Report Title: Site C Agricultural Resources Inventory: Status of Information and Recommendations for Further Study
Issuer: Norecol Environmental Consultants Ltd
Date: May, 1991

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During Stage 2 of the Site C Project, studies are underway to update many of the historical studies and information known about the project.

The potential Site C project, as originally conceived, will be updated to reflect current information and to incorporate new ideas brought forward by communities, First Nations, regulatory agencies and stakeholders. Today's approach to Site C will consider environmental concerns, impacts to land, and opportunities for community benefits, and will update design, financial and technical work.

SITE C

AGRICULTURAL RESOURCES INVENTORY: STATUS OF INFORMATION AND RECOMMENDATIONS FOR FURTHER STUDY

Prepared for:

B.C. Hydro
808 Nelson Street
Vancouver, British Columbia
V6Z 2H2

Prepared by:

Norecol Environmental Consultants Ltd.
Suite 700, 1090 West Pender Street
Vancouver, British Columbia
V6E 2N7

May, 1991

File: 1-008-06.01

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1.0 INTRODUCTION

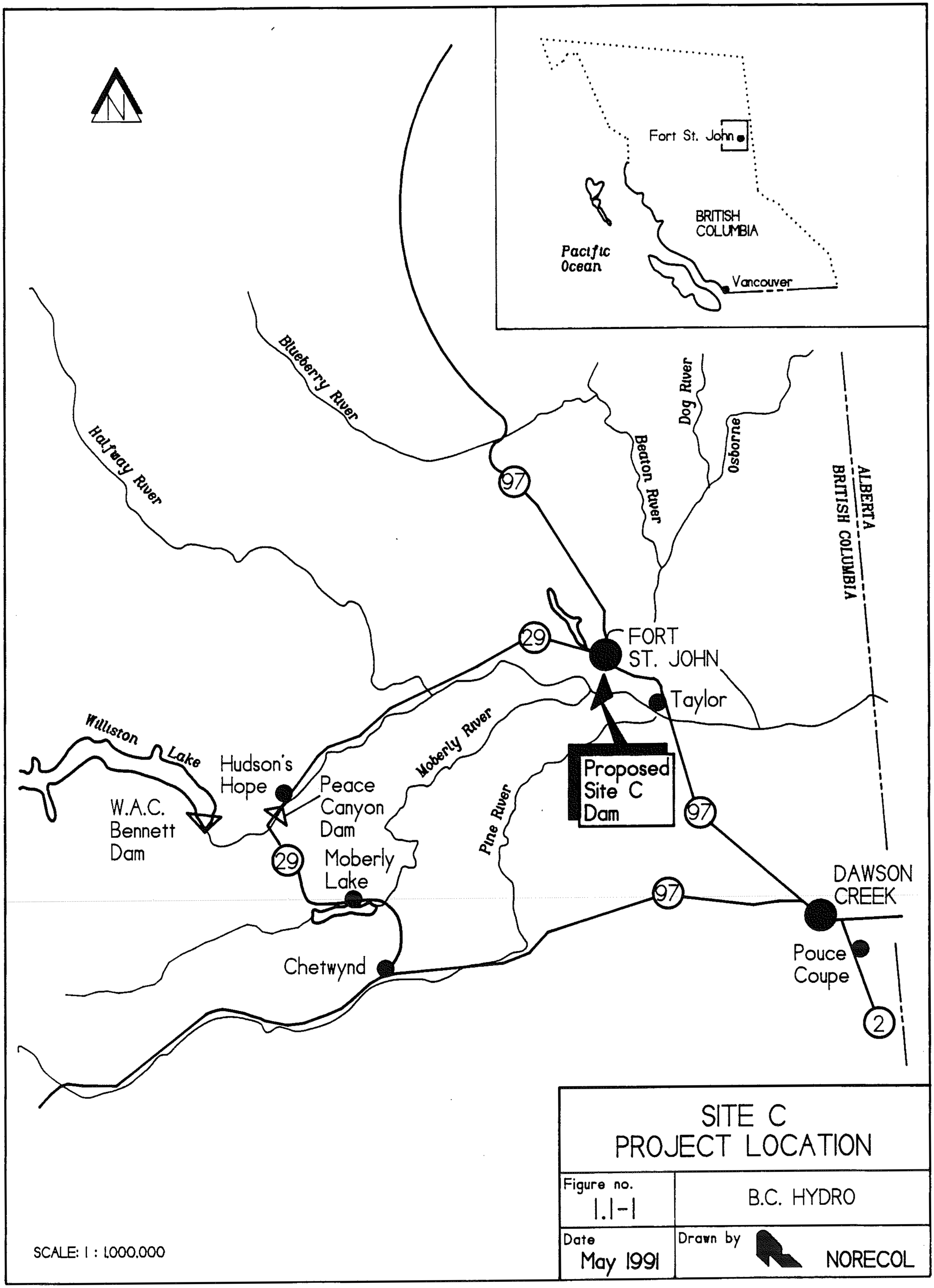
British Columbia Hydro (BCH), the agency responsible for providing hydroelectric energy to British Columbia, has developed a plan for hydroelectric power generation on the Peace River. One site for proposed construction of a hydroelectric dam, commonly referred to as "Site C," is located just upstream of the confluence between the Moberly and Peace Rivers (Figure 1.1-1). Norecol Environmental Consultants Ltd. (Norecol) was retained in August, 1990, to undertake a study of the agricultural resources in the area and to establish a basis for mitigation and compensation strategies.

1.1 Statement of Understanding

BCH applied for an Energy Project Certificate (EPC) for the Peace River Site C Project in 1981. As part of that application, an assessment was made of agricultural resources and direct project impacts on agricultural soils within the proposed reservoir and indirect impacts on agriculture in the Peace Valley area (CBRC 1979). The agricultural assessment for that application was based on data available and field studies conducted in 1977.

At the time of initiation of this current project (August 1990), BCH was proposing to re-submit an EPC application for the Site C Project. Agricultural development and socio-economic conditions in the Peace region, as well as the regulatory processes and accepted assessment methodologies, have changed since the initial application in 1981. Consequently, the agricultural resource information and assessment conclusions made in the previous Site C studies needed to be updated.

The initial intent of this agricultural resources study was to provide an updated agricultural resource inventory and revised impact assessment including mitigation and compensation strategies to adequately support a revised EPC application and the requirements of associated review processes of the British Columbia Utilities Commission (BCUC) and the Federal Environmental Assessment Review Office (FEARO).



SITE C
PROJECT LOCATION

Figure no. 1.1-1	B.C. HYDRO
Date May 1991	Drawn by NORECOL

The objective of BCH in August, 1990 (the time the project was awarded to Norecol) was to develop current documentation to support the EPC application. In December, 1990, midway through the project, BCH made the decision to postpone the Site C Project indefinitely in its planning horizon in favour of other programs such as "Power Smart". Norecol was informed in December, 1990, that the agricultural studies would be concluded at the end of the 1990-1991 fiscal year, and was requested to reduce the scope of the agricultural studies to an updated inventory of the agricultural resources. Any contacts that had been planned to discuss current land use, agricultural activities, and approaches to mitigation and compensation in the project area and the region in general were terminated.

1.2 Study Objectives

Based on the revised scope of the agricultural component of the Site C project, the objectives of this study were to update the resource information; to provide an interpretation of trends in agricultural land use; and to provide recommendations for future studies that would be required to complete the updating process. This was achieved through the following tasks:

- documentation of the existing distribution and utilization of agricultural soils within the Site C reservoir area;

- liaison with staff of Hugh Hamilton Ltd. to compile the agricultural resources information into a Geographic Information Systems (GIS) database for the production of resource maps and to establish a baseline information source for use in the future;

- review of the current land use practices within the affected areas of the Peace Valley, and evaluation of land use trends; and

- evaluation of the agriculture-related activities that remain to be done to reach a defensible position for submission of an Energy Project Certificate application at a future (as yet undetermined) date.

1.3 Report Organization

This report provides a description of the methodology used to compile the available information on agricultural resources at the proposed Site C project site (Section 2.1). The information compiled regarding the soils resource and current land use is summarized in Sections 2.2 and 2.3. Suggestions pertaining to further study requirements, with respect to both methodology for compiling the agricultural resources inventory and approaches to conducting an agricultural impact assessment, are described in Section 3.0.

Conclusions and recommendations are summarized in Section 4.0.

The intent of this report was to compile and summarize available information. This is not an assessment of potential impacts of the proposed Site C project on agriculture.

2.0 AGRICULTURAL RESOURCES INVENTORY UPDATE

2.1 Methodology

2.1.1 Soils Inventory

In March 1979, Canadian Bio Resources Consultants Ltd. (CBRC) completed a report for BCH which assessed the potential environmental and socioeconomic effects of the proposed Site C development on agriculture. This report included a summary of the soils and agricultural capability of lands which would be affected by the project. Subsequent to this, the B.C. Ministry of Agriculture and Food (BCMAF; currently the B.C. Ministry of Agriculture and Fisheries) calculated and tabulated the agricultural capabilities of the lands within the proposed reservoir area (BCMAF 1981). The BCMAF figures differed substantially from those in the CBRC report, likely because different map bases were used.

Consequently, another report was commissioned by BCH in 1982 to recalculate the areas of lands with agricultural capability of Class 1 to 5 within the reservoir area using a methodology acceptable to all parties and their advisors, to resolve the discrepancies in the land area calculations. The methodology was established during two separate meetings in August, 1982, where representatives from BCH, Agriculture Canada, B.C. Ministry of Environment Terrestrial Studies Branch, B.C. Ministry of Agriculture and Food, and CBRC agreed upon a suitable map base and mapping/area calculation methodology (Pottinger 1982). The base maps used were 1:12,000 scale; the map units were assigned soil types (as defined in Farstad *et al.* 1965) and land capability ratings. The work was reviewed by all agencies and completed September 15, 1982 (Pottinger 1982).

Since the agricultural capability of the land within the Site C reservoir area was reassessed in 1982, some changes to the British Columbia Land Inventory system of rating soils were made (Kenk and Cotic 1983). Briefly, the changes which are pertinent to the capability ratings made in 1982 for the Site C project are as follows:

- the subclass S (cumulative minor adverse characteristics) was deleted;
- the subclass X (adverse soil characteristics) was deleted; and
- the subclass M (moisture limitation) was replaced with a more comprehensive assessment of soil moisture deficit, represented by subclass A (soil moisture deficiency).

All three of the above subclass ratings were used in the Pottinger (1982) land capability for agriculture assessment.

The climatic capability of the Peace Region has also been re-evaluated in the time since the initial Site C studies were conducted. Cheesman and Davis (1982) reported the results of a detailed climate study of the Peace River Valley and surrounding area. The report was presented to the BCUC in June of 1982. The current 1:100,000 scale Climate Capability for Agriculture maps (Cheesman 1983) were reviewed for this report.

Agriculture Canada has produced revised land capability for agriculture maps, which take into account the more recent climate data and adverse soil limitations, where present (Moon, pers. comm.). However, this information does not appear to be readily available to the public, due to its recent completion and a lack of sufficient funding within the government to print and publish the maps. The mapping was requested by Norecol in February, 1991, for inclusion into this report, but the areas within the Site C study area have not been digitized and were not yet available.

The soil mapping for the Fort St. John-Dawson Creek Map Area was also updated in 1986 (Lord and Green 1986). The major difference in the newer mapping methodology, relative to the earlier published mapping used during the initial Site C studies (Farstad *et al.* 1965), is that the soil landscapes were mapped as map units rather than as soil series. [Soil series were then defined as soils developed on similar parent materials in similar environments; map unit symbols, as utilized in the 1986 report, indicate the soils that have been named and defined in the accompanying soil survey report, their subdivisions or phases, or a combination of these]. The 1986 mapping was published at 1:100,000 scale; the earlier mapping (Farstad *et al.* 1965) was at a scale of 2 miles:1 inch, or 1:126,720.

2.1.2 Land Use Inventory

As a result of the reduced scope of the agricultural studies, the land use inventory was compiled by air photo interpretation. Recent (September 1989) 1:5000 scale orthophoto coverage of the project site was made available to Norecol by BCH. The orthophotos were reviewed, and various local experts were contacted and met with to discuss the land use in the area. The following persons were contacted:

- Ken Nickel, BCMAF, Fort Saint John;
- Allan Blair, BCMAF, Fort Saint John;
- Kevin Murphy, BCMAF, Dawson Creek;
- Art Hadland, InterAg Group, local farmer;
- Ross Green and John Martin, BC Ministry of Forests (BCMOF);
- Herb Norden, BCMOF, Dawson Creek;
- Ewart Loucks and Frank Perkins, Crop Insurance, Fort Saint John; and
- Shirley Gracedon, Crop Insurance, Dawson Creek.

The land use information, as it appeared on the 1989 orthophotos, was transferred directly onto the paper prints. Individual fields were outlined as accurately as possible, given the slight distortion observed on the base.

2.1.3 Data Handling and GIS Mapping

The compiled information was forwarded to Hugh Hamilton Ltd. for entry into the GIS data base for the agricultural resources component of the 1990-1991 Site C studies. The information included:

- Soil capability for agriculture (area within the proposed reservoir) (Pottinger 1982);
- Soil Survey information (Lord and Green 1986);
- Land use information (interpretation of 1989 orthophoto coverage); and
- Agricultural Land Reserve boundaries.

Although land status information was available in the GIS, this information was not utilized for the agricultural resources inventory. It was felt that any conclusions drawn regarding, for example, land use on BCH fee-owned land would be highly speculative and based on assumption since farmers were not contacted for these studies.

GIS maps were produced to illustrate the following information:

- Agricultural capability within the Site C reservoir area; and
- Land use.

The databases were overlain within the GIS to compile and summarize information, and to identify patterns of land use within specific soil types. The following sets of data were requested:

- Soil type with land use (within the floodlines);

- Soil type (Lord and Green 1986) with agricultural capability (Pottinger 1982);
- Agricultural capability with ALR boundaries;
- ALR boundaries with floodline;
- Land use with ALR boundaries; and
- Land status with agricultural capability.

However, not all of the overlays were received as requested, due to time considerations and limitations of the software (Bunning, pers. comm.). Therefore, the data was interpreted as received.

2.2 Soils

2.2.1 Surficial Geology and Soil Parent Material

The Site C project site, in the Peace River Valley, lies within the lowlands of the Alberta Plateau, a flat or gently rolling till plain interspersed with glacial lake basins (Lord and Green 1986).

The Peace River flows in a west to east direction, and lies slightly north of 56° N latitude within the Site C project area. The river leaves the easternmost foothills of the Rocky Mountains near Hudson's Hope, and bedrock channel walls are replaced by broad alluvial terraces and high eroding banks of unconsolidated sediments (Thurber 1979).

The overall Peace River area is underlain by a succession of Cretaceous shales and sandstones that were tilted and exposed to erosion (Farstad *et al.* 1965). The period of erosion was followed by a period of glaciation (Wisconsin), in which both the Cordilleran ice sheet (from the western, mountainous region) and the Laurentide ice sheet (from the northeast, continental region) contributed largely to the surficial geology and topographic formations present in the area today.

More specific to the Site C reservoir site, the influence of the Peace River itself on soil development is significant. The stratigraphy of the overburden overlying the bedrock was generally described by Thurber (1979) in the following sequence:

- Post glacial river (and terrace) gravels, alluvial fans, slide debris, etc.

- Late glacial clays and silts up to 40 m thick. These materials were deposited in [glacial] "Lake Peace" up to the el. 686 m level. Commonly plastic, occasionally gravelly.

- Glacial till (Wisconsin) up to 25 m thick. Deposited during the last major advance of ice from the Canadian Shield.

- Interglacial river and lake deposits consisting typically of 120 m or more silt, clay (sometimes stony) and minor sands.

- Glacial till (Laurentide), rarely exposed and commonly missing in the reservoir area.

- Interglacial or preglacial basal river gravel deposits, typically not more than 30 m thick. This material was deposited by a large river flowing through a bedrock channel.

The terraces on the slopes of the Peace River portray a history of downcutting, and throughout the reservoir area there is a marked terrace about 45 to 60 m above river level, designating a period when widening of the valley predominated over vertical downcutting (Thurber 1979).

2.2.2 British Columbia Soil Survey (1986) Report

For the purpose of this study, the soils information contained in Lord and Green (1986) has been reviewed. In that report, soil landscapes were represented as map unit symbols, which describe the dominant and significant soil types (previously referred to as series) present within the unit, and the topographic phase. The area surveyed for the 1986 report (the Fort St. John-Dawson Creek Map Area) was approximately 1,390,000 ha.

The main difference noted, with respect to the Site C project, in the soils information in the new survey report compared to the previous report (Farstad *et al.* 1965) is in the areas near the Peace River. Prior to the damming of the Peace River for the W.A.C. Bennett dam in 1968, all recent materials (mainly islands, undifferentiated river-flat and low-terrace deposits) occurring within the floodplain of the river (and its tributaries) were considered to be within the "Alluvial" soil series. "Sandy loam, silt loam and, in some areas, gravel are the most common textures [of the Alluvial soils]. The texture varies horizontally and vertically to such an extent that separation into textural classes was not possible at the scale of mapping used" (Farstad *et al.* 1965).

In the newer survey (Lord and Green 1986), the Alluvial map unit is defined to include the undifferentiated, sandy, silty, loamy, and often gravelly fluvial deposits of the active floodplains of rivers and streams. In the portion of the Peace River floodplain extending from the Peace Canyon Dam near Hudson's Hope downstream to the British Columbia-Alberta border near Clayhurst, "Bear Flat" soils have been introduced into the survey system. These soils include floodplain deposits that have been stabilized and modified by plant communities since damming of the river in 1968 caused decreases in flow. Many of the soils currently designated (Lord and Green 1986) as Bear Flat were previously mapped (Farstad *et al.* 1965; Pottinger 1982) as belonging to the Alluvial series.

The following map units occur within the proposed Site C reservoir area (Table 2.2-1), and are briefly described below, from information contained in Lord and Green (1986). The reader is referred to the above publication for the soil maps.

TABLE 2.2-1

SOIL MAP UNITS OCCURRING WITHIN THE PROPOSED SITE C RESERVOIR AREA

MAP UNIT	SYMBOL	AREA (ha)
Attachie	AH	658
Alluvial	AL	697
Bear Flat 1	BF1	1850
Bear Flat 2	BF2	1025
Branham	BR	293
Branham-Clayhurst	BR-CY	626
Clayhurst	CY	5
Davis-Coldstream	DV-CD	9
Pingel-Clayhurst	PG-CY	103
Septimus	SS	406
Septimus-Attachie	SS-AH	119
Taylor	TY	187
Slide Area	SLIDE	57
TOTAL		**6035**

Alluvial

This unit (AL) includes the undifferentiated sandy, silty, loamy, and often gravelly fluvial deposits of the active floodplains of rivers and streams. The map unit represents recently deposited soils and includes dominantly Cumulic Regosols occurring on undifferentiated river and stream floodplains, islands, and low terraces. Although most areas are nearly level, soil texture and drainage may be extremely variable. Soils of the map unit support a wide range of trees, shrubs, forbs, and grasses.

The AL map unit comprises 21,387 ha within the Fort St. John-Dawson Creek map area (Lord and Green 1986). Approximately 697 ha of Alluvial soils exist within the proposed Site C reservoir area (Table 2.2-1). Alluvial soils were noted to be primarily used as grazing lease land in the vicinity of the Site C project (GIS database, data not shown).

Attachie

The Attachie (AH) map unit consists of undifferentiated colluvial materials and soils on very steep slopes along river valleys. The materials include loamy tills and shale, and sandstone bedrock that may be mantled with combinations of glaciofluvial gravels, sands, silts, loess, and colluvium. Slumps and active erosion are common geological slope failure processes. Regosols and a lithic phase of Chernozemic soils characterize this grass and shrub-covered map unit on southerly aspects above the main rivers and their tributaries.

About 658 ha of the proposed Site C reservoir area contain Attachie soils. Although instability and steep irregular topography can limit soils of the AH unit for agricultural and forestry uses (Lord and Green 1986), the results of the land use inventory suggest that they are being utilized for growing several crops, including cereal, alfalfa, domestic forage, tame pasture, and vegetables.

Bear Flat

The Bear Flat map units are dominated by Regosols on weakly calcareous sands, loams, and gravels. The floodplain deposits consist of weakly calcareous sands 1 to 3 m thick over channel gravels. The Bear Flat soils did not exist in the early soil survey of the Peace River region (i.e. Farstad *et al.* 1965). Bear Flat soils were created as a result of the damming of the Peace River in 1968, which caused stabilization of river flow. The effects of the subsequent decrease in flow led to the accumulation of sediment rather than degradation effects, and general stabilization and modification of plant communities has occurred. The Bear Flat soils are further described as the map units Bear Flat 1 and Bear Flat 2, which differ primarily in the depth of the surface sandy veneer:

The Bear Flat 1 (BF1) map unit is dominated by Cumulic Regosols on deep fine sands. Topography is nearly level or gently undulating. About 5156 ha within the entire Fort St. John-Dawson Creek Map Area are mapped as BF1 (Lord and Green 1986). About 1850 ha within the proposed Site C reservoir area are mapped BF1. Although no agricultural capability information was available for Bear Flat soils, it is expected that the finer textured BF1 soils would be quite suitable for agricultural production, including vegetable production. Air photo interpretation suggested that approximately 22 ha classified as BF1 within the proposed reservoir are used for truck farming (vegetables). Other land uses on this unit included cereal, domestic forage, and grazing.

The Bear Flat 2 (BF2) map unit is composed of abandoned back channels and cobble and gravel bars, often thinly veneered with fine-loamy sediments. These areas of recent deposition have no distinctly formed soils, and hence are likely less suitable for agricultural activities. Soils of the BF2 map unit occupy about 1025 ha within the proposed reservoir area, which is about 41% of the total 2518 ha of BF2 mapped in the Fort St. John-Dawson Creek Map Area (Lord and Green 1986). Land uses noted on the BF2 map unit soils included alfalfa, domestic forage, grazing, tame pasture, and truck farming.

Branham

The dominant soils in Branham map units are Orthic Eutric Brunisols on calcareous, sandy and silty colluvial fan and terrace materials, occurring on nearly level to gently sloping intermediate terraces in the upper valley of the Peace River at elevations below 600 m. Soils are well drained and rapidly pervious with a subhumid water regime.

The Branham (BR) map unit contains variable amounts (20 to 40%) of Regosolic soils that have weakly developed, silty and sandy-textured Ah horizons. The soils in this unit have slight limitations that restrict the range of agricultural crops that may be grown (Lord and Green 1986). The BR map unit occupies about 293 ha of the proposed reservoir area (Table 2.2-1) and 3067 of the overall Fort St. John-Dawson Creek Map Area (Lord and Green 1986). Land uses noted within the BR map unit included alfalfa, cereal, and domestic forage.

The Branham-Clayhurst (BR-CY) map unit contains about 40% gravelly Clayhurst series soils. Agricultural capability for this map unit depends primarily on the distribution of Clayhurst soils and the thickness of the mantle of fine-textured material overlying gravel, and thus is variable within the map unit. Limitations are stoniness, low moisture-holding capacity, and adverse topography. About 626 ha of the total area (Lord and Green 1986) of 3890 ha of BR-CY soils occur within the proposed reservoir. Land uses noted on areas mapped as BR-CY ranged widely and included alfalfa, cereal, domestic forage, gravel pit, tame pasture, and truck farming. This suggests that some ground-truthing is required to ensure the accuracy of both the soil mapping and the land use interpretation.

Clayhurst

The Clayhurst (CY) map unit is dominated by Eluviated Eutric Brunisols on gravelly sandy glaciofluvial deposits. This map unit occupies high elevation terraces in the river valley. Soil textures consist of gravelly sandy loam and loamy sand materials at elevations below 600 m. The gravelly stony materials are weakly calcareous and permeable. Topography is gently to moderately sloping.

Soils belonging to the Clayhurst series are well drained to moderately drained, rapidly pervious, and have a subhumid soil water regime. Soil reaction is slightly acid to neutral throughout the profile; calcium carbonate coats the gravels and cobbles at depths of about 50 cm.

The soils of the CY map unit have severe limitations for growing a wide range of agricultural crops, and only small areas of the unit are cultivated (Lord and Green 1986). Limitations include low moisture-holding capacity, stoniness, and some adverse topography. About 5 ha of soils mapped within the Clayhurst map unit occur within the proposed Site C reservoir area.

Davis-Coldstream

Davis map units are dominated by Orthic Gray Luvisols on loamy glaciofluvial materials. The parent materials are strongly calcareous and variable in thickness. Davis soils are well to moderately well drained, moderately pervious, and have a humid water regime. The Davis-Coldstream (DV-CD) map unit, which occurs below the Site C floodline, contains 30 to 50% Coldstream and Eaglesham soils. Coldstream soils (Orthic Luvic Gleysols) are medium to fine textured soils developed on clayey glaciolacustrine parent materials. Eaglesham soils (Terric Mesisols) occur in low lying fens and consist of decomposed peat materials. Only about 9 ha of the DV-CD map unit exist in the Site C reservoir location.

Pingel

The Pingel (PG) map unit is dominated by Eluviated Eutric Brunisols on clayey colluvial deposits along the south side of the Peace River, forming gently to moderately sloping clay-textured fans. These soils are moderately well drained, slowly pervious, and have a humid water regime. The soils are shallow, weakly developed, and heavy textured.

There are 1225 ha within the Fort St. John-Dawson Creek Map Area which are mapped as Pingel-Clayhurst (PG-CY). Approximately 103 ha of the map unit occur within the proposed Site C reservoir area. Pingel soils are highly productive for a wide range of crops. The amount of gravelly soils (Clayhurst) in the unit varies widely, and likely affects the agricultural suitability. On most terraces, the gravels are concentrated near the scarp face. Grazing was noted to be the predominant land use within this map unit.

Septimus

The Septimus (SS) map units consist of undifferentiated colluvial materials and soils on very steep slopes of river valleys and stream banks. The materials include loamy tills and shale and sandstone bedrock that may be mantled with combinations of glaciofluvial gravels, sands, silts, loess, and colluvium. Slumps and active erosion are common slope failure processes in this map unit. Regosols and lithic phases of Brunisols and Luvisols characterize these tree- and shrub-covered soils.

Adverse topography, instability, and shallow rocky soils prohibit agricultural activities within the Septimus map unit. This map unit covers approximately 406 ha within the proposed reservoir area.

The Septimus-Attachie (SS-AH) map unit contains more open canopied vegetative cover which provides slightly better conditions for livestock grazing than does the SS map unit.

Taylor

The Taylor (TY) map unit is dominated by Rego Black soils on clayey colluvial deposits along the north side of the Peace River (and on terraces scattered along the lower Pine and Halfway rivers). These gently to moderately sloping, clay-textured fans occur on intermediate river terraces below an elevation of 500 m. Underlying materials are variable in texture and stratigraphy.

Soils are well drained to moderately well drained, slowly pervious, and have a subhumid water regime. The soils have 10 cm or more of Ah horizon that overlays loamy or clayey C horizons and usually one or more buried A horizons. Rego Dark Gray soils and Branham soils are associated with Taylor soils. Soils of the Taylor map unit are highly productive for a wide range of agricultural crops.

There are about 3525 ha of Taylor soils in the Fort St. John-Dawson Creek Map Area (Lord and Green 1986). Approximately 187 ha of these highly productive soils occur below the floodline of the proposed reservoir. Land uses noted within the Taylor map unit included cereal, tame pasture, and truck farming.

2.2.3 Land Capability for Agriculture

The availability of current (i.e. recently updated) land capability for agriculture maps (Agriculture Canada) did not coincide with the timing of this report. In lieu of this current data, the request was made by a BCH representative (Hirst, pers. comm.) that the map units (Lord and Green 1986) used to describe the soils of the general area be assigned a "simplistic" agricultural capability rating. However, since ground studies were not included in the scope or terms of reference for this study, inadequate information (for example, regarding texture, stoniness, topographic detail) was available to assign updated ratings. It would be more efficient to conduct such ground-truthing following the acquisition of the new capability mapping as a sound base of data from which to work.

The data compiled by Pottinger (1982) regarding agricultural capability within the proposed Site C reservoir, are shown in Map 2.2-1 and summarized in Table 2.2-2. The total area of Classes 1 to 7 land, calculated from the GIS database produced from digitizing the Manuscript Maps which accompanied the 1982 capability mapping, is 4752.5 ha (Table 2.2-2), suggesting that approximately 1282.5 ha within the reservoir area were unclassified for agricultural purposes. (The total area within the proposed Site C reservoir is approximately 6035 ha, excluding area currently covered by river water).

TABLE 2.2-2

LAND CAPABILITY FOR AGRICULTURE WITHIN THE PROPOSED SITE C RESERVOIR AREA[a], AS MAPPED SEPTEMBER, 1982

CAPABILITY CLASS	LIMITATION	AREA (ha)
1	-	191.9
2	F	5.7
2	I	74.6
2	M	216.0
2	T	45.3
2	X	2639.8
Subtotal Class 2		**2981.4**
3	M	498.4
3	S	20.2
3	T	141.3
3	WI	157.1
3	X	14.9
Subtotal Class 3		**831.9**
4	IP	6.6
4	IW	32.7
4	M	123.4
4	MP	11.9
4	T	2.1
Subtotal Class 4		**176.7**
5	S	124.7
5	T	303.0
Subtotal Class 5		**427.7**
6	M	3.9
7	P	83.1
U[b]	-	55.9
TOTAL[c]		**4752.5**

a Areas calculated from GIS database.
b U = areas not classified for agricultural capability (see Map 2.2-1 for locations).
c Total refers to the land assigned a capability rating; the total area of land to be flooded is approximately 6035 ha.

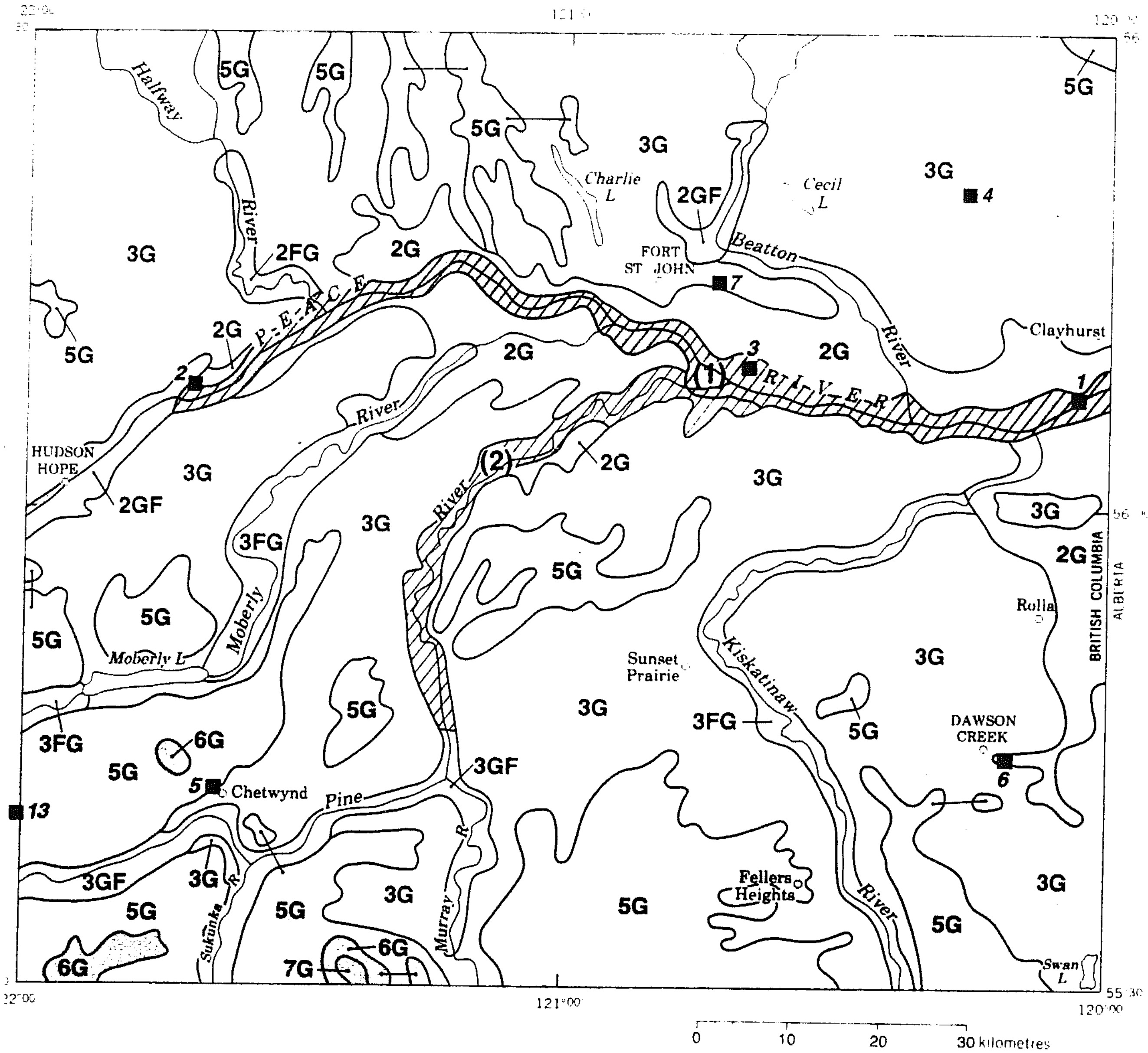
Of the total 4752 ha, approximately 2981 ha were rated as having Class 2 agricultural capability. The limitations identified included soil fertility (F), inundation (I), soil moisture limitation (M), stoniness (S), and adverse soil characteristics (X). The majority of Class 2 soils were assigned the X limitation. Using today's capability classification system (as described in Kenk and Cotic 1983) this rating would likely be identified as soil moisture deficiency (A) and/or topography (T) limitations in most areas previously rated Class 2X.

In addition, 192 ha were rated as Class 1 land for agriculture, and 832 ha as Class 3. The total area within the reservoir with land capability for agriculture between Class 1 to 3 is approximately 4005 ha.

The capability of a unit of land for agricultural production is dependent upon the combined influence of local climate and soils (Kenk and Cotic 1983). The climate component determines the range of crops that could be grown on a particular piece of land, while the soil characteristics influence which crops will be most suitable, and the level of management that will be required.

The Climate Capability for Agriculture in the overall Peace River region ranges widely, depending on proximity to the mountains, elevation, and, most importantly, the position within the river valleys. The generalized map illustrating the climate capability classes for agriculture in Lord and Green (1986) for the Fort Saint John-Dawson Creek map area has been reproduced in Figure 2.2-1.

The best climate for agriculture occurs within the Peace River Valley (Figure 2.2-1), where the capability is rated as Class (1) (Cheesman and Davis 1982; Lord and Green 1986) from approximately 17 km downstream of Hudson's Hope to the British Columbia-Alberta border. The (1) rating indicates that it was assumed that a moisture deficiency caused by drought or aridity could be compensated by irrigation (Lord and Green 1986). The unimproved rating within this part of the Peace River Valley is 3A, which indicates that drought or aridity between May 1st and September 30th results in moisture deficits which are limiting to plant growth (Cheesman 1983).



LEGEND

	Growing degree - days	Freeze-free period (days)
1	1310-1504	90-119
2	1170-1309	75-89
3	1030-1169	60-74
5	780-1029	30-49
6	670-779	<30
7	<670	<30

Subclass Limitations (May-September)

F minimum temperatures near freezing

G insufficient heat units

(1) capability class (improved by irrigation)

4 ■ climate observation station (See Tables 1 and 2)

SOURCE: Lord & Green, 1986

Figure 2.2-1

CLIMATIC CAPABILITY CLASSES FOR AGRICULTURE

In determining climate capability for agriculture, both growing degree days and freeze-free period were considered (Cheesman and Davis 1982). The climate capability within the valley west of Hudson's Hope is Class 2G (Figure 2.2-1). The G limitation indicates that "insufficient accumulation of heat units above 5°C during the growing season" (Cheesman 1983) is the main limitation to crop production.

Outside of the river valleys, climate capability for agriculture decreases with distance from the valley, from Class 2G immediately adjacent to the valley to Class 3G, and occasionally 5G, over the majority of the upland area (Figure 2.2-1). The major climatic limitation in the overall Fort Saint John-Dawson Creek map area is insufficient heat units (G). The limitation of minimum temperatures (F) appears to occur only in specific areas such as low-lying sites where cold air will pool (Lord and Green 1986).

Cheesman and Davis (1982) pointed out that the area of Climate Class 1 in the Peace River Valley is unique in B.C. north of 53°30'N latitude. They also pointed out that the longer daylength during the growing season at the northern latitude of the region (hours of sunshine are not included in climate capability analysis) enhances the capacity to grow crops. They concluded that consideration of the daylength factor equates some elements of the valley's agricultural potential (for example, for vegetable crops) to many locations in the Lower Fraser Valley and southeastern Vancouver Island.

2.3 Land Use in the Site C Project Area

Land use in the Site C reservoir area was compiled based on interpretation of 1:5000 orthophoto coverage provided by BCH, and on discussions with professionals within the area. Land use outside of the areas covered by the orthophotos was not compiled. The data was transferred to the GIS data base and is presented in Map 2.3-1.

The following definitions apply to the land use mapped for 1989:

TF Truck Farming (vegetables known to have been grown there; in most cases this does not apply to 1990);

DF Domestic Forage (or, domestic pasture);

SF Summerfallow;

CC Cash crops: this refers to wheat, barley, oats, canola. Other crops which could be grown on this land would include perennial forage, alfalfa (for seed), and lesser valued crops such as tame pasture, domestic forage, etc. The different crop types are interchangeable. That is, even though a particular field may have had a canola crop in 1989, any of these crops have the potential of being grown there, because the land is suitable;

NR Native Range: this includes much of the land along the north and south sides of the Peace River Valley which is currently in an unaltered state. Cattle may be using this pasture or range, but it is without a Ministry of Forests Grazing Lease or Grazing Permit. It is primarily used by native wildlife, or domestic animals gone wild;

TP Tame Pasture: this is land which may or may not have had any cultivation (i.e. with a plow, disc, or cultivator), but which has probably had some seeding of domestic crops, primarily forages or grasses. The seeding would usually be by means of a fertilizer spreader, or the seeds that would survive the intestinal tract of the bovine animals grazing there. This land use represents areas where ranchers would overwinter their animals. The land is not currently used for crop production, but if fully cleared it may have that capability;

FF Fox Farm; and

GP Gravel Pit.

The land usage noted in the area within the Peace River Valley included in the 1989 orthophoto coverage provided by BCH is illustrated in Map 2.3-1. Land use was assessed for all of the orthophoto sheets although the area covered was in excess of the area of the proposed Site C reservoir.

The land use within the area of the proposed Site C reservoir is summarized in Table 2.3-1. The majority (117.8 ha) of the truck farming observed in the total area covered by the orthophotos provided by BCH took place within the reservoir area. However, a large portion of the land within the proposed reservoir is currently used for grazing (1004.5 ha within grazing leases, Table 2.3-1 and Map 2.3-1), and domestic forage.

The trend in the Peace River region (in general) for the past three to five years has been for farmers to either reduce their cereal crop production and increase their cattle production (and therefore forage production), or to move from grain production into beef and hay production. It is the feeling of Brian Haddow, P.Ag., our subconsultant in Dawson Creek, that this is likely also occurring in the Peace River Valley, and that it is primarily associated with higher beef prices and lower grain prices.

Several of the professional agrologists and other persons contacted indicated that the diversity and intensity of crop production in the Peace River Valley has shifted away from higher value crops. After BCH initiated the land purchases associated with the Site C project, the subsequent lessors and remaining land owners of the Peace River Valley, upstream of Taylor, reduced capitalization and any expansion which requires longer term payback. This contributed to the (observed) reduction in areas of vegetable production, and to some extent to the switchover from cash crops (which require a relatively high amount of cash input) to beef and hay.

TABLE 2.3-1

AGRICULTURAL LAND USE BELOW THE RESERVOIR FLOODLINE
PEACE CANYON DAM TO SITE C

LAND USE	AREA (HA)
Cash Crop	333.2
Domestic Forage	100.2
Grazing Lease	1004.5
Tame Pasture	58.9
Truck Farm	117.8
Total Agricultural Use	**1614.6**
Non-Agricultural[a]	**4420.4**

[a] Non-agricultural use was determined by subtracting the total area of agricultural land use from the total area of land to be affected by the reservoir (6035 ha). In many cases "non-gricultural" may also represent use as native range.

3.0 SUGGESTED APPROACHES FOR FURTHER STUDY

Following the revision of the scope of the agricultural studies in December, 1990, BCH requested that, in place of an impact assessment, Norecol comment on those agriculture-related activities which remain to be done to reach a defensible position for submission of an EPC application. The following suggestions are given, outlining improvements in approach for both the data-gathering and interpretation/recommendation stages.

3.1 Agricultural Resources Inventory

3.1.1 Soils

The most recent soils mapping was reviewed for the purposes of this study. The survey (Lord and Green 1986) was published in 1986, and is based on survey work conducted primarily in the late 1970s. The most current water line data, provided by BCH in February, 1991, was utilized by Hugh Hamilton Ltd. in preparing the base map for this study. Any variations between the base map and the 1986 soil mapping (Lord and Green 1986) and land capability mapping (Pottinger 1982) were adjusted using the GIS software to ensure agreement between the areas covered by water and land. It is suggested that, should studies be reopened in the future for documentation to support an EPC application, a site evaluation be conducted to ensure that these assumptions and actions accurately convey the soils situation in the field.

The timing of the current study is such that the newly revised land capability for agriculture, in preparation by Agriculture Canada, could not be reviewed. In light of the changes made in the Climate Capability assessments since the last land capability for agriculture ratings were made for the Site C study area (Pottinger 1982) it will be critical that the new land capability information, which is based on the new climate capability rating, is reviewed prior to submission of an EPC application. The climate capability ratings are an important component for land capability for agriculture rating. The new land capability maps will reflect both the updated climate data and the updated soil survey information contained in Lord and Green (1986).

3.1.2 Land Use Inventory

Land use information inferred by air photo interpretation should be supplemented with data obtained from an accurate and up-to-date survey of farm operations within the study area. While air photo interpretation provides a general indication of acreages of crops being grown in a particular year, it gives no indication whatsoever regarding the following, critical pieces of information needed to assess project impacts:

- crop rotation practices and alternate uses of individual fields;
- numbers and types of livestock grazing;
- trends in agricultural land use, both historical and potential;
- motivating factors dominant in land use decision-making;
- improvements and/or investments being made on the land;
- management practices, in particular soil conservation practices; and
- the true effects of the B.C. Hydro-held flood reserve on land use decision-making.

3.2 Agricultural Impact Assessment

For an EPC application to be defensible, an assessment of both the immediate and long term impacts of the Site C development on agriculture will be needed. This should include both the direct effects (loss of farmable area to the reservoir) and indirect effects (property segmentation, potential climate effects, slumping and safeline issues, etc). This evaluation should be based not on current cropping patterns, but on land values which reflect the highest use to which the land could be put assuming agricultural management decision-making in the absence of the threat imposed by the flood reserve for a proposed dam project.

No economic evaluation was made for inclusion into this report, since the scope of the project was revised by BCH in December, 1990, eliminating the current requirement for an agricultural impact assessment (which would have included recommendations on mitigation and compensation). Future studies should include an economic evaluation of land values and the agricultural costs of the Site C project, such that mitigation and compensation plans can be developed.

As indicated above, current land use practices cannot be adequately addressed for evaluation of current land values (economic returns) simply through interpretation of air photos. Personal interviews with the farmers affected would greatly facilitate the assessment of future cropping potential and the influence of the uncertainty surrounding the Site C project on land management decisions. This would assist in forecasting short and medium term agricultural values.

In determining land values upon which to base mitigation and compensation, assumptions of previous (i.e. for the 1981 EPC application) studies that the development of secondary, value-added industries such as vegetable processing were not economically viable should be re-examined in light of changes in transportation rates, population shifts, and an increasing public health focus on the nutritional needs of northern Canadians. New sources of demand for Peace Valley horticultural production should be considered within a range of forecasts; including optimistic, probable, and pessimistic scenarios.

Several key issues and suggestions were raised by Larry Bomford, Director of Policy Analysis and Co-ordination for BCMAF, in his correspondence to BCH dated July 13, 1990. A summary of the more important points raised by the Ministry follows:

1. **Economic Linkages**

The need to acknowledge regional economic linkages is an important point raised by BCMAF which should be included in both the agricultural impact assessment and the mitigation and compensation phases of the research. Economic linkages are the interrelationships which exist between farm/agricultural operations within and outside of the study area.

Important areas of interrelationship include grazing leases, future community pasture development, and the potential upstream and/or downstream effects on water supply and quality and their implication for existing and future agricultural uses. Additionally, such interrelationships also include economic opportunities which may now or in the future exist for the development of further processing, value-added activities related to agricultural production.

2. Horticultural Production

Horticulture could potentially be an important agricultural commodity group in the Peace region, due to the high (Class 1 and 2) climate capability for agriculture within the Peace River Valley. As noted previously, an analysis of existing cropping practices provides an imperfect base upon which to judge future horticultural potential. Methodology, such as farmer interviews, should be used to identify trends in cropping patterns and yields. To more accurately assess the crop-specific capability of the affected lands, future studies should identify commercial crop alternatives, including new crops with market opportunities. Those crops which appear (based on regional factors such as long term weather conditions, transportation, etc) to be economically feasible could be short-listed for further study.

A discussion of general advantages for intensive crop management and/or organic management opportunities within the Peace River Valley should also be pursued.

Consistent with BCMAF's suggestion, a true economic assessment of agricultural potential of the Peace River lands would require that BCH undertake a comprehensive projection of inter/intra regional market demand for Peace River horticultural products and subsequently, identify the suitability of cropping alternatives based on assumed production potential and market demand.

3. Climatic Change

Potential climatic change due to the Site C reservoir is perceived by many to be an important consideration in the evaluation of agricultural values and impacts in the Peace Valley. Accurate and early data on the effects of potential climatic changes brought about by the presence of the Site C reservoir (e.g. reduced sunshine, temperature shifts, early morning fog) will be needed to estimate the impact on cropping alternatives, management schedules, and agricultural practices.

4. Market Opportunities

The request of BCMAF that estimates be made of "domestic and/or ex-regional market opportunities" and, from this, future production values be extrapolated based on potential commercial cropping patterns is a valid one. Future studies should place a priority on such analysis. Land units capable of supporting commercially viable horticultural crops will be reasonably easy to identify (especially when the updated land capability mapping becomes available) and economic potential could be assessed based upon crop-specific price, supply and demand data.

5. Compensation

As requested by BCMAF, an identification of priorities for applied research, demonstration plots, and technology transfer opportunities should be made, such that funds can be allocated to these efforts. Consideration should be given to researching the potential benefits of developing secondary processing or value-added industries in the Peace River region.

4.0 CONCLUSIONS AND RECOMMENDATIONS

This report summarizes the available information regarding the soils resources at the proposed Site C project site and the results of an inventory of current agricultural land use, based on interpretation of orthophotos. More detailed and extensive studies would be required to gather sufficient information upon which agricultural impacts could be assessed, and mitigation and compensation strategies developed.

Our recommendations for further studies (i.e. an agricultural impact assessment) are presented below:

- Updated agricultural capability mapping should be acquired from Agriculture Canada. This will be the most suitable baseline data upon which studies can be based.

- The output from the Geographical Information System should be carefully checked to ensure accuracy in data transfer and area calculations. This will assist in maintaining a "shelf-ready" or easily updated information source. In addition, more of the requested overlays should be attempted.

- Field studies should be conducted to ensure that the soils information (both soil type and agricultural capability) mapped and adjusted to fit the base map river lines is accurate.

- A survey consisting of personal interviews with producers in the Peace River region should be conducted to gather land use and potential land value information. Public consultation should be an important part of the methodology used for the agricultural impact assessment and for developing mitigation and compensation programs.

- An economic evaluation of agricultural land values should be included in the impact studies for the proposed Site C project. Mitigation and compensation plans should be based on these values.

- The British Columbia Ministry of Agriculture and Fisheries should be consulted during the various stages of future studies. Their concerns should be adequately addressed.

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