC, using BC Species and Ecosystems Explorer (BC CDC, 2015), was conducted to determine the potential presence of provincially listed ecological communities at risk occurring within the Project study area.

In addition to the individual plant species mentioned above, there is potential presence of one red-listed and two yellow-listed ecological community to occur on the forested area upslope of the HWM at the site. The red-listed community is Douglas-fir/Tall Oregon Grape/Parsley Fern; while the yellow-listed communities are Western Red cedar/Devil's Club/Lady Fern and Western Hemlock/Falsebox.

Within the project footprint impact area, there will be impacts to riparian vegetation including young upland forest and also a localized seepage area. The timing of the site visit could not preclude the noted vegetation and ecological communities presence within the site, thus there is a potential for impacts to plant species at risk that requires further field investigation.

Invasive Plant Species

Known adjacent area invasive species documented by MoTI within 1 km of the Project site include: Bladder Campion (*Silene vulgaris*), Black Locust (*Robinia pseudoacacia*), Burdock (*Arctium spp*), Chicory (*Cichorium intybus*), Common Tansy (*Tanacetum vulgare*), Hoary Alyssum (*Berteroa incana*), Japanese Knotweed (*Fallopia japonica*), Oxeye Daisy (*Leucanthemum vulgare*), Orange Hawkweed (*Hieracium aurantiacum*), Yellow Hawkweed (*Hieracium pretense*), Scotch Broom (*Cytisus scoparius*), and Spotted Knapweed (*Centaurea biebersteinii*) (iMap, 2015). Removal methods recorded for MoTI sites include mechanical (i.e. digging or hand pulling) and biological treatment (iMap, 2015).

5.4.2 Project Effects on Vegetation

The potential Project effects on vegetation include destruction of individual plants, alteration of habitat components and relationships, and opportunity for the establishment or spread of invasive species.

Emergent vegetation in the seepage area within the Project site represents the most common aquatic vegetation type for Kootenay Lake, which is found along 6.2% of the total shoreline (Ecoscape, 2011). The emergent vegetation area is within the proposed fill area for the terminal. While emergent vegetation is the most common, it is not considered abundant, and it is noted that most has previously been mapped at the confluence of larger tributaries to the lake (Ecoscape, 2011).

The selected site would be considered greenfield. While the young forest at the site indicates relatively recent disturbance, the Project site is within or near its natural state. There is potential for at risk plant species and communities to be impacted by Project construction as the construction footprint will be partially within riparian habitat. There is also potential for invasive species to establish and spread within the Project site in areas of exposed soil and disturbance.

5.4.3 Mitigation Measures

Mitigation measures and best management practices to reduce the loss of vegetation species by the Project may include:

- Demarcating areas where vegetation should be retained in the field (using flagging tape) and on construction drawings before construction begins;

- Minimizing the construction footprint and re-seeding of cleared areas surrounding the Project site with locally existing native seed stock;
- Ensuring the shoreline fill slope is revegetated above high water mark;
- Only grubbing areas that are necessary to minimize the amount of exposed soil and consequently the spread of invasive plant species;
- Re-seeding disturbed areas with native grass species as soon as possible to minimize the opportunity for invasive species to colonize the site;
- Salvaging topsoil and existing native plant material for reuse on the Project site; and
- Restricting vehicle traffic to designated access roads to avoid migration of vegetation and invasive species.

Prompt re-seeding of disturbed sites with native seed is an important component of vegetation mitigation for the Project to maintain vegetation cover and reduce erosion, sedimentation and spread of invasive plants.

The *Weed Control Act of BC* requires that landowners control the spread of noxious weeds on their property as defined in the Provincial and Regional District Noxious Weed List Schedule A.

In addition, the CEMP will provide measures and best management practices to avoid or mitigate loss of native vegetation. It is understood that vegetation clearing will be required for access and at the toe of slope where fill for the terminal intersects the bank. It is yet to be determined how much clearing will be required, whether hazard trees exist that will need to be removed, or whether at risk plant or ecological communities exist at the site.

5.5 Wildlife and Wildlife Habitat

5.5.1 Baseline Conditions

The BC CDC lists data for wildlife species at risk, which were assessed as a desktop exercise, cross referencing each species life requisite with the Project area's vegetation present and habitat quality. Background information determines potential species and data gaps to be addressed by field surveys.

Wildlife taxa that can occur near the Project sites include invertebrates, herpetofauna (amphibians and reptiles), birds and mammals. Habitat surrounding the Project site, specifically within the vicinity of the Project area, is generally in a young forest successional stage as a result of previous disturbance. Habitat at this stage offers wildlife foraging, breeding, and resting areas, especially if there is dense cover (shrub layer). For example, vole and mice populations are commonly found, attracting predator species such as raptors and carnivores (e.g., coyotes, mustelids). Depending on the geographic location and configuration of the Project site, the area may be used as a movement corridor between higher-valued habitats (e.g., for ungulates or other medium to large mammals). Songbirds with a preference for edge-habitat may actively nest in shrubs or existing infrastructure during the spring and summer.

Wildlife Species at Risk

A search of the BC CDC was conducted, using BC Species and Ecosystems Explorer (BC CDC, 2015), to determine the potential presence of wildlife species-at-risk in the Project area.

There are 18 species at risk with potential to occur within or adjacent to the Project site include 4 amphibian and reptile species (Western Toad, Western Skink, Rubber Boa, and Painted Turtle), 10 bird species (Great Blue Heron, American Bittern, Olive-sided Flycatcher, Yellow-breasted Chat, Common Nighthawk, Short-eared Owl, Western Screech Owl, Double-crested Cormorant, Foster's Tern, Western Grebe), 3 invertebrate species (Threeridge Valvata, Silver-spotted Skipper, Tawny-edged Skipper), and 1 mammal species (Fisher). Of those, five are red-listed, eleven are blue-listed and two are yellow listed:

- Red-listed: Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in BC. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed.
- Blue: Includes any indigenous species or subspecies considered to be of Special Concern (formerly Vulnerable) in BC because of characteristics that make them particularly sensitive to human activities or natural events (BC CDC, 2015).
- Yellow: Includes species that are apparently secure and not at risk of extinction. Yellow-listed species may have red- or blue-listed subspecies

The forested riparian area of the Project site, lake and seepage area habitats surrounding the site could provide suitable habitat for these species, including nesting birds. The reptile species documented just north of the Project site is the Western Skink (*Plestiodon skiltonianus*), which could be within the warm dry rocky lakeshore and bank areas of the site.

5.5.2 Project Effects on Wildlife and Wildlife Habitat

Potential construction effects on wildlife, including species at risk, include:

- Loss or alteration of wildlife habitat resulting from site clearing or other activity (e.g., direct destruction of nests, burrows, and/or den sites);
- Fragmentation of contiguous wildlife habitat, creating permanent or temporary barriers to daily movement or seasonal migration;
- Sensory disturbance or behavioral effects from construction (e.g., auditory, visual, olfactory); and
- Accidental mortality and injury to individual animals (e.g., as a result of: vehicle-wildlife collisions; site clearing; possible ingestion of solid waste, antifreeze or other toxic fluids associated with construction; unauthorized hunting, feeding or harassment of wildlife by construction personnel).

Potential effects on amphibians and reptiles include loss of habitat related to encroachment, decrease in water quality, riparian clearing, and direct mortality associated with construction and increased access.

Potential effects to birds include sensory disturbance especially during migration and breeding season, loss of breeding habitat through clearing, and direct mortality or injury associated with bird/vehicle collisions. Vegetation clearing is expected to occur during the construction phase of the project. If footprints overlap with suitable breeding bird habitat, this vegetation removal could result in loss of habitat or habitat fragmentation for breeding birds.

5.5.3 Mitigation Measures

Site specific field surveys of terrestrial habitat should be conducted at a time of the year when potential at-risk species could be present or visible (e.g. growing season for vegetation). The CEMP will provide measures to avoid or mitigate potential effects to wildlife and wildlife habitat during construction. The following mitigation measures are recommended to reduce potential impacts to wildlife:

- Implement appropriate waste management practices to prevent poisoning of wildlife;
- Report vehicle-wildlife collisions and install warning signs or impose reduced speed limits in areas where collisions occur;
- Address prevention and mitigation of wildlife mortality/morbidity in training and/or awareness sessions for construction personnel;
- Avoid unnecessary noise and other disruption;
- Report any wildlife observations to the Construction Manager/Environmental Monitor;

- Complete clearing, if required, outside of breeding bird nesting windows (starting February 15 for herons; March 1 for most raptors; April 1 for other bird species – to August 31), if possible;
- If clearing cannot occur outside the nesting windows, identify presence or absence of active bird nests within 48 hours prior to clearing activities;
- Identified nesting sites are to be assessed by the Environmental Monitor for signs of activity. If nests appear to be active an appropriate buffer will be established around the nests and they must not be disturbed (until the nests are no longer occupied);
- Even with clearing outside of the breeding bird season, ensure that no raptor nests are removed (if present);
- To the extent possible, minimize the project footprint, including lengths of new access roads;
- To the extent possible, avoid vegetation clearing to maintain existing habitat conditions and natural vegetation next to project facilities and roads;
- Use previously-disturbed areas (including clearings and built roads) to the greatest extent possible;
- Avoid retaining wall structures where possible and ensure fill areas above high water mark are revegatated; and
- Areas cleared for the culvert installation required prompt revegetation using salvaged vegetation and/or native seed mix.

5.6 Air Quality

5.6.1 Baseline Conditions

The Air Action Plan (BC Gov, 2008) targets the sources of ground-level ozone and fine particulate matter, the most harmful contributors to air pollution. Overall air quality within the Regional District of Central Kootenay/West Kootenay region can be considered as good with localized (i.e., industrial) impacts. Air quality is interpreted from data obtained from the nearest air quality station to the Project site. The proposed terminal is situated in a location with no air monitoring stations near the site. The nearest station is located in the city of Castlegar, that reports data to the BC Provincial Government. Air quality at the Castlegar monitoring station would be influenced by the Zellstoff Celgar pulp mill operations, which would not be a significant influence at Kootenay Lake. Recent readings for the Castlegar monitoring station indicate a low Air Quality Health Index value, similar to most other regions in BC, and would be considered as 'good' (i.e., low health risk) based on the most recent readings (BC Gov, 2015)[7].

[7] http://www.bcairquality.ca/readings/index.html

5.6.2 Project Effects on Air Quality

The anticipated effects on air quality are the introduction of pollutants into the atmosphere through the burning of fuels for machinery operations and dust generation.

Impacts to air quality from fugitive dust generation may result from construction related activities such as stripping, hauling or placing of topsoil. In addition, the transportation of equipment and crew members to and from the Project can temporarily increase particulate matter. The site is exposed to wind off the open lake. There is low concern related to fugitive dust due to the Project.

Emissions from machinery and equipment may contribute greenhouse gases and deleterious substances to the local air shed. In addition, diesel fuel (typically used in heavy machinery and equipment) is a contributor of particulate matter. The magnitude of emissions contributing particulate matter and/or greenhouse gas emissions is expected to be low given the size of the Project and short time frame of construction.

Emissions following construction would not be expected to significantly change compared to present operations from Balfour terminal. While a shorter crossing time would result from the relocation, additional service with more frequent crossings within current total hours of operation would be anticipated, with similar total daily running time.

5.6.3 Mitigation Measures

Specific mitigation measures will be incorporated into the CEMP from appropriate BMPs and guideline documents. The CEMP developed for the Project will include recommended measures to avoid or reduce the release of particulate matter into the environment from operating equipment. For example, construction procurement should require properly maintained equipment, operated according to specification. Unnecessary idling should be avoided by shutting off equipment when not in use. Other measures to prevent potentially harmful emissions include using machinery that meets current emission standards. Low sulphur fuels are recommended to be used, depending on local fuel supply. In addition, as discussed in the context of mitigating soil erosion, exposed soil will be covered. The CEMP will include measures for dust suppression on roadways, when appropriate, such as use of environmentally acceptable dust suppressants or watering.

5.7 Land Use and Socioeconomic Environment

5.7.1 Baseline Conditions

The proposed location at Queens Bay north is Crown land. The main land uses were vacant forest green space and recreation. To the north and south there are rural residential waterfront properties. Highway 31 is the main access route to communities on the Kootenay Lake North Arm.

5.7.2 Potential Effects on Land Use and Socioeconomic Environment

Archaeology

An archaeological review has been conducted and is considered separate from this document.

Agriculture & Range

The site is not located within the ALR and no impacts to agriculture and range land should occur.

Residential and Commercial Properties

Construction of the Project would likely create concerns from neighbouring properties over noise, increased traffic and visual impacts due to the project. The properties are occupied either as residences or recreational properties. There may be a corresponding decrease in those same concerns to a portion of the residents adjacent to the current Balfour Terminal. There are adjacent businesses that service the current Balfour Terminal which would be impacted by the relocation. These effects may or may not have impact on property values. Further consideration of socioeconomic impacts to residential and commercial land use may be required.

Forestry

Construction of the Project is not anticipated to affect nearby forestry operations (e.g., disrupt traffic flow on a forest service road). Felling of trees is likely to be required as part of the Project construction; however, the trees requiring removal would likely be from riparian reserve zone, and would account for a low volume, if merchantable. The overall construction impacts on forestry associated with the Project are anticipated to be negligible.

Recreation & Access

The site appears to be used for recreational beach access with foot paths observed between the Highway 31 road shoulder and the rocky beach, mostly south of the proposed Project site. However, the number of public access areas to undeveloped Kootenay Lake waterfront areas may be limited. There could be possibilities for developed recreation facilities once the existing Balfour terminal would be decommissioned.

Recreational boating traffic and fishing may be nominally affected by the terminal relocation, but there would be a corresponding affect of increased boat traffic safety at the entrance of Kootenay Lake West Arm by separating ferry traffic from an area often congested with recreational boaters (Western Pacific Marine, pers. comm.).

Impacts to Highway 31 traffic could occur during construction that would affect communities and businesses on Kootenay Lake North Arm.

5.7.3 Mitigation Measures

Requirements for mitigation will need to be considered as part of project planning, and will include mitigation depending on duration, type and extent of impact required. This planning would include future use of the land at the current Balfour Terminal. Consideration of recreational impacts and mitigation would be a required element of facility planning. Traffic control during construction would be required to minimize impacts on through traffic. A positive impact to traffic safety would be anticipated to occur once the terminal was operational given existing site constraints at Balfour that leave queued vehicles lining up along the highway shoulder (Western Pacific Marine, pers. comm.).

6 CONCLUSIONS AND RECOMMENDATIONS

Based on available information, the overall environmental sensitivity of the Project site at Queens Bay North is moderate. This document is intended to serve as an overview of environmental components to be considered in determining the technical feasibility of the Queens Bay North site. This document is not an environmental impact assessment, and specific detailed site investigation will be required to quantify potential impacts to environmental components identified herein as Project planning proceeds. Mitigation of identified potential effects should occur through proper Project design, and the implementation of best management practices during the construction phase should be included in a Project CEMP to minimize harmful effects.

The project effects on soils and terrain are primarily associated with soil management, erosion protection, site grading and spill response which can each be mitigated through proper Project planning.

The footprint area associated with the project impacts aquatic habitat and fisheries by displacing a combined footprint area of 25,000 m^2 of mainly littoral zone rearing habitat for potentially up to 22 species of fish recorded in Kootenay Lake, including fish species at risk. These impacts to fish and fisheries will need to be quantified to direct habitat mitigation and offsetting plans. In circumstances where design allowed more of the facility footprint impact to shift onto upland riparian area as opposed to the fill extending into aquatic lake habitat, the impacts to the aquatic habitat and fisheries value could potentially be reduced. While there may be potential for adjustments to the site design, site topography of the hill slope at Queens Bay limits the ability for impact avoidance in aquatic habitat from fill area.

In consideration of overall available habitat area within the Kootenay Lake North Arm, the combined footprint area of 25,000 m^2 does not represent a significant portion of suitable fish rearing habitat, nor has it been identified as critical habitat to species at risk. There would be a cumulative effect of increased transportation structures impact to the shoreline, and an impact to low gradient shoreline and emergent vegetation habitat. The effects of construction activities could largely be reduced through effective mitigation strategies. Once operational, the proposed site at Queens Bay North would likely present a lower risk to fisheries value than the existing Balfour Terminal in the Kootenay Lake West Arm.

The risk to vegetation and wildlife will need to be further quantified. There are provincially at-risk species either within or adjacent to the project area which could be directly or indirectly impacted by the project. It is anticipated that the majority of the disturbance with the added fill area would be to unvegetated areas. Mitigation and best practices can be incorporated into the project planning to reduce the risk to vegetation and wildlife.

Socioeconomic impacts due to residential and commercial properties at either Balfour or Queens Bay could require a large amount of mitigation. Determination of specific impacts or mitigation is outside the scope of this environmental overview assessment document.

Overall, background information available for the site did not indicate critical habitat or sensitive species that would preclude considering relocating the terminal from Balfour to Queens Bay North. However, there is limited potential that environmental attributes (e.g. sensitive species presence or specific life stage use of the habitat) requiring specific consideration or protection may be found during subsequent detailed field investigation.

It is anticipated that a formalized habitat mitigation and offsetting plan would need to be part of the planning process for federal *Fisheries Act* authorization. Fish and aquatic habitat are protected under the *Fisheries Act*. Specifically, Section 35 of the *Fisheries Act* prohibits serious harm to fish which is defined in the Act as "the death of fish or any permanent alteration to, or destruction of, fish habitat" (DFO 2013). Fish, as defined in the Act, include those that are a part of commercial, recreational, or Aboriginal (CRA) fisheries. In addition, fish species that support CRA fisheries through the contribution to the productivity of the fishery, for example as a food source, are also protected. By definition, the 25,000 m^2 footprint area would be permanent alteration of fish habitat. A provincial *Water Act* approval application is also required for works 'in and about a stream'.

The Fisheries Protection Policy Statement (DFO, 2013) provides direction on considering ecosystem context and cumulative effects. Specific environmental impact assessment would quantify overall impacts, built in mitigation strategies (i.e. project design), and remaining/residual impacts which would require formalized compensation or offsetting.

A habitat mitigation and offsetting plan at Queens Bay North may consist of elements such as:

- possible redesign of the existing culverts to improve passage of fish;
- construction materials or techniques to mimic natural habitat elements (e.g. vegetated rip rap, rock spurs, secured large wood debris habitat structures; shoreline bench habitat, riparian planting, etc);
- offsite habitat restoration and enhancement; and
- direct investments in fisheries productivity and fisheries protection or enabling partner organizations to contribute to fisheries productivity[8].

The Project footprint area is above the BC Environmental Assessment Act threshold value and will require Project Review. Review under the Navigable Waters Protection Act will also be required.

[8] http://www.dfo-mpo.gc.ca/pnw-ppe/offsetting-guide-compensation/index-eng.html

7 NOTICE TO READER

This report has been prepared and the work referred to in this report have been undertaken by the Environment & Water business unit of SNC-Lavalin Inc. (SNC-Lavalin) for the exclusive use of Ministry of Transportation and Infrastructure (MoTI), who has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. SNC-Lavalin accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report. Should this report be submitted to the BC Ministry of Environment (MoE) by MoTI, the MoE is authorized to rely on the results in the report, subject to the limitations set out herein, for the sole purpose of determining whether MoTI has fulfilled its obligations with respect to meeting the regulatory requirements of the MoE.

The findings, conclusions and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect SNC-Lavalin's best judgment based on information available at the time of preparation of this report. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our original contract and included in this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered, site conditions change or applicable standards are amended, modifications to this report may be necessary. The results of this assessment should in no way be construed as a warranty that the subject site is free from any and all contamination.

Any soil and rock descriptions in this report and associated logs have been made with the intent of providing general information on the subsurface conditions of the site. This information should not be used as geotechnical data for any purpose unless specifically addressed in the text of this report. Groundwater conditions described in this report refer only to those observed at the location and time of observation noted in the report.

This report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final version of this report, it is the final version that takes precedence. Nothing in this report is intended to constitute or provide a legal opinion.

The contents of this report are confidential and proprietary. Other than by MoTI, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of MoTI and SNC-Lavalin.

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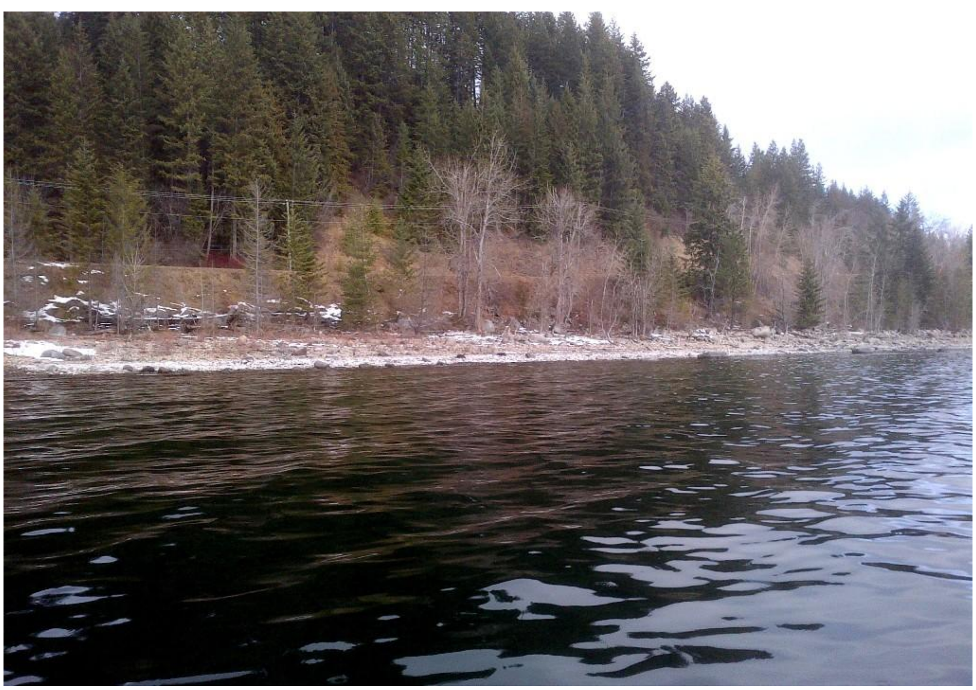
DRAWINGS

- Map (511129-FM2-001) – Location Plan
- Map (511129-TAC-001) – Location Plan

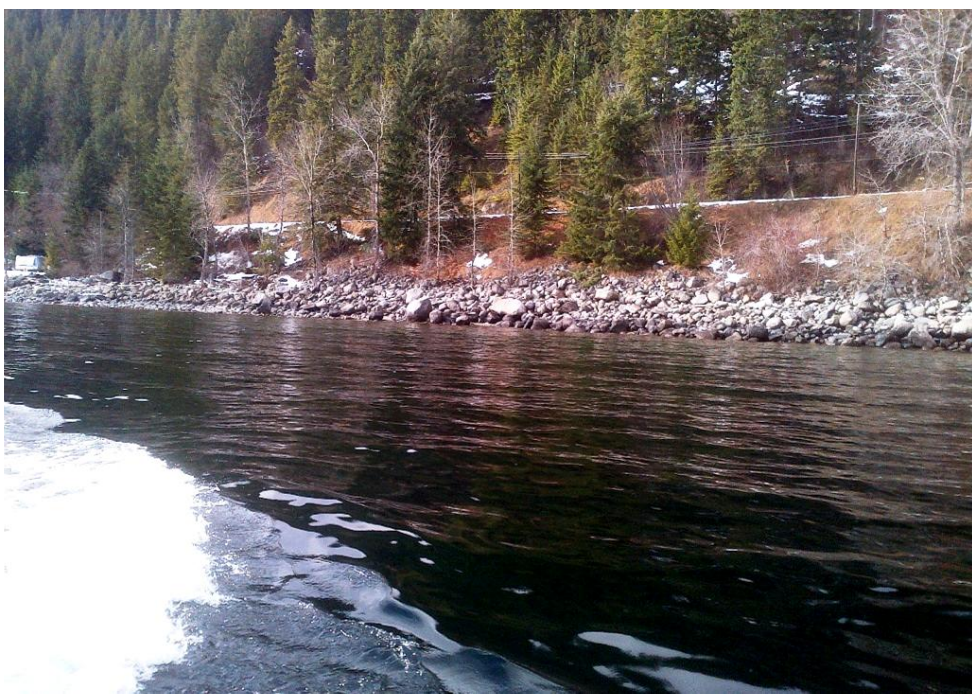
SITE PHOTOGRAPHS

Photograph 1. Overview of the Site features. Photograph dated February 3, 2015



Photograph 2. Overview of the Site features. Photograph dated February 3, 2015

Photograph 3. Adjacent land use in Queens Bay south. Photograph dated February 3, 2015.



Photograph 4. Steep boulder lake shore south of the Queens Bay North Project site. Proposed rip rap armoured fill slope would be analogous to this habitat type. Photograph dated February 3, 2015.

Photograph 5. View of existing vegetation between Highway 31 and the Queens Bay lake shore. Recent mowing of the upper bank woody vegetation was observed. Photograph dated February 3, 2015.

Photograph 6. View of the braided fish bearing portion of the Unnamed Tributary to Queens Bay which will require suitable crossing structure installation. Photograph dated February 3, 2015.

Photograph 7. View north of the low gradient cobble beach area which would be infilled to accommodate the new terminal. Photograph dated February 3, 2015.

Photograph 8. View north of the low gradient cobble beach area which would be infilled to accommodate the new terminal. Photograph dated February 3, 2015.

Photograph 9. High value seepage area habitat within the terminal footprint area. The vegetation had wildlife sign from ungulates and overwintering waterfowl. The seasonally submerged vegetation and upwelling water could also be of high value to rearing fish. Further assessment of this area is recommended. Photograph dated February 3, 2015.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Appendix E – Archaeological Report

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arrowstone@telus.net   www.arrowstone.ca

Keith Dunbar, P.Eng.
Project Manager, Ports & Marine
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Suite 1800 - 1075 W Georgia Street
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April 17, 2015

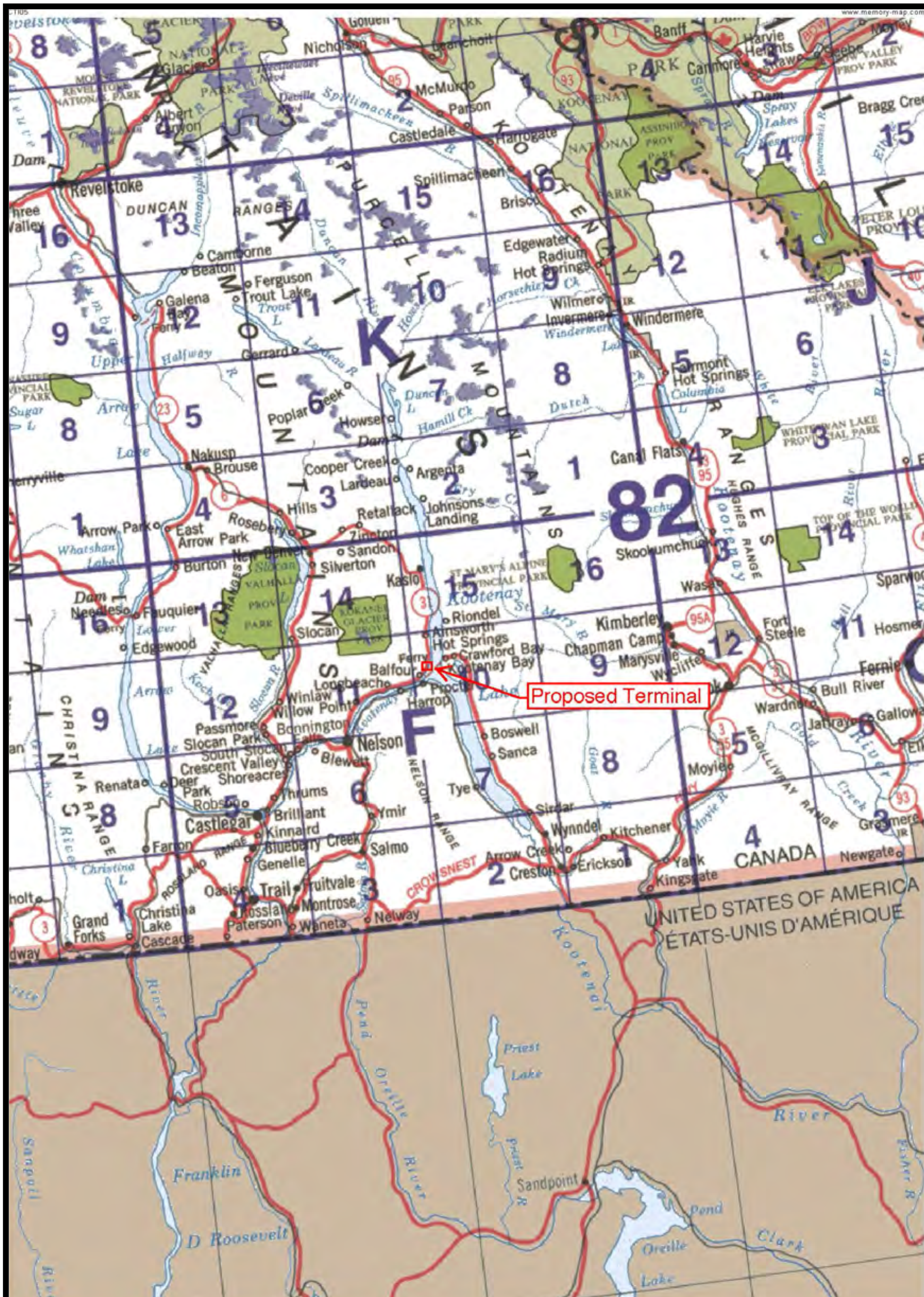
Dear Mr. Dunbar,

Re: Preliminary Field Reconnaissance (PFR) of MoTI's Proposed New Ferry Terminal on Kootenay Lake near Balfour, B.C.

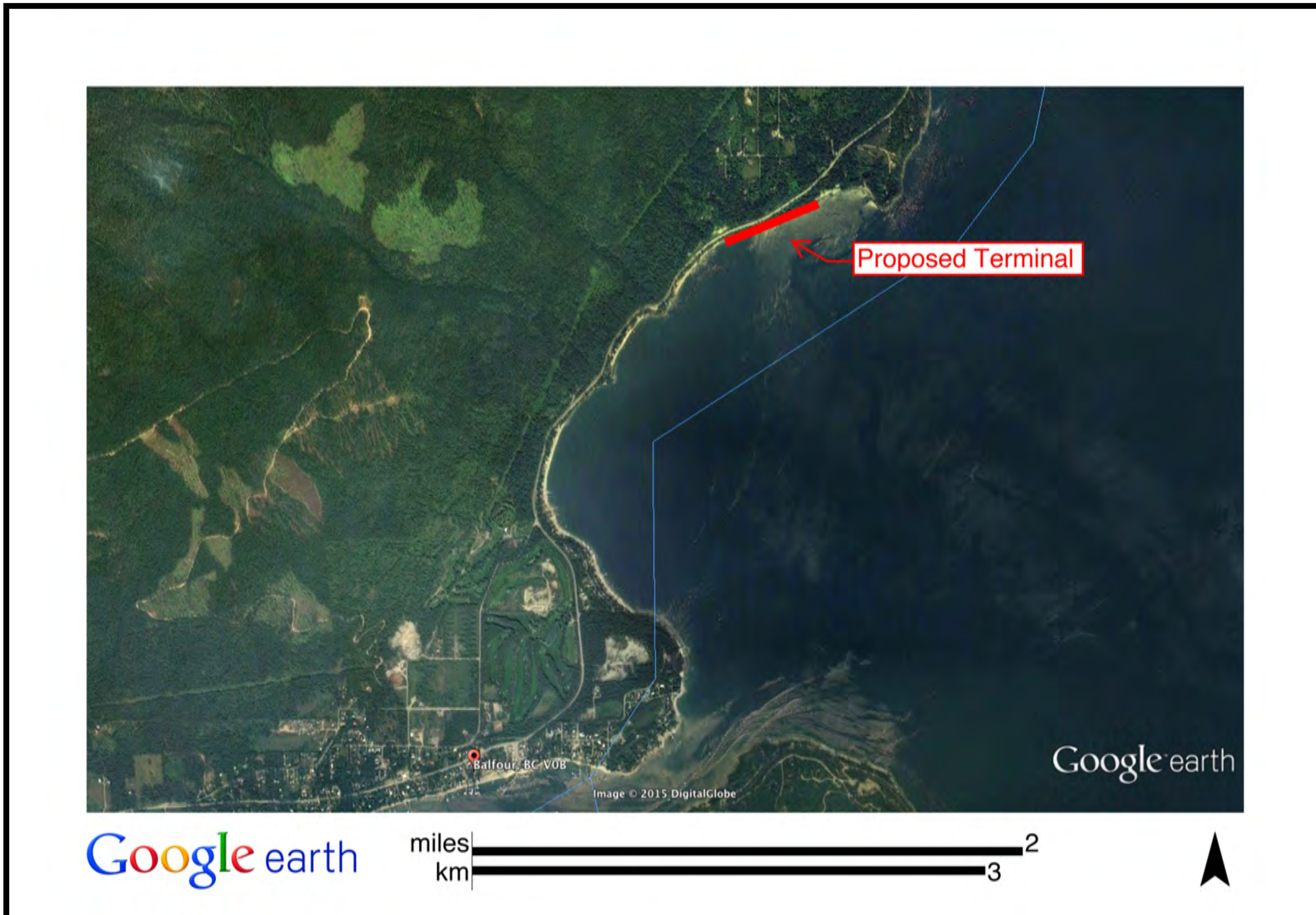
This letter report presents the results of the Preliminary Field Reconnaissance (PFR) of the Ministry of Transportation and Infrastructure's (MoTI's) proposed new ferry terminal near Balfour, B.C., on the western shoreline of Kootenay Lake near Queens Bay (Maps 1-3). The archaeological research reported herein consists of a Preliminary Field Reconnaissance (PFR) as defined by the *British Columbia Archaeological Impact Assessment Guidelines* (Apland and Kenny 1998). The PFR was undertaken at the request of Keith Dunbar of SNC-LAVALIN INC. in order to assess the archaeological resource potential of the proposed development area and to identify the need and appropriate scope of further archaeological field studies (if required). The current assessment addresses archaeological sites and the potential for the presence of archaeological sites, including forest utilization sites comprised of Culturally Modified Trees (CMTs), within the proposed development area. The current study does not address traditional use sites or possible infringements of aboriginal rights, including aboriginal title, and should not be used to fulfill consultation requirements. For information regarding traditional use sites, please contact the appropriate First Nations. The current study was conducted without prejudice to First Nations treaty negotiations, aboriginal rights, or aboriginal title. According to the Provincial Consultative Area Database (CAD), the proposed development area is located within the claim area of the Secwepemc Nation, the Lower Similkameen Band, the Penticton Indian Band, the Upper Nicola Band, the Okanagan Nation Alliance, the Okanagan Indian Band, and the Ktunaxa Nation.

Proposed Developments

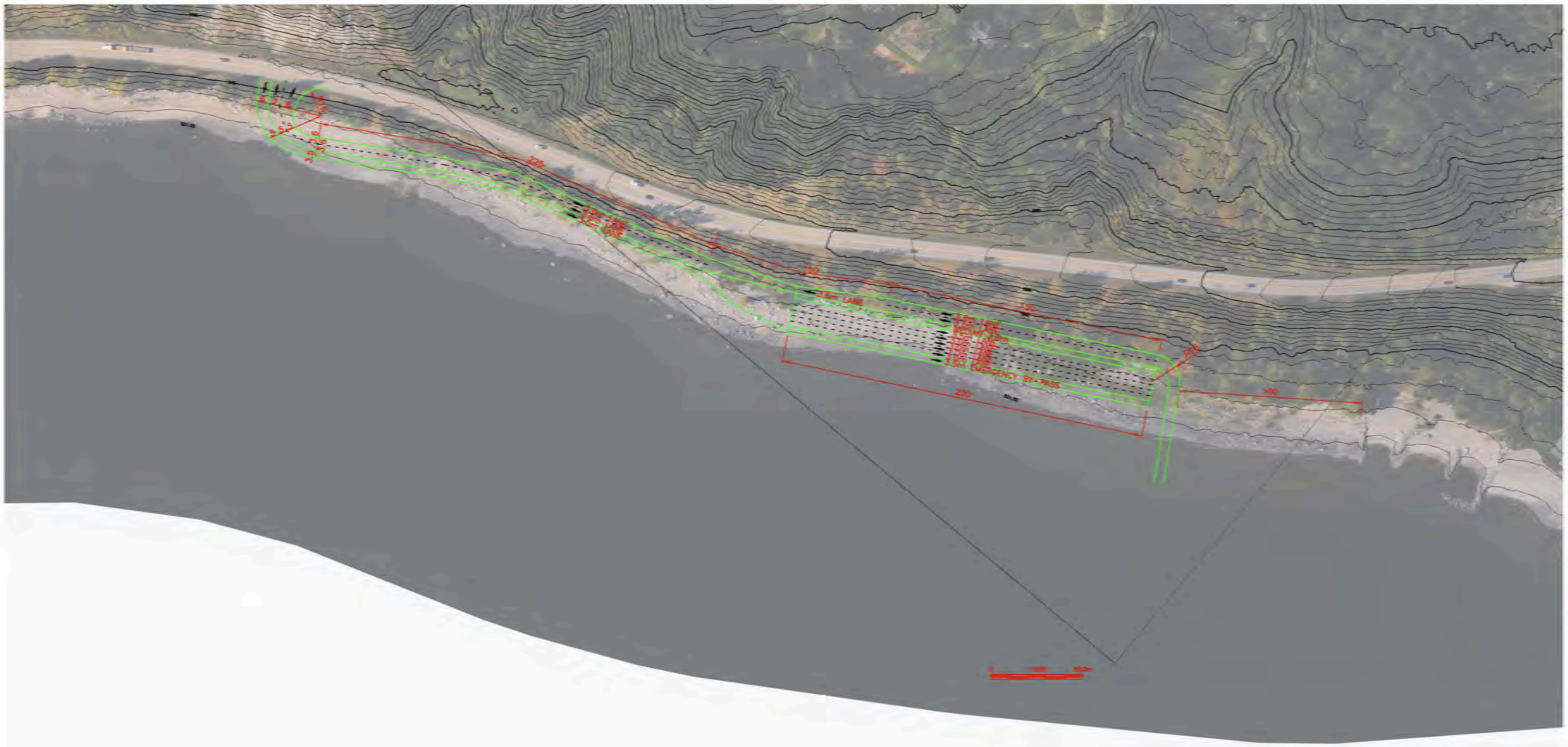
The proposed project consists of the construction of a new ferry terminal and an associated access road located along the western shoreline of Kootenay Lake, just south of Queens Bay. The proposed development will include: (1) a new ferry dock extending into Kootenay Lake, (2) terminal buildings and facilities, (3) an approximately 8 or 9 loading and off-loading lanes, (4)



Map 1: Location of the proposed ferry terminal near Balfour (NTS CT105).



Map 2: Google Earth image showing the location of the proposed ferry terminal near Balfour on Kootenay Lake near Queens Bay.



Map 3: Conceptual development plan map of the proposed ferry terminal near Balfour on Kootenay Lake.

the installation of various utilities (power, water, etc.), and (5) a new access road extending east off of Highway 31 (Balfour-Kaslo-Galena Bay Highway) to the dock and terminal facilities. The current project is a technical feasibility study and construction of the facility has not been approved.

Prefield Archaeological Site Potential Assessment

Prior to the field assessment, an in-office review of archaeological, ethnographic, and historic materials pertinent to the proposed development area was conducted. The in-office review also included a search of the Remote Access to Archaeological Data (RAAD) system at the Archaeological Inventory and Mapping Section at the Ministry of Forests, Lands, and Natural Resource Operations for the presence of previously recorded archaeological sites located within and near the proposed development area. The search revealed that no previously recorded archaeological sites are located within the proposed development area. However, numerous previously recorded archaeological sites have been identified in general proximity to the proposed development including sites **DjQf-2**, **DjQf-3**, **DjQf-6, DjQg-1, DjQg-9,** and **DjQg-11** (see Map 4). A description of these archaeological sites is provided below:

Site **DjQf-2** consists of a large surficial lithic scatter and a number of hearth features located in proximity to the current Balfour ferry terminal near the west arm of Kootenay Lake. The site was originally recorded by Wayne Choquette in 1972. Additional surficial finds were collected by private citizens at the site between 2004-2005.

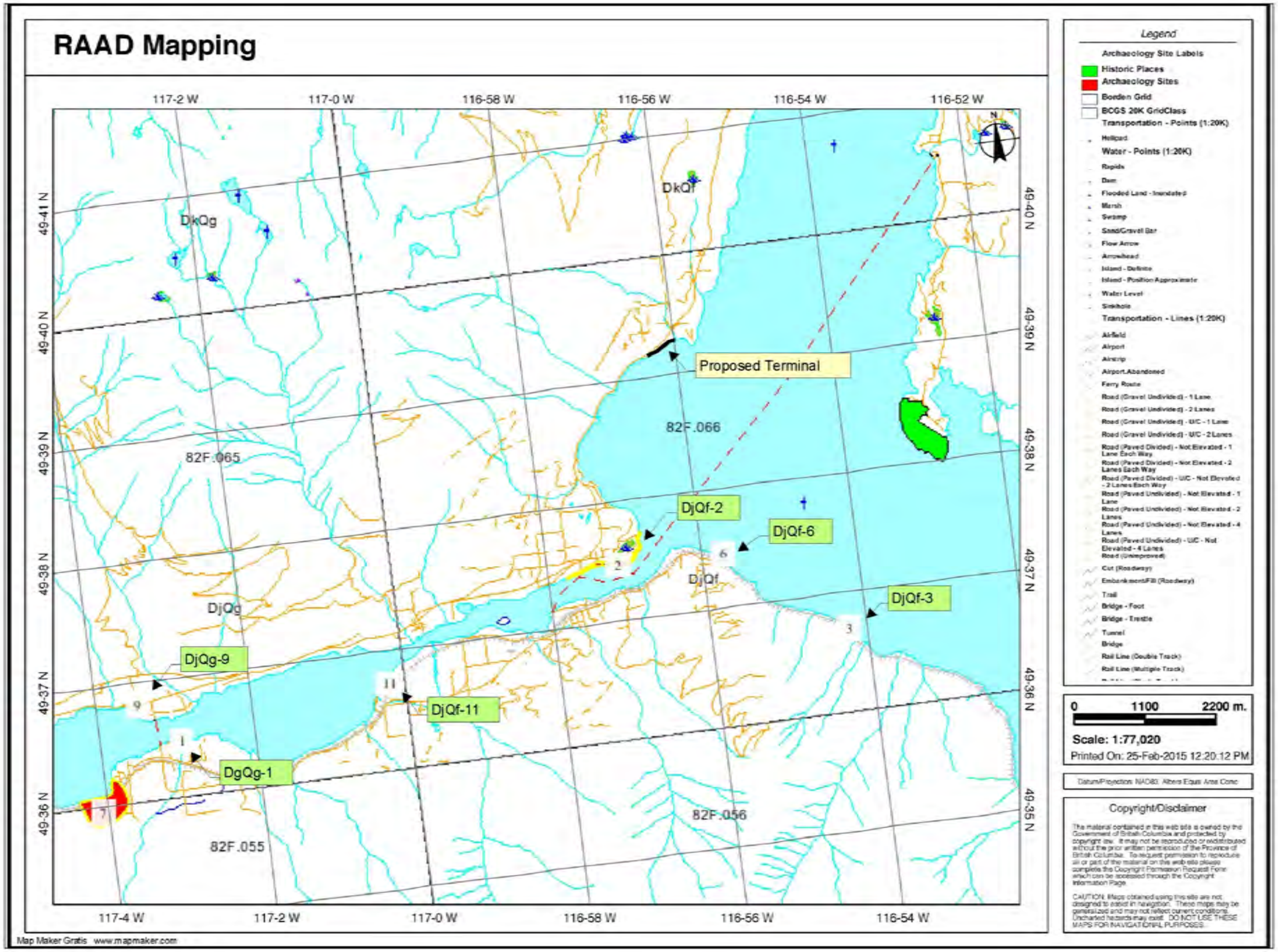
Site **DjQf-3** consists of a pictograph site located along the western shoreline of Kootenay Lake consisting of over 100 red ochre images. The site was originally recorded in 1969 and subsequently revisited in 1978 and during Baravalle's (1980) extensive pictographs surveys around the shoreline of Kootenay Lake.

Site **DjQf-6** consists of a historic shipwreck site (the Proctor CPR Railway Barge Wreck which occurred in 1901) located just offshore of the western shoreline of Kootenay Lake.

Site **DjQg-1** consists of a surfical lithic and faunal scatter, and cache pit site located near the mouth of a creek along the southern shoreline of the west arm of Kootenay Lake. The site was recorded in 1965.

Site **DjQg-9** consists of a surface and subsurface lithic scatter with a historic component located along the northern shoreline of Kootenay Lake near Harrop Narrows. The site was recorded in 1991 and was assessed as being largely destroyed by prior gravel quarrying activity associated with highway construction.

Site **DjQg-11** consists of a subsurface lithic and fire broken rock site during the Archaeological Impact Assessment (AIA) of extensions to Sunshine Bay Park by Arlene Yip (1996).



Map 4: RAAD map showing previously recorded archaeological sites and the location of the proposed ferry terminal.

Based upon the results of the literature review, the information provided in the proceeding, as well as an in-office map review conducted prior to the field assessment, the prefield archaeological site potential assessment determined that the proposed development area has moderate to high potential for the presence of archaeological sites based on: (1) the proximity of the proposed development area to numerous previously recorded archaeological sites, (2) the similar context of the previously recorded sites (along the shoreline of Kootenay Lake) to the proposed development area, and (3) the proximity of the proposed development area to Kootenay Lake.

Expected Types of Sites

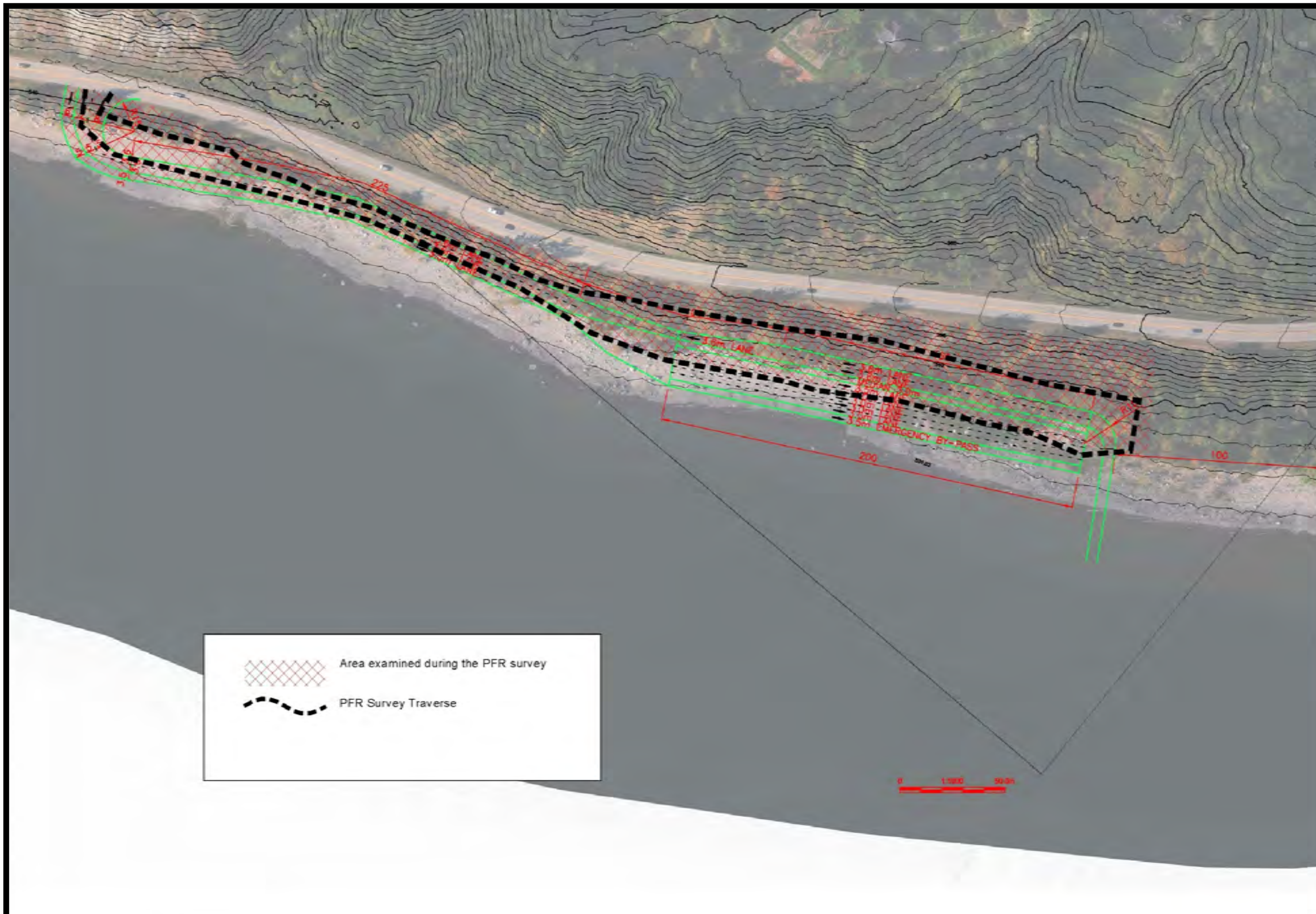
Based upon the ethnographic and historic literature review and the previously recorded sites in the general study area, the types of sites expected within the study area include: village sites, lithic scatters, artifacts scatters, quarry sites, forest utilization sites comprised of CMTs, land mammal hunting camps, pictograph sites, petroglyph sites, special use campsites (vision quest sites, plant resource processing sites, etc.), burial sites, fishing sites, trap sites, trails, etc. As one moves inland from the shoreline of the lake, CMT sites, trails, lithic and artifact scatters, quarry sites, resource extraction camps (associated with hunting and berry picking), rockshelter sites, pictograph sites, and petroglyph sites are the most likely site types to be encountered.

PFR Field Survey Methods

The field assessment took place on March 18th, 2015. The field crew consisted of Dave Hall, M.A., RPCA of Arrowstone Archaeological Research and Consulting Limited (Arrowstone) and Denise Walker (Ktunaxa Nation) (Map 5). The field survey crew was spaced 5-10 m apart traversing the proposed development area. The proposed development area was examined for the presence of cultural materials and other evidence of past human settlement and land use. Large boulders were inspected for seams of flakable lithic raw materials, possible rockshelters, and pictographs and petroglyphs. Trees of various species were examined for the presence of cultural modification. Shovel testing did not take place as the PFR was not conducted under permit. Landforms, vegetation, aspect, and sources of potable water were noted in the field.

Preliminary Field Reconnaissance Results

The POC (Point of Commencement) for the PFR survey was at 504241E, 5500019N along the shoreline at the edge of Highway 31 just north of an unnamed creek (Photo 1). The initial portion of the survey traversed along moderately to steeply sloping terrain along the edge of Highway 31 on what is obviously a manmade landform that was clearly built to accommodate the highway (Photo 2). Clear indications of imported fill were observed during the field survey. There was a clear difference observed in this artificial landform in comparison to the natural surrounding terrain. In addition, a number of installed culverts etc. had clearly altered the original drainage patterns of the area.



Map 5: Map showing the PFR survey traverse and the areas examined during the PFR survey.

As Highway 31 begins to diverge to the northeast away from the shoreline, the original largely unaltered natural terrain along the lakeside becomes apparent (Photos 3-6). The natural terrain is also largely rocky, and moderately to steeply sloping with occasional creeks being observed at irregular intervals. Five clear elevated benches/breaks in slope (Photos 7-11) which were assessed as having potential for the presence of buried archaeological deposits were observed during the PFR survey. Table 1 identifies the location of these Areas of Concerns (AOC's) and provides a description of their respective sizes. A prominent creek is located near the end of the proposed development area. Adjacent to this creek are two talus slopes (Photo 12). These talus slopes have the potential to contain prehistoric burials as talus burials are known to occur in the general study area.

Table 1. Areas of Concern (AOC's) identified within the footprint of the proposed terminal development.

AOC #	UTM (11 U)	Area (m)(approximate)	AOC Description
1	504407E, 5500053N	5 x 5	Bench #1, small elevated bench above lake.
2	504424E, 5500070N	5 x 10	Bench #2, small elevated bench above lake.
3	504517E, 5500115N	10 x 5	Bench #3, small elevated bench above lake.
4	504555E, 5500142N	20 x 5	Bench #4, small elevated bench above lake by creek/talus slope by creek.
5	504663E, 5500200N	30 x 20	Bench #5, elevated bench above lake by creek/talus slope adjacent to private property.

At the end of the traverse of the proposed development area, adjacent to the private property located at 504663E, 5500200N (Photo 13), the survey crew turned back southwest towards the POC of the traverse surveying along the beachfront and at the base of the lakeshore slope. Numerous large bounders, pebbles, cobbles, and bedrock outcrops were observed along the beachfront (Photos 13 and 14). In addition, a number of petroforms (rock circles) were observed along the beach, many associated with recent fire rings, and recent modern refuse suggesting that the petroforms are of relatively recent origin, likely associated with the clothing optional use of the beachfront by locals (Fraser Bonner, personal communication 2015) and/or local squatters (Photos 16-19). Small wetlands were observed at the mouths of some of the small creeks observed as they flow into Kootenay Lake. Numerous sawcut logs, modern refuse, and squatters' camps were observed along the beach and along the lakeshore.

Portions of the proposed development area have clearly been selectively logged. The remaining forest cover is young and sparse and consists primarily of lodgepole pine, fir, willow, and alder with some more mature western redcedar also being observed near the end of the proposed development area. The understory is sparse and includes various mosses, grasses, and ferns.

Photo 1: View of Highway 31 and the start of the proposed access road looking southwest.

Photo 2: View of edge of the existing slope, the location of the proposed access road leading to the proposed ferry terminal.

Photo 3: View of the proposed access road location looking northwest towards Queens Bay.

Photo 4: Typical rocky terrain along the proposed access road ROW.

Photo 5: Typical terrain along the proposed access road ROW.

Photo 6: Typical terrain along the proposed access road ROW.

Photo 7: Bench #1 along the proposed access road ROW.

Photo 8: Denise Walker (Ktunaxa Nation) examining Bench #2 along the proposed access road ROW.

Photo 9: Bench #3 along the proposed access road ROW/ferry terminal.

Photo 10: Bench #4 along the proposed access road ROW/ferry terminal.

Photo 11: Large boulder within Bench #5 along the proposed access road ROW/ferry terminal.

Photo 12: Talus slope by creek near the end of proposed development area.

Photo 13: Private property to the north of the proposed development area.

Photo 14: The proposed terminal location looking southwest.

Photo 15: Denise Walker (Ktunaxa Nation) examining the location of the proposed terminal along the shoreline.

Photo 16: Squatters' cabin(?) with tarp along lakeshore.

Photo 17: Circular petroforms and associated recent firepits along lakeshore.

Photo 18: Squatters' cabin with tarp along lakeshore.

Photo 19: View of one of the recent petroforms (rock formations of recent human origin) located along the shoreline of Kootenay Lake.

Recommendations

Based on the results of the search of RAAD, the pre-field archaeological site potential assessment, the results of the Preliminary Field Reconnaissance survey, the known traditional usage of the general area, and the various areas and landforms with archaeological potential observed, it is author's opinion that the proposed Queens Bay terminal and access road development should be subjected to an Archaeological Impact Assessment under a permit issued under Section 14 of the Heritage Conservation Act (1994). It is recommended that:

- In advance of the detailed engineering phase of the project an Archaeological Impact Assessment is undertaken.
- Prior to the Archaeological Impact Assessment being conducted, all appropriate First Nations permits are applied for and received.
- The Archaeological Impact Assessment concentrate on the Areas of Concerns identified during the Preliminary Field Reconnaissance survey.
- A detailed surficial survey along the lake shoreline is undertaken.
- Subsurface testing as appropriate, based upon surficial findings, is conducted prior to any development taking place.
- The two talus slopes observed within the proposed development area s be systematically surveyed for the presence of prehistoric burials.

We trust that this letter has provided you with the information that you require. Please do not hesitate to call us if you have any questions or require additional information. Thank you for the opportunity to conduct this study.

Sincerely,

Dave Hall

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1981 Final Report on a Survey of Kootenay Lake Pictographs. Heritage Inspection Permit 1980-0009. Report on file at the Archaeology Branch at the Ministry of Forests, Lands, and Natural Resource Operations.

Appendix F – Sewage Treatment Report

Certifié ISO 9001

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Victoria, British Columbia
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Telephone: (250) 360-3510
Facsimile: (250) 360-3519

May 21, 2015 Project 627472

SNC-Lavalin Inc., Ports and Marine
1075 West Georgia St
Vancouver BC

ATTENTION: Keith Dunbar, P. Eng., Project Manager

REFERENCE: Balfour Ferry Sewage Treatment Study

INTRODUCTION

In response to a request from the Ministry of Transportation and Infrastructure (MOTI), SNC-Lavalin Inc. (SLI) is tasked with undertaking a technical feasibility study for replacing the Balfour ferry terminal on Kootenay Lake with a similar terminal in a more suitable and technically feasibly location. MOTI is seeking a recommendation from SLI on a preferred terminal location, along with the information necessary to rationalize the recommendation.

The technical feasibility study will have several components, including a sewage treatment study which forms the basis of this report. The sewage treatment study builds upon the 2010 S.H.M. report[1], a detailed study previously completed for MOTI that examined the existing sewage systems and processes for the Kootenay Lake ferries and Balfour terminal, and developed options for future modifications to the sewage handling plan.

The findings and recommendations of this sewage treatment study will be aggregated into the technical feasibility study and contribute to the recommendation to MOTI regarding the preferred terminal location.

SCOPE OF WORK

The scope of work for this sewage treatment study generally involves a review of options for the treatment of sewage generated by the ferry operation at the proposed Queens Bay North location. It will analyse the feasibility, scope of work, risks, financial impact, and other considerations for each option.

[1] S.H.M. Marine International Inc. – Kootenay Lake Sewage Handling Study – March 2010

The study will provide a recommendation regarding the optimal sewage treatment strategy for the ferry operation, and quantify the necessary holding capacity on board the vessel based on this recommendation.

METHODOLOGY

The sewage treatment study is a desktop report that primarily involves analysing information about the ferry operation and applying current knowledge about sewage treatment options in the appropriate regulatory environment.

Specifically, the following activities were conducted as part of the sewage treatment study:

- Review of the 2010 S.H.M. report.
- Review of the regulatory environment, including but not limited to:
    - Transport Canada Regulations for the Prevention of Pollution from Ships.
    - Environmental Management Act, Municipal Wastewater Regulation.
    - Public Health Act, Sewerage System Regulation.
- Interviews with various technical professionals regarding leading wastewater treatment technology options for the ferry operation.
- Interviews with local septic services providers regarding wastewater removal options for the ferry operation.

BACKGROUND INFORMATION

The following information and assumptions contributed to this analysis. Further details of the sewage loading are presented in Exhibit A.

1. Ferry operations:
    - The M.V. Balfour is retired.
    - The M.V. Osprey is the sole vessel operating on the route year round, making 20 one-way trips per day.
    - A ferry terminal will provide washroom facilities for staff, and also for passengers waiting in the holding compound.
    - All traffic volumes remain constant.

2. Sewage load estimation (year-round daily average):
    - 5.76 m^3/day Vessel sewage production
    - 2.52 m^3/day Terminal sewage production
    - 8.28 m^3/day Total sewage production

3. Sewage load estimation (peak season daily average):
    - 8.39 m^3/day Vessel sewage production
    - 3.25 m^3/day Terminal sewage production
    - 11.64 m^3/day Total sewage production

4. Sewage load estimation (peak loading[2]):
    - 18 m^3/day   Vessel sewage production
    - 5 m^3/day   Terminal sewage production
    - 23 m^3/day   Total sewage production

It should be specifically noted that this study did not endeavour to reproduce the previous data collection and analysis contained within the S.H.M. report, such as estimates of traffic or sewage loading. That information is assumed to have remained unchanged.

OPTIONS SUMMARY

There are three (3) high-level sewage treatment options for the ferry operation listed below, and presented in detail in the following section. Each option considers how to treat wastewater generated from both the vessel and the terminal. The options are as follows:

1. Don't treat wastewater, pump to truck for off-site disposal.
2. Treat wastewater on the vessel.
3. Treat wastewater at the terminal.

Brief consideration was given to a fourth option that involved the vessels pumping wastewater ashore and connecting the ferry terminal to the nearest municipal system. That type of solution has long-term benefits such as low operating costs, low risk to the environment, and operational reliability. However, in this case the significant distance to the nearest municipal system would result in significant capital costs that offset other potential benefits. This option was therefore not analysed any further.

OPTIONS ANALYSIS

<u>Option #1: Don't treat wastewater, pump to truck</u>

This option involves the vessel temporarily holding its wastewater on board during operations in tanks, and then pumping to a vacuum truck which would then dispose of the wastewater at the nearest landfill/lagoon (located in Castlegar). The wastewater from the terminal would also be discharged to a vacuum truck. It is expected that the truck service would be required daily.

<u>Scope of work:</u>

- Install a new holding tank on the vessel (or convert an existing tank, pending an inspection).

[2] Peak load sewage estimates based on discussions with Ferry Operator. Note that the sewage system draws water from the lake and does not measure the discharge volumes, so these estimates are not calculated, they are based on operator experience.

- Install pump ashore infrastructure on the vessel so that the truck connection point is easily accessible.
- Install a land-based holding tank system to collect and temporarily hold terminal sewage.

Technical feasibility:

- Yes, this option is technically feasible.
- There are limitations to the maximum size of the vacuum trucks currently servicing this region (maximum 15.5 m^3). It is expected that a truck may be required daily year round, and during peak periods more than one truck may be required daily.

Risks:

- There is low environmental risk because the wastewater will not be treated on board the vessel nor discharged into the lake.
- There is low operational risk for the same reason as stated above, i.e. the likelihood of a service interruption related to sewage treatment is very low.

Financial impact:

- Capital costs[3] include:
  - For the vessel, a converted (or new) holding tank and pump ashore appurtenances connecting the vessel to the berth to the land-based holding plant. Order of magnitude cost estimate of [redacted] (assumes new tank).
  - For the terminal, a land-based holding tank system for temporary storage of wastewater. Order of magnitude cost estimate of [redacted]
- Operating costs include the fees for the vacuum truck service:
  - Labour costs amount to [redacted]/hr and include driving to the site, pumping out the sewage, and driving to the disposal lagoon.
  - Disposal costs amount to [redacted]/imp gallon.
  - Assuming daily service, the estimated total cost is approximately [redacted] per day, or approximately [redacted] per year.
  - It should be noted that MOTI could potentially negotiate a lower daily rate with a service provider over a long-term service contract.

Option #2: Treat wastewater on the vessel

This option involves the M.V. Osprey 2000 treating the sewage generated on board using an upgraded sewage treatment plant (STP), and then discharging treated effluent into Kootenay Lake. Terminal wastewater would be treated using a land-based wastewater treatment system.

Scope of work:

- Replace the two existing STPs on board the M.V. Osprey 2000 [redacted].

[3] Cost estimate based on data within 2010 S.H.M. report and estimates of current market costs.

- Install a land-based system to treat terminal sewage, and discharge effluent to a drain field.

Technical feasibility:

- Yes, technology exists that can treat the ship-generated sewage to an acceptable regulatory level.

Risks:

- There is significant environmental and operational risk due to the stringent regulatory oversight, both now and likely more so in the future. If the STP was not in compliance with regulations, [redacted] the possibility exists that service on the route could be interrupted for environmental reasons. This is especially relevant with a single vessel operating on the route, i.e. no backup vessel available.

Financial impact:

- Capital costs[4] include:
  - For the vessel, an upgraded STP and appurtenances. Order of magnitude cost estimate of [redacted]
  - For the terminal, a land-based wastewater treatment system and drain field. Order of magnitude cost estimate of [redacted]
- Operating costs include regular maintenance for the vessel STP and the land-based system. Order of magnitude cost estimate of [redacted] per year.

Option #3: Treat wastewater at the terminal

This option involves the vessel temporarily holding its wastewater on board in tanks during operations, and then pumping ashore while in dock to a land-based wastewater treatment system. The wastewater from the terminal would also feed into this system, and the combined effluent would be discharged into a drain field.

Scope of work:

- Install a new holding tank on the vessel (or convert an existing tank, pending an inspection). This tank should be sized to accommodate peak daily loading plus an appropriate contingency to accommodate outlier loads and future growth. A tank size of approximately 25 m^3 is recommended.
- Install pump ashore infrastructure on the vessel, and related piping, valves, and other appurtenances on the ramp and then underground (likely) across the terminal grounds leading to the land-based treatment plant.
- Install a land-based system to treat terminal sewage, and discharge effluent to a drain field.
  - Based on the loading estimates summarized in Exhibit A, it is recommended that the land-based system is sized to accommodate up to 25 m^3 per day. Note that a packaged plant is expected to process a full load within a day.

[4] Cost estimate based on data within 2010 S.H.M. report and estimates of current market costs.

- There are several manufacturers that produce small packaged plants that can accommodate this type of loading. These systems commonly utilize 1 or 2 holding tanks that divide the treatment process (e.g. a septic holding tank and a treatment tank).
    - The total capacity of this system would be approximately two times loading. In other words, to accommodate loading of 25 m^3 per day, the tank capacity of the treatment plant should be approximately 50 m^3.
- Install a drain field at the terminal to receive and disperse the treated effluent.
    - The type and size of the drain field is dependent upon a geotechnical analysis of the ground conditions at the site.
    - For concept planning purposes, it can be assumed that a drain field of approximately 250 m^2 to 500 m^2 would be required.

<u>Technical feasibility:</u>

- Yes, pump ashore technology exists and is becoming more common in marine applications such as this.
- Yes, small packaged treatment plants do exist for land-based treatment of domestic waste such as that produced on board the vessel and at the terminal.

<u>Risks:</u>

- There is low environmental risk because the wastewater will not be treated on board the vessel, nor discharged into the lake.
- There is low operational risk for the same reason as stated above, i.e. the likelihood of a service interruption related to sewage treatment is very low.

<u>Financial impact:</u>

- Capital costs include:
    - For the vessel[5], a converted (or new) holding tank and pump ashore appurtenances connecting the vessel to the berth to the land-based treatment plant. Order of magnitude cost estimate of [redacted] (assumes new tank).
    - For the terminal[6], a land-based wastewater treatment system and drain field. Order of magnitude cost estimate of [redacted] total for both the treatment plant and the drain field.
- Operating costs include quarterly maintenance for the land-based system to remove sludge and check equipment such as pumps and filters. Order of magnitude cost estimate of [redacted] per year.

RECOMMENDATION

SLI recommends *Option #3 – Treat Wastewater at the Terminal*. This option provides a long-term solution to the sewage treatment needs for the ferry operation, and does so with the least risk of all the options considered. In addition, the capital cost of this option

[5] Cost estimate based on data within 2010 S.H.M. report and estimates of current market costs.
[6] Cost estimate based on industry experience and discussions with sales representatives for packaged plants by Bionest and Bioharmony, two manufacturers with regional experience.

is competitive with the option of treating wastewater on the vessel, and the operating cost is minimal when compared to the option of pumping wastewater to a truck.

CLOSURE

I trust this provides you with the information you require. If you have any questions, please contact the undersigned at your convenience.

DSMcWalter

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EXHIBIT A: SEWAGE LOADING

The following calculations were used to determine sewage loading. All base data was referenced from the 2010 S.H.M. report[7].

Source		**Daily Average Year Round (m^3)**	**Daily Average Peak Season (Jun-Sep) (m^3)**
Vessels	MV Osprey 2000	5.76	5.76
	MV Balfour	-	2.63[8]
Terminals	Office	0.15	0.15
	Rest Area (Highway Users)	2.37	2.37
	Rest Area (Ferry Users) [9]	-	0.73
TOTAL		**8.28**	**11.64**

[7] All data refers to the "Most Probable" estimate using the PERT method.
[8] It is assumed that the vessel loading data remains unchanged when the MV Balfour is retired. In other words, the combined load is produced by a single vessel rather than being split between two vessels.
[9] It is assumed that the loading from the rest area from ferry users primarily occurs during peak season, as stated in the S.H.M. report.

Appendix G – Site Evaluation Review

Site Evaluation Matrix - Grading Results

Note Score 1 to 5 - Needs Improvement Score 6 to 10 - Level of Improvement		Balfour Terminal (Improved)		Queens Bay South		Queens Bay North	
Assessment Criteria	Weighting Factor	Score Factor 1 - 10	Weighted Score	Score Factor 1 - 10	Weighted Score	Score Factor 1 - 10	Weighted Score
SAFETY							
Highway Traffic and Highway Intersection and Queuing Area	20	5	100	7	140	10	200
Marine Transit	20	4	80	8	160	8	160
SERVICE							
Transportation (Intersection, queuing area, marine transit)	15	5	75	6	90	10	150
COMMUNITY / STAKEHOLDER IMPACT							
Highway Traffic and Highway Intersection and Queuing Area, marine	15	5	75	2	30	5	75
ENVIRONMENTAL IMPACT							
Highway Traffic and Highway Intersection and Queuing Area	5	6	30	4	20	4	20
Marine Transit	5	4	20	6	30	8	40
Sewage	5	5	25	9	45	9	45
FINANCIAL							
Transportation (Intersection, queuing area, marine transit)							
Capital cost	7.5	5	37.5	2	15	6	45
Operating cost	7.5	3	22.5	3	22.5	10	75
		total	465	total	553	total	810

Appendix H – Automobile Equivalent Units Appendix

Automobile Equivalent Units

The car carrying capacity for the MV Osprey 2000 and the MV Balfour are based upon standard units referred to as automobile equivalent units (AEU). The dimensions of one AEU are 2.1 m (7 ft) by 6.1 m (20 ft). Larger vehicles, such as camper vans, take up more space than a passenger car, and hence the total number of overall vehicles on the vessel would be less. Table 1 provides the automobile equivalent units for the various vehicle types.

Table 1 - Automobile Equivalent Units for Various Vehicle Types

Vehicle Type	Automobile Equivalent Units (AEU)
Automobile and Pickups	1.0 AEU
Commercial Trucks under 9 m	1.5
Commercial Trucks under 12 m	2.0
Commercial Trucks over 12 m	3.0
Resource Trucks under 24 m	3.5
Resource Trucks over 24 m	4.0
Semis under 24 m	3.5
Semis over 24 m	4.0
Recreation Vehicles under 6 m	1.0
Recreation Vehicles over 6 m	2.0
Buses	3.0
Trailers or Tow-ons	1.5
Motorcycles	0.5

Appendix I – Historic Traffic Volumes

Historic Traffic Volumes

Figure 1 and Figure 2 illustrate the trend in traffic volumes over the last 10 years in the general study area, represented by annual statistics of vehicles on Highway 31 at Kaslo, and on Highway 3A at Harrop, respectively.

Figure 1 - Highway 31 Historic Traffic Volume - Kaslo

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
AADT		2022			1756			1827		
ASDT		2821			2474			2481		

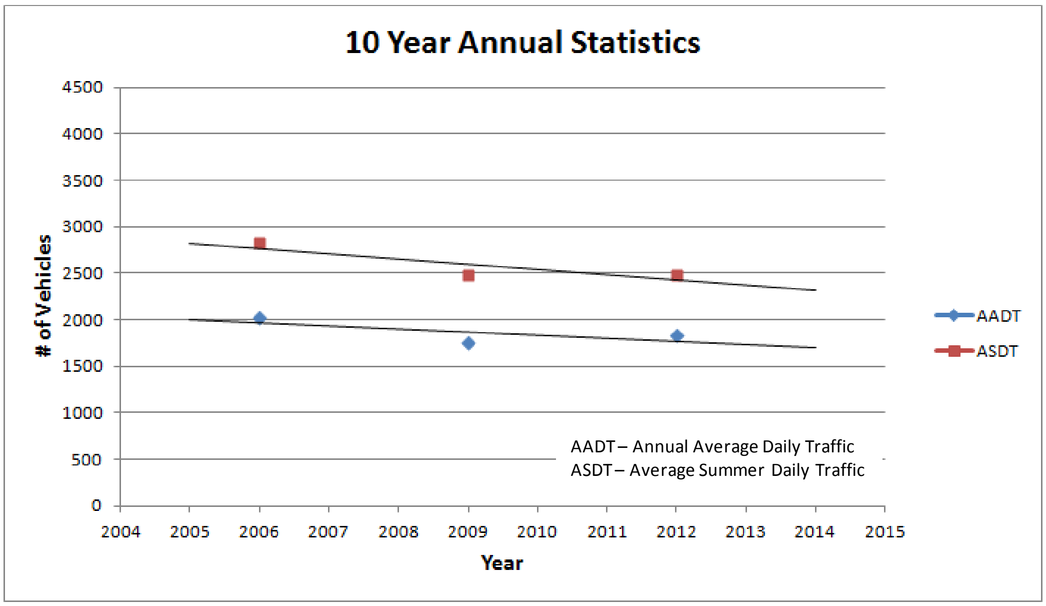
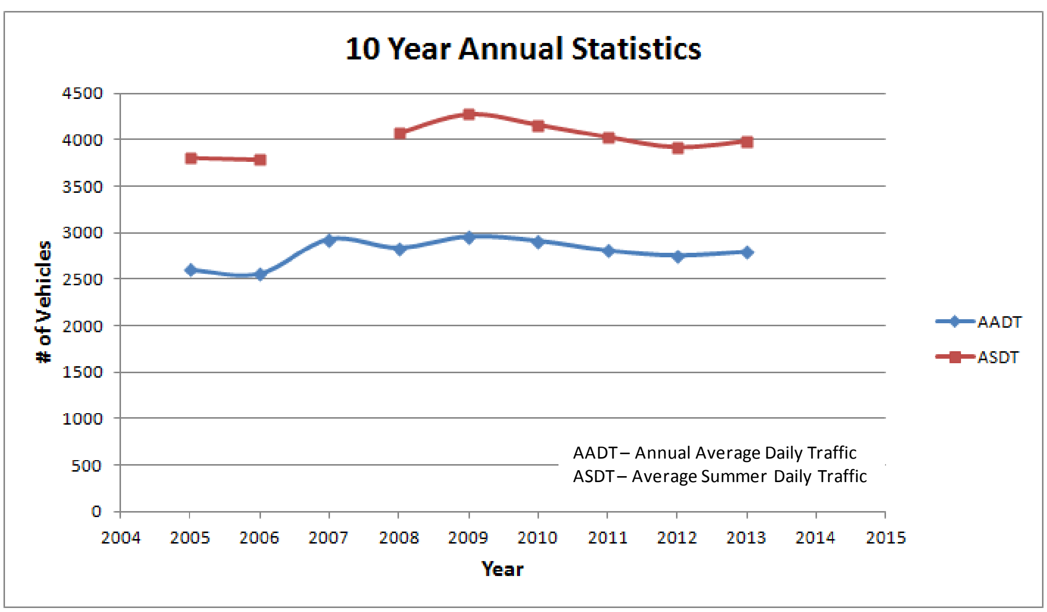


Figure 2 - Highway 3A Historic Traffic Volume - Harrop

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
AADT	2602	2559	2924	2835	2953	2908	2805	2753	2794	
ASDT	3808	3785		4072	4273	4162	4031	3923	3988	

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