LAC STE. ANNE COUNTY
PROVINCE OF ALBERTA
BYLAW 17-2004

A BYLAW TO CONTROL LAND USE.

WHEREAS, under the provisions of the Municipal Government Act, being Chapter M-26.1, Sections 633 and 692(1) of the Revised Statutes of Alberta 2000, a municipality may amend an adopted Land Use Bylaw.

AND WHEREAS the Council of Lac Ste. Anne County determined it necessary to amend the future land use plan for certain lands within Lac Ste. Anne Settlement as a means to promote effective and efficient residential land use within River Lot 15 adjacent to Lake Lac Ste. Anne.

NOW THEREFORE the Council duly assembled hereby enacts as follows:

The Lac Ste. Anne County Land Use By-law 10-98 is hereby amended in accordance with the following:

1. That the Windmill Estates Area Structure Plan, 2001, adopted through Bylaw No. 06-2001 and its corresponding Land Use District, be rescinded.
2. That Windmill Harbour Area Structure Plan, 2004, be adopted through this Bylaw in accordance with attached Schedule "A".
3. That the Country Residential Direct Control District (CR1 be amended in accordance with attached Schedule "B".
4. That the Country Residential Direct Control District (CR1) be amended to include all of River Lot 15, Lac Ste. Anne Settlement, as described under Schedule "C"

5. That this Bylaw comes into full force and effect upon third and final reading.

First Reading carried the 10th day of May, A.D. 2004.

Reeve

(SEAL)

Municipal Administrator

Read a second time this 10th day of June, A.D. 2004.

Reeve

(SEAL)

Municipal Administrator

Read a third and final time this 10th day of June, A.D. 2004.

Reeve

(SEAL)

Municipal Administrator

SCHEDULE "A"

BYLAW NO. 17-2004

WINDMILL ESTATES LTD.
WINDMILL HARBOUR
AREA STRUCTURE PLAN
LOT 15, 20-54-3-W5M
LAC STE. ANNE COUNTY

Prepared by

Jaymar Consulting Inc.
and
gpec
Consulting Ltd.
#100 - 9808 - 42 Avenue
EDMONTON, AB T6E 5V5

March 2004

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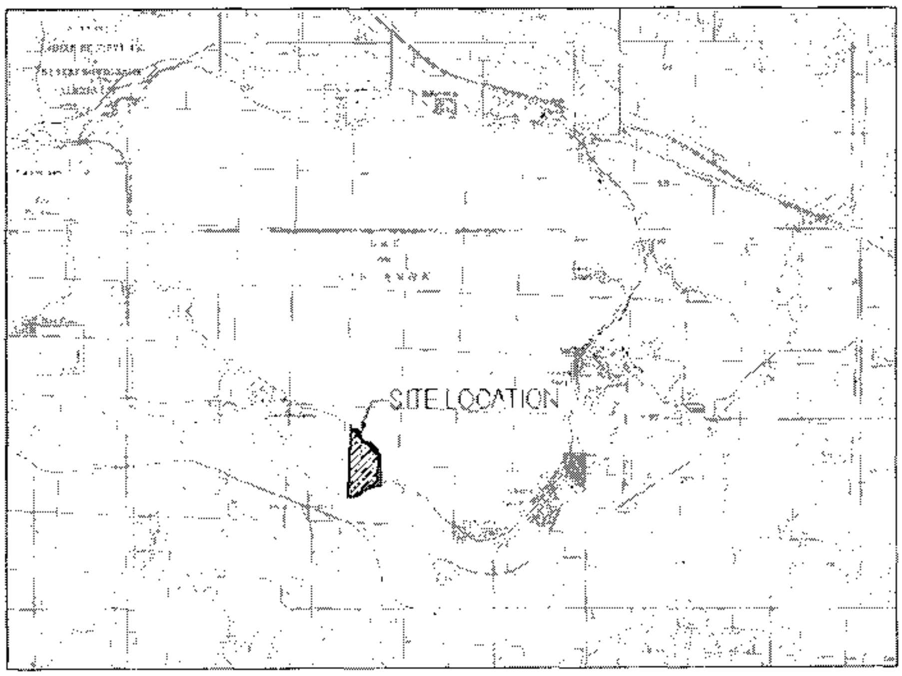
1. Application and Property Location

The area structure plan (ASP) applies to the remainder of River Lot 15 (north of Lac Ste. Anne Trail) of Section 20, Township 54, Range 3, W5M. The subject property is located on the southwest shore of Lake Lac Ste. Anne in Lac Ste. Anne County and consists of approximately 42.5 ha (103 acres) of land with approximately 700 m (2,300 ft.) of shoreline.

The plan is prepared to facilitate the development of an attractive and environmentally sensitive lakefront harbour/marina resort community in the County.



2. Purpose of Area Structure Plan

The area structure plan is prepared to guide future development of the subject property in an orderly manner. The ASP contains provisions on environmental protection, land uses, roadways, utilities, phasing and standards of development. Future land use redistricting, subdivision and development permit decisions should be based on this plan.

The land use and harbour components of this plan are designed by Jaymar Consulting Inc. Engineering components are provided by GPEC Consulting Ltd.

3. Compliance with Applicable Legislation

The area structure plan is prepared in accordance with Section 633 of the Municipal Government Act. The ASP complies with the County's Municipal Development Plan Bylaw 11-98 policies 3.4 and 3.12 on country residential and lake areas. The ASP also complies with the County's lake management guidelines for Lake Lac Ste. Anne, which requires a development setback of 200 feet from the lake shore.

The subject property was recently zoned in 2003 to a Country Residential Direct Control (CR-1) designation for Country Residential uses. The proposed bareland condominium area will require rezoning to a direct control district under the County's Land Use Bylaw. The new district will contain more site specific regulations to control the bareland condominium development. In addition, the proposed bareland condominium development will comply with the Alberta Condominium Property Act.

Any proposed lakeshore development will comply with applicable Provincial, Federal and County legislation and policies.

4. Physical and Environmental Features

4.1 Topography

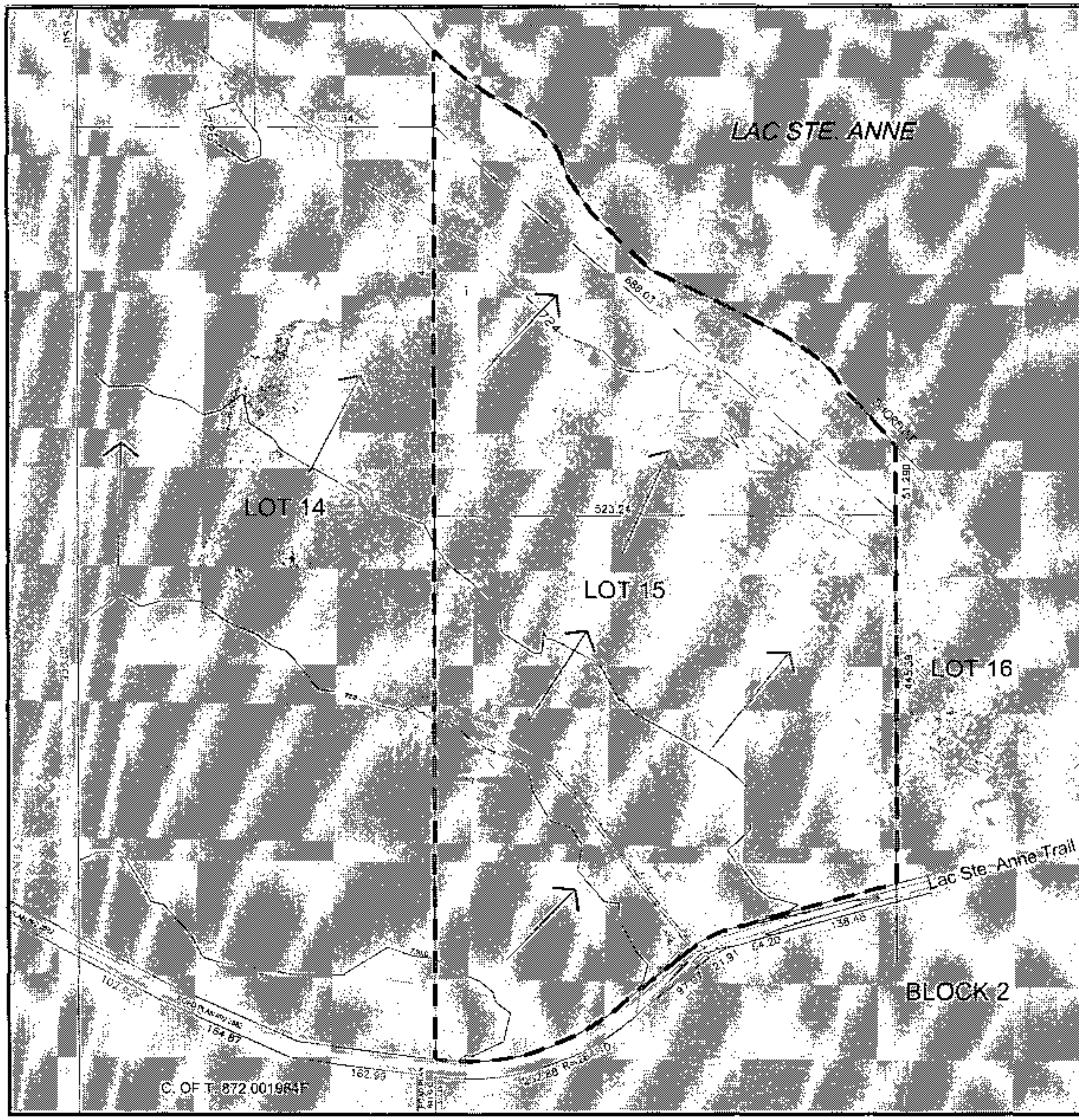
The plan area is level to gently sloping from southwest to northeast. The above sea level elevations range from 730 m to 722.89 m, which is the normal water level of Lake Lac Ste. Anne.

4.2 Soils

According to Alberta Soil Survey Report No. 24 for the Buck Lake and Wabamun Lake Areas, the subject property and surrounding areas have Podzolic soils, which were developed under forest and/or heath vegetation. The soils of Uncas series, a sub-component of the Dark Gray Wooded soils category of the Podzolic soils, are present on the subject properties. The Uncas soils are moderately well drained and can be considered as fairly good arable land. However, stones are found throughout the soil profile.

4.3 Flood Plain and Lake Shore

The 1:100 year flood plain elevation of Lake Lac Ste. Anne has been determined by Alberta Environment at 723.79 m geodetic, on the basis of the 1974 flood. The Lake is the only water body on/near the subject property. Alberta Environment has advised GPEC that future homes should be located above the 1:100 year flood plain elevation. However for added safety all homes will be located above the 724.10 m elevation.



WINDMILL ESTATES LTD.

WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15 IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 2

THE PLAN AREA

LEGEND

AREA STRUCTURE PLAN BOUNDARY

EXISTING GROUND CONTOUR

DIRECTION OF SURFACE DRAINAGE FLOW

SCALE 1:5000 APRIL 7, 2004

Although the ASP identifies the lake shore, a precise shoreline delineation may be made by the Public Lands Branch of Alberta Agricultural, Food and Rural Development.

4.4 Tree Cover

Approximately one-half of the subject property is covered by trees and brush. The predominant tree species are spruce, black poplar and aspen. Some of the spruce has been harvested by the previous landowner.

A heavily treed area is present on the neighbouring land immediately to the east. Additional tree cover is located on the neighbouring land to the west of the subject property.

4.5 Fish and Wildlife

Because the proposed Windmill Harbour project is located adjacent to the shoreline of Lake Lac Ste. Anne in a partially treed area it will likely affect the environment and as such has been reviewed by federal and provincial authorities in accordance with the Canadian Environmental Assessment Act. Mainstream Aquatics Ltd. have prepared an environmental impact assessment (EIA) of the project and have received conditional environmental approval. The report entitled "Revised Environmental Assessments-Windmill Harbour Development" dated September 2003 is attached as Appendix B. The Department of Fisheries and Oceans has issued a letter acknowledging their current envolvement and interest to issue "Fisheries Act" authorization for this project and it is included in Appendix "B".

According to the EIA Report and the DFO authorization, although a number of adverse affects may be caused by the proposed development, mitigation and compensation measures can be implemented to eliminate or reduce all of them to an acceptable level. All the recommended mitigation and compensation measures, will be incorporated into the final design and development of Windmill Harbour.

5. Existing Land Uses, Roadways and Utilities

5.1 Land Uses

At present, the cleared areas of the subject property are used for agricultural purposes. Barley and alfalfa crops have been the predominant species planted on this land. The treed and brush-covered areas are not farmed. The existing farm house and barn may be renovated for residential or recreational use by the Condominium.

Agricultural uses are present in the immediate surrounding areas to the east, south and west. Cottage development has occurred a short distance to the east on Lac Ste. Anne Trail along the south shore of Lake Lac Ste. Anne.

5.2 Roadways

The subject property is accessible from the County's Lac Ste. Anne Trail. There is no other public roadway in the vicinity.

5.3 Utilities

A natural gas line is located on the subject property. It supplies gas to the old farm house to the west and to the neighbouring parcels. Electricity and telephone services are also provided to the subject property.

Residents in the general area depend on ground water wells for domestic uses, and on individual private systems for sewage disposal. AMEC Earth & Environmental Limited have prepared a groundwater potential study which indicates that long term safe groundwater yields can be expected in the area and that an additional 156 lot subdivision (previous plan) should be serviceable without impacting existing users. Additional groundwater testing will be undertaken at the subdivision stage.

6. The Bareland Condominium Development Plan

A bareland condominium development is planned for the subject property. The bareland condominium plan contains the following guidelines:

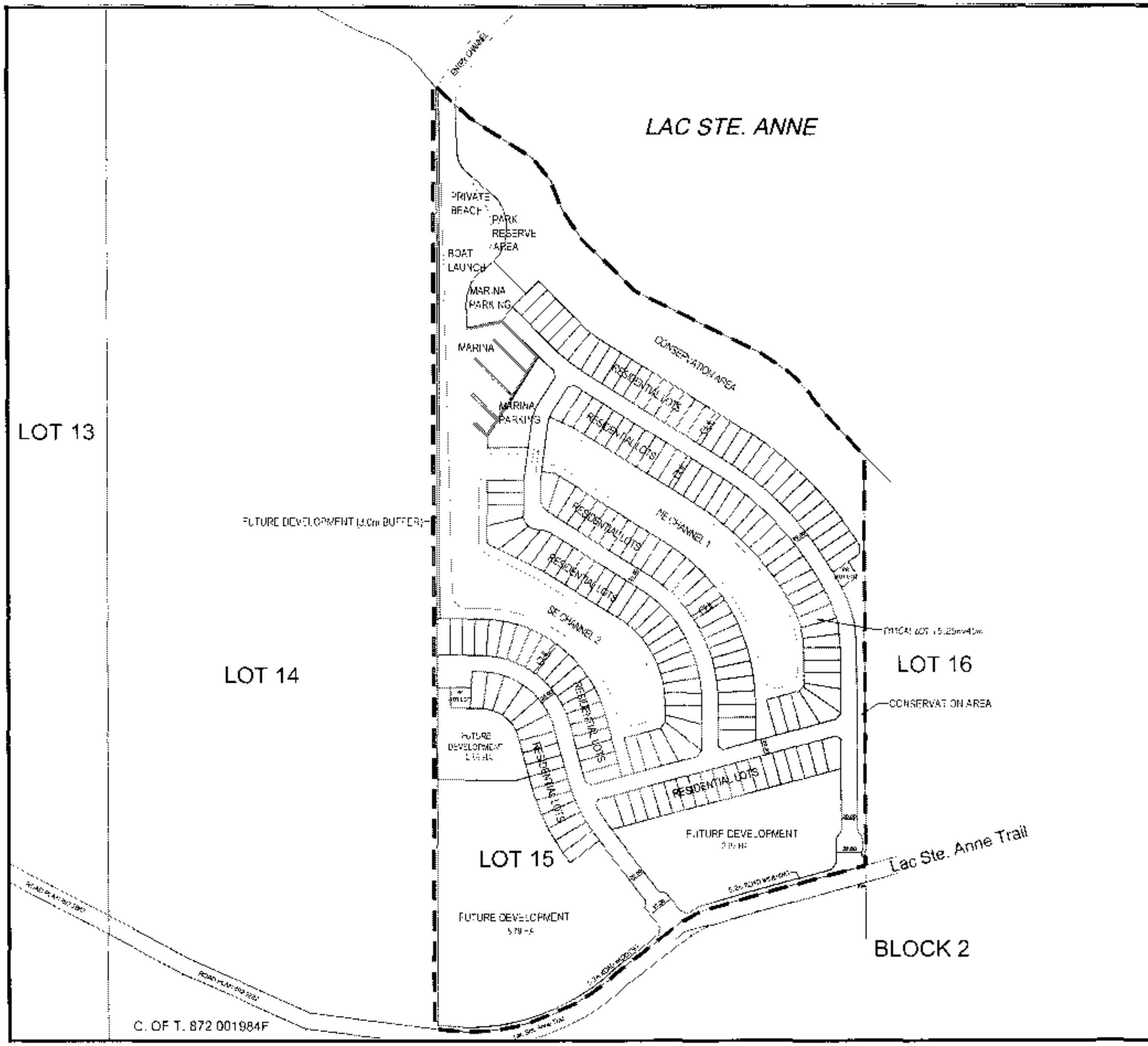
6.1 The Planning Objective

The plan is to develop an upscale, environmentally sensitive and fully serviced bareland condominium inland harbour recreational resort community in the County.

6.2 Environmental Conservation

A large lakefront conservation area including the 1:100 year floodplain is set aside to provide a natural buffer between the development and the lake. The conservation area will be protected jointly by the County and the Condominium Association.

The primary purpose of the conservation area will be to minimize disturbance to the natural environment by restricting public access. The conservation area will include a fenced exclusion zone adjacent to a well known western grebe colony, walking trails, resting areas and a nature appreciation/viewing area. Trees in this area will be protected but will be subject to partial removal, replacement and pruning to maintain lake views. The conservation area will also be extended along the east perimeter of the property to Lac Ste. Anne Trail. This area will be maintained in its natural state or enhanced with vegetation plantings. A 3.0 m wide buffer designated for future development will be provided between the inland harbour and the western property boundary of Lot 15 to maintain control over access from Lot 14. A copy of the draft Conservation Easement document and Vegetative Management Plan are included in Appendix C.



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WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20 54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 3

THE DEVELOPMENT PLAN

STATISTICAL PROFILE

LAND USE SUMMARY	AREA
RESIDENTIAL AND DWELLING LOTS	17.99 HA
ROADS AND ROAD WIDENINGS	4.96 HA
COMMON UTILITY LOT (CUL)	0.09 HA
PARK RESERVE (TOT LOT AND BEACH AREA)	0.28 HA
CONSERVATION AREA	4.57 HA
MARINA PARKING AND HARBOUR	9.81 HA
FUTURE DEVELOPMENT	9.80 HA
TOTAL AREA	42.50 HA

LEGEND

AREA STRUCTURE PLAN BOUNDARY

NOTE
ALL DIMENSION AND AREAS ARE APPROXIMATE AND ARE TO BE CONFIRMED BY PLAN OF SURVEY

HARBOUR CONCEPT BY JAYMAR CONSULTING INC

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Dwelling lots will be set back from the Lake at least 60 m (200 ft) and up to 90 m (300 ft.).

All dwellings will be above 724.1 m in elevation, which is 0.31 m higher than the 723.79 m 1:100 year flood elevation of Lake Lac Ste. Anne. The recorded average annual lake level is at 722.89 m.

Materials excavated from the man-made harbour channels will be used to build up residential lots to 724m elevation or higher.

Section 49 - Environmental Standards of the Land Use By Law will be complied with during the subdivision and construction phases of the development.

6.3 Land Uses and Amenities

Approximately 182 dwelling lots are included in the plan. The average lot size will be 15 m x 45 m (50 ft. by 148 ft.), although the actual lot widths and depths may vary.

Section 70 - Subdivision Standards of the Land Use By Law will be applicable to this development.

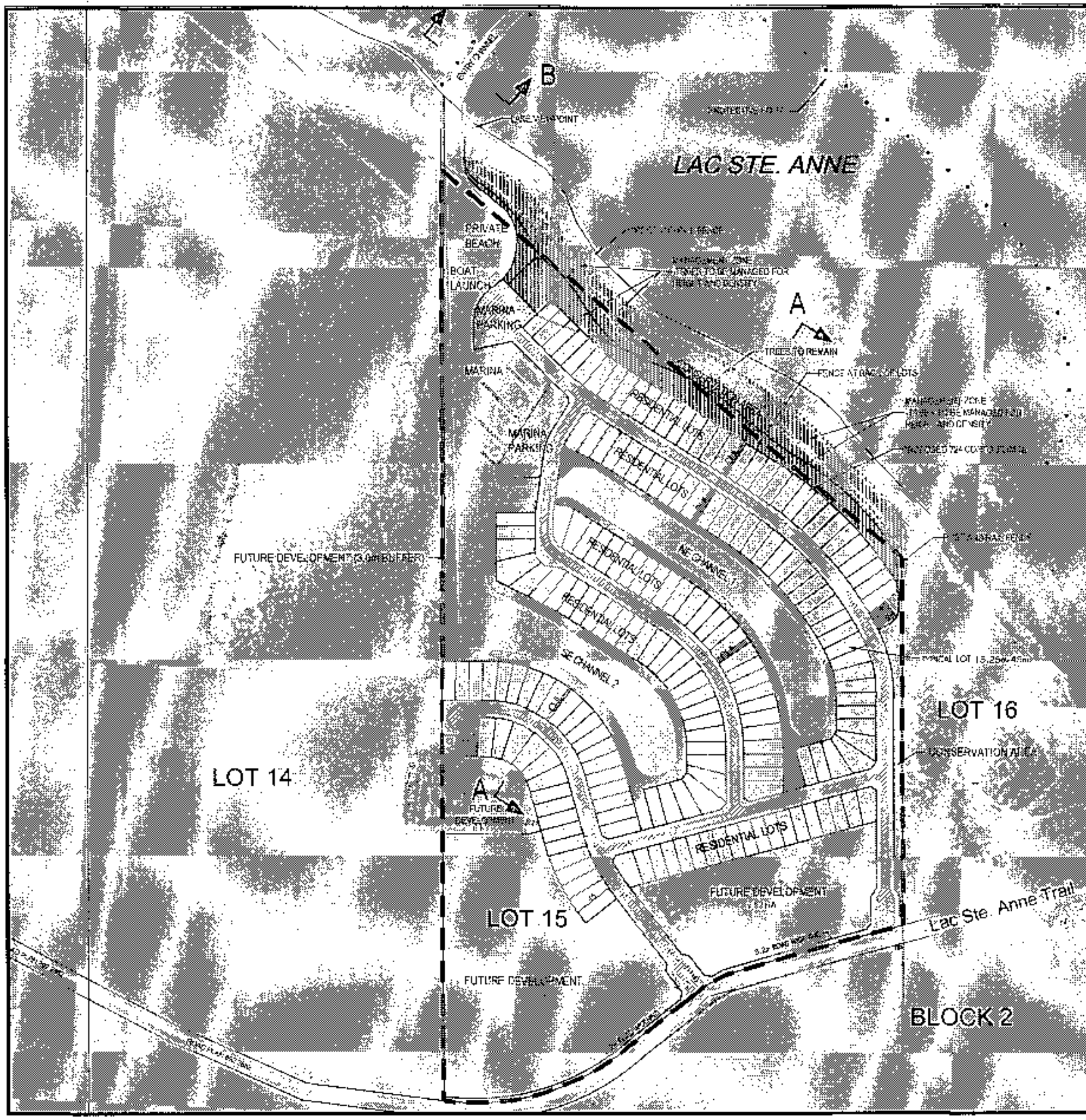
All dwellings will be stick-built or modular homes and subject to architectural control guidelines. Double and single wide manufactured homes may be considered, if they could be grouped in a suitable area. Manufactured homes will not be mixed with other homes.

Assuming an average household size at 3.1 persons per dwelling unit, the development may result in a maximum population of 564 people. However, due to the nature of this development, the actual population will fluctuate seasonally. Permanent population residing in this development will be significantly less than the projected maximum.

Two small tot lots are also proposed to facilitate playground equipment for the smaller children. One lot is proposed at the north east end of the site adjacent to the last lot on the north side of the road and the other is proposed at the south west corner next to the road turnaround in the last stage.

Approximately 12.5 ha of land will be designated as conservation area to protect the environment and promote lower impact recreational activities such as bird viewing, walking/jogging and cross country skiing.

A small private beach area for condominium residents will be developed within the inland harbour next to the conservation area. The inland harbour would consist of a marina, a main channel and two side channels (see Figure 4). The harbour would be private, and would be signed accordingly, thereby restricting access to owners



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AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 4

HARBOUR CONCEPT PLAN

LEGEND

AREA STRUCTURE PLAN BOUNDARY

NOTE:
ALL DIMENSION AND AREAS ARE APPROXIMATE AND ARE TO BE CONFIRMED BY PLAN OF SURVEY.

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gpec consulting ltd.

and guests. The marina would be used to moor larger vessels such as sail boats, while the side channels would provide passage for smaller vessels to boat slips adjacent to each residential lot. A boat launch would be located at the south end of the main channel next to the marina and the beach area.

To accommodate large vessels the minimum water depth in the marina and main channel would need to be 2.5 m below minimum lake level, which is 722.0 m. Water depths in the side channels would be reduced to approximately 1.5 m below minimum lake level to facilitate passage of smaller water craft and still provide sufficient water depth for sediment settling purposes.

The harbour banks would be constructed at a slope of 5:1 from the bottom up to the minimum lake water elevation (722.0 m) and at slope of 7:1 from the low water elevation to the maximum recorded water level elevation (723.8 m) as indicated on Figure 5. The harbour shorelines would be protected from erosion by placing a layer of clean gravel and sand over geotextile fabric or by other appropriate means of erosion protection.

An access channel would need to be dredged from the shoreline to a minimum water depth of 2.5 m to facilitate boat access. The channel would be situated at the extreme western edge of the property to take advantage of the lake bed slope at this location. It is estimated that the channel would be approximately 0.98 ha in size and would extend 490 m into the open water. The channel would have a width of 20 m along its entire length, and would be clearly marked with buoys that would be removed during the off-season. The channel sideslope would be 3:1 and the excavated lake bed material would be removed and disposed of on lots during winter or as otherwise approved by Alberta Environment.

The lake front, harbour and related developments will be subject to approvals of the Provincial and Federal Government authorities having jurisdiction and Lac Ste. Anne County. Architectural guidelines may be included in the next land use district and/or condominium bylaw for the property.

In accordance with County policy 0.40 ha (1.0 acre) of municipal reserve will be deferred to the future development areas. The condominium association will be responsible to develop its internal park systems as identified on the Development Plan. The harbour and water channels including the buffer area between the back of the lots and water edge, are considered common property and will also be available for recreation use even though they are not designated as park reserve.

6.4 Roadways

The condominium access and internal road right-of-ways will be 20 m (66 ft.) wide with the exception of the south 50 m connecting onto Lac Ste. Anne Trail which will be widened to 30 m (100 ft) to facilitate a center median and entry feature as indicated on Figure 6.

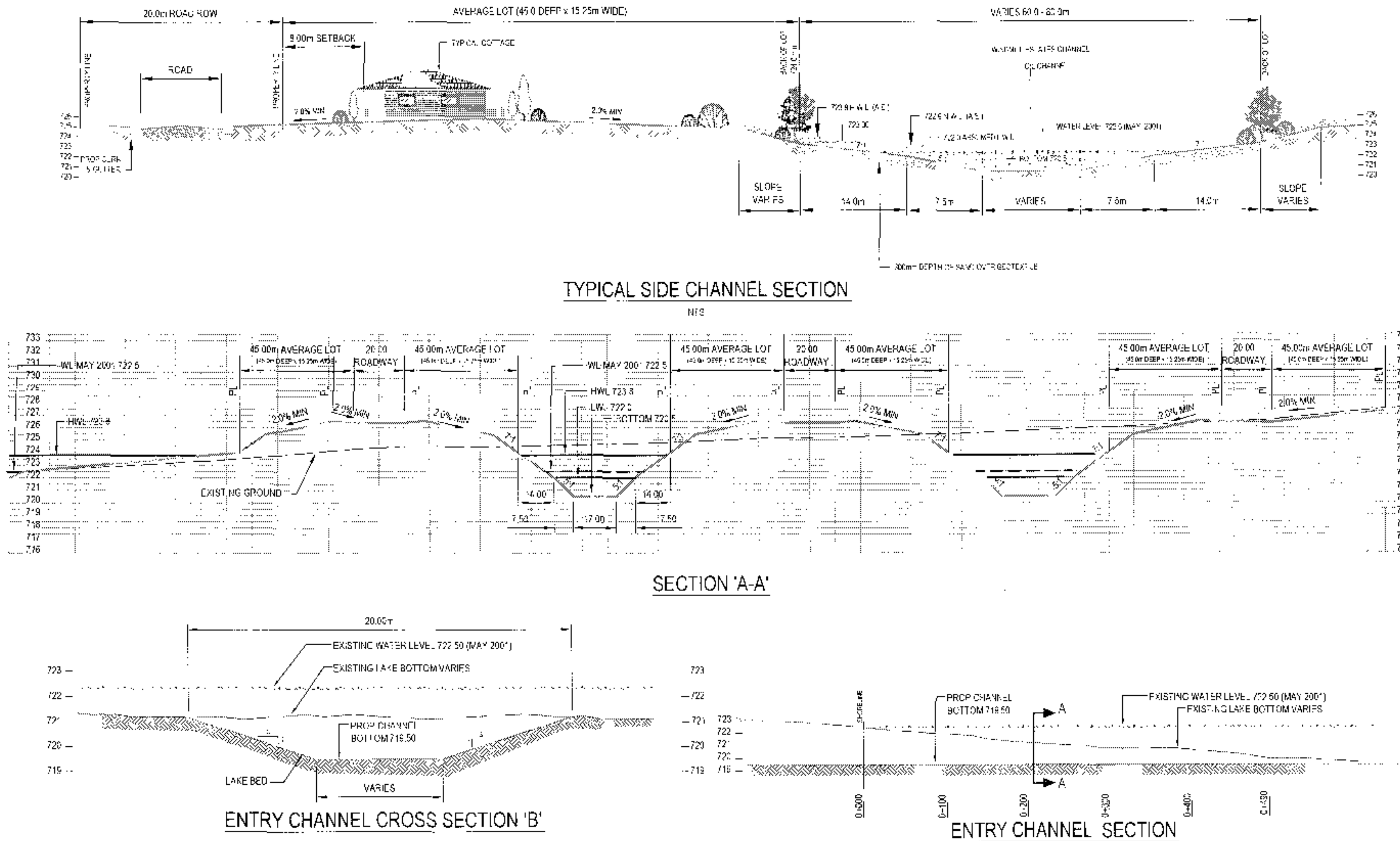

FIGURE 5

TYPICAL CROSS SECTIONS

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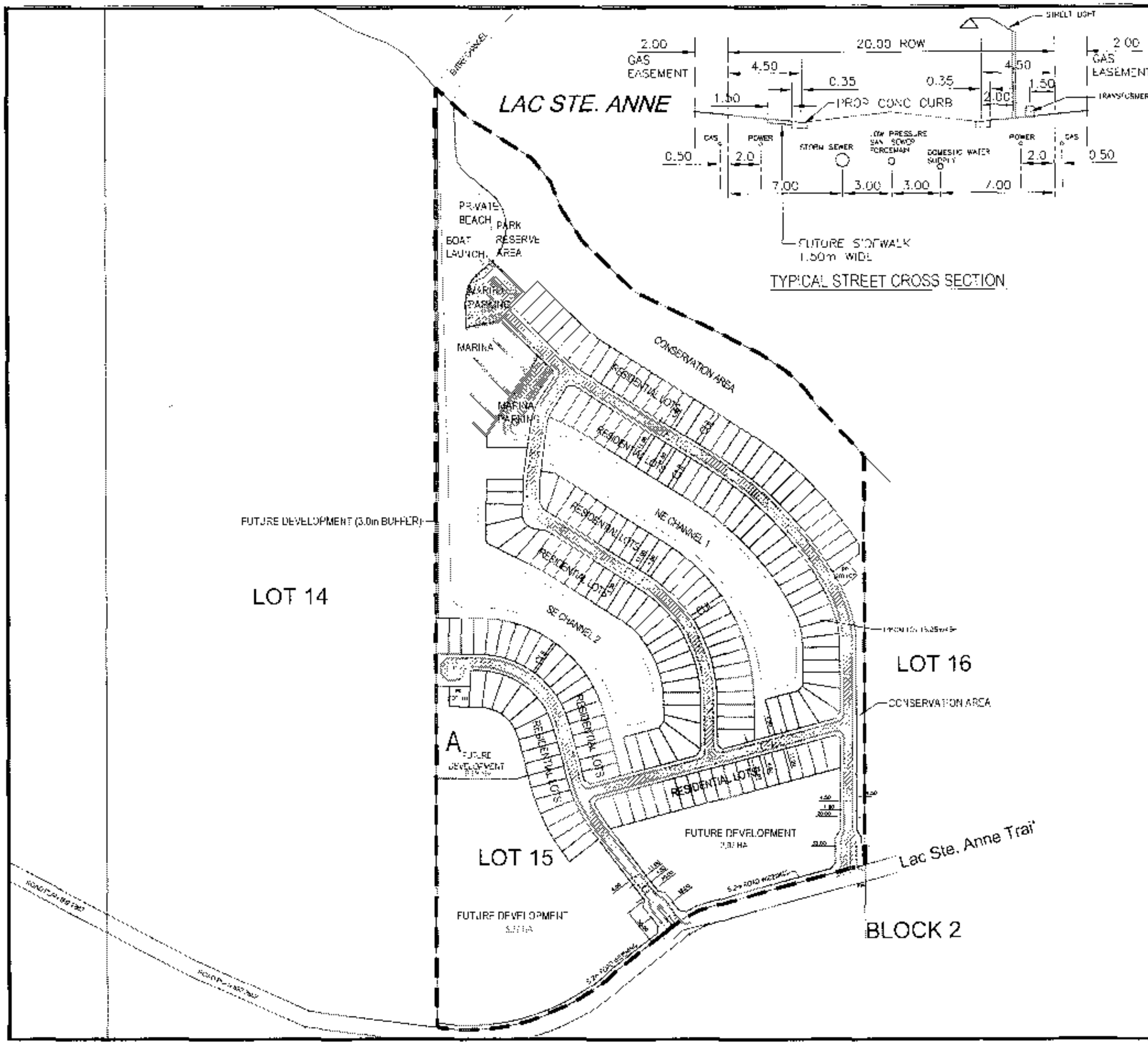

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AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 6

TRANSPORTATION PLAN

LEGEND

AREA STRUCTURE PLAN BOUNDARY

PROPOSED 11.0m PAVED ROADWAY

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Within the condominium area, an internal looped roadway system complete with a two-lane bridge will provide access to the marina, boat launch and beach area.

All roadways will be constructed to an 11.0m wide paved urban standard complete with concrete curbs and gutters. Although separate walks are not proposed at this time an alignment has been dedicated which will facilitate a 1.5m wide walkway in the future, if deemed necessary. Approximately 40 parking stalls will be provided at the marina along with an additional 30 stalls at the boat launch to service this portion of the harbour. This is considered ample parking since most of the residents are expected to walk from their houses to the marina.

Street lighting will be provided.

6.5 Utilities

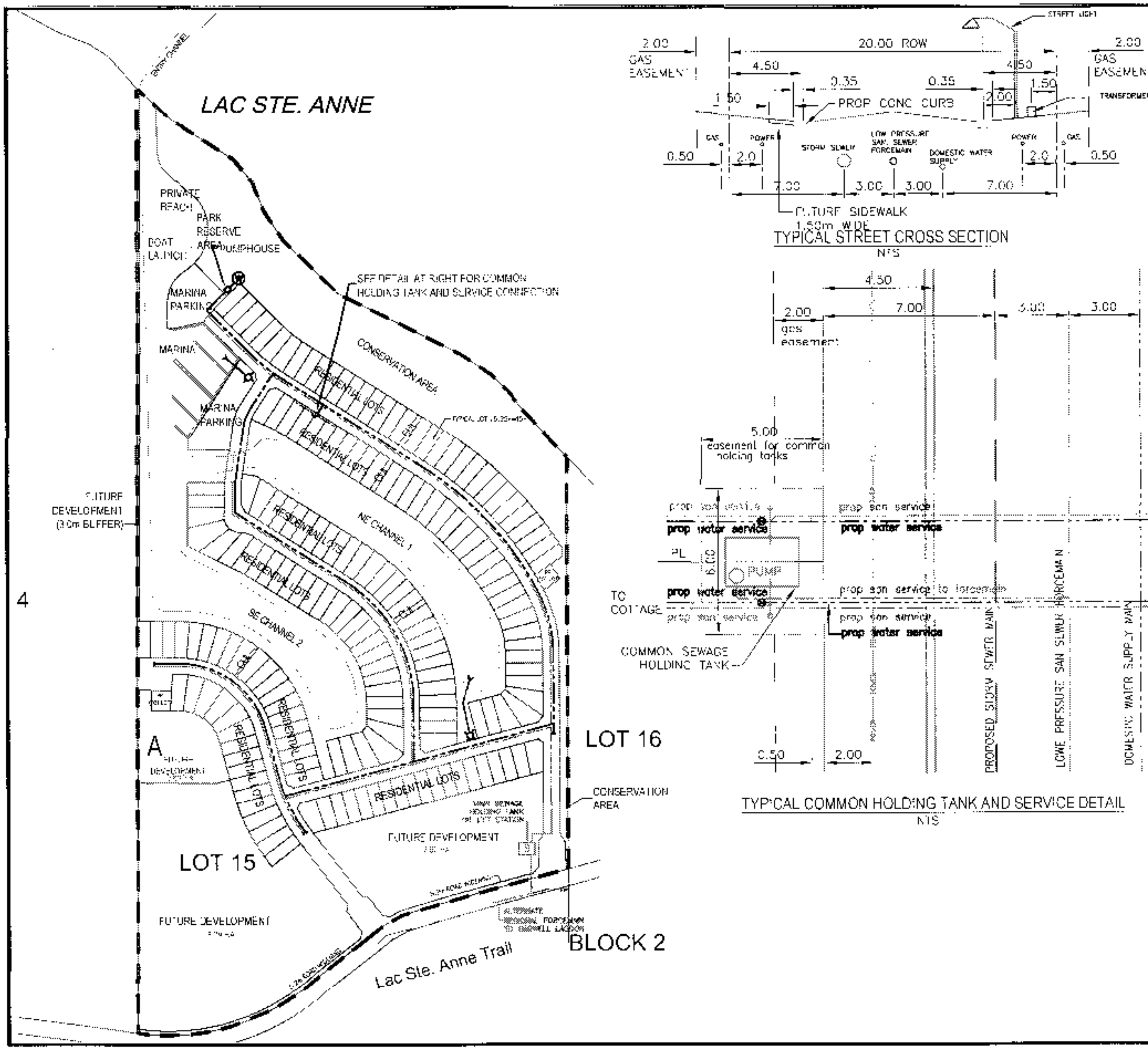
The water distribution and sanitary sewer servicing concepts are indicated on Figure 7.

Community water supply will be provided from a community well system with treatment limited to disinfection. This system will be developed in compliance with Alberta Environment standards. For this purpose, a professional hydrogeological study has been conducted to verify the sufficiency of local ground water sources for both the bareland condominium and potential additional development on the remainder of the subject property. (See Appendix A). Distribution would be provided from a common pumphouse and would facilitate domestic flows and pressures only. Potable water may be provided to nearby properties if sufficient capacity is available.

Fire protection would be provided through a trucked in source by the local rural fire department. A truck fill hydrant would be constructed at the marina during the first stage of construction for refilling fire fighting equipment. A second truck fill hydrant would be added at the south end of the project during construction of a later phase.

Sewage collection would be provided through the installation of common holding tanks (generally 1 -1600 IG tank per 4 units) which in turn would transfer the sewage through a low pressure system to a main collection holding tank located at the south east entrance to the development. The main holding tank would then be pumped out and hauled to the Darwell lagoons on a regular as needed basis. The individual holding tanks would be located in easements (approximately 6.0m wide x 5m long) on the common property line between two lots in each serviced group, adjacent to the roadway. The main holding tank would be located in a P.U.L. at the south east entrance which would allow larger trucks to turn off the main road and pumpout the tanks on a regular basis without disrupting traffic.

As an alternate to trucking the sewage to Darwell, the Developer is currently assessing the possibility of participating with the County in the construction of a regional forcemain. Under this scenario the main collection holding tank would be



WINDMILL ESTATES LTD.

WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 7

WATER DISTRIBUTION
AND SANITARY SEWER
SERVICING PLAN

LEGEND

- AREA STRUCTURE PLAN BOUNDARY
- PROPOSED WATERMAIN
- PROPOSED WELL AND PUMPHOUSE
- PROPOSED TRUCKFILL HYDRANT
- PROPOSED LOW PRESSURE SANITARY SEWER FORCEMAIN
- PROPOSED LOW PRESSURE SANITARY SERVICE AND COMMON HOLDING TANK

NOTE: WELL AND PUMPHOUSE LOCATION ARE CONCEPTUAL ONLY

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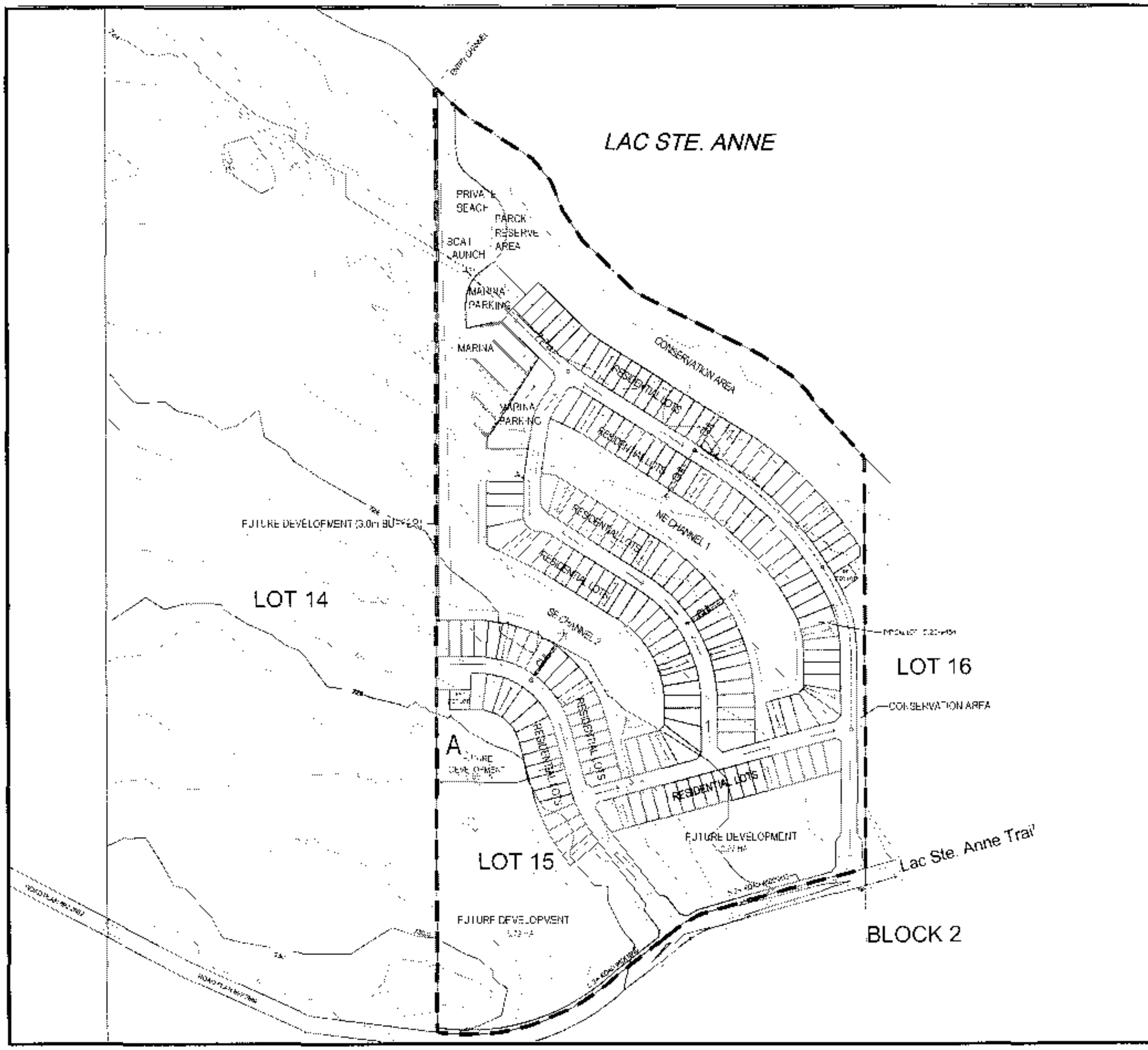

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AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 8

STORMWATER
MANAGEMENT PLAN

LEGEND

AREA STRUCTURE PLAN BOUNDARY
PROPOSED STORM SEWER SYSTEM AND LAKE OUTFALL
EXISTING GROUND CONTOUR
DIRECTION OF SURFACE DRAINAGE FLOW

HARBOUR CONCEPT BY JAYMAR CONSULTING INC.

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converted to a lift station which would pump the sewage to Darwell lagoon. Depending on the ultimate scheme, additional areas could be serviced by the lift station as well.

Individual water and sewer service connections will be provided to each lot.

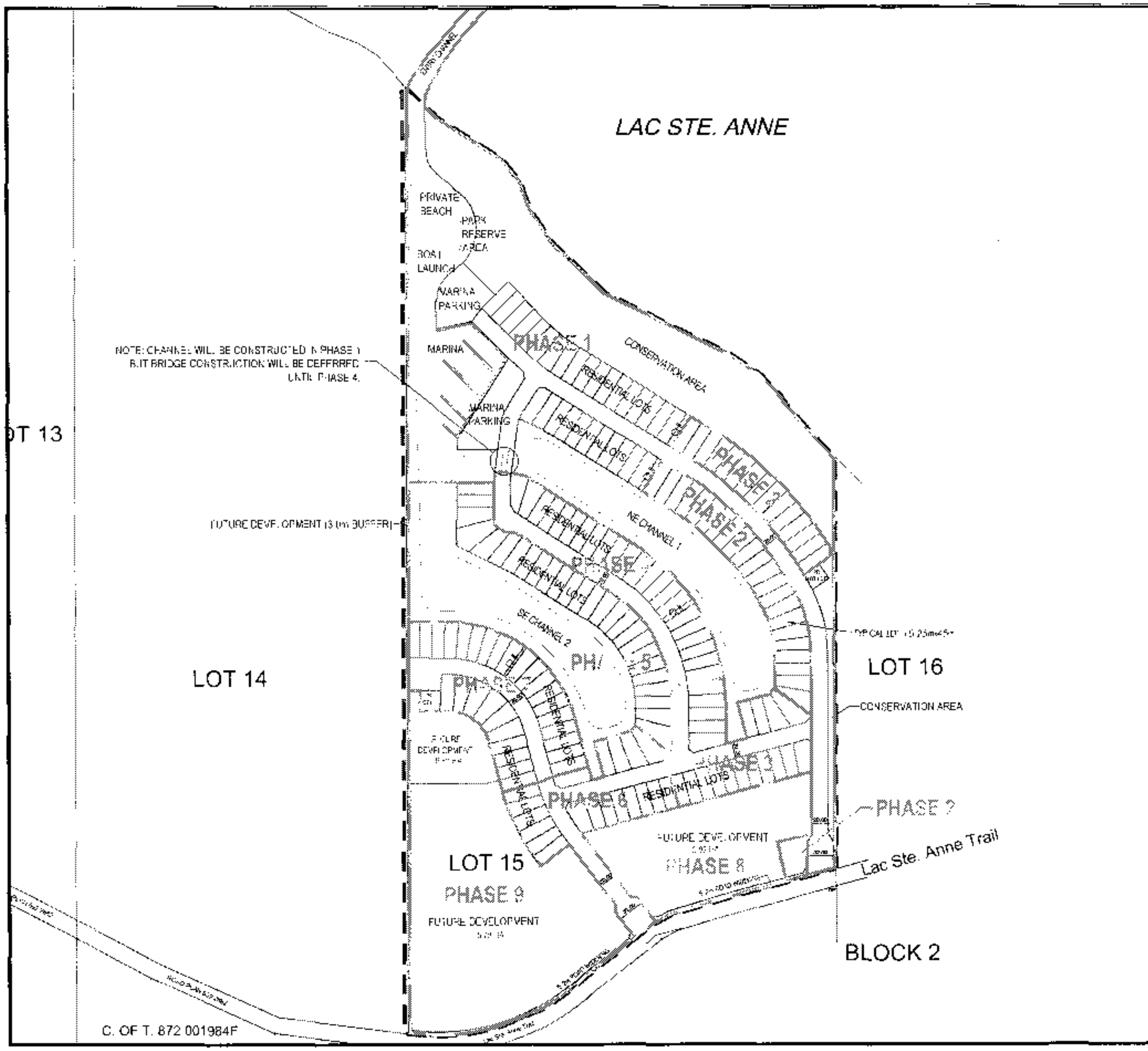
Storm water management will be used to eliminate water quality concerns associated with surface runoff flowing directly into the lake by routing all front of lot and roadway runoff through storm sewers into the inland harbour before overflowing into the lake as generally shown on Figure 8. Recirculation and aeration pumping are also proposed to improve the water quality in the harbour. The storm water management facilities are subject to approval by Alberta Environment and the requirements of the Environmental Protection and Enhancement, and Water Acts.

Franchise utilities, ie. power, gas, telephone, will be provided by the respective utility companies in the area. Geothermal heating systems may be installed if proven to be feasible.

6.6 Harbour and Access Channel Design

The harbour and channel design have been prepared to provide direct water access to a maximum number of lots as well as facilitate potential development to the west. The marina, boat launch and private beach area have been situated at the north west end of the internal looped roadway system, which is accessible from two directions. The marina itself is situated back from the shoreline in a protected area, yet close enough to the lake to minimize congestion in the entry channel. Two parking areas consisting of approximately 70 stalls will facilitate the marina as well as the boat launch and private beach area. Excavation of the harbour will increase as construction proceeds from north to south since the existing ground topography rises at an approximate six percent grade. This will result in main channel excavation depths ranging from approximately 3.0m at the north to 6.5m at the south and side channel excavation depths ranging from 4.0m at the north to 5.5m at the south. Some of the excavated materials will be used to raise the level of the lots and the remaining excess will be hauled off site or placed in fill on future development areas. Appropriate measures including the installation of silt fences will be taken to comply with Alberta Environment and D.F.O. regulations and to alleviate concerns regarding the deposition of deleterious materials into the Lake. Figure 5 illustrates a typical cross section from the lake shore through the proposed lots and two side channels.

The access channel will be dredged from the extreme western edge of the property approximately 490m into the lake as previously described. It is anticipated that this work will be constructed during the winter months when it would be least disruptive to other lake users and when the ice cover will minimize the dispersion of materials due to wave action. Other appropriate measurers including the installation of filter curtains will be used to comply with regulatory approvals and minimize dispersion



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AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 9

DEVELOPMENT PHASING PLAN

LEGEND

AREA STRUCTURE PLAN BOUNDARY
DEVELOPMENT PHASING BOUNDARY

PHASE 1	-25 LOTS (APPROXIMATELY)
PHASE 2	-37 LOTS (APPROXIMATELY)
PHASE 3	-20 LOTS (APPROXIMATELY)
PHASE 3	-22 LOTS (APPROXIMATELY)
PHASE 5	-26 LOTS (APPROXIMATELY)
PHASE 6	19 LOTS (APPROXIMATELY)
PHASE 7	-29 LOTS (APPROXIMATELY)
PHASE 8 & 9	-FUTURE DEVELOPMENT

HARBOUR CONCEPT BY : JAYMAR CONSULTING INC.

SCALE 1:5000 APRIL 21, 2004

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of silts into the lake. A typical cross section of the access channel is also illustrated on Figure 5.

6.7 Development Phasing

Phase One will include the main access road, entry gate feature, internal road to marina, marina, boat launch, entry channel and main channel up to and including the NE Channel 1, approximately 29 lots, conservation area, domestic well and water supply system, first truck fill hydrant, sewer system and common holding tanks, storm sewers, and landscaping, as indicated on Figure 9. Construction of the bridge linking phase one to phase four will be deferred until Phase 4.

Phase Two would complete the remaining 37 lots located on the north side of NE Channel 1 and would include an extension of all the above noted services as well as the construction of the main sewer holding tanks and/or lift station.

Phase Three through nine would be developed from east to west, with the intention of developing all the lots on the NE side channel before commencing excavation on the SE channel. The actual timing and rate of development will be dependent on market conditions.

The entire bareland condominium area may be subdivided all at once while its actual development will be phased.

6.8 Operation, Maintenance and Upgrading of Proposed & Existing Infrastructure

The developer will be responsible for all on site development costs.

The bareland condominium association will be responsible for all operation and maintenance of the internal roads, utilities and common properties other than the lots which will be maintained by individual lot owners. For infrastructure improvements outside of the condominium area, cost sharing arrangements may be made with the County.

To promote public safety, the harbour and channels will have shallow water near shores with gentle slopes, depth markers and life preservers on piers. Fencing, gates and signs will be erected to limit public access to the harbour and channels.

6.9 Plan Statistics

The following table shows a summary of the land use categories of the bareland condominium development, excluding the main and secondary public access roads.

Land Use Category	Area	% of Total
Residential Dwelling Lots	12.99 ha (32.10 acres)	30.6 %
Conservation Areas	4.57 ha (11.32 acres)	10.8 %
Open Space & Park	0.37 ha (0.96 acres)	0.9 %
Roads	4.96 ha (12.26 acres)	11.7 %
Harbour, Marina, etc.	9.81 ha (24.66 acres)	23.0 %
Future Development Area	9.80 ha (23.72 acres)	23.0 %
Total	42.5 ha (105 acres)	100 %

7. Future Development on Remainder of Lot 15

The existing agricultural land uses on the remainder of Lot15 will not be changed in the near future. However, should community demand arise and market conditions become favorable, the remainder of Lot 15 may be developed for additional bareland condominium lots, MR, road widening, and commercial or recreational uses as permitted under the present zoning. Detailed planning will be necessary prior to any development approval being given.

Intensive livestock, industrial, large commercial, amusement park and other high impact land uses will not be permitted.

8. Plan Amendment

Amendment to this area structure plan may be considered as deemed appropriate by the County.

PREPARED BY

JAYMAR CONSULTING INC.

____

per: Bill Martenseon

GPEC CONSULTING LTD.

____

per: Dave Scott, P. Eng.

____

per: Reg Dacyk, R.E.T.

Appendix A
Groundwater Evaluations Report by AMEC

February 20, 2001
EE31088

GPEC Consulting
202, 9808 – 42 Avenue
Edmonton, AB T6E 5V5

Attention: Reg Dacyk

Dear Mr. Dacyk:

Re: Groundwater Potential Study
Lots 14 and 15, 20-54-3-W5M
Lac Ste. Anne, Alberta

1.0 INTRODUCTION

AMEC Earth & Environmental Limited ("AMEC") is pleased to provide the results of a groundwater potential study for the above referenced property.

The referenced property is located on Lac Ste Anne and covers an area of approximately 217 acres (Figure 1). This property is the site of proposed development as 116 lake front cottage lots and the remaining portion may be later developed as acreage parcels (approximate maximum of 40 lots) (Figure 2). A community water supply system is proposed for the cottage lots, while the acreages will require individual wells.

Hydrogeological information for the site, and surrounding area was assembled and reviewed to complete this study. Information sources included the Alberta Environment (AE) water well record database and relevant published geology and hydrogeology maps and reports.

2.0 INVESTIGATION GUIDELINES

In 1994, Alberta Environment issued the "Interim Guidelines for the Evaluation of Groundwater Supply for Unserviced Residential Subdivisions using Privately Owned Domestic Water Wells". These guidelines are recommended for use for unserviced residential subdivisions where the water supply will be provided by privately owned domestic water wells and where the number of residential parcels within one quarter section is six or more. These guidelines are intended to establish principles that are in accord with the principle of sustainable development. This approach has been incorporated into the new Water Act, which came into force in 1999.

Section 23 (3) of the Water Act addresses household diversions and states that a person residing within a subdivision on a parcel of land has the right to commence and continue the diversion of water only if, "a report certified by a professional engineer, professional geologist or professional geophysicist, as defined in the Engineering, Geological and Geophysical Professions Act, was submitted to the subdivision authority as part of the application for the subdivision under the Municipal Government Act, and the report states that the diversion of 1250 cubic metres of water per year for household purposes under section 21 for each of the households within the subdivision will not interfere with any household users, licensees or traditional agriculture users who exist when the subdivision is approved."

Relevant to the proposed development at Lake Lac Ste. Anne, the Act specifies that the diversion of 1250 m^3/year per household (household use as defined in the Act) should not interfere with any household users, licensees or traditional agriculture users who exist when the subdivision is approved. The objective of this study is to render a professional opinion, based on a review of readily available information, whether aquifers underlying the development site should be able to sustain a production of (maximum 156 lots x 1250 m^3/year/lot) 195,000 m^3/year (approximately 82 igpm), and that diversion of this groundwater will not adversely impact existing groundwater users, as defined by the Water Act. AMEC's opinion is based on the assumption that existing domestic users in the area, and users proposed at the site will use $\leq$ 1250 m^3/year obtained on a reasonably continuous basis.

3.0 GEOLOGY

The surficial geology of the study area is generally mapped as stagnation moraine which is characterized by till of uneven thickness up to 30 m (Shetsen 1990). These deposits have been modified by lake or stream erosion in the study area. The surficial deposits in the east portion of the study area are mapped as silt and clay with a flat to gently undulating surface. These deposits are mapped as part of the buried preglacial Onoway bedrock channel (Ozoray 1972).

The surficial deposits overlie bedrock of the Edmonton Group (Ozoray 1972). The uppermost portion of this Group is the Horseshoe Canyon Formation, which consists of interbedded sandstone, siltstone, mudstone and coal.

Water wells in the area of the proposed development indicate a general geology of clay till overlying sand and gravel deposits above bedrock. These surficial deposits are generally less than 20 m. The Upper Horseshoe Canyon Formation consists predominantly of shale with minor sandstone and siltstone intervals in this area. A cross section through this area constructed from water well driller's reports illustrates the local geology (Figure 3).

4.0 HYDROGEOLOGY

The Alberta Environment (AE) groundwater database lists 695 water wells within a 5 km radius of the proposed site. Typically only a subset of the records listed in the AE database are active water wells. A summary listing of the well records is provided in Appendix A. Driller's reports are included in Appendix B for water wells within a 0.8 km radius of the proposed development site and the driller's reports used to construct the cross-section.

4.1 GROUNDWATER USAGE

Within this surveyed area, water wells are almost entirely used for domestic purposes. There are eleven wells with usage indicated as domestic and stock or stock wells. Fourteen wells are municipal wells for the towns of Alberta Beach and Val Quentin. There is one industrial well located in 15-54-3 W5M that is owned by Union Oil. The current status of this well is unknown (i.e. if it is currently licensed or active).

Within a radius of 0.8 km of the proposed development site there are 48 water wells listed in the AE groundwater database. Over half of these wells are located in the community of Val Quentin, to the east. All of these wells are listed as for domestic purposes except for one well listed as a municipal well for Alberta Beach. There is no active license for this well listed with Alberta Environment and this well is likely inactive. There is only one license listed with AE within this area, a municipal well for the County of Lac Ste Anne to the west of the proposed site. No other industrial or municipal wells are indicated within the immediate area of the site.

4.2 GROUNDWATER AQUIFERS AND YIELD

Regional hydrogeological mapping of the area shows expected long term safe groundwater yields of 25 to 100 igpm across the study area from either surficial sand and gravel deposits or the upper Edmonton Group and yields of 100 to 500 igpm at the eastern edge of the proposed site area from sand and gravel deposits of the Onoway buried bedrock valley (Ozoray 1972). More recent regional mapping of the Lac Ste County does not show the buried Onoway valley extending near the proposed site (Hydrogeological Consultants 1998). This study shows long term yields of greater than 15 igpm (100 m^3/day) expected from both the surficial deposits and from the upper Edmonton Group (Upper Horseshow Canyon) at the site.

Most wells in the greater area appear to be completed at depths greater than 30 m. Within the immediate area of the proposed development, water wells are generally between 30 and 45 m deep. These wells are completed in the shale and occasionally also sandstone units of the Upper Horseshoe Canyon Formation. Testing rates for water wells in the immediate vicinity of the proposed development are frequently between 10 to 30 igpm and range up to 45 igpm, suggesting that yields of greater than 15 igpm may be expected in this area.

Recovery data from two pump tests in the vicinity of the proposed site were interpreted and indicate long term safe yields of 57 and 60 igpm. The aquifer parameters are summarized in

Table 1 and plots are included with the driller's reports in Appendix C. These rates exceed the test pumping rates of 25 and 10 igpm, respectively, and further testing would be required to verify safe yields above these pumping rates. However, this data does indicate higher long term safe yields may be expected across the proposed development site.

Table 1. Summary of Pump Test Recovery Data Evaluation

Well	ΔS		Transmissivity		Long Term Safe Yield	
	(m)	(ft)	(m^2/day)	(igpd/ft)	(m^3/day)	(igpm)
SE-20-54-03 W5M	0.3	0.9	42	2815	395	60
SW-21-54-03 W5M	1.2	4.1	24	1601	372	57

GROUNDWATER QUALITY

Groundwater quality in the area appears quite good. Concentrations of Total Dissolved Solids are between 500 and 1000 mg/L. Groundwater is of a sodium/potassium bicarbonate type.

5.0 CONCLUSIONS

Bedrock and surficial aquifers underlying the proposed development site appear capable of providing the total water demands of 195,000 m3/year (82 igpm) for household use within the proposed maximum 156 lot subdivision. Based on the available data, there appears to be sufficient groundwater resources present such that impact to existing users arising from the proposed development is not expected.

The study area groundwater quality appears to be relatively good and adequate as a supply of potable water.

Two wells may be required to meet the demands of the community water source (145,000 m^3/year or 62 igpm) intended to supply 116 lots.

6.0 CLOSURE

The findings in this report are based upon a review of published maps and reports, and from AE water well database information. The assessment has been carried out in accordance with generally accepted hydrogeological practice. No other warranty is intended or implied.

We trust that this proposal meets with your current requirements. If you have any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,

AMEC Earth & Environmental Limited

N. G

Nancy Grainger, MSc.
Environmental Hydrogeologist

Reviewed by:

PROFESSIONAL GEOLOGIST
J. FRED APON
ALBERTA

J. Fred Apon, P. Geol.
Senior Hydrogeologist

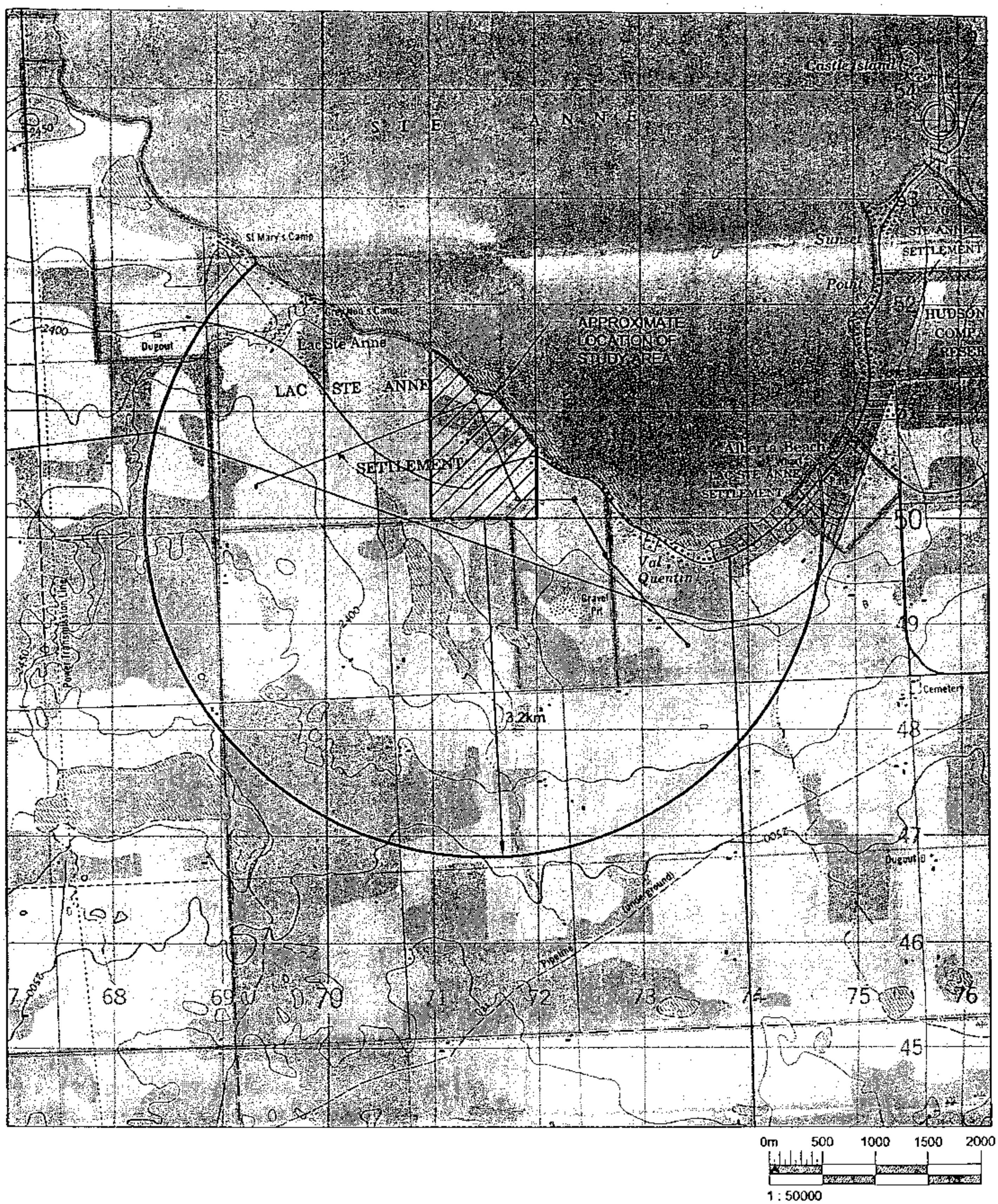
PERMIT TO PRACTICE
AMEC Earth & Environmental Limited
Signature
Date Feb 20/2001
PERMIT NUMBER: P 4546
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

7.0 REFERENCES

Hydrogeological Consultants Ltd. 1998 Lac Ste Anne County.

Ozoray, G.F. 1972. Hydrogeology of the Wabamun Lake area, Alberta. Alberta Research Council. Report 72-8.

Shetsen, I. 1990. Quaternary Geology, Central Alberta. Alberta Research Council. Map 213.



CLIENT: JAYMAR CONSULTING LTD.	DWN BY: RSW CHK'D BY: N.G.	SITE LOCATION PLAN	AMEC PROJECT NO: EE31088 REV. NO.: -
AMEC Earth & Environmental Limited / amec	SCALE: 1 : 50000 DATE: FEB, 2001		FIGURE 1

AMEC EDMONTON

*PLOT 1:1=D S:\CADD\Env\Ee31000\EE31088\ ee31088-001.dwg Thu. Feb. 15 5:30pm 2001 Model SWilcox

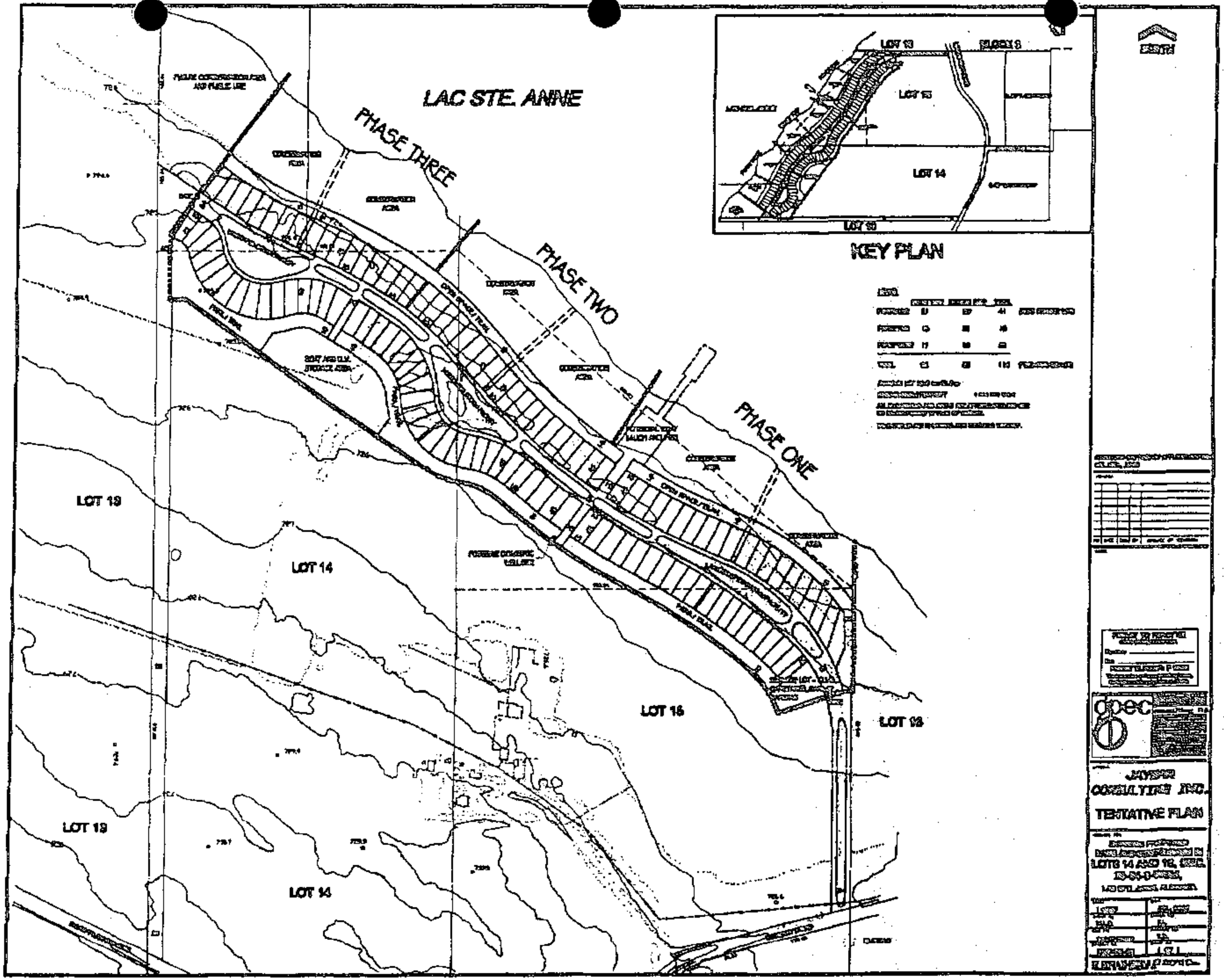
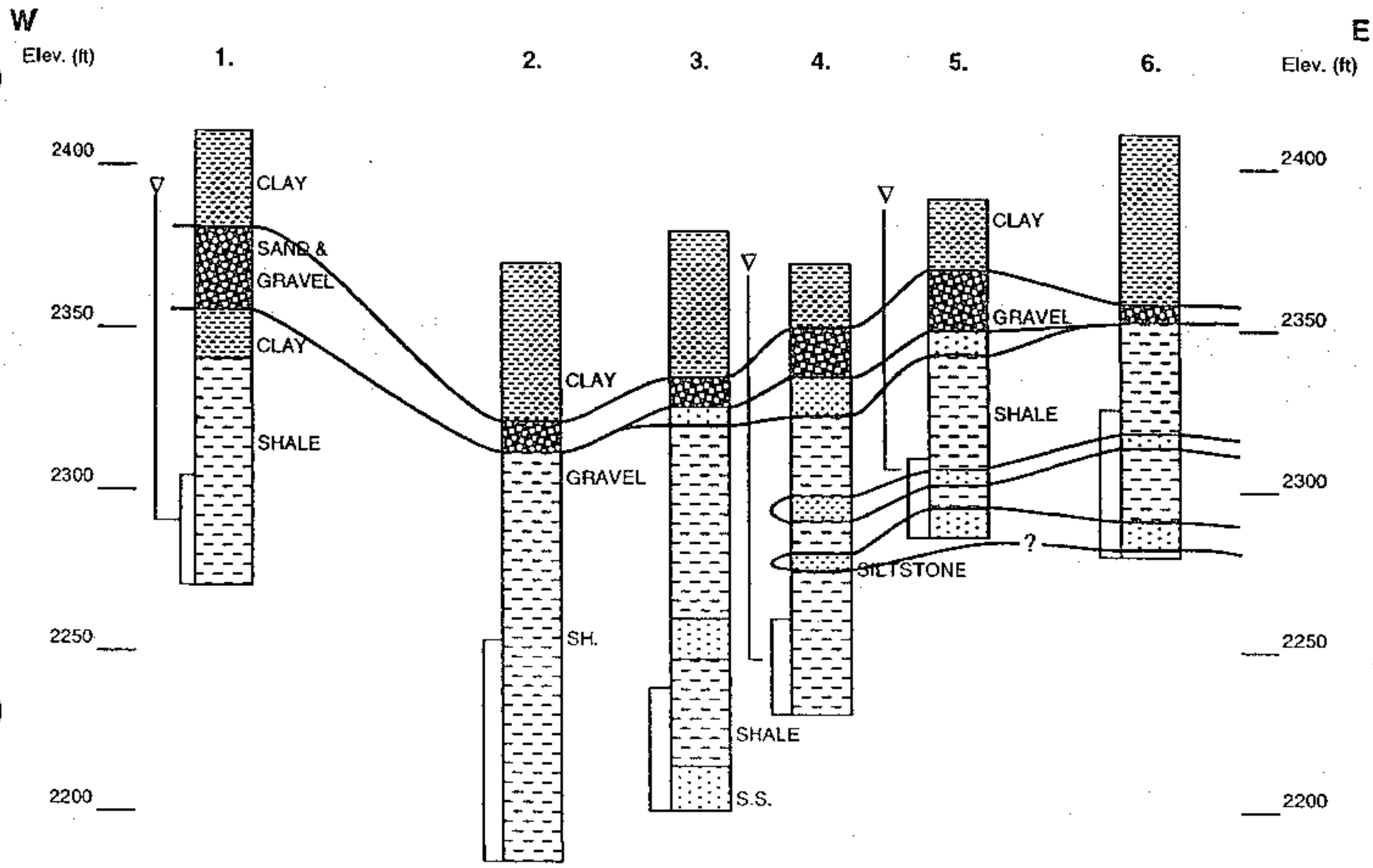
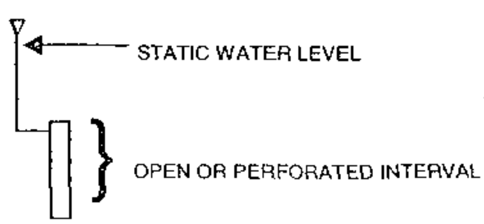

LAC STE. ANNE
PHASE THREE
PHASE TWO
PHASE ONE
KEY PLAN
LOT 13
LOT 14
LOT 15
LOT 13
LOT 13
LOT 14
TENTATIVE PLAN

Figure 3. E-W Cross-section across proposed subdivision at 20-54-03 W5M



Well locations:

1 SW-19-54-3-W5M
2 NE-20-54-3-W5M
3 01-20-54-3-W5M
4 SW-21-54-3-W5M
5 NW-16-54-3-W5M
6 SE-16-54-3-W5M



Appendix B
Revised Environmental Assessment by
Mainstream Aquatic Ltd.

REVISED ENVIRONMENTAL ASSESSMENT
- WINDMILL HARBOUR DEVELOPMENT -

Prepared for

Jaymar Consulting Inc.
#126, 11115 - 9 Avenue NW
Edmonton, Alberta
T6J 6Z1

By

Mainstream Aquatics Ltd.
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September 2003

mainstream
AQUATICS LTD

Citation: Mainstream Aquatics Ltd. 2003. Revised Environmental assessment of the Windmill Harbour Development. Prepared for Jaymar Consulting Inc. Report No. 03008D: 62 p. + Appendices and Addendum.

ACKNOWLEDGEMENTS

Mainstream Aquatics Ltd. (formerly P&E Environmental Consultants Ltd.) would like to thank Bill Martenson of Jaymar Consulting Inc. for initiating the study. The project description provided by Reg Dacyk of GPEC Consulting Ltd. and information provided by Richard Neufeld of the Lac Ste. Anne Planning and Development office are appreciated. We gratefully acknowledge assistance provided by Stephen Spencer, Stephen Hanus, and Hugh Wollis of Alberta Sustainable Resource Development and Bill Paterson of the Alberta Conservation Association.

Dr. Graham Griffiths was responsible for the evaluation the aquatic vegetation community.

The following individuals of Mainstream Aquatics Ltd. were responsible for completing the study:

Rick Pattenden -	Senior Biologist and Primary Author
Scott Millar -	Project Biologist and Coauthor
Chantal Pattenden -	Biological Technician
Charelene Williamson -	Biological Technician
Ash McKone -	Biological Technician

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1.0 INTRODUCTION

1.1 BACKGROUND

Jaymar Consulting Inc. has proposed a residential subdivision and inland harbour along the southeast shore of Lac Ste. Anne in the County of Lac Ste. Anne. The Windmill Harbour Development, subsequently referred to as the Project, is designed to provide single dwelling housing units in combination with an inland harbour, which provide access to recreational opportunities on Lac Ste. Anne. The Project has been designed to meet the long-term economic and social objectives of the County of Lac Ste. Anne, and at the same time, maintain the long-term environmental integrity of the lake.

The Windmill Harbour Development will require approvals from the municipal government. In 2001, an initial design of the Project entitled "Windmill Estates Area Structure Plan" was submitted for review to the County of Lac Ste. Anne (GPEC 2001). The County passed two bylaws approving that area structure plan and rezoned the property from commercial recreational to a CR-4 County Residential Estate - Direct Control (Bill Martenson, Owner, Jaymar Consulting Inc.). The current Project entitled "Windmill Harbour Development" will require a new area structure plan that accommodates changes to the design and an extension of rezoning by the County. The current Project design likely also will receive the support of the municipality (Richard Neufeld, Lac Ste. Anne County Development Officer, pers. comm.).

Because the Project may affect the environment, it is subject to a review by federal and provincial authorities in accordance with the Canadian Environmental Assessment Act. The Department of Fisheries and Oceans (DFO) is the Responsible Authority for the review of the Project (letter dated 19 June 2003).

In September 2001 Jaymar Consulting Inc. contracted the services of Mainstream Aquatics Ltd. (formerly P&E Environmental Consultants Ltd.) to undertake an environmental assessment (EIA) of the Project and to make applications for environmental approval. In August 2002, the draft EIA was submitted for review to the Department of Fisheries and Oceans.

In June 2003, DFO responded to the draft EIA by providing a Scope of Project, Scope of Assessment, and Terms of Reference for the environmental assessment that incorporated both federal and provincial guidelines as defined by Appendix 3 of the Canada-Alberta Agreement for Environmental Assessment Cooperation.

The present report entitled "Revised Environmental Assessment – Windmill Harbour Development" provides information that is needed to fulfill the requirements specified in these documents.

1.2 OBJECTIVES

The objectives of the revised environmental assessment are as follows:

1. Describe the Project and the existing environmental setting.
2. Identify the potential effects the Project may have on the environment.
3. Identify mitigation measures that can be used to reduce or eliminate the potential effects.
4. Evaluate the significance of the adverse residual effects that remain following mitigation, including cumulative effects.

2.0 PROJECT DESCRIPTION

2.1 PHYSICAL SETTING

Lac Ste. Anne is a popular summer and winter recreational lake located approximately 60 km from the City of Edmonton (Figure 2.1). There are six summer villages and five subdivisions that presently exist around the lake, but the Village of Alberta Beach is the focal point for most recreational activities. The Alexis and Enoch Reserves are located on the north shore of the lake. The Lac Ste. Anne Mission, which is located on the south shore 1.5 km to the west of the Project, is an important site for native peoples who gather every summer to celebrate the Christian faith and bathe in the waters that are thought to have healing powers.

The proposed development is situated on Lot 15 in Section 20, Township 54, Range 3, W5M approximately 1 km west of the Summer Village of Val Quentin. The parcel of land is bounded by Lac Ste. Anne Trail on the south, Lac Ste. Anne on the north, and it is less than 1 km north from Secondary Highway 633. The property area is approximately 42.5 ha with 700 m of shoreline.

The shoreline portion of the property falls under the jurisdiction of Alberta Public Lands. At present, there is no License of Occupation granted by the provincial government (Bill Martenson, pers. comm.).

2.2 PROJECT NEED AND ALTERNATIVES

Albertans residing in urban centers presently seek outdoor recreational opportunities during the summer months. In many areas of Canada, a "cottage at the beach" is a treasured possession that meets these needs. From a social perspective, it is desirable to find a way of increasing the utilization of the limited number of lakes within acceptable driving distance of Edmonton. The Windmill Harbour Development on Lac Ste. Anne has been designed in an attempt to achieve this goal in an environmentally acceptable manner.

The Project will be developed in Lot 15 in phases to meet market demand and to spread capital costs over the term of the development. There may be additional phases at the south end of Lot 15. These would not have waterfront and could include more single-family lots, or commercial/recreational activities to be determined by market demand. Jaymar Consulting Inc. has no immediate plans to develop its property (Lot 14), which located immediately west of Lot 15.

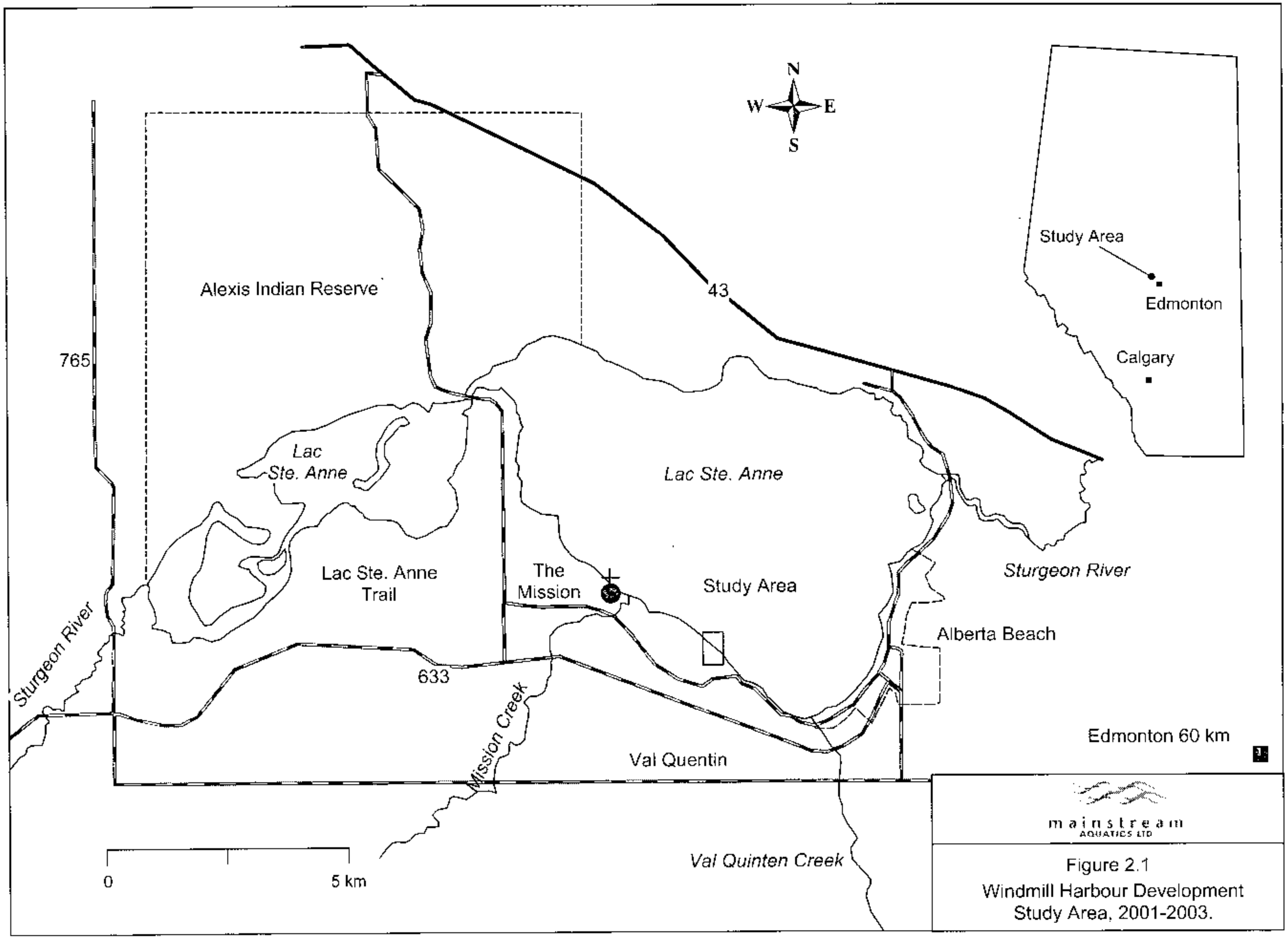

Figure 2.1
Windmill Harbour Development
Study Area, 2001-2003.

The Project has several social advantages while reducing environmental concerns. The following provides examples of these advantages.

1. The number of lots with direct access to the lake is large, while minimizing the need for development that physically impinges on the natural shoreline.
2. With access to the lake, the market will accept "urban-sized" vacation lots instead of acreages, resulting in greater utilization of the land (i.e., conservation of arable land).
3. Premiums paid for waterfront lots enables the developer to provide local improvement services to city standards and special amenities to lot owners such as a marina, clubhouse, private inland beach, and nature observation facilities.
4. Property owners will be able to build a pier at the back of their own lot without infringing on the natural lake shore. This facility becomes an extension of the patio as an area of socialization and fun for all ages. As such, many activities that might otherwise be on the lake will be focused inward to the owners' property.
5. The Project will encourage use of nonmotorized boats (i.e., sail boats). This form of recreation is healthy, challenging, in tune with nature and encourages strong social bonding. There are several yacht clubs on Lake Wabamun, but none on Lac Ste. Anne.
6. A beneficial side effect of the recreation/relaxation industry is economic growth in all sectors, particularly construction, supply and services. General employment is increased and summer jobs are created for students.
7. The Lac Ste. Anne County supports the concept and the Project fits into the long-term plans for the lake and its shoreline (Richard Neufeld, Development Officer, Lac Ste Anne County, pers. comm.)

The inland harbour concept is an attempt to satisfy the demand for recreational access to Lac Ste. Anne and provide an atmosphere of country living in a way that meets current standards and public desire for environmental protection at an acceptable cost.

Alternatives to the Project could include no development, relocation to a less environmentally sensitive area and redesign to reduce the potential environmental effects. A no development scenario would eliminate the potential environmental concerns associated with the Project, but would be contrary to the public desire for recreational access to Lac Ste. Anne.

Relocation to another waterbody within easy driving distance to Edmonton is problematic from an environmental perspective. Larger waterbodies suitable for recreational purposes proposed by the Project are more heavily utilized than Lac Ste. Anne (e.g., Lake Wabamun, Pigeon Lake, Sylvan Lake). Relocating to one of these lakes would likely increase, not lessen environmental concerns.

Relocating to another property along the shoreline of Lac Ste. Anne is also problematic because the financial costs would be prohibitive. If relocation was necessary, the proposed development likely would be terminated (Bill Martenson, pers. comm.).

Redesigning the Project to reduce environmental concerns could entail decreasing the size of the development and removing the need for access to the Lac Ste. Anne. Again, the economic viability of the Project would come into question if the development size were reduced, while trying to maintain access to the lake. Changing the design to that of a standard residential subdivision next to the lake, in theory, would eliminate environmental concerns pertaining to infringement on the lake shore. In practice, however, this does not stop lake shore degradation by residential lot owners who desire boat access to the lake adjacent to their properties (Vance Buchwald, Alberta Natural Resource Services Fisheries Biologist, pers. comm.). This type of redesign likely would increase rather then decrease environmental concerns.

2.3 DESIGN

The proposed development consists of a residential subdivision and an inland harbour (Figure 2.2). The operation and maintenance of the facility would be governed by a condominium association, which would be a private corporation. The condominium association would have the legal authority to control activities by residents of the development and enforce guidelines (e.g., use of lawn fertilizers, boat speeds in the harbour). The Project would entail construction of residential lots and supporting infrastructure, excavation of an inland harbour, and dredging of a channel in the lake bed to allow boat access.

2.3.1 Residential Lots and Infrastructure

The Project would be designed to accommodate approximately 182 lots, which would be constructed to a minimum elevation of 724.0 m using fill material excavated from the harbour. This minimum elevation was chosen to prevent potential flooding from Lac Ste. Anne. Because the lake bottom and shoreline exhibits a shallow slope, the residential lots will be set back approximately 60 m from the existing lake shore, which is the approximate location of the 1-in-100 year flood elevation of 723.79 m. This arrangement should eliminate the potential for erosion of the development area due to wave action or ice encroachment (Reg Dacyk, pers. comm.).

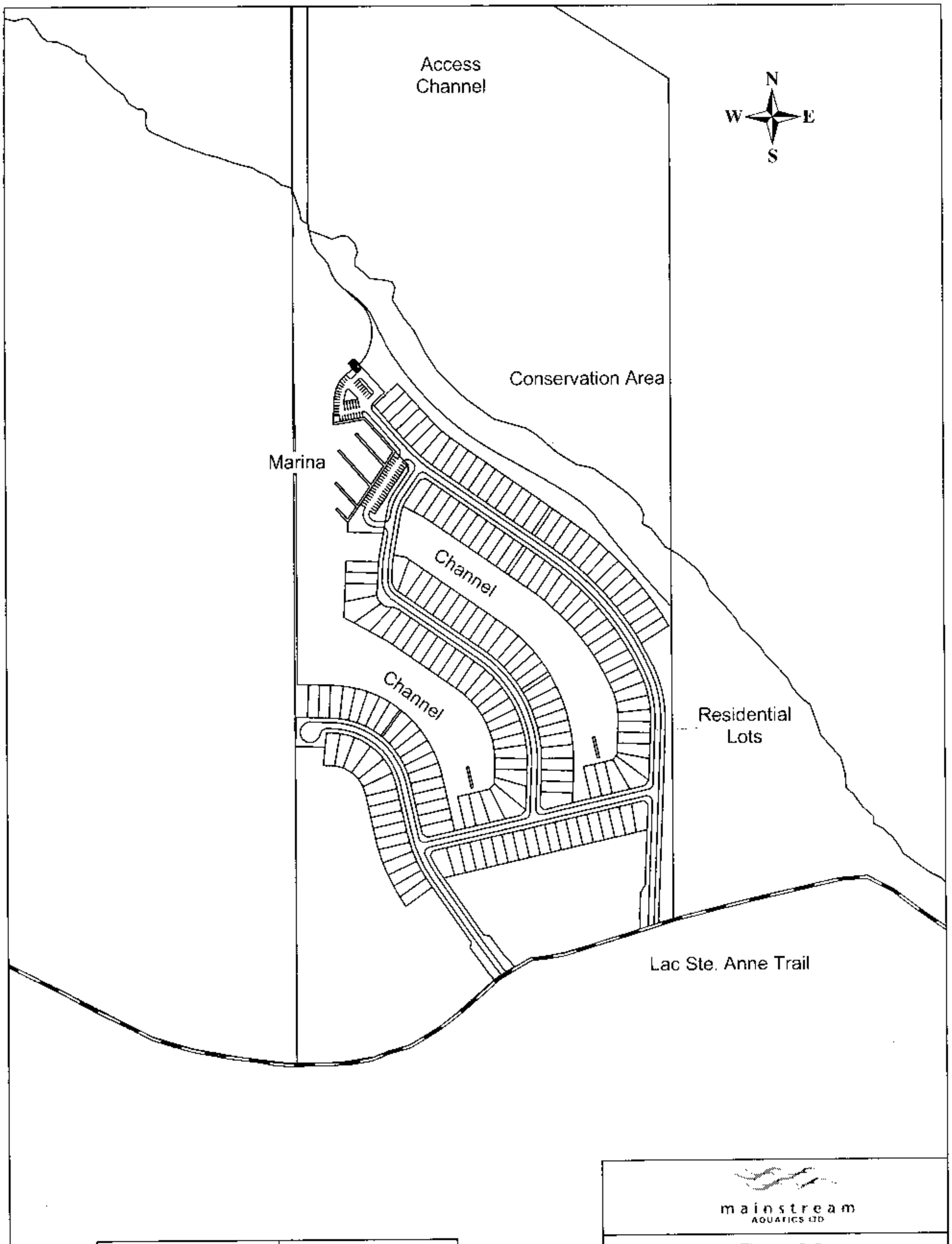

Figure 2.2
Project Description
Windmill Harbour Development.

The infrastructure associated with the Project will consist of road access to Lac Ste. Anne Trail at two locations. At the request of Lac Ste. Anne County, Jaymar Consulting Inc. has agreed to dedicate up to 5.2 meters of property along its southern boundary to accommodate widening of the right-of-way. The county will ensure that the necessary road improvements are completed, and as such, does not anticipate public safety issues associated with vehicle traffic from the Project (Richard Neufeld, pers. comm.).

A community water supply will be provided for domestic uses. A hydrogeological study completed by AMEC Earth & Environmental Ltd. in 2001 concluded that the underlying aquifers appeared capable of providing the domestic water demands to facilitate a residential development (AMEC 2001). Water for fire protection will be provided from the inland harbour.

Sanitary sewage collection will be provided using common holding tanks that will be pumped out and hauled to an appropriate off site disposal area. The system would be designed to minimize collection points with the intention of some day pumping directly to a regional treatment facility. Disposal facilities currently available in Lac Ste. Anne County have the capacity to accommodate domestic sewage expected from the Project; therefore, no immediate changes to the municipal infrastructure would be required (Richard Neufeld, pers. comm.).

Storm water management will be used to eliminate water quality concerns associated with surface runoff flowing directly into the lake by routing all front of lot and roadway runoff through separate manholes into the inland harbour. Utility companies in the area will provide power, gas, and telephone. The proposed design of the residential lots and infrastructure has been applied to similar developments in the province such as Sunset Harbour Development on Pigeon Lake (Henning F. Rasmussen, P. Eng. Civil Consulting Engineer, pers. comm.). Because the storm water management plan must meet or exceed provincial requirements, the design would be deemed acceptable by the municipality (Richard Neufeld, pers. comm.).

2.3.2 Inland Harbour

Construction of the harbour is deemed to be feasible from a geotechnical aspect (Thurber 2001). The inland harbour would be 9.3 ha in size and would consist of a marina, a main channel, and two side channels (Figure 2.2). The harbour would be private, thereby eliminating public access from land and severely restricting public access from the lake. The marina would be used to moor larger vessels such as sail boats, while the side channels would provide passage for smaller vessels to boat slips adjacent to each residential lot. A boat launch would be located at the south end of the main channel next to the marina. To accommodate larger vessels the minimum water depth in the marina and main channel would need to be 2.5 m below minimum lake water level, which is 722.0 m. Water depths in the side channels would be reduced to 1.5 m below minimum lake water level to facilitate passage of smaller watercraft and still provide sufficient water depth for sediment settling purposes.

The harbour banks would be constructed at a slope of 5:1 from the bottom up to the minimum lake water elevation (722.0 m) and at slope of 7:1 from the low water elevation to the maximum recorded water level elevation (723.79 m). The harbour shorelines would be protected from erosion by placing a layer of clean gravel and sand over geotextile fabric. If appropriate, other means of erosion protection will be considered at the design stage.

A small private beach is being considered for the inland harbour. If incorporated into the Project, it would be located at the northwest end adjacent to the marina.

2.3.3 Access Channel

From a geotechnical perspective, construction of the access channel is deemed to be feasible (Thurber 2001). Because Lac Ste. Anne is shallow in the vicinity of the proposed development, a channel extending from the shoreline to a water depth of at 2.5 m would need to be dredged to facilitate boat access. The channel would be situated at the extreme western edge of the property to take advantage of the lake bed slope at this location. It is estimated that the channel would be approximately 0.98 ha in size. The channel would extend 490 m into the open water, would have a width of 20 m along its entire length, and would be clearly marked with buoys that would be removed during the off-season. It is anticipated that the channel would in fill over time; therefore, some maintenance dredging would be required. The frequency for maintenance dredging of the access channel is estimated to be 15 years. This is similar to maintenance dredging requirements for Marina Bay Estates on Sylvan Lake (Jim Jardine, co-developer of project, pers. comm.). The channel side slope would be 3:1 and the excavated lake bed material would be removed and disposed of on lots during winter.

2.3.4 Conservation Area

A conservation area approximately 60 m wide and 690 m long (4.2 ha) will be located along the shoreline of Lac Ste. Anne and will be designed to provide a buffer between the development and the lake (Figure 2.2). It would be governed either by the County or by the Condominium Association. The primary purpose of the conservation area will be to minimize disturbance to the natural environment by prohibiting public access. It would include a fenced exclusion zone adjacent to a known western grebe colony, walking trails, resting areas, and a nature appreciation/viewing area immediately adjacent to the boat channel. Trees in the conservation area zone will be subject to partial removal, replacement, and pruning to maintain the lake view by lot owners.

The conservation area also will be extended along the east perimeter of the property To Lac Ste. Anne Trail. This area will encompass approximately 0.74 ha and will be maintained in its natural state or enhanced with vegetation plantings. The purpose of the area will be similar to that of the lakeshore conservation area: to protect the natural environment and promote low-impact recreational activities.

The landscape design of the conservation area will be finalized following discussions with regulatory authorities.

2.4 FACILITY OPERATION

The purpose of the Project is to provide single-family housing units. It is estimated that 33% of the lots would be permanent residences, while the remainder would be used for recreational purposes during the summer months. On average, 3.25 persons would be expected to utilize each residential lot and there would be an estimated 1.0 to 1.5 watercraft per household (Bill Martenson, pers. comm.). These vessels would consist of sailboats, motorized boats, and personal watercraft. An unknown number of snowmobiles could be associated with the residences during the winter months.

Based on these estimates and assuming complete occupation of 182 residential lots, the Project would increase the number of persons in the area by 592 and boat use on Lac Ste. Anne would increase by 273 vessels. These estimates are deemed to be conservative because two factors will lessen the utilization of the lake by boaters. First, repetitious boat rides soon loses the appeal to boat owners. Second, the majority of the socialization associated with boat ownership will take place in and around the boat moorings as an extension of the back yard patio. It also should be noted that facilities within the complex would be available only for use by residents.

2.5 PROJECT SCHEDULE

The initial stages of the development following approval are scheduled for completion within a 15-month period commencing in February 2004. The window of activity for each major component is identified in Table 2.1.

Table 2.1 Proposed development schedule for the Windmill Harbour Development.

Task		Window of Activities
Permitting and project approval		September 2003 to January 2004
Construction:	Access channel	February 2004
	Marina and main channel	July to September 2004
	Infrastructure (roads, electricity, etc.)	August to November 2004
	Start dwelling unit construction	November 2004
Full Operation of Facility		January 2011

2.6 CONSTRUCTION

Construction would use accepted techniques and equipment. The conservation area will be clearly demarcated to ensure that unnecessary construction does not occur in the area during this phase of the Project.

The boat channel will be dredged during winter from the lake ice. A back hoe will be used to excavate the channel, while trucks will remove the material to an appropriate location. The inland harbour would be excavated in the dry by maintaining a plug of undisturbed material between the lake and the excavation area. Excavated material will be used as fill for the residential area to achieve the required elevation of 724.0 m. Excess material will be trucked to an appropriate as yet to be determined location.

Once the bulk of the inland harbour has been complete, the infrastructure for the development would be initiated. Once the inland harbour and infrastructure are completed construction of the dwelling units and landscaping will commence. It is anticipated that all dwelling units will be built and operating by January 2010.

3.0 ENVIRONMENTAL DESCRIPTION

3.1 INTRODUCTION

The Windmill Harbour Development would entail a number of activities that potentially could affect the environment. As such, a description that characterizes the environmental setting and the biological community is required in order to evaluate Project effects. A review of existing information, discussions with government personnel, and site inventories were used to develop the environmental description. The following section briefly outlines the approach used, provides a general overview of the environment setting, and describes the results.

3.2 APPROACH

3.2.1 Study Area

The site of the Windmill Harbour Development lies along the southeastern shore of the east basin of Lac Ste. Anne (Figure 3.1). The study area is defined as the proposed development property (Lot 15) and the lake shoreline immediately adjacent to the property (Development Section). In addition, surveys were undertaken to the west (West Section) and east of the property (East Section).

3.2.2 Study Period

Surveys of vegetation and wildlife resources were completed on five separate occasions. Tasks completed during each survey are outlined in Table 3.1.

Table 3.1 Tasks completed during surveys of vegetation and wildlife resources in the Windmill Harbour Study Area.

Task	**Date**					
	12 Oct 01	**29 Oct 01**	**29 Mar 02**	**22 May 02**	**28 Jun 02**	**5-6 Aug 03**
Waterbird Survey	*	*		*	*	
Wildlife and Bird Survey	*	*	*	*	*	
Vegetation Mapping				*	*	
Vegetation Survey						*

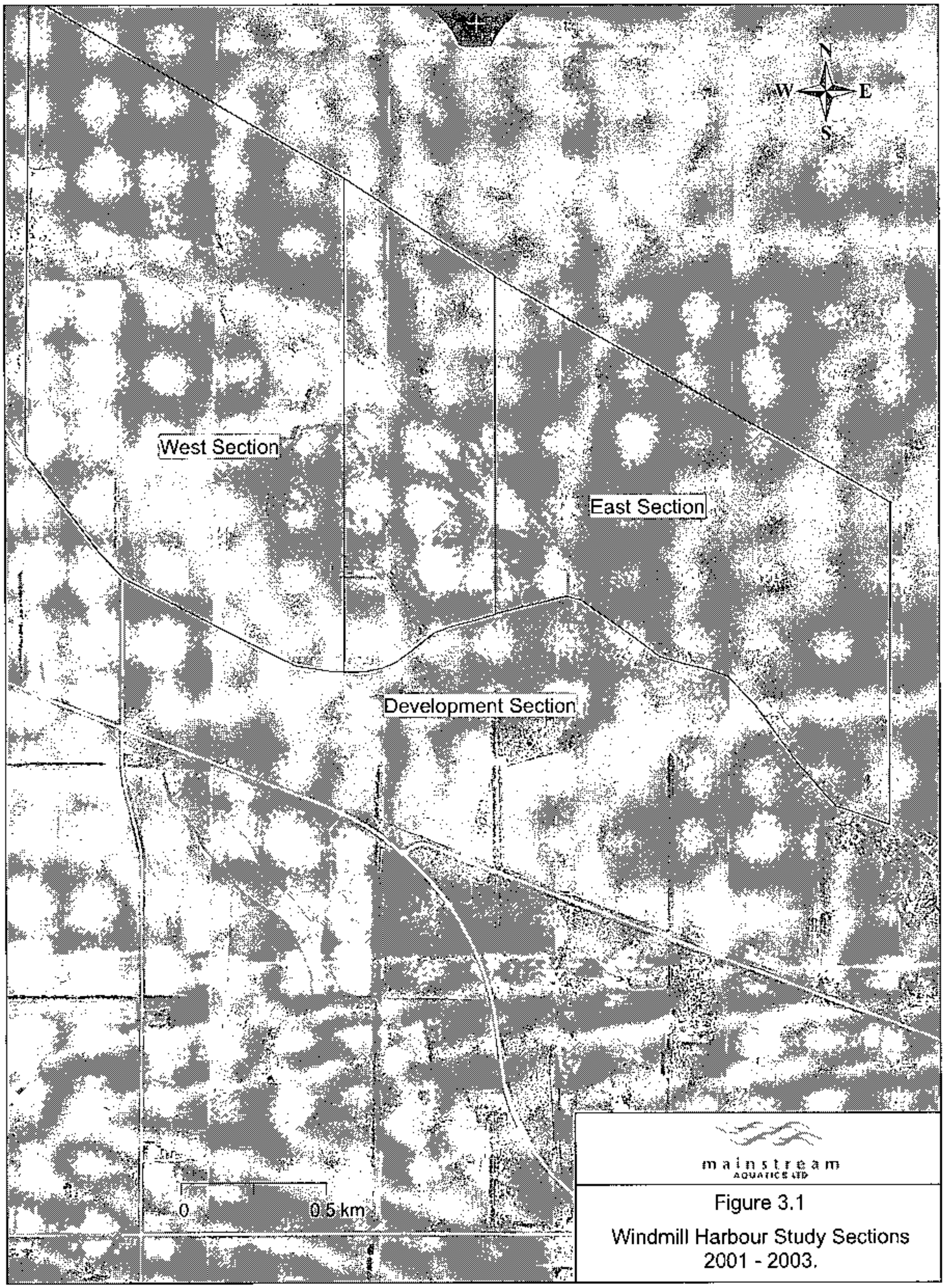

Figure 3.1

Windmill Harbour Study Sections
2001 - 2003.

A survey of water and fish resources was undertaken during a three-day period from 22 to 24 May 2002. The session was used to document general water quality conditions and use of the area by fish. Sampling focused on walleye and northern pike, which potentially could use the shoreline area adjacent to the property for spawning, rearing, and feeding.

3.3 METHODS

3.3.1 Information Review

Information from Alberta government offices was reviewed and government personnel were contacted to obtain information. Richard Neufeld of Lac Ste. Anne County Planning and Development office provided information regarding present land use in the area. Several literature sources were keyword searched, which included Fisheries and Oceans Canada WAVES library catalog, American Fisheries Society catalog of online journals, and the University of Alberta Libraries Collection. In addition, a general web query was undertaken for additional information on Lac Ste. Anne.

3.3.2 Field Assessments

3.3.2.1 Vegetation

The vegetation community (aquatic and terrestrial) was inventoried, mapped, and described. Black and white aerial photographs at a scale of 1:20,000 (dated 15 Aug 2000) were used to delineate major terrestrial vegetation communities present in the study area. This work was followed by ground truthing to confirm general terrestrial vegetation community boundaries and to identify the dominant plant species.

Aquatic vegetation was mapped based on field conditions rather using aerial photographs. This approach was required because the air photo coverage for the study area did not represent the current distribution and density of the emergent vegetation community. The perimeter of the emergent vegetation zone was delineated using a Gamin™ Model 12XL global positioning unit (±10m). These data were later downloaded and plotted. Field surveys completed on 22 May and 28 June 2002 were used to identify the dominant emergent and submergent plant species.

In addition to mapping of the major communities, more detailed information was collected for aquatic vegetation 0n 5 and 6 August 2003. This component of the vegetation inventory was conducted based on the Alberta Wetland Inventory Standard (Halsey *et al.* 2003) and included rare vascular and nonvascular plant assessments. Three transects were placed perpendicular to the lake shore in the Development Section and quadrats were established along each transect out into open water. The presence of rare plants, species composition, and relative density (percent cover) were recorded in each quadrat. In addition, ground truthing was undertaken outside the quadrats as part of the rare plant survey.

3.3.2.2 Wildlife

Wildlife inventories consisted of synoptic surveys designed to document the presence or absence of wildlife and avifauna in the study area and to enumerate the number of animals encountered. Amphibians, reptiles, mammals, and birds were recorded based on their physical presence or signs of activity (e.g., tracks and vocalizations). Particular attention was given to use of the area by waterbird species during the fall and spring migration, and nesting periods.

3.3.2.3 Water Resources

Three water quality parameters were measured on-site during the survey, including water temperature (hand-held alcohol thermometer, ± 1°C), conductivity (TDSTestr3 conductivity meter, ± 2%), and pH (pHTestr2 pH meter, ± 0.1 pH units). Personnel also noted wind direction and wave conditions on the lake and evidence of surface runoff during each site visit.

3.3.2.4 Fish Resources

<u>Fish</u>

The objectives of fish collections on Lac Ste. Anne were to determine the presence or absence of fish species, determine their reproductive state, and to determine the use of the proposed development area. A variety of fish sampling methodologies were employed to meet these objectives.

A 5 m boat electrofisher propelled by a 175 Hp sport-jet inboard motor was used to sample fish along the outer perimeter of shoreline emergent and submerging vegetation. The craft was equipped with a double, fixed-boom anode system and Smith-Root Type VIA electrofisher system. Electrofisher settings were maintained at an amperage output of 3.0 to 4.0 A, pulsed DC current, and a frequency of 60 Hz. The sampling procedure involved drifting at motor idle along the channel margins in water depths <2.0 m, while outputting a continuous current of pulsed DC electricity. Two netters, positioned at the bow of the boat, netted fish immobilized by the electrical field. All captured fish were held in a 225 L live-well for processing. Upon completion of an electrofishing section, observed fish were enumerated, and captured fish were processed and released.

Standard experimental gill net gangs were deployed to sample deeper portions of the lake. Gill net sets were of short duration and were checked continuously to minimize any mortality associated with gill net usage. Each gang consisted of six monofilament net panels measuring 2.4 by 15.3 m; the stretched mesh gill net apertures used were 1.3, 3.8, 6.4, 8.9, 11.4 and 14.0 cm.

A fyke net was deployed along the margin of Lac Ste. Anne as a non-lethal method of capturing fish moving along the shoreline. The fyke net consisted of two parts: the hoop portion and the lead net. The hoop portion of the net is a round tube of netting 3.7 m in length. A 1.2 x 2.4 m rectangular fiberglass hoop supported the net opening; the remainder of the netting was supported by four 1.2 m diameter round fiberglass hoops. The end of the tube was drawn closed using a drawstring and a steel ring. The hoop portion of the net also sported two inner 'finger style' funnels or throats designed to prevent fish from retreating toward the mouth of the net. The lead portion of the net was intended to guide fish moving through the area into the hoop portion of the net. Consisting of two - 1.8 x 15.3 m mesh panels, the lead net extended from the center of the rectangular opening hoop towards the shoreline.

In an attempt to capture smaller-sized fish, standard minnow traps (Gee type) baited with canned cat food were deployed. The dimensions of the traps were 0.4 m length x 0.2 m diameter with an aperture opening at either end of 0.02 m.

Artificial substrate mats and sweep nets were utilized to document the presence of fish eggs or larvae in the vicinity of the proposed development. Substrate mats placed in potential northern pike spawning areas consisted of a 30-cm square section of latex horsehair matting secured to the lake substrate using a stake.

Sweep nets were utilized to collect eggs and larvae already deposited amongst the substrate and vegetation. Sweep nets consisted of a semi-circular net frame (17 cm radius) with a handle attached opposite of the flattened portion of the frame. The 1 mm mesh netting was sewn into a canvas neck that was 17 cm deep. The flattened lower portion of the net frame was swept along the substrate and vegetation; each sweep was approximately one meter in length.

Collected eggs and larvae were preserved using buffered 1% formalin and labeled for later identification.

<u>Fish Habitat</u>

Fish habitat was assessed by mapping the aquatic vegetation as described in Section 3.3.2.1. Additional data were collected in order to describe and quantify fish habitat. Five depth transects were completed perpendicular to the shoreline to ascertain the lake bed bathymetry in the vicinity of the Project. Geo-referenced locations were recorded at 0.5 m depth intervals from 0.5 to 5.0 m of depth. Water depth was measured using an Eagle Fish Easy II depth sounder. Substrate along each transect was classified as either fine (sand/muck) or coarse (gravel/cobble) material using a wading rod or anchor. Where coarse material was encountered, a sample was collected where possible to verify the size of the material.

An experienced fish biologist rated the quality of fish habitat. The rating system was specific to species and life-requisites expected to be important in shoreline habitats found in the study area (i.e., egg incubation/spawning, juvenile rearing, adult feeding). Rating categories corresponded to guidelines specified by DFO (1998) and are as follows:

Category	Description
Negligible (1)	Habitat has no value to the species life stage.
Low (2)	Habitat contributes marginally to production of the species life stage.
Moderate (3)	Habitat is used by the species life stage, but is present in large amounts.
High (4)	Habitat is unique and is critical to the well-being of the species life stage.

3.3.2.5 Data Processing

In general, raw data were entered into Microsoft Access® software data storage files. Quality control measures included a visual inspection of the data immediately following entry, random inspections by a second party, and basic summary statistics to identify data entry errors.

Geo-referenced location data were plotted to a geo-referenced aerial photograph of the study area using MapInfo®.

Summary information was generated using Microsoft Excel® software. Fish catch rates were calculated based on the number of captured fish divided by the sampling effort expended using a particular sampling methodology.

3.4 RESULTS

3.4.1 Social Issues

Land Use

The main land use in the Lac Ste. Anne watershed is agriculture, which consists of mixed farming, livestock grazing, and forage production (Mitchell and Prepas 1990). There are six summer villages and five subdivisions that occur around the lake, but Alberta Beach is the focal point for most recreational lake activities. These include boating and fishing in the summer and ice fishing and snowmobiling in the winter. There has been no formal boat counts undertaken by the County of Lac Ste. Anne, but the majority of recreational watercraft on the lake are thought to originate from outside areas such as the City of Edmonton (Richard Neufeld, pers. comm.). Similarly, no formal snowmobile counts have been made, but the lake is used for recreational snowmobiling and the majority of activity is concentrated along the lake shore or is associated with ice fishing.

The site of the Windmill Harbour Development lies along the southeastern shore of the east basin of Lac Ste. Anne approximately 1 km west of the Summer Village of Val Quentin. Properties adjacent to the Project are under private ownership. A wooded lot and residence are owned by Leanne Knysh to the east. Art & Ben Sonnenberg presently own Lot 13 immediately west of Lot 14 of the Project. Fritz Sonnenberg is the tenant farmer who cultivates Lot 15, 14 and Lot A (formerly part of Lot 15) on the south side of Lac Ste. Anne Trail.

<u>Historical Resources</u>
The Alexis Indian Reserve is located on the northwest section of the lake. Also, the Lac Ste. Anne Mission, which is located on the south shore approximately 1.5 km to the west of the development, is an important gathering site for native peoples wishing to celebrate their Christian faith and bathe in the healing waters of the lake.

Due to the extensive amount of physical disturbance in the area that has occurred historically, no unique resources are expected to occur on the Windmill Harbour Development site. Jaymar Consulting Inc. will make an application to the Alberta Community Development to ascertain whether a historical resource assessment be conducted for the proposed development. If this agency deems that an assessment is required, the work and mitigation measures will be completed prior to initiation of construction.

<u>Public Issues</u>
Jaymar Consulting Inc. made a previous submission to the County for change of zoning and approval of an Area Structure Plan on approximately 26 hectares associated with the Project. A public meeting was advertised and held in the Albert Beach Community Hall at which 85 people were in attendance. Bill Martenson of Jaymar Consulting Inc. chaired the meeting and information was provided by town planner Eugene Lee and Reg Dacyk of GPEC Consulting Engineers, aided by maps, plans and overhead projections. Richard Neufeld and three County Councilors were also in attendance. About 15 of the attendants resided in the County, while the balance was from the adjacent summer villages.

The public meeting was followed by an additional hearing at the County Office in Sangudo, with minimal public attendance. The Area Structure Plan and Rezoning bylaw were then passed unanimously that same afternoon.

Based on the results of the public meeting and hearing, the concerns of the local community were addressed to the satisfaction of the Lac Ste. Anne County with the exception of a small group that were against any development near the lake.

The current Project will require a new area structure plan and a second set of public meetings (Richard Neufeld, pers. comm.). Any new public concerns identified at this time will need to be addressed to the County's satisfaction as part of the municipal approval process.

3.4.2 Terrain and Soils

AMEC Earth & Environmental Limited (AMEC) completed a groundwater potential study for the proposed development (AMEC 2001). The following summarizes information in that document that was related to terrain and soils.

The Project area is located on generally flat terrain that gradually slopes towards Lac Ste. Anne. Surficial geology in the area is generally characterized by glacial till that has been modified by lake or stream erosion. The east portion of the development area is mapped as silt and clay with a flat to gently undulating surface. Water wells in the area indicate a general geology of clay till overlaying sand and gravel deposits above bedrock.

3.4.3 Surface and Ground Water

The following section summarizes information related to surface and ground water that was presented in a report by AMEC Earth & Environmental Limited (AMEC 2001).

Surface water in the area is characterized as ill-defined drainage towards the lake shore. There are no defined watercourses or ponded waters in the development area. Regional hydrogeological mapping of the area shows groundwater flow from either surficial sand or gravel deposits. The expected groundwater yields are 25 to 100 igpm. Most wells in the greater area appear to be completed in shale or sandstone at depths greater then 30 m. Recovery data from two pump tests in the vicinity of the Project area indicate long term safe yields of 57 and 60 igmp. Groundwater quality appears to be good with Total Dissolved Solids being from 500 to 1000 mg/L.

3.4.4 Vegetation

A search of the Alberta Natural Heritage Information Centre (ANHIC) identified no occurrences of rare plants in the Project area (John Rintoul, Section Head and Information Coordinator, Alberta Natural Heritage Information Centre, pers. comm.). This information review was supplemented by field surveys of the upland and aquatic vegetation communities.

3.4.4.1 Upland Vegetation

A large percentage of the basin consists of undeveloped forest. The area is located in the Boreal Mixedwood Ecoregion (Strong and Leggat 1981). Trembling aspen (*Populus tremuloides*) dominate in the well-drained soils, while black spruce (*Picea mariana*) and balsam poplar (*Populus balsamifera*) are prevalent in poorly drained areas.

The upland portion of the proposed development is 42.8 ha in size (Figure 3.2, Table 3.2). The majority of the area has been disturbed in the recent past or by present human activities (34.1 ha or 80%). The undisturbed area consists of mature stand of balsam polar/black spruce (6.5 ha). In terms of percent surface area, land use activities consist of cultivated (25) and forage crop sections (20%), as well as farm buildings and an access road (5%).

Table 3.2 Vegetation zones mapped in the Development Section of the Windmill Harbour Study Area, 28 June 2002.

Zone		Area (ha)	Percent
Cultivated land		10.72	25.0
Forage Crop		8.56	20.0
Farm buildings and access road		1.96	4.6
Mature poplar/spruce		6.45	15.1
Planted spruce		0.44	1.0
Logged forest		12.42	29.0
Riparian		2.26	5.3
Terrestrial Total		**42.81**	**100.0**
Emergent Vegetation -	Bulrush	11.21	80.0
	Water lily	0.68	4.9
	Open water in emergents	2.12	15.1
Emergent Total		**14.01**	**100.0**

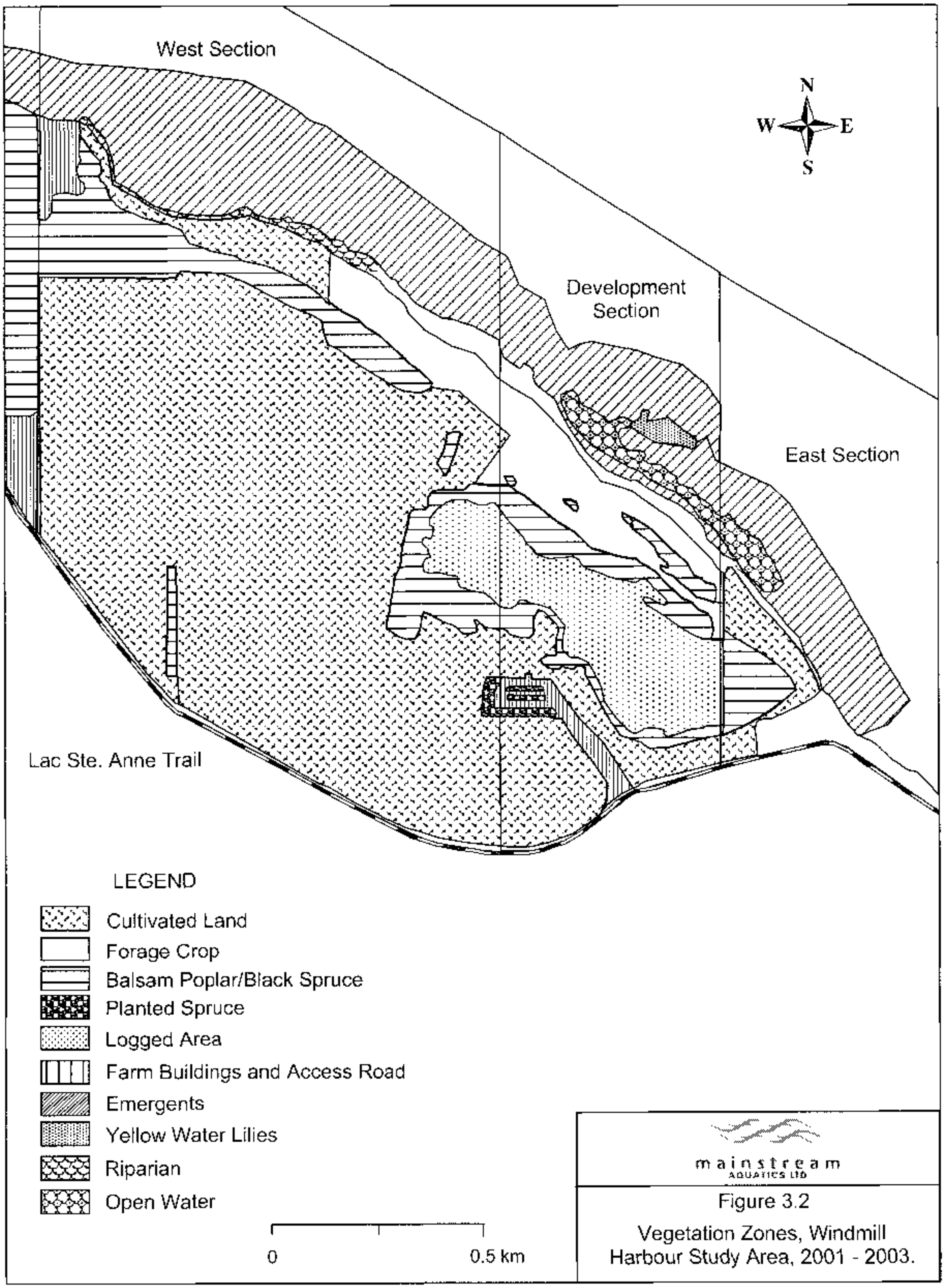

Figure 3.2

Vegetation Zones, Windmill Harbour Study Area, 2001 - 2003.

The remainder of the upland area in the Development Section consists of a small stand of planted spruce trees adjacent to the farm buildings (1%), a band of riparian vegetation (primarily willows [*Salix spp.*]) adjacent to the shoreline (5%), and a forest block that was logged in 1992 (29%). The mature stand of balsam poplar/black spruce (15%) is generally situated between the cut block and the forage crop area. The cut block is presently regenerating and is dominated by trembling aspen, balsam poplar with a dense understory of red-osier dogwood (*Cornus stolonifera*) and gooseberry (*Ribes spp.*).

3.4.4.2 Aquatic Vegetation

There is an extensive zone of emergent vegetation dominated by bulrushes (*Scirpus spp.*) that occurs along the entire shoreline of the property that has an approximate area of 14.0 ha (Figure 3.2, Table 3.2). In general emergent vegetation extends up to 150 m offshore and exhibits a stem density that is sufficient to prevent wave action from disturbing a number of open water areas next to shore.

One of these sheltered areas supports a dense stand of yellow water lily (*Nuphar variegatum*) approximately 0.7 ha in area. Yellow water lily and submergent vegetation (e.g., common bladderwort [*Utricularia vulgaris*]) also are interspersed throughout the emergent vegetation zone. This zone also contains an open water area that is approximately 2.1 ha in size.

In addition to mapping of the dominant plant communities a detailed survey was completed. The results are presented as follows: detailed information is presented in Addendum A.

There are two well-defined, more or less continuous beach ridges in the study area. The primary beach ridge marked by the outer limits of poplar forest and tilled cropland was formed at a time when lake levels were higher, probably in early postglacial times. There is second lower second beach ridge (close to the existing shoreline) occupied by a strip of dense willow shrubbery. Between the two beach ridges there is a broad band of open land mainly occupied by sedge fen, with varying degrees of recent willow invasion. The detailed survey focused on riparian and aquatic vegetation below the primary beach ridge.

The shoreline vegetation in the Project area is representative of natural vegetation of Lac Ste. Anne and similar lakes in central Alberta. It shows little evidence of recent manmade disturbance. It was not found to contain any plant species listed as rare on the Provincial "Tracking List" published by the Alberta Natural Heritage Information Centre. Most of the plant communities extend (continuously or with only short gaps) along the entire shoreline. The only exception was the pond lily community, which is confined to north-central part of the Development Section.

Water depth at the outer limit of bulrush beds was measured at 1.3 m. The lake water was murky due to abundant microorganisms, so the lake bottom could not be seen in open water plots (1.3 m and beyond). Rack samples indicated that coverage by rooted aquatics is at most patchy, but the presence of *Chara* spp. may have been underestimated due to its short stems not being effectively sampled with the tool used. Given the poor light penetration into the water, abundance growth of rooted aquatics in water depths >1.3 m seems unlikely.

The following are more detailed comments on particular vegetation types.

Sedge Fens

The extensive band of open ground between the two main beach ridges is mainly occupied by sedge fen , the dominant sedges being awned sedge *(Carex atherodes)* and/or graceful sedge *(C. praegracilis)* (see plots 1A, 2A, 3A). Many parts of this fen are being invaded by willow saplings (mainly basket willow, *Salix petiolaris*,). This willow invasion may indicate that the site has become drier in recent years, or that willow growth was previously suppressed due to cultivation or grazing. The prevalence of graceful sedge suggests that the land is slightly saline (oligohaline), as also does the fact that most of the willow saplings belong to basket willow, which is the species of willow most tolerant of salinity. No poplar saplings were recorded in this area. The vegetation complex indicates that the land must have a high water table for at least part of the year.

Limited bands of sedge fen dominated by awned sedge also occur below the second beach ridge (see plot 2C). This species is commonly found on intermittently flooded ground.

Willows

An almost continuous band of dense mature willow shrubbery extends along the second beach ridge (see plots 1B, 2B, 3B). The dominant willow is basket willow, a species indicative of eutrophic to oligohaline conditions. Some weedy herbs were recorded in the understory of this strip: stinging nettle (*Urtica dioica*) and hemp nettle (*Galeopsis tetrahit*).

Reed Beds

Reed beds dominated by the tall reed Canary grass (*Phalaris arundinacea* and/or blue joint (*Calamagrostis canadensis*) (see plots 1C, 2D, 3C) occur extensively along the upper shoreline, either immediately below the second beach ridge or on a slight third beach ridge separated from the second ridge by a strip of sedge fen (transect 2). These robust grasses predominate on sites subject to disturbance by wind and wave action during severe storms, but above normal water levels.

Cattail Beds

Cattail beds (*Typha latifolia*) commonly form continuous bands on saturated to shallowly flooded ground at the edges of eutrophic lakes and ponds with more or less stable water levels (see plots 1D, 2E, 3D). The stands at this site contain a rather diverse mixture of other wetland plants, especially common manna grass (*Glyceria grandis*), giant burreed (*Sparganium eurycarpum*) and creeping spikerush (*Eleocharis palustris*). This is the only plant community at the site with an extensive moss layer (consisting of *Drepanocladus aduncus*).

Bulrush Beds

Broad beds of hard-stemmed bulrush (*Scirpus acutus*) extend along the entire shoreline, occupying water ranging in depth from a few centimetres at the edge of the cattail beds to about 1.3 m. The density of the bulrushes decreased with increasing distance from the shore. Some parts of the beds contain dense growth of the submersed aquatics such as common bladderwort (*Utricularia vulgaris*) and hornwort (*Ceratophyllum demersum*), but in other places few or no rooted plants other than bulrush were present (compare plot 2F with plots 1E and 3E). Bulrush beds are both physically and biologically important, as they break up and slow down waves before they reach the shore; thus they protect shorelines from erosion, as well as provide shelter for wildlife.

Submersed Aquatics

A zone of rooted aquatic vegetation beyond the bulrush beds appears poorly developed in this lake, only *Chara* spp. being present in all three of our samples (plots 1F, 2G, 3F). While *Chara* spp. is classified as an alga, it is normally listed as a rooted aquatic because it is attached to the substrate. Patches of clasping-leaf pondweed (*Potamogeton richardsonii*) and sago pondweed (*P. pectinatus*) were found, but appeared not to be extensive. Poor light penetration of the water is probably responsible for poor development of a rooted aquatic flora in this lake beyond the bulrush beds. A series of shallow lagoons along the shore contains a different community of submersed aquatic plants dominated by thread-leaved pondweed (*Potamogeton filiformis*) (see plot 4B).

Pondlily Beds

Extensive beds of yellow pondlilies (*Nuphar variegatum*) are found towards the east end of the site. The water beneath the pondlilies is occupied by dense mats of common bladderwort and hornwort. Much of this area is free of bulrushes, but there is a transition zone containing both pondilies and bulrushes in the location of the western grebe colony.

3.4.5 Wildlife

The Lac Ste. Anne region provides habitat for a wide variety of wildlife species including white-tail deer (*Odocoileus virginianus*), moose (*Alces alces*), snowshoe hare (*Lepus americanus*), coyote (*Canis latrans*), and many other species. Semi-aquatic furbearers such as muskrat (*Ondatra zibethica*) and mink (*Mustela vision*) also inhabit the area. Amphibians expected to occur in the region include striped chorus frogs (*Pseudacris triseriata*), wood frogs (*Rana sylvatica*), and western toad (*Bufo boreas*) (Russell and Bauer 1993). The red-sided garter snake (*Thamnophis sirtalis*) is also present in the area (Russell and Bauer 1993). Over 130 species of birds have been recorded in the general area, including numerous forest and grassland song birds, upland game birds, and waterfowl (Semenchuk 1992).

Lac Ste. Anne and portions of undisturbed shoreline provide habitat for a variety of waterbirds including geese, ducks, herons and grebes. Lac Ste. Anne is considered nationally important for waterfowl and for western grebes (Poston et al. 1990).

Extensive cultivation and haying activities on the upland portion of the proposed development site limits the amount of habitat available to wildlife, but the natural vegetation communities that are present provide good habitat diversity. Wildlife and bird surveys documented a wide variety of species in the Windmill Harbour study area that are typical of this part of Alberta (Appendix Tables A1 and A2) and the majority of these species were recorded in the Development Section

The cut block provides winter browse for ungulates such as white-tailed deer and moose and the uncut portion of mature forest provides refuge for these species. Track patterns recorded during winter also suggests that the area is a movement corridor for ungulates and smaller mammals such as coyote, red fox (*Vulpes fulva*) and striped skunk (*Mephitis mephitis*).

Raptors such as osprey (*Pandion haliaetus*) and hawks use the mature trees on the property as perches. In addition, an active red-tailed hawk nest was present in the mature stand of popular/spruce. There are also a variety of song birds and game birds (e.g., ruffed grouse) are present.

During the spring survey, breeding chorus frogs and wood frogs were recorded along the shoreline of Lac Ste. Anne and in some ephemeral ponds present in the cut block.

Waterbirds use the lake shore in the study area. Fall and spring surveys suggest that this portion of the lake is a staging area for waterfowl, and in particular, for lesser scaup (*Aythya affinis*), common goldeneye (*Bucephala clangula*), and bufflehead (*Bucephala albeola*). The size, characteristics, and isolation of the emergent vegetation suggest that it is also used as a moulting area for ducks. Based on the presence of paired birds, nestling ducks and goslings, ducks and geese likely nest in the study area and probably within the Development Section. The riparian vegetation zone and forage crop land also provide good nesting habitat for several species of upland nesting waterfowl.

The emergent vegetation zone within the study area provides nesting areas for several songbird species including yellow-headed blackbird (*Xanthocephalus xanthocephalus*), red-winged blackbird (*Agelaius phoeniceus*), and long-billed marsh wrens (*Telmatodytes palustris*). Nesting colonies of both blackbird species were present in the Development Section.

Nesting water bird colonies also were identified in the emergent vegetation zone within the Development Section of the study area. These included black tern (*Chlidonias niger*) and common tern (*Sterna hirundo*), eared grebe (*Podiceps nigricollis*), and western grebe (*Aechmophorus occidentalis*). The western grebe colony is of particular importance because it is considered a "sensitive" species by the province (Alberta Sustainable Resource Development 2001). The western grebes and the eared grebes have been the focus of a monitoring program currently being conducted by Alberta Sustainable Resource Development, Fish and Wildlife Division (Stephen Hanus, Northeastern Slopes Area Wildlife Biologist, pers. comm.). The relevant findings of this study by Hanus *et al.* (2002) are summarized below.

A survey conducted by the researchers in 2001 identified a colony of western grebes on Lac Ste. Anne that was located in the emergent vegetation zone within the Development Section of the Project. The approximate location of the colony based on information collected in the field in 2002 and information provided by Hugh Wollis of Sustainable Resource Development is presented by Figure 3.3. In 2001 the colony consisted of 1268 adults and 634 nests. Of these nests, 47% were considered active. Historically, western grebes nested at two colonies at the narrows that separate the east and west basins of Lac Ste. Anne. The present colony apparently relocated to what is considered a more secluded lake shore.

A single eared grebe colony was also identified on Lac Ste. Anne and it is also adjacent to the Project. This colony consisted of 934 individuals and 467 nests, 85% of which were active. Investigations in May and June confirmed that these colonies were active in 2002.

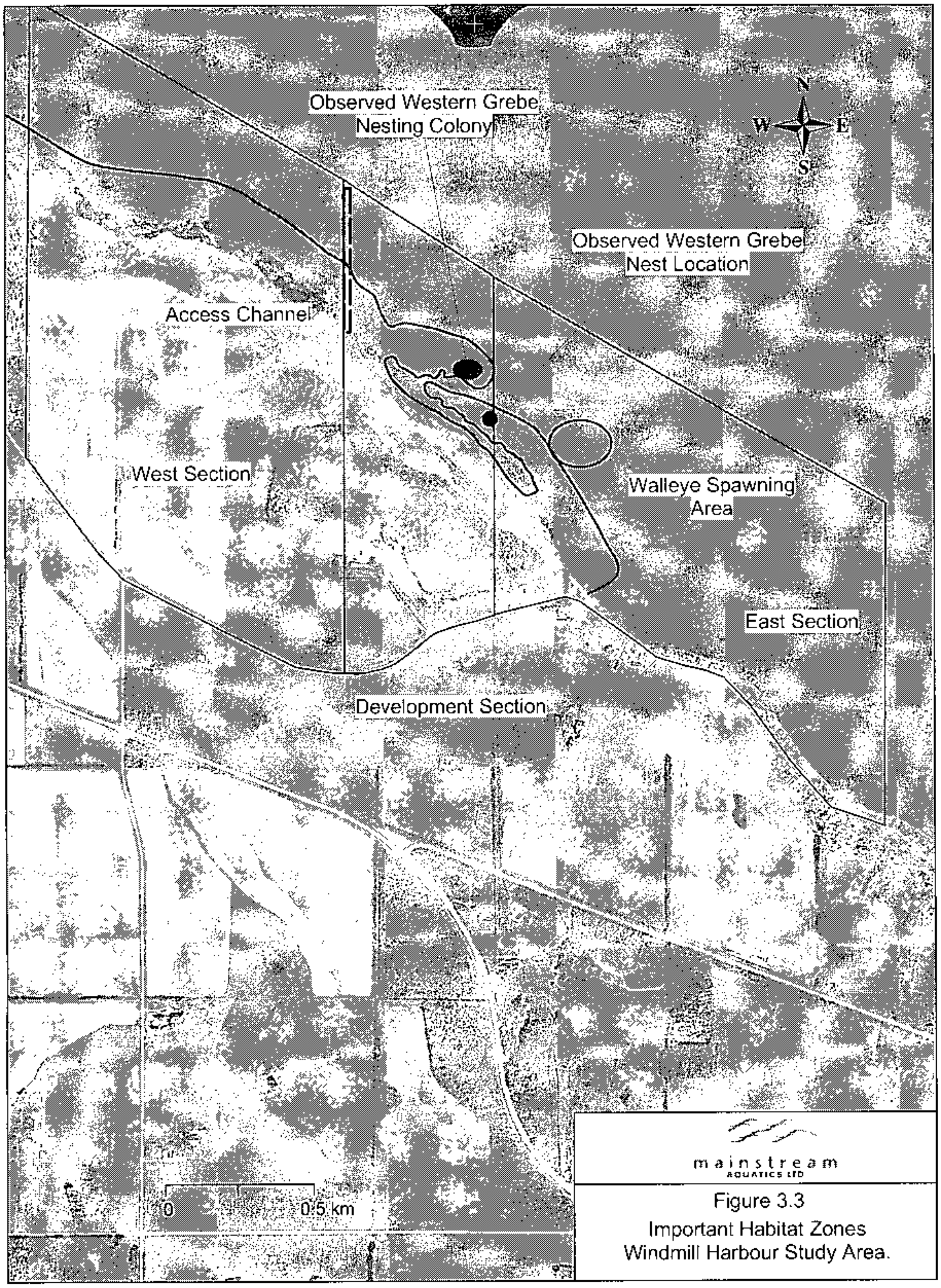

Figure 3.3
Important Habitat Zones
Windmill Harbour Study Area.

The 2002 field investigations and information provided by Hugh Wollis of Sustainable Resource Development for western grebes indicates that the colonies are situated approximately 440 m east of the proposed location of the access channel and approximately 150 m north of the residential lots.

3.4.6 Water Quality

Lac Ste. Anne is a moderate sized lake with a surface area of 5690 hectares (Mitchell and Prepas 1990). Lac Ste. Anne is part of the North Saskatchewan River basin and is fed by several tributaries. The largest is the Sturgeon River, which enters the lake from the west and is the primary lake outflow to the east.

Lake Ste. Anne consists of two basins connected by a narrow passage (Mitchell and Prepas 1990). The east basin is the larger of the two being about 9.5 km long and 7.0 km wide, and it also is the deepest (9 m). A weir present at the outflow of Lac Ste. Anne does not appreciably control water levels, but it does help maintain minimum lake levels. Records maintained since 1993 indicate that water levels have fluctuated between 721.99 m and 723.79 m (Mitchell and Prepas 1990). Lake water levels recorded between 1969 and 1998 were generally below the long-term average. In July 2002, the Lac Ste. Anne water level elevation was 722.54 m, or 0.46 m below the average for that month (Alberta Environment Hydrology Branch).

Lac Ste. Anne is a fresh water lake that contains low amounts of total dissolved solids (Mitchell and Prepas 1990). The water column in the east basin periodically mixes throughout the summer, but on calm days the lake may thermally stratify. This can result in rapid oxygen depletion and anoxic conditions next to the lake bottom. Lac Ste. Anne is eutrophic and algae blooms are evident during late summer. These blooms are largely caused by nutrient enrichment from phosphorous loading (Mitchell 1999). Sources of phosphorous include lake sediments (42%), agricultural activities in the watershed (49%), deposition from the atmosphere (2%), and domestic sewage (7%). Although Lac Ste. Anne is rich in nutrients, there is no evidence that water quality of the lake has deteriorated (Mitchell 1999). Water temperatures in Lac Ste. Anne can reach 21^{0}C during the summer months, which is typical for north central Alberta lakes (Mitchell and Prepas 1990). During spring, temperatures during the field program ranged from 5.0 to 7.0^{o}C; warmer water temperatures were observed in sheltered, shallow nearshore areas. Conductivity measurements ranged between 290 and 310 μS/cm, while pH ranged from 8.4 to 8.7.

3.4.7 Fish

3.4.7.1 Fish

Several fisheries inventories and research studies completed by the provincial government and universities have documented eight fish species in Lac Ste. Anne (Table 3.4). Five sportfish species have been documented including lake whitefish, northern pike, walleye, yellow perch, and burbot (Agra 1994, Lane 1971, Lane and Lynch 1969, Rhude 1979, Zelt 1976). Non-sportfish species identified include white sucker, spottail shiner, and brook stickleback.

Agra Earth and Environmental conducted a recent investigation into the physical, chemical, and biological characteristics and conditions of Lac Ste. Anne (Agra 1994). A comparison of the sportfish harvest data collected in 1969 and 1984 indicated that sportfish catches were near capacity. The report also speculated that periodic lake whitefish and walleye reproductive failures were correlated with fluctuations in lake water level. Low fall water levels result in desiccation and freezing of lake whitefish eggs on shallow, sloping sandy areas.

Table 3.4 Fish species present in Lac Ste. Anne.

Family	Common Name	Scientific Name
Sportfish		
Salmonidae	Lake whitefish	*Coregonus clupeaformis* (Mitchill)
Esocidae	Northern pike	*Esox lucius* Linnaeus
Percidae	Walleye	*Stizostedion vitreum* (Mitchill)
Percidae	Yellow perch	*Perca flavescens* (Mitchill)
Gadidae	Burbot	*Lota lota* (Linnaeus)
Non-Sportfish		
Catostomidae	White sucker	*Catostomus commersoni* (Lacépède)
Cyprinidae	Spottail shiner	*Notropis hudsonius* (Clinton)
Gasterosteidae	Brook stickleback	*Culaea inconstans* (Kirtland)

Creel surveys designed to determine the status and population of the northern pike recreational fishery also have been conducted on Lac Ste. Anne. In 1986, Sullivan (1986) described high catches of northern pike (6700 fish) and walleye (3400 fish). The report concluded that Lac Ste. Anne experienced moderate fishing pressure (6.3 angler-hours/ha) in comparison to six other northeast region lakes. A recent creel survey by Patterson (2002) reported much lower angling pressure (2.6 angler-hours/ha), a low catch rate for northern pike (0.336 fish/hr), and a preponderance of sub-legal sized northern pike in the angler catch.

Species Composition

During the field program, a total of 667 fish were captured or observed (Appendix B). The sample represented seven species, which included five sportfish and two non-sportfish species. Most species known to occur in Lac Ste. Anne (all except brook stickleback) were recorded.

Sportfish accounted for nearly 90% of the catch and lake whitefish was the principal species accounting for 64% of the total (Table 3.5). The remaining sportfish species contributed approximately 25% to the catch and were, in decreasing order of abundance, northern pike, walleye, yellow perch, and burbot. Non-sportfish species were not abundant. As a group they contributed approximately 10% to the total.

Distribution

The distribution of fish species varied slightly among the three sample sections (Table 3.6). Lake whitefish, northern pike, and walleye were captured throughout the study area. Yellow perch were not encountered in the West Section and burbot were not captured or observed in the Development Section. White suckers were found in all three sections, while spottail shiner were not captured in the Development Section. This distribution is likely a reflection of sampling effectiveness and the relative abundance of each species rather than actual spatial distribution. It is probable that all species are present throughout the study area.

Table 3.5 Number and percent composition of fish species recorded during sampling in the Windmill Harbour Study Area, 22-24 May 2002 (all methods combined).

Species	Captured	Observed	Total	Percent
Sportfish				
Lake whitefish	150	279	429	*64.3*
Northern pike	68	16	84	*12.6*
Walleye	43	19	62	*9.3*
Yellow perch	19		19	*2.8*
Burbot	3		3	*0.4*
Subtotal	**283**	**314**	**597**	***89.4***
Non-Sportfish				
White sucker	42	25	67	*10.0*
Spottail shiner	3		3	*0.4*
Subtotal	**45**	**25**	**70**	***10.4***
Total	**328**	**339**	**667**	***100.0***

Abundance

Numerical importance of a particular species in the fish community was ascertained by examining relative abundance values (catch-per-unit-effort or catch rate) generated using a variety of sampling techniques. Boat electrofishing appeared to be the most productive fish sampling method. In total, 2.12 hours of total electrofishing effort was expended during the survey and sampling occurred in each section.

Table 3.6 Distribution of fish species recorded during fish sampling in the Windmill Harbour Study Area, 22-24 May 2002 (all methods combined).

Species	Section		
	West	Development	East
Sportfish			
Lake whitefish	*	*	*
Northern pike	*	*	*
Walleye	*	*	*
Yellow perch		*	*
Burbot	*		*
Non-Sportfish			
White sucker	*	*	*
Spottail shiner	*		*

The overall catch rate for boat electrofishing was 257 fish/hour, with section catch rates ranging between 193 and 382 fish/hour (Table 3.7). Highest catch rates were recorded in the East Section. Catch rates for lake whitefish (198 fish/hour) were more than 10 times those of all other fish species including walleye (17 fish/hour) and northern pike (12 fish/hour), and white sucker (29 fish/hour).

One gill net site was established in each section to determine fish use of deeper habitats not effectively sampled by boat electrofishing. In total, 3.9 hours of gill net effort were expended yielding 98 captured fish (Table 3.8). The overall catch rate was 25 fish/hour with individual section rates ranging from 10 to 60 fish/hour. As with boat electrofishing, the highest catch rates were recorded in the East Section. In general, the catch rates for northern pike, walleye, and yellow perch were considered moderate (9.9 to 4.1 fish/hour, respectively) and low for all other species (<2.4 fish/hour).

Two fyke net sites were established within the Development Section. In total, 45.6 hours of net effort were expended (22.1 and 23.5 hours at FN1 and FN2, respectively). A total of 21 fish were captured in the fyke nets; 20 northern pike and 1 white sucker. The overall catch rate was 0.5 fish/hour (0.3 and 0.6 fish/hour for FN1 and FN2, respectively).

Table 3.7 Catch and catch rate for fish (fish/hour) recorded by boat electrofishing in the Windmill Harbour Study Area, 22-23 May 2002 (includes captured and observed fish).

Species	Site						Total	
	ES1 (West)		ES2 (Development)		ES3 (East)			
	No.	*CPUE*	No.	*CPUE*	No.	*CPUE*	No.	*CPUE*
Sportfish								
Lake whitefish	132	*158.5*	104	*148.9*	184	*311.4*	**420**	***197.9***
Northern pike	4	*4.8*	6	*8.6*	15	*25.4*	**25**	***11.8***
Walleye	9	*10.8*	16	*22.9*	10	*16.9*	**35**	***16.5***
Yellow perch	0	*0.0*	0	*0.0*	0	*0.0*	**0**	***0.0***
Burbot	1	*1.2*	0	*0.0*	2	*3.4*	**3**	***1.4***
Subtotal	**146**	***175.3***	**126**	***180.4***	**211**	***357.1***	**483**	***227.6***
Non-Sportfish								
White sucker	36	*43.2*	9	*12.9*	15	*25.4*	**60**	***28.3***
Spottail shiner	2	*2.4*	0	*0.0*	0	*0.0*	**2**	***0.9***
Subtotal	**38**	***45.6***	**9**	***12.9***	**15**	***25.4***	**62**	***29.2***
Total	**184**	***220.9***	**135**	***193.2***	**226**	***382.5***	**545**	***256.8***

Table 3.8 Catch and catch rate for fish (fish/hour) captured by gill net in the Windmill Harbour Study Area, 22-23 May 2002.

Species	Site						Total	
	GN1 (West)		GN2 (Development)		GN3 (East)			
	No.	*CPUE*	No.	*CPUE*	No.	*CPUE*	No.	*CPUE*
Sportfish								
Lake whitefish	4	*2.8*	3	*1.5*	2	*4.0*	**9**	***2.3***
Northern pike	7	*4.9*	23	*11.5*	9	*18.0*	**39**	***9.9***
Walleye	2	*1.4*	23	*11.5*	2	*4.0*	**27**	***6.9***
Yellow perch	0	*0.0*	0	*0.0*	16	*32.0*	**16**	***4.1***
Burbot	0	*0.0*	0	*0.0*	0	*0.0*	**0**	***0.0***
Subtotal	**13**	***9.2***	**49**	***24.5***	**29**	***58.0***	**91**	***23.2***
Non-Sportfish								
White sucker	1	*0.7*	5	*2.5*	0	*0.0*	**6**	***1.5***
Spottail shiner	0	*0.0*	0	*0.0*	1	*2.0*	**1**	***0.3***
Subtotal	**1**	***0.7***	**5**	***2.5***	**1**	***2.0***	**7**	***1.8***
Total	**14**	***9.9***	**54**	***27.0***	**30**	***60.0***	**98**	***25.0***

In total, 231.5 hours of minnow trap effort (mean of 25.7 hours/trap) was expended during the sample period amongst nine sample sites established within the Development Section (Figure 3.3). These efforts yielded three yellow perch at a single location for a mean catch rate of <1 fish/hour.

Biological Characteristics

Summaries of biological characteristics by species recorded from fish captured during the field survey are presented in Table 3.9.

Data from 150 lake whitefish were collected during the study. These fish ranged from 322 to 520 mm in fork length and 438 to 1610 g in weight. Over 80% of the fish were between 350 and 450 mm fork length.

Sampled northern pike ranged in fork length from 420 to 930 mm and from 488 to 8500 g in weight. Approximately 87% of the fish were less than 620 mm. Two individuals (2.9%) exceeded 900 mm in length. Nearly 68% of the northern pike captured were in an advanced stage of sexual development and were ready to spawn.

Biological data were collected from 68 walleye. These fish ranged in length from 355 to 555 mm and 364 to 1694 g in weight. Approximately 75% of the fish measured were between 350 and 450 mm fork length. The majority of the walleye examined were in spawning condition (93%).

Table 3.9 Summary of life history characteristics for fish captured in the Windmill Harbour Study Area, 22-24 May 2002 (all methods combined).

Species	Fork Length (mm)			Weight (g)		
	n	Mean	Range	*n*	Mean	Range
Sportfish						
Lake whitefish	150	401.7	322 - 520	123	843.0	438 - 1610
Northern pike	68	565.7	420 - 930	66	1579.2	488 - 8500
Walleye	43	408.8	355 - 555	43	739.5	364 - 1694
Yellow perch	19	78.1	57 - 96	15	5.6	4 - 8
Burbot	3	591.7	561 - 625	1	1526.0	1526
Non-Sportfish						
White sucker	42	439.3	390 - 508	39	1194.1	622 - 1732
Spottail shiner	3	75.3	63 - 83			

Limited numbers of yellow perch and burbot were sampled. Yellow perch ranged between 57 and 96 mm fork length and 4 to 8 g weight. Although quite small, some of these individuals were in spawning condition. Burbot ranged in fork length between 561 and 625 mm; weight was recorded for a single individual, which weighed 1526 g.

The 42 white suckers sampled during the study ranged in length from 390 to 508 mm with a mean of 439.3 mm. The mean weight of these fish was 1194.1 g and ranged between 622 and 1732 g. Approximately 60% of the white suckers in the catch were in spawning condition.

Sample information for spottail shiners included length; these fish ranged from 63 to 83 mm fork length.

Fish Eggs and Larvae

Two sample methods, artificial substrate mats and sweep nets, were utilized to determine whether spawning occurred in the Development Section. Twenty substrate mat locations were placed along the perimeter of the emergent vegetation in a sheltered area immediately east of the proposed access channel. In total, 980.9 hours of mat effort were expended. No eggs or fry were captured.

Twenty sweep net sites were established along the inner and outer perimeter of the emergent vegetation bed; the sweeps effectively sampled an area of 3.4 m^2. A single northern pike egg was encountered approximately 100 m east of the proposed access channel.

3.4.6.2 Fish Habitat

Habitat Characteristics

A continuous band of emergent vegetation occurs along the shoreline adjacent to the Project (Figure 3.2). At the time of the 28 June survey, this zone varied in width from 100 to 150 m, with narrowest band being located at the proposed location of the access channel. The outer boundary was generally defined by the 1.5 m depth contour. Bulrush was the dominant plant recorded (see Section 3.4.3.2); however, yellow water lily was also noted within the bulrush bed. The emergent vegetation within the Development Section was 14.0 ha in size (Table 3.2). Also present within the Development Section was a single, well-defined yellow water lily bed that measured 0.7 ha.

Depth measurements collected along five transects located perpendicular to shore indicated that the lake bed in the vicinity of the project is shallow and it exhibits a gradual slope (Figure 3.4). At the proposed location of the access channel, the minimum water depth of 2.5 m was located approximately 500 m offshore.

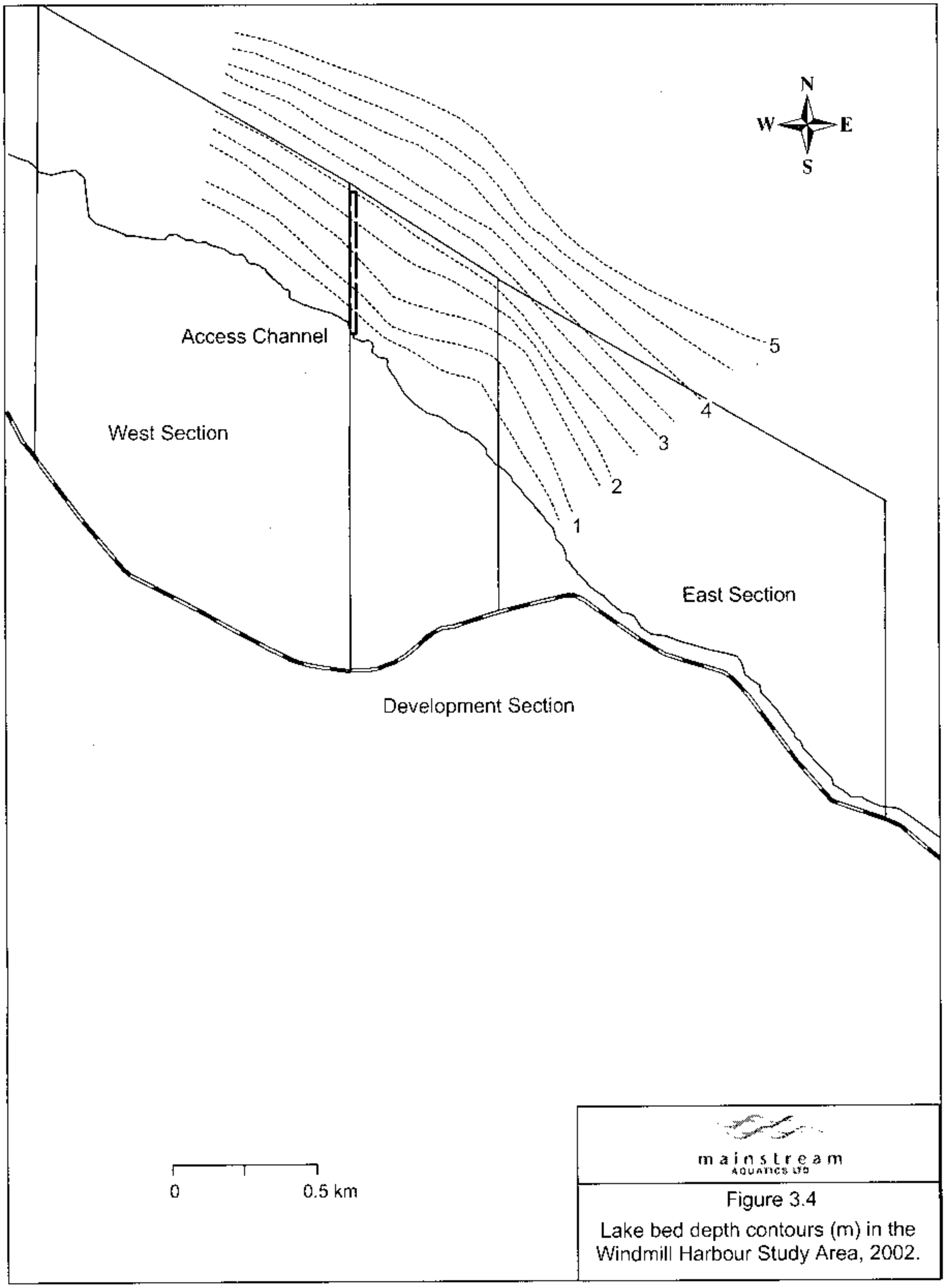

Figure 3.4
Lake bed depth contours (m) in the Windmill Harbour Study Area, 2002.

The majority of the substrate encountered within the study area consisted of sand and silt. In the emergent vegetation zone, this substrate was overlain with organic material. Larger substrates such as cobbles and boulders were sporadically encountered in nearshore areas along the shoreline. A continuous zone of gravel and cobble was documented east of the proposed access channel beyond the outer perimeter of the emergent vegetation. The approximate size and location of the area is delineated in Figure 3.3

During the 22 May field survey, the southeast shore of Lac Ste. Anne was subjected to severe wave action generated by strong northwest winds. This caused substrate disturbance along exposed portions of shorelines. However, the band of emergent vegetation in the study area dampened the effect of the wave action, which reduced the severity of shoreline disturbance.

<u>Fish Habitat Quality</u>

Quality of fish habitat in the Development Section of the study area was rated in terms of its suitability for spawning/egg incubation, rearing, and feeding for selected fish species (i.e., northern pike, walleye, lake whitefish). These species were chosen because they have recreational and/or economic value, the populations may be at risk in Lac Ste. Anne, and lakeshore in the vicinity of the Project has the potential to provide high quality habitat. The assessment, which is based primarily on site characteristics, provides an objective evaluation of habitat quality and its value to a particular species and life stage. Because construction of the access channel will affect fish habitat, the quality of this specific area was also evaluated.

Northern pike

Northern pike typically spawn shortly in shallow water, usually less than 0.5 m deep after ice-out at water temperatures between 8 and 12°C (Inskip 1982). The primary spawning habitat for this species is a submerged mat of dense vegetation in a sheltered location. A variety of vegetation types are used, although grasses and sedges are preferred. The vegetation should provide abundant surface area for the eggs to adhere to and allow for sufficient water flow. The embryos are susceptible to low oxygen conditions and can be adversely impacted by high suspended sediment levels.

Northern pike fry (defined as fish up to 65 mm length) initially use habitat similar to that used for spawning (Inskip 1982). Yolk-sac fry attach themselves to the vegetation via papillae on their forehead. The vegetation serves to protect the fry from predators and from low oxygen conditions that may occur near the substrate. After a period of growth and development, fry become very mobile emigrate from their rearing area into deeper water that also contains an abundance of vegetation. Adults prefer deeper water than juvenile fish (>2.0 m), but still rely on vegetation to provide cover and food

The suitability for spawning/egg incubation habitat in the study area and in the access channel was considered moderate for northern pike (Table 3.10). This rating is based on the predominance of aquatic vegetation, shallow water depths, and sheltered areas along the lake shoreline. The area was not given a high rating because this type of habitat was not limited in Lac Ste. Anne (i.e., present at several locations elsewhere in the lake) and the absence of dense vegetation mats on the lake bottom, which is important for egg survival.

Table 3.10 Rating of fish habitat quality[a] for fish species expected to occur in Windmill Harbour Development Section and within the proposed access channel.

Species	Area	Life Stage		
		Spawning/ Egg Incubation	**Juvenile Rearing**	**Adult Feeding**
Northern Pike	Development Section	3	3	3
	Access channel/Beach	3	3	3
Walleye	Development Section	3	3	2
	Access channel/Beach	2	3	2
Lake whitefish	Development Section	3	3	3
	Access channel/Beach	3	3	3

[a] Description of habitat ratings provided in Section 2.0; 1 (Negligible) to 4 (High).

The prevalence of emergent vegetation and sheltered shallow water areas close to shore are considered important for northern pike rearing habitat. Further out in deeper water, the emergent vegetation can be an important feeding area for adult fish during certain times of the year. As such, both habitat types in the Development Section and the proposed access channel/beach received a rating of moderate.

Walleye

Walleye spawn in spring at water temperatures between approximately 6 and 9°C (Scott and Crossman 1985). The preferred spawning grounds for this species consist of rocky areas in fast water in rivers or coarse gravel to cobble shoals in lakes that are subject to water currents. Walleye hatch in approximately 10 to 15 days, and after a short period of growth, the fry move from the interstitial space amongst the gravel into the water column where they initially rear in the open water. As they increase in size the young fish move into areas with structure such as emergent vegetation to feed and for protection from predators. Adult fish reside in open water and are often associated with physical structures next to the lake bottom.

The suitability of the Development Section for spawning/egg incubation was considered moderate for walleye due to the presence of gravel/cobble substrate, which could be used by spawning fish. Although spawning walleye were encountered during the study, these fish were located to the east of the Development Section. The proposed access channel contained no suitable spawning substrates (i.e., gravels or cobbles) and did not infringe on the spawning area. As such, it received a low rating for spawning/egg incubation. The lake area adjacent to the Project received a moderate rating for rearing due to the emergent vegetation zone, but a low rating for adult feeding habitat. In general, adult walleye infrequently use shallow water emergent vegetation as feeding areas.

Lake whitefish

Lake whitefish are fall spawners that typically spawn when water temperatures drop below 8°C (Scott and Crossman 1985). Eggs are broadcast over a hard rocky bottom or sand. Whitefish eggs incubate over the winter and hatch the following spring. Larval lake whitefish remain in shallow protected areas until approximately mid-summer before moving offshore. Adults feed in a variety of habitats including emergent vegetation zones.

Within the Development Section the habitat quality for lake whitefish spawning was considered moderate along the outside perimeter of the emergent vegetation zone due to the presence of rock and sand substrates. The access channel also has the potential to be used for spawning, but a large portion of the channel is situated in the emergent vegetation zone, which is not typically used for spawning by this species. As such, the access channel received was rated of moderate quality. Rearing habitat for lake whitefish also was rated as moderate given the sheltered shallow water areas provided by the emergent vegetation. The preponderance of adult lake whitefish in the catch during the spring survey also suggests that the area can be important adult feeding. As for northern pike, this type of habitat is widely distributed in Lac Ste. Anne, and therefore, was given a habitat quality rating of moderate.

3.5 SUMMARY

The purpose of the baseline investigation for the Windmill Harbour Development was to collect sufficient information to allow evaluation of potential Project effects on the environment. The work included an information review and field surveys to characterize the environmental setting.

The main land use in the Lac Ste. Anne watershed is agriculture. Lac Ste Anne is used extensively for recreational activities during summer and winter. The Windmill Harbour Development is situated on private land that has been heavily impacted by past and present human activities. The majority of the area is under cultivation, is used for forage production, or has been logged. Given the extensive amount of physical disturbance that has occurred at the site, unique historical resources are not expected to occur within the development area.

Public consultations were held to allow input by the general public regarding the initial Area Structure Plan for the Project. Based on the results of a public meeting and a public hearing, the concerns of the local community were addressed to the satisfaction of the Lac Ste. Anne County.

The Project area is located on generally flat terrain that gradually slopes towards Lac Ste. Anne. Surficial geology in the area is generally characterized by glacial till that has been modified by lake or stream erosion. Surface water in the area is characterized as ill-defined drainage towards the lake shore. There are no defined watercourses or ponded waters in the Project area. Regional hydrogeological mapping of the area shows groundwater flow from either surficial sand or gravel deposits. The expected groundwater yields are 25 to 100 igpm.

Upland vegetation present in the Windmill Harbour Development study area reflects the influence of cultivation, forage production, and logging. The limited amounts of natural vegetation that is currently present on the property provide habitat for a variety of wildlife and avifauna and may be used as a travel corridor for some species.

An extensive band emergent vegetation along the entire length of the development shoreline appears to have been largely undisturbed by human activities, but no rare or endangered plant species were recorded. This zone provides important habitat for wildlife and avifauna. It is likely the area and the adjacent upland vegetation zones are used for nesting and moulting by waterfowl. The emergent vegetation zone also supports colonies of nesting waterbirds. Of particular importance is a western grebe colony located east of the proposed access channel within the Development Section. This species is susceptible to human disturbance and is presently listed as "sensitive" by the provincial government.

Lac Ste. Anne is a moderate sized lake that is fed by several tributaries, the largest of which is the Sturgeon River. Lac Ste. Anne is eutrophic and algae blooms occur during late summer. These blooms are largely caused by nutrient enrichment from phosphorous loading from a variety of sources, including human activities in the watershed and domestic sewage disposal. This information suggests that the lake's water quality, although good at the present time, could be susceptible to disturbances that introduce additional nutrients into the lake.

The composition, distribution, and relative abundance of fish species encountered in the Windmill Harbour Study Area were typical of the fish communities found in north central Alberta lakes. The dominant fish species encountered during the study were lake whitefish, northern pike, walleye, and white sucker.

The Development Section contains moderate quality fish habitat. Northern pike spawning/egg incubation, rearing, and feeding habitats were rated as moderate quality. This species was encountered in and adjacent to the emergent vegetation zone, as well as in deeper offshore areas. The majority of northern pike were in spawning condition and the presence of northern pike eggs indicates the occurrence of spawning activity. The study area also provides high quality walleye spawning in the form of a rocky shoal that is located to the east of the Development Section. Walleye were prevalent in the catch and most fish were in spawning condition. Lake whitefish were also abundant and it is likely that the area provides good quality habitat for this species.

Fish habitat in the immediate vicinity of the proposed access channel provided moderate to low quality habitats for fish depending on species and life stage. Northern pike likely spawn and rear in the area; however, the abundance of similar habitats elsewhere in the lake suggests that this location is not critical to the long-term viability of the population. Other species such as walleye and lake whitefish may also use the vicinity of the access channel for rearing and feeding purposes, but again, the abundance of similar habitats elsewhere in the lake suggests that this location is not critical to the long-term viability of these populations.

4.0 EFFECTS ASSESSMENT

4.1 INTRODUCTION

The assessment will follow procedures outlined by the Canadian Environmental Assessment Agency (1994, 1997) and Barnes and Davey (1999) and will be used to ascertain whether one or more Project activities will cause a Significant Adverse Effect on the environment. For the purposes of this assessment, a significant adverse effect is defined as any Project related activity that changes the characteristics of a resource in sufficient magnitude, duration, or frequency, as to cause a permanent change from pre-development conditions. For example, a population of fish may be sufficiently affected by the Project's access channel to cause a permanent reduction in fish numbers.

The effects assessment includes an evaluation of two scenarios. The first involves an evaluation of Project effects on existing environmental conditions (application case). The second involves an evaluation of Project effects on existing environmental conditions in combination with past, present, or planned activities (cumulative effects assessment). An assessment of past and present activities (baseline case) has been incorporated into the environmental description (Section 3.0) and will not be discussed in this section.

Spatial boundaries of the assessment include all areas where measurable changes to the environment may be caused by the Project. They include three categories. Sub-local refers to the area in the immediate influence of the Project (foot print). Local includes the sub-local area and immediately adjoining areas. Regional includes the previous two categories, Lac Ste. Anne proper and the biological boundaries of animal populations potentially affected by the Project.

Temporal boundaries of the effects assessment include the construction and operation phases of the Project. It is assumed that the proponent will not decommission the facility in the foreseeable future; therefore, a decommissioning phase has not been included in the evaluation.

The assessment will be completed using a stepwise approach. Project activities will be examined to identify the potential adverse effect(s) on the environment. Mitigation measures designed to reduce or eliminate the effect will be described and their effectiveness ascertained. A comprehensive summary of all strategies or plans to minimize, mitigate, and manage the potential adverse effects, if they exist, are presented for each environmental component.

It should be noted that the strategies employed to minimize Project effects would adhere to regulatory requirements (e.g., Alberta Water Act Codes of Practice and Federal Fish Habitat Protection Guidelines [DFO 1998]). Once the effectiveness of mitigation has been established, each Project activity will be categorized as having no adverse effect or a residual effect (what remains after mitigation). Each Project activity that causes a residual effect will be evaluated in terms of its environmental significance using rating categories developed under the Canadian Environmental Assessment Act (CEAA 1994). The categories to be used are listed in Appendix C.

It should be acknowledged that the proposed Project has an overall effect on the environment, which will result from a combination of activities. As such, the overall Project effect may receive a higher significance rating than the individual components.

4.2 SOCIAL ISSUES AND LAND USE

It is unlikely that there are historical resources of social importance on the Windmill Harbour Development site. Present land use activities on and in the immediate vicinity of the Project include agricultural to the south and west, and a private woodlot to the east. At a greater distance, recreational activities occur on the lake, the Summer Village of Val Quentin is located to the east, and the Lac Ste. Anne Mission is located to the west.

The Project will change land use on the site from agricultural to residential/recreational. The Project is self-contained and will not physically infringe on land use of the surrounding area. The social activities promoted by the Project are consistent with the long-term plans for the area by the Lac Ste. Anne County (i.e., residential and recreation) and is designed to be aesthetically pleasing to the general public. The only residence in the immediate vicinity of the Project (located to the east) will be visually screened by a woodlot. Similarly noise will not be an issue given the nature of the Project and its distance from other land users. Car traffic will increase, but will be well within limits that are acceptable to the municipal government. Boat and snowmobile use of the lake also will increase. Lac Ste. Anne is presently used extensively for recreational boating and snowmobiling. As such, an increase in these activities would not markedly change existing conditions.

Because the Project will adhere to all necessary municipal and provincial guidelines, concerns associated with public safety, noise, and traffic will be addressed at the planning stage. As such the development should not cause significant adverse effects on land use or social issues.

4.3 TERRESTRIAL RESOURCES

4.3.1 Terrain and Soils

The development will require re-contouring the terrain to accommodate the Project infrastructure and harbour. Best management practices will be employed during construction to utilize topsoil and to fully mitigate issues of erosion. No activities during facility operation are expected to affect terrain and soils.

Terrain and soils will be significantly altered during the construction phase; however, mitigation measures will be used to ensure that Project effects will not extend outside of the Project footprint (including disposal of overburden) or adversely influence other components of the environment. Standard construction techniques and mitigation strategies will be employed to control dust and mud tracked off site, soil erosion and potential soil contamination. At the present time the haul route for fill and construction materials has not been finalized, but it is expected that Secondary Highway 633 via Lac Ste. Anne Trail will be the primary transportation corridor. All mitigation will meet municipal and provincial standards, which will be a prerequisite for Project approval by the county (Richard Neufeld, pers. comm.).

4.3.2 Vegetation/Wildlife Habitat

Project Effects

Construction of residential lots and infrastructure and the inland harbour will potentially affect 43.0 ha of the upland. The area will be cleared of vegetation, the inland harbour will be excavated, and portions of the property will be filled to obtain a minimum elevation of 724.0 m. The majority of this area (34 ha) is presently under cultivation or is used for forage production, and therefore, has limited value to wildlife and birds. The remaining upland vegetation (7.0 ha) provides habitat for a variety of species such as deer, moose, song birds, and nesting waterfowl, but it is limited in area, and there is an abundance of similar habitats within the local boundaries of the project.

The emergent vegetation zone along the shoreline of Lac Ste. Anne (14 ha) has been undisturbed by human activity and contains a number of distinct vegetation communities. No rare plants were recorded in this area. The emergent vegetation zone provides habitat for a variety of species including semi-aquatic furbearers, song birds, waterfowl, and waterbirds. It provides nesting, brood and moulting habitats for waterfowl and nesting habitat for waterbirds such as grebes and terns. Construction of the access channel will remove a portion of the emergent vegetation (0.5 ha), which represents approximately 4% of the emergent vegetation zone. Nesting red-winged black birds were the only species recorded nesting within the footprint of the boat access channel.

During the operation phase of the Project, there also is the potential for habitat loss. Boat traffic using or approaching the access channel could physically damage habitat. Motorized boats attempting to access the shoreline would cause damage to the emergent vegetation zone. Snowmobile traffic associated with the facility may physically damage emergent vegetation that is used by wildlife in winter. The vegetation is also required by waterbirds during the initial stages of nest building during early spring.

Wave action associated with boating activity in and near the access channel may also damage habitat. This potential effect is deemed to be minor because the vegetation in the area is presently subjected to natural wave action.

Other human activities during the operation phase also have the potential to cause physical destruction or alteration to habitat along the shoreline. Residential lot owners adjacent to lakes may infringe on shoreline habitat by clearing emergent vegetation for boat access (Vance Buchwald, pers. comm.). Residential lot owners are unlikely to undertake this activity because they will have access to the inland harbour and the general public will not infringe on this area because it is a private development.

Based on this information, construction and operation of the residential lots and infrastructure, inland harbour, and access channel have the potential to cause habitat loss. As such, the Project may have adverse effects on vegetation/habitat that presently exists in the area.

Mitigation

Measures to be adopted to minimize the adverse effects of vegetation/wildlife habitat loss are as follows:

- Establish a conservation area along the east side of the property. This area would partially replace habitat removed during construction.
- Implement a program (e.g., information brochures) to educate facility users regarding the effects of disturbance on wildlife and promote stewardship of the resource.
- Protect the shoreline with a conservation area that will extend 60 m from the lake shore to the residential lots.
- Eliminate damage to the emergent vegetation outside the access channel by clearly marking the channel and posting speed limits that will be enforced by the condominium association.
- Control human activities in the conservation area along the lake shore to eliminate potential disturbance to the emergent vegetation zone.
- Monitor human activities to ascertain whether the conservation area is effective in protecting vegetation/wildlife habitat. This would involve structured surveys and physical measurements to quantify the frequency and extent of physical disturbance.

Mitigation measures designed to protect the shoreline emergent vegetation zone will adhere to the objectives of the "Federal Policy on Wetland Conservation". Specifically it will promote conservation of migratory bird habitat in order to sustain its long-term ecological and socio-economic functions. With the exception of the boat access channel, protection of the emergent vegetation zone can be achieved by promoting public awareness and by use of the conservation area.

Effects Evaluation

Loss of vegetation/wildlife habitat caused by the construction and operation of the Project cannot be fully mitigated; therefore, there will be a residual adverse effect. Specifically, the majority of existing upland habitat will be removed during construction. Measures implemented during operation of the facility will partially mitigate loss of habitat. The geographic extent of habitat loss will be sub-local and similar habitats are available immediately adjacent to the development. As such, some wildlife groups (e.g., ungulates and song birds) may be displaced from the site. but will have access to other habitats. Given the permanence of the Project it will be of long duration and the effect likely is not reversible.

The magnitude of vegetation/wildlife habitat loss is deemed to be moderate. The most important wildlife habitat is provided by the emergent vegetation zone and this is the area that will be largely protected by use of the conservation area (all except the boat channel). Because similar habitats are located immediately adjacent to the Project and they are widely available in the watershed, the long-term viability of most species populations will be unaffected. This includes western grebes because the Project will not physically infringe on the breeding colony habitat.

As such, it is the Project should not have a significant adverse effect on vegetation/wildlife habitat.

4.3.3 Wildlife Disturbance

Project Effects

Wildlife and bird populations adjacent to the project area will be disturbed during construction, which will result in displacement of animals. Operation of the facilities will cause displacement of wildlife and waterbirds within the immediate vicinity of the development and in surrounding areas of Lac Ste. Anne. This will be caused primarily by increased recreational activity in the form of boat and snowmobile traffic originating from the facility. It also should be acknowledged that adverse effects could be caused by other activities by residential lot owners (e.g., depredation by domestic pets).

Of particular concern is displacement of the nesting western grebe colony, which is a species known to be susceptible to human disturbance (Burger 1997). A review of historical information suggested that two nesting western grebe colonies in the narrows of Lac Ste. Anne may have been abandoned due to excessive boat traffic and the existing nesting location adjacent to the Project was chosen, in part, because it was subjected to less disturbance (Hanus *et al.* 2002).

Construction and operation of the residential lots and infrastructure and boat access channel has the potential to cause disturbance to wildlife and birds. As such, the Project may have adverse effects on these resources.

<u>Mitigation</u>

Mitigation measures can be implemented to reduce the adverse effects associated with disturbance as follows:

- Do not disturb the willow vegetation along the shoreline during construction.
- Reduce boat numbers in the facility by not allowing public access to the harbour's boat launch.
- Implement a program (e.g., information brochures) to educate facility users regarding the effects of disturbance on wildlife and promote stewardship of the resource.
- Allow only low impact human activity in the conservation area. This would include walking trails, resting areas, and a nature watching area. It would also include elimination of boat mooring along the shoreline.
- Eliminate all human activity within the conservation area immediately adjacent to the western grebe colony (exclusion zone). The size of the exclusion zone will be established following discussions with representatives of the provincial and federal governments.
- Monitor human activity-western grebe interactions to ascertain whether the conservation area and exclusion zone is effective in minimizing disturbance to western grebes during the breeding and nesting season. This would involve structured surveys to quantify the frequency and extent of disturbance to western grebes due to shoreline and boating activities.
- If monitoring results indicate that the proposed measures are not sufficient to protect the western grebe colony from disturbance, additional steps (e.g., increase in the exclusion zone) will be considered following discussions with representatives of the provincial and federal governments.

<u>Effects Evaluation</u>

The mitigation measures will reduce the adverse effects of disturbance on most wildlife and bird populations during construction and operation. But, for sensitive species such as western grebes, these measures may not be sufficient. Hanus *et al.* (2002) recommended a buffer of 250 m to 500 m around nesting colonies from 15 May to 15 July as a measure to eliminate human disturbance.

During construction, noise from heavy equipment in May and June may disturb nesting and breeding birds. This effect may be partially mitigated by the willow vegetation along the shoreline, which will provide a visual barrier during construction.

During operation, the present location of the western grebe colony is approximately 440 m from the boat access channel, 150 m from the residential lots, and 90 m from the shoreline of the conservation area. There will be some human activity within the conservation area and boat traffic along the perimeter of the emergent vegetation zone. As such, the minimum buffer distance of 250 m recommended by Hanus *et al.* (2002) will not be achieved. As such, disturbance of western grebes during facility operation likely will occur, which will result in a residual adverse effect.

Boat traffic also will increase in the lake during the operation phase of the Project. Although much of this traffic will be concentrated near the facility in the area of the access channel, it will extend to the entire lake, which would cause additional disturbance to waterfowl and waterbirds that use the lake for feeding and staging.

Based on this information, the geographic extent of disturbance is considered regional (i.e., disturbance could occur within the entire lake) and it will occur over an extended duration. The effect would be reversible if the sources of disturbance were removed. Using the western grebe population as a benchmark, the magnitude of the effect is deemed to be high because the Lac Ste. Anne nesting colony may be abandoned and loss of this colony could have adverse effects on the national grebe population (Hanus *et al.* 2002).

As such, disturbance caused by Project operation will have a significant adverse effect on wildlife and bird resources. This evaluation is made with a moderate degree of certainty because it is not known what level of human disturbance actually affects western grebes. Based on the conservative approach used for this assessment, however, there is a high likelihood that there will be an significant adverse effect.

4.3.4 Mortality

The Project will cause an increase in vehicle traffic in the area, which could result in an increase in the number of vehicle-wildlife collisions. The extent of this potential issue cannot be easily quantified. Assuming that most traffic will occur along Lac Ste. Anne Trail, the location of the development will not pre-dispose ungulates to increased collisions with vehicles because there are no major ungulate wintering areas or travel corridors in the immediate vicinity of the Project. Also, the roadway configuration does not allow excessive vehicle speed, which is an important cause of collisions.

The Project may promote, or conversely, it may inhibit consumptive use of wildlife resources. A portion of the residential lot owners may undertake recreational hunting in the area. But, the existence of the development and the conservation area will eliminate hunting activity that historically may have occurred in the immediate vicinity of the Project.

No mitigation is planned to address the issue of wildlife mortality. It is expected that this potential adverse effect will have negligible affects on wildlife and bird populations in the area.

4.4 WATER RESOURCES

4.4.1 Surface Runoff and Ground Water

Water resources could be adversely affected by the Project by altering surface runoff and ground water. There are no defined watercourses or ponded waters that potentially could be affected by the Project. Surface drainage will be maintained by implementing measures described for protection of water quality (see below). As such, no issues associated with surface water are expected.

Bedrock and surficial aquifers underlying the proposed development appear to be capable of providing the total water demands of 82igpm for household use described in the initial area structure plan without impacting existing users (AMEC 2001). Because municipal and provincial approvals are contingent on the existence of a sufficient supply of quality water for domestic use, the Project will have to ensure that these requirements are met prior to the development (Richard Neufeld, pers. comm.). As such no issues associated with ground water are expected.

4.4.2 Water Quality

Degraded water quality in Lac Ste. Anne may result from nutrient and sediment inputs from the Project during construction and operation. Construction of the residential lots and infrastructure, and the inland harbour will require excavation and recontouring. This activity could cause surface runoff containing high sediment loads to potentially drain directly into Lac Ste. Anne. The resulting effect on water quality would be nutrient and sediment loading in the vicinity of the development. Because Lac Ste. Anne presently is eutrophic any additional loading could promote algal growth.

Construction of the access channel could also affect water quality of the lake in the vicinity of the development. The dredging process will disturb the lake bottom resulting in suspension of sediments and transport to the surrounding area. In addition, nutrients will be released making them available for plant and algal growth.

During operation of the facility, nutrient loading of Lac Ste. Anne would continue to be a concern. Storm water drainage may introduce sediments and other contaminants into the lake. Domestic sewage from residential lots and nutrients from lawn fertilizers also may leach into the lake. Sewage entering the lake can be a problem, both to the aquatic environment through nutrient loading and to recreational users due to increased risk of disease. Infilling of the channel caused by natural and boat induced wave action also will occur; therefore, periodic maintenance of the channel will be required. At the present time, the frequency of this maintenance is unknown.

The inland harbour will receive hydrocarbons in the form of oil and gasoline, which are pollutants typically associated with boating activities. Because the harbour basin will have the configuration of an impoundment (limited water exchange with lake) there is also the potential for reduced water quality within the harbour proper. More seriously, a fuel spill has the potential to pollute Lac Ste. Anne.

Mitigation

The following measures will be implemented in order to mitigate project effects on water quality.

- A storm water management system will be designed to accommodate a 1:25 year surface runoff event and prevent run-off from entering directly into Lac Ste. Anne during construction and operation of the Project. Drainage systems will intercept and direct the water into the harbour, and if required, accommodate settling of suspended sediments.
- An earth plug will be used to isolate the inland harbour from the lake during construction to prevent suspended sediments in the harbour from entering the lake.
- Sediment releases associated with dredging of the access channel during the initial excavation and subsequent maintenance activities will be restricted using the following measures:
  - Dredging will be undertaken in winter from the ice surface using a backhoe. The shallowness of the water in the area (<1.5 m) and presence of ice cover will restrict the spread of the suspended sediments to the surrounding waters.
  - A silt curtain will be used to isolate the work area, further increasing the containment of suspended sediments.
- A water quality monitoring program will be implemented to establish whether provincial and federal water quality guidelines for the protection of aquatic life are met.
- If the monitoring program identifies issues such as exceedence of water quality guidelines, the management system will be adjusted following discussions with representatives of the provincial and federal governments.

During operation of the proposed facilities, impacts of nutrient loading will be further reduced using the following mitigation measures.

- A central sewage collection and storage facility will service the entire complex instead of storage tanks for each residential lot. The central storage facility will be periodically pumped and the material removed for disposal to an appropriate site. The system will consist of underground pipes installed to provincial standards leading to the central holding tank. Pump out and hauling will be to the existing County lagoon.
- Water quality in the harbour will be maintained using an aeration system. This will entail a network of diffuser pipes on the harbour bottom that are supplied with air by a compressor. These systems are designed to maintain dissolved oxygen levels and promote mixing of the water column which would inhibit the formation of undesirable algal blooms and subsequent die-offs that are characteristic of stagnant, anaerobic conditions. Aeration systems are commercially available and are routinely used for the purposes required by this development (Mackay 1999a, 1999b).
- An emergency response plan, trained personnel, and the required containment equipment administered by the condominium association will be used to contain and clean up any accidental fuel spills in the harbour. In the event of a major spill, this would involve placement of an inflatable bladder (e.g., Aquadam™) or containment boom across the entrance to the harbour to block the spill from the lake.
- The frequency of maintenance activities due to infilling of the channel caused by wave action from boats will be reduced by enforcement of speed limits through the condominium association.

Effects Evaluation

Implementation of these mitigation measures will remove the potential adverse effects of the Project on water resources during the construction and operation phases. As such there will be no residual adverse affects of the Project on the water quality of Lac Ste. Anne.

4.5 FISH RESOURCES

4.5.1 Habitat Loss

Project Effects

The construction of the access channel (0.98 ha) will result in the destruction of fish habitat. This loss could be detrimental to fish populations in Lac Ste. Anne because the area is potentially used for spawning/egg incubation, rearing, and adult feeding. Species of concern are northern pike, walleye, and lake whitefish.

In addition to physical removal of fish habitat, construction activities (i.e., dredging of the access channel) have the potential to alter fish habitat by introduction of suspended sediments resulting in siltation in the immediate vicinity of the channel. Consequences of siltation are numerous, but the most serious issues are destruction of fish habitat and smothering of fish eggs. This potential effect will be fully mitigated (see Section 4.4) and will not be discussed in this section.

Construction of the residential lots and infrastructure and inland harbour could also introduce sediments into the lake resulting in alteration of fish habitat. This potential effect will be fully mitigated (see Section 4.4) and will not be discussed in this section.

During Project operation, damage to fish habitat outside the access channel may result from boats attempting to access the shoreline. Other human activities during the operation phase also have the potential to cause loss of habitat. Residential lot owners adjacent to lakes typically infringe on shoreline habitat by clearing emergent vegetation for boat access (Vance Buchwald, pers. comm.). These activities have the potential to remove habitat along the entire length of the proposed development.

Mitigation

The measures to be adopted to protect existing fish habitat will be as follows:

- Control human activity in the conservation area along the lake shore to prevent disturbance to the emergent vegetation zone. This would include shoreline protection guidelines and elimination of boat mooring along the shoreline that would be enforced by the condominium association.
- Monitor human activities to ascertain whether the conservation area is effective in protecting fish habitat. This would involve structured surveys and physical measurements to quantify the frequency and extent of physical disturbance to the emergent vegetation.

Effects Evaluation

This mitigation measure can eliminate habitat loss during operation, but construction of the boat access channel will cause habitat loss. Therefore, the project will cause a residual adverse effect associated with loss of fish habitat.

The geographic extent of this residual effect will be local. The effect would be of long duration, but it also would be reversible given the ability of emergent vegetation to rapidly re-colonize disturbed areas. The magnitude of habitat loss on the fish populations is deemed to be low for the following reasons. First, critical or high quality fish habitat will not be disturbed by the access channel. Critical habitats are present in the vicinity of the access channel (i.e., walleye spawning shoal), but there should be no disturbance to these sites. Second, similar habitats are available immediately adjacent to the Project and they are widely distributed in the lake.

Under Section 35 of the Fisheries Act, the Project will be required to provide compensation for the loss of fish habitat associated with the foot print of the boat access channel. Assuming Project approval, a fish habitat compensation plan will be presented to the Department of Fisheries and Oceans at the permitting stage. This plan will focus on physical habitat enhancement in areas of low to nil habitat quality. Assuming a 2:1 ratio of habitat replacement, the fish habitat compensation plan will require physical disturbance of 1.96 ha of low to nil quality fish habitat. This activity will not have any adverse effects on fish populations.

Based on this information, habitat loss caused by Project construction and operation will not affect the viability of fish populations in Lac Ste. Anne. As such, there will be no significant adverse affects. This evaluation is made with a high degree of certainty based on the assumption that measures implemented by the condominium association will control human activity during Project operation.

4.5.2 Disturbance

Project Effects

Disturbance to fish in shallow water along the shoreline and in the access channel may prevent fish from completing important activities such as spawning. The effect of human disturbance on fish in lake environments is not well documented in Alberta. Information from Marina Bay Estates at Sylvan Lake suggests that fish present in harbours or harbour entrances do not appear to be disturbed by human activity (R.L. & L. Environmental Services Ltd. 1995). Movements of radio-tagged fish indicated that individuals regularly moved in and out of two marinas despite the presence of recreational anglers and boat traffic. Radio-tagged fish also utilized a zone immediately in front of these marinas as a 'resting' area; a zone that was subjected to intense boat traffic. Based on this information, it is unlikely that disturbance by increased human activity will have an adverse effect on fish.

Spring spawning fish (e.g., northern pike) typically seek out warm water areas in early spring when the main body of the lake is still ice-covered as a cue for spawning activity. Because the inland harbour may provide warmer water temperatures than the lake proper, this has some potential to affect spawning activity by attracting spawning fish into the harbour. This potential effect is considered negligible for the following reasons. First, the entrance to the inland harbour is small relative to the shoreline area of the lake, which would reduce the probability of fish finding the harbour. Second, the harbour will contain low value fish habitat; therefore, there would be little incentive for fish to remain in the harbour.

Mitigation

No mitigation is required.

Effects Evaluation

There should be no residual adverse effect associated with disturbance to fish.

4.5.3 Mortality

Project Effects

Construction of the access channel has the potential to cause mortality of fish and fish eggs. Preparation of the site for dredging will cause fish to disperse, but the area to be dredged could contain the eggs of lake whitefish.

The Project will promote recreational use of the fisheries resource within and adjacent to the development. A portion of the residential lot owners may angle. The absence of public access to the lake shore from the development would eliminate the potential for increase angling pressure by the general public. Activities by the residents could result in elevated harvest rates of sportfish such as northern pike, walleye (currently catch and release), lake whitefish, and yellow perch.

The expected increase in angling pressure caused by the Project cannot be easily quantified. At Marina Bay Estates on Sylvan Lake, intense angling has occurred by the general public who access the lake along an existing environmental reserve, but very few residents angle in the harbour (Vance Buchwald, pers. Comm.). Approximately 80 of 100 boat slips were used at Marina Bay Estates in 1999; 40 for sailboats and 40 for motor boats (Marina Bay Home Owners' Association, letter dated 11 June 1999 [Appendix D]). On average, 12 boats a day entered the lake, but none were associated with anglers.

Poor water quality in the inland harbour may also cause fish mortality. Fish may move into the harbour to feed during early summer, as has been documented at Marina Bay Estates (R.L. & L. Environmental Services Ltd. 1995). If oxygen levels drop below a critical value at this time, mortalities may occur. During the open water period, fish can move out of the harbour to the main lake if oxygen levels become to low. During winter fish may become trapped by the formation of ice at the entrance to the harbour, which would prevent egress from the area. Low oxygen levels at this time could also result in fish mortality. It is unknown whether fish will concentrate in the harbour, however, the potential for adverse effects associated with low water quality do exist.

Mitigation

The following measures will be implemented to eliminate or reduce effects that may increase fish mortality.

- Dredging of the access channel will occur during winter to avoid destruction of fish eggs of spring spawning species.
- A program (e.g., information brochures) will be implemented to educate facility users about their effects on fish.
- The harbour's boat launch will not be available to the general public, which will reduce the number of boats using the facility.
- An aeration system will be operated in the boat harbour to maintain oxygen levels. At present, the developer is committed to using this system during the summer months. However, aeration may not be undertaken during winter due to issues of human safety.

Effects Evaluation

Mitigation will reduce fish mortality associated with harvest by recreational anglers. Evidence from another similar development indicates that a minimal increase will be associated with residents of the Project. Also, the conservation area will eliminate recreational activities by the public from the shoreline. It should be noted that provincial angling regulations are in place to protect the fisheries resource. At present there are restrictive regulations: zero harvest limit for walleye and three northern pike over 63 cm in length. In addition, there is a lake wide closure to angling each spring.

A properly designed aeration system in summer will eliminate the potential for fish mortality, but is unknown whether fish concentrations will occur in the harbour during winter when the aeration system is not operational.

There will be residual adverse effects of fish mortality caused by the Project following mitigation. The magnitude of this effect would be low because provincial angling regulations should limit the numbers of fish harvested and it is highly unlikely that large numbers of fish would concentrate in the harbour during winter. The geographic extent of the effect is regional because the fish populations of the entire lake would be affected. The effect will be of long duration, but it would be reversible if recreational angling originating from the Project were stopped.

Based on this information, there would be no significant adverse affects of the Project on the fisheries resource caused by fish mortality. This evaluation is made with a low degree of certainty for two reasons. There is a lack of empirical data needed to quantify the increase in fish harvest rates associated with the Project and it is unknown whether fish will concentrate in the inland harbour during winter.

4.5 ACCIDENTS AND MALFUNCTIONS

Although very unlikely to occur, certain accidents or malfunctions could be detrimental to the environment. These accidents and malfunctions would include failure of the earth plug during the harbour excavation, a large hydrocarbon spill in the harbour, and failure of the domestic sewage system.

Earth Plug Failure

Failure of the earth plug could result from a design flaw, or severe and continuous wave action. In all cases, sediments would be released into the lake and there is the potential for a contaminants spill from stranded equipment. These potential effects on Lac Ste. Anne would be a very short duration because the connection to Lac Ste. Anne would be quickly blocked using a silt curtain and/or hydrocarbon collection boom. If excavation work continued in the flooded harbour, these barriers would prevent contaminants from entering the lake. Based on this information, the potential adverse effects of the earth plug failure are considered negligible.

Large Hydrocarbon Spill

Equipment failure or human negligence may result in an accidental spill of a large amount of hydrocarbons (i.e., fuel and oil) into the inland harbour. A large spill is not expected in the lake because fuel storage containers would be located in the harbour area. Similar to the assessment for failure of the earth plug, these potential effects on Lac Ste. Anne would be a very short duration because the connection to Lac Ste. Anne could be blocked. An emergency response plan would be used to contain and clean the spill. Based on this information, the potential adverse effects of a large hydrocarbon spill are considered negligible.

Sewage System Failure

The sewage conveyance and storage system planned for the Project could potentially fail causing a spill to enter Lac Ste. Anne. This accident is highly unlikely because there will be extra capacity built into the storage system. Any sewage that is released would enter the storm water system, which is designed to flow into the inland harbour rather than Lac Ste. Anne. In this cause, an emergency response plan would be use to contain the spill before a large amount entered the lake. Therefore, the potential adverse effects of sewage system failure are considered negligible.

4.4 CUMULATIVE EFFECTS

An assessment of cumulative effects should incorporate all known past, present, and known future activities that would add to the adverse effects of the Project. In the case of the Windmill Harbour Development, incremental destruction of upland and lakeshore habitats by small-scale developments represent the most important activities that would cause cumulative effects. The importance of these activities to environmental resources in and around Lace Ste. Anne is difficult to quantify due to the lack of empirical data. As such, a primary assumption of the cumulative effects assessment is that use of qualitative information is sufficient to accurately predict Project effects. Because the validity of this assumption cannot be tested, the confidence in the assessment is deemed to be low.

At present, there are several summer villages and residential subdivisions distributed around the perimeter of Lac Ste. Anne. Lakeside complexes similar to the proposed Project and residential subdivisions are compatible with the long-term development plans by the County of Lac Ste. Anne (Richard Neufeld, pers. comm.). Therefore, increase use of the lake and surrounding area can be expected to increase over time.

Historically human activities have had an influence on the lake's water quality (Mitchell 1999), and there has been physical removal or alteration of habitats required by terrestrial resources. Recreational angling also has been sufficient to reduce sportfish populations in the lake. Many of these cumulative effects have been reduced or eliminated by implementing new environmental standards. For example, regulations prohibit development activities that would affect the water quality of Lac Ste. Anne, many of which have been adopted by the Project. Strict regulations now apply to the Lac Ste. Anne sportfishery that are designed to maintain fish populations.

Physical removal of habitats by the footprints of past, present, and future developments and disturbances associated with human activities are two effects that cannot be easily controlled. These issues also are associated with the Project; therefore, the proposed development will cause cumulative adverse effects associated with loss of habitat and disturbance.

4.7 SUMMARY

The Project should have no detrimental effects on cultural resources, land use, social issues, terrain and soils, surface water or ground water. This conclusion is reached based on the conditions that presently occur at the site in combination with municipal and provincial requirements that will ensure protection of these resources if the development proceeds.

There are a number of potential adverse effects that may be caused by the proposed development. They include vegetation/habitat loss, disturbance, and mortality of wildlife, birds, and fish, and reduced water quality of Lake Ste. Anne.

Mitigation measures can be implemented to reduce or eliminate many of these potential adverse effects. Establishment of a conservation area adjacent to the shoreline and placing controls on the type of human activity that occurs in this zone will substantially reduce the potential adverse effects on vegetation, habitats, wildlife, birds, and fish. A specific example of an appropriate mitigation measure is exclusion of all human activity immediately adjacent to the western grebe colony.

Water quality in the lake will be protected by intercepting runoff, by use of a central sewage storage facility, use of an aeration system in the harbour, and other mitigation measures. As such, no significant adverse effects to water quality are expected.

There will be residual adverse effects associated with the Project following mitigation. The development will affect wildlife and fish resources in the form of habitat loss, disturbance, and mortality.

The majority of the residual effects are deemed to be not significant because they will not change the characteristics of the affected resource in a sufficient amount as to cause a permanent change from pre-development conditions. This is primarily due to the limited geographic extent of the Project's influence, the limited magnitude of the effect on the populations in question, and the availability of similar habitats in the immediate vicinity of the Project.

The only exception to this statement is the adverse effects of disturbance during Project operation on wildlife. Specifically, activities likely will cause a significant adverse effect on the nesting colony of western grebes immediately adjacent to the Project.

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APPENDICES

APPENDIX A
Wildlife Resources

Table A1 List of wildlife species observed during field surveys of the Windmill Harbour Study Area, October 2001 to June 2002.

Group	Common Name	Latin Name	Recorded in Development Section
Mammals	Striped skunk	*Mephitis mephitis*	*
	Mink	*Mustela vision*	
	Muskrat	*Ondatra zibethica*	
	Red fox	*Vulpes fulva*	*
	Coyote	*Canis latrans*	*
	Red squirrel	*Tamiasciurus hudsonicus*	*
	Woodland jumping mouse	*Zapus hudsonius*	*
	Porcupine	*Erethizon dorsatum*	*
	Snowshoe hare	*Lepus americanus*	*
	White tailed deer	*Odocoileus virginianus*	*
	Moose	*Alces alces*	*
Amphibians	Wood frog	*Rana sylvatica*	*
	Stripped chorus frog	*Pseudacris triseriata*	
	Western toad	*Bufo boreas*	*
Reptiles	Red-sided garter snake	*Thamnophis sirtalis*	

Table A2 List of bird species observed during field surveys of the Windmill Harbour Study Area, October 2001 to June 2002.

Group	Common Name	Latin Name	Recorded in Development Section
Waterbirds	Western grebe	*Aechmophorus occidentalis*	*
	Eared grebe	*Podiceps nigricollis*	*
	Rednecked grebe	*Podiceps grisegena*	*
	Great blue heron	*Ardea herodias*	
	American coot	*Fulica americana*	
	Sora	*Porzana carolina*	*
Waterfowl	Tundra swan	*Olor columbianus*	
	Canada goose	*Branta canadensis*	*
	Mallard	*Anas platyrhynchos*	*
	Gadwall	*Anas strepera*	*
	Northern shoveller	*Anas clypeata*	*
	Blue winged teal	*Anas discors*	*
	American wigeon	*Anas americana*	*
	Bufflehead	*Bucephala albeola*	*
	Common goldeneye	*Bucephala clangula*	*
	Lesser scaup	*Aythya affinis*	*
	Ruddy duck	*Oxyura jamaicensis*	
Shorebirds	Spotted sandpiper	*Actitis macularia*	*
	Lesser yellowlegs	*Tringa flavipes*	*
	Killdeer	*Charadrius vociferus*	
Gulls	Ring-billed gull	*Larus delawarensis*	*
	Franklin's gull	*Larus pipixcan*	
Terns	Common tern	*Sterna hirundo*	*
	Black tern	*Chlidonias niger*	*
Raptors	Red-tailed hawk	*Buteo jamaicensis*	*
	Osprey	*Pandion haliaetus*	
Game birds	Ruffed grouse	*Bonasa umbellus*	*
Woodpeckers	Pileated woodpecker	*Dryocopus pileatus*	
	Hairy woodpecker	*Dendrocopos villosus*	*
	Downy woodpecker	*Dendrocopos pubescens*	*
Perching birds	Barn swallow	*Hirundo rustica*	
	Tree swallow	*Iridoprocne bicolor*	*
	Blue jay	*Cyanocitta cristata*	
	Black-billed magpie	*Pica pica*	*
	Common raven	*Corvus corax*	*
	Black-capped chickadee	*Parus atricapillus*	*
	Brown creeper	*Certhia familiaris*	*
	Long-billed marsh wren	*Telmatodytes palustris*	*
	Yellow warbler	*Dendroica petechia*	*
	Red-winged blackbird	*Agelaius phoeniceus*	*
	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	*
	Common redpoll	*Acanthis flammea*	*
	Chipping sparrow	*Spizella passerina*	*

APPENDIX B
Fisheries Resources

Appendix B Table B1. Information for fish sampling sites in the Windmill Harbour Development Study Area, 2002.

Waterbody	Type of Sampling	Method	Site Label	Nad	Zone	Easting	Northing
Lac Ste. Anne							
	Fisheries						
		Boat Electrofish					
			ES01	27	11U	670903	5951866
			ES02	27	11U	670903	5951866
			ES03	27	11U	672020	5950941
		Fyke Net					
			FN01	27	11U	671483	5951232
			FN02	27	11U	671488	5951374
		Gee Trap					
			GT01	27	11U	671482	5951242
			GT02	27	11U	671504	5951267
			GT03	27	11U	671453	5951267
			GT04	27	11U	671489	5951206
			GT05	27	11U	671505	5951198
			GT06	27	11U	671561	5951165
			GT07	27	11U	671389	5951309
			GT08	27	11U	671415	5951301
			GT09	27	11U	671539	5951244
		Gill Net					
			GN01	27	11U	671003	5952086
			GN02	27	11U	671722	5951515
			GN03	27	11U	672232	5951293
	Spawning						
		Egg Mat					
			EG01	27	11U	671481	5951218
			EG02	27	11U	671485	5951221
			EG03	27	11U	671484	5951229
			EG04	27	11U	671492	5951246
			EG05	27	11U	671506	5951246
			EG06	27	11U	671508	5951257
			EG07	27	11U	671497	5951265
			EG08	27	11U	671488	5951272
			EG09	27	11U	671481	5951274
			EG10	27	11U	671467	5951273
			EG11	27	11U	671463	5951271
			EG12	27	11U	671456	5951270
			EG13	27	11U	671455	5951268
			EG14	27	11U	671448	5951280
			EG15	27	11U	671442	5951287
			EG16	27	11U	671414	5951210
			EG17	27	11U	671441	5951192
			EG18	27	11U	671456	5951185
			EG19	27	11U	671479	5951234
			EG20	27	11U	671480	5951243
		Sweep Net					
			SW01	27	11U	671425	5951210
			SW02	27	11U	671419	5951218
			SW03	27	11U	671401	5951230
			SW04	27	11U	671386	5951244
			SW05	27	11U	671377	5951256
			SW06	27	11U	671368	5951266

Appendix B Table B1. Information for fish sampling sites in the Windmill Harbour Development Study Area, 2002.

Waterbody	Type of Sampling	Method	Site Label	Nad	Zone	Easting	Northing
Lac Ste. Anne							
	Spawning						
		Sweep Net					
			SW07	27	11U	671358	5951282
			SW08	27	11U	671390	5951309
			SW09	27	11U	671399	5951311
			SW10	27	11U	671405	5951309
			SW11	27	11U	671415	5951299
			SW12	27	11U	671422	5951293
			SW13	27	11U	671430	5951297
			SW14	27	11U	671432	5951292
			SW15	27	11U	671441	5951286
			SW16	27	11U	671445	5951273
			SW17	27	11U	671453	5951274
			SW18	27	11U	671482	5951239
			SW19	27	11U	671545	5951237
			SW20	27	11U	671560	5951219

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES01	22-May-02							
		Burbot	589	1526				0
		Lake whitefish	390	800				0
		Lake whitefish	520	1190				0
		Lake whitefish	362	756				0
		Lake whitefish	402	902				0
		Lake whitefish	450	1110				0
		Lake whitefish	373	604				0
		Lake whitefish	390	694				0
		Lake whitefish	368	644				0
		Lake whitefish	367	550				0
		Lake whitefish	431	632				0
		Lake whitefish	393	688				0
		Lake whitefish	510	1610				0
		Lake whitefish	370	960				0
		Lake whitefish	514	1300				0
		Lake whitefish	368	722				0
		Lake whitefish	411	986				0
		Lake whitefish	365	856				0
		Lake whitefish	432	1010				0
		Lake whitefish	369	648				0
		Lake whitefish	374	570				0
		Lake whitefish	372	684				0
		Lake whitefish	356	568				0
		Lake whitefish	384	564				0
		Lake whitefish	365	646		Scale		0
		Lake whitefish	375	710		Scale		0
		Lake whitefish	365	708		Scale		0
		Lake whitefish	370	636		Scale		0
		Lake whitefish	422	934		Scale		0
		Lake whitefish	392			Scale		0
		Lake whitefish	408	778		Scale		0
		Lake whitefish	372	564				0
		Lake whitefish	396	822		Scale		0
		Lake whitefish						0
		Lake whitefish	375	720		Scale		0
		Lake whitefish	480	1312		Scale		0
		Lake whitefish	422	966		Scale		0
		Lake whitefish	396	812		Scale		0
		Lake whitefish	390	820		Scale		0
		Lake whitefish	499	1286		Scale		0
		Lake whitefish	375	730		Scale		0
		Lake whitefish						0
		Lake whitefish	392	809		Scale		0
		Northern pike						0
		Northern pike	580	1172				0
		Northern pike	607	1176	7			0
		Spottail shiner	83					0
		Spottail shiner	63					0
		Walleye	390	618	8	Fin Ray		0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES01	22-May-02							
		Walleye						0
		Walleye	384	596	8	Fin Ray		0
		Walleye	391	646	8			0
		Walleye	459	978				0
		Walleye	454	1020	8			0
		Walleye	555	1694	8			0
		Walleye						0
		White sucker	481	1600				0
		White sucker						0
		White sucker	415	1070	8			0
		White sucker	420	982	7			0
		White sucker	401	914	8			0
		White sucker	429	1014				0
		White sucker	393	1012	8			0
		White sucker	434	1260	17			0
		White sucker	420	1110				0
		White sucker	489	1448	8			0
		White sucker	485	1650	17			0
		White sucker	433	1298	7			0
		White sucker	414	1050	8			0
		White sucker						0
		White sucker	412	964	8			0
		White sucker	400	1150				0
		White sucker	424	1078				0
		White sucker	502	1540	19			0
		White sucker	482	1590	17			0
		White sucker	502	1732	17			0
		White sucker	479	1336	19			0
		White sucker	418	1204				0
		White sucker	390	622	8			0
		White sucker	506	1382				0
		White sucker	428	894				0
ES02	23-May-02							
		Lake whitefish	439	1028				0
		Lake whitefish	456	1084				0
		Lake whitefish	350	678				0
		Lake whitefish	395	874				0
		Lake whitefish	412	936				0
		Lake whitefish	355	682				0
		Lake whitefish	425	1064				0
		Lake whitefish	359	664				0
		Lake whitefish	460	1158				0
		Lake whitefish	405	806				0
		Lake whitefish	377	818				0
		Lake whitefish	397	788				0
		Lake whitefish	426	1194				0
		Lake whitefish	368	686				0
		Lake whitefish	392					0
		Lake whitefish	384	760				0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES02	23-May-02							
		Lake whitefish	359	632				0
		Lake whitefish	367	650				0
		Lake whitefish	398	872				0
		Lake whitefish	398	916				0
		Lake whitefish	406	810				0
		Lake whitefish	406	884				0
		Lake whitefish						0
		Lake whitefish	518	1442				0
		Lake whitefish	372	752				0
		Lake whitefish	386	748				0
		Lake whitefish	430	972				0
		Lake whitefish	424	934				0
		Lake whitefish	374	788				0
		Lake whitefish	400	866				0
		Lake whitefish	391	860				0
		Lake whitefish	394	958				0
		Lake whitefish	473	1422				0
		Lake whitefish	375	728				0
		Lake whitefish	432	1098				0
		Lake whitefish	388	866				0
		Lake whitefish	371	654				0
		Lake whitefish	391	770				0
		Lake whitefish						0
		Lake whitefish	358	594				0
		Lake whitefish	404	964				0
		Lake whitefish	404	880				0
		Lake whitefish	394	904				0
		Lake whitefish	474	1204				0
		Lake whitefish	405	764				0
		Lake whitefish	378	704				0
		Lake whitefish	388	700				0
		Lake whitefish	434	1072				0
		Northern pike	514	964	8	Fin Ray		0
		Northern pike	808	6500		Fin Ray		0
		Northern pike						0
		Walleye	454	948	8			0
		Walleye	426	934		Fin Ray		0
		Walleye						0
		Walleye	425	766	8			0
		Walleye	374	592	8			0
		Walleye	380	584	8			0
		Walleye	390	676	8			0
		Walleye	406	620	8			0
		Walleye						0
		White sucker						0
		White sucker	488	1720	17			0
		White sucker	420	986	8			0
		White sucker	443	1252				0
		White sucker	454	1208	8			0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES02	23-May-02							
		White sucker	484	1400				0
ES03	22-May-02							
		Burbot	561					0
		Burbot	625					0
		Lake whitefish	392					0
		Lake whitefish	388					0
		Lake whitefish	394					0
		Lake whitefish	407					0
		Lake whitefish	424					0
		Lake whitefish	380					0
		Lake whitefish	381					0
		Lake whitefish	398					0
		Lake whitefish	406					0
		Lake whitefish	379					0
		Lake whitefish	407	862				0
		Lake whitefish	387					0
		Lake whitefish	392					0
		Lake whitefish	391					0
		Lake whitefish	510					0
		Lake whitefish	518					0
		Lake whitefish	497					0
		Lake whitefish	359					0
		Lake whitefish	391					0
		Lake whitefish	361					0
		Lake whitefish	375					0
		Lake whitefish	463					0
		Lake whitefish	399					0
		Lake whitefish	377					0
		Lake whitefish	414					0
		Lake whitefish	392	792				0
		Lake whitefish	398	936				0
		Lake whitefish	392	714				0
		Lake whitefish	363	574				0
		Lake whitefish	390	734				0
		Lake whitefish	397	690				0
		Lake whitefish	383	726				0
		Lake whitefish	372	704				0
		Lake whitefish	404	826				0
		Lake whitefish	396	882				0
		Lake whitefish	396	894				0
		Lake whitefish	420	824				0
		Lake whitefish	371	732				0
		Lake whitefish	468	1164				0
		Lake whitefish	460	1082				0
		Lake whitefish	414	944				0
		Lake whitefish						0
		Lake whitefish	385					0
		Lake whitefish	391	734				0
		Lake whitefish	375	808				0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES03	22-May-02							
		Lake whitefish						0
		Lake whitefish	380	804				0
		Lake whitefish	420	874				0
		Lake whitefish	359	596				0
		Lake whitefish	404	754				0
		Lake whitefish	375	818				0
		Lake whitefish	322	438				0
		Lake whitefish	500	1220				0
		Lake whitefish	427	1074				0
		Lake whitefish	388	1080				0
		Lake whitefish	405	828				0
		Lake whitefish	419	842				0
		Northern pike	672	3000	18	Fin Ray		0
		Northern pike	930	8500		Fin Ray		0
		Northern pike	890	8000		Fin Ray		0
		Northern pike						0
		Northern pike	710	3800		Fin Ray		0
		Northern pike						0
		Northern pike	485	880				0
		Walleye						0
		Walleye	475	1110	17			0
		Walleye	364	526	8			0
		Walleye						0
		Walleye	386	626	8			0
		White sucker	400		8			0
		White sucker	422	1320				0
		White sucker	422	908				0
		White sucker	405	814				0
		White sucker	411	988				0
		White sucker	406	1116				0
		White sucker						0
		White sucker	440					0

For fish captured by Fyke Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
FN01	22-May-02							
		None						0
		Northern pike	420	488	7			0
		Northern pike	518	922	18			0
		Northern pike	521	920	7			0
		Northern pike	580	1272	7			0
		Northern pike	423	588	7			0
		Northern pike	510	796	7			0
		White sucker	459					0
FN02	23-May-02							
		None						0
		Northern pike	562	1072				0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Fyke Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
FN02	23-May-02							
		Northern pike	505	854	8			0
		Northern pike	532	988	8			0
		Northern pike	515	970				0
		Northern pike	575	1124	7			0
		Northern pike	523	1082				0
		Northern pike	600	1414				0
		Northern pike	547	1178	7			0
		Northern pike	554	1070				0
		Northern pike	552	1278				0
		Northern pike	457					0
		Northern pike	554	1030				0
		Northern pike	598	1218				0
		Northern pike	532	1092	7			0

For fish captured by Gee Trap

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
GT01	23-May-02							
		None						0
GT02	23-May-02							
		None						0
GT03	23-May-02							
		None						0
GT04	23-May-02							
		Yellow perch	61					0
		Yellow perch	60					0
		Yellow perch	57					0
GT05	23-May-02							
		None						0
GT06	24-May-02							
		None						0
GT07	24-May-02							
		None						0
GT08	24-May-02							
		None						0
GT09	24-May-02							
		None						0

For fish captured by Gill Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
GN01	22-May-02							
		Lake whitefish	393	570				0
		Lake whitefish	402	1374				0
		Lake whitefish	392	856				0
		Lake whitefish	375	746				0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Gill Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
GN01	22-May-02							
		Northern pike	611	1572	18	Fin Ray		0
		Northern pike	552	1246	8	Fin Ray		0
		Northern pike	580	1152		Fin Ray		0
		Northern pike	544	1254	8	Fin Ray		0
		Northern pike	485	866	8	Fin Ray		0
		Northern pike	538	1058	8	Fin Ray		0
		Northern pike	619	1628		Fin Ray		0
		Walleye	439	914	8	Fin Ray		0
		Walleye	355	692	8	Fin Ray		0
		White sucker	508	1604	17			0
GN02	22-May-02							
		Lake whitefish	471	1064				0
		Lake whitefish	380	532				0
		Lake whitefish	391	634				0
		Northern pike	621		18			0
		Northern pike	537	1066				0
		Northern pike	609	1322	18			0
		Northern pike	460	690	7			0
		Northern pike	608	1622	7			0
		Northern pike	461	730				0
		Northern pike	526	924	7			0
		Northern pike	520	928				0
		Northern pike	550	1134				0
		Northern pike	512	1030	7			0
		Northern pike	539	1074	7			0
		Northern pike	531	952	8			0
		Northern pike	543	898	8	Fin Ray		0
		Northern pike	521	756	8			0
		Northern pike	532	1138	8			0
		Northern pike	522	894	8	Fin Ray		0
		Northern pike	537	994	8	Fin Ray		0
		Northern pike	790	6500		Fin Ray		0
		Northern pike	540	1118	8			0
		Northern pike	467	822	8	Fin Ray		0
		Northern pike	530	1066	7			0
		Northern pike	487	824	8			0
		Northern pike	485	968	8			0
		Walleye	381	492	8			0
		Walleye	463	962	8	Fin Ray		0
		Walleye	400	760	8			0
		Walleye	388	626	8			0
		Walleye	363	466	8			0
		Walleye	380	574	8			0
		Walleye	391	570	8			0
		Walleye	453	910	8	Fin Ray		0
		Walleye	390	504	8			0
		Walleye	366	498	8			0
		Walleye	384	562	8			0
		Walleye	378	612	8			0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Gill Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
GN02	22-May-02							
		Walleye	389	746	8			0
		Walleye	385	426	8			0
		Walleye	361	364	8			0
		Walleye	377	686	8			0
		Walleye	409	738	8			0
		Walleye	390	650	8			0
		Walleye	369	506	8	Fin Ray		0
		Walleye	505	1452	8	Fin Ray		0
		Walleye	468	1006	8			0
		Walleye	401	618	8	Fin Ray		0
		Walleye	387	584	8			0
		White sucker	406	1002	8			0
		White sucker	420	990	8			0
		White sucker	421	1076	17			0
		White sucker	494	1634	17			0
		White sucker	390	652	8			0
GN03	23-May-02							
		Lake whitefish	375	494				0
		Lake whitefish	366	538				0
		Northern pike	600	1322	7			0
		Northern pike	508	732	7			0
		Northern pike	474	624	7			0
		Northern pike	521	868	7			0
		Northern pike	542	966	8			0
		Northern pike	506	818	7			0
		Northern pike	545	840	7			0
		Northern pike	826	7000	7			0
		Northern pike	812	1486	7			0
		Spottail shiner	80					0
		Walleye	510	1490				0
		Walleye	385	456	8			0
		Yellow perch	86	6	8			0
		Yellow perch	71		8			0
		Yellow perch	86	6	8			0
		Yellow perch	77	4	8			0
		Yellow perch	81	6	8			0
		Yellow perch	74	4	8			0
		Yellow perch	84	6	8			0
		Yellow perch	77	4	8			0
		Yellow perch	85	8	8			0
		Yellow perch	80	4	8			0
		Yellow perch	81	6	8			0
		Yellow perch	82	8	8			0
		Yellow perch	83	6	8			0
		Yellow perch	77	4	8			0
		Yellow perch	86	6	8			0
		Yellow perch	96	6	8			0

Appendix B Table B3. Fisheries sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Sample Effort (h)	Species	Observed	Captured	Total Catch	CPUE (Fish/h)
Boat Electrofish								
	ES01							
		22-May-02	0.45					
				Burbot	0	1	1	*2.24*
				Lake whitefish	38	16	54	*120.75*
				Walleye	2	2	4	*8.94*
				White sucker	6	5	11	*24.60*
		23-May-02	0.39					
				Northern pike	2	2	4	*10.37*
				Spottail shiner	0	2	2	*5.19*
				Walleye	1	4	5	*12.97*
				White sucker	7	18	25	*64.84*
				Lake whitefish	54	24	78	*202.31*
	ES01 Totals:		**0.83**				**184**	***220.95***
	ES02							
		22-May-02	0.38					
				Northern pike	4	2	6	*15.71*
				Walleye	2	1	3	*7.85*
				Lake whitefish	31	17	48	*125.67*
				White sucker	0	1	1	*2.62*
		23-May-02	0.32					
				Lake whitefish	27	29	56	*176.84*
				Walleye	7	6	13	*41.05*
				White sucker	4	4	8	*25.26*
	ES02 Totals:		**0.70**				**135**	***193.24***
	ES03							
		22-May-02	0.29					
				Walleye	3	1	4	*13.97*
				White sucker	0	2	2	*6.98*
				Northern pike	7	5	12	*41.90*
				Lake whitefish	81	25	106	*370.13*
				Burbot	0	2	2	*6.98*
		23-May-02	0.30					
				Northern pike	3	0	3	*9.85*
				Walleye	4	2	6	*19.71*
				White sucker	8	5	13	*42.70*
				Lake whitefish	48	30	78	*256.20*
	ES03 Totals:		**0.59**				**226**	***382.51***
Boat Electrofish Totals:				**2.12**			**545**	***256.81***

Appendix B Table B3. Fisheries sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Sample Effort (h)	Species	Observed	Captured	Total Catch	CPUE (Fish/h)
Fyke Net								
	FN01							
		22-May-02	6.08					
				None	0	0	0	*0.00*
		23-May-02	16.00					
				Northern pike	0	6	6	*0.38*
				White sucker	0	1	1	*0.06*
	FN01 Totals:		**22.08**				**7**	***0.32***
	FN02							
		23-May-02	7.25					
				None	0	0	0	*0.00*
		24-May-02	16.25					
				Northern pike	0	14	14	*0.86*
	FN02 Totals:		**23.50**				**14**	***0.60***
Fyke Net Totals:				**45.58**			**21**	***0.46***

Appendix B Table B3. Fisheries sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Sample Effort (h)	Species	Observed	Captured	Total Catch	CPUE (Fish/h)
Gee Trap								
	GT01							
		23-May-02	22.98					
				None	0	0	0	*0.00*
	GT01 Totals:		**22.98**				**0**	***0.00***
	GT02							
		23-May-02	22.97					
				None	0	0	0	*0.00*
	GT02 Totals:		**22.97**				**0**	***0.00***
	GT03							
		23-May-02	22.95					
				None	0	0	0	*0.00*
	GT03 Totals:		**22.95**				**0**	***0.00***
	GT04							
		23-May-02	22.85					
				Yellow perch	0	1	1	*0.04*
		24-May-02	23.47					
				Yellow perch	0	2	2	*0.09*
	GT04 Totals:		**46.32**				**3**	***0.06***
	GT05							
		23-May-02	22.92					
				None	0	0	0	*0.00*
	GT05 Totals:		**22.92**				**0**	***0.00***
	GT06							
		24-May-02	23.48					
				None	0	0	0	*0.00*
	GT06 Totals:		**23.48**				**0**	***0.00***
	GT07							
		24-May-02	23.67					
				None	0	0	0	*0.00*
	GT07 Totals:		**23.67**				**0**	***0.00***
	GT08							
		24-May-02	23.73					
				None	0	0	0	*0.00*
	GT08 Totals:		**23.73**				**0**	***0.00***
	GT09							
		24-May-02	22.50					
				None	0	0	0	*0.00*
	GT09 Totals:		**22.50**				**0**	***0.00***
Gee Trap Totals:				**231.52**			**3**	***0.01***

Appendix B Table B3. Fisheries sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Sample Effort (h)	Species	Observed	Captured	Total Catch	CPUE (Fish/h)
Gill Net								
	GN01							
		22-May-02	1.42					
				Northern pike	0	7	7	*4.94*
				Walleye	0	2	2	*1.41*
				Lake whitefish	0	4	4	*2.82*
				White sucker	0	1	1	*0.71*
	GN01 Totals:		**1.42**				**14**	***9.88***
	GN02							
		22-May-02	1.25					
				Lake whitefish	0	3	3	*2.40*
				Northern pike	0	13	13	*10.40*
				Walleye	0	19	19	*15.20*
				White sucker	0	4	4	*3.20*
		23-May-02	0.75					
				Northern pike	0	10	10	*13.33*
				Walleye	0	4	4	*5.33*
				White sucker	0	1	1	*1.33*
	GN02 Totals:		**2.00**				**54**	***27.00***
	GN03							
		23-May-02	0.50					
				Yellow perch	0	16	16	*32.00*
				Lake whitefish	0	2	2	*4.00*
				Northern pike	0	9	9	*18.00*
				Spottail shiner	0	1	1	*2.00*
				Walleye	0	2	2	*4.00*
	GN03 Totals:		**0.50**				**30**	***60.00***
Gill Net Totals:				**3.92**			**98**	***25.02***

Appendix B Table B4. Egg mat sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date Set	Pull	Sample Effort (h)	Species	Total Catch	CPUE (Fish/h)
Egg Mat							
	EG01	22 May 10:15	24 May 11:20	49.08	None	0	*0.00*
	EG02	22 May 10:17	24 May 11:22	49.08	None	0	*0.00*
	EG03	22 May 10:19	24 May 11:23	49.07	None	0	*0.00*
	EG04	22 May 10:21	24 May 11:25	49.07	None	0	*0.00*
	EG05	22 May 10:23	24 May 11:27	49.07	None	0	*0.00*
	EG06	22 May 10:26	24 May 11:27	49.02	None	0	*0.00*
	EG07	22 May 10:28	24 May 11:29	49.02	None	0	*0.00*
	EG08	22 May 10:30	24 May 11:31	49.02	None	0	*0.00*
	EG09	22 May 10:31	24 May 11:31	49.00	None	0	*0.00*
	EG10	22 May 10:33	24 May 11:33	49.00	None	0	*0.00*
	EG11	22 May 10:34	24 May 11:35	49.02	None	0	*0.00*
	EG12	22 May 10:36	24 May 11:37	49.02	None	0	*0.00*
	EG13	22 May 10:36	24 May 11:39	49.05	None	0	*0.00*
	EG14	22 May 10:37	24 May 11:40	49.05	None	0	*0.00*
	EG15	22 May 10:39	24 May 11:41	49.03	None	0	*0.00*
	EG16	22 May 10:41	24 May 11:43	49.03	None	0	*0.00*
	EG17	22 May 10:42	24 May 11:45	49.05	None	0	*0.00*
	EG18	22 May 10:44	24 May 11:47	49.05	None	0	*0.00*
	EG19	22 May 10:45	24 May 11:49	49.07	None	0	*0.00*
	EG20	22 May 10:46	24 May 11:51	49.08	None	0	*0.00*
Egg Mat Totals:				**980.87**		**0**	***0.00***

Appendix B Table B5. Sweep net sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Length (m)	Width (m)	Sample Effort (m^2)	Species	Total Catch	CPUE (Catch/m^2)
Sweep Net								
	SW01	23-May-02	1.00	0.17	0.17	Northern pike	1	*5.88*
	SW02	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW03	22-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW04	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW05	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW06	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW07	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW08	22-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW09	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW10	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW11	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW12	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW13	22-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW14	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW15	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW16	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW17	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW18	22-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW19	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW20	23-May-02	1.00	0.17	0.17	None	0	*0.00*
Sweep Net Totals:					**3.40**		**1**	***0.29***

APPENDIX C
Significance Rating Criteria

Magnitude
Magnitude describes the nature and extent of the environmental effect. The magnitude of an effect is quantified in terms of the amount of change in a parameter or variable from an appropriate threshold value, which may be represented by a guideline or baseline conditions. Three general categories of change to be employed are low (1), medium (2), and high (3). The definitions used to rate the magnitude will be specific to a resource, and will depend on the type of effect, the methods available to measure the effect, and the accepted practices for a particular discipline.

Geographic Extent
Geographic extent can be separated into three ratings:

- Sub-local - area in the immediate influence of the Project (e.g., construction zone)
- Local - Sub-local area and immediately adjoining areas
- Regional - Lac Ste Anne and/or biological boundaries of potentially affected populations

Duration and Timing
Duration is defined as a measure of the length of time that the potential effect could last. It is closely related to the project phase or activity that could cause the effect. The two project phases that define the temporal boundaries include construction and operation. The duration ratings are divided into two classes based on the time scale of each Project phase:

- Short-term - effect lasting for less than one year (Construction)
- Long-term - effect lasting longer than 20 years (Operation)

Frequency
Frequency is associated with duration and defines the number of occurrences that can be expected during each phase of the project. The frequency ratings are divided into three classes:

- Low - effect occur infrequently during each phase (one event)
- Moderate - effect occur frequently during each phase
- High - effect occur continuously

Reversibility
Reversibility is the ability of the VEC to return to conditions that existed prior to the adverse environmental effect. The prediction of reversibility can be difficult because environmental effects may, or may not, be reversible. Despite this, it is important to ascertain reversibility because it has an important influence on the significance of an effect. Two ratings will be used: reversible (R) and not reversible (NR).

Level of Confidence
Using the rating criteria described in the preceding paragraphs, the significance of adverse environmental effects is evaluated based on a review of project specific data, relevant literature and professional opinion. Based on recommendations by Barnes and Davey (1999), the assessment should also include a rating system that evaluates the level of confidence in the prediction of significance. Three rating classes will be used to assess the level of confidence: low, moderate, and high.

Likelihood

The more likely that an adverse effect will occur (or not occur), the higher the level of confidence that the effect will be significant (or not significant). Probability of occurrence is used to assess likelihood using three rating classes as follows: low, moderate, and high.

Certainty

During the assessment of significance, it is desirable to apply rigorous scientific and/or statistical methods (quantitative approach), but where such methods are not feasible, professional judgment is usually employed (qualitative approach). Rating the certainty of significance is an additional step that can be used to justify or substantiate the likelihood that a significant adverse effect will occur. The three ratings that will be applied are: low, moderate, and high.

APPENDIX D

MARINA BAY HOMEOWNER'S ASSOCIATION
100 Marina Bay Court
Sylvan Lake, AB T4S 1E9

June 11, 1999

Sunset Harbor Development
RR 1
Falun, AB T0C 1H0

In response to your request for information on the Marina Bay Developments at Sylvan Lake, we are pleased to provide you with the following information.

Marina Bay has 100 boat slips in the marina. Of these, approximately 40 are relatively large sailboats, about 40 are motor boats used for water skiing and pleasure cruising. The remaining slips are used by a few sea-dos and a few are used as guest slips and for RCMP use.

Although the public is allowed to fish in Marina Bay, the residents do not as we consider it a key fish habitat and spawning area. In fact, fishing in the marina is not sporting as it is teeming with fish due to the spawning lodges and aeration system.

The property owners have come to value and protect not only the fish habitat but the bird life that our neighborhood has nurtured and have become watchdogs over public abuse of the area.

The majority of our residents are weekend recreational property owners. As a result, the marina is quiet during the week with only occasional boat counts except Wednesday evenings when about 20 sailboats participate in a weekly sailing race on the lake.

If we were to do boat counts in and out of the marina it would probably average 12 boats a day over the summer season. We have never had any major line-ups of boats launching for the season.

Hopefully, this is the information you require and please feel free to contact us if you require additional information.

Yours truly,

Marina Bay Home Owners Association

- ADDENDUM -

SHORELINE VEGETATION SURVEY
WINDMILL HARBOUR DEVELOPMENT

Windmill Harbour Project

Note on shoreline vegetation by Dr. Graham C. D. Griffiths, based on field work on 5 and 6 August, 2003.

There are two well-defined, more or less continuous beach ridges at this site: the primary beach ridge marked by the outer limits of poplar forest and tilled cropland, was formed at a time when lake levels were higher, probably in early postglacial times; then there is a lower second beach ridge (close to the existing shoreline) occupied by a strip of dense willow shrubbery. Between the two beach ridges there is a broad band of open land mainly occupied by sedge fen, with a varying degree of recent willow invasion. I was asked to document the vegetation of land below the primary beach ridge. This was done on 5 and 6 August by recording the content of plots along 3 transects, with two additional plots in the vicinity of the western grebe colony. In total 21 plots were documented (see attached Stand Description Forms; the location of the plots is shown on the attached air photos).

The shoreline vegetation of this site is representative of the natural shoreline vegetation of Lac Ste. Anne and similar lakes in Central Alberta, and shows little evidence of recent manmade disturbance. It provides valuable wildlife habitat, but was not found to contain any plant species listed as rare on the Provincial "Tracking List" published by the Alberta Natural Heritage Information Centre. Most of the plant communities extend (continuously or with only short gaps) along the entire shoreline, as indicated by the polygon overlay on the attached air photos; the exception is the pondlily community, which is confined to the vicinity of the western grebe colony. Measures to avoid disturbance of this colony must include retention of the natural vegetation (including pondlily beds) along the relevant stretch of shoreline.

Water depth at the outer limit of bulrush beds was measured at 1.3 m. The lake water was murky due to abundant microorganisms, so the lake bottom could not be seen in open water plots (1.3 m and beyond). As far as I could tell, coverage by rooted aquatics was at most patchy, but the coverage of *Chara* may have been underestimated due to its short stems not being effectively sampled with the tool used. Since *Chara* does not grow to the surface, its presence is of no concern to boaters. Given the poor light penetration of the water, invasion by rooted aquatics of an access channel dredged to a depth of about 2 m (as I believe is proposed) seems unlikely.

The following are more detailed comments on particular vegetation types:

Sedge Fens. The extensive band of open ground between the two main beach ridges is mainly occupied by sedge fen , the dominant sedges being *Carex atherodes* (awned sedge) and/or C. *praegracilis* (graceful sedge) (see plots 1A, 2A, 3A). Many parts of this fen are being invaded by willow saplings (mainly *Salix petiolaris*, basket willow). This willow invasion may indicate that the site has become drier in recent years, or that willow growth was previously suppressed under grazing management. The prevalence of *Carex praegracilis* suggests that the land is slightly saline (oligohaline), as also does the fact that most of the willow saplings belong to *Salix petiolaris* (the species of willow most tolerant of salinity). No poplar saplings were observed. The vegetation indicates that the land must have a high water table for at least part of the year, and its suitability for building construction may be subject to limitations.

Limited bands of sedge fen dominated by awned sedge *(Carex atherodes)* also occur below the second beach ridge (see plot 2C). This species is commonly found on intermittently flooded ground.

Willow Shrubbery. An almost continuous band of dense mature willow shrubbery extends along the second beach ridge (see plots 1B, 2B, 3B). The dominant willow is basket willow *(Salix petiolaris)*, a species indicative of eutrophic to oligohaline conditions. The presence of some weedy herbs in the understory of this strip, such as stinging nettle *(Urtica dioica)* and hemp nettle *(Galeopsis tetrahit)*, is due to its use as shelter by deer and other wildlife.

Reed Beds. Reed beds dominated by the tall reed grasses *Phalaris arundinacea* (reed Canary grass) and/or *Calamagrostis canadensis* (bluejoint) (see plots 1C, 2D, 3C) occur extensively along the upper shoreline, either immediately below the second beach ridge or on a slight third beach ridge separated from the second ridge by a strip of sedge fen (transect 2). These robust grasses predominate on sites subject to disturbance by wind and wave action during severe storms, but above normal water levels.

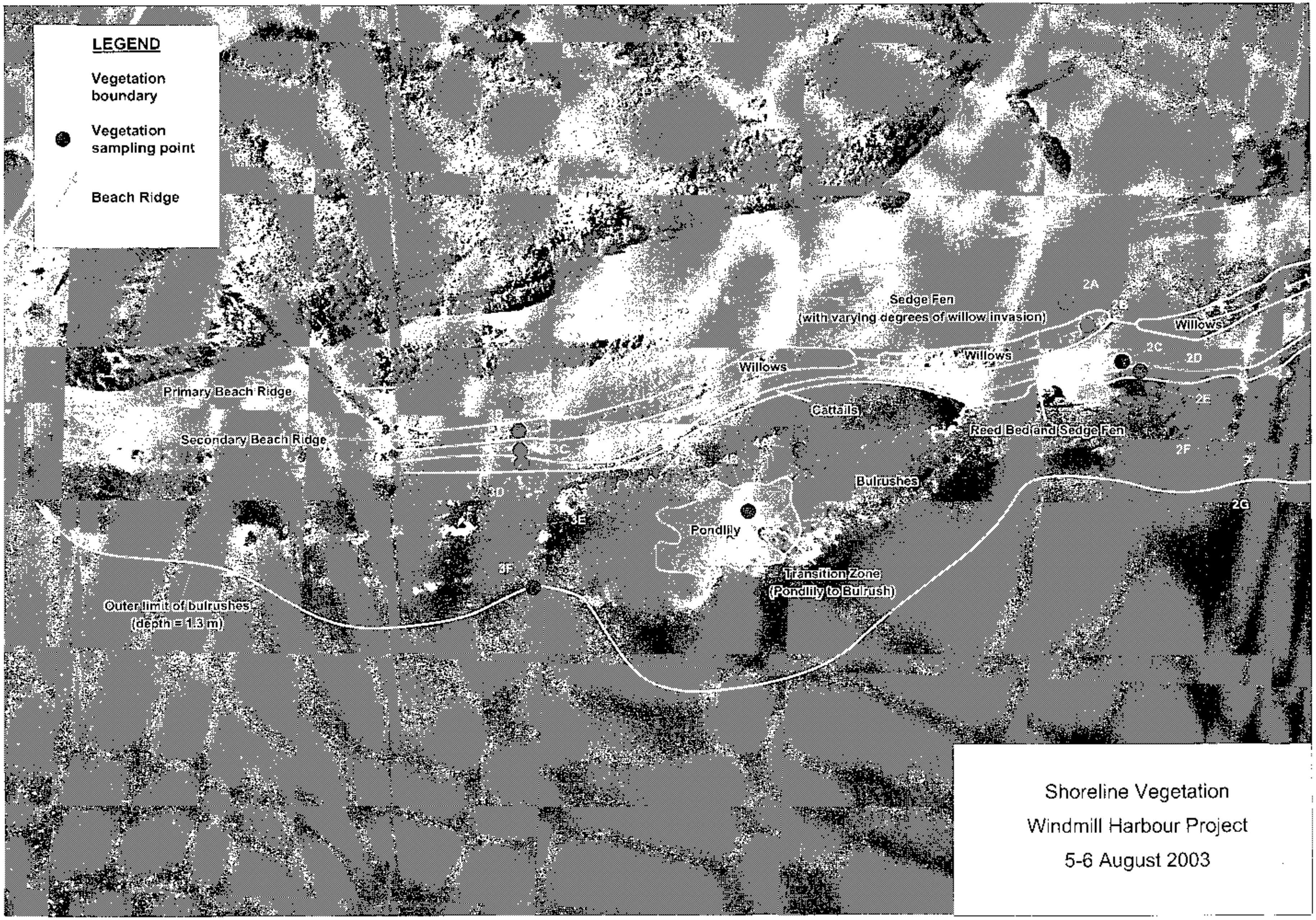
Cattail Beds. Cattail beds *(Typha latifolia)* commonly form continuous bands on saturated to shallowly flooded ground at the edges of eutrophic lakes and ponds with more or less stable water levels (see plots 1D, 2E, 3D). The stands at this site contain a rather diverse admixture of other wetland plants, especially *Glyceria grandis* (common manna grass), *Sparganium eurycarpum* (giant burreed) and *Eleocharis palustris* (creeping spikerush). This is the only plant community at the site with an extensive moss layer (consisting of *Drepanocladus aduncus).*

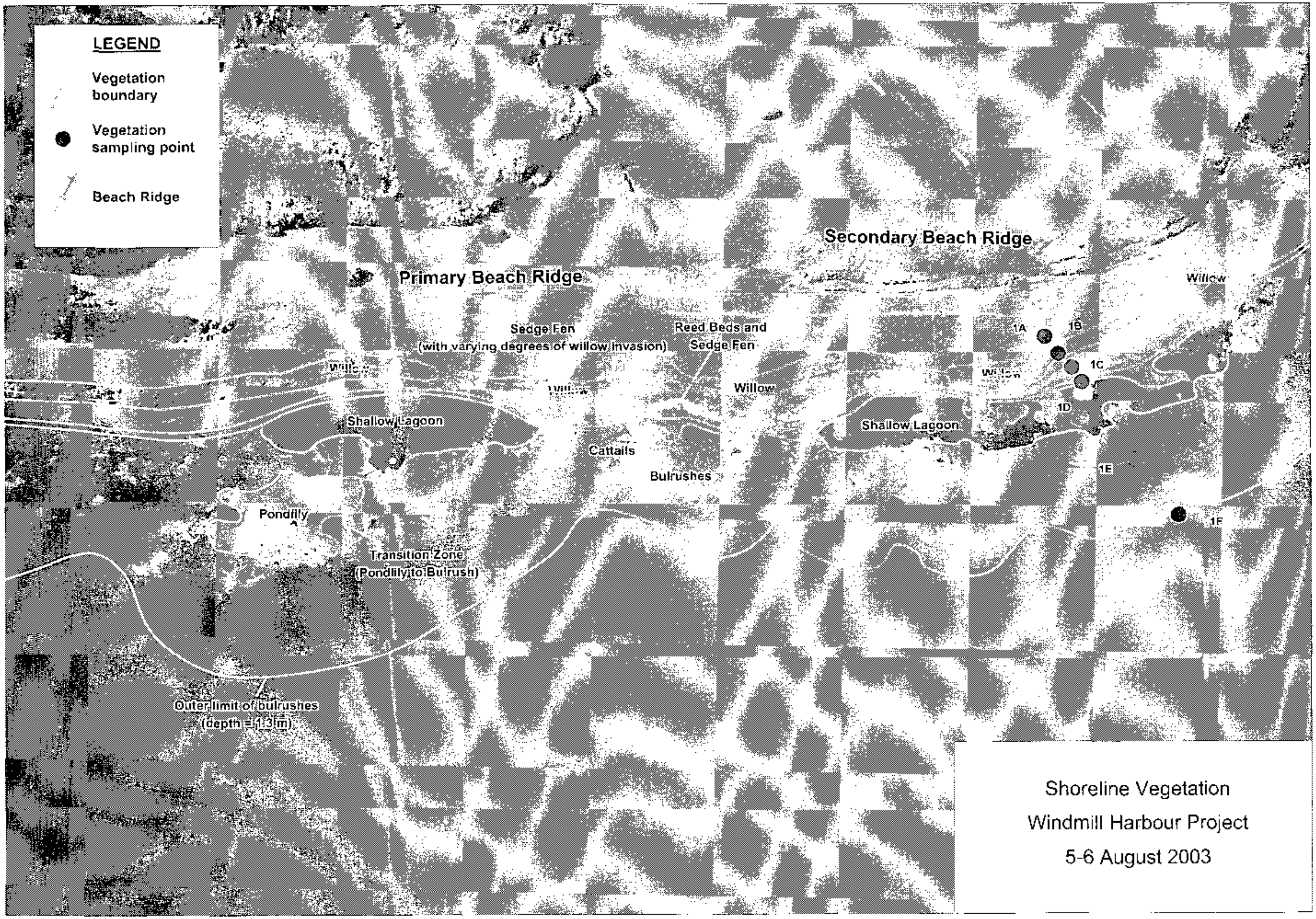
Bulrush Beds. Broad beds of hard-stemmed bulrush *(Scirpus acutus)* extend along the entire shoreline, occupying water ranging in depth from a few cm (at the edge of the cattail beds) to about 1.3 m. The density of the bulrushes decreases with increasing distance from the shore. Some parts of these beds contain dense growth of the submersed aquatics *Utricularia vulgaris* (common bladderwort) and *Ceratophyllum demersum* (hornwort), but in other places few or no rooted plants other than bulrush were present (compare plot 2F with plots 1E and 3E). Bulrush beds are both physically and biologically important, as they break up and slow down waves before they reach the shore; thus they protect shorelines from erosion, as well as provide shelter for wildlife.

Submersed Aquatics. A zone of rooted aquatic vegetation beyond the bulrush beds appears poorly developed in this lake, only *Chara* sp. being present in all three of our samples (plots 1F, 2G, 3F). [While *Chara* is classified as an alga, it is normally listed as a rooted aquatic because it is attached to the substrate]. Patches of *Potamogeton richardsonii* and *P. pectinatus* (clasping-leaf pondweed and sago pondweed) were found, but appeared not to be extensive. Poor light penetration of the water is probably responsible for poor development of a rooted aquatic flora in this lake beyond the bulrush beds.

A series of shallow lagoons along the shore contains a different community of submersed aquatic plants dominated by *Potamogeton filiformis* (thread-leaved pondweed) (see plot 4B). Since the water depth in these lagoons is within the range occupied by bulrush beds, I suspect that they are kept free of bulrushes by the activity of mammals (such as beaver and muskrats).

Pondlily Beds. Extensive beds of yellow pondlilies *(Nuphar variegatum)* are found towards the east end of the site. The water beneath the pondlilies is occupied by dense mats of *Utricularia vulgaris* (common bladderwort) and *Ceratopyllum demersum* (hornwort). Much of this area is free of bulrushes, but there is a (more sheltered) transition zone contains both pondilies and bulrushes in which the colony of western grebes is situated. Whether there is a direct biological connection between the presence of grebes and pondlilies (e. g., substrate enrichment to the benefit of pondlilies, or the use of pondlily parts by grebes for nest construction) is not known to me.


LEGEND
Vegetation boundary
Vegetation sampling point
Beach Ridge
Sedge Fen
(with varying degrees of willow invasion)
2A
2B
Willows
2C
2D
Willows
Willows
Primary Beach Ridge
Cattails
2E
Reed Bed and Sedge Fen
Secondary Beach Ridge
3C
2F
Bulrushes
3D
2G
Pondlily
3E
Transition Zone
(Pondlily to Bulrush)
3F
Outer limit of bulrushes
(depth = 1.3 m)
Shoreline Vegetation
Windmill Harbour Project
5-6 August 2003


LEGEND
Vegetation boundary
Vegetation sampling point
Beach Ridge
Secondary Beach Ridge
Primary Beach Ridge
Willow
Sedge Fen
(with varying degrees of willow invasion)
Reed Beds and
Sedge Fen
1A
1B
1C
1D
1E
1F
Willow
Willow
Shallow Lagoon
Shallow Lagoon
Cattails
Bulrushes
Pondlily
Transition Zone
(Pondlily to Bulrush)
Outer limit of bulrushes
(depth = 1.3 m)
Shoreline Vegetation
Windmill Harbour Project
5-6 August 2003

STAND DESCRIPTION

Vegetation Type: Pondweed Beds Sample No.: 4B Location: Windmill Harbour Date: 5/8/2003
Elevation: Slope: — Aspect: — Quadrat Size: 5.64 m around marker buoy (= 100 m²)
Landform & Topography:
shallow to [illegible] sheltered from [illegible] waves by adjacent [illegible] (depth at buoy c. 2 m)
Drainage Class: none Hygrotope: hydric ([illegible] water)
Soil:
mud (no soil)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil) 100%

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS < 0.5 m high

—

HERBS

Potamogeton filiformis	C5
Potamogeton pusillus	C1
Utricularia vulgaris	C1
Sparganium angustifolium	+
Potamogeton richardsonii	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Pondlily Beds   Sample No.: 40   Location: [illegible] Harbour   Date: 6/8/2005
Elevation: Slope: —   Aspect: —   Quadrat Size: 5.64 m radius circle around marker buoy (= 100 m²)
Landform & Topography:
shallow lagoon sheltered from wind and waves by adjacent bulrush beds (depth at buoy 0.5 m)
Drainage Class: none   Hygrotope: hydric (underwater)
Soil:
lake bed [illegible]

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil) [illegible]

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS < 0.5 m high

—

HERBS

Nuphar variegatum C8
Utricularia vulgaris C7
Ceratophyllum demersum C7

FLOATING AQUATICS

Lemna trisulca +

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

Western Grebe colony site situated roughly in the transition from these pondlily beds to bulrush beds (containing the above plant species in addition to C6 coverage of Scirpus acutus)

STAND DESCRIPTION

Vegetation Type: Submersed Aquatics Sample No.: 3F Location: [illegible] harbour Date: 6/8/2003
Elevation: Slope: — Aspect: — Quadrat Size: 5.64 m circle around marker [illegible] (= 100 m²)
Landform & Topography:
open water close to outer edge of bulrush beds (depth at buoy 1.5 m)
Drainage Class: none Hygrotope: hydric (in di[illegible]ter)
Soil:
lake bed (nonsoil)

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil) 100%

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS < 0.5 m high

—

HERBS

Potamogeton richardsonii C4 ? (quantification unsure due to lack of visibility)
Chara sp. (a macroalgae) C2 ?

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: [illegible] Sample No.: 20 Location: [illegible] Date: 6/9/2003
Elevation: Slope: – Aspect: – Quadrat Size: [illegible]
([illegible] m^2)
Landform & Topography:
[illegible] edge of [illegible] (depth at [illegible] 1.4 [illegible])
Drainage Class: none Hygrotope: [illegible]
Soil: lake bed ([illegible])

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil) 100%

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

–

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

DWARF SHRUBS <0.5 m high

–

HERBS

Chara sp. ([illegible]) C2 ([illegible] of visibility)

MOSSES AND LICHENS

–

EPIPHYTES (common/ frequent/ scarce/ rare) –

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Submersed Aquatics   Sample No.: 1F   Location: [illegible]   Date: 6/8/2003

Elevation: Slope: —   Aspect: —   Quadrat Size: 5.64 m circle around a [illegible] (= 100 m²)

Landform & Topography:
open water close to [illegible] of bulrush beds (depth [illegible] 1.3 m)

Drainage Class: none   Hygrotope: hydric ([illegible])

Soil: [illegible]

Ground cover other than vegetation (e.g. rocks, water ~100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS < 0.5 m high

—

HERBS

Potamogeton richardsonii   C2 ?   ([illegible] unreliable [illegible] lack of visibility)

Potamogeton pectinatus   C2 ?

Chara sp. (a macroalga)   C2 ?

Ceratophyllum demersum

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Bulrush Beds   Sample No.: [illegible]   Location: [illegible] Harbour   Date: 6/8/2002
Elevation: Slope: —   Aspect: –   Quadrat Size: 5.64 m radius around a central buoy (= 100 m²)
Landform & Topography:
shallow water close to shore (depth at buoy c. 1 m)
Drainage Class: none   Hygrotope: hydric (underwater)
Soil:
lake bed (no soil)
Ground cover other than vegetation (e.g. rocks, water 100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, cbh, height, age if cored)

Cover Scale	
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS < 0.5 m high

—

HERBS
Scirpus acutus   C8
Potamogeton richardsonii   +
Nuphar variegatum   + (young plants only)
Myriophyllum sibiricum   +
Potamogeton filiformis   +

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare)

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Bulrush Beds Sample No.: 2F Location: [illegible] Harbour Date: 6/8/2008

Elevation: Slope: Aspect: — Quadrat Size: [illegible] circle around marker buoy [illegible]

Landform & Topography:

[illegible] 0.75 m

Drainage Class: [illegible] Hygrotope: [illegible]

Soil:

[illegible] (no soil)

Ground cover other than vegetation (e.g. rocks, water 100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS < 0.5 m high

HERBS

Scirpus acutus C8

Utricularia vulgaris C7

Ceratophyllum demersum C6

Myriophyllum sibiricum C1

Nuphar variegatum + (young leaves only)

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare)

OTHER COMMENTS

<u>STAND DESCRIPTION</u>

Vegetation Type: B[illegible] Beds   Sample No.: [illegible]   Location: [illegible] Harbour   Date: 6/8/20[illegible]
Elevation: Slope: –   Aspect: –   Quadrat Size: [illegible] (= 100 m²)
Landform & Topography:
[illegible] water close to shore (depth [illegible] 0.7 m)
Drainage Class: none   Hygrotope: hydric ([illegible] water)
Soil: lake [illegible] (no soil)

Ground cover other than vegetation (e.g. rocks, water 100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover Scale	
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

DWARF SHRUBS <0.5 m high

—

HERBS
S. [illegible] acutus   8

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare)   —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Cattail beds | Sample No.: 56 | Location: [illegible] | Date: [illegible]
Elevation: | Slope: | Aspect: — | Quadrat Size: 5 x 20 m
Landform & Topography:
[illegible]

Drainage Class: very poor | Hygrotope: subhydric to hydric
Soil:
not sampled (gleysol to be expected)

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil) – open water C1

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover Scale	
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS < 0.5 m high

—

HERBS

Typha latifolia	C7	Beckmannia syzigachne	+	FLOATING AQUATICS (partly [illegible])	
Glyceria grandis	C6	Calamagrostis [illegible]	+	Lemna [illegible]	+
Sparganium eurycarpum	C1	Sium suave	+	Utricularia vulgaris	+
Eleocharis palustris	C1	Mentha arvensis	+	[illegible] ([illegible])	+
Juncus nodosus	C1	Bidens cernua	+		
Scirpus validus	C1	Galium trifidum	+		

MOSSES AND LICHENS

Drepanocladus aduncus C3

EPIPHYTES (common/ frequent/ scarce/ rare) –

OTHER COMMENTS

Site more extensively flooded earlier in season (as evidenced by stranded floating [illegible])

STAND DESCRIPTION

Vegetation Type: [illegible] Sample No.: 20 Location: [illegible] Date: [illegible]
Elevation: Slope: — Aspect: Quadrat Size: 5 x 20 m
Landform & Topography: lake shore

Drainage Class: [illegible] Hygrotope: subhydric
Soil:
not sampled, [illegible])

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

SHRUBS 0.5 - 5 m high

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

DWARF SHRUBS < 0.5 m high
Salix petiolaris [illegible] + [illegible] to reach maturity [illegible]

HERBS

Typha latifolia	C7	Polygonum amphibium	+
Sparganium eurycarpum	C1	Calamagrostis canadensis	+
Glyceria grandis	C1	Epilobium ciliatum	+
Calamagrostis stricta	C1	Beckmannia syzigachne	+
Mentha arvensis	C1	Senecio congestus	+
Impatiens capensis	+	Galium trifidum	+
[illegible]	+	Ranunculus sceleratus	+
Urtica dioica	+	Bidens cernua	+
Cirsium arvense	+	Rumex maritimus	+
Phalaris arundinacea	+		

FLOATING AQUATICS (stranded)

Lemna turionifera	+
Utricularia vulgaris	+

MOSSES AND LICHENS
Drepanocladus aduncus C4

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS
Site flooded earlier in season (see [illegible] stranded floating plants)

STAND DESCRIPTION

Vegetation Type: [illegible] Sample No.: [illegible] Location: [illegible] Date: [illegible]
Elevation: Slope: — Aspect: — Quadrat Size: [illegible]
Landform & Topography: [illegible] shore

Drainage Class: very poor Hygrotope: [illegible] to hydric
Soil: not sampled (gleyed [illegible])

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

DWARF SHRUBS < 0.5 m high

Salix [illegible] seedlings + [illegible]

HERBS

Typha latifolia	C7
[illegible] palustris	C2
Bidens cernua	C1
Glyceria grandis	C1
Calamagrostis canadensis	C1
Sparganium [illegible]	C1
Calamagrostis stricta	C1
Scirpus validus	C1
Agrostis scabra	+
Cirsium arvense	+
Senecio congestus	+
Impatiens capensis	+
Epilobium ciliatum	+
Galium trifidum	+
Rorippa palustris	+
Juncus nodosus	+
Ranunculus sceleratus	+
Sium suave	+
Mentha arvensis	+
Rumex [illegible]	+
Po[illegible]	+
Ranunculus [illegible]	+

Floating Aquatics (submerged)

[illegible] turionifera	C1
Utricularia vulgaris	+

MOSSES AND LICHENS

Drepanocladus aduncus C7

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

[illegible] in season [illegible]

STAND DESCRIPTION

Vegetation Type: [illegible] Sample No.: 3C Location: [illegible] Date: [illegible]/2003
Elevation: Slope: – Aspect: – Quadrat Size: [illegible]
Landform & Topography: upper shoreline ([illegible] ridge)
Drainage Class: [illegible] Hygrotope: [illegible]gric
Soil: [illegible] ([illegible] or regosol [illegible])
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

–

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

–

DWARF SHRUBS <0.5 m high

–

HERBS

[illegible] arundinacea	C6	[illegible] galericulata	+
[illegible]grostis [illegible]	C2	[illegible]	+
Poa pa[illegible]	C2	[illegible] scabra	+
Polygonum amphibium	C1	[illegible]	+
[illegible] arvensis	C1	Impatiens [illegible]	+
Calamagrostis stricta	C1		

MOSSES AND LICHENS

–

EPIPHYTES (common/ frequent/ scarce/ rare) –

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: [illegible]　　Sample No.: 1C　Location: [illegible]　　Date: [illegible]
Elevation:　　Slope: —　　Aspect: —　　Quadrat Size: 5x10 m
Landform & Topography:
[illegible] (... beach ridge)
Drainage Class: fair　　Hygrotope: [illegible]
Soil:
not sampled (... to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS < 0.5 m high
Rubus idaeus　+

HERBS

Calamagrostis canadensis	C5	Epilobium ciliatum	+
Phalaris arundinacea	C4	Poa palustris	+
Urtica dioica	C1	Cirsium arvense	+
Galeopsis tetrahit	C1	Potentilla norvegica	+
		Senecio [illegible]	+
		Impatiens capensis	+
		Mentha arvensis	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare)　—

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Reed Grass Sample No.: 2D Location: [illegible] Date: 5/[illegible]/2003
Elevation: Slope: — Aspect: — Quadrat Size: 5 x 20 m
Landform & Topography:
slight [illegible]

Drainage Class: [illegible] Hygrotope: hygric
Soil:
not cored (gleysol or regosol to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover Scale	
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

DWARF SHRUBS < 0.5 m high

—

HERBS

Phalaris arundinacea	C7
Carex atherodes	C1
Poa palustris	C1
Cirsium arvense	C1
Mentha arvensis	C1
Urtica dioica	C1
Scutellaria galericulata	+
Impatiens capensis	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Sedge Fen   Sample No.: 26   Location: [illegible]   Date: 5/8/[illegible]
Elevation: Slope: Aspect: Quadrat Size: 5x5 m
Landform & Topography:
[illegible] plain between [illegible] ridges
Drainage Class: moist   Hygrotope: hygric
Soil:
not sampled ([illegible] to be [illegible])
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

DWARF SHRUBS < 0.5 m high

HERBS

Carex atherodes	C1
Phalaris arundinacea	C1
Cirsium arvense	C1
Calamagrostis stricta	+
Senecio [illegible]	+
Mentha arvensis	+
Scutellaria galericulata	+
Urtica dioica	+

MOSSES AND LICHENS

EPIPHYTES (common/ frequent/ scarce/ rare)

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Willow Shrubbery   Sample No.: 36 Location: [illegible] Date: 5/8/2003
Elevation: Slope: --   Aspect: -   Quadrat Size: 5 x 20 m
Landform & Topography:
low beach ridge
Drainage Class: imperfect   Hygrotope: subhygric
Soil: ?

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil).

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

Salix petiolaris	C6
Salix planifolia	C2
Salix discolor	C2

DWARF SHRUBS < 0.5 m high

Rubus idaeus	C2

HERBS

Calamagrostis canadensis	C3
Carex atherodes	C1
Petasites sagittatus	C1
Cirsium arvense	+
Epilobium angustifolium	+
Aster hesperius	+
Polygonum amphibium	+
Poa palustris	+

MOSSES AND LICHENS

none

EPIPHYTES (common/ frequent/ scarce/ rare) --

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Willow Shrubbery Sample No.: 28 Location: [illegible] Harbour Date: 5/8/2003
Elevation: Slope: – Aspect: – Quadrat Size: 5 x 2 m
Landform & Topography: [illegible] ridge
Drainage Class: [illegible] Hygrotope: [illegible]
Soil: ?

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

–

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

Salix petiolaris C8

DWARF SHRUBS < 0.5 m high

Rubus idaeus C1

HERBS

[illegible] dioica	C2	[illegible] arvensis	+
Poa palustris	C2	Calamagrostis [illegible]	+
Poa pratensis	C1	Geum macrophyllum	+
Solidago canadensis	C1	Fragaria virginiana	+
Carex [illegible]	C1	Senecio eremophilus	+
Phalaris arundinacea	C1	Erigeron philadelphicus	+
Stachys palustris	C1	[illegible] arvense	+
		Epilobium angustifolium	+
		Taraxacum officinale	+

MOSSES AND LICHENS

[illegible]

EPIPHYTES (common/ frequent/ scarce/ rare)

OTHER COMMENTS

[illegible] 06709[illegible]
[illegible]

STAND DESCRIPTION

Vegetation Type: [illegible] Sample No.: [illegible] Location: [illegible] Date: 5/8/200[illegible]
Elevation: Slope: – Aspect: – Quadrat Size: 5 × 10 m
Landform & Topography:
[illegible] beach ridge
Drainage Class: imperfect Hygrotope: [illegible]
Soil: ?

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

Salix [illegible]olaris C6
Salix planifolia C3
Salix [illegible]ssima C1
Cornus stolonifera C1
Ribes americanum C1

DWARF SHRUBS < 0.5 m high

HERBS

Calamagrostis canadensis [illegible]
Cirsium arvense [illegible]
Polygonum amphibium [illegible]
Equisetum arvense C1
Impatiens capensis seedlings +
Galeopsis tetrahit +
Aster hesperius +
Geum macrophyllum +
Urtica dioica +
Scutellaria galericulata +
[illegible] arvensis +
[illegible] longifolia +
[illegible] angustifolium +
[illegible] palustris +
[illegible]s sp. ([illegible] or [illegible]) +

MOSSES AND LICHENS

mosses sparse ([illegible])

EPIPHYTES (common/ frequent/ scarce/ rare)

OTHER COMMENTS

[illegible] 0610940 E
5951560 N

STAND DESCRIPTION

Vegetation Type: Sedge Fen   Sample No.: [illegible]   Location: [illegible]   Date: [illegible]
Elevation: Slope: —   Aspect: Quadrat Size: [illegible]
Landform & Topography: Open [illegible] between [illegible] ridges

Drainage Class: [illegible]   Hygrotope: hygric
Soil:
[illegible] exposed)

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

Salix [illegible] C1 [illegible]

HERBS

Carex [illegible]alis C4
Poa palustris C2
Polygonum [illegible] C3
Calamagrostis canadensis C1
Calamagrostis [illegible] 2
Carex [illegible] [illegible]
Poa pratensis C1

Scutellaria galericulata +
[illegible] [illegible]ophyllum +
[illegible] hesperius +
Trifolium [illegible]
[illegible] (Juncus) +

MOSSES AND LICHENS —

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Sedge Fen   Sample No.: 24 Location: [illegible] Harbour   Date: 5/8/03
Elevation: Slope: –   Aspect: –   Quadrat Size: 10x10 m
Landform & Topography:
[illegible] fen between beach ridges
Drainage Class: poor   Hygrotope: [illegible]
Soil:
not sampled (gleysol to be [illegible])
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

DWARF SHRUBS < 0.5 m high

—

HERBS

Carex atherodes	C6	Sium suave	+
Calamagrostis stricta	C4	[illegible] arvense	+
Polygonum [illegible]	C[illegible]	Hordeum jubatum	+
[illegible] [illegible]acea	C1	Poa [illegible]	+
Poa palustris	C1	Stachys palustris	+
Mentha arvensis	C1	Potentilla rivalis	+
Carex praegracilis	C1	Polygonum convolvulus	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare)   —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Sedge Fen Sample No.: 27 Location: [illegible] Harbour Date: 5/[illegible]/83
Elevation: Slope: – Aspect: – Quadrat Size: 10 x 10 m
Landform & Topography:
[illegible] advanced stages
Drainage Class: poor Hygrotope: [illegible]
Soil:
not sampled (gravel to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

–

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

Salix petiolaris	C2
Salix planifolia	+

DWARF SHRUBS < 0.5 m high

Salix [illegible]	+
Ribes americanum	+

HERBS

Carex praegracilis	C5	[illegible] macrophyllum	+
Carex atherodes	C3	[illegible]	+
Poa palustris	C2	[illegible]	+
Polygonum amphibium	C2	[illegible]	+
[illegible]	C1	Stachys palustris	+
Aster hesperius	C1	Petasites sagittatus	+
		Carex tenera	+

MOSSES AND LICHENS

–

EPIPHYTES (common/ frequent/ scarce/ rare) –

OTHER COMMENTS

Appendix C
Draft Conservation Easement and Vegetative Management Plan

SCHEDULE "B"

BYLAW NO. 17-2004

CR1 - Country Residential Direct Control District

(1) Purpose

This district is intended to accommodate the development of an upscale, environmentally sensitive and fully serviced bare-land condominium lake front resort community.

(2) Uses

Land uses in this District shall be as follows:

Permitted Uses

- Single detached dwelling
- Modular home
- Condominium club house
- Condominium caretakers' residence
- Condominium equipment garage and yard
- Condominium boat launch, pier/wharf and accessory parking
- Condominium boat and RV storage
- Nature conservation
- Private park, playground and open space including trail
- Utility building and operation
- Geothermal/wind/solar energy installations

Discretionary Uses

- Accessory building or use
- Condominium convenience store
- Condominium food and beverage service
- Home based business (minor)
- Public use

Replaced April 2007

(3) Development Standards

(a) The following standards shall apply:

Minimum lot area	743 m2 (7,998 ft2)
Minimum lot frontage	16.8 m (55 ft), or 9 m (29.5 ft) in cul-de-sac
Minimum lot width	13.716 m (45 ft)
Minimum lot depth	41.148 m (135.0 ft)
Minimum front yard setback	7.5 m (24.6 ft)
Minimum side yard setback	1.5 m (4.92 ft) for principal building, 7.5 m (24.6 ft) for accessory building
Minimum rear yard setback	15 m (49.2 ft) for principal building, 7.5 m (24.6 ft) for accessory building
Maximum developed area of a lot	40%
Minimum dwelling floor area not including deck, porch, attached garage, etc.	111 m2 (1,195 ft2)
Maximum dwelling floor area not including deck, porch, attached garage, etc.	465 m2 (5,005 ft2)
Maximum dwelling height in the front row of lots from the lake	7.5 m (24.6 ft)
Maximum dwelling height in the second row of lots from the lake	9 m (29.5 ft)

(b) No habitable floor or mechanical/utility room of any building shall be located below 724.1m geodetic in elevation, unless adequate water proofing in compliance with good engineering practice is provided.

(c) Access to each lot shall be in accordance with Development Authority standards.

(4) Dwelling Density

(a) A maximum of one single detached dwelling, modular home or manufactured home may be located on a lot.

(b) Temporary guest RV may be permitted as regulated by the condominium association.

(5) Parking and Storage

(a) Each lot shall accommodate the parking of two passenger vehicles on-site.
(b) The storage of RV and/or boat on a lot other than the condominium RV and boat storage yard may be permitted, provided that the RV and/or boat belong to the lot owner and as regulated by the condominium association.

(6) Landscaping and Nature Conservation (excluding habitat management area)

(a) Each lot and undeveloped common land shall be landscaped with proper vegetation and tree retention for appearance and drainage purposes.
(b) Fence shall not exceed 1.8 m (5.9 ft) in height, unless for security reason a higher fence is necessary. No fence shall be located in the front yard of a lot. Only chain link fence (without inserts) shall be allowed; however, the condominium association may consider exceptional circumstance and specifically permit the installation of a fence of different construction, design and/or location.
(c) Land designated as conservation area shall not be developed except for nature conservation, passive open space recreation, natural and storm water drainage, access to the lake, and geothermal/wind/solar energy installations.

(7) Utilities and Drainage

(a) Water supply and sanitary sewage disposal systems shall be provided to all lots and shall be operated by the condominium association in compliance with Provincial and County standards.
(b) Where appropriate, surface storm water shall be retained, managed and released in accordance with Alberta Environment guidelines. The neighbouring land shall not be adversely affected by surface drainage from development in this district.

(8) Character and Appearance of Development

The condominium association may impose additional development and architectural guidelines, which shall be consistent with the provisions of this district.

(9) Delegation of Development Authority

(a) Lac Ste. Anne Council delegates approving authority for all residential development and uses related to a residential development as described in Subsection (2) above to the Development Officer. All other development and uses shall be determined by the Municipal Planning Commission.

(b) Development permits and stop orders are subject to the Subdivision and Development Appeal Board.

SCHEDULE "C"

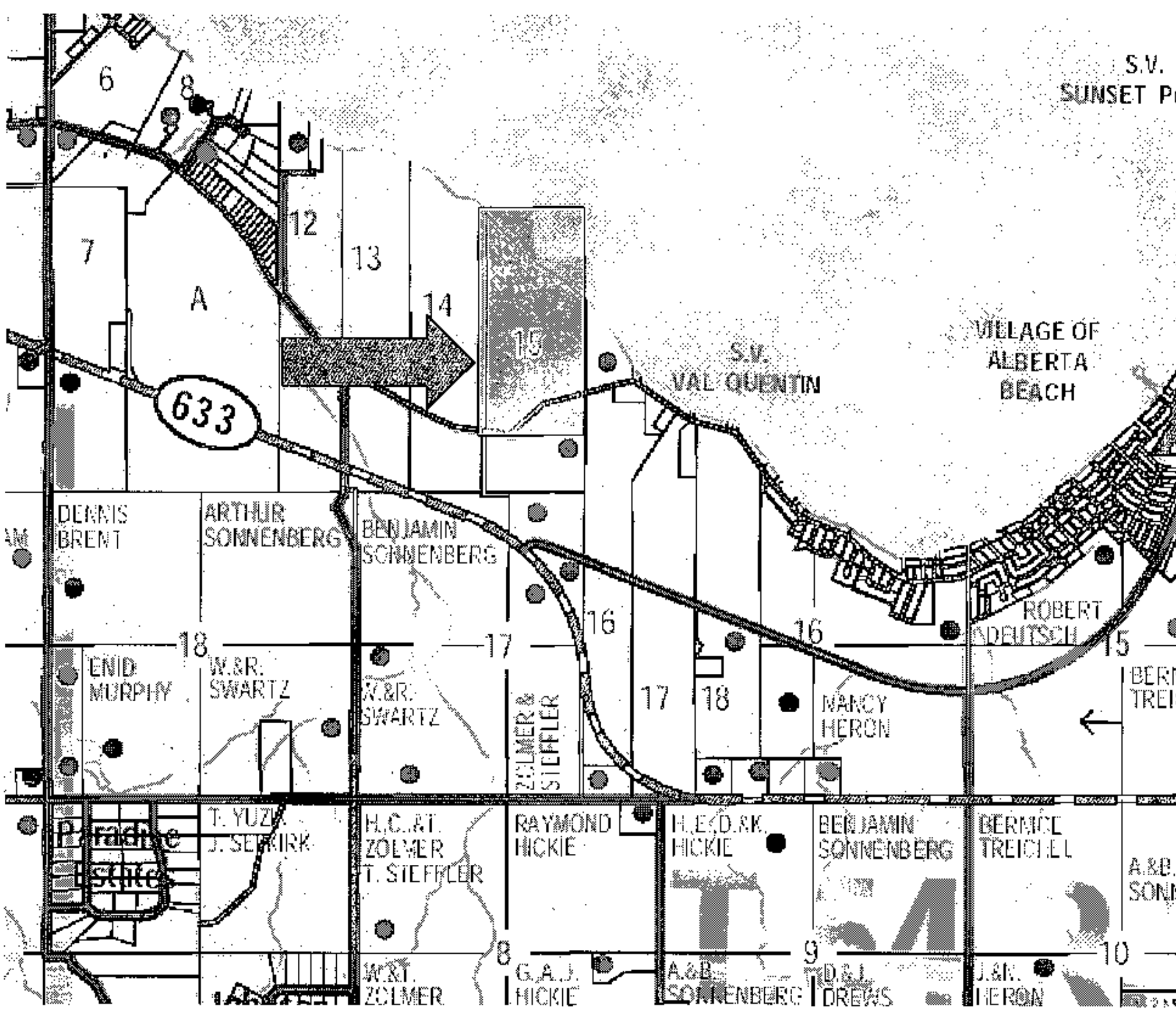
BYLAW NO. 17-2004

CR1 - Country Residential Direct Control District

The area subject to this Bylaw is as described below as that portion of River Lot 15, which lies north of Lakeshore Road in the area, known as Lac Ste. Anne Settlement.

That portion of River Lot 15 that is subject to former Area Structure Plan No. 06-2001 is amended to a land use schedule in accordance with attached Schedule "A" as described under this Bylaw.

That remainder of the Plan Area of River Lot 15 north of Lakeshore Road shall be amended from Agricultural "B" District to Country Residential Direct Control District "CR1".



SCHEDULE "B"

BYLAW NO. 17-2004

CR1 - Country Residential Direct Control District

(1) Purpose

This district is intended to accommodate the development of an upscale, environmentally sensitive and fully serviced bare-land condominium lake front resort community.

(2) Uses

Land uses in this District shall be as follows:

Permitted Uses

- Single detached dwelling
- Modular home
- Condominium club house
- Condominium caretakers' residence
- Condominium equipment garage and yard
- Condominium boat launch, pier/wharf and accessory parking
- Condominium boat and RV storage
- Nature conservation
- Private park, playground and open space including trail
- Utility building and operation
- Geothermal/wind/solar energy installations

Discretionary Uses

- Accessory building or use
- Condominium convenience store
- Condominium food and beverage service
- Home based business (minor)
- Public use

(3) Development Standards

(a) The following standards shall apply:

Minimum lot area	553 m2 (5,737 ft2)
Minimum lot frontage	15.25 m (50 ft) or 9.0 m (29.5 ft in cul-de-sac)
Minimum lot depth	35 m (114.8 ft) or 32 m (105 ft) in cul-de-sac)
Minimum front yard setback	7.5 m (24.6 ft)
Minimum side yard setback	1.5 m (4.92 ft) for principal building, 7.5 m (24.6 ft) for accessory building
Minimum rear yard setback Principal Building	12 m (39.4 ft) on channel and lake lots or, 7.5 m (24.6 ft) on inland lots
Minimum rear yard setback Accessory Building	7.5 m (24.6 ft) on channel and lake lots or, 0.5 m (1.6 ft) on inland lots
Maximum developed area of a lot	40%
Minimum dwelling floor area not including deck, porch, attached garage, etc.	111 m2 (1,195 ft2)
Maximum dwelling floor area not including deck, porch, attached garage, etc.	465 m2 (5,005 ft2)
Maximum dwelling height in the front row of lots from the lake	7.5 m (24.6 ft)
Maximum dwelling height in the second row of lots from the lake	9 m (29.5 ft)

(b) No habitable floor or mechanical/utility room of any building shall be located below 724 m geodetic in elevation, unless adequate water proofing in compliance with good engineering practice is provided.

(c) Access to each lot shall be in accordance with Development Authority standards.

(4) Dwelling Density

(a) A maximum of one single detached dwelling, modular home or manufactured home may be located on a lot.

(b) Temporary guest RV may be permitted as regulated by the condominium association.

W. [illegible]

Regular Council Item – Redistricting, Public Hearings & Bylaws

Subject: Bylaw #17-2004, 03REDST2004
Location: River Lot 15 within 20-54-03-W5M
Division: 5
MPC Date: April 18th, 2007
Roll #: 5403515002

Applicant Name: Windmill Harbour Development
Owners Name: Windmill Harbour Development
Subdivision No: 019SUB2005
Purpose of Application:

SCHEDULE "A"
BYLAW NO. 10-2005
Section 86 Country Residential Direct Control District – Schedule G – Windmill Estates
That Sub-Section (3)(a) be amended as follows:

Lot Area	553 m2 (5,737 ft2)
Lot Frontage	15.25 m (50 ft) or 9.0 m (29.5 ft in cul-de-sac)
Lot Depth	35 m (114.8 ft) or 32 m (105 ft) in cul-de-sac)
Principal Bldg Rear Yard	12 m (39.4 ft) on channel and lake lots or, 7.5 m (24.6 ft) on inland lots
Accessory Bldg. Rear Yard	7.5 m (24.6 ft) on channel and lake lots or, 0.5 m (1.6 ft) on inland lots

SCHEDULE "B"
BYLAW NO. 17-2004
CR1 - Country Residential Direct Control District

Minimum lot area	743 m2 (7,998 ft2)
Minimum lot frontage	16.8 m (55 ft), or 9 m (29.5 ft) in cul-de-sac
Minimum lot depth	45 m (147.6 ft)
Minimum rear yard setback	15 m (49.2 ft) for principal building, 7.5 m (24.6 ft) for accessory building

Recommendation:

That Schedule B of Bylaw #17-2004 be amended to reflect changes as approved through LUB 10-98 amendment (Bylaw 10-2005).

LAC STE. ANNE COUNTY

PROVINCE OF ALBERTA

BY-LAW 7-2001

A BY-LAW TO CONTROL LAND USE.

WHEREAS, under the provisions of the Municipal Government Act, being Chapter M-26.1, Sections 633 and 692(1) of the Statutes of Alberta 1994, a municipality may adopt an Area Structure Plan

AND WHEREAS the Council of Lac Ste. Anne County determined it necessary to adopt the "*Windmill Estates On Lac Ste. Anne*" Area Structure Plan to allow for bare-land country residential development on a portion of River Lot 14 and 15, Lac Ste. Anne Settlement.

NOW THEREFORE the Council duly assembled hereby enacts as follows:

1. The Lac Ste. Anne County Land Use By-law 7-2001 is hereby adopted in accordance with attached Schedule "A"
2. That this By-law comes into full force and effect upon third and final reading.

First Reading carried the 8th day of March, A.D. 2001.

Reeve

(SEAL)

Municipal Administrator

Read a second time this 29th day of March, A.D. 2001.

Reeve

(SEAL)

Municipal Administrator

Read a third and final time this 29th day of March, A.D. 2001.

Reeve

(SEAL)

Municipal Administrator

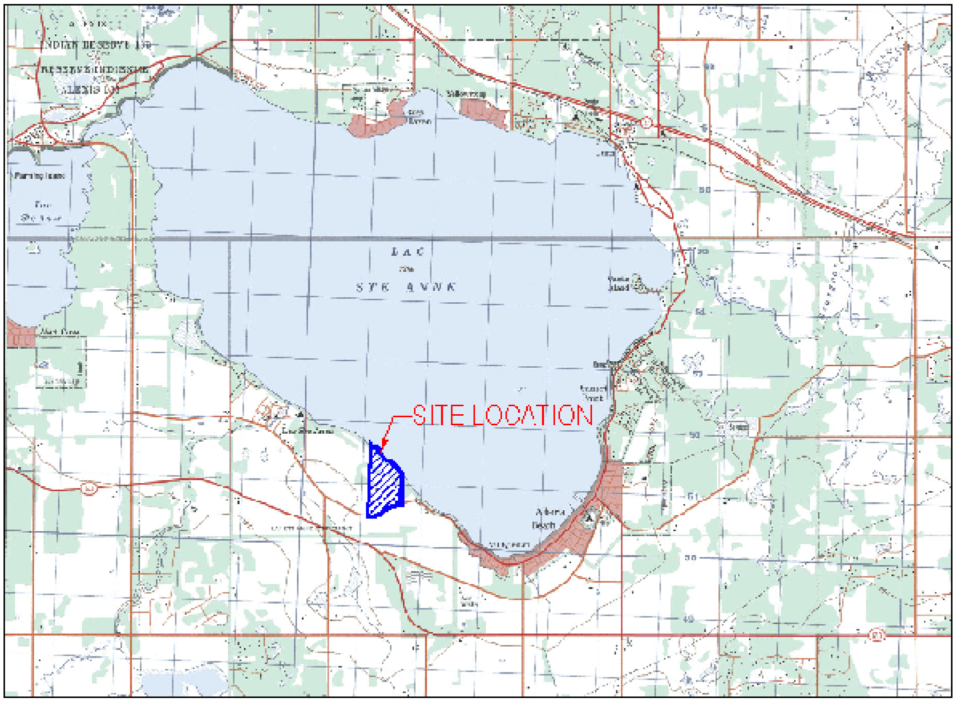
SCHEDULE "A"
BYLAW NO. 7- 2001

WINDMILL ESTATES ON LAC STE. ANNE AREA STRUCTURE PLAN

1. Application and Property Location

The area structure plan (ASP) applies to the remainder of River Lot 15 (north of Lac Ste. Anne Trail) of Section 20, Township 54, Range 3, W5M. The subject property is located on the southwest shore of Lake Lac Ste. Anne in Lac Ste. Anne County and consists of approximately 42.5 ha (103 acres) of land with approximately 700 m (2,300 ft.) of shoreline.

The plan is prepared to facilitate the development of an attractive and environmentally sensitive lakefront harbour/marina resort community in the County.



2. Purpose of Area Structure Plan

The area structure plan is prepared to guide future development of the subject property in an orderly manner. The ASP contains provisions on environmental protection, land uses, roadways, utilities, phasing and standards of development. Future land use redistricting, subdivision and development permit decisions should be based on this plan.

The land use and harbour components of this plan are designed by Jaymar Consulting Inc. Engineering components are provided by GPEC Consulting Ltd.

3. Compliance with Applicable Legislation

The area structure plan is prepared in accordance with Section 633 of the Municipal Government Act. The ASP complies with the County's Municipal Development Plan Bylaw 11-98 policies 3.4 and 3.12 on country residential and lake areas. The ASP also complies with the County's lake management guidelines for Lake Lac Ste. Anne, which requires a development setback of 200 feet from the lake shore.

The subject property was recently zoned in 2003 to a Country Residential Direct Control (CR-1) designation for Country Residential uses. The proposed bareland condominium area will require rezoning to a direct control district under the County's Land Use Bylaw. The new district will contain more site specific regulations to control the bareland condominium development. In addition, the proposed bareland condominium development will comply with the Alberta Condominium Property Act.

Any proposed lakeshore development will comply with applicable Provincial, Federal and County legislation and policies.

4. Physical and Environmental Features

4.1 Topography

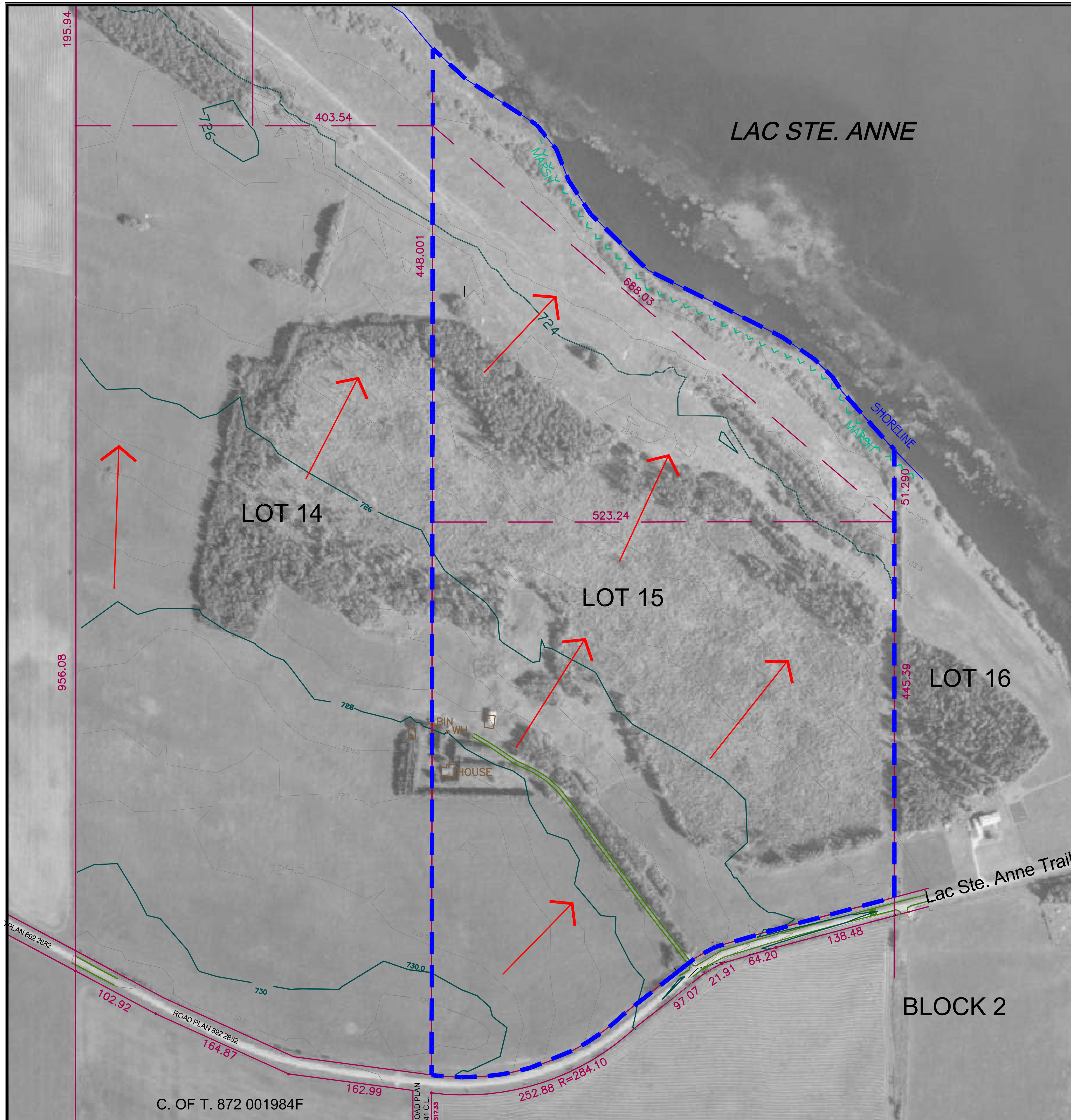
The plan area is level to gently sloping from southwest to northeast. The above sea level elevations range from 730 m to 722.89 m, which is the normal water level of Lake Lac Ste. Anne.

4.2 Soils

According to Alberta Soil Survey Report No. 24 for the Buck Lake and Wabamun Lake Areas, the subject property and surrounding areas have Podzolic soils, which were developed under forest and/or heath vegetation. The soils of Uncas series, a sub-component of the Dark Gray Wooded soils category of the Podzolic soils, are present on the subject properties. The Uncas soils are moderately well drained and can be considered as fairly good arable land. However, stones are found throughout the soil profile.

4.3 Flood Plain and Lake Shore

The 1:100 year flood plain elevation of Lake Lac Ste. Anne has been determined by Alberta Environment at 723.79 m geodetic, on the basis of the 1974 flood. The Lake is the only water body on/near the subject property. Alberta Environment has advised GPEC that future homes should be located above the 1:100 year flood plain elevation. However for added safety all homes will be located above the 724.10 m elevation.



WINDMILL ESTATES LTD.

WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 2

THE PLAN AREA

LEGEND

- AREA STRUCTURE PLAN BOUNDARY
- EXISTING GROUND CONTOUR
- DIRECTION OF SURFACE DRAINAGE FLOW

SCALE 1:5000

APRIL 7, 2004

gpec consulting ltd.

Although the ASP identifies the lake shore, a precise shoreline delineation may be made by the Public Lands Branch of Alberta Agricultural, Food and Rural Development.

4.4 Tree Cover

Approximately one-half of the subject property is covered by trees and brush. The predominant tree species are spruce, black poplar and aspen. Some of the spruce has been harvested by the previous landowner.

A heavily treed area is present on the neighbouring land immediately to the east. Additional tree cover is located on the neighbouring land to the west of the subject property.

4.5 Fish and Wildlife

Because the proposed Windmill Harbour project is located adjacent to the shoreline of Lake Lac Ste. Anne in a partially treed area it will likely affect the environment and as such has been reviewed by federal and provincial authorities in accordance with the Canadian Environmental Assessment Act. Mainstream Aquatics Ltd. have prepared an environmental impact assessment (EIA) of the project and have received conditional environmental approval. The report entitled “Revised Environmental Assessments-Windmill Harbour Development” dated September 2003 is attached as Appendix B. The Department of Fisheries and Oceans has issued a letter acknowledging their current envolvement and interest to issue “Fisheries Act” authorization for this project and it is included in Appendix “B”.

According to the EIA Report and the DFO authorization, although a number of adverse affects may be caused by the proposed development, mitigation and compensation measures can be implemented to eliminate or reduce all of them to an acceptable level. All the recommended mitigation and compensation measures, will be incorporated into the final design and development of Windmill Harbour.

5. Existing Land Uses, Roadways and Utilities

5.1 Land Uses

At present, the cleared areas of the subject property are used for agricultural purposes. Barley and alfalfa crops have been the predominant species planted on this land. The treed and brush-covered areas are not farmed. The existing farm house and barn may be renovated for residential or recreational use by the Condominium.

Agricultural uses are present in the immediate surrounding areas to the east, south and west. Cottage development has occurred a short distance to the east on Lac Ste. Anne Trail along the south shore of Lake Lac Ste. Anne.

5.2 Roadways

The subject property is accessible from the County's Lac Ste. Anne Trail. There is no other public roadway in the vicinity.

5.3 Utilities

A natural gas line is located on the subject property. It supplies gas to the old farm house to the west and to the neighbouring parcels. Electricity and telephone services are also provided to the subject property.

Residents in the general area depend on ground water wells for domestic uses, and on individual private systems for sewage disposal. AMEC Earth & Environmental Limited have prepared a groundwater potential study which indicates that long term safe groundwater yields can be expected in the area and that an additional 156 lot subdivision (previous plan) should be serviceable without impacting existing users. Additional groundwater testing will be undertaken at the subdivision stage.

6. The Bareland Condominium Development Plan

A bareland condominium development is planned for the subject property. The bareland condominium plan contains the following guidelines:

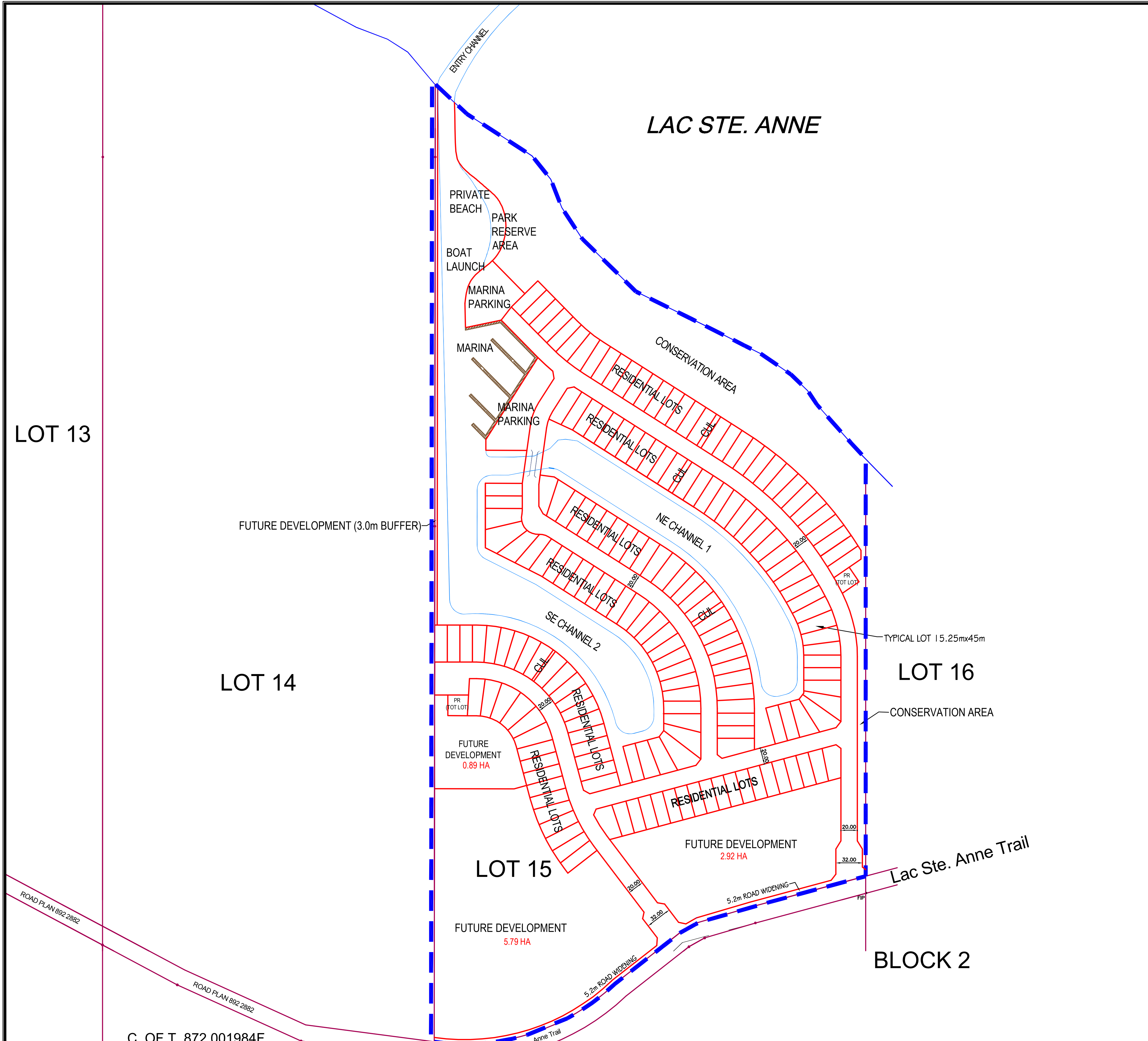
6.1 The Planning Objective

The plan is to develop an upscale, environmentally sensitive and fully serviced bareland condominium inland harbour recreational resort community in the County.

6.2 Environmental Conservation

A large lakefront conservation area including the 1:100 year floodplain is set aside to provide a natural buffer between the development and the lake. The conservation area will be protected jointly by the County and the Condominium Association.

The primary purpose of the conservation area will be to minimize disturbance to the natural environment by restricting public access. The conservation area will include a fenced exclusion zone adjacent to a well known western grebe colony, walking trails, resting areas and a nature appreciation/viewing area. Trees in this area will be protected but will be subject to partial removal, replacement and pruning to maintain lake views. The conservation area will also be extended along the east perimeter of the property to Lac Ste. Anne Trail. This area will be maintained in its natural state or enhanced with vegetation plantings. A 3.0 m wide buffer designated for future development will be provided between the inland harbour and the western property boundary of Lot 15 to maintain control over access from Lot 14. A copy of the draft Conservation Easement document and Vegetative Management Plan are included in Appendix C.



WINDMILL ESTATES LTD.

WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 3

THE DEVELOPMENT PLAN

STATISTICAL PROFILE

LAND USE SUMMARY	AREA
RESIDENTIAL AND DWELLING LOTS	12.99 HA
ROADS AND ROAD WIDENINGS	4.96 HA
COMMON UTILITY LOT (CUL)	0.09 HA
PARK RESERVE (TOT LOT AND BEACH AREA)	0.28 HA
CONSERVATION AREA	4.57 HA
MARINA PARKING AND HARBOUR	9.81 HA
FUTURE DEVELOPMENT	9.80 HA
TOTAL AREA	42.50 HA

LEGEND

AREA STRUCTURE PLAN BOUNDARY

NOTE:
ALL DIMENSION AND AREAS ARE APPROXIMATE AND ARE TO BE CONFIRMED BY PLAN OF SURVEY.

HARBOUR CONCEPT BY : JAYMAR CONSULTING INC.

SCALE 1:5000 APRIL 21, 2004

consulting ltd.

Dwelling lots will be set back from the Lake at least 60 m (200 ft) and up to 90 m (300 ft.).

All dwellings will be above 724.1 m in elevation, which is 0.31 m higher than the 723.79 m 1:100 year flood elevation of Lake Lac Ste. Anne. The recorded average annual lake level is at 722.89 m.

Materials excavated from the man-made harbour channels will be used to build up residential lots to 724m elevation or higher.

Section 49 - Environmental Standards of the Land Use By Law will be complied with during the subdivision and construction phases of the development.

6.3 Land Uses and Amenities

Approximately 182 dwelling lots are included in the plan. The average lot size will be 15 m x 45 m (50 ft. by 148 ft.), although the actual lot widths and depths may vary.

Section 70 - Subdivision Standards of the Land Use By Law will be applicable to this development.

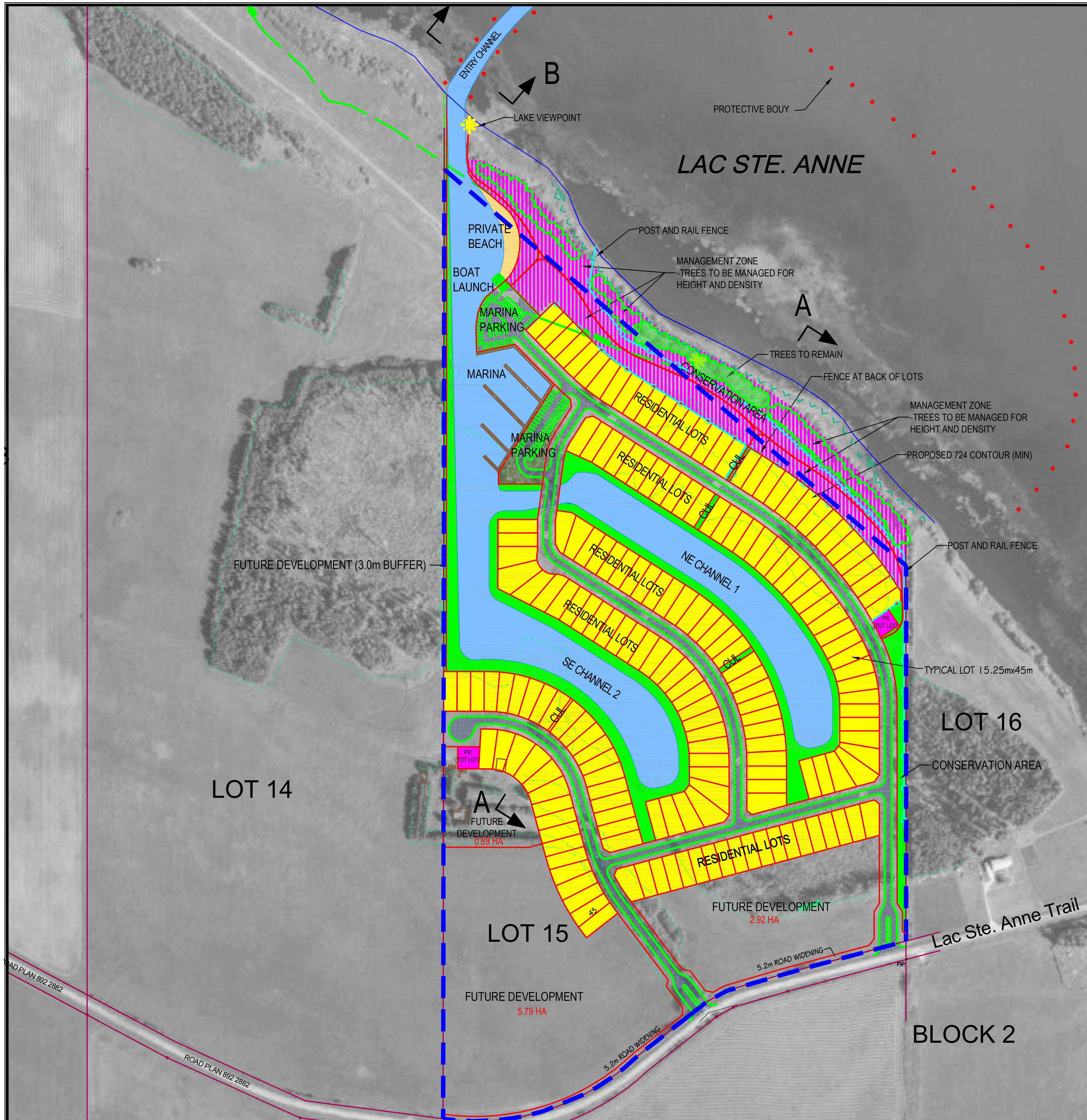
All dwellings will be stick-built or modular homes and subject to architectural control guidelines. Double and single wide manufactured homes may be considered, if they could be grouped in a suitable area. Manufactured homes will not be mixed with other homes.

Assuming an average household size at 3.1 persons per dwelling unit, the development may result in a maximum population of 564 people. However, due to the nature of this development, the actual population will fluctuate seasonally. Permanent population residing in this development will be significantly less than the projected maximum.

Two small tot lots are also proposed to facilitate playground equipment for the smaller children. One lot is proposed at the north east end of the site adjacent to the last lot on the north side of the road and the other is proposed at the south west corner next to the road turnaround in the last stage.

Approximately 12.5 ha of land will be designated as conservation area to protect the environment and promote lower impact recreational activities such as bird viewing, walking/jogging and cross country skiing.

A small private beach area for condominium residents will be developed within the inland harbour next to the conservation area. The inland harbour would consist of a marina, a main channel and two side channels (see Figure 4). The harbour would be private, and would be signed accordingly, thereby restricting access to owners



WINDMILL ESTATES LTD.

WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 4

HARBOUR CONCEPT PLAN

LEGEND

AREA STRUCTURE PLAN BOUNDARY

NOTE:
ALL DIMENSION AND AREAS ARE APPROXIMATE AND ARE TO BE CONFIRMED BY PLAN OF SURVEY.

HARBOUR CONCEPT BY : JAYMAR CONSULTING INC.

SCALE 1:5000 APRIL 21, 2004

gpec consulting ltd.

and guests. The marina would be used to moor larger vessels such as sail boats, while the side channels would provide passage for smaller vessels to boat slips adjacent to each residential lot. A boat launch would be located at the south end of the main channel next to the marina and the beach area.

To accommodate large vessels the minimum water depth in the marina and main channel would need to be 2.5 m below minimum lake level, which is 722.0 m. Water depths in the side channels would be reduced to approximately 1.5 m below minimum lake level to facilitate passage of smaller water craft and still provide sufficient water depth for sediment settling purposes.

The harbour banks would be constructed at a slope of 5:1 from the bottom up to the minimum lake water elevation (722.0 m) and at slope of 7:1 from the low water elevation to the maximum recorded water level elevation (723.8 m) as indicated on Figure 5. The harbour shorelines would be protected from erosion by placing a layer of clean gravel and sand over geotextile fabric or by other appropriate means of erosion protection.

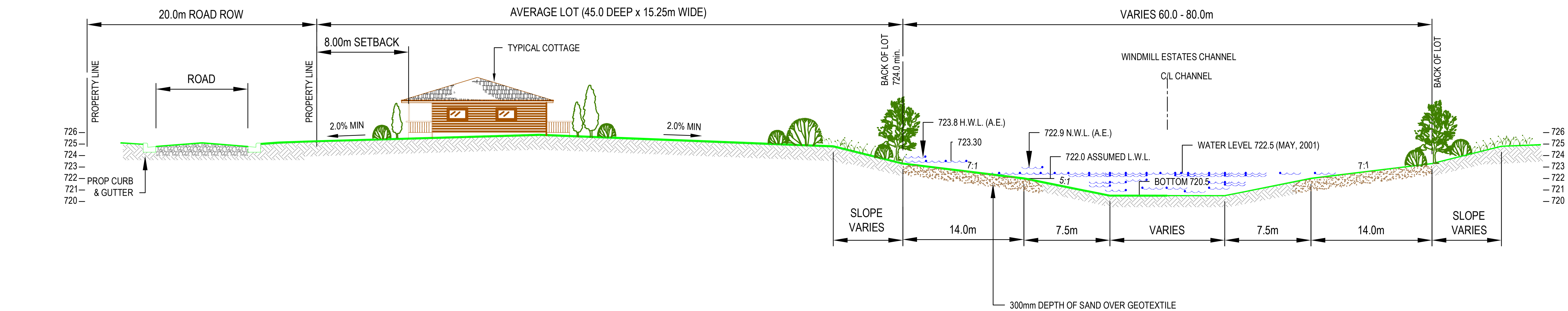
An access channel would need to be dredged from the shoreline to a minimum water depth of 2.5 m to facilitate boat access. The channel would be situated at the extreme western edge of the property to take advantage of the lake bed slope at this location. It is estimated that the channel would be approximately 0.98 ha in size and would extend 490 m into the open water. The channel would have a width of 20 m along its entire length, and would be clearly marked with buoys that would be removed during the off-season. The channel sideslope would be 3:1 and the excavated lake bed material would be removed and disposed of on lots during winter or as otherwise approved by Alberta Environment.

The lake front, harbour and related developments will be subject to approvals of the Provincial and Federal Government authorities having jurisdiction and Lac Ste. Anne County. Architectural guidelines may be included in the next land use district and/or condominium bylaw for the property.

In accordance with County policy 0.40 ha (1.0 acre) of municipal reserve will be deferred to the future development areas. The condominium association will be responsible to develop its internal park systems as identified on the Development Plan. The harbour and water channels including the buffer area between the back of the lots and water edge, are considered common property and will also be available for recreation use even though they are not designated as park reserve.

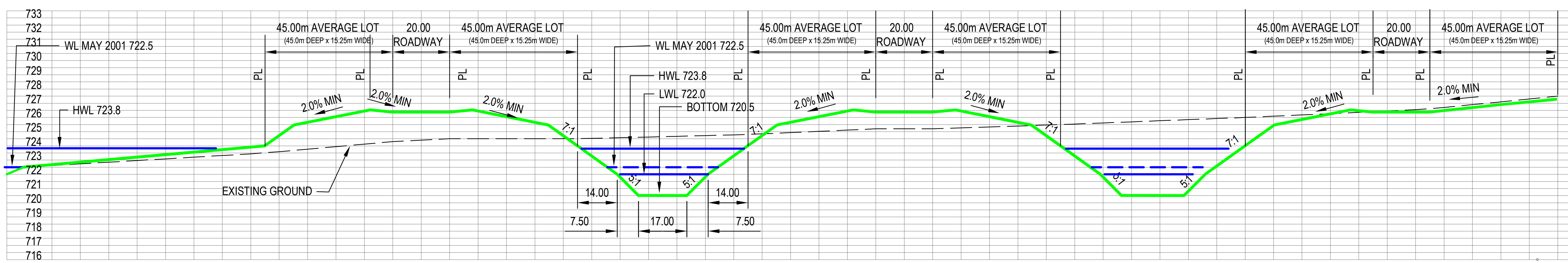
6.4 Roadways

The condominium access and internal road right-of-ways will be 20 m (66 ft.) wide with the exception of the south 50 m connecting onto Lac Ste. Anne Trail which will be widened to 30 m (100 ft) to facilitate a center median and entry feature as indicated on Figure 6.

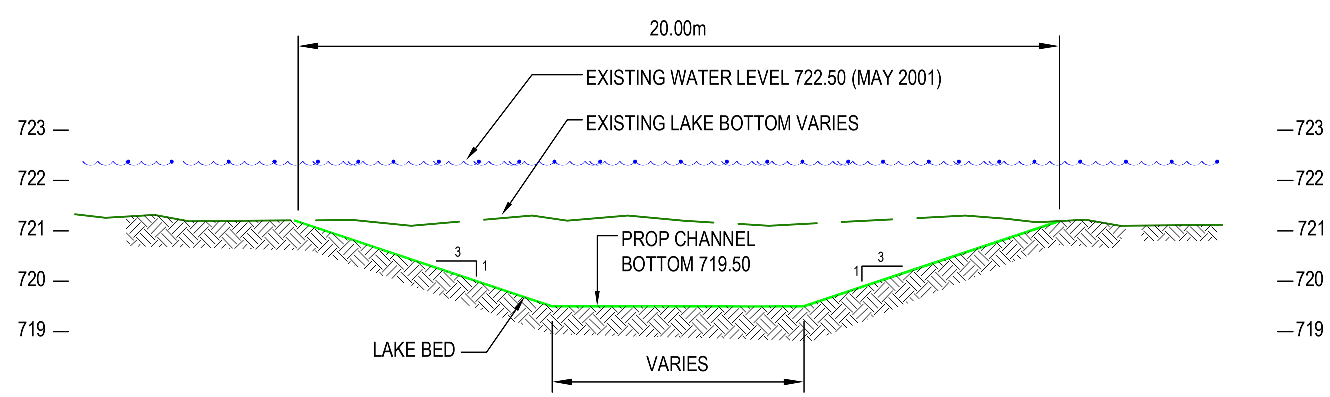


TYPICAL SIDE CHANNEL SECTION

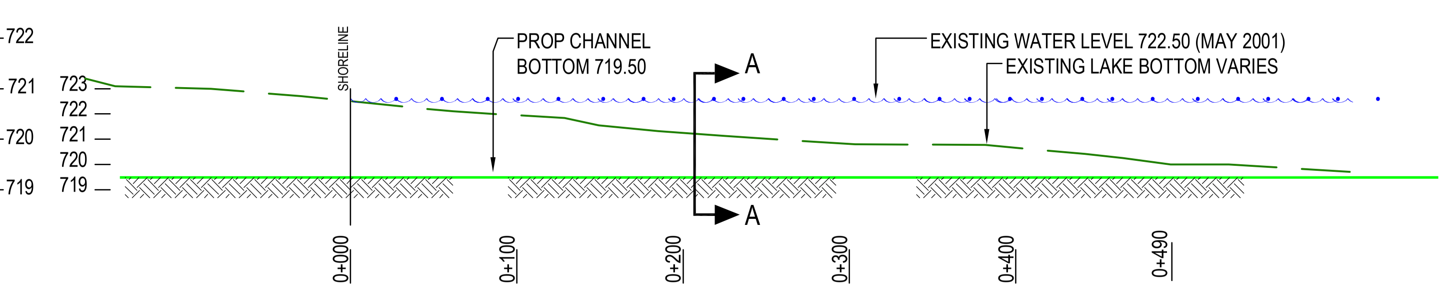
NTS



SECTION 'A-A'



ENTRY CHANNEL CROSS SECTION 'B'



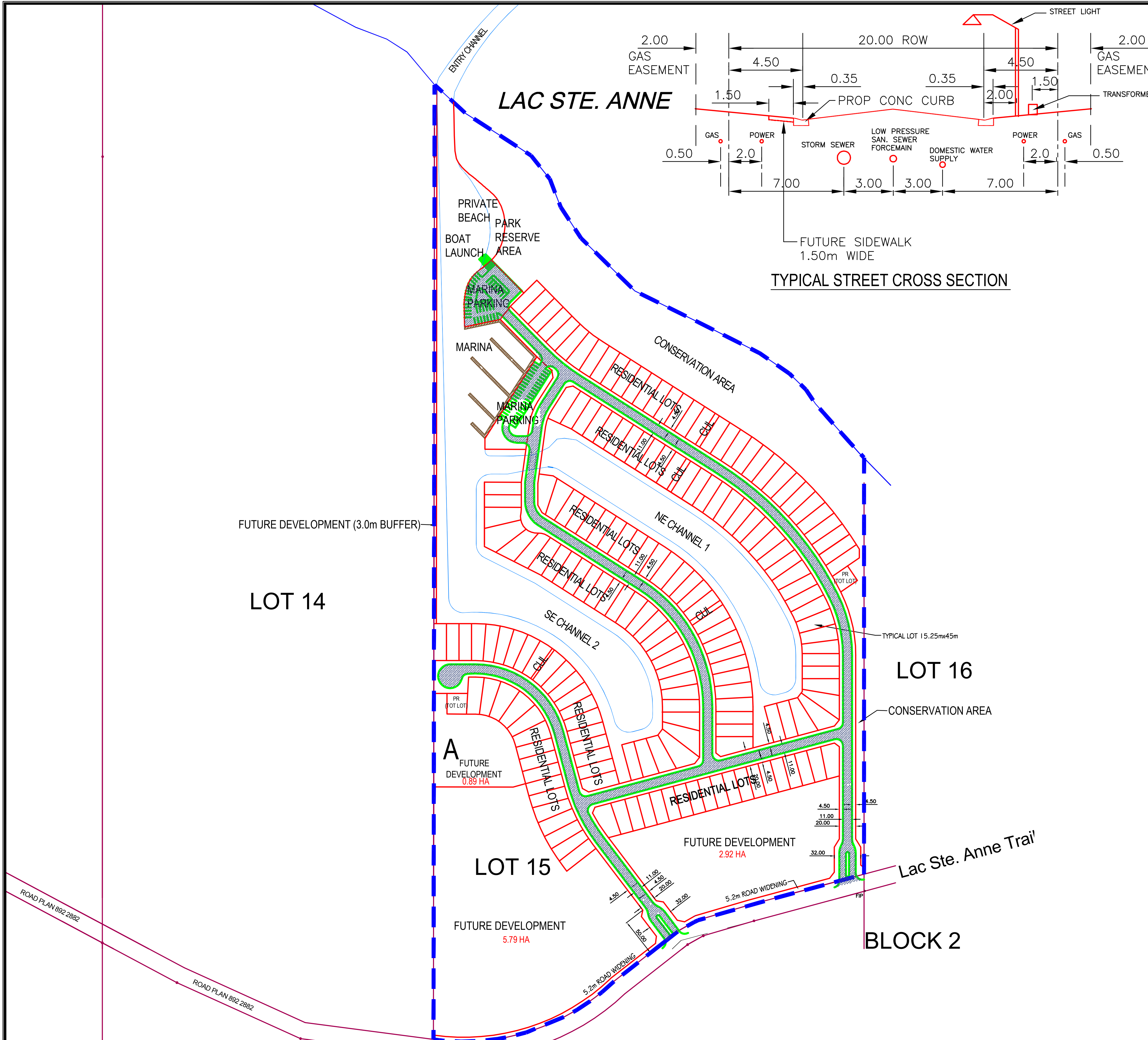
ENTRY CHANNEL SECTION

FIGURE 5

TYPICAL CROSS SECTIONS

APRIL 7, 2004

gpec consulting ltd.



WINDMILL ESTATES LTD.

WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 6

TRANSPORTATION PLAN

LEGEND

- AREA STRUCTURE PLAN BOUNDARY
- PROPOSED 11.0m PAVED ROADWAY

HARBOUR CONCEPT BY : JAYMAR CONSULTING INC.

SCALE 1:5000 APRIL 21, 2004

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Within the condominium area, an internal looped roadway system complete with a two-lane bridge will provide access to the marina, boat launch and beach area.

All roadways will be constructed to an 11.0m wide paved urban standard complete with concrete curbs and gutters. Although separate walks are not proposed at this time an alignment has been dedicated which will facilitate a 1.5m wide walkway in the future, if deemed necessary. Approximately 40 parking stalls will be provided at the marina along with an additional 30 stalls at the boat launch to service this portion of the harbour. This is considered ample parking since most of the residents are expected to walk from their houses to the marina.

Street lighting will be provided.

6.5 Utilities

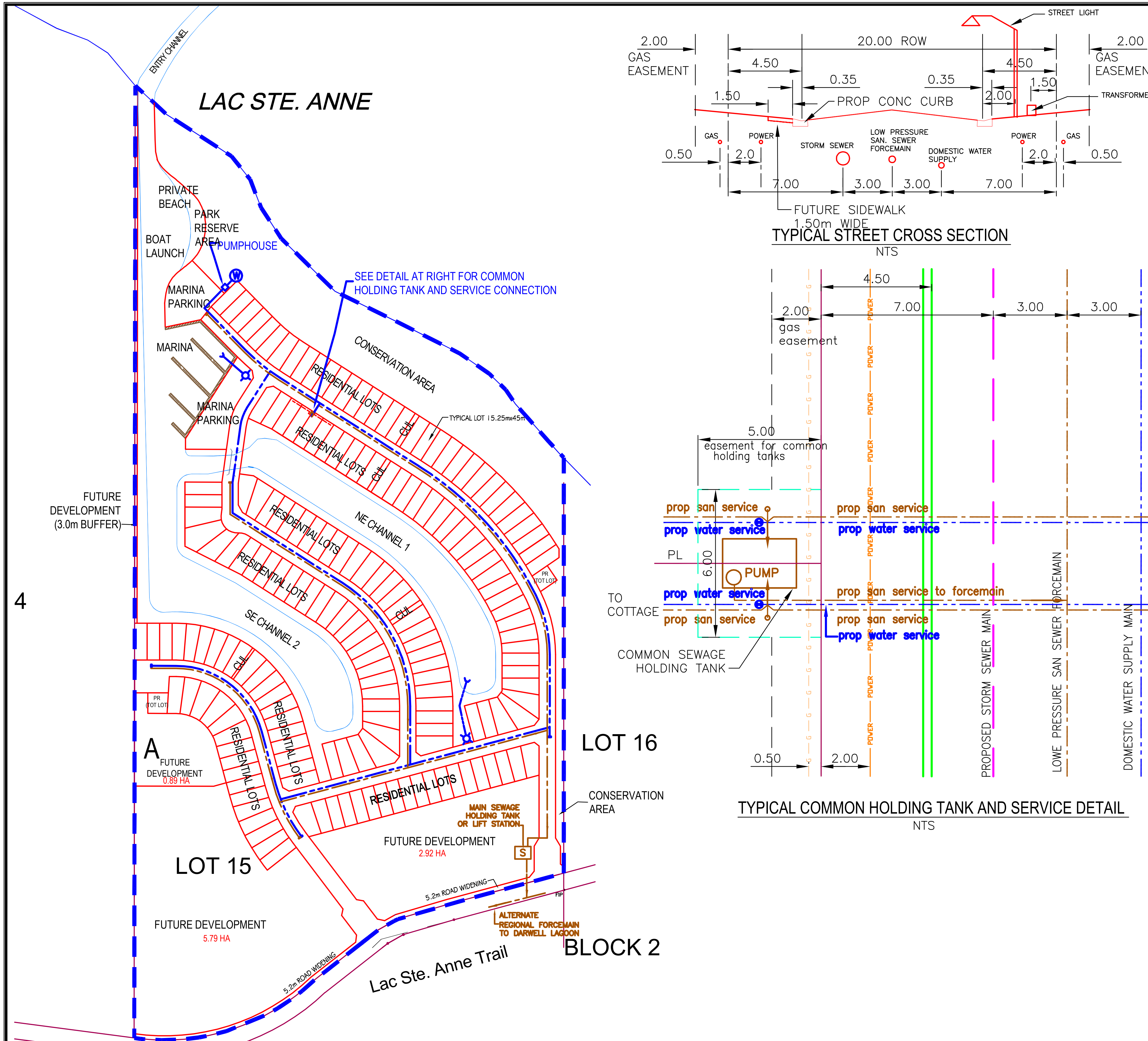
The water distribution and sanitary sewer servicing concepts are indicated on Figure 7.

Community water supply will be provided from a community well system with treatment limited to disinfection. This system will be developed in compliance with Alberta Environment standards. For this purpose, a professional hydrogeological study has been conducted to verify the sufficiency of local ground water sources for both the bareland condominium and potential additional development on the remainder of the subject property. (See Appendix A). Distribution would be provided from a common pumphouse and would facilitate domestic flows and pressures only. Potable water may be provided to nearby properties if sufficient capacity is available.

Fire protection would be provided through a trucked in source by the local rural fire department. A truck fill hydrant would be constructed at the marina during the first stage of construction for refilling fire fighting equipment. A second truck fill hydrant would be added at the south end of the project during construction of a later phase.

Sewage collection would be provided through the installation of common holding tanks (generally 1 -1600 IG tank per 4 units) which in turn would transfer the sewage through a low pressure system to a main collection holding tank located at the south east entrance to the development. The main holding tank would then be pumped out and hauled to the Darwell lagoons on a regular as needed basis. The individual holding tanks would be located in easements (approximately 6.0m wide x 5m long) on the common property line between two lots in each serviced group, adjacent to the roadway. The main holding tank would be located in a P.U.L. at the south east entrance which would allow larger trucks to turn off the main road and pumpout the tanks on a regular basis without disrupting traffic.

As an alternate to trucking the sewage to Darwell, the Developer is currently assessing the possibility of participating with the County in the construction of a regional forcemain. Under this scenario the main collection holding tank would be



WINDMILL ESTATES LTD.

WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 7

WATER DISTRIBUTION AND SANITARY SEWER SERVICING PLAN

LEGEND

- AREA STRUCTURE PLAN BOUNDARY
- PROPOSED WATERMAIN
- PROPOSED WELL AND PUMPHOUSE
- PROPOSED TRUCKFILL HYDRANT
- PROPOSED LOW PRESSURE SANITARY SEWER FORCEMAIN
- PROPOSED LOW PRESSURE SANITARY SERVICE AND COMMON HOLDING TANK

NOTE: WELL AND PUMPHOUSE LOCATION ARE CONCEPTUAL ONLY

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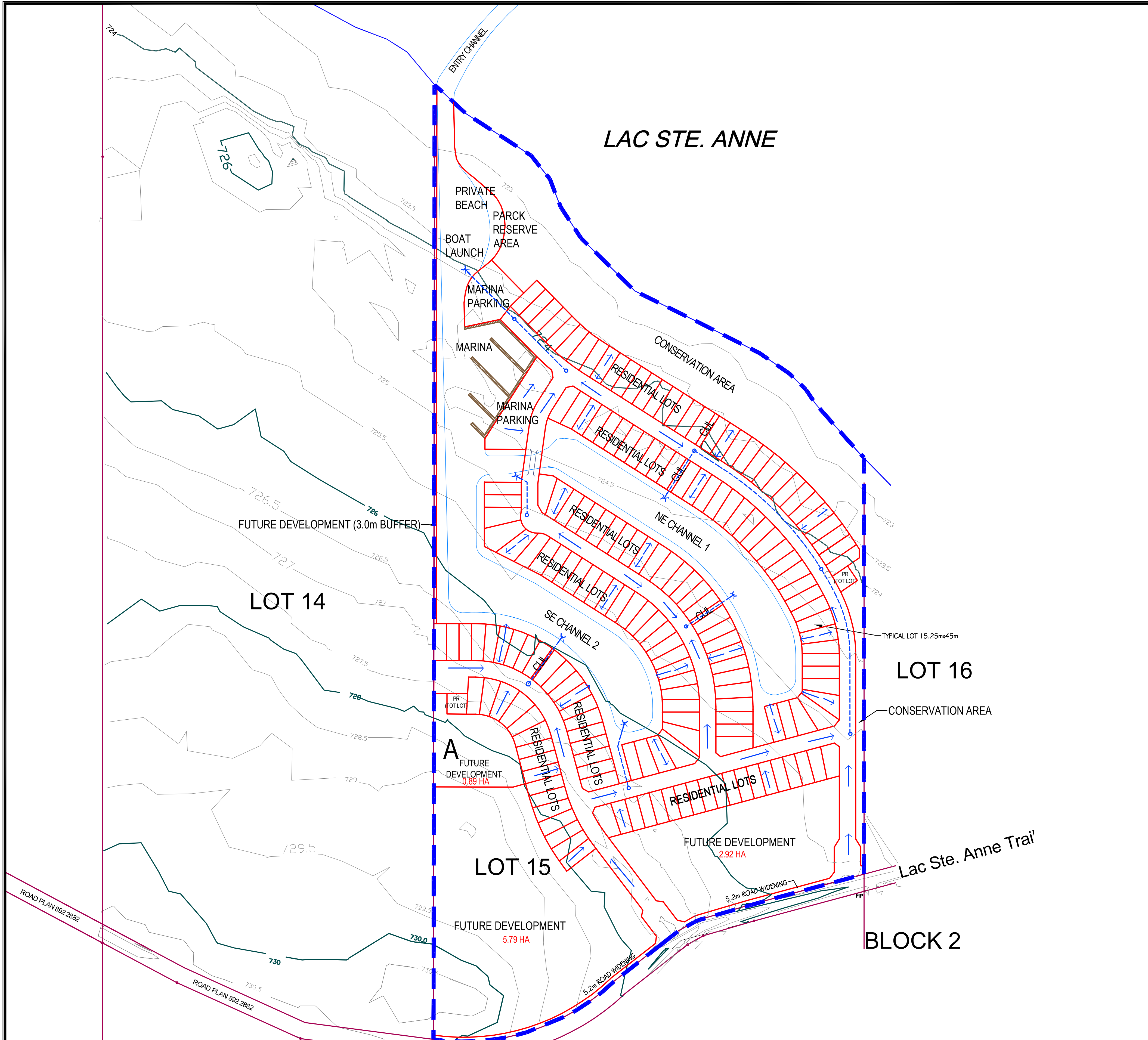

WINDMILL ESTATES LTD.

WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

NORTH

FIGURE 8

STORMWATER MANAGEMENT PLAN

LEGEND

- AREA STRUCTURE PLAN BOUNDARY
- PROPOSED STORM SEWER SYSTEM AND LAKE OUTFALL
- 726 EXISTING GROUND CONTOUR
- DIRECTION OF SURFACE DRAINAGE FLOW

HARBOUR CONCEPT BY : JAYMAR CONSULTING INC.

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converted to a lift station which would pump the sewage to Darwell lagoon. Depending on the ultimate scheme, additional areas could be serviced by the lift station as well.

Individual water and sewer service connections will be provided to each lot.

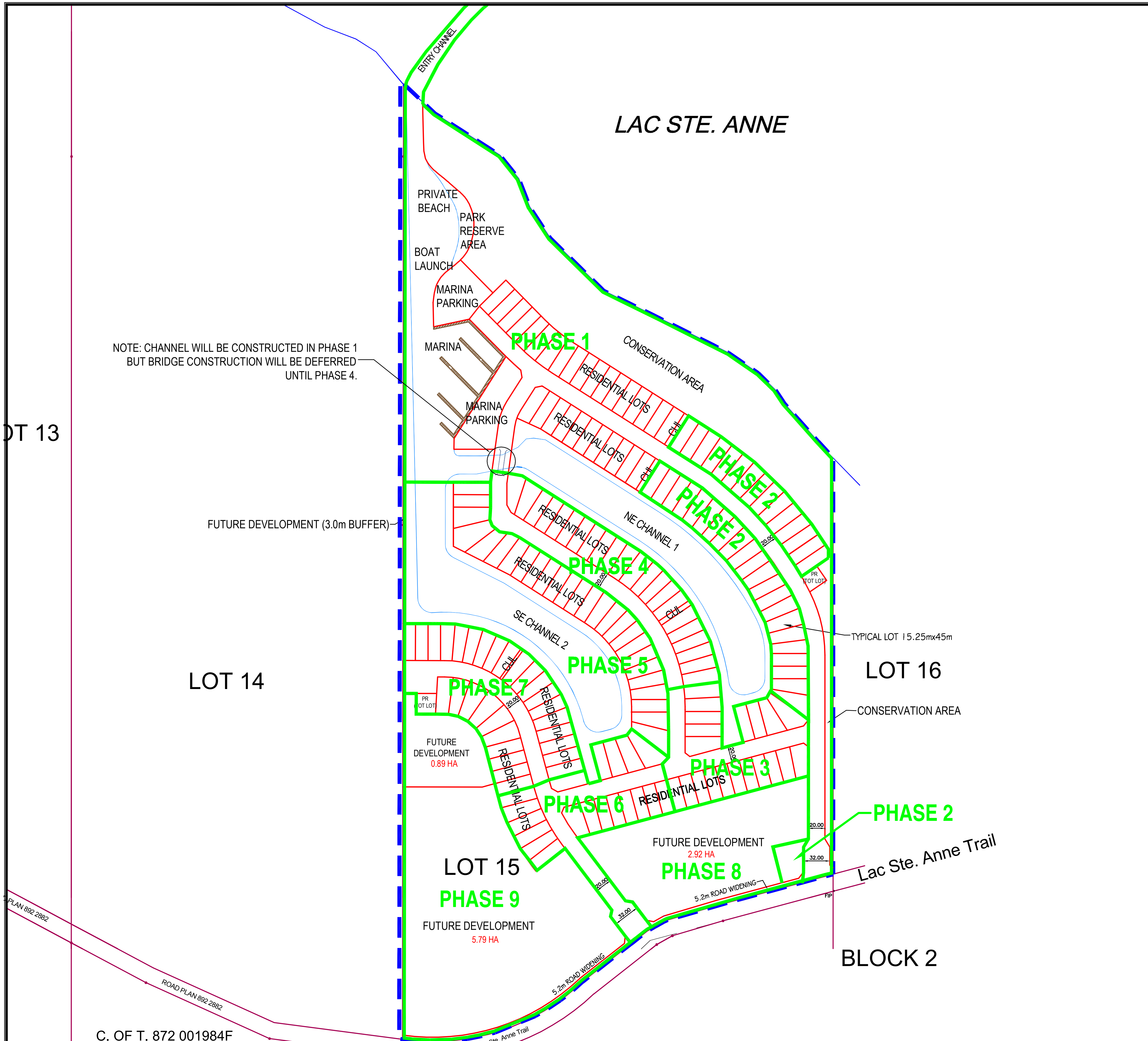
Storm water management will be used to eliminate water quality concerns associated with surface runoff flowing directly into the lake by routing all front of lot and roadway runoff through storm sewers into the inland harbour before overflowing into the lake as generally shown on Figure 8. Recirculation and aeration pumping are also proposed to improve the water quality in the harbour. The storm water management facilities are subject to approval by Alberta Environment and the requirements of the Environmental Protection and Enhancement, and Water Acts.

Franchise utilities, ie. power, gas, telephone, will be provided by the respective utility companies in the area. Geothermal heating systems may be installed if proven to be feasible.

6.6 Harbour and Access Channel Design

The harbour and channel design have been prepared to provide direct water access to a maximum number of lots as well as facilitate potential development to the west. The marina, boat launch and private beach area have been situated at the north west end of the internal looped roadway system, which is accessible from two directions. The marina itself is situated back from the shoreline in a protected area, yet close enough to the lake to minimize congestion in the entry channel. Two parking areas consisting of approximately 70 stalls will facilitate the marina as well as the boat launch and private beach area. Excavation of the harbour will increase as construction proceeds from north to south since the existing ground topography rises at an approximate six percent grade. This will result in main channel excavation depths ranging from approximately 3.0m at the north to 6.5m at the south and side channel excavation depths ranging from 4.0m at the north to 5.5m at the south. Some of the excavated materials will be used to raise the level of the lots and the remaining excess will be hauled off site or placed in fill on future development areas. Appropriate measures including the installation of silt fences will be taken to comply with Alberta Environment and D.F.O. regulations and to alleviate concerns regarding the deposition of deleterious materials into the Lake. Figure 5 illustrates a typical cross section from the lake shore through the proposed lots and two side channels.

The access channel will be dredged from the extreme western edge of the property approximately 490m into the lake as previously described. It is anticipated that this work will be constructed during the winter months when it would be least disruptive to other lake users and when the ice cover will minimize the dispersion of materials due to wave action. Other appropriate measurers including the installation of filter curtains will be used to comply with regulatory approvals and minimize dispersion



WINDMILL ESTATES LTD.

WINDMILL HARBOUR

AREA STRUCTURE PLAN

PROPOSED BARELAND CONDOMINIUM IN
LOT 15, IN THE NORTH PORTION OF
SEC. 20-54-3-W5M
LAC ST. ANNE, ALBERTA

FIGURE 9

DEVELOPMENT PHASING PLAN

LEGEND

AREA STRUCTURE PLAN BOUNDARY
DEVELOPMENT PHASING BOUNDARY

PHASE 1	-29 LOTS (APPROXIMATELY)
PHASE 2	-37 LOTS (APPROXIMATELY)
PHASE 3	-20 LOTS (APPROXIMATELY)
PHASE 3	-22 LOTS (APPROXIMATELY)
PHASE 5	-26 LOTS (APPROXIMATELY)
PHASE 6	-19 LOTS (APPROXIMATELY)
PHASE 7	-29 LOTS (APPROXIMATELY)
PHASE 8 & 9	-FUTURE DEVELOPMENT

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of silts into the lake. A typical cross section of the access channel is also illustrated on Figure 5.

6.7 Development Phasing

Phase One will include the main access road, entry gate feature, internal road to marina, marina, boat launch, entry channel and main channel up to and including the NE Channel 1, approximately 29 lots, conservation area, domestic well and water supply system, first truck fill hydrant, sewer system and common holding tanks, storm sewers, and landscaping, as indicated on Figure 9. Construction of the bridge linking phase one to phase four will be deferred until Phase 4.

Phase Two would complete the remaining 37 lots located on the north side of NE Channel 1 and would include an extension of all the above noted services as well as the construction of the main sewer holding tanks and/or lift station.

Phase Three through nine would be developed from east to west, with the intention of developing all the lots on the NE side channel before commencing excavation on the SE channel. The actual timing and rate of development will be dependent on market conditions.

The entire bareland condominium area may be subdivided all at once while its actual development will be phased.

6.8 Operation, Maintenance and Upgrading of Proposed & Existing Infrastructure

The developer will be responsible for all on site development costs.

The bareland condominium association will be responsible for all operation and maintenance of the internal roads, utilities and common properties other than the lots which will be maintained by individual lot owners. For infrastructure improvements outside of the condominium area, cost sharing arrangements may be made with the County.

To promote public safety, the harbour and channels will have shallow water near shores with gentle slopes, depth markers and life preservers on piers. Fencing, gates and signs will be erected to limit public access to the harbour and channels.

6.9 Plan Statistics

The following table shows a summary of the land use categories of the bareland condominium development, excluding the main and secondary public access roads.

Land Use Category	Area	% of Total
Residential Dwelling Lots	12.99 ha (32.10 acres)	30.6 %
Conservation Areas	4.57 ha (11.32 acres)	10.8 %
Open Space & Park	0.37 ha (0.96 acres)	0.9 %
Roads	4.96 ha (12.26 acres)	11.7 %
Harbour, Marina, etc.	9.81 ha (24.66 acres)	23.0 %
Future Development Area	9.80 ha (23.72 acres)	23.0 %
Total	42.5 ha (105 acres)	100 %

7. **Future Development on Remainder of Lot 15**

The existing agricultural land uses on the remainder of Lot15 will not be changed in the near future. However, should community demand arise and market conditions become favorable, the remainder of Lot 15 may be developed for additional bareland condominium lots, MR, road widening, and commercial or recreational uses as permitted under the present zoning. Detailed planning will be necessary prior to any development approval being given.

Intensive livestock, industrial, large commercial, amusement park and other high impact land uses will not be permitted.

8. **Plan Amendment**

Amendment to this area structure plan may be considered as deemed appropriate by the County.

PREPARED BY

JAYMAR CONSULTING INC.

____
per: Bill Martenseon

GPEC CONSULTING LTD.

____________________________ ____________________________
per: Dave Scott, P. Eng. per: Reg Dacyk, R.E.T.

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Appendix A
Groundwater Evaluations Report by AMEC

Appendix B
Revised Environmental Assessment by
Mainstream Aquatic Ltd.

Appendix C
Draft Conservation Easement
and Vegetative Management Plan

Memorandum

mainstream AQUATICS LTD

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Telephone: (780) 440-1334 · Fax: (780) 440- 1252
email: info@mainstreamaquatics.ca

Project:	Windmill Harbour Development Advisory	Page:	1 of 8
From:	Rick Pattenden	Date:	18 December 2003
To:	Bill Martenson, Jaymar Consulting Inc.	Project:	03010
cc:			
Re:	Response to Windmill Harbour Development Supplemental Information Request		

The following provides a response by Mainstream Aquatics Ltd. to the Supplemental Information Request for the proposed Windmill Harbour Development by the Department of Fisheries and Oceans dated 3 December 2003. I understand that ISL Butler Krebes & Associates Inc. has submitted the conservation area plan to you under separate cover.

Inland Harbour

Statement #1
Section 2.3.2 of the EIA states that the harbour would be private thereby eliminating public access. The review team is concerned that as the resort Condominium Association membership changes over time, public boat launching may be permitted. We require clarification as to how no public access will be maintained in the long-term.

Response
The bylaws of the Condo Association will restrict the use of the marina and channels to members and registered guests. The Condominium Act stipulates that Condo bylaws can be changed by a minimum 75 percent majority vote. Windmill Harbour will be a fenced and gated community with high value placed on privacy and security. Residents will mostly high-income second-home owners. It is highly unlikely that the limited revenue generated from seasonal boat launching would entice the owners to give up their "quiet enjoyment" of their project.

Access Channel

Statement #2
Section 2.3.3 Pg. 9 of the EIA states that a 20 m wide channel will be maintained and clearly marked with buoys and speed limits, and enforced by the Condominium Association. The review team requires clarification as to what provisions will be put in place to prevent recreational users from entering into the reed beds where the grebes will be nesting. We also request clarification as to how the Condominium Association will enforce these rules. This should be detailed as part of an overall monitoring plan.

Response
The entrance of the channel and the boat channel proper will be clearly marked with buoys to direct boat traffic into and through the channel to the marina and maximum boat speed limits will be posted. The buoy system will conform to federal Coast Guard requirements. Contingent upon approval by the Coast Guard, marker buoys also will be placed around the outside perimeter of the reed bed to inform the public regarding the existence of the nesting grebe habitat. If this mitigation measure is approved, discussions will be initiated regarding annual maintenance of the marker buoys.

Because the reed bed is part of the lake bed it is public property. As such, the Condominium Association has no legal authority to restrict public access into the bed from the lake. Without special provincial or federal designation, there is no legal avenue available to the Condominium Association to restrict access into the reed bed from the lake.

However, if a person enters the reed bed resulting in disturbance to breeding grebes, their nests, or young, then they would be in contravention of Sections 5 and/or 6 of the Migratory Bird Convention Act. In this case enforcement by federal and provincial authorities is possible.

A description of the monitoring plan is provided under a separate section.

Conservation Area

Statement #3
Section 2.3.4 Pg 9 of the EIA states that a conservation area will be governed either by the County or by the Condominium Association (see conservation area plan). The review team requests clarification on the type of conservation area that will be established. We are concerned that the mandate of the County and the Condominium Association will evolve as priorities and membership evolves over time, and therefore long-term protection may not be realized.

Response
It is proposed that the area be protected under Section 22.1(2) of the Alberta Environmental Protection and Enhancement Act, whereby an easement will be placed on the property, which will be used to ensure long-term protection of the area. The easement would be registered on the land with the specific rules for protection, maintenance, and monitoring incorporated into the agreement. Under Section 22.1(3) of the same Act, a qualified organization or steward will be designated by the County to maintain the conservation area and to enforce restrictions placed on that area under the easement.

Activities in the protected area will include a limited number of maintained walking paths, a fenced exclusion zone designed to prevent access to the grebe colonies by humans and pets, a bird observation blind, a lake view point, and pruning of trees in designated areas as to density and height in order to maintain the residential lot lake view. The following are measures to be incorporated into the easement.

1. Public access will be restricted. Maintaining the area under private ownership will facilitate enforcement of trespass law.
2. The area will be maintained in its existing state with the exception of selected vegetation pruning.
3. Inappropriate activities and physical impingement onto the lake shore will be eliminated
4. Activities will be restricted to low impact recreation within specified zones. These will include use of designated walking trails and a bird observation blind.
5. An exclusion fence will be used to physically prevent humans and their pets from accessing the reed bed in the vicinity of the grebe colonies and to maintain a minimum buffer zone.
6. A fence along the back lots of residences will prevent expansion of the manicured lawns into the conservation area.
7. A buoy system will clearly demarcate the boat channel and reed bed around the perimeter of the conservation area. Sign markers will be placed on the ice during the winter to inform snow mobile users.

At the present time, the preferred steward would be Lac Ste. Anne County, although other potential candidates could be approached (e.g., independent bodies such as Ducks Unlimited Canada and the Federation of Alberta Naturalists). The steward will adhere to conditions placed on the conservation area by the easement. The final easement conditions will be established through discussions between representatives of the proponent and regulatory authorities. Once the development is operational, a three-person advisory group having representation from the Condominium Association, the County, and the regulatory authorities will oversee stewardship activities. The County would have the power to enforce easement conditions by bylaw or other appropriate mechanism.

Statement #4
The fenced exclusion zone will only be effective as long as the fence is maintained. The review team requires the proponent clarify how it will ensure long-term maintenance of the fence. The length of the fence has not been defined.

Response
The fence will be maintained under the powers of the conservation easement. The costs of fence maintenance would be borne by the County. The length of fence would be 400 m and placed 50 m back from the present shoreline, which will provide a minimum protective distance of 100 m from the grebe colony (see dimensions on the conservation area plan).

Statement #5
The review team requests that the proponent provide a map showing the fence and walking trails and resting areas, and in relation to the grebe colonies.

Response
Conservation area plan has been provided under separate cover.

Statement #6
The EIA states that human activities will be controlled in the conservation area along the lake shore to eliminate potential disturbance to the emergent vegetation zone. The review team requires the proponent to elaborate upon how this will be undertaken and enforced. This should be part of a detailed monitoring plan.

Response
As described under response to Statement #3. A description of the monitoring plan is provided under a separate section.

Statement #7
The EIA notes that trees in the conservation area will be subject to partial removal to preserve the view. The review team recommends that these trees be preserved to provide an effective sight and intrusion barrier between the grebe colonies and the development.

Response
The potential for a lake view by residential lot owners is a critical aesthetic attribute that must be an integral part of the development. Failure to provide a lake view will substantially reduce the value of the lake-facing lots. Therefore, selective pruning must occur within the conservation area.

Selective pruning will be completed only to the extent that it ensures a clear view of the lake by lake-front lots. Pruning will include removal or cropping of selected, pre-determined sections of willows and trees. Pruning activities will be mechanical and/or manual to minimize disturbance and will occur annually. The location and extent of pruning will be dependant on the aesthetic needs of residential lot owners and the ability to screen human activities from the grebe colonies. A map is provided in a separate section that illustrates the proposed pruning locations. The final extent of selective pruning will be established following discussions with regulatory authorities.

Statement #8
The review team requires clarification, on a map, to plot the conservation area and how it relates to the Lac Ste Anne trail.

Response
A conservation area plan has been provided under separate cover.

Monitoring

Statement #9
The proponent has stated that it will monitor human activities to ascertain whether the conservation area is effective in protecting the habitat. The proponent should provide a 5-year management plan that will outline all activities that will be undertaken, on an ongoing basis, to minimize the overall environmental impacts of the project, especially as it relates to the grebe colonies. It should include, but not be limited to, management of the conservation area, fence maintenance, monitoring of public and recreational vehicle access, pet and human access, timing of tree pruning, snowmobiles, etc.

Response
The 5-year management plan will consist of two components – monitoring environmental conditions and human activities that impact those conditions, and maintenance of the conservation area. Activities associated with the plan will occur annually.

Conservation Area Management
The conservation area will be used to maintain the existing environmental conditions adjacent to the lake shore with the primary focus being protection of the western grebe and eared grebe nesting colonies. An easement will be used to establish appropriate restrictions on human activities within the conservation area. Monitoring and maintenance of the conservation area will be managed by a three-person advisory group having representation from the Condominium Association, the County, and Alberta Sustainable Resource Development. The County, which will accept stewardship responsibilities of the area, will have the power to enforce these conditions by bylaw or other appropriate mechanism.

Monitoring
Monitoring will include annual surveys of the western grebe and eared grebe colonies. Surveys will be completed shortly after the nesting season to reduce disturbance to the birds using sampling protocols developed by Alberta Sustainable Resource Development. The objective of the survey will be to estimate of the number of grebe nests.

Monitoring will include annual surveys of human activity-grebe interactions to ascertain whether the conservation area and exclusion zone is effective in minimizing disturbance during the breeding and nesting season. This will involve structured surveys to quantify the frequency and extent of disturbance to grebes due to shoreline and boating activities during periods of peak activity.

Monitoring will include identification of restricted human activities within the conservation area and reed bed. The County, with assistance from concerned residential lot owners, will be responsible for monitoring activities, particularly during the grebe courtship and nesting period (approximately 15 May to 15 July). Infractions will be reported to a predetermined County representative. When a restricted activity within the conservation area has been identified, the County will resolve the issue, and if necessary, enforce its mandate to protect the resource as specified in the easement agreement.

Monitoring will include promotion of an education program that will be designed to inform residential lot owners and the general public about the sensitivity of the grebe colonies to human disturbance, the importance of the conservation area (and reed bed) for the protection of the grebes. The education program will be designed to foster good stewardship of the resource. A component of **the** education program will be placement of signage around the perimeter of the conservation area on land and on water, and notices at all public boat launches.

An important component of the educational program will be the bird observation blind located adjacent to the boat channel as shown on the plan. The blind will be designed to promote bird and wildlife watching while eliminating the potential for disturbance. An information display describing the natural history and behaviour of western grebes is being considered as part of the bird observation deck. The blind has been placed in the area that is best for bird watching as a way to attract people to that location. This will avoid issues associated with random access by bird watchers in other areas.

Maintenance
Maintenance of the conservation area will be the responsibility of the County. Maintenance will involve annual inspections and repair of the exclusion fence, walking trails and other facilities such as the bird observation blind. A request will made to the County regarding annual deployment and removal of the buoy system during the open water period and sign markers placed on the ice during winter.

Selective pruning of woody vegetation will be completed annually by the County or qualified contractor under the supervision of the County. This would involve removal and/or pruning of trees in specific, pre-determined areas. The objective of the pruning will be to maintain the lake view of the residential lot owners without causing undue physical disturbance to the conservation area.

Arrangements will be made for maintenance costs to be born by the County.

Facility Operations

Statement #10
Section 2.4 Pg 10 of the EIA states that the current development permits the use of personal watercraft (e.g. Sea-Doos). The review team recommends that the use of personal watercraft be prohibited.

Response
The Condominium Association will prohibit the use of personal water craft in the common areas under its control (i.e., inland marina and boat launch).

Statement #11
The review team requires clarification on what measures will be put in place to protect the grebe colony habitat from snowmobile incursions.

Response
Similar measures described in response to Statement #2 will be implemented. As indicated, the reed bed is deemed public property; therefore, trespass law does not apply. Signage will be used to inform recreational users of the lake that the reed bed is a sensitive area. Special federal or provincial protective designation for the area is required in order to control access from the lake.

Statement #12
The EIA provides no real discussion of the potential beach (reference being to a private beach). As such, the review team requests clarification as to whether a beach is planned, and if so, where it will be located. Any creation of the beach will require further discussions between the developer and the land manager. A separate approval will be required, as this will likely involve an encroachment on crown land. In that sense, it will not be exclusively private.

Response
In the interests of minimizing lakeshore disturbance, a beach will not be created on the lake. It will be replaced by a man-made swimming area built as part of the marina, which is located outside the conservation area. It will not be available to the public and it will focus human activities inward, away from the lakeshore.

Project Schedule

Statement #13
Section 2.5, Pg 11 Table 2.1 of the EIA identifies some summer construction activities. To minimize disturbance to migratory birds, the review team recommends that the proponent avoid construction at least between May 1 and July 31 in areas where migratory birds may be nesting. Alternatively the proponent should pre-clear the vegetation outside of the breeding season.

Response
For the protection of migratory birds, construction where migratory birds may be nesting will be limited to the months of August to April inclusive in areas where migratory birds will be nesting.

Mitigation

Statement #14
The EIA identifies a possible monitoring plan to ascertain impacts to western grebes. This should be expanded to include eared grebes. The proponent cites this monitoring as measures that "can" be implemented; therefore the review team requires clarification as to whether this "will" be implemented. This could be included in an overall project monitoring plan.

Response
The monitoring plan will be implemented as part of the easement conditions placed on the conservation area. Eared grebes will be included as part of the monitoring plan.

Statement #15
There is no discussion in the EIA with respect to the erosion control measures proposed for the construction/dredging of the boat channel. The channel will require approval under the Public Lands Act.

Response
A silt curtain will be installed to isolate the work area during construction of the boat channel. Full time supervision will be provided by a qualified engineer to ensure the work is completed to generally accepted standards. A qualified aquatic specialist will be on site to monitor suspended sediment concentrations adjacent to the work area.

Cumulative Effects

Statement #16
The EIA provides only a cursory discussion of cumulative effects. The proponent does not discuss future development of the adjacent parcel of land that it owns, which if developed, would double traffic in the marina.

Response
There are no plans to develop Lot 14 at the present time. As such, a discussion as to the nature and timing of a development on Lot 14 is purely hypothetical. When and if the area is developed, it would have to meet all regulatory requirements at that time.

Statement #17
The proponent does not discuss the cumulative effects to the grebe colonies. The grebes would be considered valued ecosystem components and should have their own cumulative effects assessment. The Western grebe colonies have relocated several times on the lake to more secluded areas, presumably due to past and existing disturbances.

Response

Western Grebe Populations

The western grebe colony that nests on Lac Ste. Anne is part of a continental population. On a regional scale (central Alberta) the western grebe breeding population is restricted primarily to three lakes: Lac Ste. Anne, Wabamun Lake, and Isle Lake (Hanus *et al.* 2002). In 2002, the Lac Ste. Anne colony accounted for 49% of the regional breeding population in the area, which was estimated at 2542 individuals (Hanus *et al.* 2002). Although empirical data are lacking, historical information collected from Lac Ste. Anne suggests that the regional breeding population of western grebes is stable or has increased slightly (Hanus *et al.* 2002).

Cumulative Adverse Effects

A number of human activities have detrimental effects on breeding western grebes. Boating disturbances, shoreline development practices, and water level declines were identified as the primary causes of western grebe population extirpations from several lakes in British Columbia (Burger 1997). These activities also are a cause for concern in Alberta (Hugh Wollis, Wildlife Biologist, Alberta Sustainable Resource Development, pers. comm.). Hanus *et al*. (2002) suggested that boating disturbance on Lac Ste. Anne is the likely reason why western grebe colonies have relocated to the present site adjacent to the proposed development.

Anecdotal information indicates that boating activities on Lac Ste. Anne and other central Alberta lakes will continue to increase as will the occurrence of shoreline developments. In the case of Lac Ste. Anne, incremental destruction of lakeshore habitats by small-scale developments and disturbance by boaters represent activities that would cause cumulative adverse effects to the western grebe population.

Project Mitigation

Mitigation measures proposed for the development are designed to minimize disturbance to the western grebe colony and to eliminate the potential for habitat destruction by residential lot owners. Unfortunately, there are no guidelines to identify measures that will guarantee protection of the grebes short of a no development scenario.

It is unclear whether the proposed measures will be sufficient to reduce human disturbance to an acceptable level. Therefore, it is assumed that mitigation will be sufficient to prevent habitat destruction but, it will not prevent human disturbance from affecting the viability of the western grebe colony on Lac Ste Anne.

Cumulative Effects Assessment

For the purpose of the assessment, the valued ecosystem component is defined as the western grebe breeding colony and the bounds of the effects assessment is restricted to the lake. It should be noted that from an ecological context the western grebe breeding colony on Lac Ste Anne is part of a much larger continental population. Similarly, human activities that may adversely affect western grebes are not restricted to the breeding season or the lake. Also, the assessment will not consider changing water levels as a potential adverse effect even though it has been identified as an issue of concern by some researchers (e.g., Burger 1997). Given the specific habitat requirements of breeding western grebes, the location and long-term viability of the Lac Ste Anne colony may be dictated by changes in water levels rather than human activities.

The impact of human activities on the western grebe colony is difficult to quantify due to the lack of empirical data. As such, a primary assumption of the cumulative effects assessment is that use of qualitative information is sufficient to accurately predict Project effects. Because the validity of this assumption cannot be tested, the confidence in the assessment is deemed to be low.

At present, there are several summer villages and residential subdivisions distributed around the perimeter of Lac Ste. Anne. Lakeside complexes similar to the proposed Project and residential subdivisions are compatible with the long-term development plans by the County of Lac Ste. Anne (Richard Neufeld, pers. comm.); therefore, use of the lakeshore and surrounding area can be expected to increase over time.

Recreational activities on Lac Ste Anne that cause disturbance to breeding western grebes also can be expected to increase. Recreational activities of concern would include boating by local persons and persons from Edmonton, which is a large, expanding urban center located 50 km to the east.

Assuming no limitations to increased shoreline development and recreational use of Lac Ste Anne, the cumulative effects of these impacts in combination with the proposed Project will cause a significant adverse effect. This would result in extirpation of the western grebe breeding colony from Lac Ste Anne. The colony may relocate to another lake, but it is unclear whether this would result in a viable colony elsewhere given the current development activities on other central Alberta lakes.

If the assumption regarding the long-term increase in human activities on Lac Ste Anne is correct, then there will be a cumulative significant adverse effect on the western grebe breeding colony whether the proposed development exists or not. If, however, the Project proceeds and the proposed mitigation measures are successful, the western grebe colony may have sufficient protection to ensure its long-term viability. Under this scenario, the Project would have a positive effect that would benefit the colony.

Literature Cited

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REVISED ENVIRONMENTAL ASSESSMENT
- WINDMILL HARBOUR DEVELOPMENT -

Prepared for

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Dr. Graham Griffiths was responsible for the evaluation the aquatic vegetation community.

The following individuals of Mainstream Aquatics Ltd. were responsible for completing the study:

Rick Pattenden -	Senior Biologist and Primary Author
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1.0 INTRODUCTION

1.1 BACKGROUND

Jaymar Consulting Inc. has proposed a residential subdivision and inland harbour along the southeast shore of Lac Ste. Anne in the County of Lac Ste. Anne. The Windmill Harbour Development, subsequently referred to as the Project, is designed to provide single dwelling housing units in combination with an inland harbour, which provide access to recreational opportunities on Lac Ste. Anne. The Project has been designed to meet the long-term economic and social objectives of the County of Lac Ste. Anne, and at the same time, maintain the long-term environmental integrity of the lake.

The Windmill Harbour Development will require approvals from the municipal government. In 2001, an initial design of the Project entitled “Windmill Estates Area Structure Plan” was submitted for review to the County of Lac Ste. Anne (GPEC 2001). The County passed two bylaws approving that area structure plan and rezoned the property from commercial recreational to a CR-4 County Residential Estate - Direct Control (Bill Martenson, Owner, Jaymar Consulting Inc.). The current Project entitled “Windmill Harbour Development” will require a new area structure plan that accommodates changes to the design and an extension of rezoning by the County. The current Project design likely also will receive the support of the municipality (Richard Neufeld, Lac Ste. Anne County Development Officer, pers. comm.).

Because the Project may affect the environment, it is subject to a review by federal and provincial authorities in accordance with the Canadian Environmental Assessment Act. The Department of Fisheries and Oceans (DFO) is the Responsible Authority for the review of the Project (letter dated 19 June 2003).

In September 2001 Jaymar Consulting Inc. contracted the services of Mainstream Aquatics Ltd. (formerly P&E Environmental Consultants Ltd.) to undertake an environmental assessment (EIA) of the Project and to make applications for environmental approval. In August 2002, the draft EIA was submitted for review to the Department of Fisheries and Oceans.

In June 2003, DFO responded to the draft EIA by providing a Scope of Project, Scope of Assessment, and Terms of Reference for the environmental assessment that incorporated both federal and provincial guidelines as defined by Appendix 3 of the Canada-Alberta Agreement for Environmental Assessment Cooperation.

The present report entitled "Revised Environmental Assessment – Windmill Harbour Development" provides information that is needed to fulfill the requirements specified in these documents.

1.2 OBJECTIVES

The objectives of the revised environmental assessment are as follows:

1. Describe the Project and the existing environmental setting.
2. Identify the potential effects the Project may have on the environment.
3. Identify mitigation measures that can be used to reduce or eliminate the potential effects.
4. Evaluate the significance of the adverse residual effects that remain following mitigation, including cumulative effects.

2.0 PROJECT DESCRIPTION

2.1 PHYSICAL SETTING

Lac Ste. Anne is a popular summer and winter recreational lake located approximately 60 km from the City of Edmonton (Figure 2.1). There are six summer villages and five subdivisions that presently exist around the lake, but the Village of Alberta Beach is the focal point for most recreational activities. The Alexis and Enoch Reserves are located on the north shore of the lake. The Lac Ste. Anne Mission, which is located on the south shore 1.5 km to the west of the Project, is an important site for native peoples who gather every summer to celebrate the Christian faith and bathe in the waters that are thought to have healing powers.

The proposed development is situated on Lot 15 in Section 20, Township 54, Range 3, W5M approximately 1 km west of the Summer Village of Val Quentin. The parcel of land is bounded by Lac Ste. Anne Trail on the south, Lac Ste. Anne on the north, and it is less than 1 km north from Secondary Highway 633. The property area is approximately 42.5 ha with 700 m of shoreline.

The shoreline portion of the property falls under the jurisdiction of Alberta Public Lands. At present, there is no License of Occupation granted by the provincial government (Bill Martenson, pers. comm.).

2.2 PROJECT NEED AND ALTERNATIVES

Albertans residing in urban centers presently seek outdoor recreational opportunities during the summer months. In many areas of Canada, a “cottage at the beach” is a treasured possession that meets these needs. From a social perspective, it is desirable to find a way of increasing the utilization of the limited number of lakes within acceptable driving distance of Edmonton. The Windmill Harbour Development on Lac Ste. Anne has been designed in an attempt to achieve this goal in an environmentally acceptable manner.

The Project will be developed in Lot 15 in phases to meet market demand and to spread capital costs over the term of the development. There may be additional phases at the south end of Lot 15. These would not have waterfront and could include more single-family lots, or commercial/recreational activities to be determined by market demand. Jaymar Consulting Inc. has no immediate plans to develop its property (Lot 14), which located immediately west of Lot 15.

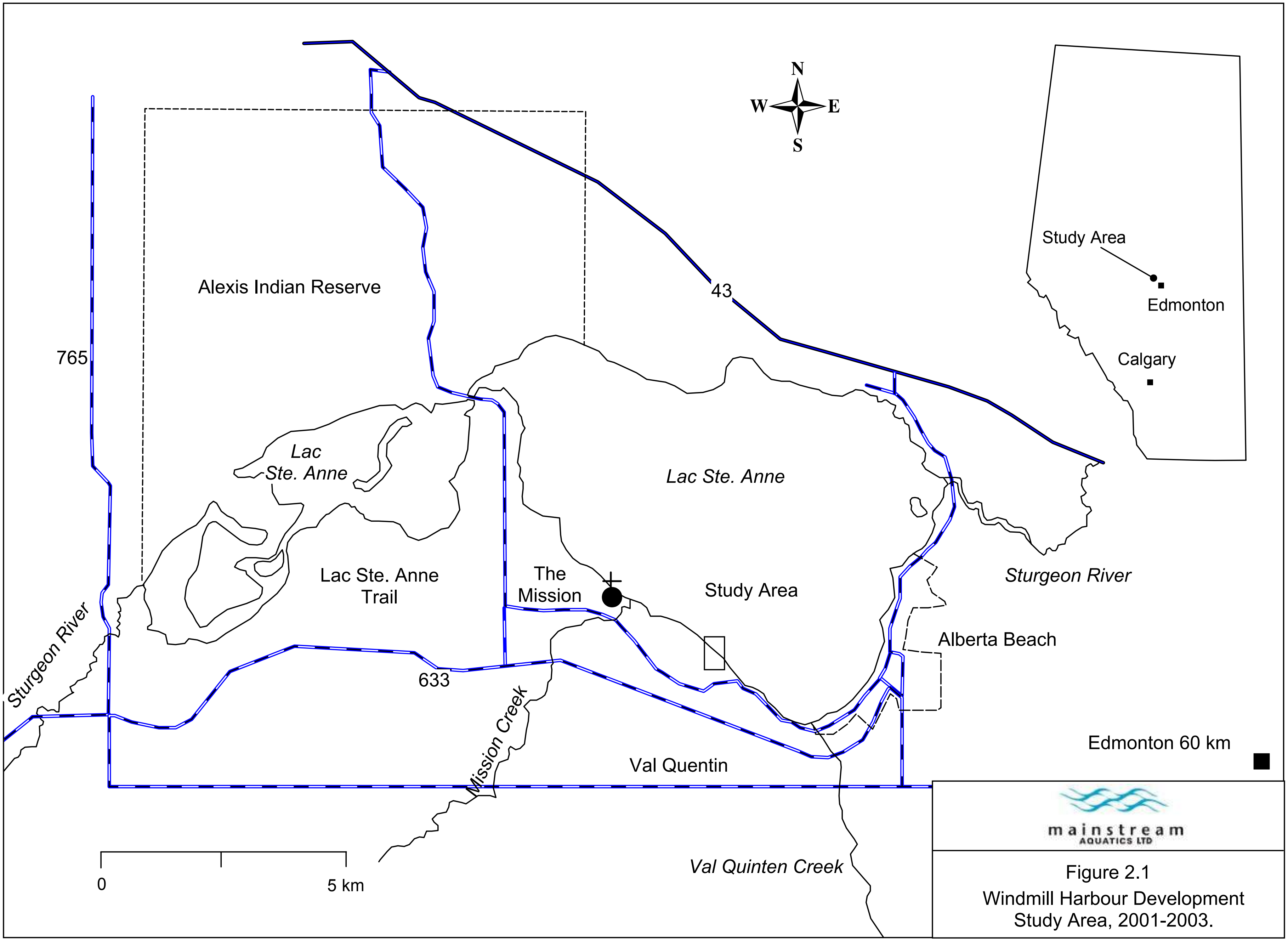

Figure 2.1
Windmill Harbour Development
Study Area, 2001-2003.

The Project has several social advantages while reducing environmental concerns. The following provides examples of these advantages.

1. The number of lots with direct access to the lake is large, while minimizing the need for development that physically impinges on the natural shoreline.

2. With access to the lake, the market will accept “urban-sized” vacation lots instead of acreages, resulting in greater utilization of the land (i.e., conservation of arable land).

3. Premiums paid for waterfront lots enables the developer to provide local improvement services to city standards and special amenities to lot owners such as a marina, clubhouse, private inland beach, and nature observation facilities.

4. Property owners will be able to build a pier at the back of their own lot without infringing on the natural lake shore. This facility becomes an extension of the patio as an area of socialization and fun for all ages. As such, many activities that might otherwise be on the lake will be focused inward to the owners’ property.

5. The Project will encourage use of nonmotorized boats (i.e., sail boats). This form of recreation is healthy, challenging, in tune with nature and encourages strong social bonding. There are several yacht clubs on Lake Wabamun, but none on Lac Ste. Anne.

6. A beneficial side effect of the recreation/relaxation industry is economic growth in all sectors, particularly construction, supply and services. General employment is increased and summer jobs are created for students.

7. The Lac Ste. Anne County supports the concept and the Project fits into the long-term plans for the lake and its shoreline (Richard Neufeld, Development Officer, Lac Ste Anne County, pers. comm.)

The inland harbour concept is an attempt to satisfy the demand for recreational access to Lac Ste. Anne and provide an atmosphere of country living in a way that meets current standards and public desire for environmental protection at an acceptable cost.

Alternatives to the Project could include no development, relocation to a less environmentally sensitive area and redesign to reduce the potential environmental effects. A no development scenario would eliminate the potential environmental concerns associated with the Project, but would be contrary to the public desire for recreational access to Lac Ste. Anne.

Relocation to another waterbody within easy driving distance to Edmonton is problematic from an environmental perspective. Larger waterbodies suitable for recreational purposes proposed by the Project are more heavily utilized than Lac Ste. Anne (e.g., Lake Wabamun, Pigeon Lake, Sylvan Lake). Relocating to one of these lakes would likely increase, not lessen environmental concerns.

Relocating to another property along the shoreline of Lac Ste. Anne is also problematic because the financial costs would be prohibitive. If relocation was necessary, the proposed development likely would be terminated (Bill Martenson, pers. comm.).

Redesigning the Project to reduce environmental concerns could entail decreasing the size of the development and removing the need for access to the Lac Ste. Anne. Again, the economic viability of the Project would come into question if the development size were reduced, while trying to maintain access to the lake. Changing the design to that of a standard residential subdivision next to the lake, in theory, would eliminate environmental concerns pertaining to infringement on the lake shore. In practice, however, this does not stop lake shore degradation by residential lot owners who desire boat access to the lake adjacent to their properties (Vance Buchwald, Alberta Natural Resource Services Fisheries Biologist, pers. comm.). This type of redesign likely would increase rather then decrease environmental concerns.

2.3 DESIGN

The proposed development consists of a residential subdivision and an inland harbour (Figure 2.2). The operation and maintenance of the facility would be governed by a condominium association, which would be a private corporation. The condominium association would have the legal authority to control activities by residents of the development and enforce guidelines (e.g., use of lawn fertilizers, boat speeds in the harbour). The Project would entail construction of residential lots and supporting infrastructure, excavation of an inland harbour, and dredging of a channel in the lake bed to allow boat access.

2.3.1 Residential Lots and Infrastructure

The Project would be designed to accommodate approximately 182 lots, which would be constructed to a minimum elevation of 724.0 m using fill material excavated from the harbour. This minimum elevation was chosen to prevent potential flooding from Lac Ste. Anne. Because the lake bottom and shoreline exhibits a shallow slope, the residential lots will be set back approximately 60 m from the existing lake shore, which is the approximate location of the 1-in-100 year flood elevation of 723.79 m. This arrangement should eliminate the potential for erosion of the development area due to wave action or ice encroachment (Reg Dacyk, pers. comm.).

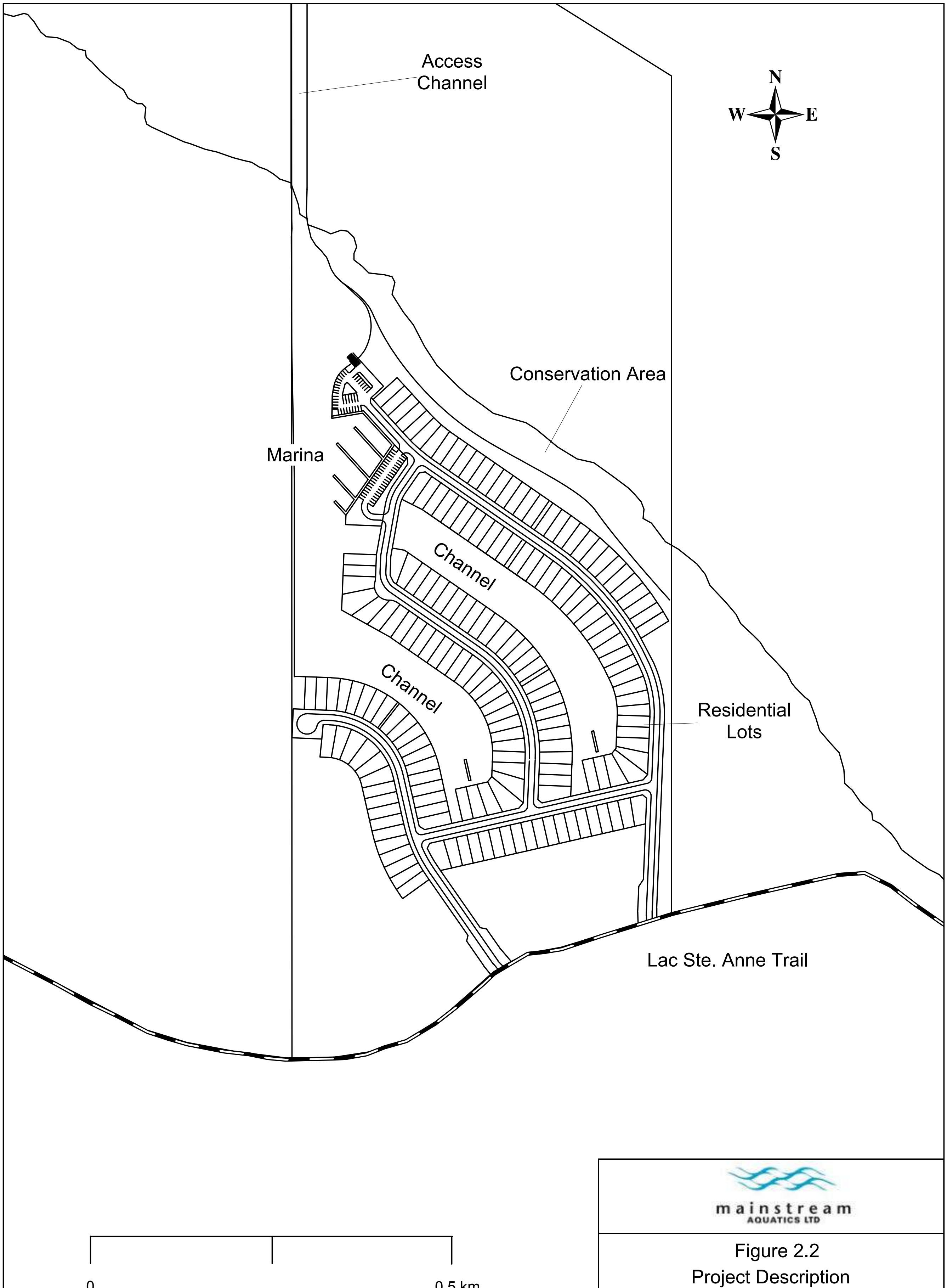

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Figure 2.2
Project Description
Windmill Harbour Development.

The infrastructure associated with the Project will consist of road access to Lac Ste. Anne Trail at two locations. At the request of Lac Ste. Anne County, Jaymar Consulting Inc. has agreed to dedicate up to 5.2 meters of property along its southern boundary to accommodate widening of the right-of-way. The county will ensure that the necessary road improvements are completed, and as such, does not anticipate public safety issues associated with vehicle traffic from the Project (Richard Neufeld, pers. comm.).

A community water supply will be provided for domestic uses. A hydrogeological study completed by AMEC Earth & Environmental Ltd. in 2001 concluded that the underlying aquifers appeared capable of providing the domestic water demands to facilitate a residential development (AMEC 2001). Water for fire protection will be provided from the inland harbour.

Sanitary sewage collection will be provided using common holding tanks that will be pumped out and hauled to an appropriate off site disposal area. The system would be designed to minimize collection points with the intention of some day pumping directly to a regional treatment facility. Disposal facilities currently available in Lac Ste. Anne County have the capacity to accommodate domestic sewage expected from the Project; therefore, no immediate changes to the municipal infrastructure would be required (Richard Neufeld, pers. comm.).

Storm water management will be used to eliminate water quality concerns associated with surface runoff flowing directly into the lake by routing all front of lot and roadway runoff through separate manholes into the inland harbour. Utility companies in the area will provide power, gas, and telephone. The proposed design of the residential lots and infrastructure has been applied to similar developments in the province such as Sunset Harbour Development on Pigeon Lake (Henning F. Rasmussen, P. Eng. Civil Consulting Engineer, pers. comm.). Because the storm water management plan must meet or exceed provincial requirements, the design would be deemed acceptable by the municipality (Richard Neufeld, pers. comm.).

2.3.2 Inland Harbour

Construction of the harbour is deemed to be feasible from a geotechnical aspect (Thurber 2001). The inland harbour would be 9.3 ha in size and would consist of a marina, a main channel, and two side channels (Figure 2.2). The harbour would be private, thereby eliminating public access from land and severely restricting public access from the lake. The marina would be used to moor larger vessels such as sail boats, while the side channels would provide passage for smaller vessels to boat slips adjacent to each residential lot. A boat launch would be located at the south end of the main channel next to the marina. To accommodate larger vessels the minimum water depth in the marina and main channel would need to be 2.5 m below minimum lake water level, which is 722.0 m. Water depths in the side channels would be reduced to 1.5 m below minimum lake water level to facilitate passage of smaller watercraft and still provide sufficient water depth for sediment settling purposes.

The harbour banks would be constructed at a slope of 5:1 from the bottom up to the minimum lake water elevation (722.0 m) and at slope of 7:1 from the low water elevation to the maximum recorded water level elevation (723.79 m). The harbour shorelines would be protected from erosion by placing a layer of clean gravel and sand over geotextile fabric. If appropriate, other means of erosion protection will be considered at the design stage.

A small private beach is being considered for the inland harbour. If incorporated into the Project, it would be located at the northwest end adjacent to the marina.

2.3.3 Access Channel

From a geotechnical perspective, construction of the access channel is deemed to be feasible (Thurber 2001). Because Lac Ste. Anne is shallow in the vicinity of the proposed development, a channel extending from the shoreline to a water depth of at 2.5 m would need to be dredged to facilitate boat access. The channel would be situated at the extreme western edge of the property to take advantage of the lake bed slope at this location. It is estimated that the channel would be approximately 0.98 ha in size. The channel would extend 490 m into the open water, would have a width of 20 m along its entire length, and would be clearly marked with buoys that would be removed during the off-season. It is anticipated that the channel would in fill over time; therefore, some maintenance dredging would be required. The frequency for maintenance dredging of the access channel is estimated to be 15 years. This is similar to maintenance dredging requirements for Marina Bay Estates on Sylvan Lake (Jim Jardine, co-developer of project, pers. comm.). The channel side slope would be 3:1 and the excavated lake bed material would be removed and disposed of on lots during winter.

2.3.4 Conservation Area

A conservation area approximately 60 m wide and 690 m long (4.2 ha) will be located along the shoreline of Lac Ste. Anne and will be designed to provide a buffer between the development and the lake (Figure 2.2). It would be governed either by the County or by the Condominium Association. The primary purpose of the conservation area will be to minimize disturbance to the natural environment by prohibiting public access. It would include a fenced exclusion zone adjacent to a known western grebe colony, walking trails, resting areas, and a nature appreciation/viewing area immediately adjacent to the boat channel. Trees in the conservation area zone will be subject to partial removal, replacement, and pruning to maintain the lake view by lot owners.

The conservation area also will be extended along the east perimeter of the property To Lac Ste. Anne Trail. This area will encompass approximately 0.74 ha and will be maintained in its natural state or enhanced with vegetation plantings. The purpose of the area will be similar to that of the lakeshore conservation area: to protect the natural environment and promote low-impact recreational activities.

The landscape design of the conservation area will be finalized following discussions with regulatory authorities.

2.4 FACILITY OPERATION

The purpose of the Project is to provide single-family housing units. It is estimated that 33% of the lots would be permanent residences, while the remainder would be used for recreational purposes during the summer months. On average, 3.25 persons would be expected to utilize each residential lot and there would be an estimated 1.0 to 1.5 watercraft per household (Bill Martenson, pers. comm.). These vessels would consist of sailboats, motorized boats, and personal watercraft. An unknown number of snowmobiles could be associated with the residences during the winter months.

Based on these estimates and assuming complete occupation of 182 residential lots, the Project would increase the number of persons in the area by 592 and boat use on Lac Ste. Anne would increase by 273 vessels. These estimates are deemed to be conservative because two factors will lessen the utilization of the lake by boaters. First, repetitious boat rides soon loses the appeal to boat owners. Second, the majority of the socialization associated with boat ownership will take place in and around the boat moorings as an extension of the back yard patio. It also should be noted that facilities within the complex would be available only for use by residents.

2.5 PROJECT SCHEDULE

The initial stages of the development following approval are scheduled for completion within a 15-month period commencing in February 2004. The window of activity for each major component is identified in Table 2.1.

Table 2.1 Proposed development schedule for the Windmill Harbour Development.

Task		Window of Activities
Permitting and project approval		September 2003 to January 2004
Construction:	Access channel	February 2004
	Marina and main channel	July to September 2004
	Infrastructure (roads, electricity, etc.)	August to November 2004
	Start dwelling unit construction	November 2004
Full Operation of Facility		January 2011

2.6 CONSTRUCTION

Construction would use accepted techniques and equipment. The conservation area will be clearly demarcated to ensure that unnecessary construction does not occur in the area during this phase of the Project.

The boat channel will be dredged during winter from the lake ice. A back hoe will be used to excavate the channel, while trucks will remove the material to an appropriate location. The inland harbour would be excavated in the dry by maintaining a plug of undisturbed material between the lake and the excavation area. Excavated material will be used as fill for the residential area to achieve the required elevation of 724.0 m. Excess material will be trucked to an appropriate as yet to be determined location.

Once the bulk of the inland harbour has been complete, the infrastructure for the development would be initiated. Once the inland harbour and infrastructure are completed construction of the dwelling units and landscaping will commence. It is anticipated that all dwelling units will be built and operating by January 2010.

3.0 ENVIRONMENTAL DESCRIPTION

3.1 INTRODUCTION

The Windmill Harbour Development would entail a number of activities that potentially could affect the environment. As such, a description that characterizes the environmental setting and the biological community is required in order to evaluate Project effects. A review of existing information, discussions with government personnel, and site inventories were used to develop the environmental description. The following section briefly outlines the approach used, provides a general overview of the environment setting, and describes the results.

3.2 APPROACH

3.2.1 Study Area

The site of the Windmill Harbour Development lies along the southeastern shore of the east basin of Lac Ste. Anne (Figure 3.1). The study area is defined as the proposed development property (Lot 15) and the lake shoreline immediately adjacent to the property (Development Section). In addition, surveys were undertaken to the west (West Section) and east of the property (East Section).

3.2.2 Study Period

Surveys of vegetation and wildlife resources were completed on five separate occasions. Tasks completed during each survey are outlined in Table 3.1.

Table 3.1 Tasks completed during surveys of vegetation and wildlife resources in the Windmill Harbour Study Area.

Task	**Date**					
	12 Oct 01	**29 Oct 01**	**29 Mar 02**	**22 May 02**	**28 Jun 02**	**5-6 Aug 03**
Waterbird Survey	*	*		*	*	
Wildlife and Bird Survey	*	*	*	*	*	
Vegetation Mapping				*	*	
Vegetation Survey						*

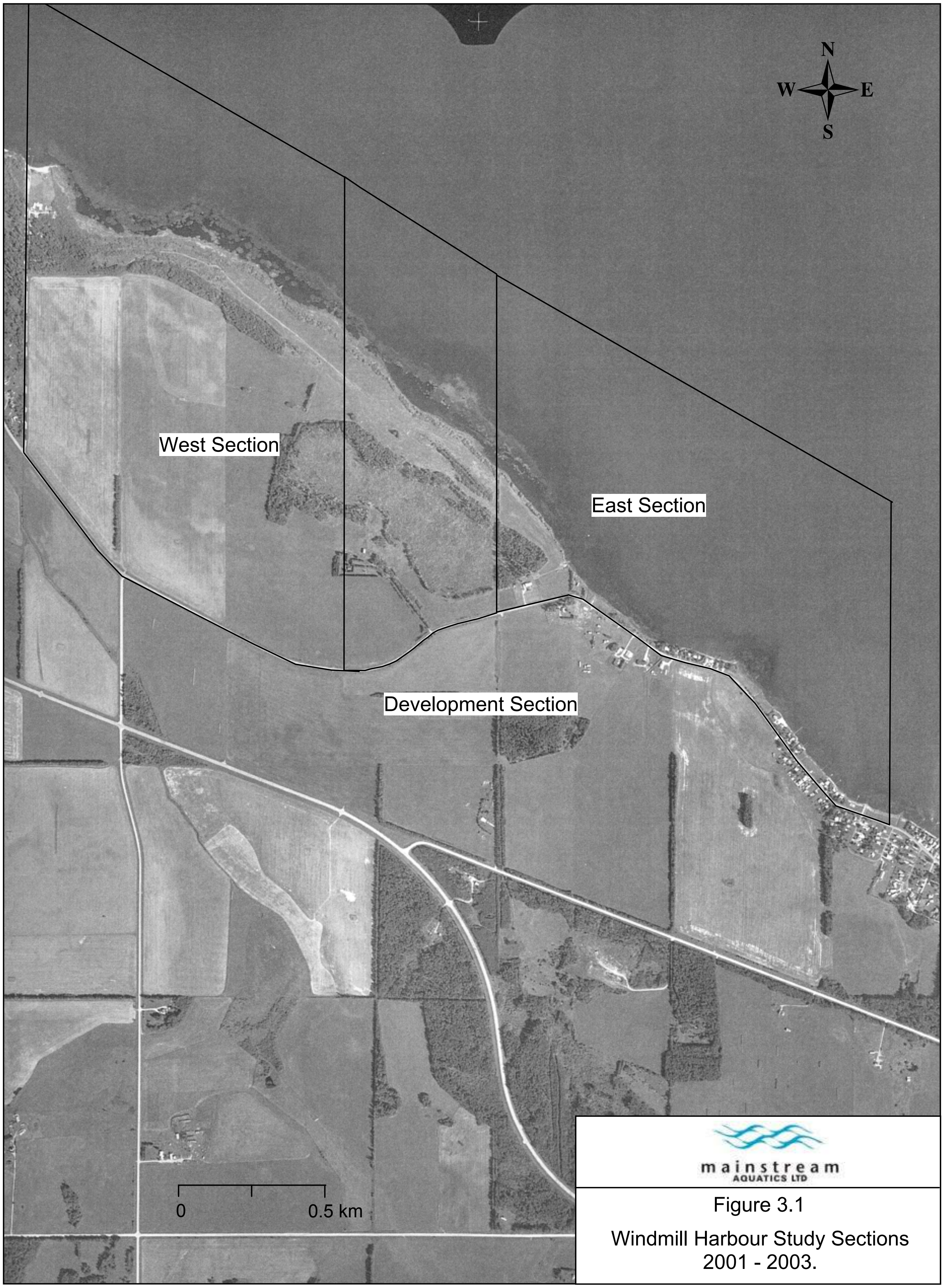

Figure 3.1

Windmill Harbour Study Sections
2001 - 2003.

A survey of water and fish resources was undertaken during a three-day period from 22 to 24 May 2002. The session was used to document general water quality conditions and use of the area by fish. Sampling focused on walleye and northern pike, which potentially could use the shoreline area adjacent to the property for spawning, rearing, and feeding.

3.3 METHODS

3.3.1 Information Review

Information from Alberta government offices was reviewed and government personnel were contacted to obtain information. Richard Neufeld of Lac Ste. Anne County Planning and Development office provided information regarding present land use in the area. Several literature sources were keyword searched, which included Fisheries and Oceans Canada WAVES library catalog, American Fisheries Society catalog of online journals, and the University of Alberta Libraries Collection. In addition, a general web query was undertaken for additional information on Lac Ste. Anne.

3.3.2 Field Assessments

3.3.2.1 Vegetation

The vegetation community (aquatic and terrestrial) was inventoried, mapped, and described. Black and white aerial photographs at a scale of 1:20,000 (dated 15 Aug 2000) were used to delineate major terrestrial vegetation communities present in the study area. This work was followed by ground truthing to confirm general terrestrial vegetation community boundaries and to identify the dominant plant species.

Aquatic vegetation was mapped based on field conditions rather using aerial photographs. This approach was required because the air photo coverage for the study area did not represent the current distribution and density of the emergent vegetation community. The perimeter of the emergent vegetation zone was delineated using a Gamin™ Model 12XL global positioning unit (±10m). These data were later downloaded and plotted. Field surveys completed on 22 May and 28 June 2002 were used to identify the dominant emergent and submergent plant species.

In addition to mapping of the major communities, more detailed information was collected for aquatic vegetation 0n 5 and 6 August 2003. This component of the vegetation inventory was conducted based on the Alberta Wetland Inventory Standard (Halsey *et al.* 2003) and included rare vascular and nonvascular plant assessments. Three transects were placed perpendicular to the lake shore in the Development Section and quadrats were established along each transect out into open water. The presence of rare plants, species composition, and relative density (percent cover) were recorded in each quadrat. In addition, ground truthing was undertaken outside the quadrats as part of the rare plant survey.

3.3.2.2 Wildlife

Wildlife inventories consisted of synoptic surveys designed to document the presence or absence of wildlife and avifauna in the study area and to enumerate the number of animals encountered. Amphibians, reptiles, mammals, and birds were recorded based on their physical presence or signs of activity (e.g., tracks and vocalizations). Particular attention was given to use of the area by waterbird species during the fall and spring migration, and nesting periods.

3.3.2.3 Water Resources

Three water quality parameters were measured on-site during the survey, including water temperature (hand-held alcohol thermometer, ± 1ºC), conductivity (TDSTestr3 conductivity meter, ± 2%), and pH (pHTestr2 pH meter, ± 0.1 pH units). Personnel also noted wind direction and wave conditions on the lake and evidence of surface runoff during each site visit.

3.3.2.4 Fish Resources

<u>Fish</u>

The objectives of fish collections on Lac Ste. Anne were to determine the presence or absence of fish species, determine their reproductive state, and to determine the use of the proposed development area. A variety of fish sampling methodologies were employed to meet these objectives.

A 5 m boat electrofisher propelled by a 175 Hp sport-jet inboard motor was used to sample fish along the outer perimeter of shoreline emergent and submerging vegetation. The craft was equipped with a double, fixed-boom anode system and Smith-Root Type VIA electrofisher system. Electrofisher settings were maintained at an amperage output of 3.0 to 4.0 A, pulsed DC current, and a frequency of 60 Hz. The sampling procedure involved drifting at motor idle along the channel margins in water depths <2.0 m, while outputting a continuous current of pulsed DC electricity. Two netters, positioned at the bow of the boat, netted fish immobilized by the electrical field. All captured fish were held in a 225 L live-well for processing. Upon completion of an electrofishing section, observed fish were enumerated, and captured fish were processed and released.

Standard experimental gill net gangs were deployed to sample deeper portions of the lake. Gill net sets were of short duration and were checked continuously to minimize any mortality associated with gill net usage. Each gang consisted of six monofilament net panels measuring 2.4 by 15.3 m; the stretched mesh gill net apertures used were 1.3, 3.8, 6.4, 8.9, 11.4 and 14.0 cm.

A fyke net was deployed along the margin of Lac Ste. Anne as a non-lethal method of capturing fish moving along the shoreline. The fyke net consisted of two parts: the hoop portion and the lead net. The hoop portion of the net is a round tube of netting 3.7 m in length. A 1.2 x 2.4 m rectangular fiberglass hoop supported the net opening; the remainder of the netting was supported by four 1.2 m diameter round fiberglass hoops. The end of the tube was drawn closed using a drawstring and a steel ring. The hoop portion of the net also sported two inner 'finger style' funnels or throats designed to prevent fish from retreating toward the mouth of the net. The lead portion of the net was intended to guide fish moving through the area into the hoop portion of the net. Consisting of two - 1.8 x 15.3 m mesh panels, the lead net extended from the center of the rectangular opening hoop towards the shoreline.

In an attempt to capture smaller-sized fish, standard minnow traps (Gee type) baited with canned cat food were deployed. The dimensions of the traps were 0.4 m length x 0.2 m diameter with an aperture opening at either end of 0.02 m.

Artificial substrate mats and sweep nets were utilized to document the presence of fish eggs or larvae in the vicinity of the proposed development. Substrate mats placed in potential northern pike spawning areas consisted of a 30-cm square section of latex horsehair matting secured to the lake substrate using a stake.

Sweep nets were utilized to collect eggs and larvae already deposited amongst the substrate and vegetation. Sweep nets consisted of a semi-circular net frame (17 cm radius) with a handle attached opposite of the flattened portion of the frame. The 1 mm mesh netting was sewn into a canvas neck that was 17 cm deep. The flattened lower portion of the net frame was swept along the substrate and vegetation; each sweep was approximately one meter in length.

Collected eggs and larvae were preserved using buffered 1% formalin and labeled for later identification.

Fish Habitat

Fish habitat was assessed by mapping the aquatic vegetation as described in Section 3.3.2.1. Additional data were collected in order to describe and quantify fish habitat. Five depth transects were completed perpendicular to the shoreline to ascertain the lake bed bathymetry in the vicinity of the Project. Geo-referenced locations were recorded at 0.5 m depth intervals from 0.5 to 5.0 m of depth. Water depth was measured using an Eagle Fish Easy II depth sounder. Substrate along each transect was classified as either fine (sand/muck) or coarse (gravel/cobble) material using a wading rod or anchor. Where coarse material was encountered, a sample was collected where possible to verify the size of the material.

An experienced fish biologist rated the quality of fish habitat. The rating system was specific to species and life-requisites expected to be important in shoreline habitats found in the study area (i.e., egg incubation/spawning, juvenile rearing, adult feeding). Rating categories corresponded to guidelines specified by DFO (1998) and are as follows:

Category	Description
Negligible (1)	Habitat has no value to the species life stage.
Low (2)	Habitat contributes marginally to production of the species life stage.
Moderate (3)	Habitat is used by the species life stage, but is present in large amounts.
High (4)	Habitat is unique and is critical to the well-being of the species life stage.

3.3.2.5 Data Processing

In general, raw data were entered into Microsoft Access® software data storage files. Quality control measures included a visual inspection of the data immediately following entry, random inspections by a second party, and basic summary statistics to identify data entry errors.

Geo-referenced location data were plotted to a geo-referenced aerial photograph of the study area using MapInfo®.

Summary information was generated using Microsoft Excel® software. Fish catch rates were calculated based on the number of captured fish divided by the sampling effort expended using a particular sampling methodology.

3.4 RESULTS

3.4.1 Social Issues

Land Use

The main land use in the Lac Ste. Anne watershed is agriculture, which consists of mixed farming, livestock grazing, and forage production (Mitchell and Prepas 1990). There are six summer villages and five subdivisions that occur around the lake, but Alberta Beach is the focal point for most recreational lake activities. These include boating and fishing in the summer and ice fishing and snowmobiling in the winter. There has been no formal boat counts undertaken by the County of Lac Ste. Anne, but the majority of recreational watercraft on the lake are thought to originate from outside areas such as the City of Edmonton (Richard Neufeld, pers. comm.). Similarly, no formal snowmobile counts have been made, but the lake is used for recreational snowmobiling and the majority of activity is concentrated along the lake shore or is associated with ice fishing.

The site of the Windmill Harbour Development lies along the southeastern shore of the east basin of Lac Ste. Anne approximately 1 km west of the Summer Village of Val Quentin. Properties adjacent to the Project are under private ownership. A wooded lot and residence are owned by Leanne Knysh to the east. Art & Ben Sonnenberg presently own Lot 13 immediately west of Lot 14 of the Project. Fritz Sonnenberg is the tenant farmer who cultivates Lot 15, 14 and Lot A (formerly part of Lot 15) on the south side of Lac Ste. Anne Trail.

<u>Historical Resources</u>

The Alexis Indian Reserve is located on the northwest section of the lake. Also, the Lac Ste. Anne Mission, which is located on the south shore approximately 1.5 km to the west of the development, is an important gathering site for native peoples wishing to celebrate their Christian faith and bathe in the healing waters of the lake.

Due to the extensive amount of physical disturbance in the area that has occurred historically, no unique resources are expected to occur on the Windmill Harbour Development site. Jaymar Consulting Inc. will make an application to the Alberta Community Development to ascertain whether a historical resource assessment be conducted for the proposed development. If this agency deems that an assessment is required, the work and mitigation measures will be completed prior to initiation of construction.

<u>Public Issues</u>

Jaymar Consulting Inc. made a previous submission to the County for change of zoning and approval of an Area Structure Plan on approximately 26 hectares associated with the Project. A public meeting was advertised and held in the Albert Beach Community Hall at which 85 people were in attendance. Bill Martenson of Jaymar Consulting Inc. chaired the meeting and information was provided by town planner Eugene Lee and Reg Dacyk of GPEC Consulting Engineers, aided by maps, plans and overhead projections. Richard Neufeld and three County Councilors were also in attendance. About 15 of the attendants resided in the County, while the balance was from the adjacent summer villages.

The public meeting was followed by an additional hearing at the County Office in Sangudo, with minimal public attendance. The Area Structure Plan and Rezoning bylaw were then passed unanimously that same afternoon.

Based on the results of the public meeting and hearing, the concerns of the local community were addressed to the satisfaction of the Lac Ste. Anne County with the exception of a small group that were against any development near the lake.

The current Project will require a new area structure plan and a second set of public meetings (Richard Neufeld, pers. comm.). Any new public concerns identified at this time will need to be addressed to the County's satisfaction as part of the municipal approval process.

3.4.2 Terrain and Soils

AMEC Earth & Environmental Limited (AMEC) completed a groundwater potential study for the proposed development (AMEC 2001). The following summarizes information in that document that was related to terrain and soils.

The Project area is located on generally flat terrain that gradually slopes towards Lac Ste. Anne. Surficial geology in the area is generally characterized by glacial till that has been modified by lake or stream erosion. The east portion of the development area is mapped as silt and clay with a flat to gently undulating surface. Water wells in the area indicate a general geology of clay till overlaying sand and gravel deposits above bedrock.

3.4.3 Surface and Ground Water

The following section summarizes information related to surface and ground water that was presented in a report by AMEC Earth & Environmental Limited (AMEC 2001).

Surface water in the area is characterized as ill-defined drainage towards the lake shore. There are no defined watercourses or ponded waters in the development area. Regional hydrogeological mapping of the area shows groundwater flow from either surficial sand or gravel deposits. The expected groundwater yields are 25 to 100 igpm. Most wells in the greater area appear to be completed in shale or sandstone at depths greater then 30 m. Recovery data from two pump tests in the vicinity of the Project area indicate long term safe yields of 57 and 60 igmp. Groundwater quality appears to be good with Total Dissolved Solids being from 500 to 1000 mg/L.

3.4.4 Vegetation

A search of the Alberta Natural Heritage Information Centre (ANHIC) identified no occurrences of rare plants in the Project area (John Rintoul, Section Head and Information Coordinator, Alberta Natural Heritage Information Centre, pers. comm.). This information review was supplemented by field surveys of the upland and aquatic vegetation communities.

3.4.4.1 Upland Vegetation

A large percentage of the basin consists of undeveloped forest. The area is located in the Boreal Mixedwood Ecoregion (Strong and Leggat 1981). Trembling aspen (*Populus tremuloides*) dominate in the well-drained soils, while black spruce (*Picea mariana*) and balsam poplar (*Populus balsamifera*) are prevalent in poorly drained areas.

The upland portion of the proposed development is 42.8 ha in size (Figure 3.2, Table 3.2). The majority of the area has been disturbed in the recent past or by present human activities (34.1 ha or 80%). The undisturbed area consists of mature stand of balsam polar/black spruce (6.5 ha). In terms of percent surface area, land use activities consist of cultivated (25) and forage crop sections (20%), as well as farm buildings and an access road (5%).

Table 3.2 Vegetation zones mapped in the Development Section of the Windmill Harbour Study Area, 28 June 2002.

Zone		Area (ha)	Percent
Cultivated land		10.72	25.0
Forage Crop		8.56	20.0
Farm buildings and access road		1.96	4.6
Mature poplar/spruce		6.45	15.1
Planted spruce		0.44	1.0
Logged forest		12.42	29.0
Riparian		2.26	5.3
Terrestrial Total		**42.81**	**100.0**
Emergent Vegetation -	Bulrush	11.21	80.0
	Water lily	0.68	4.9
	Open water in emergents	2.12	15.1
Emergent Total		**14.01**	**100.0**

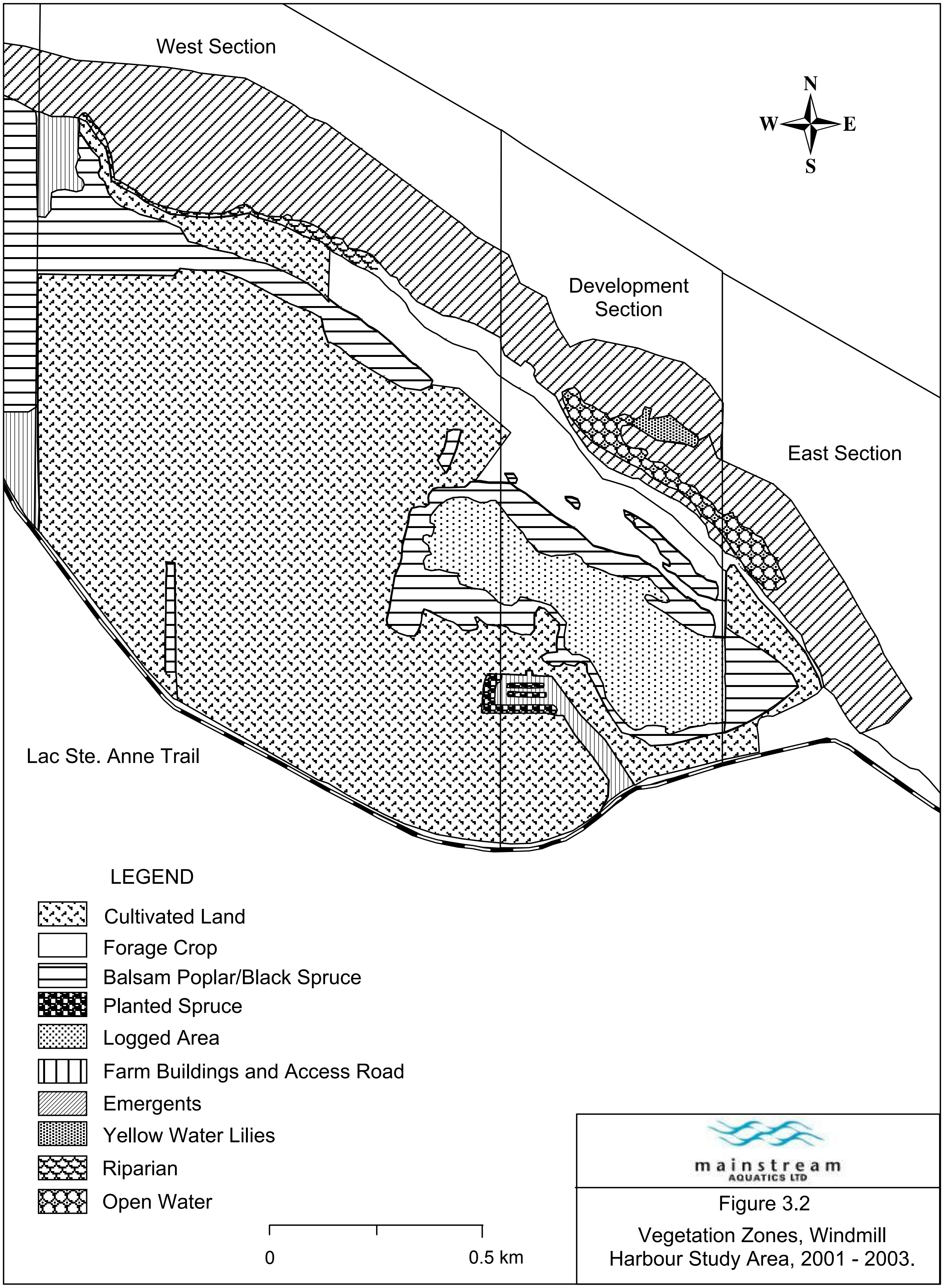

Figure 3.2

Vegetation Zones, Windmill Harbour Study Area, 2001 - 2003.

The remainder of the upland area in the Development Section consists of a small stand of planted spruce trees adjacent to the farm buildings (1%), a band of riparian vegetation (primarily willows [*Salix spp.*]) adjacent to the shoreline (5%), and a forest block that was logged in 1992 (29%). The mature stand of balsam poplar/black spruce (15%) is generally situated between the cut block and the forage crop area. The cut block is presently regenerating and is dominated by trembling aspen, balsam poplar with a dense understory of red-osier dogwood (*Cornus stolonifera*) and gooseberry (*Ribes spp.*).

3.4.4.2 Aquatic Vegetation

There is an extensive zone of emergent vegetation dominated by bulrushes (*Scirpus spp.*) that occurs along the entire shoreline of the property that has an approximate area of 14.0 ha (Figure 3.2, Table 3.2). In general emergent vegetation extends up to 150 m offshore and exhibits a stem density that is sufficient to prevent wave action from disturbing a number of open water areas next to shore.

One of these sheltered areas supports a dense stand of yellow water lily (*Nuphar variegatum*) approximately 0.7 ha in area. Yellow water lily and submergent vegetation (e.g., common bladderwort [*Utricularia vulgaris*]) also are interspersed throughout the emergent vegetation zone. This zone also contains an open water area that is approximately 2.1 ha in size.

In addition to mapping of the dominant plant communities a detailed survey was completed. The results are presented as follows: detailed information is presented in Addendum A.

There are two well-defined, more or less continuous beach ridges in the study area. The primary beach ridge marked by the outer limits of poplar forest and tilled cropland was formed at a time when lake levels were higher, probably in early postglacial times. There is second lower second beach ridge (close to the existing shoreline) occupied by a strip of dense willow shrubbery. Between the two beach ridges there is a broad band of open land mainly occupied by sedge fen, with varying degrees of recent willow invasion. The detailed survey focused on riparian and aquatic vegetation below the primary beach ridge.

The shoreline vegetation in the Project area is representative of natural vegetation of Lac Ste. Anne and similar lakes in central Alberta. It shows little evidence of recent manmade disturbance. It was not found to contain any plant species listed as rare on the Provincial "Tracking List" published by the Alberta Natural Heritage Information Centre. Most of the plant communities extend (continuously or with only short gaps) along the entire shoreline. The only exception was the pond lily community, which is confined to north-central part of the Development Section.

Water depth at the outer limit of bulrush beds was measured at 1.3 m. The lake water was murky due to abundant microorganisms, so the lake bottom could not be seen in open water plots (1.3 m and beyond). Rack samples indicated that coverage by rooted aquatics is at most patchy, but the presence of *Chara* spp. may have been underestimated due to its short stems not being effectively sampled with the tool used. Given the poor light penetration into the water, abundance growth of rooted aquatics in water depths >1.3 m seems unlikely.

The following are more detailed comments on particular vegetation types.

<u>Sedge Fens</u>

The extensive band of open ground between the two main beach ridges is mainly occupied by sedge fen , the dominant sedges being awned sedge *(Carex atherodes)* and/or graceful sedge *(C. praegracilis)* (see plots 1A, 2A, 3A). Many parts of this fen are being invaded by willow saplings (mainly basket willow, *Salix petiolaris*,). This willow invasion may indicate that the site has become drier in recent years, or that willow growth was previously suppressed due to cultivation or grazing. The prevalence of graceful sedge suggests that the land is slightly saline (oligohaline), as also does the fact that most of the willow saplings belong to basket willow, which is the species of willow most tolerant of salinity. No poplar saplings were recorded in this area. The vegetation complex indicates that the land must have a high water table for at least part of the year.

Limited bands of sedge fen dominated by awned sedge also occur below the second beach ridge (see plot 2C). This species is commonly found on intermittently flooded ground.

<u>Willows</u>

An almost continuous band of dense mature willow shrubbery extends along the second beach ridge (see plots 1B, 2B, 3B). The dominant willow is basket willow, a species indicative of eutrophic to oligohaline conditions. Some weedy herbs were recorded in the understory of this strip: stinging nettle (*Urtica dioica*) and hemp nettle (*Galeopsis tetrahit*).

<u>Reed Beds</u>

Reed beds dominated by the tall reed Canary grass (*Phalaris arundinacea* and/or blue joint (*Calamagrostis canadensis*) (see plots 1C, 2D, 3C) occur extensively along the upper shoreline, either immediately below the second beach ridge or on a slight third beach ridge separated from the second ridge by a strip of sedge fen (transect 2). These robust grasses predominate on sites subject to disturbance by wind and wave action during severe storms, but above normal water levels.

Cattail Beds

Cattail beds (*Typha latifolia*) commonly form continuous bands on saturated to shallowly flooded ground at the edges of eutrophic lakes and ponds with more or less stable water levels (see plots 1D, 2E, 3D). The stands at this site contain a rather diverse mixture of other wetland plants, especially common manna grass (*Glyceria grandis*), giant burreed (*Sparganium eurycarpum*) and creeping spikerush (*Eleocharis palustris*). This is the only plant community at the site with an extensive moss layer (consisting of *Drepanocladus aduncus*).

Bulrush Beds

Broad beds of hard-stemmed bulrush (*Scirpus acutus*) extend along the entire shoreline, occupying water ranging in depth from a few centimetres at the edge of the cattail beds to about 1.3 m. The density of the bulrushes decreased with increasing distance from the shore. Some parts of the beds contain dense growth of the submersed aquatics such as common bladderwort (*Utricularia vulgaris*) and hornwort (*Ceratophyllum demersum*), but in other places few or no rooted plants other than bulrush were present (compare plot 2F with plots 1E and 3E). Bulrush beds are both physically and biologically important, as they break up and slow down waves before they reach the shore; thus they protect shorelines from erosion, as well as provide shelter for wildlife.

Submersed Aquatics

A zone of rooted aquatic vegetation beyond the bulrush beds appears poorly developed in this lake, only *Chara* spp. being present in all three of our samples (plots 1F, 2G, 3F). While *Chara* spp. is classified as an alga, it is normally listed as a rooted aquatic because it is attached to the substrate. Patches of clasping-leaf pondweed (*Potamogeton richardsonii*) and sago pondweed (*P. pectinatus*) were found, but appeared not to be extensive. Poor light penetration of the water is probably responsible for poor development of a rooted aquatic flora in this lake beyond the bulrush beds. A series of shallow lagoons along the shore contains a different community of submersed aquatic plants dominated by thread-leaved pondweed (*Potamogeton filiformis*) (see plot 4B).

Pondlily Beds

Extensive beds of yellow pondlilies (*Nuphar variegatum*) are found towards the east end of the site. The water beneath the pondlilies is occupied by dense mats of common bladderwort and hornwort. Much of this area is free of bulrushes, but there is a transition zone containing both pondilies and bulrushes in the location of the western grebe colony.

3.4.5 Wildlife

The Lac Ste. Anne region provides habitat for a wide variety of wildlife species including white-tail deer (*Odocoileus virginianus*), moose (*Alces alces*), snowshoe hare (*Lepus americanus*), coyote (*Canis latrans*), and many other species. Semi-aquatic furbearers such as muskrat (*Ondatra zibethica*) and mink (*Mustela vision*) also inhabit the area. Amphibians expected to occur in the region include striped chorus frogs (*Pseudacris triseriata*), wood frogs (*Rana sylvatica*), and western toad (*Bufo boreas*) (Russell and Bauer 1993). The red-sided garter snake (*Thamnophis sirtalis*) is also present in the area (Russell and Bauer 1993). Over 130 species of birds have been recorded in the general area, including numerous forest and grassland song birds, upland game birds, and waterfowl (Semenchuk 1992).

Lac Ste. Anne and portions of undisturbed shoreline provide habitat for a variety of waterbirds including geese, ducks, herons and grebes. Lac Ste. Anne is considered nationally important for waterfowl and for western grebes (Poston et al. 1990).

Extensive cultivation and haying activities on the upland portion of the proposed development site limits the amount of habitat available to wildlife, but the natural vegetation communities that are present provide good habitat diversity. Wildlife and bird surveys documented a wide variety of species in the Windmill Harbour study area that are typical of this part of Alberta (Appendix Tables A1 and A2) and the majority of these species were recorded in the Development Section

The cut block provides winter browse for ungulates such as white-tailed deer and moose and the uncut portion of mature forest provides refuge for these species. Track patterns recorded during winter also suggests that the area is a movement corridor for ungulates and smaller mammals such as coyote, red fox (*Vulpes fulva*) and striped skunk (*Mephitis mephitis*).

Raptors such as osprey (*Pandion haliaetus*) and hawks use the mature trees on the property as perches. In addition, an active red-tailed hawk nest was present in the mature stand of popular/spruce. There are also a variety of song birds and game birds (e.g., ruffed grouse) are present.

During the spring survey, breeding chorus frogs and wood frogs were recorded along the shoreline of Lac Ste. Anne and in some ephemeral ponds present in the cut block.

Waterbirds use the lake shore in the study area. Fall and spring surveys suggest that this portion of the lake is a staging area for waterfowl, and in particular, for lesser scaup (*Aythya affinis*), common goldeneye (*Bucephala clangula*), and bufflehead (*Bucephala albeola*). The size, characteristics, and isolation of the emergent vegetation suggest that it is also used as a moulting area for ducks. Based on the presence of paired birds, nestling ducks and goslings, ducks and geese likely nest in the study area and probably within the Development Section. The riparian vegetation zone and forage crop land also provide good nesting habitat for several species of upland nesting waterfowl.

The emergent vegetation zone within the study area provides nesting areas for several songbird species including yellow-headed blackbird (*Xanthocephalus xanthocephalus*), red-winged blackbird (*Agelaius phoeniceus*), and long-billed marsh wrens (*Telmatodytes palustris*). Nesting colonies of both blackbird species were present in the Development Section.

Nesting water bird colonies also were identified in the emergent vegetation zone within the Development Section of the study area. These included black tern (*Chlidonias niger*) and common tern (*Sterna hirundo*), eared grebe (*Podiceps nigricollis*), and western grebe (*Aechmophorus occidentalis*). The western grebe colony is of particular importance because it is considered a “sensitive” species by the province (Alberta Sustainable Resource Development 2001). The western grebes and the eared grebes have been the focus of a monitoring program currently being conducted by Alberta Sustainable Resource Development, Fish and Wildlife Division (Stephen Hanus, Northeastern Slopes Area Wildlife Biologist, pers. comm.). The relevant findings of this study by Hanus *et al.* (2002) are summarized below.

A survey conducted by the researchers in 2001 identified a colony of western grebes on Lac Ste. Anne that was located in the emergent vegetation zone within the Development Section of the Project. The approximate location of the colony based on information collected in the field in 2002 and information provided by Hugh Wollis of Sustainable Resource Development is presented by Figure 3.3. In 2001 the colony consisted of 1268 adults and 634 nests. Of these nests, 47% were considered active. Historically, western grebes nested at two colonies at the narrows that separate the east and west basins of Lac Ste. Anne. The present colony apparently relocated to what is considered a more secluded lake shore.

A single eared grebe colony was also identified on Lac Ste. Anne and it is also adjacent to the Project. This colony consisted of 934 individuals and 467 nests, 85% of which were active. Investigations in May and June confirmed that these colonies were active in 2002.

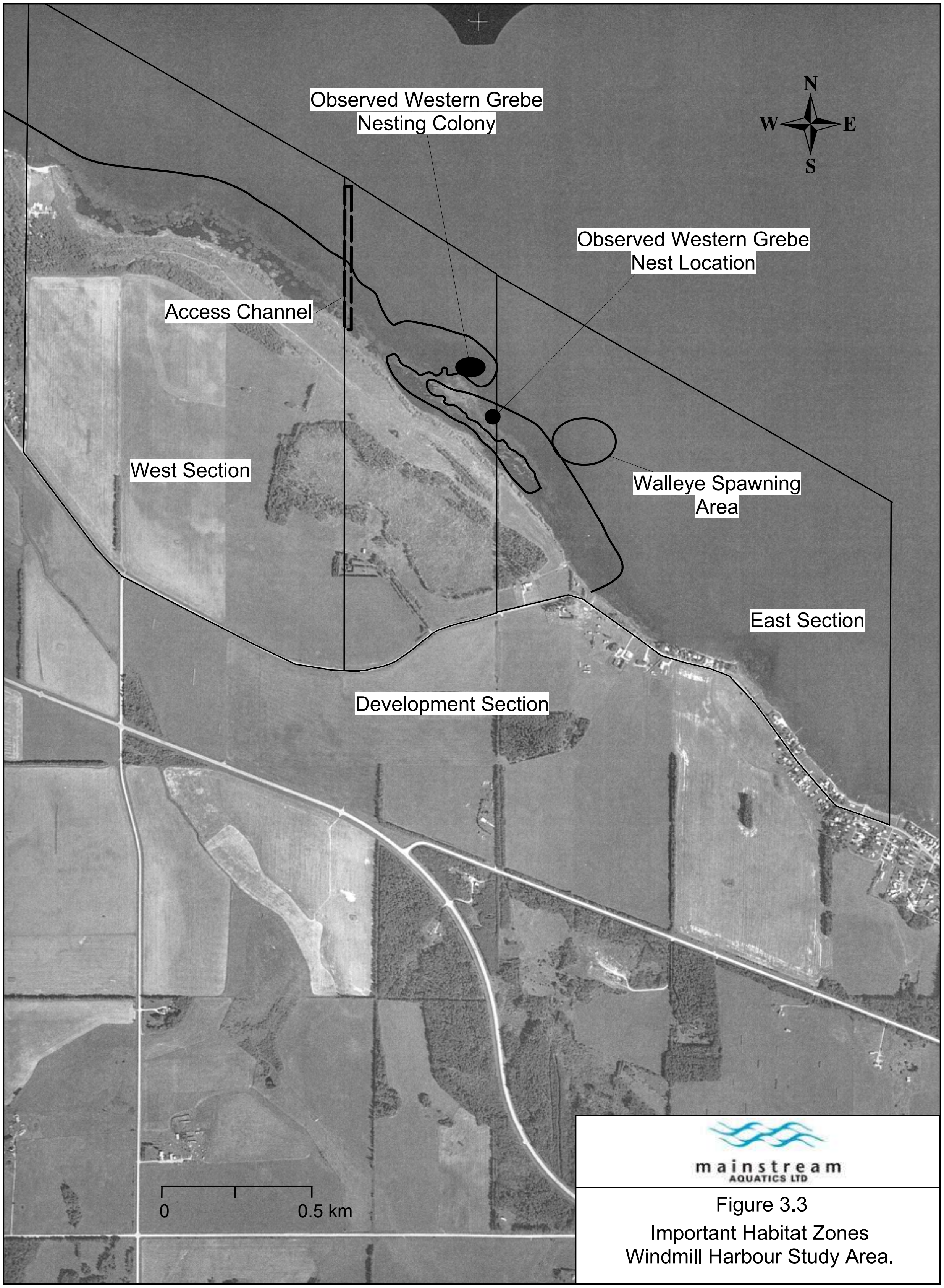

Figure 3.3
Important Habitat Zones
Windmill Harbour Study Area.

The 2002 field investigations and information provided by Hugh Wollis of Sustainable Resource Development for western grebes indicates that the colonies are situated approximately 440 m east of the proposed location of the access channel and approximately 150 m north of the residential lots.

3.4.6 Water Quality

Lac Ste. Anne is a moderate sized lake with a surface area of 5690 hectares (Mitchell and Prepas 1990). Lac Ste. Anne is part of the North Saskatchewan River basin and is fed by several tributaries. The largest is the Sturgeon River, which enters the lake from the west and is the primary lake outflow to the east.

Lake Ste. Anne consists of two basins connected by a narrow passage (Mitchell and Prepas 1990). The east basin is the larger of the two being about 9.5 km long and 7.0 km wide, and it also is the deepest (9 m). A weir present at the outflow of Lac Ste. Anne does not appreciably control water levels, but it does help maintain minimum lake levels. Records maintained since 1993 indicate that water levels have fluctuated between 721.99 m and 723.79 m (Mitchell and Prepas 1990). Lake water levels recorded between 1969 and 1998 were generally below the long-term average. In July 2002, the Lac Ste. Anne water level elevation was 722.54 m, or 0.46 m below the average for that month (Alberta Environment Hydrology Branch).

Lac Ste. Anne is a fresh water lake that contains low amounts of total dissolved solids (Mitchell and Prepas 1990). The water column in the east basin periodically mixes throughout the summer, but on calm days the lake may thermally stratify. This can result in rapid oxygen depletion and anoxic conditions next to the lake bottom. Lac Ste. Anne is eutrophic and algae blooms are evident during late summer. These blooms are largely caused by nutrient enrichment from phosphorous loading (Mitchell 1999). Sources of phosphorous include lake sediments (42%), agricultural activities in the watershed (49%), deposition from the atmosphere (2%), and domestic sewage (7%). Although Lac Ste. Anne is rich in nutrients, there is no evidence that water quality of the lake has deteriorated (Mitchell 1999). Water temperatures in Lac Ste. Anne can reach 21^{0}C during the summer months, which is typical for north central Alberta lakes (Mitchell and Prepas 1990). During spring, temperatures during the field program ranged from 5.0 to 7.0ºC; warmer water temperatures were observed in sheltered, shallow nearshore areas. Conductivity measurements ranged between 290 and 310 µS/cm, while pH ranged from 8.4 to 8.7.

3.4.7 Fish

3.4.7.1 Fish

Several fisheries inventories and research studies completed by the provincial government and universities have documented eight fish species in Lac Ste. Anne (Table 3.4). Five sportfish species have been documented including lake whitefish, northern pike, walleye, yellow perch, and burbot (Agra 1994, Lane 1971, Lane and Lynch 1969, Rhude 1979, Zelt 1976). Non-sportfish species identified include white sucker, spottail shiner, and brook stickleback.

Agra Earth and Environmental conducted a recent investigation into the physical, chemical, and biological characteristics and conditions of Lac Ste. Anne (Agra 1994). A comparison of the sportfish harvest data collected in 1969 and 1984 indicated that sportfish catches were near capacity. The report also speculated that periodic lake whitefish and walleye reproductive failures were correlated with fluctuations in lake water level. Low fall water levels result in desiccation and freezing of lake whitefish eggs on shallow, sloping sandy areas.

Table 3.4 Fish species present in Lac Ste. Anne.

Family	Common Name	Scientific Name
Sportfish		
Salmonidae	Lake whitefish	*Coregonus clupeaformis* (Mitchill)
Esocidae	Northern pike	*Esox lucius* Linnaeus
Percidae	Walleye	*Stizostedion vitreum* (Mitchill)
Percidae	Yellow perch	*Perca flavescens* (Mitchill)
Gadidae	Burbot	*Lota lota* (Linnaeus)
Non-Sportfish		
Catostomidae	White sucker	*Catostomus commersoni* (Lacépède)
Cyprinidae	Spottail shiner	*Notropis hudsonius* (Clinton)
Gasterosteidae	Brook stickleback	*Culaea inconstans* (Kirtland)

Creel surveys designed to determine the status and population of the northern pike recreational fishery also have been conducted on Lac Ste. Anne. In 1986, Sullivan (1986) described high catches of northern pike (6700 fish) and walleye (3400 fish). The report concluded that Lac Ste. Anne experienced moderate fishing pressure (6.3 angler-hours/ha) in comparison to six other northeast region lakes. A recent creel survey by Patterson (2002) reported much lower angling pressure (2.6 angler-hours/ha), a low catch rate for northern pike (0.336 fish/hr), and a preponderance of sub-legal sized northern pike in the angler catch.

Species Composition

During the field program, a total of 667 fish were captured or observed (Appendix B). The sample represented seven species, which included five sportfish and two non-sportfish species. Most species known to occur in Lac Ste. Anne (all except brook stickleback) were recorded.

Sportfish accounted for nearly 90% of the catch and lake whitefish was the principal species accounting for 64% of the total (Table 3.5). The remaining sportfish species contributed approximately 25% to the catch and were, in decreasing order of abundance, northern pike, walleye, yellow perch, and burbot. Non-sportfish species were not abundant. As a group they contributed approximately 10% to the total.

Distribution

The distribution of fish species varied slightly among the three sample sections (Table 3.6). Lake whitefish, northern pike, and walleye were captured throughout the study area. Yellow perch were not encountered in the West Section and burbot were not captured or observed in the Development Section. White suckers were found in all three sections, while spottail shiner were not captured in the Development Section. This distribution is likely a reflection of sampling effectiveness and the relative abundance of each species rather than actual spatial distribution. It is probable that all species are present throughout the study area.

Table 3.5 Number and percent composition of fish species recorded during sampling in the Windmill Harbour Study Area, 22-24 May 2002 (all methods combined).

Species	Captured	Observed	Total	Percent
Sportfish				
Lake whitefish	150	279	429	*64.3*
Northern pike	68	16	84	*12.6*
Walleye	43	19	62	*9.3*
Yellow perch	19		19	*2.8*
Burbot	3		3	*0.4*
Subtotal	**283**	**314**	**597**	***89.4***
Non-Sportfish				
White sucker	42	25	67	*10.0*
Spottail shiner	3		3	*0.4*
Subtotal	**45**	**25**	**70**	***10.4***
Total	**328**	**339**	**667**	***100.0***

<u>Abundance</u>

Numerical importance of a particular species in the fish community was ascertained by examining relative abundance values (catch-per-unit-effort or catch rate) generated using a variety of sampling techniques. Boat electrofishing appeared to be the most productive fish sampling method. In total, 2.12 hours of total electrofishing effort was expended during the survey and sampling occurred in each section.

Table 3.6 Distribution of fish species recorded during fish sampling in the Windmill Harbour Study Area, 22-24 May 2002 (all methods combined).

Species	Section		
	West	Development	East
Sportfish			
Lake whitefish	*	*	*
Northern pike	*	*	*
Walleye	*	*	*
Yellow perch		*	*
Burbot	*		*
Non-Sportfish			
White sucker	*	*	*
Spottail shiner	*		*

The overall catch rate for boat electrofishing was 257 fish/hour, with section catch rates ranging between 193 and 382 fish/hour (Table 3.7). Highest catch rates were recorded in the East Section. Catch rates for lake whitefish (198 fish/hour) were more than 10 times those of all other fish species including walleye (17 fish/hour) and northern pike (12 fish/hour), and white sucker (29 fish/hour).

One gill net site was established in each section to determine fish use of deeper habitats not effectively sampled by boat electrofishing. In total, 3.9 hours of gill net effort were expended yielding 98 captured fish (Table 3.8). The overall catch rate was 25 fish/hour with individual section rates ranging from 10 to 60 fish/hour. As with boat electrofishing, the highest catch rates were recorded in the East Section. In general, the catch rates for northern pike, walleye, and yellow perch were considered moderate (9.9 to 4.1 fish/hour, respectively) and low for all other species (<2.4 fish/hour).

Two fyke net sites were established within the Development Section. In total, 45.6 hours of net effort were expended (22.1 and 23.5 hours at FN1 and FN2, respectively). A total of 21 fish were captured in the fyke nets; 20 northern pike and 1 white sucker. The overall catch rate was 0.5 fish/hour (0.3 and 0.6 fish/hour for FN1 and FN2, respectively).

Table 3.7 Catch and catch rate for fish (fish/hour) recorded by boat electrofishing in the Windmill Harbour Study Area, 22-23 May 2002 (includes captured and observed fish).

Species	Site						Total	
	ES1 (West)		ES2 (Development)		ES3 (East)			
	No.	*CPUE*[a]	No.	*CPUE*	No.	*CPUE*	No.	*CPUE*
Sportfish								
Lake whitefish	132	*158.5*	104	*148.9*	184	*311.4*	**420**	***197.9***
Northern pike	4	*4.8*	6	*8.6*	15	*25.4*	**25**	***11.8***
Walleye	9	*10.8*	16	*22.9*	10	*16.9*	**35**	***16.5***
Yellow perch	0	*0.0*	0	*0.0*	0	*0.0*	**0**	***0.0***
Burbot	1	*1.2*	0	*0.0*	2	*3.4*	**3**	***1.4***
Subtotal	**146**	***175.3***	**126**	***180.4***	**211**	***357.1***	**483**	***227.6***
Non-Sportfish								
White sucker	36	*43.2*	9	*12.9*	15	*25.4*	**60**	***28.3***
Spottail shiner	2	*2.4*	0	*0.0*	0	*0.0*	**2**	***0.9***
Subtotal	**38**	***45.6***	**9**	***12.9***	**15**	***25.4***	**62**	***29.2***
Total	**184**	***220.9***	**135**	***193.2***	**226**	***382.5***	**545**	***256.8***

Table 3.8 Catch and catch rate for fish (fish/hour) captured by gill net in the Windmill Harbour Study Area, 22-23 May 2002.

Species	Site						Total	
	GN1 (West)		GN2 (Development)		GN3 (East)			
	No.	*CPUE*	No.	*CPUE*	No.	*CPUE*	No.	*CPUE*
Sportfish								
Lake whitefish	4	*2.8*	3	*1.5*	2	*4.0*	**9**	***2.3***
Northern pike	7	*4.9*	23	*11.5*	9	*18.0*	**39**	***9.9***
Walleye	2	*1.4*	23	*11.5*	2	*4.0*	**27**	***6.9***
Yellow perch	0	*0.0*	0	*0.0*	16	*32.0*	**16**	***4.1***
Burbot	0	*0.0*	0	*0.0*	0	*0.0*	**0**	***0.0***
Subtotal	**13**	***9.2***	**49**	***24.5***	**29**	***58.0***	**91**	***23.2***
Non-Sportfish								
White sucker	1	*0.7*	5	*2.5*	0	*0.0*	**6**	***1.5***
Spottail shiner	0	*0.0*	0	*0.0*	1	*2.0*	**1**	***0.3***
Subtotal	**1**	***0.7***	**5**	***2.5***	**1**	***2.0***	**7**	***1.8***
Total	**14**	***9.9***	**54**	***27.0***	**30**	***60.0***	**98**	***25.0***

In total, 231.5 hours of minnow trap effort (mean of 25.7 hours/trap) was expended during the sample period amongst nine sample sites established within the Development Section (Figure 3.3). These efforts yielded three yellow perch at a single location for a mean catch rate of <1 fish/hour.

Biological Characteristics

Summaries of biological characteristics by species recorded from fish captured during the field survey are presented in Table 3.9.

Data from 150 lake whitefish were collected during the study. These fish ranged from 322 to 520 mm in fork length and 438 to 1610 g in weight. Over 80% of the fish were between 350 and 450 mm fork length.

Sampled northern pike ranged in fork length from 420 to 930 mm and from 488 to 8500 g in weight. Approximately 87% of the fish were less than 620 mm. Two individuals (2.9%) exceeded 900 mm in length. Nearly 68% of the northern pike captured were in an advanced stage of sexual development and were ready to spawn.

Biological data were collected from 68 walleye. These fish ranged in length from 355 to 555 mm and 364 to 1694 g in weight. Approximately 75% of the fish measured were between 350 and 450 mm fork length. The majority of the walleye examined were in spawning condition (93%).

Table 3.9 Summary of life history characteristics for fish captured in the Windmill Harbour Study Area, 22-24 May 2002 (all methods combined).

Species	**Fork Length (mm)**			**Weight (g)**		
	n	**Mean**	**Range**	***n***	**Mean**	**Range**
Sportfish						
Lake whitefish	150	401.7	322 - 520	123	843.0	438 - 1610
Northern pike	68	565.7	420 - 930	66	1579.2	488 - 8500
Walleye	43	408.8	355 - 555	43	739.5	364 - 1694
Yellow perch	19	78.1	57 - 96	15	5.6	4 - 8
Burbot	3	591.7	561 - 625	1	1526.0	1526
Non-Sportfish						
White sucker	42	439.3	390 - 508	39	1194.1	622 - 1732
Spottail shiner	3	75.3	63 - 83			

Limited numbers of yellow perch and burbot were sampled. Yellow perch ranged between 57 and 96 mm fork length and 4 to 8 g weight. Although quite small, some of these individuals were in spawning condition. Burbot ranged in fork length between 561 and 625 mm; weight was recorded for a single individual, which weighed 1526 g.

The 42 white suckers sampled during the study ranged in length from 390 to 508 mm with a mean of 439.3 mm. The mean weight of these fish was 1194.1 g and ranged between 622 and 1732 g. Approximately 60% of the white suckers in the catch were in spawning condition.

Sample information for spottail shiners included length; these fish ranged from 63 to 83 mm fork length.

<u>Fish Eggs and Larvae</u>

Two sample methods, artificial substrate mats and sweep nets, were utilized to determine whether spawning occurred in the Development Section. Twenty substrate mat locations were placed along the perimeter of the emergent vegetation in a sheltered area immediately east of the proposed access channel. In total, 980.9 hours of mat effort were expended. No eggs or fry were captured.

Twenty sweep net sites were established along the inner and outer perimeter of the emergent vegetation bed; the sweeps effectively sampled an area of 3.4 m^2. A single northern pike egg was encountered approximately 100 m east of the proposed access channel.

3.4.6.2 Fish Habitat

<u>Habitat Characteristics</u>

A continuous band of emergent vegetation occurs along the shoreline adjacent to the Project (Figure 3.2). At the time of the 28 June survey, this zone varied in width from 100 to 150 m, with narrowest band being located at the proposed location of the access channel. The outer boundary was generally defined by the 1.5 m depth contour. Bulrush was the dominant plant recorded (see Section 3.4.3.2); however, yellow water lily was also noted within the bulrush bed. The emergent vegetation within the Development Section was 14.0 ha in size (Table 3.2). Also present within the Development Section was a single, well-defined yellow water lily bed that measured 0.7 ha.

Depth measurements collected along five transects located perpendicular to shore indicated that the lake bed in the vicinity of the project is shallow and it exhibits a gradual slope (Figure 3.4). At the proposed location of the access channel, the minimum water depth of 2.5 m was located approximately 500 m offshore.

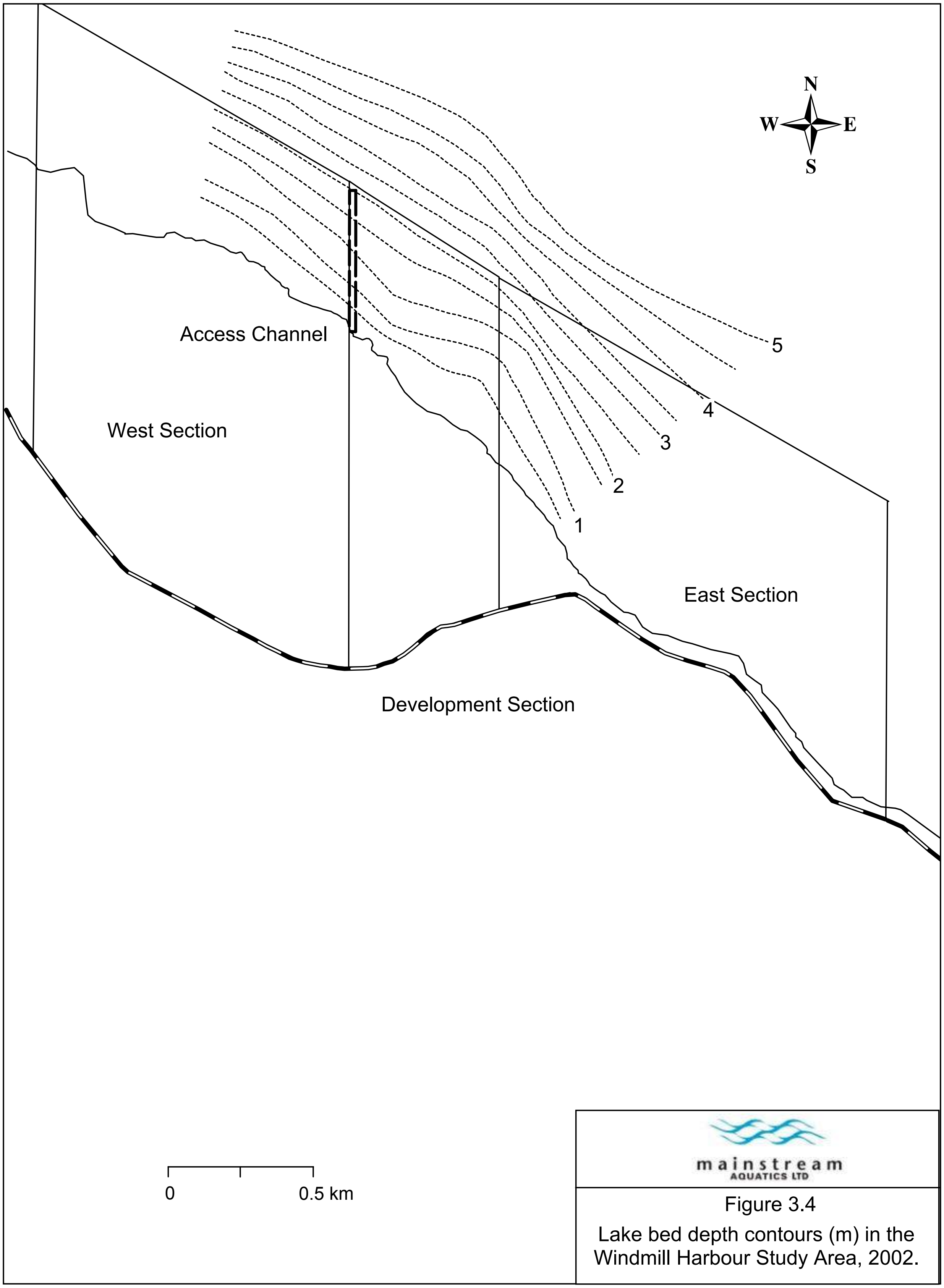

Figure 3.4

Lake bed depth contours (m) in the Windmill Harbour Study Area, 2002.

The majority of the substrate encountered within the study area consisted of sand and silt. In the emergent vegetation zone, this substrate was overlain with organic material. Larger substrates such as cobbles and boulders were sporadically encountered in nearshore areas along the shoreline. A continuous zone of gravel and cobble was documented east of the proposed access channel beyond the outer perimeter of the emergent vegetation. The approximate size and location of the area is delineated in Figure 3.3

During the 22 May field survey, the southeast shore of Lac Ste. Anne was subjected to severe wave action generated by strong northwest winds. This caused substrate disturbance along exposed portions of shorelines. However, the band of emergent vegetation in the study area dampened the effect of the wave action, which reduced the severity of shoreline disturbance.

Fish Habitat Quality

Quality of fish habitat in the Development Section of the study area was rated in terms of its suitability for spawning/egg incubation, rearing, and feeding for selected fish species (i.e., northern pike, walleye, lake whitefish). These species were chosen because they have recreational and/or economic value, the populations may be at risk in Lac Ste. Anne, and lakeshore in the vicinity of the Project has the potential to provide high quality habitat. The assessment, which is based primarily on site characteristics, provides an objective evaluation of habitat quality and its value to a particular species and life stage. Because construction of the access channel will affect fish habitat, the quality of this specific area was also evaluated.

Northern pike

Northern pike typically spawn shortly in shallow water, usually less than 0.5 m deep after ice-out at water temperatures between 8 and 12ºC (Inskip 1982). The primary spawning habitat for this species is a submerged mat of dense vegetation in a sheltered location. A variety of vegetation types are used, although grasses and sedges are preferred. The vegetation should provide abundant surface area for the eggs to adhere to and allow for sufficient water flow. The embryos are susceptible to low oxygen conditions and can be adversely impacted by high suspended sediment levels.

Northern pike fry (defined as fish up to 65 mm length) initially use habitat similar to that used for spawning (Inskip 1982). Yolk-sac fry attach themselves to the vegetation via papillae on their forehead. The vegetation serves to protect the fry from predators and from low oxygen conditions that may occur near the substrate. After a period of growth and development, fry become very mobile emigrate from their rearing area into deeper water that also contains an abundance of vegetation. Adults prefer deeper water than juvenile fish (>2.0 m), but still rely on vegetation to provide cover and food

The suitability for spawning/egg incubation habitat in the study area and in the access channel was considered moderate for northern pike (Table 3.10). This rating is based on the predominance of aquatic vegetation, shallow water depths, and sheltered areas along the lake shoreline. The area was not given a high rating because this type of habitat was not limited in Lac Ste. Anne (i.e., present at several locations elsewhere in the lake) and the absence of dense vegetation mats on the lake bottom, which is important for egg survival.

Table 3.10 Rating of fish habitat quality[a] for fish species expected to occur in Windmill Harbour Development Section and within the proposed access channel.

Species	Area	Life Stage		
		Spawning/ Egg Incubation	Juvenile Rearing	Adult Feeding
Northern Pike	Development Section	3	3	3
	Access channel/Beach	3	3	3
Walleye	Development Section	3	3	2
	Access channel/Beach	2	3	2
Lake whitefish	Development Section	3	3	3
	Access channel/Beach	3	3	3

[a] Description of habitat ratings provided in Section 2.0; 1 (Negligible) to 4 (High).

The prevalence of emergent vegetation and sheltered shallow water areas close to shore are considered important for northern pike rearing habitat. Further out in deeper water, the emergent vegetation can be an important feeding area for adult fish during certain times of the year. As such, both habitat types in the Development Section and the proposed access channel/beach received a rating of moderate.

Walleye

Walleye spawn in spring at water temperatures between approximately 6 and 9ºC (Scott and Crossman 1985). The preferred spawning grounds for this species consist of rocky areas in fast water in rivers or coarse gravel to cobble shoals in lakes that are subject to water currents. Walleye hatch in approximately 10 to 15 days, and after a short period of growth, the fry move from the interstitial space amongst the gravel into the water column where they initially rear in the open water. As they increase in size the young fish move into areas with structure such as emergent vegetation to feed and for protection from predators. Adult fish reside in open water and are often associated with physical structures next to the lake bottom.

The suitability of the Development Section for spawning/egg incubation was considered moderate for walleye due to the presence of gravel/cobble substrate, which could be used by spawning fish. Although spawning walleye were encountered during the study, these fish were located to the east of the Development Section. The proposed access channel contained no suitable spawning substrates (i.e., gravels or cobbles) and did not infringe on the spawning area. As such, it received a low rating for spawning/egg incubation. The lake area adjacent to the Project received a moderate rating for rearing due to the emergent vegetation zone, but a low rating for adult feeding habitat. In general, adult walleye infrequently use shallow water emergent vegetation as feeding areas.

Lake whitefish

Lake whitefish are fall spawners that typically spawn when water temperatures drop below 8ºC (Scott and Crossman 1985). Eggs are broadcast over a hard rocky bottom or sand. Whitefish eggs incubate over the winter and hatch the following spring. Larval lake whitefish remain in shallow protected areas until approximately mid-summer before moving offshore. Adults feed in a variety of habitats including emergent vegetation zones.

Within the Development Section the habitat quality for lake whitefish spawning was considered moderate along the outside perimeter of the emergent vegetation zone due to the presence of rock and sand substrates. The access channel also has the potential to be used for spawning, but a large portion of the channel is situated in the emergent vegetation zone, which is not typically used for spawning by this species. As such, the access channel received was rated of moderate quality. Rearing habitat for lake whitefish also was rated as moderate given the sheltered shallow water areas provided by the emergent vegetation. The preponderance of adult lake whitefish in the catch during the spring survey also suggests that the area can be important adult feeding. As for northern pike, this type of habitat is widely distributed in Lac Ste. Anne, and therefore, was given a habitat quality rating of moderate.

3.5 SUMMARY

The purpose of the baseline investigation for the Windmill Harbour Development was to collect sufficient information to allow evaluation of potential Project effects on the environment. The work included an information review and field surveys to characterize the environmental setting.

The main land use in the Lac Ste. Anne watershed is agriculture. Lac Ste Anne is used extensively for recreational activities during summer and winter. The Windmill Harbour Development is situated on private land that has been heavily impacted by past and present human activities. The majority of the area is under cultivation, is used for forage production, or has been logged. Given the extensive amount of physical disturbance that has occurred at the site, unique historical resources are not expected to occur within the development area.

Public consultations were held to allow input by the general public regarding the initial Area Structure Plan for the Project. Based on the results of a public meeting and a public hearing, the concerns of the local community were addressed to the satisfaction of the Lac Ste. Anne County.

The Project area is located on generally flat terrain that gradually slopes towards Lac Ste. Anne. Surficial geology in the area is generally characterized by glacial till that has been modified by lake or stream erosion. Surface water in the area is characterized as ill-defined drainage towards the lake shore. There are no defined watercourses or ponded waters in the Project area. Regional hydrogeological mapping of the area shows groundwater flow from either surficial sand or gravel deposits. The expected groundwater yields are 25 to 100 igpm.

Upland vegetation present in the Windmill Harbour Development study area reflects the influence of cultivation, forage production, and logging. The limited amounts of natural vegetation that is currently present on the property provide habitat for a variety of wildlife and avifauna and may be used as a travel corridor for some species.

An extensive band emergent vegetation along the entire length of the development shoreline appears to have been largely undisturbed by human activities, but no rare or endangered plant species were recorded. This zone provides important habitat for wildlife and avifauna. It is likely the area and the adjacent upland vegetation zones are used for nesting and moulting by waterfowl. The emergent vegetation zone also supports colonies of nesting waterbirds. Of particular importance is a western grebe colony located east of the proposed access channel within the Development Section. This species is susceptible to human disturbance and is presently listed as "sensitive" by the provincial government.

Lac Ste. Anne is a moderate sized lake that is fed by several tributaries, the largest of which is the Sturgeon River. Lac Ste. Anne is eutrophic and algae blooms occur during late summer. These blooms are largely caused by nutrient enrichment from phosphorous loading from a variety of sources, including human activities in the watershed and domestic sewage disposal. This information suggests that the lake's water quality, although good at the present time, could be susceptible to disturbances that introduce additional nutrients into the lake.

The composition, distribution, and relative abundance of fish species encountered in the Windmill Harbour Study Area were typical of the fish communities found in north central Alberta lakes. The dominant fish species encountered during the study were lake whitefish, northern pike, walleye, and white sucker.

The Development Section contains moderate quality fish habitat. Northern pike spawning/egg incubation, rearing, and feeding habitats were rated as moderate quality. This species was encountered in and adjacent to the emergent vegetation zone, as well as in deeper offshore areas. The majority of northern pike were in spawning condition and the presence of northern pike eggs indicates the occurrence of spawning activity. The study area also provides high quality walleye spawning in the form of a rocky shoal that is located to the east of the Development Section. Walleye were prevalent in the catch and most fish were in spawning condition. Lake whitefish were also abundant and it is likely that the area provides good quality habitat for this species.

Fish habitat in the immediate vicinity of the proposed access channel provided moderate to low quality habitats for fish depending on species and life stage. Northern pike likely spawn and rear in the area; however, the abundance of similar habitats elsewhere in the lake suggests that this location is not critical to the long-term viability of the population. Other species such as walleye and lake whitefish may also use the vicinity of the access channel for rearing and feeding purposes, but again, the abundance of similar habitats elsewhere in the lake suggests that this location is not critical to the long-term viability of these populations.

4.0 EFFECTS ASSESSMENT

4.1 INTRODUCTION

The assessment will follow procedures outlined by the Canadian Environmental Assessment Agency (1994, 1997) and Barnes and Davey (1999) and will be used to ascertain whether one or more Project activities will cause a Significant Adverse Effect on the environment. For the purposes of this assessment, a significant adverse effect is defined as any Project related activity that changes the characteristics of a resource in sufficient magnitude, duration, or frequency, as to cause a permanent change from pre-development conditions. For example, a population of fish may be sufficiently affected by the Project's access channel to cause a permanent reduction in fish numbers.

The effects assessment includes an evaluation of two scenarios. The first involves an evaluation of Project effects on existing environmental conditions (application case). The second involves an evaluation of Project effects on existing environmental conditions in combination with past, present, or planned activities (cumulative effects assessment). An assessment of past and present activities (baseline case) has been incorporated into the environmental description (Section 3.0) and will not be discussed in this section.

Spatial boundaries of the assessment include all areas where measurable changes to the environment may be caused by the Project. They include three categories. Sub-local refers to the area in the immediate influence of the Project (foot print). Local includes the sub-local area and immediately adjoining areas. Regional includes the previous two categories, Lac Ste. Anne proper and the biological boundaries of animal populations potentially affected by the Project.

Temporal boundaries of the effects assessment include the construction and operation phases of the Project. It is assumed that the proponent will not decommission the facility in the foreseeable future; therefore, a decommissioning phase has not been included in the evaluation.

The assessment will be completed using a stepwise approach. Project activities will be examined to identify the potential adverse effect(s) on the environment. Mitigation measures designed to reduce or eliminate the effect will be described and their effectiveness ascertained. A comprehensive summary of all strategies or plans to minimize, mitigate, and manage the potential adverse effects, if they exist, are presented for each environmental component.

It should be noted that the strategies employed to minimize Project effects would adhere to regulatory requirements (e.g., Alberta Water Act Codes of Practice and Federal Fish Habitat Protection Guidelines [DFO 1998]). Once the effectiveness of mitigation has been established, each Project activity will be categorized as having no adverse effect or a residual effect (what remains after mitigation). Each Project activity that causes a residual effect will be evaluated in terms of its environmental significance using rating categories developed under the Canadian Environmental Assessment Act (CEAA 1994). The categories to be used are listed in Appendix C.

It should be acknowledged that the proposed Project has an overall effect on the environment, which will result from a combination of activities. As such, the overall Project effect may receive a higher significance rating than the individual components.

4.2 SOCIAL ISSUES AND LAND USE

It is unlikely that there are historical resources of social importance on the Windmill Harbour Development site. Present land use activities on and in the immediate vicinity of the Project include agricultural to the south and west, and a private woodlot to the east. At a greater distance, recreational activities occur on the lake, the Summer Village of Val Quentin is located to the east, and the Lac Ste. Anne Mission is located to the west.

The Project will change land use on the site from agricultural to residential/recreational. The Project is self-contained and will not physically infringe on land use of the surrounding area. The social activities promoted by the Project are consistent with the long-term plans for the area by the Lac Ste. Anne County (i.e., residential and recreation) and is designed to be aesthetically pleasing to the general public. The only residence in the immediate vicinity of the Project (located to the east) will be visually screened by a woodlot. Similarly noise will not be an issue given the nature of the Project and its distance from other land users. Car traffic will increase, but will be well within limits that are acceptable to the municipal government. Boat and snowmobile use of the lake also will increase. Lac Ste. Anne is presently used extensively for recreational boating and snowmobiling. As such, an increase in these activities would not markedly change existing conditions.

Because the Project will adhere to all necessary municipal and provincial guidelines, concerns associated with public safety, noise, and traffic will be addressed at the planning stage. As such the development should not cause significant adverse effects on land use or social issues.

4.3 TERRESTRIAL RESOURCES

4.3.1 Terrain and Soils

The development will require re-contouring the terrain to accommodate the Project infrastructure and harbour. Best management practices will be employed during construction to utilize topsoil and to fully mitigate issues of erosion. No activities during facility operation are expected to affect terrain and soils.

Terrain and soils will be significantly altered during the construction phase; however, mitigation measures will be used to ensure that Project effects will not extend outside of the Project footprint (including disposal of overburden) or adversely influence other components of the environment. Standard construction techniques and mitigation strategies will be employed to control dust and mud tracked off site, soil erosion and potential soil contamination. At the present time the haul route for fill and construction materials has not been finalized, but it is expected that Secondary Highway 633 via Lac Ste. Anne Trail will be the primary transportation corridor. All mitigation will meet municipal and provincial standards, which will be a prerequisite for Project approval by the county (Richard Neufeld, pers. comm.).

4.3.2 Vegetation/Wildlife Habitat

<u>Project Effects</u>

Construction of residential lots and infrastructure and the inland harbour will potentially affect 43.0 ha of the upland. The area will be cleared of vegetation, the inland harbour will be excavated, and portions of the property will be filled to obtain a minimum elevation of 724.0 m. The majority of this area (34 ha) is presently under cultivation or is used for forage production, and therefore, has limited value to wildlife and birds. The remaining upland vegetation (7.0 ha) provides habitat for a variety of species such as deer, moose, song birds, and nesting waterfowl, but it is limited in area, and there is an abundance of similar habitats within the local boundaries of the project.

The emergent vegetation zone along the shoreline of Lac Ste. Anne (14 ha) has been undisturbed by human activity and contains a number of distinct vegetation communities. No rare plants were recorded in this area. The emergent vegetation zone provides habitat for a variety of species including semi-aquatic furbearers, song birds, waterfowl, and waterbirds. It provides nesting, brood and moulting habitats for waterfowl and nesting habitat for waterbirds such as grebes and terns. Construction of the access channel will remove a portion of the emergent vegetation (0.5 ha), which represents approximately 4% of the emergent vegetation zone. Nesting red-winged black birds were the only species recorded nesting within the footprint of the boat access channel.

During the operation phase of the Project, there also is the potential for habitat loss. Boat traffic using or approaching the access channel could physically damage habitat. Motorized boats attempting to access the shoreline would cause damage to the emergent vegetation zone. Snowmobile traffic associated with the facility may physically damage emergent vegetation that is used by wildlife in winter. The vegetation is also required by waterbirds during the initial stages of nest building during early spring.

Wave action associated with boating activity in and near the access channel may also damage habitat. This potential effect is deemed to be minor because the vegetation in the area is presently subjected to natural wave action.

Other human activities during the operation phase also have the potential to cause physical destruction or alteration to habitat along the shoreline. Residential lot owners adjacent to lakes may infringe on shoreline habitat by clearing emergent vegetation for boat access (Vance Buchwald, pers. comm.). Residential lot owners are unlikely to undertake this activity because they will have access to the inland harbour and the general public will not infringe on this area because it is a private development.

Based on this information, construction and operation of the residential lots and infrastructure, inland harbour, and access channel have the potential to cause habitat loss. As such, the Project may have adverse effects on vegetation/habitat that presently exists in the area.

<u>Mitigation</u>

Measures to be adopted to minimize the adverse effects of vegetation/wildlife habitat loss are as follows:

- Establish a conservation area along the east side of the property. This area would partially replace habitat removed during construction.
- Implement a program (e.g., information brochures) to educate facility users regarding the effects of disturbance on wildlife and promote stewardship of the resource.
- Protect the shoreline with a conservation area that will extend 60 m from the lake shore to the residential lots.
- Eliminate damage to the emergent vegetation outside the access channel by clearly marking the channel and posting speed limits that will be enforced by the condominium association.
- Control human activities in the conservation area along the lake shore to eliminate potential disturbance to the emergent vegetation zone.
- Monitor human activities to ascertain whether the conservation area is effective in protecting vegetation/wildlife habitat. This would involve structured surveys and physical measurements to quantify the frequency and extent of physical disturbance.

Mitigation measures designed to protect the shoreline emergent vegetation zone will adhere to the objectives of the "Federal Policy on Wetland Conservation". Specifically it will promote conservation of migratory bird habitat in order to sustain its long-term ecological and socio-economic functions. With the exception of the boat access channel, protection of the emergent vegetation zone can be achieved by promoting public awareness and by use of the conservation area.

Effects Evaluation

Loss of vegetation/wildlife habitat caused by the construction and operation of the Project cannot be fully mitigated; therefore, there will be a residual adverse effect. Specifically, the majority of existing upland habitat will be removed during construction. Measures implemented during operation of the facility will partially mitigate loss of habitat. The geographic extent of habitat loss will be sub-local and similar habitats are available immediately adjacent to the development. As such, some wildlife groups (e.g., ungulates and song birds) may be displaced from the site, but will have access to other habitats. Given the permanence of the Project it will be of long duration and the effect likely is not reversible.

The magnitude of vegetation/wildlife habitat loss is deemed to be moderate. The most important wildlife habitat is provided by the emergent vegetation zone and this is the area that will be largely protected by use of the conservation area (all except the boat channel). Because similar habitats are located immediately adjacent to the Project and they are widely available in the watershed, the long-term viability of most species populations will be unaffected. This includes western grebes because the Project will not physically infringe on the breeding colony habitat.

As such, it is the Project should not have a significant adverse effect on vegetation/wildlife habitat.

4.3.3 Wildlife Disturbance

Project Effects

Wildlife and bird populations adjacent to the project area will be disturbed during construction, which will result in displacement of animals. Operation of the facilities will cause displacement of wildlife and waterbirds within the immediate vicinity of the development and in surrounding areas of Lac Ste. Anne. This will be caused primarily by increased recreational activity in the form of boat and snowmobile traffic originating from the facility. It also should be acknowledged that adverse effects could be caused by other activities by residential lot owners (e.g., depredation by domestic pets).

Of particular concern is displacement of the nesting western grebe colony, which is a species known to be susceptible to human disturbance (Burger 1997). A review of historical information suggested that two nesting western grebe colonies in the narrows of Lac Ste. Anne may have been abandoned due to excessive boat traffic and the existing nesting location adjacent to the Project was chosen, in part, because it was subjected to less disturbance (Hanus *et al.* 2002).

Construction and operation of the residential lots and infrastructure and boat access channel has the potential to cause disturbance to wildlife and birds. As such, the Project may have adverse effects on these resources.

Mitigation

Mitigation measures can be implemented to reduce the adverse effects associated with disturbance as follows:

- Do not disturb the willow vegetation along the shoreline during construction.
- Reduce boat numbers in the facility by not allowing public access to the harbour's boat launch.
- Implement a program (e.g., information brochures) to educate facility users regarding the effects of disturbance on wildlife and promote stewardship of the resource.
- Allow only low impact human activity in the conservation area. This would include walking trails, resting areas, and a nature watching area. It would also include elimination of boat mooring along the shoreline.
- Eliminate all human activity within the conservation area immediately adjacent to the western grebe colony (exclusion zone). The size of the exclusion zone will be established following discussions with representatives of the provincial and federal governments.
- Monitor human activity-western grebe interactions to ascertain whether the conservation area and exclusion zone is effective in minimizing disturbance to western grebes during the breeding and nesting season. This would involve structured surveys to quantify the frequency and extent of disturbance to western grebes due to shoreline and boating activities.
- If monitoring results indicate that the proposed measures are not sufficient to protect the western grebe colony from disturbance, additional steps (e.g., increase in the exclusion zone) will be considered following discussions with representatives of the provincial and federal governments.

Effects Evaluation

The mitigation measures will reduce the adverse effects of disturbance on most wildlife and bird populations during construction and operation. But, for sensitive species such as western grebes, these measures may not be sufficient. Hanus *et al.* (2002) recommended a buffer of 250 m to 500 m around nesting colonies from 15 May to 15 July as a measure to eliminate human disturbance.

During construction, noise from heavy equipment in May and June may disturb nesting and breeding birds. This effect may be partially mitigated by the willow vegetation along the shoreline, which will provide a visual barrier during construction.

During operation, the present location of the western grebe colony is approximately 440 m from the boat access channel, 150 m from the residential lots, and 90 m from the shoreline of the conservation area. There will be some human activity within the conservation area and boat traffic along the perimeter of the emergent vegetation zone. As such, the minimum buffer distance of 250 m recommended by Hanus *et al.* (2002) will not be achieved. As such, disturbance of western grebes during facility operation likely will occur, which will result in a residual adverse effect.

Boat traffic also will increase in the lake during the operation phase of the Project. Although much of this traffic will be concentrated near the facility in the area of the access channel, it will extend to the entire lake, which would cause additional disturbance to waterfowl and waterbirds that use the lake for feeding and staging.

Based on this information, the geographic extent of disturbance is considered regional (i.e., disturbance could occur within the entire lake) and it will occur over an extended duration. The effect would be reversible if the sources of disturbance were removed. Using the western grebe population as a benchmark, the magnitude of the effect is deemed to be high because the Lac Ste. Anne nesting colony may be abandoned and loss of this colony could have adverse effects on the national grebe population (Hanus *et al.* 2002).

As such, disturbance caused by Project operation will have a significant adverse effect on wildlife and bird resources. This evaluation is made with a moderate degree of certainty because it is not known what level of human disturbance actually affects western grebes. Based on the conservative approach used for this assessment, however, there is a high likelihood that there will be an significant adverse effect.

4.3.4 Mortality

The Project will cause an increase in vehicle traffic in the area, which could result in an increase in the number of vehicle-wildlife collisions. The extent of this potential issue cannot be easily quantified. Assuming that most traffic will occur along Lac Ste. Anne Trail, the location of the development will not pre-dispose ungulates to increased collisions with vehicles because there are no major ungulate wintering areas or travel corridors in the immediate vicinity of the Project. Also, the roadway configuration does not allow excessive vehicle speed, which is an important cause of collisions.

The Project may promote, or conversely, it may inhibit consumptive use of wildlife resources. A portion of the residential lot owners may undertake recreational hunting in the area. But, the existence of the development and the conservation area will eliminate hunting activity that historically may have occurred in the immediate vicinity of the Project.

No mitigation is planned to address the issue of wildlife mortality. It is expected that this potential adverse effect will have negligible affects on wildlife and bird populations in the area.

4.4 WATER RESOURCES

4.4.1 Surface Runoff and Ground Water

Water resources could be adversely affected by the Project by altering surface runoff and ground water. There are no defined watercourses or ponded waters that potentially could be affected by the Project. Surface drainage will be maintained by implementing measures described for protection of water quality (see below). As such, no issues associated with surface water are expected.

Bedrock and surficial aquifers underlying the proposed development appear to be capable of providing the total water demands of 82igpm for household use described in the initial area structure plan without impacting existing users (AMEC 2001). Because municipal and provincial approvals are contingent on the existence of a sufficient supply of quality water for domestic use, the Project will have to ensure that these requirements are met prior to the development (Richard Neufeld, pers. comm.). As such no issues associated with ground water are expected.

4.4.2 Water Quality

Degraded water quality in Lac Ste. Anne may result from nutrient and sediment inputs from the Project during construction and operation. Construction of the residential lots and infrastructure, and the inland harbour will require excavation and recontouring. This activity could cause surface runoff containing high sediment loads to potentially drain directly into Lac Ste. Anne. The resulting effect on water quality would be nutrient and sediment loading in the vicinity of the development. Because Lac Ste. Anne presently is eutrophic any additional loading could promote algal growth.

Construction of the access channel could also affect water quality of the lake in the vicinity of the development. The dredging process will disturb the lake bottom resulting in suspension of sediments and transport to the surrounding area. In addition, nutrients will be released making them available for plant and algal growth.

During operation of the facility, nutrient loading of Lac Ste. Anne would continue to be a concern. Storm water drainage may introduce sediments and other contaminants into the lake. Domestic sewage from residential lots and nutrients from lawn fertilizers also may leach into the lake. Sewage entering the lake can be a problem, both to the aquatic environment through nutrient loading and to recreational users due to increased risk of disease. Infilling of the channel caused by natural and boat induced wave action also will occur; therefore, periodic maintenance of the channel will be required. At the present time, the frequency of this maintenance is unknown.

The inland harbour will receive hydrocarbons in the form of oil and gasoline, which are pollutants typically associated with boating activities. Because the harbour basin will have the configuration of an impoundment (limited water exchange with lake) there is also the potential for reduced water quality within the harbour proper. More seriously, a fuel spill has the potential to pollute Lac Ste. Anne.

<u>Mitigation</u>

The following measures will be implemented in order to mitigate project effects on water quality.

- A storm water management system will be designed to accommodate a 1:25 year surface runoff event and prevent run-off from entering directly into Lac Ste. Anne during construction and operation of the Project. Drainage systems will intercept and direct the water into the harbour, and if required, accommodate settling of suspended sediments.
- An earth plug will be used to isolate the inland harbour from the lake during construction to prevent suspended sediments in the harbour from entering the lake.
- Sediment releases associated with dredging of the access channel during the initial excavation and subsequent maintenance activities will be restricted using the following measures:
    - Dredging will be undertaken in winter from the ice surface using a backhoe. The shallowness of the water in the area (<1.5 m) and presence of ice cover will restrict the spread of the suspended sediments to the surrounding waters.
    - A silt curtain will be used to isolate the work area, further increasing the containment of suspended sediments.
- A water quality monitoring program will be implemented to establish whether provincial and federal water quality guidelines for the protection of aquatic life are met.
- If the monitoring program identifies issues such as exceedence of water quality guidelines, the management system will be adjusted following discussions with representatives of the provincial and federal governments.

During operation of the proposed facilities, impacts of nutrient loading will be further reduced using the following mitigation measures.

- A central sewage collection and storage facility will service the entire complex instead of storage tanks for each residential lot. The central storage facility will be periodically pumped and the material removed for disposal to an appropriate site. The system will consist of underground pipes installed to provincial standards leading to the central holding tank. Pump out and hauling will be to the existing County lagoon.
- Water quality in the harbour will be maintained using an aeration system. This will entail a network of diffuser pipes on the harbour bottom that are supplied with air by a compressor. These systems are designed to maintain dissolved oxygen levels and promote mixing of the water column which would inhibit the formation of undesirable algal blooms and subsequent die-offs that are characteristic of stagnant, anaerobic conditions. Aeration systems are commercially available and are routinely used for the purposes required by this development (Mackay 1999a, 1999b).
- An emergency response plan, trained personnel, and the required containment equipment administered by the condominium association will be used to contain and clean up any accidental fuel spills in the harbour. In the event of a major spill, this would involve placement of an inflatable bladder (e.g., Aquadam™) or containment boom across the entrance to the harbour to block the spill from the lake.
- The frequency of maintenance activities due to infilling of the channel caused by wave action from boats will be reduced by enforcement of speed limits through the condominium association.

Effects Evaluation

Implementation of these mitigation measures will remove the potential adverse effects of the Project on water resources during the construction and operation phases. As such there will be no residual adverse affects of the Project on the water quality of Lac Ste. Anne.

4.5 FISH RESOURCES

4.5.1 Habitat Loss

Project Effects

The construction of the access channel (0.98 ha) will result in the destruction of fish habitat. This loss could be detrimental to fish populations in Lac Ste. Anne because the area is potentially used for spawning/egg incubation, rearing, and adult feeding. Species of concern are northern pike, walleye, and lake whitefish.

In addition to physical removal of fish habitat, construction activities (i.e., dredging of the access channel) have the potential to alter fish habitat by introduction of suspended sediments resulting in siltation in the immediate vicinity of the channel. Consequences of siltation are numerous, but the most serious issues are destruction of fish habitat and smothering of fish eggs. This potential effect will be fully mitigated (see Section 4.4) and will not be discussed in this section.

Construction of the residential lots and infrastructure and inland harbour could also introduce sediments into the lake resulting in alteration of fish habitat. This potential effect will be fully mitigated (see Section 4.4) and will not be discussed in this section.

During Project operation, damage to fish habitat outside the access channel may result from boats attempting to access the shoreline. Other human activities during the operation phase also have the potential to cause loss of habitat. Residential lot owners adjacent to lakes typically infringe on shoreline habitat by clearing emergent vegetation for boat access (Vance Buchwald, pers. comm.). These activities have the potential to remove habitat along the entire length of the proposed development.

<u>Mitigation</u>

The measures to be adopted to protect existing fish habitat will be as follows:

- Control human activity in the conservation area along the lake shore to prevent disturbance to the emergent vegetation zone. This would include shoreline protection guidelines and elimination of boat mooring along the shoreline that would be enforced by the condominium association.
- Monitor human activities to ascertain whether the conservation area is effective in protecting fish habitat. This would involve structured surveys and physical measurements to quantify the frequency and extent of physical disturbance to the emergent vegetation.

<u>Effects Evaluation</u>

This mitigation measure can eliminate habitat loss during operation, but construction of the boat access channel will cause habitat loss. Therefore, the project will cause a residual adverse effect associated with loss of fish habitat.

The geographic extent of this residual effect will be local. The effect would be of long duration, but it also would be reversible given the ability of emergent vegetation to rapidly re-colonize disturbed areas. The magnitude of habitat loss on the fish populations is deemed to be low for the following reasons. First, critical or high quality fish habitat will not be disturbed by the access channel. Critical habitats are present in the vicinity of the access channel (i.e., walleye spawning shoal), but there should be no disturbance to these sites. Second, similar habitats are available immediately adjacent to the Project and they are widely distributed in the lake.

Under Section 35 of the Fisheries Act, the Project will be required to provide compensation for the loss of fish habitat associated with the foot print of the boat access channel. Assuming Project approval, a fish habitat compensation plan will be presented to the Department of Fisheries and Oceans at the permitting stage. This plan will focus on physical habitat enhancement in areas of low to nil habitat quality. Assuming a 2:1 ratio of habitat replacement, the fish habitat compensation plan will require physical disturbance of 1.96 ha of low to nil quality fish habitat. This activity will not have any adverse effects on fish populations.

Based on this information, habitat loss caused by Project construction and operation will not affect the viability of fish populations in Lac Ste. Anne. As such, there will be no significant adverse affects. This evaluation is made with a high degree of certainty based on the assumption that measures implemented by the condominium association will control human activity during Project operation.

4.5.2 Disturbance

<u>Project Effects</u>

Disturbance to fish in shallow water along the shoreline and in the access channel may prevent fish from completing important activities such as spawning. The effect of human disturbance on fish in lake environments is not well documented in Alberta. Information from Marina Bay Estates at Sylvan Lake suggests that fish present in harbours or harbour entrances do not appear to be disturbed by human activity (R.L. & L. Environmental Services Ltd. 1995). Movements of radio-tagged fish indicated that individuals regularly moved in and out of two marinas despite the presence of recreational anglers and boat traffic. Radio-tagged fish also utilized a zone immediately in front of these marinas as a ‘resting’ area; a zone that was subjected to intense boat traffic. Based on this information, it is unlikely that disturbance by increased human activity will have an adverse effect on fish.

Spring spawning fish (e.g., northern pike) typically seek out warm water areas in early spring when the main body of the lake is still ice-covered as a cue for spawning activity. Because the inland harbour may provide warmer water temperatures than the lake proper, this has some potential to affect spawning activity by attracting spawning fish into the harbour. This potential effect is considered negligible for the following reasons. First, the entrance to the inland harbour is small relative to the shoreline area of the lake, which would reduce the probability of fish finding the harbour. Second, the harbour will contain low value fish habitat; therefore, there would be little incentive for fish to remain in the harbour.

Mitigation
No mitigation is required.

Effects Evaluation
There should be no residual adverse effect associated with disturbance to fish.

4.5.3 Mortality

Project Effects
Construction of the access channel has the potential to cause mortality of fish and fish eggs. Preparation of the site for dredging will cause fish to disperse, but the area to be dredged could contain the eggs of lake whitefish.

The Project will promote recreational use of the fisheries resource within and adjacent to the development. A portion of the residential lot owners may angle. The absence of public access to the lake shore from the development would eliminate the potential for increase angling pressure by the general public. Activities by the residents could result in elevated harvest rates of sportfish such as northern pike, walleye (currently catch and release), lake whitefish, and yellow perch.

The expected increase in angling pressure caused by the Project cannot be easily quantified. At Marina Bay Estates on Sylvan Lake, intense angling has occurred by the general public who access the lake along an existing environmental reserve, but very few residents angle in the harbour (Vance Buchwald, pers. Comm.). Approximately 80 of 100 boat slips were used at Marina Bay Estates in 1999; 40 for sailboats and 40 for motor boats (Marina Bay Home Owners' Association, letter dated 11 June 1999 [Appendix D]). On average, 12 boats a day entered the lake, but none were associated with anglers.

Poor water quality in the inland harbour may also cause fish mortality. Fish may move into the harbour to feed during early summer, as has been documented at Marina Bay Estates (R.L. & L. Environmental Services Ltd. 1995). If oxygen levels drop below a critical value at this time, mortalities may occur. During the open water period, fish can move out of the harbour to the main lake if oxygen levels become to low. During winter fish may become trapped by the formation of ice at the entrance to the harbour, which would prevent egress from the area. Low oxygen levels at this time could also result in fish mortality. It is unknown whether fish will concentrate in the harbour, however, the potential for adverse effects associated with low water quality do exist.

Mitigation

The following measures will be implemented to eliminate or reduce effects that may increase fish mortality.

- Dredging of the access channel will occur during winter to avoid destruction of fish eggs of spring spawning species.
- A program (e.g., information brochures) will be implemented to educate facility users about their effects on fish.
- The harbour's boat launch will not be available to the general public, which will reduce the number of boats using the facility.
- An aeration system will be operated in the boat harbour to maintain oxygen levels. At present, the developer is committed to using this system during the summer months. However, aeration may not be undertaken during winter due to issues of human safety.

Effects Evaluation

Mitigation will reduce fish mortality associated with harvest by recreational anglers. Evidence from another similar development indicates that a minimal increase will be associated with residents of the Project. Also, the conservation area will eliminate recreational activities by the public from the shoreline. It should be noted that provincial angling regulations are in place to protect the fisheries resource. At present there are restrictive regulations: zero harvest limit for walleye and three northern pike over 63 cm in length. In addition, there is a lake wide closure to angling each spring.

A properly designed aeration system in summer will eliminate the potential for fish mortality, but is unknown whether fish concentrations will occur in the harbour during winter when the aeration system is not operational.

There will be residual adverse effects of fish mortality caused by the Project following mitigation. The magnitude of this effect would be low because provincial angling regulations should limit the numbers of fish harvested and it is highly unlikely that large numbers of fish would concentrate in the harbour during winter. The geographic extent of the effect is regional because the fish populations of the entire lake would be affected. The effect will be of long duration, but it would be reversible if recreational angling originating from the Project were stopped.

Based on this information, there would be no significant adverse affects of the Project on the fisheries resource caused by fish mortality. This evaluation is made with a low degree of certainty for two reasons. There is a lack of empirical data needed to quantify the increase in fish harvest rates associated with the Project and it is unknown whether fish will concentrate in the inland harbour during winter.

4.5 ACCIDENTS AND MALFUNCTIONS

Although very unlikely to occur, certain accidents or malfunctions could be detrimental to the environment. These accidents and malfunctions would include failure of the earth plug during the harbour excavation, a large hydrocarbon spill in the harbour, and failure of the domestic sewage system.

Earth Plug Failure

Failure of the earth plug could result from a design flaw, or severe and continuous wave action. In all cases, sediments would be released into the lake and there is the potential for a contaminants spill from stranded equipment. These potential effects on Lac Ste. Anne would be a very short duration because the connection to Lac Ste. Anne would be quickly blocked using a silt curtain and/or hydrocarbon collection boom. If excavation work continued in the flooded harbour, these barriers would prevent contaminants from entering the lake. Based on this information, the potential adverse effects of the earth plug failure are considered negligible.

Large Hydrocarbon Spill

Equipment failure or human negligence may result in an accidental spill of a large amount of hydrocarbons (i.e., fuel and oil) into the inland harbour. A large spill is not expected in the lake because fuel storage containers would be located in the harbour area. Similar to the assessment for failure of the earth plug, these potential effects on Lac Ste. Anne would be a very short duration because the connection to Lac Ste. Anne could be blocked. An emergency response plan would be used to contain and clean the spill. Based on this information, the potential adverse effects of a large hydrocarbon spill are considered negligible.

Sewage System Failure

The sewage conveyance and storage system planned for the Project could potentially fail causing a spill to enter Lac Ste. Anne. This accident is highly unlikely because there will be extra capacity built into the storage system. Any sewage that is released would enter the storm water system, which is designed to flow into the inland harbour rather than Lac Ste. Anne. In this cause, an emergency response plan would be use to contain the spill before a large amount entered the lake. Therefore, the potential adverse effects of sewage system failure are considered negligible.

4.4 CUMULATIVE EFFECTS

An assessment of cumulative effects should incorporate all known past, present, and known future activities that would add to the adverse effects of the Project. In the case of the Windmill Harbour Development, incremental destruction of upland and lakeshore habitats by small-scale developments represent the most important activities that would cause cumulative effects. The importance of these activities to environmental resources in and around Lace Ste. Anne is difficult to quantify due to the lack of empirical data. As such, a primary assumption of the cumulative effects assessment is that use of qualitative information is sufficient to accurately predict Project effects. Because the validity of this assumption cannot be tested, the confidence in the assessment is deemed to be low.

At present, there are several summer villages and residential subdivisions distributed around the perimeter of Lac Ste. Anne. Lakeside complexes similar to the proposed Project and residential subdivisions are compatible with the long-term development plans by the County of Lac Ste. Anne (Richard Neufeld, pers. comm.). Therefore, increase use of the lake and surrounding area can be expected to increase over time.

Historically human activities have had an influence on the lake's water quality (Mitchell 1999), and there has been physical removal or alteration of habitats required by terrestrial resources. Recreational angling also has been sufficient to reduce sportfish populations in the lake. Many of these cumulative effects have been reduced or eliminated by implementing new environmental standards. For example, regulations prohibit development activities that would affect the water quality of Lac Ste. Anne, many of which have been adopted by the Project. Strict regulations now apply to the Lac Ste. Anne sportfishery that are designed to maintain fish populations.

Physical removal of habitats by the footprints of past, present, and future developments and disturbances associated with human activities are two effects that cannot be easily controlled. These issues also are associated with the Project; therefore, the proposed development will cause cumulative adverse effects associated with loss of habitat and disturbance.

4.7 SUMMARY

The Project should have no detrimental effects on cultural resources, land use, social issues, terrain and soils, surface water or ground water. This conclusion is reached based on the conditions that presently occur at the site in combination with municipal and provincial requirements that will ensure protection of these resources if the development proceeds.

There are a number of potential adverse effects that may be caused by the proposed development. They include vegetation/habitat loss, disturbance, and mortality of wildlife, birds, and fish, and reduced water quality of Lake Ste. Anne.

Mitigation measures can be implemented to reduce or eliminate many of these potential adverse effects. Establishment of a conservation area adjacent to the shoreline and placing controls on the type of human activity that occurs in this zone will substantially reduce the potential adverse effects on vegetation, habitats, wildlife, birds, and fish. A specific example of an appropriate mitigation measure is exclusion of all human activity immediately adjacent to the western grebe colony.

Water quality in the lake will be protected by intercepting runoff, by use of a central sewage storage facility, use of an aeration system in the harbour, and other mitigation measures. As such, no significant adverse effects to water quality are expected.

There will be residual adverse effects associated with the Project following mitigation. The development will affect wildlife and fish resources in the form of habitat loss, disturbance, and mortality.

The majority of the residual effects are deemed to be not significant because they will not change the characteristics of the affected resource in a sufficient amount as to cause a permanent change from pre-development conditions. This is primarily due to the limited geographic extent of the Project's influence, the limited magnitude of the effect on the populations in question, and the availability of similar habitats in the immediate vicinity of the Project.

The only exception to this statement is the adverse effects of disturbance during Project operation on wildlife. Specifically, activities likely will cause a significant adverse effect on the nesting colony of western grebes immediately adjacent to the Project.

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APPENDICES

APPENDIX A
Wildlife Resources

Table A1 List of wildlife species observed during field surveys of the Windmill Harbour Study Area, October 2001 to June 2002.

Group	Common Name	Latin Name	Recorded in Development Section
Mammals	Striped skunk	*Mephitis mephitis*	*
	Mink	*Mustela vision*	
	Muskrat	*Ondatra zibethica*	
	Red fox	*Vulpes fulva*	*
	Coyote	*Canis latrans*	*
	Red squirrel	*Tamiasciurus hudsonicus*	*
	Woodland jumping mouse	*Zapus hudsonius*	*
	Porcupine	*Erethizon dorsatum*	*
	Snowshoe hare	*Lepus americanus*	*
	White tailed deer	*Odocoileus virginianus*	*
	Moose	*Alces alces*	*
Amphibians	Wood frog	*Rana sylvatica*	*
	Stripped chorus frog	*Pseudacris triseriata*	
	Western toad	*Bufo boreas*	*
Reptiles	Red-sided garter snake	*Thamnophis sirtalis*	

Table A2 List of bird species observed during field surveys of the Windmill Harbour Study Area, October 2001 to June 2002.

Group	Common Name	Latin Name	Recorded in Development Section
Waterbirds	Western grebe	*Aechmophorus occidentalis*	*
	Eared grebe	*Podiceps nigricollis*	*
	Rednecked grebe	*Podiceps grisegena*	*
	Great blue heron	*Ardea herodias*	
	American coot	*Fulica americana*	
	Sora	*Porzana carolina*	*
Waterfowl	Tundra swan	*Olor columbianus*	
	Canada goose	*Branta canadensis*	*
	Mallard	*Anas platyrhynchos*	*
	Gadwall	*Anas strepera*	*
	Northern shoveller	*Anas clypeata*	*
	Blue winged teal	*Anas discors*	*
	American wigeon	*Anas americana*	*
	Bufflehead	*Bucephala albeola*	*
	Common goldeneye	*Bucephala clangula*	*
	Lesser scaup	*Aythya affinis*	*
	Ruddy duck	*Oxyura jamaicensis*	
Shorebirds	Spotted sandpiper	*Actitis macularia*	*
	Lesser yellowlegs	*Tringa flavipes*	*
	Killdeer	*Charadrius vociferus*	
Gulls	Ring-billed gull	*Larus delawarensis*	*
	Franklin's gull	*Larus pipixcan*	
Terns	Common tern	*Sterna hirundo*	*
	Black tern	*Chlidonias niger*	*
Raptors	Red-tailed hawk	*Buteo jamaicensis*	*
	Osprey	*Pandion haliaetus*	
Game birds	Ruffed grouse	*Bonasa umbellus*	*
Woodpeckers	Pileated woodpecker	*Dryocopus pileatus*	
	Hairy woodpecker	*Dendrocopos villosus*	*
	Downy woodpecker	*Dendrocopos pubescens*	*
Perching birds	Barn swallow	*Hirundo rustica*	
	Tree swallow	*Iridoprocne bicolor*	*
	Blue jay	*Cyanocitta cristata*	
	Black-billed magpie	*Pica pica*	*
	Common raven	*Corvus corax*	*
	Black-capped chickadee	*Parus atricapillus*	*
	Brown creeper	*Certhia familiaris*	*
	Long-billed marsh wren	*Telmatodytes palustris*	*
	Yellow warbler	*Dendroica petechia*	*
	Red-winged blackbird	*Agelaius phoeniceus*	*
	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	*
	Common redpoll	*Acanthis flammea*	*
	Chipping sparrow	*Spizella passerina*	*

APPENDIX B
Fisheries Resources

Appendix B Table B1. Information for fish sampling sites in the Windmill Harbour Development Study Area, 2002.

Waterbody	Type of Sampling	Method	Site Label	Nad	Zone	Easting	Northing
Lac Ste. Anne							
	Fisheries						
		Boat Electrofish					
			ES01	27	11U	670903	5951866
			ES02	27	11U	670903	5951866
			ES03	27	11U	672020	5950941
		Fyke Net					
			FN01	27	11U	671483	5951232
			FN02	27	11U	671488	5951374
		Gee Trap					
			GT01	27	11U	671482	5951242
			GT02	27	11U	671504	5951267
			GT03	27	11U	671453	5951267
			GT04	27	11U	671489	5951206
			GT05	27	11U	671505	5951198
			GT06	27	11U	671561	5951165
			GT07	27	11U	671389	5951309
			GT08	27	11U	671415	5951301
			GT09	27	11U	671539	5951244
		Gill Net					
			GN01	27	11U	671003	5952086
			GN02	27	11U	671722	5951515
			GN03	27	11U	672232	5951293
	Spawning						
		Egg Mat					
			EG01	27	11U	671481	5951218
			EG02	27	11U	671485	5951221
			EG03	27	11U	671484	5951229
			EG04	27	11U	671492	5951246
			EG05	27	11U	671506	5951246
			EG06	27	11U	671508	5951257
			EG07	27	11U	671497	5951265
			EG08	27	11U	671488	5951272
			EG09	27	11U	671481	5951274
			EG10	27	11U	671467	5951273
			EG11	27	11U	671463	5951271
			EG12	27	11U	671456	5951270
			EG13	27	11U	671455	5951268
			EG14	27	11U	671448	5951280
			EG15	27	11U	671442	5951287
			EG16	27	11U	671414	5951210
			EG17	27	11U	671441	5951192
			EG18	27	11U	671456	5951185
			EG19	27	11U	671479	5951234
			EG20	27	11U	671480	5951243
		Sweep Net					
			SW01	27	11U	671425	5951210
			SW02	27	11U	671419	5951218
			SW03	27	11U	671401	5951230
			SW04	27	11U	671386	5951244
			SW05	27	11U	671377	5951256
			SW06	27	11U	671368	5951266

Appendix B Table B1. Information for fish sampling sites in the Windmill Harbour Development Study Area, 2002.

Waterbody	Type of Sampling	Method	Site Label	Nad	Zone	Easting	Northing
Lac Ste. Anne							
	Spawning						
		Sweep Net					
			SW07	27	11U	671358	5951282
			SW08	27	11U	671390	5951309
			SW09	27	11U	671399	5951311
			SW10	27	11U	671405	5951309
			SW11	27	11U	671415	5951299
			SW12	27	11U	671422	5951293
			SW13	27	11U	671430	5951297
			SW14	27	11U	671432	5951292
			SW15	27	11U	671441	5951286
			SW16	27	11U	671445	5951273
			SW17	27	11U	671453	5951274
			SW18	27	11U	671482	5951239
			SW19	27	11U	671545	5951237
			SW20	27	11U	671560	5951219

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES01	22-May-02							
		Burbot	589	1526				0
		Lake whitefish	390	800				0
		Lake whitefish	520	1190				0
		Lake whitefish	362	756				0
		Lake whitefish	402	902				0
		Lake whitefish	450	1110				0
		Lake whitefish	373	604				0
		Lake whitefish	390	694				0
		Lake whitefish	368	644				0
		Lake whitefish	367	550				0
		Lake whitefish	431	632				0
		Lake whitefish	393	688				0
		Lake whitefish	510	1610				0
		Lake whitefish	370	960				0
		Lake whitefish	514	1300				0
		Lake whitefish	368	722				0
		Lake whitefish	411	986				0
		Lake whitefish	365	856				0
		Lake whitefish	432	1010				0
		Lake whitefish	369	648				0
		Lake whitefish	374	570				0
		Lake whitefish	372	684				0
		Lake whitefish	356	568				0
		Lake whitefish	384	564				0
		Lake whitefish	365	646		Scale		0
		Lake whitefish	375	710		Scale		0
		Lake whitefish	365	708		Scale		0
		Lake whitefish	370	636		Scale		0
		Lake whitefish	422	934		Scale		0
		Lake whitefish	392			Scale		0
		Lake whitefish	408	778		Scale		0
		Lake whitefish	372	564				0
		Lake whitefish	396	822		Scale		0
		Lake whitefish						0
		Lake whitefish	375	720		Scale		0
		Lake whitefish	480	1312		Scale		0
		Lake whitefish	422	966		Scale		0
		Lake whitefish	396	812		Scale		0
		Lake whitefish	390	820		Scale		0
		Lake whitefish	499	1286		Scale		0
		Lake whitefish	375	730		Scale		0
		Lake whitefish						0
		Lake whitefish	392	809		Scale		0
		Northern pike						0
		Northern pike	580	1172				0
		Northern pike	607	1176	7			0
		Spottail shiner	83					0
		Spottail shiner	63					0
		Walleye	390	618	8	Fin Ray		0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES01	22-May-02							
		Walleye						0
		Walleye	384	596	8	Fin Ray		0
		Walleye	391	646	8			0
		Walleye	459	978				0
		Walleye	454	1020	8			0
		Walleye	555	1694	8			0
		Walleye						0
		White sucker	481	1600				0
		White sucker						0
		White sucker	415	1070	8			0
		White sucker	420	982	7			0
		White sucker	401	914	8			0
		White sucker	429	1014				0
		White sucker	393	1012	8			0
		White sucker	434	1260	17			0
		White sucker	420	1110				0
		White sucker	489	1448	8			0
		White sucker	485	1650	17			0
		White sucker	433	1298	7			0
		White sucker	414	1050	8			0
		White sucker						0
		White sucker	412	964	8			0
		White sucker	400	1150				0
		White sucker	424	1078				0
		White sucker	502	1540	19			0
		White sucker	482	1590	17			0
		White sucker	502	1732	17			0
		White sucker	479	1336	19			0
		White sucker	418	1204				0
		White sucker	390	622	8			0
		White sucker	506	1382				0
		White sucker	428	894				0
ES02	23-May-02							
		Lake whitefish	439	1028				0
		Lake whitefish	456	1084				0
		Lake whitefish	350	678				0
		Lake whitefish	395	874				0
		Lake whitefish	412	936				0
		Lake whitefish	355	682				0
		Lake whitefish	425	1064				0
		Lake whitefish	359	664				0
		Lake whitefish	460	1158				0
		Lake whitefish	405	806				0
		Lake whitefish	377	818				0
		Lake whitefish	397	788				0
		Lake whitefish	426	1194				0
		Lake whitefish	368	686				0
		Lake whitefish	392					0
		Lake whitefish	384	760				0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES02	23-May-02							
		Lake whitefish	359	632				0
		Lake whitefish	367	650				0
		Lake whitefish	398	872				0
		Lake whitefish	398	916				0
		Lake whitefish	406	810				0
		Lake whitefish	406	884				0
		Lake whitefish						0
		Lake whitefish	518	1442				0
		Lake whitefish	372	752				0
		Lake whitefish	386	748				0
		Lake whitefish	430	972				0
		Lake whitefish	424	934				0
		Lake whitefish	374	788				0
		Lake whitefish	400	866				0
		Lake whitefish	391	860				0
		Lake whitefish	394	958				0
		Lake whitefish	473	1422				0
		Lake whitefish	375	728				0
		Lake whitefish	432	1098				0
		Lake whitefish	388	866				0
		Lake whitefish	371	654				0
		Lake whitefish	391	770				0
		Lake whitefish						0
		Lake whitefish	358	594				0
		Lake whitefish	404	964				0
		Lake whitefish	404	880				0
		Lake whitefish	394	904				0
		Lake whitefish	474	1204				0
		Lake whitefish	405	764				0
		Lake whitefish	378	704				0
		Lake whitefish	388	700				0
		Lake whitefish	434	1072				0
		Northern pike	514	964	8	Fin Ray		0
		Northern pike	808	6500		Fin Ray		0
		Northern pike						0
		Walleye	454	948	8			0
		Walleye	426	934		Fin Ray		0
		Walleye						0
		Walleye	425	766	8			0
		Walleye	374	592	8			0
		Walleye	380	584	8			0
		Walleye	390	676	8			0
		Walleye	406	620	8			0
		Walleye						0
		White sucker						0
		White sucker	488	1720	17			0
		White sucker	420	986	8			0
		White sucker	443	1252				0
		White sucker	454	1208	8			0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES02	23-May-02							
		White sucker	484	1400				0
ES03	22-May-02							
		Burbot	561					0
		Burbot	625					0
		Lake whitefish	392					0
		Lake whitefish	388					0
		Lake whitefish	394					0
		Lake whitefish	407					0
		Lake whitefish	424					0
		Lake whitefish	380					0
		Lake whitefish	381					0
		Lake whitefish	398					0
		Lake whitefish	406					0
		Lake whitefish	379					0
		Lake whitefish	407	862				0
		Lake whitefish	387					0
		Lake whitefish	392					0
		Lake whitefish	391					0
		Lake whitefish	510					0
		Lake whitefish	518					0
		Lake whitefish	497					0
		Lake whitefish	359					0
		Lake whitefish	391					0
		Lake whitefish	361					0
		Lake whitefish	375					0
		Lake whitefish	463					0
		Lake whitefish	399					0
		Lake whitefish	377					0
		Lake whitefish	414					0
		Lake whitefish	392	792				0
		Lake whitefish	398	936				0
		Lake whitefish	392	714				0
		Lake whitefish	363	574				0
		Lake whitefish	390	734				0
		Lake whitefish	397	690				0
		Lake whitefish	383	726				0
		Lake whitefish	372	704				0
		Lake whitefish	404	826				0
		Lake whitefish	396	882				0
		Lake whitefish	396	894				0
		Lake whitefish	420	824				0
		Lake whitefish	371	732				0
		Lake whitefish	468	1164				0
		Lake whitefish	460	1082				0
		Lake whitefish	414	944				0
		Lake whitefish						0
		Lake whitefish	385					0
		Lake whitefish	391	734				0
		Lake whitefish	375	808				0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Boat Electrofish

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
ES03	22-May-02							
		Lake whitefish						0
		Lake whitefish	380	804				0
		Lake whitefish	420	874				0
		Lake whitefish	359	596				0
		Lake whitefish	404	754				0
		Lake whitefish	375	818				0
		Lake whitefish	322	438				0
		Lake whitefish	500	1220				0
		Lake whitefish	427	1074				0
		Lake whitefish	388	1080				0
		Lake whitefish	405	828				0
		Lake whitefish	419	842				0
		Northern pike	672	3000	18	Fin Ray		0
		Northern pike	930	8500		Fin Ray		0
		Northern pike	890	8000		Fin Ray		0
		Northern pike						0
		Northern pike	710	3800		Fin Ray		0
		Northern pike						0
		Northern pike	485	880				0
		Walleye						0
		Walleye	475	1110	17			0
		Walleye	364	526	8			0
		Walleye						0
		Walleye	386	626	8			0
		White sucker	400		8			0
		White sucker	422	1320				0
		White sucker	422	908				0
		White sucker	405	814				0
		White sucker	411	988				0
		White sucker	406	1116				0
		White sucker						0
		White sucker	440					0

For fish captured by Fyke Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
FN01	22-May-02							
		None						0
		Northern pike	420	488	7			0
		Northern pike	518	922	18			0
		Northern pike	521	920	7			0
		Northern pike	580	1272	7			0
		Northern pike	423	588	7			0
		Northern pike	510	796	7			0
		White sucker	459					0
FN02	23-May-02							
		None						0
		Northern pike	562	1072				0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Fyke Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
FN02	23-May-02							
		Northern pike	505	854	8			0
		Northern pike	532	988	8			0
		Northern pike	515	970				0
		Northern pike	575	1124	7			0
		Northern pike	523	1082				0
		Northern pike	600	1414				0
		Northern pike	547	1178	7			0
		Northern pike	554	1070				0
		Northern pike	552	1278				0
		Northern pike	457					0
		Northern pike	554	1030				0
		Northern pike	598	1218				0
		Northern pike	532	1092	7			0

For fish captured by Gee Trap

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
GT01	23-May-02							
		None						0
GT02	23-May-02							
		None						0
GT03	23-May-02							
		None						0
GT04	23-May-02							
		Yellow perch	61					0
		Yellow perch	60					0
		Yellow perch	57					0
GT05	23-May-02							
		None						0
GT06	24-May-02							
		None						0
GT07	24-May-02							
		None						0
GT08	24-May-02							
		None						0
GT09	24-May-02							
		None						0

For fish captured by Gill Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
GN01	22-May-02							
		Lake whitefish	393	570				0
		Lake whitefish	402	1374				0
		Lake whitefish	392	856				0
		Lake whitefish	375	746				0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Gill Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
GN01	22-May-02							
		Northern pike	611	1572	18	Fin Ray		0
		Northern pike	552	1246	8	Fin Ray		0
		Northern pike	580	1152		Fin Ray		0
		Northern pike	544	1254	8	Fin Ray		0
		Northern pike	485	866	8	Fin Ray		0
		Northern pike	538	1058	8	Fin Ray		0
		Northern pike	619	1628		Fin Ray		0
		Walleye	439	914	8	Fin Ray		0
		Walleye	355	692	8	Fin Ray		0
		White sucker	508	1604	17			0
GN02	22-May-02							
		Lake whitefish	471	1064				0
		Lake whitefish	380	532				0
		Lake whitefish	391	634				0
		Northern pike	621		18			0
		Northern pike	537	1066				0
		Northern pike	609	1322	18			0
		Northern pike	460	690	7			0
		Northern pike	608	1622	7			0
		Northern pike	461	730				0
		Northern pike	526	924	7			0
		Northern pike	520	928				0
		Northern pike	550	1134				0
		Northern pike	512	1030	7			0
		Northern pike	539	1074	7			0
		Northern pike	531	952	8			0
		Northern pike	543	898	8	Fin Ray		0
		Northern pike	521	756	8			0
		Northern pike	532	1138	8			0
		Northern pike	522	894	8	Fin Ray		0
		Northern pike	537	994	8	Fin Ray		0
		Northern pike	790	6500		Fin Ray		0
		Northern pike	540	1118	8			0
		Northern pike	467	822	8	Fin Ray		0
		Northern pike	530	1066	7			0
		Northern pike	487	824	8			0
		Northern pike	485	968	8			0
		Walleye	381	492	8			0
		Walleye	463	962	8	Fin Ray		0
		Walleye	400	760	8			0
		Walleye	388	626	8			0
		Walleye	363	466	8			0
		Walleye	380	574	8			0
		Walleye	391	570	8			0
		Walleye	453	910	8	Fin Ray		0
		Walleye	390	504	8			0
		Walleye	366	498	8			0
		Walleye	384	562	8			0
		Walleye	378	612	8			0

Appendix B Table B2. Life history data for fish captured in the Windmill Harbour Development Study Area, 200

For fish captured by Gill Net

Site	Date	Common Name	Fork Length (mm)	Weight (g)	Sexual Maturity	Age Structure	Age	Capture Code
GN02	22-May-02							
		Walleye	389	746	8			0
		Walleye	385	426	8			0
		Walleye	361	364	8			0
		Walleye	377	686	8			0
		Walleye	409	738	8			0
		Walleye	390	650	8			0
		Walleye	369	506	8	Fin Ray		0
		Walleye	505	1452	8	Fin Ray		0
		Walleye	468	1006	8			0
		Walleye	401	618	8	Fin Ray		0
		Walleye	387	584	8			0
		White sucker	406	1002	8			0
		White sucker	420	990	8			0
		White sucker	421	1076	17			0
		White sucker	494	1634	17			0
		White sucker	390	652	8			0
GN03	23-May-02							
		Lake whitefish	375	494				0
		Lake whitefish	366	538				0
		Northern pike	600	1322	7			0
		Northern pike	508	732	7			0
		Northern pike	474	624	7			0
		Northern pike	521	868	7			0
		Northern pike	542	966	8			0
		Northern pike	506	818	7			0
		Northern pike	545	840	7			0
		Northern pike	826	7000	7			0
		Northern pike	812	1486	7			0
		Spottail shiner	80					0
		Walleye	510	1490				0
		Walleye	385	456	8			0
		Yellow perch	86	6	8			0
		Yellow perch	71		8			0
		Yellow perch	86	6	8			0
		Yellow perch	77	4	8			0
		Yellow perch	81	6	8			0
		Yellow perch	74	4	8			0
		Yellow perch	84	6	8			0
		Yellow perch	77	4	8			0
		Yellow perch	85	8	8			0
		Yellow perch	80	4	8			0
		Yellow perch	81	6	8			0
		Yellow perch	82	8	8			0
		Yellow perch	83	6	8			0
		Yellow perch	77	4	8			0
		Yellow perch	86	6	8			0
		Yellow perch	96	6	8			0

Appendix B Table B3. Fisheries sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Sample Effort (h)	Species	Observed	Captured	Total Catch	CPUE (Fish/h)
Boat Electrofish								
	ES01							
		22-May-02	0.45					
				Burbot	0	1	1	*2.24*
				Lake whitefish	38	16	54	*120.75*
				Walleye	2	2	4	*8.94*
				White sucker	6	5	11	*24.60*
		23-May-02	0.39					
				Northern pike	2	2	4	*10.37*
				Spottail shiner	0	2	2	*5.19*
				Walleye	1	4	5	*12.97*
				White sucker	7	18	25	*64.84*
				Lake whitefish	54	24	78	*202.31*
	ES01 Totals:		**0.83**				**184**	***220.95***
	ES02							
		22-May-02	0.38					
				Northern pike	4	2	6	*15.71*
				Walleye	2	1	3	*7.85*
				Lake whitefish	31	17	48	*125.67*
				White sucker	0	1	1	*2.62*
		23-May-02	0.32					
				Lake whitefish	27	29	56	*176.84*
				Walleye	7	6	13	*41.05*
				White sucker	4	4	8	*25.26*
	ES02 Totals:		**0.70**				**135**	***193.24***
	ES03							
		22-May-02	0.29					
				Walleye	3	1	4	*13.97*
				White sucker	0	2	2	*6.98*
				Northern pike	7	5	12	*41.90*
				Lake whitefish	81	25	106	*370.13*
				Burbot	0	2	2	*6.98*
		23-May-02	0.30					
				Northern pike	3	0	3	*9.85*
				Walleye	4	2	6	*19.71*
				White sucker	8	5	13	*42.70*
				Lake whitefish	48	30	78	*256.20*
	ES03 Totals:		**0.59**				**226**	***382.51***
Boat Electrofish Totals:			**2.12**				**545**	***256.81***

Appendix B Table B3. Fisheries sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Sample Effort (h)	Species	Observed	Captured	Total Catch	CPUE (Fish/h)
Fyke Net								
	FN01							
		22-May-02	6.08					
				None	0	0	0	*0.00*
		23-May-02	16.00					
				Northern pike	0	6	6	*0.38*
				White sucker	0	1	1	*0.06*
	FN01 Totals:		**22.08**				**7**	***0.32***
	FN02							
		23-May-02	7.25					
				None	0	0	0	*0.00*
		24-May-02	16.25					
				Northern pike	0	14	14	*0.86*
	FN02 Totals:		**23.50**				**14**	***0.60***
Fyke Net Totals:			**45.58**				**21**	***0.46***

Appendix B Table B3. Fisheries sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Sample Effort (h)	Species	Observed	Captured	Total Catch	CPUE (Fish/h)
Gee Trap								
	GT01							
		23-May-02	22.98					
				None	0	0	0	*0.00*
	GT01 Totals:		**22.98**				**0**	***0.00***
	GT02							
		23-May-02	22.97					
				None	0	0	0	*0.00*
	GT02 Totals:		**22.97**				**0**	***0.00***
	GT03							
		23-May-02	22.95					
				None	0	0	0	*0.00*
	GT03 Totals:		**22.95**				**0**	***0.00***
	GT04							
		23-May-02	22.85					
				Yellow perch	0	1	1	*0.04*
		24-May-02	23.47					
				Yellow perch	0	2	2	*0.09*
	GT04 Totals:		**46.32**				**3**	***0.06***
	GT05							
		23-May-02	22.92					
				None	0	0	0	*0.00*
	GT05 Totals:		**22.92**				**0**	***0.00***
	GT06							
		24-May-02	23.48					
				None	0	0	0	*0.00*
	GT06 Totals:		**23.48**				**0**	***0.00***
	GT07							
		24-May-02	23.67					
				None	0	0	0	*0.00*
	GT07 Totals:		**23.67**				**0**	***0.00***
	GT08							
		24-May-02	23.73					
				None	0	0	0	*0.00*
	GT08 Totals:		**23.73**				**0**	***0.00***
	GT09							
		24-May-02	22.50					
				None	0	0	0	*0.00*
	GT09 Totals:		**22.50**				**0**	***0.00***
Gee Trap Totals:				**231.52**			**3**	***0.01***

Appendix B Table B3. Fisheries sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Sample Effort (h)	Species	Observed	Captured	Total Catch	CPUE (Fish/h)
Gill Net								
	GN01							
		22-May-02	1.42					
				Northern pike	0	7	7	*4.94*
				Walleye	0	2	2	*1.41*
				Lake whitefish	0	4	4	*2.82*
				White sucker	0	1	1	*0.71*
	GN01 Totals:		**1.42**				**14**	***9.88***
	GN02							
		22-May-02	1.25					
				Lake whitefish	0	3	3	*2.40*
				Northern pike	0	13	13	*10.40*
				Walleye	0	19	19	*15.20*
				White sucker	0	4	4	*3.20*
		23-May-02	0.75					
				Northern pike	0	10	10	*13.33*
				Walleye	0	4	4	*5.33*
				White sucker	0	1	1	*1.33*
	GN02 Totals:		**2.00**				**54**	***27.00***
	GN03							
		23-May-02	0.50					
				Yellow perch	0	16	16	*32.00*
				Lake whitefish	0	2	2	*4.00*
				Northern pike	0	9	9	*18.00*
				Spottail shiner	0	1	1	*2.00*
				Walleye	0	2	2	*4.00*
	GN03 Totals:		**0.50**				**30**	***60.00***
Gill Net Totals:				**3.92**			**98**	***25.02***

Appendix B Table B4. Egg mat sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date Set	Sample Date Pull	Sample Effort (h)	Species	Total Catch	CPUE (Fish/h)
Egg Mat							
	EG01	22 May 10:15	24 May 11:20	49.08	None	0	*0.00*
	EG02	22 May 10:17	24 May 11:22	49.08	None	0	*0.00*
	EG03	22 May 10:19	24 May 11:23	49.07	None	0	*0.00*
	EG04	22 May 10:21	24 May 11:25	49.07	None	0	*0.00*
	EG05	22 May 10:23	24 May 11:27	49.07	None	0	*0.00*
	EG06	22 May 10:26	24 May 11:27	49.02	None	0	*0.00*
	EG07	22 May 10:28	24 May 11:29	49.02	None	0	*0.00*
	EG08	22 May 10:30	24 May 11:31	49.02	None	0	*0.00*
	EG09	22 May 10:31	24 May 11:31	49.00	None	0	*0.00*
	EG10	22 May 10:33	24 May 11:33	49.00	None	0	*0.00*
	EG11	22 May 10:34	24 May 11:35	49.02	None	0	*0.00*
	EG12	22 May 10:36	24 May 11:37	49.02	None	0	*0.00*
	EG13	22 May 10:36	24 May 11:39	49.05	None	0	*0.00*
	EG14	22 May 10:37	24 May 11:40	49.05	None	0	*0.00*
	EG15	22 May 10:39	24 May 11:41	49.03	None	0	*0.00*
	EG16	22 May 10:41	24 May 11:43	49.03	None	0	*0.00*
	EG17	22 May 10:42	24 May 11:45	49.05	None	0	*0.00*
	EG18	22 May 10:44	24 May 11:47	49.05	None	0	*0.00*
	EG19	22 May 10:45	24 May 11:49	49.07	None	0	*0.00*
	EG20	22 May 10:46	24 May 11:51	49.08	None	0	*0.00*
Egg Mat Totals:				**980.87**		**0**	***0.00***

Appendix B Table B5. Sweep net sampling effort, catch, and catch-per-unit-effort (CPUE), Windmill Harbour Development Study Area, 22-24 May 2002.

Method	Site Name	Sample Date	Length (m)	Width (m)	Sample Effort (m^2)	Species	Total Catch	CPUE (Catch/m^2)
Sweep Net								
	SW01	23-May-02	1.00	0.17	0.17	Northern pike	1	*5.88*
	SW02	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW03	22-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW04	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW05	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW06	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW07	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW08	22-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW09	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW10	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW11	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW12	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW13	22-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW14	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW15	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW16	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW17	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW18	22-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW19	23-May-02	1.00	0.17	0.17	None	0	*0.00*
	SW20	23-May-02	1.00	0.17	0.17	None	0	*0.00*
Sweep Net Totals:					**3.40**		**1**	***0.29***

APPENDIX C
Significance Rating Criteria

Magnitude
Magnitude describes the nature and extent of the environmental effect. The magnitude of an effect is quantified in terms of the amount of change in a parameter or variable from an appropriate threshold value, which may be represented by a guideline or baseline conditions. Three general categories of change to be employed are low (1), medium (2), and high (3). The definitions used to rate the magnitude will be specific to a resource, and will depend on the type of effect, the methods available to measure the effect, and the accepted practices for a particular discipline.

Geographic Extent
Geographic extent can be separated into three ratings:

- Sub-local - area in the immediate influence of the Project (e.g., construction zone)
- Local - Sub-local area and immediately adjoining areas
- Regional - Lac Ste Anne and/or biological boundaries of potentially affected populations

Duration and Timing
Duration is defined as a measure of the length of time that the potential effect could last. It is closely related to the project phase or activity that could cause the effect. The two project phases that define the temporal boundaries include construction and operation. The duration ratings are divided into two classes based on the time scale of each Project phase:

- Short-term - effect lasting for less than one year (Construction)
- Long-term - effect lasting longer than 20 years (Operation)

Frequency
Frequency is associated with duration and defines the number of occurrences that can be expected during each phase of the project. The frequency ratings are divided into three classes:

- Low - effect occur infrequently during each phase (one event)
- Moderate - effect occur frequently during each phase
- High - effect occur continuously

Reversibility
Reversibility is the ability of the VEC to return to conditions that existed prior to the adverse environmental effect. The prediction of reversibility can be difficult because environmental effects may, or may not, be reversible. Despite this, it is important to ascertain reversibility because it has an important influence on the significance of an effect. Two ratings will be used: reversible (R) and not reversible (NR).

Level of Confidence
Using the rating criteria described in the preceding paragraphs, the significance of adverse environmental effects is evaluated based on a review of project specific data, relevant literature and professional opinion. Based on recommendations by Barnes and Davey (1999), the assessment should also include a rating system that evaluates the level of confidence in the prediction of significance. Three rating classes will be used to assess the level of confidence: low, moderate, and high.

Likelihood

The more likely that an adverse effect will occur (or not occur), the higher the level of confidence that the effect will be significant (or not significant). Probability of occurrence is used to assess likelihood using three rating classes as follows: low, moderate, and high.

Certainty

During the assessment of significance, it is desirable to apply rigorous scientific and/or statistical methods (quantitative approach), but where such methods are not feasible, professional judgment is usually employed (qualitative approach). Rating the certainty of significance is an additional step that can be used to justify or substantiate the likelihood that a significant adverse effect will occur. The three ratings that will be applied are: low, moderate, and high.

APPENDIX D

MARINA BAY HOMEOWNER'S ASSOCIATION
100 Marina Bay Court
Sylvan Lake, AB T4S 1E9

June 11, 1999

Sunset Harbor Development
RR 1
Falun, AB T0C 1H0

In response to your request for information on the Marina Bay Developments at Sylvan Lake, we are pleased to provide you with the following information.

Marina Bay has 100 boat slips in the marina. Of these, approximately 40 are relatively large sailboats, about 40 are motor boats used for water skiing and pleasure cruising. The remaining slips are used by a few sea-dos and a few are used as guest slips and for RCMP use.

Although the public is allowed to fish in Marina Bay, the residents do not as we consider it a key fish habitat and spawning area. In fact, fishing in the marina is not sporting as it is teeming with fish due to the spawning ledges and aeration system.

The property owners have come to value and protect not only the fish habitat but the bird life that our neighborhood has nurtured and have become watchdogs over public abuse of the area.

The majority of our residents are weekend recreational property owners. As a result, the marina is quiet during the week with only occasional boat counts except Wednesday evenings when about 20 sailboats participate in a weekly sailing race on the lake.

If we were to do boat counts in and out of the marina it would probably average 12 boats a day over the summer season. We have never had any major line-ups of boats launching for the season.

Hopefully, this is the information you require and please feel free to contact us if you require additional information.

Yours truly,

Marina Bay Home Owners Association

- ADDENDUM -

SHORELINE VEGETATION SURVEY
WINDMILL HARBOUR DEVELOPMENT

Windmill Harbour Project

Note on shoreline vegetation by Dr. Graham C. D. Griffiths, based on field work on 5 and 6 August, 2003.

There are two well-defined, more or less continuous beach ridges at this site: the primary beach ridge marked by the outer limits of poplar forest and tilled cropland, was formed at a time when lake levels were higher, probably in early postglacial times; then there is a lower second beach ridge (close to the existing shoreline) occupied by a strip of dense willow shrubbery. Between the two beach ridges there is a broad band of open land mainly occupied by sedge fen, with a varying degree of recent willow invasion. I was asked to document the vegetation of land below the primary beach ridge. This was done on 5 and 6 August by recording the content of plots along 3 transects, with two additional plots in the vicinity of the western grebe colony. In total 21 plots were documented (see attached Stand Description Forms; the location of the plots is shown on the attached air photos).

The shoreline vegetation of this site is representative of the natural shoreline vegetation of Lac Ste. Anne and similar lakes in Central Alberta, and shows little evidence of recent manmade disturbance. It provides valuable wildlife habitat, but was not found to contain any plant species listed as rare on the Provincial "Tracking List" published by the Alberta Natural Heritage Information Centre. Most of the plant communities extend (continuously or with only short gaps) along the entire shoreline, as indicated by the polygon overlay on the attached air photos; the exception is the pondlily community, which is confined to the vicinity of the western grebe colony. Measures to avoid disturbance of this colony must include retention of the natural vegetation (including pondlily beds) along the relevant stretch of shoreline.

Water depth at the outer limit of bulrush beds was measured at 1.3 m. The lake water was murky due to abundant microorganisms, so the lake bottom could not be seen in open water plots (1.3 m and beyond). As far as I could tell, coverage by rooted aquatics was at most patchy, but the coverage of *Chara* may have been underestimated due to its short stems not being effectively sampled with the tool used. Since *Chara* does not grow to the surface, its presence is of no concern to boaters. Given the poor light penetration of the water, invasion by rooted aquatics of an access channel dredged to a depth of about 2 m (as I believe is proposed) seems unlikely.

The following are more detailed comments on particular vegetation types:

Sedge Fens. The extensive band of open ground between the two main beach ridges is mainly occupied by sedge fen , the dominant sedges being *Carex atherodes* (awned sedge) and/or *C. praegracilis* (graceful sedge) (see plots 1A, 2A, 3A). Many parts of this fen are being invaded by willow saplings (mainly *Salix petiolaris*, basket willow). This willow invasion may indicate that the site has become drier in recent years, or that willow growth was previously suppressed under grazing management. The prevalence of *Carex praegracilis* suggests that the land is slightly saline (oligohaline), as also does the fact that most of the willow saplings belong to *Salix petiolaris* (the species of willow most tolerant of salinity). No poplar saplings were observed. The vegetation indicates that the land must have a high water table for at least part of the year, and its suitability for building construction may be subject to limitations.

Limited bands of sedge fen dominated by awned sedge *(Carex atherodes)* also occur below the second beach ridge (see plot 2C). This species is commonly found on intermittently flooded ground.

Willow Shrubbery. An almost continuous band of dense mature willow shrubbery extends along the second beach ridge (see plots 1B, 2B, 3B). The dominant willow is basket willow *(Salix petiolaris),* a species indicative of eutrophic to oligohaline conditions. The presence of some weedy herbs in the understory of this strip, such as stinging nettle *(Urtica dioica)* and hemp nettle *(Galeopsis tetrahit),* is due to its use as shelter by deer and other wildlife.

Reed Beds. Reed beds dominated by the tall reed grasses *Phalaris arundinacea* (reed Canary grass) and/or *Calamagrostis canadensis* (bluejoint) (see plots 1C, 2D, 3C) occur extensively along the upper shoreline, either immediately below the second beach ridge or on a slight third beach ridge separated from the second ridge by a strip of sedge fen (transect 2). These robust grasses predominate on sites subject to disturbance by wind and wave action during severe storms, but above normal water levels.

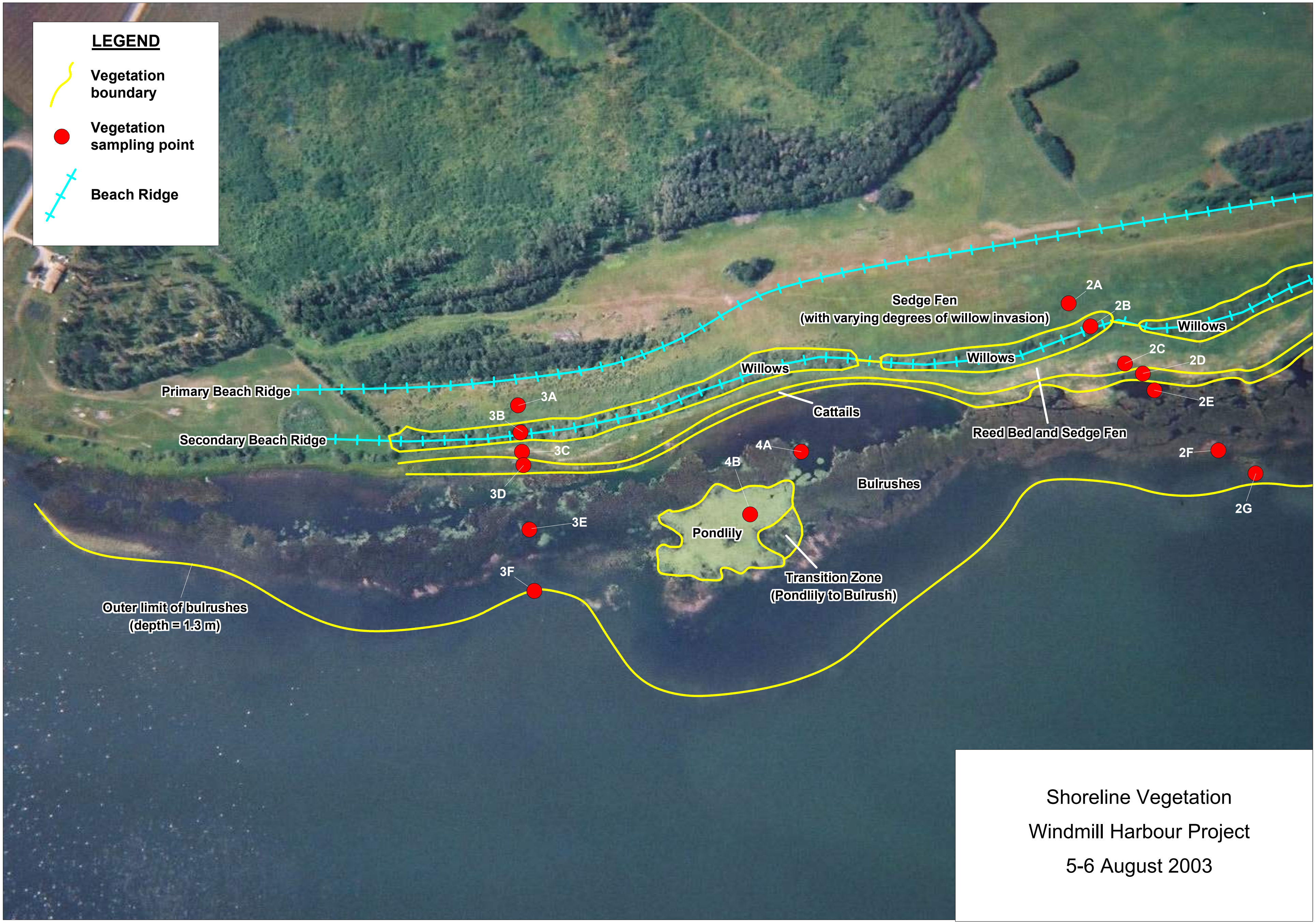
Cattail Beds. Cattail beds *(Typha latifolia)* commonly form continuous bands on saturated to shallowly flooded ground at the edges of eutrophic lakes and ponds with more or less stable water levels (see plots 1D, 2E, 3D). The stands at this site contain a rather diverse admixture of other wetland plants, especially *Glyceria grandis* (common manna grass), *Sparganium eurycarpum* (giant burreed) and *Eleocharis palustris* (creeping spikerush). This is the only plant community at the site with an extensive moss layer (consisting of *Drepanocladus aduncus).*

Bulrush Beds. Broad beds of hard-stemmed bulrush *(Scirpus acutus)* extend along the entire shoreline, occupying water ranging in depth from a few cm (at the edge of the cattail beds) to about 1.3 m. The density of the bulrushes decreases with increasing distance from the shore. Some parts of these beds contain dense growth of the submersed aquatics *Utricularia vulgaris* (common bladderwort) and *Ceratophyllum demersum* (hornwort), but in other places few or no rooted plants other than bulrush were present (compare plot 2F with plots 1E and 3E). Bulrush beds are both physically and biologically important, as they break up and slow down waves before they reach the shore; thus they protect shorelines from erosion, as well as provide shelter for wildlife.

Submersed Aquatics. A zone of rooted aquatic vegetation beyond the bulrush beds appears poorly developed in this lake, only *Chara* sp. being present in all three of our samples (plots 1F, 2G, 3F). [While *Chara* is classified as an alga, it is normally listed as a rooted aquatic because it is attached to the substrate]. Patches of *Potamogeton richardsonii* and *P. pectinatus* (clasping-leaf pondweed and sago pondweed) were found, but appeared not to be extensive. Poor light penetration of the water is probably responsible for poor development of a rooted aquatic flora in this lake beyond the bulrush beds.

A series of shallow lagoons along the shore contains a different community of submersed aquatic plants dominated by *Potamogeton filiformis* (thread-leaved pondweed) (see plot 4B). Since the water depth in these lagoons is within the range occupied by bulrush beds, I suspect that they are kept free of bulrushes by the activity of mammals (such as beaver and muskrats).

Pondlily Beds. Extensive beds of yellow pondlilies *(Nuphar variegatum)* are found towards the east end of the site. The water beneath the pondlilies is occupied by dense mats of *Utricularia vulgaris* (common bladderwort) and *Ceratopyllum demersum* (hornwort). Much of this area is free of bulrushes, but there is a (more sheltered) transition zone contains both pondilies and bulrushes in which the colony of western grebes is situated. Whether there is a direct biological connection between the presence of grebes and pondlilies (e. g., substrate enrichment to the benefit of pondlilies, or the use of pondlily parts by grebes for nest construction) is not known to me.


LEGEND
Vegetation boundary
Vegetation sampling point
Beach Ridge
Primary Beach Ridge
Secondary Beach Ridge
Sedge Fen
(with varying degrees of willow invasion)
Willows
Willows
Willows
Cattails
Reed Bed and Sedge Fen
Bulrushes
Pondlily
Transition Zone
(Pondlily to Bulrush)
Outer limit of bulrushes
(depth = 1.3 m)
2A
2B
2C
2D
2E
2F
2G
3A
3B
3C
3D
3E
3F
4A
4B
Shoreline Vegetation
Windmill Harbour Project
5-6 August 2003


LEGEND
Vegetation boundary
Vegetation sampling point
Beach Ridge
Primary Beach Ridge
Secondary Beach Ridge
Sedge Fen
(with varying degrees of willow invasion)
Reed Beds and
Sedge Fen
Willow
Willow
Willow
Willow
Willow
1A
1B
1C
1D
1E
1F
Shallow Lagoon
Shallow Lagoon
Cattails
Bulrushes
Pondlily
Transition Zone
(Pondlily to Bulrush)
Outer limit of bulrushes
(depth = 1.3 m)
Shoreline Vegetation
Windmill Harbour Project
5-6 August 2003

STAND DESCRIPTION

Vegetation Type: Pondweed Beds   Sample No.: 4B Location: Windmill Harbour Date: 6/8/2003
Elevation: Slope: —   Aspect: —   Quadrat Size: 5.64 m around marker buoy (= 100 m²)
Landform & Topography:
shallow lagoon sheltered from wind and waves by adjacent bulrush beds (depth at buoy 0.2 m)
Drainage Class: none   Hygrotope: hydric (underwater)
Soil:
lake bed (nonsoil)
Ground cover other than vegetation (e.g. rocks, water 100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Potamogeton filiformis	C5
Potamogeton pusillus	C1
Utricularia vulgaris	C1
Sparganium angustifolium	+
Potamogeton richardsonii	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Pondlily Beds   Sample No.: 4A Location: Windmill Harbour Date: 6/8/2003
Elevation: Slope: —   Aspect: — Quadrat Size: 5.64 m circle around marker buoy (= 100 m²)
Landform & Topography:
shallow lagoon sheltered from wind and waves by adjacent bulrush beds (depth at buoy 0.5 m)
Drainage Class: none   Hygrotope: hydric (underwater)
Soil: lake bed (nonsoil)

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil) 100%

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Nuphar variegatum C8
Utricularia vulgaris C7
Ceratophyllum demersum C7

FLOATING AQUATICS

Lemna turionifera +

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

Western Grebe colony site situated nearbye in the transition from these pondlily beds to bulrush beds (containing the above plant species in addition to C6 coverage of Scirpus acutus)

STAND DESCRIPTION

Vegetation Type: Submersed Aquatics Sample No.: 3F Location: Windmill Harbour Date: 6/8/2003
Elevation: Slope: — Aspect: — Quadrat Size: 5.64 m circle around marker buoy (= 100 m^2)
Landform & Topography:
open water close to outer edge of bulrush beds (depth at buoy 1.5 m)
Drainage Class: none Hygrotope: hydric (underwater)
Soil: lake bed (nonsoil)

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil) 100%

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Potamogeton richardsonii C4 ? (quantifications unreliable due to lack of visibility)
Chara sp. (a macroalga) C2 ?

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Submersed Aquatics Sample No.: 26 Location: Windmill Harbour Date: 6/8/2003
Elevation: Slope: – Aspect: – Quadrat Size: 5.64 m circle around marker buoy (= 100 m²)
Landform & Topography:
open water close to outer edge of bulrush beds (depth at buoy 1.4 m)
Drainage Class: none Hygrotope: hydric (underwater)
Soil: lake bed (nonsoil)

Ground cover other than vegetation (e.g. rocks, water 100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

–

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

–

DWARF SHRUBS <0.5 m high

–

HERBS

Chara sp. (a macroalga) C2? (quantification unreliable due to lack of visibility)

MOSSES AND LICHENS

–

EPIPHYTES (common/ frequent/ scarce/ rare) –

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Submersed Aquatics   Sample No.: 1F   Location: Windmill Harbour   Date: 6/8/2003
Elevation: Slope: —   Aspect: —   Quadrat Size: 5.64 m circle around marker buoy (= 100 m²)
Landform & Topography: open water close to outer edge of bulrush beds (depth at buoy 1.3 m)
Drainage Class: none   Hygrotope: hydric (underwater)
Soil: lake bed (nonsoil)

Ground cover other than vegetation (e.g. rocks, water 100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Potamogeton richardsonii	C2 ?	(Quantifications unreliable due to lack of visibility)
Potamogeton pectinatus	C2 ?	
Chara sp. (a macroalga)	C2 ?	
Ceratophyllum demersum	+	

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Bulrush Beds Sample No.: 3E Location: Windmill Harbour Date: 6/8/2003
Elevation: Slope: — Aspect: — Quadrat Size: 5.64 m circle around marker buoy (= 100 m²)
Landform & Topography:
shallow water close to shore (depth at buoy 0.8m)
Drainage Class: none Hygrotope: hydric (underwater)
Soil:
lake bed (nonsoil)
Ground cover other than vegetation (e.g. rocks, water 100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover Scale	
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS
Scirpus acutus C8
Potamogeton richardsonii +
Nuphar variegatum + (young plants only)
Myriophyllum sibiricum +
Potamogeton filiformis +

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Bulrush Beds   Sample No.: 2F Location: Windmill Harbour Date: 6/8/2003
Elevation: Slope: —   Aspect: —   Quadrat Size: 5.64 m circle around marker buoy (= 100 m²)
Landform & Topography: shallow water close to shore (depth at buoy 0.75 m)
Drainage Class: none   Hygrotope: hydric (underwater)
Soil: lake bed (nonsoil)

Ground cover other than vegetation (e.g. rocks, water 100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Scirpus acutus C8
Utricularia vulgaris C7
Ceratophyllum demersum C6
Myriophyllum sibiricum C1
Nuphar variegatum + (young plants only)

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Bulrush Beds   Sample No.: 1E Location: Windmill Harbour Date: 6/8/2003
Elevation: Slope: —   Aspect: —   Quadrat Size: 5.64 m circle around marker buoy (= 100 m²)
Landform & Topography:
shallow water close to shore (depth at buoy 0.7 m)
Drainage Class: none   Hygrotope: hydric (underwater)
Soil: lake bed (nonsoil)

Ground cover other than vegetation (e.g. rocks, water 100%, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Scirpus acutus   C8

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Cattail Beds
Sample No.: 3D Location: Windmill Harbour Date: 5/8/2003
Elevation: Slope: —
Aspect: — Quadrat Size: 5 x 20 m
Landform & Topography: lake shore
Drainage Class: very poor
Hygrotope: subhydric to hydric
Soil: not sampled (gleysol to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil) – open water C1

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

SHRUBS 0.5 - 5 m high

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

DWARF SHRUBS <0.5 m high

—

HERBS

Typha latifolia	C7	Beckmannia syzigachne	+
Glyceria grandis	C6	Calamagrostis stricta	+
Sparganium eurycarpum	C1	Sium suave	+
Eleocharis palustris	C1	Mentha arvensis	+
Juncus nodosus	C1	Bidens cernua	+
Scirpus validus	C1	Galium trifidum	+

FLOATING AQUATICS (partly stranded)

Lemna turionifera	+
Utricularia vulgaris	+
Ricciocarpus natans (a liverwort)	+

MOSSES AND LICHENS

Drepanocladus aduncus C3

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

Site more extensively flooded earlier in season (as evidenced by stranded floating plants)

STAND DESCRIPTION

Vegetation Type: Cattail Beds   Sample No.: 2E Location: Windmill Harbour   Date: 5/8/2003
Elevation: Slope: —   Aspect: —   Quadrat Size: 5 x 20 m
Landform & Topography: lake shore

Drainage Class: very poor   Hygrotope: subhydric
Soil: not sampled (gleysol to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

SHRUBS 0.5 - 5 m high

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

DWARF SHRUBS <0.5 m high
Salix petiolaris seedlings + (unlikely to reach maturity unless water levels fail to return to normal)

HERBS

Typha latifolia	C7
Sparganium eurycarpum	C1
Glyceria grandis	C1
Calamagrostis stricta	C1
Mentha arvensis	C1
Impatiens capensis	+
Senecio eremophilus	+
Urtica dioica	+
Cirsium arvense	+
Phalaris arundinacea	+
Polygonum amphibium	+
Calamagrostis canadensis	+
Epilobium ciliatum	+
Beckmannia syzigachne	+
Senecio congestus	+
Galium trifidum	+
Ranunculus sceleratus	+
Bidens cernua	+
Rumex maritimus	+

FLOATING AQUATICS (stranded)

Lemna turionifera	+
Utricularia vulgaris	+

MOSSES AND LICHENS
Drepanocladus aduncus C4

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS
Site flooded earlier in season (as evidenced by stranded floating plants)

STAND DESCRIPTION

Vegetation Type: Cattail Beds Sample No.: 1D Location: Windmill Harbour Date: 5/8/2003
Elevation: Slope: — Aspect: — Quadrat Size: 5 x 20 m
Landform & Topography: lake shore

Drainage Class: very poor Hygrotope: Subhydric to hydric
Soil: not sampled (gleysol to be expected)

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover Scale	
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

Salix planifolia seedlings + (unlikely to reach maturity unless water levels fail to return to normal,

HERBS

Typha latifolia	C7
Eleocharis palustris	C2
Bidens cernua	C1
Glyceria grandis	C1
Calamagrostis canadensis	C1
Sparganium eurycarpum	C1
Calamagrostis stricta	C1
Scirpus validus	C1
Agrostis scabra	+
Cirsium arvense	+
Senecio congestus	+
Impatiens capensis	+
Epilobium ciliatum	+
Galium trifidum	+
Rorippa palustris	+
Juncus nodosus	+
Ranunculus sceleratus	+
Sium suave	+
Mentha arvensis	+
Rumex maritimus	+
Polygonum amphibium	+
Ranunculus cymbalaria	+

FLOATING AQUATICS (stranded)

Lemna turionifera	C1
Utricularia vulgaris	+

MOSSES AND LICHENS

Drepanocladus aduncus C7

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

Site flooded earlier in season (as evidenced by stranded floating plants)

STAND DESCRIPTION

Vegetation Type: Reed Beds   Sample No.: 3C Location: Windmill Harbour Date: 5/8/2003
Elevation: Slope: —   Aspect: — Quadrat Size: 5 x 20 m
Landform & Topography: upper shoreline (below beach ridge)
Drainage Class: poor   Hygrotope: hygric
Soil: not sampled (gleysol or regosol to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Phalaris arundinacea	C6	Scutellaria galericulata	+
Calamagrostis canadensis	C2	Urtica dioica	+
Poa palustris	C2	Agrostis scabra	+
Polygonum amphibium	C1	Poa pratensis	+
Mentha arvensis	C1	Impatiens capensis	+
Calamagrostis stricta	C1		

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Reed Beds Sample No.: 1C Location: Windmill Harbour Date: 5/8/2003
Elevation: Slope: — Aspect: — Quadrat Size: 5 x 20 m
Landform & Topography:
upper shoreline (below beach ridge)
Drainage Class: poor Hygrotope: hygric
Soil:
not sampled (gleysol or regosol to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	< 1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS < 0.5 m high
Rubus idaeus +

HERBS

Calamagrostis canadensis	C5	Epilobium ciliatum	+
Phalaris arundinacea	C4	Poa palustris	+
Urtica dioica	C1	Cirsium arvense	+
Galeopsis tetrahit	C1	Potentilla norvegica	+
		Senecio eremophilus	+
		Impatiens capensis	+
		Mentha arvensis	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Reed Beds   Sample No.: 2D   Location: Windmill Harbour   Date: 5/8/2003
Elevation: Slope: —   Aspect: —   Quadrat Size: 5 x 20 m
Landform & Topography: slight beach ridge
Drainage Class: poor   Hygrotope: hygric
Soil: not sampled (gleysol or regosol to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover Scale	
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Phalaris arundinacea	C7
Carex atherodes	C1
Poa palustris	C1
Cirsium arvense	C1
Mentha arvensis	C1
Urtica dioica	C1
Scutellaria galericulata	+
Impatiens capensis	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Sedge Fen Sample No.: 2C Location: Windmill Harbour Date: 5/8/2003
Elevation: Slope: — Aspect: – Quadrat Size: 5 x 20 m
Landform & Topography:
Open fen between beach ridges
Drainage Class: poor Hygrotope: hygric
Soil:
not sampled (gleysol to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Carex atherodes	C8
Phalaris arundinacea	C1
Cirsium arvense	C1
Calamagrostis stricta	+
Senecio eremophilus	+
Mentha arvensis	+
Scutellaria galericulata	+
Urtica dioica	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Willow Shrubbery Sample No.: 3B Location: Windmill Harbour Date: 5/8/2003
Elevation: Slope: — Aspect: — Quadrat Size: 5 x 20 m
Landform & Topography: low beach ridge
Drainage Class: imperfect Hygrotope: Subhygric
Soil: ?

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

Salix petiolaris	C6
Salix planifolia	C2
Salix discolor	C2

DWARF SHRUBS <0.5 m high

Rubus idaeus	C2

HERBS

Calamagrostis canadensis	C3
Carex atherodes	C1
Petasites sagittatus	C1
Cirsium arvense	+
Epilobium angustifolium	+
Aster hesperius	+
Polygonum amphibium	+
Poa palustris	+

MOSSES AND LICHENS

none

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Willow Shrubbery Sample No.: 28 Location: Windmill Harbour Date: 5/8/2003
Elevation: Slope: — Aspect: — Quadrat Size: 5 x 20m
Landform & Topography: low beach ridge
Drainage Class: imperfect Hygrotope: Subhygric
Soil: ?

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

Salix petiolaris C8

DWARF SHRUBS <0.5 m high

Rubus idaeus C1

HERBS

Urtica dioica	C2	Mentha arvensis	+
Poa palustris	C2	Galeopsis tetrahit	+
Poa pratensis	C1	Geum macrophyllum	+
Solidago canadensis	C1	Fragaria virginiana	+
Carex atherodes	C1	Senecio eremophilus	+
Phalaris arundinacea	C1	Erigeron philadelphicus	+
Stachys palustris	C1	Cirsium arvense	+
		Epilobium angustifolium	+
		Taraxacum officinale	+

MOSSES AND LICHENS

none

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

4U 0670917
5951575

STAND DESCRIPTION

Vegetation Type: Willow Shrubbery   Sample No.: 1B   Location: Windmill Harbour   Date: 5/8/2003
Elevation: Slope: —   Aspect: —   Quadrat Size: 5 x 20 m
Landform & Topography: low beach ridge
Drainage Class: imperfect   Hygrotope: subhygric
Soil: ?

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

Salix petiolaris	C6
Salix planifolia	C3
Salix serissima	C1
Cornus stolonifera	C1
Ribes americanum	C1

DWARF SHRUBS <0.5 m high

—

HERBS

Calamagrostis canadensis	C7
Cirsium arvense	C1
Polygonum amphibium	C1
Equisetum arvense	C1
Impatiens capensis seedlings	+
Galeopsis tetrahit	+
Aster hesperius	+
Geum macrophyllum	+
Urtica dioica	+
Scutellaria galericulata	+
Mentha arvensis	+
Stellaria longifolia	+
Epilobium angustifolium	+
Stachys palustris	+
Ranunculus sp. (macounii or pensylvanicus)	+

MOSSES AND LICHENS

mosses sparse (<5%)

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

UTM 11U 0670911E
5951560 N

STAND DESCRIPTION

Vegetation Type: Sedge Fen | Sample No.: 1A | Location: Windmill Harbour | Date: 5/8/03
Elevation: | Slope: – | Aspect: – | Quadrat Size: 10x10m
Landform & Topography: open fen between beach ridges

Drainage Class: poor | Hygrotope: hygric
Soil: not sampled (gleysol to be expected)

Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)

TREES >5m high (cover, dbh, height, age if cored)

–

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

–

DWARF SHRUBS <0.5 m high

Salix petiolaris C1 (young plants only, indicating recent invasion)

HERBS

Carex praegracilis C4
Poa palustris C3
Polygonum amphibium C3
Calamagrostis canadensis C2
Calamagrostis stricta C2
Carex atherodes C1
Poa pratensis C1

Scutellaria galericulata +
Geum macrophyllum +
Aster hesperius +
Trifolium hybridum +
Ranunculus sp. (macounii or pensylvanicus) +

MOSSES AND LICHENS –

EPIPHYTES (common/ frequent/ scarce/ rare) –

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Sedge Fen Sample No.: 2A Location: Windmill Harbour Date: 5/8/03
Elevation: Slope: — Aspect: — Quadrat Size: 10 x 10 m
Landform & Topography: Open fen between beach ridges
Drainage Class: poor Hygrotope: hygric
Soil: not sampled (gleysol to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover	Scale
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

—

DWARF SHRUBS <0.5 m high

—

HERBS

Carex atherodes	C6	Sium suave	+
Calamagrostis stricta	C4	Cirsium arvense	+
Polygonum amphibium	C2	Hordeum jubatum	+
Phalaris arundinacea	C1	Poa pratensis	+
Poa palustris	C1	Stachys palustris	+
Mentha arvensis	C1	Potentilla rivalis	+
Carex praegracilis	C1	Polygonum convolvulus	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

STAND DESCRIPTION

Vegetation Type: Sedge Fen
Sample No.: 3A Location: Windmill Harbour Date: 5/8/03
Elevation: Slope: ~
Aspect: – Quadrat Size: 10 × 10 m
Landform & Topography: Open fen between beach ridges
Drainage Class: poor Hygrotope: hygric
Soil: not sampled (gleysol to be expected)
Ground cover other than vegetation (e.g. rocks, water, deadfalls, bare soil)

Successional Status (early/ intermediate/ advanced/ mature)
TREES >5m high (cover, dbh, height, age if cored)

—

Cover Scale	
+	<1%
1	1-5%
2	6-15%
3	16-25%
4	26-50%
5	51-75%
6	76-85%
7	86-95%
8	96-100%

SHRUBS 0.5 - 5 m high

Salix petiolaris	C2
Salix planifolia	+

DWARF SHRUBS <0.5 m high

Salix bebbiana	+
Ribes americanum	+

HERBS

Carex praegracilis	C5	Geum macrophyllum	+
Carex atherodes	C3	Ranunculus macounii	+
Poa palustris	C2	Scutellaria galericulata	+
Polygonum amphibium	C2	Cicuta maculata	+
Mentha arvensis	C1	Stachys palustris	+
Aster hesperius	C1	Petasites sagittatus	+
		Carex tenera	+

MOSSES AND LICHENS

—

EPIPHYTES (common/ frequent/ scarce/ rare) —

OTHER COMMENTS

WINDMILL ESTATES LTD.
WINDMILL HARBOUR
AREA STRUCTURE PLAN
LOT 15, 20-54-3-W5M
LAC STE. ANNE COUNTY

Prepared by

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