5. LNG PORT TERMINAL PROPOSAL FOR SITES UNDER STUDY

5.1 LAYOUT PROPOSAL

A typical LNG receiving port terminal includes the following components:

- Four breasting dolphins, aligned over a total distance of approximately 150 m to form the berthing station. These dolphins are equipped with fenders designed to withstand berthing impacts;
- A central section housing the LNG unloading equipment. For safety reasons, this platform is placed in a recessed position with respect to the berthing face in order to avoid any impact from the ship;
- A total of six mooring dolphins, three units at each end of the berthing station, positioned about 35 to 50 m behind the berth face alignment. This offset position results in smaller vertical angles in the mooring lines and thus ensures better efficiency to maintain the ship in a stable position during unloading operations.

Moreover, due to the particular ice conditions on the St. Lawrence river and based on Ultramar's excellent operating experience at the St. Romuald terminal for more than 30 years, it appears essential to include in the facility two additional cells designed specifically for stabilizing the ice cover and preventing floating ice floes from reaching the berthing area from upstream.

All dolphins, with the exception of the central platform, are equipped with "quick release" hooks and capstans to ensure, on the one hand, very stable mooring of ships essential for the safety of the LNG unloading operations, and, on the other hand, the capability of a quick departure from the berth, in case of an emergency.

Figures 5.1 to 5.6 show specific layout proposals for each site under study. These proposals have been developed taking into account the physical and hydrodynamic conditions described in a previous chapter. For each site, the general location of the berth is superimposed onto the bathymetric map (Figures 5.1, 5.3 and 5.5) and a general arrangement drawing (Figures 5.2, 5.4 and 5.6) presents in plan and in elevation, the main dimensions and technical features of the proposed layout. A turning area (= 2 x ship length) and anchorage area are also shown at each site.

Ville Guay Site

Accounting for the bathymetric conditions in the Ville Guay area, the berthing station is established approximately 250 to 300 m away from the shoreline, near the 15 m isobath (this corresponds to the water depth at mean lower low water, since it is referred to the chart datum). This distance from the shoreline is about equal to that of the island surrounding the base of the south tower of the high voltage power line crossing to Île d'Orléans, located a few kilometres downstream from the dock. This is a reasonably favourable situation from a navigation standpoint: on the one hand, the island, which is not too far offshore, does not obstruct the movement of the incoming ship in its final approach; on the other hand, both structures, the dock and the island, will contribute in stabilizing the edge of the shore-fast ice during the winter months, which will therefore tend to be aligned with the isobath, and therefore not obstruct navigation.

Due to the probable nature and geotechnical properties of the overburden and bedrock on the river bottom, dolphins consisting of concrete gravity caissons resting on a stone base placed and levelled under water. The caissons are filled with quarry stones and/or gravely material and topped with a concrete slab. It should be kept in mind that this interpretation of geotechnical conditions rests on data obtained from locations several kilometres away from the site, and is therefore rather unreliable. It will be of course essential, in the next phase of studies, to conduct a suitable geotechnical reconnaissance program at the actual site of the project.

Access to the dock is ensured by means of a road supported on a rock fill jetty starting from the shoreline about 100 m long, followed by a steel bridge supported on piers spaced at 75 m intervals approximately. This bridge will be designed for a vehicle of the size of a pick-up truck and permit access to the centre of the berth, where the LNG unloading arms are located. The bridge will be about 3 m wide, and therefore restricted to one-way usage. Beyond the central portion, access to the other mooring dolphins or ice protection dolphins, will be on foot only.

In Figure 5.2, the jetty is shown connected to the berth from the upstream side, in an L-shaped configuration, although a T-shape, with the jetty connected directly to the centre of the berth, is most common in LNG terminals. The choice of the final configuration should be validated in subsequent phases of the design, based of functional requirements, access needs to each part of the dock, ease of access for maintenance purposes, lay-down and pick-up areas for consumables, components and spares, etc.

Pointe Saint-Denis

In this general vicinity of the coast, Rivière Ouelle was the first location to be considered, but it was decided that this quiet coastal community was not suitable for an industrial development. The focus was therefore moved several kilometres downstream to Pointe St. Denis, where there are only a few houses.

The very wide coastal margin in this general area requires the establishment of a 3 km jetty in order to reach the 15 m isobath. This situation is evidently most unfavourable from a construction cost perspective, but it also creates a substantial interference to small craft navigation. Remoteness from shore renders regular supply and maintenance operations much more difficult and time-consuming. It also makes it more difficult to react quickly to emergency situations.

Given the extreme seismic exposure of the site (in fact one of the most seismically active zones in Canada), the dolphins would likely have to be supported on steel piles to minimize the mass of the structures. Based on geotechnical properties of the river bottom, penetration of the piles into the riverbed would probably have to reach some 20 to 30 m. It is noted once again that geotechnical assumptions are very uncertain, being based on extrapolation of a few borings taken from several kilometres upstream, and also much closer to shore.

In this layout, as for the previous one, a part of the jetty would be built from rock fill extracted from a near-by quarry, yet to be identified. Because of local eel fishing and small craft navigation, it is likely that this solid jetty could only be acceptable for a short distance from shore. We have assumed this to be about 300 m, which is only slightly longer than the existing jetty at Rivière Ouelle. The rest of the road reaching out to the berth is a bridge resting on piers.

Gros Cacouna

At Gros Cacouna, the water depth increases very rapidly, reaching 15 m a few 200-250 m from shore. This bathymetric condition is similar to that at Ville Guay.

The soil profile consists in a relatively soft layer near the surface, inadequate as a foundation material, underlain by a much stiffer clay layer, which could support a gravity structure. Therefore, concrete caissons of the type proposed for Ville Guay would be used here, but the soft surface material would have to be removed first. It has been assumed, for developing the cost estimate, that 5 to 10 m of material would have to be dredged. As before, this assumption will need to be verified by a site-specific geotechnical reconnaissance program in due course.

Considering the uncertainty level of this pre-feasibility evaluation, an alternative scheme has also been discussed briefly for the particular case of Gros Cacouna, for the eventuality of having to provide a better sheltered berth in order to ensure safety of berthing / unberthing manoeuvres and of unloading operations. This alternative layout would include:

- a rock breakwater 500 m long, parallel to the shoreline, to give protection against N-NW winds, waves and ice,
- an open structure causeway built on piles, allowing tidal currents to flow through the berthing area. In comparison with the actual layout shown on Figure 5.5, this proposal would require a 200 m seaward extension of the access bridge,
- as compared to the actual layout comprising 13 cells, this proposal would require 7 cells, the six mooring cells being replaced by concrete bases embedded in the jetty,
- the width of the berthing area would be 5 times the ship breadth with a minimum water depth of 13,4 m at tow tide (= 11,7 m draught + 15% underkeel clearance), allowing tugboats to position themselves on the shore side of ship during berthing manoeuvres.

At this point, neither the necessity nor the effectiveness of this arrangement have been demonstrated, its presentation aiming only at foreseeing sufficient budgetary provision on a comparative basis with the other alternatives considered. The preliminary cost estimate presented in Table 5.1 is based on this layout but more detailed engineering would be required at a later stage of the project in order to establish its final validation.

5.2 AIR SPACE UNDER THE HIGH VOLTAGE POWER LINE AT VILLE GUAY

The Ville Guay site presents a particular situation due to the presence of a high voltage (735 kV) power transmission line belonging to Hydro-Québec, crossing from the south shore to Île d'Orléans over the navigation channel. This crossing is located approximately 1,3 kilometres downstream from the proposed site for the LNG marine terminal. The central span of the crossing, between the suspension towers, is 1 580 m long.

In general, LNG carriers have a much greater sail (but smaller draft) than other ships of similar dimensions. Temperatures of the electric conductors and potential accumulations of ice have a major effect on the sag of the conductors. Since a minimum distance must be maintained between the conductor and the ship, access to the berth as a function of the loading of the power line and the water level in the river becomes an issue to be examined.

The 2003 edition of the bathymetric chart published by the Canadian Hydrographic Service (CHS) indicates that the vertical clearance available between the water at high tide (+5,7 m) and the power line is 53 m in normal conditions, reducing to 44 m under "severe" icing. The chart does not specify the frequency of occurrence of these conditions.

It is noted that the clearances mentioned above provide a residual air gap of 6.4 m between the obstacle and the conductor, a safety margin required to avoid formation of an electric arc from the 735 kV line. In other words, the clearance corresponds to the maximum allowable height of any part of the ship above the water line, i.e. the sail height.

The restrictions mentioned above correspond to the centre of the span, where the sag is maximum. This is also close to the middle of the river. The pilots of the Lower St. Lawrence have confirmed that they navigate in a corridor offset towards the south shore or the north shore when required, which allows them to gain additional air space as they pass closer to the suspension tower, away from the centre of the span. This trajectory would be natural for LNG carriers approaching the dock on the north shore before initiating the turning manoeuvre in front of the berth. Considering also that these vessels have a relatively small draft, the water depth would pose less of a constraint than for other major ships.

Figure 5.7 illustrates that there may be a corridor in the center of the river unaccessible to some LNG carriers. The most constraining situations occur with the highest ships passing under the power lines at high tide in ballasted conditions. This issue will have to be addressed carefully in the next stage of the project assessment. At this point, considering that very high cruise ships have already crossed under the power lines it is believed that it should not be a major constraint to this project but this has to be ascertained.

5.3 CAPITAL COST OF PORT INFRASTRUCTURE (CAPEX)

Table 5.1 presents preliminary cost estimates for the port infrastructure at each of the sites, based on the available information and assumptions described hereabove. Given the uncertainties on some of the data, particularly on the topographical, bathymetric and geotechnical conditions, these budgetary provisions require a contingency margin of 25% of the total estimate.

For Ville Guay and Gros Cacouna (without breakwater), the construction costs may be considered to be about equivalent, to the degree of accuracy currently possible. The marginally higher cost at Gros Cacouna is attributable primarily to the seismic conditions, which are more severe than at Ville Guay.

The Gros Cacouna alternative layout comprising a rock breakwater would represent a construction cost some $ 35 millions higher than the base solution. As mentioned previously, the necessity of such a sheltered berthing station has not been proved at this point, considering the present level of knowledge and understanding of the climatic and hydrodynamic conditions at the site.

Pointe St. Denis appears to be clearly disadvantaged due to the high seismicity, and the great length of the jetty required to attain an appropriate water depth of 15 m. Construction costs at Pointe St. Denis are more than double those at the other sites. An alternative for reducing costs would be to move the berth closer to shore and to dredge a suitable area on front of the berth. However, a cursory examination of this option indicates that the initial dredging quantities would be on the order 6 to 8 million m^3 , if a 50% reduction of the distance offshore is considered. This still leaves a long jetty of 1.5 km. Moreover, it is certain that regular maintenance dredging would be required to compensate the effect of the littoral sediment transport, which would tend to fill the artificial channel, although at a rate which cannot be predicted without further analysis and modeling. Based on past experience with various dredging projects in various locations of the St. Lawrence, this approach does not appear viable from an environmental standpoint, due to the huge quantity involved initially as well as the repeated maintenance interventions most likely to be required. Moreover, this approach does not appear to have any evident economic advantage either, since initial dredging costs, estimated at $4/m3, are in the range of $24M to $32M whereas the infrastructure construction cost reduction should be in the range of $ 15 millions (Ref: Table 5.1: the cost reduction would affect item 5 – Bridges and gangways by 50% approximately, i.e 1,5 km vs 3 km).

The cost estimate shown in Table 5.1 is in Canadian dollars, as of November 2003. The following items are not included:

Pipelines and related equipment,

Access roads (Ville Guay and Pointe-Saint-Denis),

Power supply (from Hydro-Quebec network),

Potable water (from municipal network),

Cost escalation,

Land acquisition,

Owner's costs,

Operational costs,

PST and GST.

Table 5.1 - Preliminary Construction Cost Estimate (CAPEX)

	Description	Total Cost (x $ 1 000 CAN)			
		Ville Guay	Pointe Saint-Denis	Gros-Cacouna	Gros-Cacouna with breakwater
1	Worksite Organization	$ 3 500	$ 9 000	$ 4 000	$ 5 000
2	Dolphins - Concrete circular cells (incl. Reinforced concrete, towing and placement, foundation, backfilling)	$ 29 000	---	$ 35 000	$ 24 000
3	Dolphins - Concrete decked platforms on steel piles	---	$ 57 000	---	---
4	Bridges and Gangways	$ 2 800	$ 32 000	$ 2 500	$ 14 000
5	Access Jetty and Breakwater	$ 2 300	$ 2 200	$ 900	$ 25 000
6	Berthing and Mooring Equipment (Bollards, Capstans, Fenders)	$ 1 200	$ 1 200	$ 1 200	$ 1 200
7	Electricity and Mechanics (On-Site Distribution Networks - Power, lighting, water, fire protection)	$ 350	$ 800	$ 300	$ 1 000
8	Contingencies (25 %)	$ 9 800	$ 25 600	$ 11 000	$ 17 000
	Total Construction Cost	**$ 48 950**	**$ 127 800**	**$ 54 900**	**$ 87 200**
	Engineering and technical studies, Site surveys (topo-bathymetry, geotechnics), Environmental studies, including public hearings (BAPE), Work supervision	**$ 3 750**	**$ 7 000**	**$ 4 000**	**$ 5 000**
	Total Project Cost	**$ 52 700**	**$ 134 800**	**$ 58 900**	**$ 92 200**

Not included in the cost estimates:

Pipelines and related equipment
Access roads (Ville Guay and Pointe St. Denis)
Power supply (from Hydro-Quebec network)
Potable water (from municipal network)
Cost escalation
Land acquisition
Owner's costs
Operational costs (OPEX)
PST and GST

5.4 OPTIMIZATION OF PORT INFRASTRUCTURE DESIGN

It must be emphasized that the general arrangements of the port facilities presented above and the corresponding cost estimates require further optimization. We believe reasonably conservative assumptions have been used and therefore, we would expect that further refinements in the data and in the design could possibly entail significant reductions to the construction budget.

At the client's request, layout proposals have been developed largely inspired by existing LNG terminal facilities in Europe, where the number of distinct berthing and mooring dolphins is typically four (4) and six (6) respectively, added to an independent central unloading platform for the process equipment, as discussed in section 5.1. In general, mooring dolphins, which are recessed behind the berthing face, do not have to be designed for the ship berthing impact forces, which allows their size and cost to be substantially reduced, compared to the berthing dolphins.

In this case, the particular ice conditions along the St. Lawrence River, which are not in common with any other LNG terminal, require at least two additional protective cells upstream from the berth, to help stabilize the land-fast ice, and reduce or eliminate impacts from floating ice. Such protective cells have been constructed in the early seventies at the Ultramar's marine terminal, which has been operated successfully for the least 30 years. Because of the presence of ice, all dolphins must be designed to withstand large horizontal loads, which are much larger than the berthing loads. For Ville Guay, lateral ice loads are similar to earthquake loads, and earthquake governs at Gros Cacouna. Therefore all dolphins at a given site are subjected to lateral loads of a similar magnitude, and are therefore of a similar size.

The number and position of mooring dolphins must be determined primarily to provide a very rigid attachment of the ship so that it has a highly stable berthing position in the longitudinal direction. However, because of the large diameter of the cells in this case, it appears feasible to use each cell more effectively by increasing the number of moorings attached to each, for example to have two (2) « Quick Release » hooks placed side by side on a cell, rather than a single one in the centre. Further study of the mooring strategy should be conducted in a subsequent phase of the project, and this could lead to a reduction in the number of dolphins, and therefore a significant reduction in costs. This work will be based on the recommendations of the Oil Companies International Marine Forum (OCIMF, 1977).

Further study of the berthing arrangement may also lead to a reduction of the number of cells, from two (2) to one (1) on each side of the central unloading platform.

The various conceptual schemes presented in Figure 5.8 help visualize this discussion. Scheme A incorporates thirteen (13) dolphins. Notwithstanding the two (2) additional ice dolphins, which are deemed necessary along the St. Lawrence, the eleven (11) berthing and mooring cells are standard for an LNG terminal.

Scheme D shows the layout at the Ultramar terminal, which includes a total of eight (8) cells, including the ice dolphins. It should be noted that this terminal is designed for the simultaneous presence of ships on both sides of the dock, with the inside position being restricted to smaller vessels. This is why the downstream mooring cells have to be aligned along the berthing face.

Schemes B and C correspond to intermediate solutions, where mooring cell or breasting cells are combined as explained earlier. Cost vary substantially amongst the various solutions: the differential can be estimated roughly from the different number of cells, each costing approximately $ 2,5 M.

5.5 Operational Expenditures (OPEX)

5.5.1 Pilotage

The pilotage charges are established as a function of ship dimensions (length, beam, height, tonnage) and also according to the services rendered. Typical services listed in the Laurentian Pilotage Authority's (LPA) price list include (Ref: Canada Gazette Part II, Vol. 137, No.1):

- Trip
- Movage
- Anchorage during a trip or a movage
- Docking of a ship at a wharf or pier at the end of a trip
- Request by a master. owner or agent of a ship for a pilot designated by the Corporation to perform a docking or undocking
- Detention of a pilot at a pilot boarding station or on board ship
- Ship movements required for adjusting compasses
- Pilot carried on a ship beyond the district for which the pilot is licensed.

For a typical LNG carrier ship, preliminary pilotage cost simulations obtained from LPA give the following estimates (CAN dollars 2003, excluding applicable taxes), based on the assumptions listed hereafter:

- 2 pilots on board
- Intervention of a docking pilot for docking-undocking manoeuvres
- No detention on board during unloading operations
- Frequency of trips: 1 / week or 52 per year

	Pilotage Cost per Trip / Annual (x 1000 CAN dollars 2003, excluding applicable taxes)		
SITE	**Ville-Guay**	**Pointe-Saint-Denis**	**Cacouna**
Summer period (35 weeks / year)	51	43	42
Winter period (17 weeks / year)	56	45	44
Annual (rounded)	**2 740**	**2 270**	**2 220**

The higher cost expected during winter period is due essentially to delays related to adverse weather conditions. Based on past experience, it is assumed that the cost increase with respect to summer cost would be 5 – 10%.

5.5.2 Tugboating

The tugboating cost can be evaluated on the basis of official rates published by the Shipping Federation of Canada (SFC) or using effective costs applied by Ocean Group, a private marine operator based in the Port of Quebec, and primary supplier of tug services in the St. Lawrence estuary and river. These rates are established as a function of the ship's gross registered tonnage (GRT). For the purpose of the current pre-feasibility evaluation, a value of 96 000 GRT (provided by the Client) has been considered as representative of most LNG ships considered in this project:

GRT	Rate
Up to 50 000	$ 4 670.
Over 50 000	$ 34. / 1 000 ton GRT

Hourly rate for assisting a ship:

- staying aside, pushing	$ 1 250 / hr
- removing ice	$ 900 / 30 min
Waiting time	$ 500 / hr
Travel time	$ 850 / hr

Notes: (1) All the above rates are "summer" rates and are to be doubled during winter period (except cost for "removing ice"). The winter season is a fixed period, from 7 Dec to 7 April (17 weeks).

Travel rate not applicable within the Port of Quebec limits.

PST and GST not included.

Based on the following conservative assumptions, the tugboating costs can be calculated from the above rates:

GRT of a typical LNG carrier ship:	96 000 tons	
Travel time (one way):	Pointe-Saint-Denis:	5 hrs
	Gros Cacouna:	8 hrs
Number of tugboats required	berthing:	4
:	unberthing:	3
	Assisting during LNG unloading:	1 (**)

(**) It is assumed that each ship requires partial assistance from one tugboat, either for removing ice for 30 minutes or for pushing for 1 hr. Cost for this assistance (rounded): $ 1 000

Duration of unloading operations: 12 hrs

Frequency of LNG ships at terminal: 1 / week or 52 / year

Ville Guay:

Berthing / Unberthing:

Berthing: $ 4 670 + $ 34. x 46 = $ 6 234 / un. (summer)

X 4 tugboats = $ 25 000

Unberthing: x 3 tugboats = $ 19 000

Pushing / removing ice: $ 1 000

Cost / ship: $ 45 000 (summer)

$ 90 000 (winter)

Annual cost: $ 90 000 x 17 weeks = $ 1 530 000 (winter)

+ $ 45 000 x 35 weeks = $ 1 575 000 (summer)

Total (rounded) = **$ 3 100 000**

Pointe-Saint-Denis :

Travel (Quebec – Pointe-Saint-Denis – Quebec):

4 tugboats x (2 x 5 hrs) x $ 850 / hr = $ 34 000 (summer)

= $ 68 000 (winter)

Berthing / Unberthing:

Berthing: $ 4 670 + $ 34. x 46 = $ 6 234 / un. (summer)

X 4 tugboats = $ 25 000

Unberthing: x 3 tugboats = $ 19 000

Pushing / removing ice: $ 1 000

Cost / ship: $ 45 000 (summer)

$ 90 000 (winter)

Waiting time: 3 tugboats x 12 hrs x $ 500 = $ 18 000. (summer)

= $ 36 000. (winter)

Total cost / ship $ 34 000 + $ 45 000 + $ 18 000 = $ 97 000 (summer)

= $ 194 000 (winter)

Annual cost: $ 194 000 x 17 weeks = $ 3 298 000 (winter)

+ $ 97 000 x 35 weeks = $ 3 395 000 (summer)

Total (rounded) = $ 6 690 000

Gros-Cacouna :

Travel (Quebec – Gros Cacouna – Quebec):

4 tugboats x (2 x 8 hrs) x $ 850 / hr = $ 54 000 (summer)

= $ 108 000 (winter)

Berthing / Unberthing:

Berthing: $ 4 670 + $ 34. x 46 = $ 6 234 / un. (summer)

X 4 tugboats = $ 25 000

Unberthing: x 3 tugboats = $ 19 000

Pushing / removing ice: $ 1 000

Cost / ship: $ 45 000 (summer)

$ 90 000 (winter)

Waiting time: 3 tugboats x 12 hrs x $ 500 = $ 18 000. (summer)

= $ 36 000. (winter)

Total cost / ship $ 54 000 + $ 45 000 + $ 18 000 = $ 117 000 (summer)

= $ 234 000 (winter)

Annual cost: $ 234 000 x 17 weeks = $ 3 978 000 (winter)

+ $ 117 000 x 35 weeks = $ 4 095 000 (summer)

Total (rounded) = **$ 8 075 000**

5.5.3 Icebreaking

The information about the icebreaking fee charged by the Government of Canada can be found on the Canadian Coast Guard web site, at:

http://www.ccg-gcc.gc.ca/msf-dsm/news/ISFDec98FEEschedule_e.htm

The fee payable by a ship for each transit to or from a Canadian port located in the ice zone within the ice season dates prescribed is $3,100, for a maximum of 8 times per ship during each ice season. For the purpose of this regulation, the three sites under study are included in Area 2 (St. Lawrence River) for which the ice season extends from December 21 to April 15 of each year.

A fee reduction may apply where a ship has submitted documentation satisfactory to the Minister demonstrating that it is classified as Arctic Class or Canada Type, or as an international equivalent to Canada Type:

(a) Arctic Class or Canada Type A or Canada Type B or an international equivalent to Canada Type A or B: = 35% reduction;

(b) Canada Type C or international equivalent to Canada Type C: = 25% reduction;

(c) Canada Type D or international equivalent to Canada Type D: = 15% reduction.

Considering, as a preliminary assumption, that no fee reduction would apply to the LNG carrier ships (this would have to be verified by ship certification officers), the total annual cost to be incurred in the project would reach the maximum stated in this regulation, no matter which one of the three sites under consideration would be selected: $ 3 100. x 8 = $ 25 000.

5.5.4 Dredging

This fee applies only to ships having to pass in the North Channel at the east end of Orleans island.

Therefore, this cost would not apply to Pointe-Saint-Denis or Gros Cacouna sites.

Based on Transport-Canada rates, the estimated annual cost is:

Ville Guay: $ 0.037 x 96 000 GRT = $ 3 552 / passage

Annual cost : $ 3 552 x 52 trips x 2 passages = $ 370 000

There is no cap applicable to this fee.

5.5.5 Marine Navigation Services

The information about the marine navigation services provided by the Government of Canada can be found on the Canadian Coast Guard web site, at:

http://www.ccg-gcc.gc.ca/msf-dsm/archive/oct98/Oct98FEEschedule_e.htm

The navigation services include the provision and maintenance of buoys, beacons, lighthouses, LORAN-C, racons or other devices, structures and facilities, for the purpose of assisting the navigation of ships. It also covers vessel traffic services and information provided by Canadian Coast Guard marine communications and traffic services centres.

The fee payable, for marine navigation services, by a non-Canadian ship whose principal purpose is the transportation of goods or merchandise, that is loading or unloading cargo at a Canadian port is, for cargo that is unloaded, the amount obtained by multiplying the weight in tonnes of the cargo that is unloaded, to a maximum of 50,000 tonnes, by $0.152, in the Laurentian and Central Region (The St. Lawrence River is part of the Laurentian Region). This fee is payable for each entry into Canadian waters, to a maximum of 12 times per 12-month period.

The quarterly fee payable, for marine navigation services, by a Canadian ship that is operating in Canadian waters in the Maritimes Region, Newfoundland Region or Laurentian and Central Region is the amount obtained by multiplying the gross tonnage of that ship, to a maximum of 50,000 gross tons, by $1.14.

The application of this regulation, assuming LNG carriers would not be Canadian vessels, results in the following annual charges:

For a non-Canadian vessel: 50 000 t x $ 0.152 x 12 times = $ 91 000.

5.5.6 Regular operation of the terminal

From previous discussions with the Client and the consultant responsible for the on-land facility development during the course of this mandate, we understand that the regular operation of the LNG unloading equipment located on the maritime terminal (connecting pipelines to ship, opening or closing valves, etc) is included in the overall terminal operation budget. Therefore, no specific budget provision is included in the current estimate.

However, on-dock services will have to be provided to assist ships at the berth upon arrival and departure, to tie / untie mooring lines, install / remove gangways, etc. According to the official rates published by the Canadian Shipping Federation, the cost of a team of linesmen (4 persons) is $ 2000 per ship call. Assuming weekly LNG deliveries, this cost would total approximately $ 100 000 annually; it would be similar for the three potential sites.

5.5.7 Maintenance and repair of maritime infrastructure

Although a maritime infrastructure is heavy work and usually does not require yearly maintenance, it is submitted to severe conditions such as waves, salt water, freeze–thaw, impacts from ships, etc. Therefore, it may require important repair interventions after a service period of many years (10, 15, 20 years). Some minor maintenance interventions may also be required more frequently (snow removal. Seasonal installation (spring) and removal (winter) of fenders, painting of bollards and steel structures, local minor deteriorations, asphalt repair, replacement of mooring equipment parts,...). It is therefore common practice to include a repair and maintenance budget representing 1 to 2 % of the capital cost in the regular operation budget. In this case, this would represent an annual budget of (assuming 1,5%): Ville Guay: $ 730 K; Pointe saint-Denis: $ 1,9 M; Gros Cacouna: $ 825 K.

5.5.8 Summary of Operational Expenditures (OPEX)

Table 5.2 summarizes all annual operational costs described before.

Table 5.2 - Summary of Annual Operational Expenditures related to Navigation Activities on the Saint Lawrence

	Annual Operational Expenditures (OPEX) (x 1000 CAN dollars 2003, excluding applicable taxes)		
Site	**Ville-Guay**	**Pointe Saint-Denis**	**Cacouna**
Pilotage	2 740	2 270	2 220
Tugboating			
- Travel	---	2 350	3 725
- Berthing / Unberthing	3 045	3 045	3 045
- Pushing / removing ice	55	55	55
- Waiting	---	1 240	1 250
Icebreaking	25	25	25
Dredging	370	---	---
Marine Navigation Services	91	91	91
Regular operation of terminal	100	100	100
Repair and Maintenance (1,5%)	730	1 900	825
TOTAL (rounded)	**$ 7 200**	**$ 11 100**	**$ 11 300**

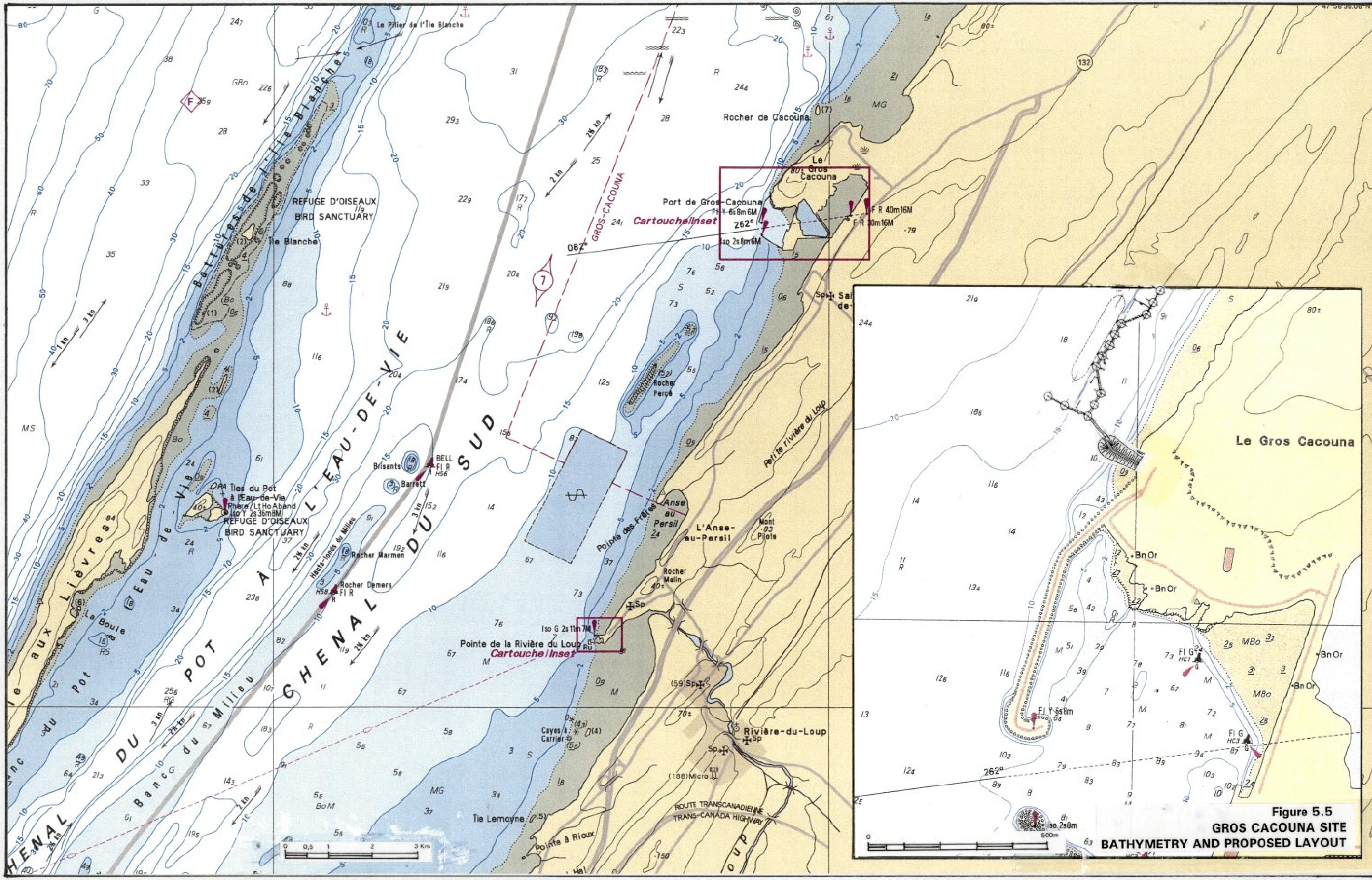

Figure 5.5
GROS CACOUNA SITE
BATHYMETRY AND PROPOSED LAYOUT

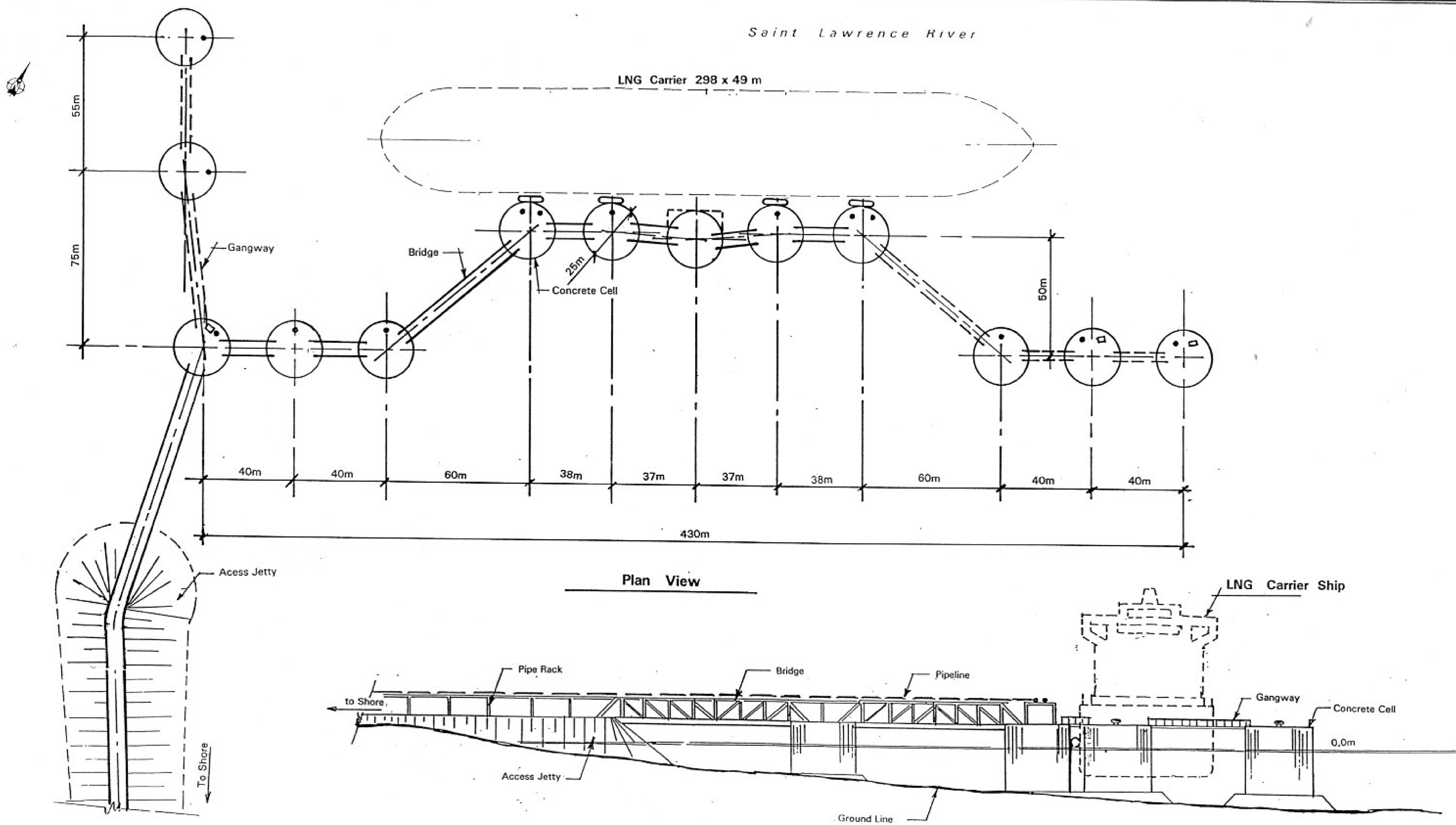

Figure 5.6
GROS CACOUNA SITE
GENERAL ARRANGEMENT - PLAN AND ELEVATION

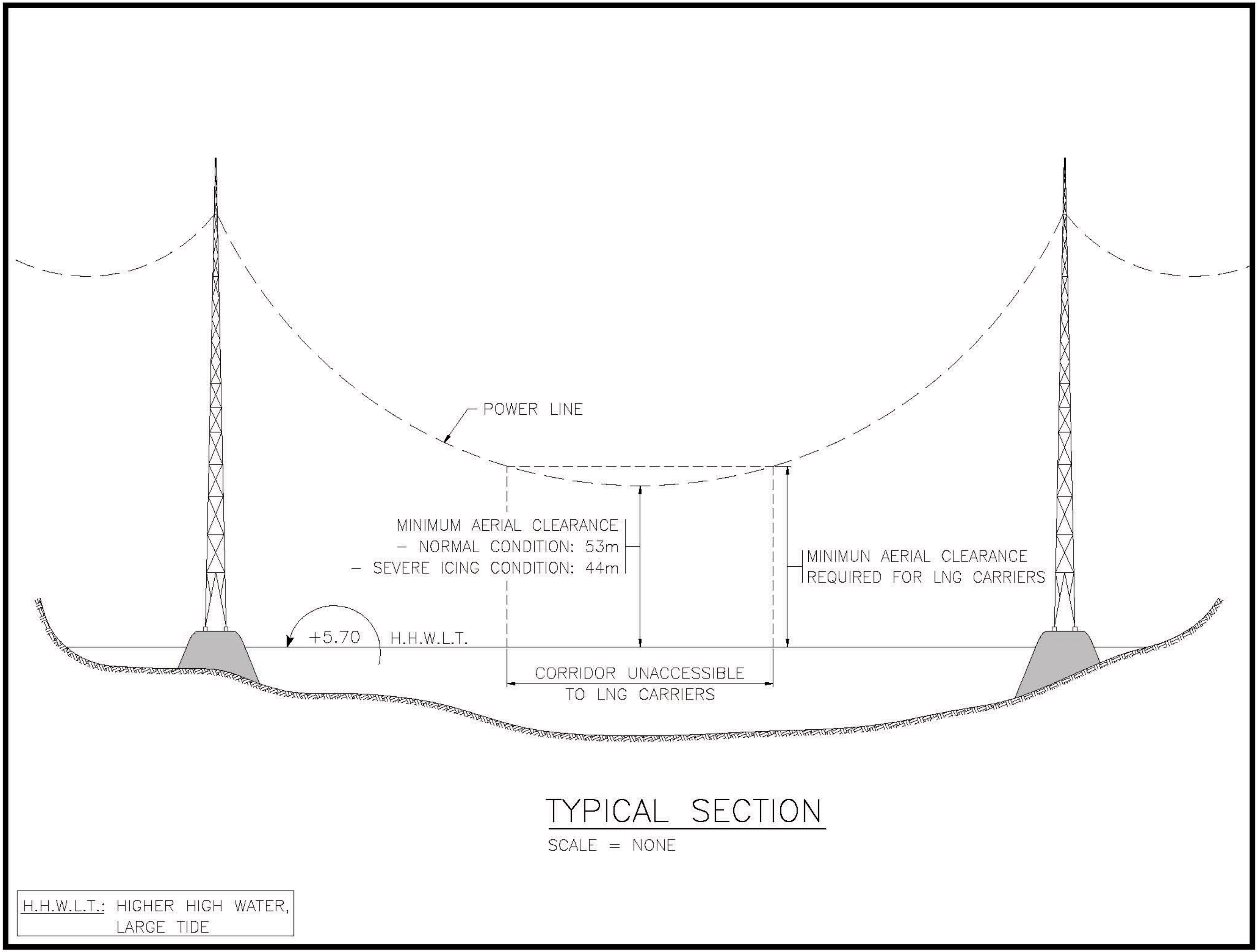

Figure 5.7 - Aerial clearance under Hydro Quebec power line across the St-Laurence river in the Levis-Beaumont area.

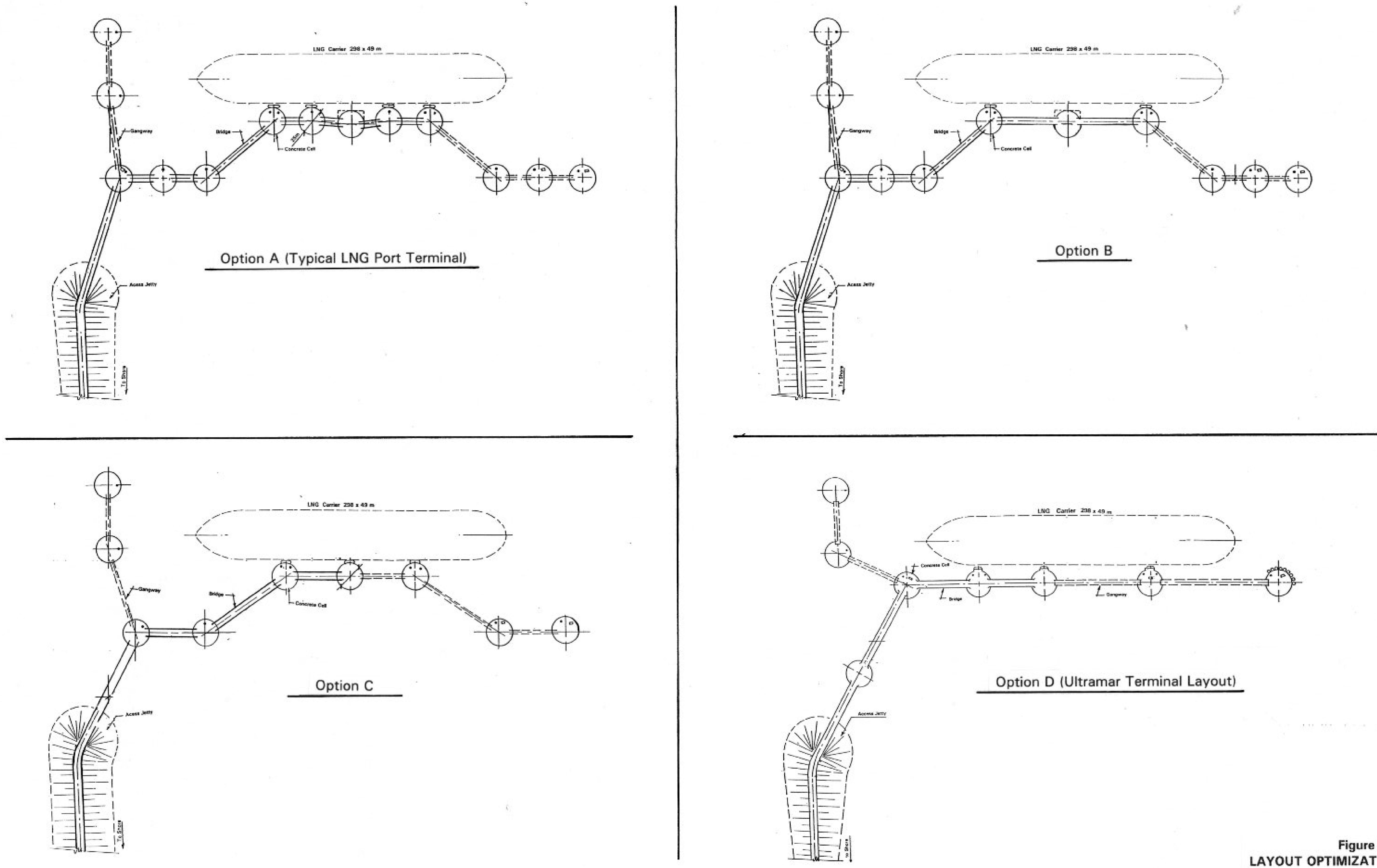

Figure 5.8
LAYOUT OPTIMIZATION