AGRICULTURAL LAND DRAINAGE IN BRITISH COLUMBIA: 
THE RICHARDS CREEK-SOMENOS CREEK EXAMPLE

by

Carla Vander Sluys
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APPROVAL

Name: Carla Vander Sluys
Degree: Master of Natural Resources Management
Title of research project:
   Agricultural Land Drainage in British Columbia:
   The Richards Creek-Somenos Creek Example

Examining Committee:

Senior Supervisor
Dr. J.C. Day
Director
MRM Program
Simon Fraser University

Committee Member
Dr. T. Gunton
Professor
MRM Program
Simon Fraser University

Date Approved: December 6, 1986
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Agricultural Land Drainage in British Columbia: The Richards Creek-Somenos Creek Example

Author: Carla Vandersluys

carla vandersluys

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ABSTRACT

Land drainage, a common management practice whereby farmland is drained to increase its productivity, is associated with a number of significant economic and environmental problems.

The major purposes of this study are to: identify major land drainage issues, provide an analysis of the legislative and institutional arrangements involved, outline the process involved in making land-drainage decisions, and finally, analyse the effectiveness of this framework in dealing with some of the more significant land-drainage issues. This will be done through the use of a case study, the Richards Creek-Somenos Creek Drainage Improvement Plan. Research is focussed on the economic efficiency and benefit distribution of the project in the study area, the effectiveness of the process in dealing with resource conflict, and the extent to which project and policy objectives were fulfilled.

A post-audit, cost-benefit analysis indicates that even though the project ratio was positive, over 87.8% of the benefits went to only one landowner with most farmers (77.3%) receiving little or no benefits from the project. The federal and provincial governments provided 75% of the project funding under the ARDSA program. A special reserve fund established by the municipality of the District of North Cowichan provided the additional 25%. Cost to individual landowners was nonexistent. Thus, the project was entirely funded by the public sector, for the major benefit of one individual. This question of benefit distribution was not addressed in the project evaluation. Project planning took over three years, and lack of interagency agreement on mitigatory measures required for fisheries protection caused a two year delay in project approval.

Appropriate planning on the part of the controlling agencies, specific policy objectives including prioritization of important habitats, more baseline data, and increased monitoring of requested mitigatory measures could reduce conflict significantly. More stringent cost-benefit requirements, including a realistic assessment of anticipated project benefits, as well as an analysis of potential benefit distribution, would aid in determining which proposed drainage projects best fulfill government policy objectives.
DEDICATION

To my family
ACKNOWLEDGEMENTS

I am indebted to a number of people without whom this project could not have been completed. Dr. J.C. Day provided constant encouragement and valuable insight throughout this research project as my senior supervisor. Dr. T. Gunton provided constructive criticism. Fellow graduate students in the MRM program have always created a stimulating environment for discussion and interaction, and I thank all of them. Special mention goes to the landowners in the study area for contributing their time and enthusiasm in responding to my inquiries. I would also like to thank R. Sirois for his moral support throughout my studies. Funding for this research was provided by a Natural Sciences and Engineering Research Scholarship.
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<td>Agricultural and Rural Development Subsidiary Agreement</td>
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<td>MDNC</td>
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<td>British Columbia Ministry of Lands, Parks, and Housing</td>
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CHAPTER 1
INTRODUCTION

Agricultural land drainage is a management practice whereby excess water is removed from agricultural lands, increasing productivity of existing crops as well as allowing changes in land use patterns to more lucrative crops. Prior to the 1970's, land drainage was considered to be a necessity in most poorly-drained areas, and there was little demand for detailed studies of the environmental impacts of drainage projects (Brady 1982, 1). There was also little emphasis placed on benefits and costs of drainage projects, particularly the distributional question of who benefits and who pays for the drainage works. Norton and MacMillan (1972, 1) suggest that this may be due, in part, to the fact that agricultural land drainage is frequently associated with more marginal agricultural areas, where economic efficiency is less important than survival.

Agricultural development policies at the federal level encourage land drainage through economic incentives such as the ARDSA (Agricultural and Rural Development Subsidiary Agreement) grants. This funding is generally a result of lobbying by vocal interest groups who support drainage. As Chambers (Canada 1985, 3) suggests "the easiest way to improve an individual farmer's situation is to build bigger and better drains, particularly if someone else pays the bills." The rationale behind these subsidies is that the drainage projects will improve income distribution by increasing earnings in the lower income rural regions of the country. It has often been argued that these types of subsidies encourage the uneconomic development of marginal farmland that would otherwise be left in a natural state. Also, there is little incentive for critical evaluation of these programs due to their concentrated benefit and diffused cost nature. Since projects are funded by federal taxes, the cost to each taxpayer is minimal whereas program benefits are highly concentrated in the project area.

Planning for drainage projects is undertaken by a number of government agencies with varied interests. The mandates of these agencies are often very specific and divergent, resulting in conflicts. As is the case in many resource issues, a single objective approach by controlling agencies is unsatisfactory in resolving conflict. An integrated decision-making process is necessary, one which considers current use and
future potential, as well as the economic costs and benefits of all proposed management actions.

In mountainous regions like British Columbia, productive agricultural land subject to drainage tends to be located in valleys where it must compete with many other potential land and resource uses. Water management conflicts frequently arise in such areas, particularly with respect to wetland destruction and the potential destruction or impairment of fish habitat. Increasing interest by both the federal and provincial governments towards the protection of fish habitat, and the use of the *Fisheries Act* as a powerful legislative tool, have had a major influence in the debate between agriculture and fisheries. In many cases, strict application of the federal *Fisheries Act* without due consideration being given to agricultural interests is seen to be a problem (British Columbia 1979, 1). The *Fisheries Act* has been described as a very 'blunt instrument' to deal with management conflicts (Pearse 1984; presentation at the water resources conference). Lack of appropriate baseline data in many instances renders conflict resolution between agriculture and fisheries difficult.

Although there has been extensive research conducted on agricultural land drainage in other provinces, relatively little work has been done in British Columbia. There is recognition that potential problems exist, as was evidenced by the creation of the Farm and Stream Committee in 1977. The role of this committee, initiated by the BC Federation of Agriculture, was to undertake an enquiry into "the nature of government restraint placed upon farmers attempting to manage water for the benefit of farm operations (British Columbia 1979, 1)." The committee identified two important needs. The first was that there should be procedures developed for farmers with water management problems. These procedures would aid in increasing the farmers' understanding of government regulations, and identify potential problem areas before they arise. The second was that there should be a system developed for solving water management problems that would be satisfactory to both farmers and concerned agencies.
1.1 Study Purpose

The purpose of this study is to examine the effectiveness of British Columbia land drainage policy, and its approach to planning and decision-making. The major objectives of the study are:

- to provide a theoretical perspective of the major issues in land drainage,
- to provide a framework of the financial, legislative, and institutional land drainage arrangements in British Columbia,
- to outline the process involved in making land drainage decisions as evidenced in a case study,
- to provide an analysis of the effectiveness of this framework and process in dealing with some major land drainage issues; and,
- to provide conclusions and recommendations to improve the process of land drainage evaluation.

1.2 Report Format

This study uses evaluative research techniques, including a literature review, interviews with landowners, and an analysis of administrative records. A case study is presented to illustrate the approach to drainage planning and decision-making in British Columbia. A series of land-drainage analyses have been undertaken in Ontario, and a general methodology that can be applied to this type of evaluative research has been developed (Day et al. 1977). The hindsight evaluation methodology provides a seven-step evaluative model. These include: (1) project environment, (2) institutional arrangements and policies, (3) management actions (4) management impacts (5) process and adequacy, (6) utilization of findings and, (7) recommendations. A modified version of the model is used in this study. Chapter two provides a theoretical framework for the study by outlining past agricultural land drainage research, identifying current issues, and introducing the evaluative criteria used in the study. In chapter three, the land drainage planning and decision-making process in British Columbia is presented, including relevant legislation and institutional arrangements. Chapter four provides a brief history of the drainage problems in the case study area, and outlines major steps in the planning process.
as evidenced in the case study. Chapter five presents an analysis of the Richards Creek–Somenos Creek Drainage Improvement Plan, using the criteria outlined in chapter two. Conclusions and recommendations are presented in the final chapter.

1.3 The Case Study

The Somenos drainage basin is located north of the City of Duncan on Vancouver Island (fig 1). It is 65.7 km² (25.4 mi²) in size; Richards Creek is a major tributary. Somenos Creek drains into the Cowichan River upstream of the estuary.

The Somenos drainage basin is subject to frequent inundations during high-water periods. Up to 228 ha of agricultural land are affected by flooding annually. Eighty percent of this land is in the Richards Creek subbasin (British Columbia 1981). The major impact of this annual flooding is the inability of the farmers to get on their land early in the season to plant crops. As a result, the productivity of the area is lower than it could be.

Historically, flood control in the area was the responsibility of the Somenos Drainage Board. The board was unsuccessful in implementing a drainage scheme in the area in the 1950's, for reasons to be discussed in chapter four. Subsequently, the Municipality of the District of North Cowichan (MDNC) applied to the federal-provincial program established under the Agricultural and Rural Development Subsidiary Agreement (ARDSA) for funding to complete drainage works in the basin. Under the application, an initial project feasibility study examined four alternatives. In 1983, funding was approved and the first alternative was undertaken, that of cleaning both Somenos Creek and Richards Creek. The case study presented in chapter four analyses actions taken during the period 1980 to 1983.
Figure 1.
The Richards Creek-Somenos Creek Drainage Improvement Plan
CHAPTER 2
THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The purpose of this chapter is to identify major land drainage issues, and selected factors significant in the success or failure of drainage projects. The information provided here is the result of an extensive literature review as well as the examination of a number of drainage case studies undertaken in Ontario.

2.1 Rationale for Public Investment in Drainage

Public investment in water resources, including drainage projects, involves a number of goals, including: a more equitable distribution of income, regional development, and increased economic efficiency of the system. Gardiner (1973, 2) suggests that until recently

... economic decision-making criteria, or the importance of having the benefits of a project outweigh the costs, exceeded any other as the most important criteria for public investment decisions in water resource projects. Objectives such as income redistribution and more recently, a pristine natural environment, tended to be ranked lower. Problems of creating policies which satisfy all criteria are numerous. One must design a policy which considers all possible effects and impacts, as well as determining which objectives will be the most important and should therefore carry the greatest weight. Unless these objectives are clearly defined, policy evaluation is extremely difficult.

2.2 Physical Objectives of Land Drainage

Major benefits of land drainage include increased productivity due to a lowering of the water table (Hill 1975, 253). By increasing the depth of the root zone, more plant nutrients are made available to crops (Manitoba 1972, 2). Soil structure is improved as a result of better ventilation which allows for increased availability of oxygen around the root area. Soil temperatures also tend to increase following a drainage project (Manitoba 1972, 2). These effects result in increased soil fertility and crop production because of
earlier germination, improved soil ability to support a wider range of crops and improved reactions of the soil to different cropping techniques. There is also a marked improvement in crop quality (British Columbia 1972). Although land drainage is frequently undertaken in areas of already high productivity, a major goal of many drainage projects is to render marginal farming areas more economically viable through improvements in productivity.

There are various methods whereby land can be drained. These include: construction of, or cleaning, a main drainage channel; construction of outlet or field ditches to carry water from agricultural fields to main channels, and tile drain construction, or perforated pipes, which underly agricultural fields. Most drainage schemes are a combination of these three methods.

2.3 Environmental Impacts of Land Drainage

There is a relatively large body of literature on the effects of channelization on channel morphology, turbidity, hydrology, and stream water chemistry. There is, however, a paucity of information on the effects of altering hydrological regimes on fish and wildlife populations. Most research is site-specific, and extrapolation of results from one watershed to another is not always possible or desirable. Insufficient data on the direct effect of land drainage on fish and wildlife populations make it difficult for managers to reach objective decisions regarding land drainage schemes. Recent Ontario work has attempted to quantify the effects of land drainage on the biological environment (Diebolt 1981; Hill 1975; Irwin and Whitely 1983; Day, Brady, and Straite 1976). Hill (1975, 253) describes the goal of these studies as follows:

... the documentation of these environmental impacts forms a necessary basis for better decisions regarding the design and implementation of drainage schemes. Furthermore, this information is a vital pre-requisite to development of legal and institutional frameworks which can cope with the indirect effects of agricultural land drainage on the environment.

Major land drainage impacts can be divided into several categories of change: channel morphology, surface and subsurface flow characteristics, water quality, and vegetation and wildlife as a result of habitat alterations (Diebolt 1981, 110–142).
2.3.1 Channel Morphology

Channel morphology is altered as a result of modifications in stream discharge, sediment loads, or both. The major effect of changes in sediment load or stream discharge is an alteration in the equilibrium state of the watercourse. This is defined as "the state at which the stream gradient, channel form, and all other physical characteristics are adjusted so as to move the available sediment with as little energy as possible" (Hill 1975, 263). The degree of change that occurs depends on the nature of the disturbance. These changes are often a result of increased sedimentation due to bank disturbance and erosion during drain construction. It must be noted, however, that there is a lack of quantitative data on the relationship between land drainage and increased sedimentation in watercourses. Diebolt (1981, 112) noted in a case study of drain reconstruction in Ontario, that the channel was almost doubled in size and the banks were excavated at abrupt, unstable angles of approximately 60 degrees. Suspended sediments were 600 times greater than prior to construction (Diebolt 1981, 123). In addition to potential harm to the fish population, these results suggest that the potential benefits of any project could be reduced if there is substantial erosion, returning the project site to preproject conditions in a shorter period of time. In drainage projects, most sediment is produced during the initial channel clearing and when the banks are exposed immediately after construction.

2.3.2 Water Temperatures and Light

Drainage projects can also significantly affect water temperature, particularly if the project requires the removal of bank vegetation which normally provides shade. Most average stream temperatures increase slightly with a decrease in the amount of canopy cover and streamside vegetation. Opinions on the actual effect of this on fish populations varies (Hartman and Holtby 1982; Canada 1981). Generally, increased water temperature increases the rate of metabolism and respiration as well as potentially affecting reproductive and feeding capacity of some species (Hill 1975, 268). Decreased canopy also affects the amount of light available, and this can affect stream productivity, increasing it somewhat (Hartman and Holtby 1982).
2.3.3 Flow Characteristics

In addition to altering sediment load and channel morphology, drainage projects can also have a significant effect on downstream flow characteristics. There are two conflicting opinions concerning land drainage and streamflow (Irwin and Whitely 1983, 90). The first is that drainage improvements speed the movement of water through a stream system and will therefore increase downstream flooding through an increase of peak flows. The alternate view suggests that drainage projects tend to increase the natural soil storage capacity and, as a result, downstream flooding is reduced. Results of a literature survey by Whitely (1975) indicate that drainage will usually increase peak flow. Installation of tile drainage, however, may reduce flooding since tile drains tend to increase the soil storage capacity to a depth below the normal level. Thus, following a dry period, the effects of a storm event may be less significant in an area which has tile drainage as compared to an area that has none. Overall, the effect of drainage on flow characteristics remains unresolved.

2.3.4 Water Quality

Water chemistry is also affected by agricultural land drainage. Hill (1975, 264) suggests that land drainage can result in the accelerated movement of water containing fertilizers and pesticides into the aquatic system. Of particular interest is the increased nitrogen in the system in the form of nitrates. Although increased nitrates may increase productivity of the system in the short run, long-term eutrophication problems may result (Hartman and Holtby 1982; Hetherington 1976 in Hartman 1982).

2.3.5 Vegetation and Wildlife

Drainage impacts on vegetation and wildlife are varied. Langer (British Columbia 1980) Slaney, Halsey, and Tautz (British Columbia 1977) and Hooten and Reid (British Columbia 1975) studied the effects of sedimentation and channelization on fish populations. They found that increased sediment loads often result in adverse effects on plant and animal life. Stream sediment plays an important role in determining the type and amount of primary producers in a stream and may be a limiting parameter in many ecosystems. The major effects of increased sedimentation include increased stream
turbidity which limits photosynthetic activity, and may act as a visual barrier to some predaceous fish species, decreasing their feeding efficiency. Increased substrate also has an abrasive effect on the streambed, altering channel morphology and blanketing certain streambed areas with fine deposits. It may form a mobile substrate that inhibits algal growth, clogs the filter feeding apparatus of benthic invertebrates, and creates a general reduction in food availability. Changes in the subgravel environment as a result of fine sediment deposits is perhaps the most significant impact. Destruction of fish eggs may result through sedimentation of spawning grounds. Salmonid alevin are extremely dependent on physical and chemical conditions of the gravel environment for survival. Often, there is a decreased egg to fry survival rate as a result of decreased oxygen in the subgravel environment. Fry survival is also affected. Juveniles and adults may suffer from abrasion of gill tissues and accumulation of fine sediment in the gills.

Actual physical removal of streamside vegetation occurs in most drainage projects, particularly along banks where large machinery cuts a path to complete the work. In areas where spoil is deposited, vegetation is often covered and destroyed. Expansion of the agricultural land base as a result of drainage reduces the size and number of natural plant communities. Water table changes can also cause alterations in the wetland species composition. Marshes, bogs, and other poorly-drained areas are important in the life cycle of a number of waterfowl and wildlife species. Changes to, or complete removal of, such areas can have a significant local, regional, and sometimes even a national impact on some wildlife populations (Diebolt 1981; Brady 1982; Hill 1975).
2.4 **Economics of Land Drainage**

2.4.7 Cost–benefit Analysis

Discussion of the economic impact of land drainage focuses primarily on cost–benefit analysis. Under this procedure, the anticipated benefits of a project, specifically the expected increase in crop production, or transfer to a more lucrative crop, are totalled. This value is then compared to the cost of undertaking the drainage project. If the predicted benefits outweigh the expected costs, a project is considered to be feasible.

There are a number of problems associated with the use of cost–benefit analysis in the determination of drainage project feasibility. Accurate crop price forecasting is difficult, as is predicting anticipated crop production increases. Predictions of an individual farmer's behavior with respect to cropping patterns and investment is also significant in the calculation of project benefits. Most drainage cost–benefit analyses assume that newly–drained land will eventually be adapted to the most revenue–maximizing land use. Although this does occur in some instances, many farmers do not have the financial ability, economic incentive, or the initiative to alter their farming methods or productivity. Day, Brady, and Straite (1976, 20) found that the preconstruction cost–benefit ratios of some projects tended to overestimate the willingness to invest by individual farmers. The degree of tile drainage installed following completion of a project is also significant in the outcome of drainage cost–benefit analysis. Percent of tile drainage installed has been shown to significantly impact total net project benefits. Research in Ontario indicates that:

... outlet drains provide little increase in crop yields without associated tile drains to remove water from the crops. Therefore, for the agricultural benefits of drainage technology to be reaped, it is essential that both tile drains and outlet drains be constructed to increase agricultural productivity and quality (Topecon Group Ltd. 1971, 1).

Also important in the calculation of project benefits is the degree to which there is post project maintenance. Often, drains are neglected and benefits do not accrue as anticipated due to the rapid deterioration of the drains as a result of this neglect.

The costs associated with large–scale drainage projects are numerous. In addition to material and labor, there are a number of indirect expenses such as administrative,
legal, and maintenance costs. The discussion of environmental impacts in the preceding section also indicates that there may be a number of indirect, long-term, environmental impacts associated with drainage which are extremely difficult, if not impossible, to quantify.

Past research in land drainage economics reveals significant variations in the economic efficiency of drainage schemes (Brady 1982, 9). The Topecon Group Ltd. (Brady 1982, 9) undertook a cost-benefit analysis of ARDA projects in Ontario, and discovered that for a number of projects, benefits accrued did not warrant project expense. Found, Hill, and Spense (1974) also completed a study on economic and environmental implications of drainage in Ontario. They found that in 11 of 37 drains, benefits failed to surpass the expense of drainage. These studies indicated that seven factors accounted for the decrease of benefit-cost ratios in drainage projects. These factors were:

- the initial productivity of the land, whether the soil was fertile to begin with or needed substantial investment in fertilizer as well as drainage to become productive
- the propensity of landowners to install field underdrainage (tile drains)
- special conditions such as unstable soil type and hydrology which can affect the cost of construction
- type of project (large scale versus small scale)
- local initiative to invest in and maintain the project
- quality of engineering, and
- weather conditions since the start of the project

These factors are frequently ignored in preliminary drainage economic feasibility studies. Found, Hill, and Spense (1974) suggest that all benefit-cost studies of drainage projects should take these seven important factors into account.

2.4.2 Distribution of Benefits and Costs

Gardiner (1973, 5) discusses public investment in drainage in terms of the distributional objective, suggesting that the goal of public investment in drainage is to cause changes in the way that income is distributed among members of society. The
distributional objective raises a number of questions with respect to drainage projects. Particularly relevant here are the cost-benefit aspects: who benefits from the project and who pays; and who should benefit and who should pay? In the case of a federally-subsidized project, these questions become significant since it is national tax dollars which pay for a local project.

2.5 Land Use Conflicts Resulting From Drainage Projects

Land drainage projects, while undoubtedly creating benefits to some individuals, frequently conflict with other user groups including fisheries, environmentalists, and downstream landowners.

2.5.1 Environmentalists

Environmental objections to land drainage are most often associated with the loss of wetlands. Wetlands have rich organic soils, and as a result they are the target of many drainage works. Draining them converts otherwise unsuitable land for crop production. Wetlands are also drained to improve adjacent agricultural areas (Ontario 1974, 18). Wetlands, unlike some other natural habitats, are not subject to intensive recreational activities. The nature of the habitat is such that boating, camping, hiking, and other traditional recreational activities are impossible. Use of wetlands is therefore restricted to very specific user groups such as bird-watchers and hunters. It is only in recent years that groups have begun to oppose large-scale wetland drainage. In Ontario, and particularly the United States, these conflicts have escalated to bitter disputes between environmentalists and those responsible for land drainage. Conflict resolution is difficult when there is inadequate assessment of project impacts on alternative land uses.

2.5.2 Downstream Users

Frequently, approval of a drainage plan is dependent upon agreement by all, or at least a majority of, landowners in a drainage basin. Approval is sometimes difficult to achieve, however, for a number of reasons. First, as section 1.3.3 indicates, drainage in one area may increase flows further downstream. Thus, downstream landowners occasionally object to proposed drains on the basis that their property may be flooded.
more frequently as a result. Associated with this is the distribution of project-related benefits. Downstream landowners often believe they will not derive the same amount of long-term benefits from a project as landowners directly affected (Brady 1982). Indeed, they often believe that they will suffer as a result.

2.5.3 Fisheries

In British Columbia, a major land drainage conflict is associated with drainage impacts on fisheries, an important provincial resource. Metzger (1982) discusses the fisheries problems at length. He states that associated conflicts are due to three factors. The first is ignorance of potential negative drainage impacts and legislative requirements on the part of the farmers. The second is the relatively confused regulatory role of the agencies involved, and the third is the maintenance of too rigid a stance by those agencies, which results in a confrontational rather than a cooperative attitude towards conflict resolution. An example of this conflict with fisheries is evident in a paper by Regts (1983). He estimated that agricultural losses due to the failure to obtain approval for cleaning and maintaining drainage channels in the District of Matsqui were approximately $1,100,000 per annum, although he concedes that part of this cost is attributable to lack of federal and provincial funding. Regts also states that:

... the fisheries ministry has lost the confidence of the municipal and consulting engineers. It appears that the [federal] fisheries ministry is unable to provide the type of leadership which will lead to a cooperative approach for maintaining desirable streams for a multitude of uses including fisheries, drainage, irrigation and recreation.

2.5.4 Mitigation as a conflict resolution tool

In British Columbia, fisheries conflicts are often solved through the use of mitigatory measures to reduce negative project impacts on the fisheries resource. There are a number of mitigative measures commonly used to reduce land drainage impacts on fisheries. Streamside vegetation management is one measure of which the most common is to leave a vegetative strip along the streambank (Canada 1981). Controversy exists over how wide this strip should be. Gillick and Scott (Washington 1975) provide an analysis of the ideal buffer strip width, suggesting that the actual width depends on such things as the value of the resource being supplanted, and the income that resource owners are willing to forfeit to protect the fisheries resource. Use of detailed soil inventories to
guide construction, the use of certain construction techniques to minimize gullying and sheet erosion and control point-source sediments, (British Columbia 1977b; Hartman and Holtby 1982; Nelson and Salwasser n.d.; Hartman 1982), and timing construction to avoid critical fisheries periods are all common mitigation measures (Hartman and Holtby 1982; British Columbia 1980b). Swanson (1979) identifies six factors leading to effective mitigation. These include:

- a clear understanding of the concept of mitigation by all those involved;
- development of criteria for determining the type of mitigative measures to be used. Carlton (1979) points out that mitigation in the forestry industry is more often than not piecemeal or ad hoc. In the absence of established objectives, mitigative measures become something which are simply added on at the end of a project. Standard quantitative methodologies to predict and evaluate impacts and the effectiveness of mitigative measures are essentially nonexistent;
- early involvement in planning by all interest parties;
- effective implementation of plans. This is often the least successful aspect of resource planning. British Columbia has some examples of successful implementation planning, such as the Tsitika Follow-up Committee, but such committees are rare (Vreeswijk 1985, 95);
- effective operation and maintenance of mitigative measures; and
- adequate mitigation funding, including the issue of who provides the mitigation funds;

Determination of the success of mitigation in terms of both environmental and social allocation of resources is an important part of conflict resolution analysis. Information on the costs and benefits of such measures in British Columbia is rare (Dorcey, McPhee, and Sydneysmith 1980).

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2.6 **Evaluative Criteria**

The preceding sections indicate that there are a number of significant issues that should be considered before a drainage project proceeds. Once a project is initiated, new issues arise, such as which construction techniques to use, how to maximize benefits, minimize negative impacts, and ensure that everyone affected will be relatively satisfied with the final result. Planning, consultation between the public and the ministries involved, and appropriate legislation and funding agreements are essential if projects are to be economically efficient and socially and environmentally acceptable. Norton and MacMillan (1972) define economic welfare efficiency as a position that is equitable and yet gives a distribution of benefits that is considered to be fair. The degree to which any development achieves this goal is a function of the political and institutional arrangements controlling that development. In order to evaluate this, the following criteria, derived from the preceding literature review and adapted from a number of texts on policy evaluation, will be used as a basis for the evaluation of the Richards Creek–Somenos Creek Drainage Improvement Plan.

2.7 **Criterion 1: Project Economic Efficiency**

This criterion will evaluate the economics of the Richards–Creek Somenos–Creek Drainage Improvement Plan. It can be divided into three sections. The first is a critique of the cost–benefit analysis completed as part of the project feasibility study. Important points to be considered are whether all expenses, including environmental and mitigation costs, and administrative costs of conflict resolution, are included. Second, an independent cost–benefit analysis of the project is presented to determine project efficiency. Data on benefits in 1984, one year after project implementation, are used as well as updated values in 1986, three years after project completion. Finally, the availability and success of current legislative and economic incentives in ensuring economic efficiency and equity are examined in the third section.
2.8 **Criterion 2: Administrative and Legislative Simplicity**

This criterion examines legal and institutional aspects of drainage policy to determine the extent to which the institutional and legislative aspects are clearly understood by those who must deal with them. Ease of policy implementation is also analysed.

2.9 **Criterion 3: Project and Policy Effectiveness**

The goal of this criterion is to determine the success of the project and policy in achieving its stated objectives. At the project level, analysis concentrates on whether the stated objectives of the project were realized. In the policy section, the discussion focuses on whether the project succeeded in fulfilling government policy objectives. An important aspect of effectiveness project equity in terms of who benefits, who pays, and whether that distribution of project benefits is in accordance with government policy objectives.

2.10 **Criterion 4: Process Adequacy: Dealing with Resource Conflict**

This criterion examines the ability of the process to deal with environmental objections to drainage projects. Evaluative information will include:

- the project environmental impacts and how they were dealt with,
- the existence of an adequate appeals procedure in the case of dissatisfaction by interested or affected parties,
- success of existing planning mechanisms to ensure that all present and potential land uses in the area are adequately considered before the project proceeds, and
- the availability of a forum for public participation in the planning process.

This criterion also examines the role of the federal and provincial fisheries departments in project planning. Important points reviewed include: the clarity of both governments’ objectives with respect to fisheries habitat in the study area; the basis for
establishing various mitigative measures requested by these departments; the willingness of the fisheries departments to participate in the planning process; and, the availability of monitoring programs to determine the effectiveness of mitigative measures employed. Finally, comments are made concerning the openness and accountability of the decision-making process.
CHAPTER 3
BRITISH COLUMBIA AGRICULTURAL LAND DRAINAGE LEGISLATION, PLANNING, AND DECISION-MAKING

Primary objectives of this chapter are to provide:

- a review of legislation affecting land drainage;
- a framework of the planning and decision-making process concerning drainage funding and project development; and,
- an introduction to the federal and provincial land drainage agencies.

3.1 Legislation

There are two types of legislation relating to land drainage in British Columbia: common law and statute law.

3.1.1 Common Law

Most law for water courses is founded on the maxim "Aqua currit et delet currere" or, "water flows naturally and should be permitted to flow." Thus, common law imposes an obligation on landowners to avoid altering natural drainage to the detriment of others. According to Chessman (1984), the riparian water rights doctrine has created a presumption that:

...secure water flows and consumption must not be transferred within the water basin or beyond it without unanimous consent from all riparians and potential riparians.

Use of this presumption in dealing with drainage projects where unanimous approval is virtually impossible to achieve would ensure that hardly any project is constructed. In response to this, the doctrine of prior appropriation was developed in the United States. In Canada, the 1894 Northwest Irrigation Act established the principle of prior appropriation in the western provinces through the development of the first water licensing system. Subsequent legislation in all of the western provinces has followed this principle (Chessman 1984). In the area of land drainage, statutory powers of the province used to expand landowners' rights beyond that which is traditionally permitted through the court's interpretation of the common law (11 A C.E.D. (Western) 2nd. ed).
These statutes are briefly described in the following section.

3.1.2 Statute Law

Licensing and approval of the right to use water is covered under the **Water Act** (British Columbia 1979c). All drainage projects require a water licence before they can proceed. Under section 6 of the act, the comptroller of water rights may issue a license to a municipality, improvement district, or water district for land improvement. Land improvement is defined as:

...the diversion or impoundment of water to protect property, facilitate the development of a park or for the reclamation, drainage or other improvement of the land.

The **Municipal Act** (British Columbia 1979d) has a number of sections relating to land drainage undertaken by municipalities. According to section 585, all drainage provisions of that act are subject to the applicable provisions of the **Water Act**. The **Municipal Act** is complex and has a number of stipulations relating to the planning process and funding for drainage projects. These points will be dealt with in more detail in the following section.

The **Drainage, Ditch and Dyke Act** (British Columbia 1979e) applies to municipalities proposing drainage projects involving construction in rural areas, or smaller projects where the work is undertaken by individuals. Any alterations to existing drainage systems must follow the same procedures applied to the initial construction. This act has a number of sections dealing with project approvals and funding. These points will be discussed in more detail later. In addition to these three acts, there are a numerous other pieces of legislations which deal, albeit indirectly, with land drainage. These include tax exemption regulations under the **Taxation Act** (British Columbia 1979f) and property easement regulations. These regulations are significant in land drainage because frequently, right-of-ways are requested for maintenance or for leave strips in the case of fisheries mitigation requirements. The **Agricultural and Rural Development Act** (British Columbia 1979g) stipulates the conditions for federal-provincial funding arrangements for ARDSA grants.

The **Federal Fisheries Act** (Canada 1970) allows the federal government to maintain jurisdiction over anadromous and inland fisheries resources. In British Columbia, the
federal fisheries department plays an important role in determining the way in which a drainage project will be constructed. Its role has been perceived as being too powerful by some interests, including MAF (Metzger 1982), who feel that agricultural priorities come second in projects involving fisheries.

In summary, statute law in British Columbia covers a wide range of land drainage aspects, including project initiation, planning, and funding.

3.2 Planning and Decision-Making

The planning and decision-making process for agricultural land drainage in British Columbia is based primarily on the licensing system in the Water Act, and the petition procedure for initiating municipal drains as described in the Municipal Act. This section will outline the planning and decision-making process for drainage projects as outlined in the relevant legislation. The decision-making process is illustrated in figure 2.

3.2.1 The Petition Process: Initiation of a Project

Sections 588(2), (3), and (4) of the Municipal Act gives municipalities the right to:

- purchase, construct, improve, extend, alter, remove, repair, maintain and operate works to maintain proper flow of water in a stream...

as defined by the Water Act. To do this, council may

- prevent, divert or improve drainage of surface water, but must first prepare a plan to carry out those works, and prepare a report which includes descriptions of all landowners affected, the cost of the work and the division of the cost. They must also apply to the minister who may authorize works in terms of compensation and costs to the owners of land affected.

Drainage projects may be initiated by a municipal council, or through a petition by individual landowners. Either of these must identify the area to be affected by the proposed project, and list the landowners. The petition is not valid unless it has been signed by two thirds of the owners to be affected by the project, representing greater than one half of the total assessed value of the land in question. After a landowner has petitioned for a drainage project, the municipal council must, within 15 days, order a preliminary report to be prepared by the municipal engineer. The engineer’s role is to determine whether or not the project is required, whether benefits will exceed estimated costs, and what lands will be affected. Items in the cost estimates include engineering
Figure 2

THE LAND DRAINAGE DECISION MAKING PROCESS

1. PETITION by landowner or municipality
   - WATER LICENSE APPROVAL
     - MOE WATER MANAGEMENT BRANCH
       - REFERRALS TO DFO, BCFW, and other agencies
         - Appeal to comptroller
           - No
             - Project does not proceed
           - Yes
             - Project proceeds with subsidy
         - Yes
           - Project proceeds without subsidy
   - FUNDING APPROVAL
     - ARDSA: MAF and Agriculture Canada
       - FEASIBILITY STUDY ECONOMIC ANALYSIS by independent consultant
         - No
           - Project cancelled or proceeds without subsidy
         - Yes
           - Project proceeds with 75% subsidy
expenses, cost of advertising and mailing, compensation for land taken for the project, and expenses incurred by the municipality in determining compensation. Council then decides whether or not to proceed with a more detailed survey including design details, cost estimates, maintenance costs, all land affected, and assessments of costs to each landowner.

Ideally, once the petition procedure has been initiated, the municipality will simultaneously submit an application for a water license and, should it be eligible, funding for the project under the ARDSA program. In addition, all drainage projects require a water license under the British Columbia Water Act. The comptroller of water rights has a great deal of decision-making power, since he or she has the final word on the approval or rejection of any license. The comptroller also has the discretionary power to determine whether or not a public hearing is required (BC Wildlife Federation v Nu-West Development Corporation Ltd. (1976) 1 B.C.L.R. 244, 72 D.L.R. 581).

3.2.2 Appeals

The Water Act sets out procedures for the suspension and cancellation of licenses as well as for appeals of the comptroller’s decision. The Environmental Appeal Board was set up under the Environmental Management Act (British Columbia 1981b) to deal with objections to the comptroller’s decision. Engineer’s decisions can be appealed to the comptroller. Objections to the initial granting of a license may be made by riparian landowners, other licensees, the deputy attorney general, the deputy minister of lands, parks and housing, or the deputy minister of agriculture and food. Remedial measures exist for failure to comply with an order of the comptroller or engineer, or misstatement or material misrepresentation in the application furnished with respect to it (British Columbia 1981b). Appeals are also possible under the Municipal Act. Once municipal council has determined that a project will go ahead, the only way to reverse the decision is if a majority of landowners, again, majority meaning those landowners representing greater than one half of the total assessed value of the land affected, oppose the project (British Columbia 1979d). Any landowner may, within 30 days of receiving an assessment of costs apportioned to his or her land, appeal the decision to the county court on the grounds that potential benefits are less than the assessed costs to the property, or if he
or she feels that certain parcels of land should be included or excluded from the analysis.

The Drainage, Ditch and Dyke Act also has sections relating to appeals. Section 12 states that there must be agreement between all landowners affected as to the cost and maintenance of the project. If agreement cannot be reached, landowners requesting the project can demand that the appointed engineer re-examine the project site. The engineer then determines whether or not everyone was notified, and he or she must also decide whether or not any potentially affected landowners were neglected. It is also up to the engineer to determine whether land damage in some instances exceeds the accrued benefits, and the degree of compensation to be awarded in such cases. If landowners are dissatisfied with the engineer’s decision, they can appeal it within 15 days. The appellant is permitted to have the site inspected by any other person, such as a biologist or fisheries officer, to get a second opinion on the engineer’s calculations and assumptions. If any landowner feels that the benefits allotted to his or her land have not accrued as anticipated once the project is complete, he or she may, after two years, initiate proceedings for the reconsideration of agreements or awards. According to the act, all drainage system maintenance is to be undertaken by the benefitting landowners.

3.3 Subsidies and Funding

When a drainage project does not receive federal or provincial funding, it is paid for by landowners benefitting from the project, as determined by the project engineer. If an area is located outside a municipality, the funds required are supplied by the Ministry of Finance and collected as provincial taxes.

The Agricultural and Rural Development Act was created to establish the basis for federal-provincial funding arrangements for projects concerned with the alternate use of the land, rural development projects, and soil and water conservation projects. Under this act, the Province of British Columbia may enter into an agreement with the federal government to receive funding for such projects. An identical amount must be supplied by the province. Section 3 of the act states that the Ministry of Agriculture may pay entirely for certain projects in anticipation of an agreement with the federal government, where the project costs more than the agreement under the act provides for, or where the
ministry feels that no agreement can be reached under the act, but still desires to fund a project. The Canada-British Columbia Subsidiary Agreement on Agriculture and Rural Development outlines the specific goals and objectives of the provincial and federal governments. The purpose of this agreement is to enable

... Canada and the provinces to jointly participate in initiatives directed towards the attainment of maximum economic and socio-economic benefits from the agricultural and rural resources of the province of British Columbia, and particularly rural development initiatives to reinforce federal and provincial government policies and programs relating to the development of, or support of, the agricultural sector.

The agreement states that there are at least 2.5-million acres of marginal farmland in the provincial land base that can be upgraded through irrigation or drainage to class 1-4 agricultural land. Factors identified as significant in encouraging improved land utilization included

... the quality of land management, the low ratio of improved land, ownership of a large percentage of unexploited land by non-farmers such as pensioners, non-residents and small scattered estates, and substantial amounts of good quality agricultural land which has never been exploited.

Four programs were established to achieve these objectives. Land drainage funding falls under part three, primary resource development. Under it, federal and provincial governments each contribute 37.5% of the cost of the project, with a local contribution of 25%. Projects under this program would be initiated only in selected areas of the province. To aid in implementation, a management committee was established to coordinate programs, create operational guidelines, and adopt responsibility for project approvals. In order to obtain funds, the province must submit a document for each proposed project detailing the purpose, cost, cash flow, expected benefits, expenses, and assessments of the economic significance of each part of the project, as well as design and construction standards.

3.4 Governmental Planning

Participation and input from different government agencies for a drainage plan is usually initiated through the informal referral system that exists between ministries to deal with resource conflicts. Under this system, the Water Management Branch of the Ministry of the Environment (MOE), upon receiving an application for a water license,
refers it to all other agencies that it considers could be potentially affected by the license. This would usually include its Fish and Wildlife Branch, the federal Department of Fisheries and Oceans, and any other relevant ministry. In the case of land drainage, the Ministry of Agriculture and Food (MAF) handles the initial project details, including funding requests. The result is that MOE, MAF, and DFO are the lead agencies in land drainage discussions.

3.4.1 The Department of Fisheries and Oceans

In British Columbia, the federal government has control over both coastal and anadromous fisheries while the province is responsible for resident sports fish (Canada 1981). The federal fisheries’ management objective is:

... to protect and preserve salmon habitat, the quality and productivity of which is jeopardized by conflicting water use, land use and waste disposal practices (Canada 1981).

The DFO habitat management policy is currently under review. Although not yet finalized, the main objective of this new policy has been termed the 'no net loss' objective, whereby the department will work towards ensuring that net habitat loss is nil. This objective will be achieved through mitigation, alternative development sites in case of conflict, and replacement and prohibition of certain activities. The main legislation to enforce DFO objectives is the Fisheries Act, particularly sections 30(1), 31(1), 33(2), and 33(3). This act has been amended as the need arose to ensure that fisheries department objectives are met. DFO response to habitat loss, traditionally, has been through planning and enforcement.

... many feel that there has been too much of the latter and not enough of the former (DeBane 1984).

The proposed policy would introduce 'habitat management area planning'. Under this system, a habitat area management plan would be formulated, based on consultation with all water and land users and other interested parties. Other points of interest in the new policy include the willingness of the department to consider habitat replacement for any losses, the recognition of the need for public consultation, the legal requirement for proponents to provide habitat impact studies at their own expense, and the opportunity for DFO decisions to be reviewed and reconsidered (Canada 1985c). The resource services of DFO are responsible for habitat protection and the handling of interagency
referrals. The fisheries officers of that department are usually the first point of contact between DFO and other agencies in any conflict situation (Dorcey et al. 1980). Under the present referral system, fisheries officers must make quick, site-specific, decisions based on a combination of available technical and ecological information and value judgement (Canada 1981; Hartman 1982). A fisheries officer in the field is faced with a variety of quantitative data requirements such as escapement, migration timing, spawning and rearing areas, and the overall significance of a given fisheries resource. Often there is inadequate ecological information for good decision-making.

3.4.2 The Ministry of Environment

MOE recently published a document describing ministry priorities and objectives for 1985–1990, including a status report on environmental planning in British Columbia. The following section describes the planning framework and MOE objectives as they relate to drainage projects. It is important to note that many of these objectives and procedures were not in place during the period examined in this report.

The following is summarized from the MOE status report on environmental planning and project assessment in August 1985. The goal of the MOE environmental management plans is to specify management objectives for various resources under the ministry’s mandate, and to provide a policy context within which specific project impacts can be considered and cumulative effects evaluated. If proposed projects affect the management objectives set out in the ministry plans, mitigation is sought through replacement-in-kind or enhancement in accordance with economic criteria. MOE has four planning levels. Recent planning process changes have been made in an attempt to strengthen the process and provide "a policy context at the front end of project assessment". The top planning level is the ministry or corporate level. This describes the overall mandate of the ministry, outlining the management philosophy, and different program objectives and priorities. At the regional planning level, management objectives are set for specific species, based on supply and demand analysis and potential resource conflicts. Management priorities are identified for major program activities. It is hoped that regional planning will identify management issues that can be further dealt with at the subregional level. Subregional plans are "integrated statements" which resolve any
internal conflicts between the various branches of MOE. The goal of these plans is to "provide a set of area-specific objectives" which fulfill the broader objectives identified at the upper planning levels. They are completed when specific management issues have been identified in an area, either through the regional plan, or through the interagency referral process in place within the government. MOE has also developed measures to ensure that environmental conditions such as mitigation plans are implemented effectively. These include a procedures manual to be followed by the proponent. The goal of this manual is to identify the proponent's intentions with respect to project impacts, mitigatory measures, as well as outlining the regulatory requirements for the project. The list of commitments describes the mitigatory actions and regulatory requirements that the proponent agrees to implement. Contract specifications provide contractors with an outline of the proponents' commitments. The goal of this is to reduce uncertainty and identify extra costs which may affect project bidding. All permits and licenses required to complete the project are a part of the procedures manual.

The above outline of ministerial planning indicates that MOE has developed a framework through which resource conflict can be effectively identified and dealt with at an early stage. This allows consultation with interested parties and resolution of major issues within a reasonable amount of time, creating a more efficient process. Of particular relevance to land drainage, MOE has indicated that more emphasis will be placed on the management of cumulative impacts and evaluation of mitigatory actions. Negotiation of mitigatory measures will be based on ministry surveys identifying the recreational values of fish and wildlife resources. These values will serve as a basis for addressing resource conflicts as well. There is no formal provision for public consultation in the MOE planning framework (British Columbia 1985).

3.4.3 The Ministry of Agriculture and Food

The district agriculturalist of MAF is usually in close contact with landowners, is aware of government policies, legislations, and programs, and provides advice to district residents concerning agricultural issues. MAF also plays a role in negotiating among landowners, municipalities, and government agencies. They are involved in most land drainage projects from the beginning. As a part of the ARDSA management committee,
which has joint federal-provincial representation, they are responsible for the planning and implementation of ARDA programs, project approvals, and related responsibilities.
CHAPTER 4
THE RICHARDS CREEK/SOMENOS CREEK DRAINAGE IMPROVEMENT PLAN

The purpose of this chapter is to outline the events of the Richards Creek–Somenos Creek Drainage Improvement Plan to illustrate the British Columbia approach to land drainage planning and decision-making. For the purpose of analysis, the project is divided into four planning stages: the preproject, project initiation and planning, construction, and postproject stages.

4.1 Preproject Stage

The Somenos Creek Drainage Basin is on southern Vancouver Island, north of the city of Duncan (fig. 1). The drainage basin covers 63.7 km². The principle agricultural region of the drainage basin is in the vicinity of Somenos Lake and the lower part of Richards Creek. Current land use in the area includes hay, pasture, blueberries, and potatoes. The land is all in the agricultural land reserve. The Somenos Creek–Richards Creek area has been subject to flooding on a regular basis for many years. When questioned, 93% (12; n=22)1 of the basin landowners cited flooding as the most severe agricultural problem with which they deal. Severe floods have occurred at least six times in the past 40 years, and low lying agricultural areas are inundated annually.

Planning for flooding relief has been ongoing since 1951, when the Somenos Drainage Board was established. Board membership consisted of all landowners affected by flooding. A $10,000 bond was floated to provide funds for the initial ditching contract. Each member contributed a flat rate of $2.75 per acre annually to service the debt and provide maintenance funds. Early work by the Somenos Drainage Board included the straightening of Richards Creek, paid for partially with government funds, and clearing of Somenos Creek from Somenos Lake to the Cowichan River. This initial work increased the usable cropland from 60 to 600 acres. Yearly maintenance kept the area relatively flood-free for a few years. Gradually, maintenance on individual properties diminished, and the creek became overgrown. In 1955, a bottleneck of gravel deposits on the

1 In the following analysis, the first number represents the number of positive respondents; n is the total sample size
Cowichan River was cleared at the request of a Somenos Creek farmer. During the late 1950's, the Somenos Drainage Board was dissolved because landowners bordering Somenos Lake were dissatisfied with the benefits they were receiving relative to the other landowners. These landowners consistently voted against any type of drainage investment. For close to 20 years, drainage remained an unresolved issue.

A comprehensive study on regional drainage problems was undertaken in 1967 by the Water Investigations Branch, now the Ministry of Environment, but none of the study recommendations, including integrated drainage of the Richards Creek-Somenos Creek basin, were implemented. The 1967 recommendations to alleviate flooding concentrated on Somenos Creek diking and improvements to the Cowichan River channel. As early as 1971 it was recognized that it would be difficult to obtain agreement by all concerned parties for drainage construction, and the municipal engineer recommended that negotiations to overcome the flooding problems should begin as soon as possible.

4.2 Project Initiation and Planning

In 1980, after three seasons of particularly bad flooding, the Municipality of the District of North Cowichan (MDNC), acting on a MOE recommendation, applied for assistance under the ARDSA program to develop a drainage plan for Somenos and Richards Creeks. Thus, project initiation was due in part to increased flooding, and in part to the substantial drainage subsidies available from the federal and provincial governments. Interviews with affected landowners indicate that there was strong support for a subsidized drainage plan. Thirty-two percent (7; n=22) expressed support for the project, while 14% (3; n=22) were opposed and 14% (3; n=22) were indifferent. When asked whether they would have supported the project if it had not been subsidized, only 9% (2; n=22) said no. Thirty-six percent (8; n=22) were undecided, indicating that the project benefits would have to exceed the costs charged to them to warrant support. Once the project was initiated, meetings with affected landowners and government agencies commenced immediately. These meetings were of an informal nature and nonaffected parties, including public interest groups, were not invited to participate. In addition to the Ministry of Agriculture and Food, the Fish and Wildlife and Water Resources Branches of MOE and DFO were identified as the lead agencies, and it was agreed that they would be consulted and their
approval required prior to final plan authorization.

Major issues emerged at an early planning stage. These included resource conflict with downstream users and other resource users, particularly fisheries, institutional problems associated with the resolution of these conflicts, and the importance of obtaining project funding. Without this funding the project could not be completed. In order to fulfill ARDSA requirements, MDNC agreed to complete an initial feasibility study. This included engineering feasibility, environmental impacts, and an economic analysis. Steps were also undertaken to apply for a water license, as required by the Water Management Branch (see section 3.2.1). The contract for this study was awarded to Willis, Cunliffe, and Tait (WCT), an engineering firm with experience in land drainage and conflict resolution. Terms of reference for the feasibility study were set and it was reemphasized that DFO and BCFW would be contacted by the consultants with regard to their recommendations concerning the planning and construction of the project.

Once the feasibility study commenced, initial clearing of Richards Creek was undertaken by a local farmer, G. Pastula, in October 1980. Using a backhoe on floats, he deepened the channel by eight feet and deposited the spoil on the west bank of the creek. Fisheries gave their approval for this work. Downstream landowners opposed this action, fearing that drainage might only be completed in the upper reaches of the basin, resulting in increased flooding of their land. The reasons for this initial creek clearing are unclear, and are significant since the action only served to aggravate downstream landowners and impede negotiations for project approval. One important point to note is that the farmer responsible for the clearing was also the prime potential project beneficiary, since he owned the greatest amount of property and was the largest agricultural producer. Commenting on this initial clearing, S.B. Peterson (assistant deputy minister of agriculture) stated:

...this [clearing] presents some conflict with the purpose of a feasibility study. Nonetheless, I feel that we must realistically expect the cost–benefit to be positive and certain to justify work (Carne 1980).

By this time, project planning had been ongoing for close to two years, yet there was no co-ordination or incorporation of the drainage plans into a regional context. In May 1981, there was a sudden realization that the Cowichan River Estuary Plan could have
a significant influence on the project outcome. If no dredging occurred on the Cowichan, the anticipated benefits of draining Somenos and Richards Creeks would be substantially reduced. This effect had to be taken into account in the feasibility study. Input by the fisheries departments had also been extremely limited. Other than having been identified as significant agencies, they had, until then, played a minor role in project planning.

The initial feasibility report was completed in March 1982, at which time comments were invited from all agencies. The economic analysis was severely criticized by both Agriculture Canada and ARDSA. Problems associated with the cost–benefit study are discussed in detail in chapter 5. Despite this, the ARDSA agreement was signed between MAF and MDNC on 31 March 1982. A $318,750 subsidy was approved out of the $425,000 project cost. The municipality’s share of the cost, initially estimated at $106,250, is to be taken from a special municipal reserve fund for capital projects. This reserve ensures that projects not benefitting the municipality population majority are not funded through general revenues. The total ARDSA allocation for that year was $1.8 million for the completion of 10 projects in British Columbia. The comptroller of water rights issued a 'Letter of Allowance' which outlined the requirements to be met by MDNC prior to the issuance of a water license. These included:

- detailed engineering design and plans,
- a detailed fisheries habitat mitigation plan to be developed in co-operation with BCFW and DFO and approved by the regional water manager,
- approval of plans for the relocation of all licensed water intakes
- signed agreements by all affected landowners, and
- an assessment of project effects on waterfowl habitat and a mitigation plan submitted to the regional water manager.

4.2.1 Fisheries Conflicts

Identification of DFO and BCFW as important agencies occurred in 1980. However, specific information regarding the fisheries resource was not provided by the fisheries agencies at that time. Once funding was approved for the project, a meeting was set up with all agencies for final design plans. Fisheries concerns were identified for the first time. These included: the need to define rearing habitat on the Richards–Somenos
system, and the need to evaluate project impacts on the fisheries resource. At that time, DFO had no idea of the roles of the creeks as habitat, and they emphasized that any impact assessment was the responsibility of the proponent, in this case, MDNC. MAF was insistent that mitigative measures be practical to implement, recognize farmers' rights, recognize financial limitations of the project, and finally, recognize time constraints for construction and funding.

The first on-site meeting was held with fisheries to establish the groundwork for a mitigation plan in June 1982. An analysis of existing habitat was completed concurrently. Mitigation plans for fisheries and wildlife were made by the same engineering firm responsible for project design. During this period, Ducks Unlimited expressed opposition to the project for the first time, indicating a concern for waterfowl habitat in the area. They requested $40 000 worth of dike construction to ensure habitat protection. A variety of measures were proposed to protect the fisheries resource. These included: the establishment of a greenbelt to provide shade, 7.5-m wide on Somenos Creek and 5.0-m on Richards Creek, a restrictive covenant to prevent clearing or cutting of brush without written consent from BCFW, and shade rafts and pond development in the creeks. On some properties, only a 2-m greenbelt was possible. Fisheries responded to these plans by stipulating a minimum acceptable greenbelt of 5-m, indicating that the average width of such strips must be at least 15-m. In addition, they did not support dredging of the mouth of Somenos Creek. By the end of July 1982, the only outstanding issue in the way of project approval was the lack of agreement on the right-of-way for maintenance purposes as well as the width of the fisheries leave strip. DFO insisted on a 5-m strip while the engineering firm (WCT) maintained that a 2-m strip was adequate. DFO also wanted the greenbelt fenced, and a 2 m wide no-farming strip on the bank adjacent the greenbelt. Anything wider than that, they suggested, was enhancement rather than mitigation. WCT felt that both provincial and federal fisheries were using their power to enforce demands in excess of mitigation. They also charged that new demands were introduced after 6 weeks of negotiations which could easily have been dealt with earlier.

Two important points should be noted about this dispute. The first was that ARDSA was only in effect until December 1983, after which the project would no longer be eligible for funding. Thus, if the project was to go ahead, agreement had to be reached
before the end of the year. The second important factor was that, in order for benefits to accrue as soon as possible, creek clearing had to be completed before the winter, or else farmlands would be flooded in the spring as usual.

4.2.2 Conflict Resolution

In July 1980, MAF contacted its deputy minister to get help in dealing with both DFO and BCFW (Metzger 1982b). It also suggested that MDNC could appeal the water license decision. Ministerial response to the MAF request was that it should contact senior management officials in DFO who "...may better appreciate the difficulty of the situation" (Peterson 1982). Finally, in October 1982, DFO identified the upper reaches of Richards Creek as the critical rearing area in that drainage basin; all previously agreed-upon mitigative measures were altered in favor of protection of Richards Creek on the Van Euwan property. It was too late, however, to complete the project for the 1983 season.

4.3 Construction

A construction schedule was chosen which coincided with the low-flow season when there would be the least disturbance to the fisheries resource. Construction continued from June through September 1983. There were some problems with construction, the most critical of these being a collapse of part of the streambank in late June due to a shear failure zone which extended at least 12 m beyond the streambank. Spoil taken from the creek-bed was deposited in a 15-m strip along the west bank of the creeks.

4.4 Postproject Stage

Following project completion, a maintenance program was prepared to be administered by the municipality. Interviews with landowners were undertaken in the summer of 1984 to determine the effect of the project on productivity. Only two landowners expressed any interest in making alterations to their cropping patterns or investing in measures to increase productivity. None had, at that point, experienced any increase in productivity. Despite this, all landowners supported the project as being good for "future generations".
Monitoring of the fisheries resource was the responsibility of DFO. There were no plans to monitor agricultural productivity or other changes to determine the project effects.

4.5 Summary

Flooding in the case study area has been a problem for many years. The Richards Creek–Somenos Creek Drainage Improvement Plan, initiated to a large extent by the availability of government subsidies, had numerous problems during the planning stages. These included weaknesses in the economic analysis, institutional problems preventing adequate resolution of resource conflicts, an inadequate data base for impact assessment and mitigation, and misconceived perceptions by some landowners of the effects of the project. These important issues led to considerable controversy and delays in project completion.
CHAPTER 5

AN ANALYSIS OF THE RICHARDS CREEK-SOMENOS CREEK DRAINAGE IMPROVEMENT PLAN

The purpose of this chapter is to analyse the effectiveness of British Columbia legislation, planning, and decision-making for dealing with the major land drainage issues, as reflected in the case study. The four criteria identified in chapter 2 (sections 2.7 to 2.11) provide the framework for analysis.

5.1 Economic Analysis

This analysis is divided into two sections. The first examines and critiques the cost-benefit analysis by the engineers for the Richards Creek-Somenos Creek Drainage Improvement Plan, and the second section provides a cost-benefit reassessment by the author for the same project.

5.1.1 The Richards Creek-Somenos Creek Cost-Benefit Analysis

To determine whether or not the project was economically feasible, WCT hired an economist to complete a cost-benefit analysis. His results, based on predictions of increased crop yields and land use changes over the 25-year project period, concluded that the project was economic. The cost-benefit ratios for the various schemes proposed varied from 4.8 to 15.8. The ratio for scheme 1, the recommended option, was 8.4. Criticism of this cost-benefit analysis came from both Agriculture Canada and the ARDA Primary Resource Branch. Agriculture Canada stated:

... It is recommended (Handbook for Agricultural Project Appraisal, J. Hardie) that increments in benefits and costs gained through staged development be distributed over years 1 through 5, at which time full project benefits will have been attained. Then it is but a matter of projecting the fifth year levels through to year 25. I find it difficult to have confidence in a statement to the effect that in the 15th year an additional 10 acres of vegetables will be developed. It is too difficult to be sure of any event occurring 15 years from now to base benefit or cost projections on this level of forecasting. The sooner full benefits the better the project in terms of our analysis and in terms of the distribution of those benefits to producers (Andison 1981).

The Primary Resource Branch of ARDA also criticized the initial cost-benefit analysis for the following reasons (Wallin 1982):

- no attempt was made to determine shadow prices for the commodities
produced,
- production volumes were very high,
- no attempt was made to determine the probability of long-term flood damage and its effect on agriculture,
- replication of the results was impossible,
- no sensitivity analysis was undertaken,
- the market analysis made unsatisfactory assumptions and was very optimistic, and
- the study methodology appeared questionable.

The ARDA report on the cost-benefit analysis described it as "an attempt to justify the project" rather than an objective analysis. Despite this, project funding was provided by ARDSA without significant changes being made to the analysis.

5.7.2 Analysis of the Economic Feasibility Study

The initial cost-benefit study had a number of other discrepancies. It was based on a simple questionnaire administered to basin residents. With the results of this questionnaire, estimates were made of the total land use change in the project area. The study did not incorporate any sensitivity analysis of crop prices or proposed benefits.

The only variable was project cost, depending on which alternative was being considered. The study failed to include the administrative cost of conflict resolution and it did not incorporate environmental costs. Cumulative, long-term impacts such as soil degradation and erosion and resultant decreases in productivity were not considered. Extras such as contingency fees and material trucking fees were not included. Benefits were extremely unrealistic, based on a very simple questionnaire that neglected many important issues, such as productivity losses due to land removals for the right-of-way or the fisheries leavestrip, a value which could decrease potential increased productivity estimates by up to 8 percent. Benefits were not disaggregated by property owner, making benefit distribution analysis impossible. There was no explanation of the assumptions made in calculating project benefits. As indicated in the benefit calculations, it was assumed that all landowners were willing and able to develop their land to attain maximum productivity. The fact that many landowners were elderly or retired, or simply not interested in developing the land, was not addressed.
5.1.3 Independent Cost-Benefit Analysis

As a result of the perceived inadequacies of the consultants' cost-benefit analysis, this independent study was undertaken. Since this work was completed the year following project completion, it serves two purposes. First, it provides a basis for comparison with the consultants' cost-benefit results discussed above, and second, it provides verification as to whether or not benefits predicted in the first years of the project were realized.

5.1.4 Methodology

To obtain data for the economic analysis, a questionnaire was distributed to affected basin residents. The main purpose of this questionnaire was to determine:

- future land use plans,
- costs incurred on the farm as a result of the project,
- ecological costs to the area,
- benefits to the area in terms of increased crop productivity and crop changes, and
- residents' attitude towards the drainage plan.

Methods used to calculate costs and benefits are discussed in the following sections.

5.1.5 Project Costs

There are a number of costs associated with the drain. These can be divided into: administrative costs of conflict resolution; on-farm expenses as a result of increased productivity associated with improved drainage; and, consulting and engineering, legal, construction, maintenance, and environmental costs such as loss of wetland habitat and downstream effects. Onfarm costs are not included in this section as they are subtracted from onfarm benefits to estimate net project benefits in the following section.

Administrative costs are estimated to be the time spent by bureaucrats over and above what would normally be spent at meetings to resolve major issues prior to project approval. It was assumed that people from the MOE Water Management Branch would normally have to attend meetings for water licence approvals. Since it was impossible to determine how much time was normally spent versus the time spent in conflict resolution,
their time was not included in the estimate of administrative costs. The same was true for the Ministry of Agriculture and Food staff. Conversely, fisheries staff would not normally be present at such meetings; their presence over a two-year period was considered to be a direct project cost. Transcripts of meeting minutes were used to calculate fisheries personnel attendance, total number of meetings, and average meeting length. Using an average annual salary of $35,000 per year, and an average meeting time of two hours, a total of 40 person hours was estimated to give an administrative cost of $840, less than 1% of the total project cost. This was significantly lower than anticipated.

Consulting fees for the feasibility study were substantial. Initial estimates ranged under $60,000, but final costs exceeded $100,000 (John Blanchet 1983). These costs include fisheries and wildlife mitigation plans, a preliminary cost-benefit analysis, engineering plans, and detailed creek-flow data.

Total construction costs in 1982 dollars are shown in table 1. Costs included channelization of the two creekbeds, and minor costs such as cattle bridge replacements and fencing to prevent animals from walking into the creekbeds. Contingencies and engineering and supervision costs also formed a significant portion of total cost. Gravel removal at Somenos Creek, estimated by the engineer to be approximately $14,000, may actually cost as much as $80,000, depending on the gradient required. This gradient will have some affect on the final project success. If Somenos Creek can be kept relatively free of debris, it will be easier to drain the upper reaches of the basin. For the purpose of this cost-benefit analysis, the lower cost figure is used.

Maintenance costs were distributed over the project life. Some maintenance costs are incurred annually while others only occur every ten years. These calculations were based on the engineers' assumptions as to the speed with which bank erosion and creek bed aggradation would occur, and the amount of gravel removal required in the lower Somenos Creek area near the Cowichan River confluence. It was estimated that Richards Creek would need cleaning within five years of project completion, with subsequent upkeep every five years. Somenos Creek would only need cleaning ten years after project completion, with upkeep every five years thereafter. The small west tributary flowing into Richards Creek would need cleaning at ten-year intervals, to begin ten years
Table 1

Estimated Richards Creek-Somenos Creek Drainage Improvement Plan
Construction Costs (1982 dollars)

<table>
<thead>
<tr>
<th>Improvements to Richards Creek</th>
<th>$ 104,715</th>
</tr>
</thead>
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<tr>
<td>Cleaning of Richards Creek at</td>
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<tr>
<td>Somenos Lake</td>
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<tr>
<td>Culvert at Richards Trail</td>
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</tr>
<tr>
<td>Fencing on Van Eeuwen property</td>
<td>12,000</td>
</tr>
<tr>
<td>Replacement of two cattle bridges</td>
<td>5,000</td>
</tr>
<tr>
<td>Improvements to Somenos Creek</td>
<td>90,850</td>
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<tr>
<td>Cleaning of Somenos Creek at</td>
<td>8,000</td>
</tr>
<tr>
<td>Somenos Lake</td>
<td></td>
</tr>
<tr>
<td>Gravel removal at lower Somenos Creek</td>
<td>*14,000</td>
</tr>
<tr>
<td>Contingencies (15%)</td>
<td>47,000</td>
</tr>
<tr>
<td>Engineering and supervision</td>
<td>44,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$365,565</strong></td>
</tr>
</tbody>
</table>

*may be as high as $80,000

source: British Columbia 1981.

after project completion. Yearly maintenance costs included right-of-way and inchannel maintenance, and gravel removal on Somenos Creek (British Columbia 1981). Maintenance costs are illustrated in table 2. To calculate maintenance costs, the net present value of costs were calculated using 7, 10, 12, and 15% discount rates. These net present values were then increased by 20%, since the engineer stated that the estimated maintenance costs did not include such factors as trucking of supplies and contingency fees.

Provision of a statutory right-of-way for maintenance as well as a restrictive covenant as part of the fisheries mitigation plan cost $27,000 in legal fees. It is not known if this amount included payments to farmers for the removal of their land from productivity, but it is assumed that such payments were not included. Fencing of the fisheries leave strip for the entire length of both creeks, an estimated total cost of $124,000, was not included since the fencing was not constructed, although it may occur
Table 2

Estimated Stream of maintenance costs at varying discount rates

<table>
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<tr>
<th>year</th>
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<td>3 606</td>
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</tr>
<tr>
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<td>11 425</td>
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<td>29 300</td>
<td>5 399</td>
<td>2 704</td>
<td>1 724</td>
<td>890</td>
</tr>
</tbody>
</table>

| total (20% increase) | 118 856 | 89 154 | 75 074 | 59 660 |

source: British Columbia 1981.

at some point in the future. Only a small amount of fencing was placed on the Van Eeuwen property, and these costs were included in the project construction costs.
5.1.6 Project Benefits

There are a number of methods whereby agricultural land drainage benefits can be estimated. The first is to use a cartographical analysis of the benefitting lands, attempt to estimate the total land area that will be affected, and predict changing land use patterns on the newly drained land. This method is holistic in nature and addresses the question of total benefits rather than dealing with individual properties.

A second method to estimate benefits is through land resale value. In this study, this method could not be adopted because factors other than production appear to be more significant in land valuation, and data were impossible obtain.

A final method, used in this study, was to question each landowner individually. A questionnaire was devised by land drainage researchers in other areas (Brady 1982; Diebolt 1981). A similar questionnaire was administered to 22 landowners in the study area (appendix A). The major goal was to quantify increased productivity of existing croplands, potential land use changes as a result of the project, and any onfarm costs incurred by the landowner, including environmental costs, to realize the benefits made possible by the project. With this method, benefits to each landowner could be isolated and their distribution examined.

To calculate project benefits, estimates of the affected land area were tabulated by property (table 3). Table 3 includes three land base estimates: the first is the engineer's original calculation, the second is the author's estimate based on landowner interviews, and the third is the same land base minus the land area required for the fisheries leave strip and statutory right-of-way necessary for inchannel maintenance. Although this area appears insignificant, it is important to note, since the total potential productivity of the area will decrease by about 8% as a result of this change.

The next step in benefit calculations is to obtain price and quantity estimates of agricultural produce grown in the valley now and under the proposed land use changes, as well as land clearing and maintenance costs, including fertilizers and labor. These values were obtained from the consultants' cost-benefit analysis, supplemented by verification with recent MAF information. These values are shown in table 4. No analysis was
Table 3

Benefitting Area by Property (acres)

<table>
<thead>
<tr>
<th>landowner</th>
<th>1981 estimate</th>
<th>1984 estimate</th>
<th>final estimate (including removals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastula</td>
<td>60</td>
<td>60</td>
<td>57</td>
</tr>
<tr>
<td>Robison</td>
<td>13</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Bishop</td>
<td>07</td>
<td>07</td>
<td>07</td>
</tr>
<tr>
<td>Vink</td>
<td>10</td>
<td>18</td>
<td>17</td>
</tr>
<tr>
<td>Young</td>
<td>21</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>Kloosterman</td>
<td>30</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>Doty</td>
<td>14</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>James</td>
<td>16</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Krysler</td>
<td>49</td>
<td>49</td>
<td>47</td>
</tr>
<tr>
<td>Hayes</td>
<td>56</td>
<td>56</td>
<td>54</td>
</tr>
<tr>
<td>Comer</td>
<td>14</td>
<td>06</td>
<td>06</td>
</tr>
<tr>
<td>Woodward</td>
<td>16</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Paddle</td>
<td>39</td>
<td>39</td>
<td>35</td>
</tr>
<tr>
<td>Bradshaw</td>
<td>68</td>
<td>68</td>
<td>63</td>
</tr>
<tr>
<td>Doman</td>
<td>69</td>
<td>69</td>
<td>63</td>
</tr>
<tr>
<td>Van Eeuwan</td>
<td>03</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>Ingham</td>
<td>03</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>Lipp</td>
<td>08</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>King</td>
<td>07</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>MNC</td>
<td>20</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>Miller and Horne</td>
<td>01</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>McDowell &amp; Whittaker</td>
<td>17</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td><strong>total benefitting acreage</strong></td>
<td><strong>562</strong></td>
<td><strong>488</strong></td>
<td><strong>457</strong></td>
</tr>
<tr>
<td><strong>estimated reduction from 1981</strong></td>
<td><strong>-13.2%</strong></td>
<td><strong>-18.7%</strong></td>
<td></td>
</tr>
</tbody>
</table>

Sources: 1 WCT feasibility study  
2 Vander Sluys, this study

undertaken to determine what effect different agricultural produce prices would have on the results; it was assumed that the real price of agricultural goods would remain relatively constant over time. The market effect of having an increased supply of certain agricultural produce was not considered because most land use change in the basin would
only increase potato production. The island potato market is price inelastic, especially since other areas of the island, particularly the Saanich Peninsula, are losing potato acreage (British Columbia 1981).

In attempting to quantify project benefits to each farmer, it was important to isolate how much of the land productivity was due to the project as opposed to normal farm production. To accomplish this, flood loss estimates for each farmer since 1978 were made. These estimates were relatively realistic since flooding has increased steadily over this period, and most flood losses could be attributed to the fact that there had been no channel maintenance on Richards or Somenos Creeks in the past few years; many farmers claimed that it was not worth their while to farm badly-drained land. On properties where the affected land base had not been used at all, benefits were estimated to be the total increased productivity as a result of drainage improvements. Assumptions made are outlined in appendix B.

A major problem in calculating land drainage benefits is the difficulty of forecasting land use changes. In many instances, land use changes occur after a significant delay, and there tends to be slow incremental land use intensification. Most land drainage cost–benefit analyses assume that land use changes will occur immediately, thus increasing the net present benefit value and rendering projects more economically desirable. To overcome this problem, this study examines three different land use scenarios. The first, the highest possible benefit scenario, assumes that all land use changes will occur within five years of project completion, and that most farmers will invest in tile drainage to further enhance potential benefits. This scenario is similar to the one adopted by the project economic consultant in the initial cost–benefit. It also assumes that most farmers will take advantage of the project to increase their land productivity. The second, the optimistic scenario, assumes there will no substantial onfarm investment. It is based on the assumption that most farmers will enhance drainage benefits by transferring to the ideal land use within at least ten years, with no tile drainage. The final scenario, the most probable, assumes that only a few farmers (36%; n=22) will take advantage of the project while the others will continue to use the land in the existing fashion. The set of assumptions associated with this scenario are those which, in the author’s opinion, reflect what is most likely to occur in the Richards
## Table 4

**Onfarm Production Costs and Produce Prices ($)**

<table>
<thead>
<tr>
<th>Hay/hay pasture</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>clearing and breaking costs:</td>
<td>$592/acre</td>
</tr>
<tr>
<td>hay establishment/harvest costs:</td>
<td>$424/acre</td>
</tr>
<tr>
<td>annual maintenance/harvest costs:</td>
<td>$429/acre</td>
</tr>
<tr>
<td>price of poor hay:</td>
<td>$80/ton</td>
</tr>
<tr>
<td>price of cereal hay:</td>
<td>$100/ton</td>
</tr>
<tr>
<td>price of good hay:</td>
<td>$120/ton</td>
</tr>
<tr>
<td>expected yields:</td>
<td></td>
</tr>
<tr>
<td>old stands:</td>
<td>3 tons/acre</td>
</tr>
<tr>
<td>first year:</td>
<td>3 tons/acre</td>
</tr>
<tr>
<td>second year:</td>
<td>5 tons/acre</td>
</tr>
<tr>
<td>life of stand:</td>
<td>7 tons/acre</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetables</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>initial production/harvest costs:</td>
<td>$793/acre</td>
</tr>
<tr>
<td>price of potatoes:</td>
<td>$254/ton</td>
</tr>
<tr>
<td>expected yields:</td>
<td></td>
</tr>
<tr>
<td>first ten years:</td>
<td>15 tons/acre</td>
</tr>
<tr>
<td>after ten years:</td>
<td>17 tons/acre</td>
</tr>
<tr>
<td>with fertilizer:</td>
<td>28 tons/acre</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blueberries</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>establishment:</td>
<td>$1500/acre</td>
</tr>
<tr>
<td>annual maintenance:</td>
<td>$300/acre</td>
</tr>
<tr>
<td>harvesting:</td>
<td>0.20/lb</td>
</tr>
<tr>
<td>price of blueberries:</td>
<td>1.00/lb</td>
</tr>
<tr>
<td>expected yields:</td>
<td></td>
</tr>
<tr>
<td>first crop</td>
<td>4000 lbs/acre</td>
</tr>
<tr>
<td>second crop:</td>
<td>8000 lbs/acre</td>
</tr>
<tr>
<td>third crop:</td>
<td>12000 lbs/acre</td>
</tr>
<tr>
<td>subsequent crops:</td>
<td>12000 lbs/acre</td>
</tr>
</tbody>
</table>

source: British Columbia 1981.
Creek–Somenos Creek drainage basin, as it is based on interview results with landowners. Project benefits and costs and final cost–benefit ratios are shown in table 5.

5.1.7 Results and Discussion

The highest cost–benefit ratio (7.53) is found under the highest possible scenario at a discount rate of 7% (table 5). This ratio varies under the different scenarios, ranging from the maximum mentioned above to a low of 1.62 under the most probable scenario at a discount rate of 15%. These values are at least three times lower than those obtained in the 1982 study. However, the results suggest that from a cost–benefit perspective, the Richards Creek–Somenos Creek Drainage Improvement Plan is justified. Although the cost–benefit ratio is positive, there are a number of assumptions inherent in its calculation, particularly relating to land use. As indicated in chapter two, maximum drainage benefits are a function of a number of factors. The willingness of the landowners to transfer to more capital-intensive crops and make other important land use changes and investments, such as installation of tile drainage, is important. In this study, 87% (19; n=22) of the basin landowners did not have any intention of transferring to more lucrative crops. This is reflected in the 'most probable' scenario. and none made any land use change in the first year. Closely related to this is the availability of legislative and economic incentives, information accessibility, and education to encourage farmers to manage their land effectively. The initial land productivity, and the degree of postproject maintenance, are other important factors which will be examined below.

Legislative and economic incentives to ensure economic efficiency include incentives for land development and improvements such as subsidies, low interest loans to farmers to enable them to install tile drainage once a drainage project is completed, or to purchase equipment required to transfer to a more capital-intensive crop, and tax incentives. British Columbia has some legislative land development incentives. Under the Agricultural Land Development Program, a farmer may obtain up to $25,000 for land development. The lending rate is approximately half the current prime interest rate (Charles 1986). Sections 17 and 18 of the Taxation Act (British Columbia 1979f) provide some incentive to develop and use improved land as well. These sections state that improved areas not used for farming shall be taxed at 1%, while improved lands in use will
Table 5

Cost-Benefit Ratios

Benefits:

<table>
<thead>
<tr>
<th>discount rate</th>
<th>highest possible</th>
<th>optimistic</th>
<th>most probable</th>
</tr>
</thead>
<tbody>
<tr>
<td>.07</td>
<td>4 611 883</td>
<td>3 355 239</td>
<td>2 045 223</td>
</tr>
<tr>
<td>.10</td>
<td>3 236 481</td>
<td>2 277 202</td>
<td>1 451 793</td>
</tr>
<tr>
<td>.12</td>
<td>2 605 022</td>
<td>1 798 340</td>
<td>1 182 498</td>
</tr>
<tr>
<td>.15</td>
<td>1 929 739</td>
<td>1 320 396</td>
<td>897 570</td>
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</tbody>
</table>

Costs:

<table>
<thead>
<tr>
<th>discount rate</th>
<th>highest possible</th>
<th>optimistic</th>
<th>most probable</th>
</tr>
</thead>
<tbody>
<tr>
<td>.07</td>
<td>612 261</td>
<td>612 261</td>
<td>612 261</td>
</tr>
<tr>
<td>.10</td>
<td>582 559</td>
<td>582 559</td>
<td>582 559</td>
</tr>
<tr>
<td>.12</td>
<td>568 479</td>
<td>568 479</td>
<td>568 479</td>
</tr>
<tr>
<td>.15</td>
<td>553 065</td>
<td>553 065</td>
<td>553 065</td>
</tr>
</tbody>
</table>

Cost/Benefit Ratio

<table>
<thead>
<tr>
<th>discount rate</th>
<th>highest possible</th>
<th>optimistic</th>
<th>most probable</th>
</tr>
</thead>
<tbody>
<tr>
<td>.07</td>
<td>7.53</td>
<td>5.48</td>
<td>3.34</td>
</tr>
<tr>
<td>.10</td>
<td>5.56</td>
<td>3.91</td>
<td>2.49</td>
</tr>
<tr>
<td>.12</td>
<td>4.58</td>
<td>3.19</td>
<td>2.14</td>
</tr>
<tr>
<td>.15</td>
<td>3.49</td>
<td>2.39</td>
<td>1.62</td>
</tr>
</tbody>
</table>
be taxed at 0.5%. Therefore landowners who take advantage of improved land benefit by a 50% tax saving. Other incentives include the write-off of up to $5000 for farm purchases related to land improvement (British Columbia 1979d) The act states that:

... all improvements other than dwellings and fixtures, machinery, and similar things erected on farm land and used to operate the farm, up to and not exceeding $5000, shall be exempt from taxation.

Information accessibility concerning efficient and effective land management and maintenance programs to ensure that project benefits continue to accrue beyond the first year or two are also important. This includes making landowners aware of actions they should undertake to maximize benefits, or informing them about incentives available to develop their land. MAF has a number of small publications relating to farm management and ministry programs which are available at district offices. When questioned regarding such information, not a single study-area farmer interviewed was aware of any action he could undertake to increase potential benefits.

The degree of tile drainage installed prior to project completion is perhaps the most significant factor in project economic success. Only 8% (1; n=13) of the farmers demonstrated any interest in tile drainage when asked about it, while the other 92% (12; n=13) were either uninterested or considered tiles to be too expensive. No one had any tile drains in place at the time of the project construction, and 71% (9; n=13) were completely unaware of tile drainage benefits.

Effective maintenance programs are also important in ensuring that benefits accrue as anticipated. Maintenance in British Columbia is the sole responsibility of the municipality or district undertaking the project. As such, the only assurance that necessary work will be done is the integrity of the responsible organization. Whether this is sufficient is dependent on the degree of commitment of the municipality and landowners to ensure that the work is kept up. In the case study, a detailed maintenance plan was prepared. An interview with the municipal engineer (Berikoff 1986) indicates that funds were allocated to reclean Richards Creek according to the prepared maintenance schedule, and yearly maintenance of the right-of-way, inchannel maintenance, and gravel removal at the mouth of Somenos Creek had been undertaken. Conversely, maintenance plans by individuals were almost nonexistent. Only 31% (4;
n=13) had undertaken any maintenance since the project completion, and this was restricted to cleaning existing side ditches to improve their effectiveness. Thus, while construction of the drains is subsidized, maintenance is not, and there are no measures available to ensure compliance to agreed-upon maintenance plans.

5.1.8 Summary

The WCT study had a number of problems. These included overly optimistic benefit calculations, and a questionable study methodology. This study indicates that three years following project construction, it is economically justified if all costs are considered. There are, however, a number of factors which should be taken into account in any drainage evaluation. These have a strong influence on cost–benefit outcomes since they affect the benefits significantly.

5.2 Administrative and Legislative Simplicity

Legal and institutional arrangements should be a means whereby a government can implement its policy effectively. When conflicting policies result in a variety of goals for a specific area, the institutional arrangements and legislation should enable various agencies to resolve their differences effectively.

A brief introduction to the complex legislation and institutional bodies dealing with land drainage in British Columbia was presented in chapter 3. There are at least three important acts dealing directly with drainage, as well as other legislation which affects drainage indirectly. Legislation varies depending on whether a project is initiated through a petition, undertaken on an individual property, or located in a municipality or a district. For any drainage project, a water license is required. The requirements and conditions to obtain this license are somewhat nebulous and depend on the demands established by various agencies dealing with land and water resources in the area. These problems are discussed at length in following sections, but it should be noted that obtaining permission to undertake a drainage scheme is a long and arduous process. All landowners interviewed indicate that the permit system was far too complex and made it very difficult to accomplish anything. Appeals procedures are outlined in at least three acts,
depending on who is appealing and the basis for appeal. Indeed, individual landowners have a great deal of difficulty in understanding the complexities of the land drainage legal system.

Although laws, licensing, and appeals are lengthy and complex, channelling of concerned parties to appropriate information sources can be effective in avoiding delays. The farmland drainage procedures outlined in a MAF leaflet, 'Farmland Drainage', does this effectively. This information leaflet summarizes the relevant legislation and briefly outlines its requirements as well as providing contacts within concerned government agencies. Interview results with landowners suggest that the role of MAF in channelling and dealing with drainage requests is effective. Landowners (53.8%; n=13) who had had experience in dealing with administrative and legal problems concerning land drainage felt that MAF was easy to deal with and quite responsive, since they were primarily concerned with "getting the project done."

The multiplicity of administrative agencies responsible for drainage results in some problems such as a lack of coordination among drainage agencies. Since there is no agency responsible for comprehensive drainage planning, an integrated, holistic view of land drainage and associated problems is lacking. Landowners (83.6%; n=22) also indicated that fisheries agencies made unreasonable demands on them and failed to adequately consider their views.

5.2.1 Summary

British Columbia land drainage legislation is confusing. Licensing and approval procedures are lengthy and complex. However, if concerned parties are directed to appropriate agencies effectively, the procedure is simplified somewhat.

Varying mandates of the four agencies responsible for provincial drainage planning and decision-making, and the lack of one responsible agency, result in difficulties, particularly, the absence of coordinated drainage planning. Although the MOE planning framework described in chapter 3 appears to be an effective means of drainage planning in conjunction with its other watershed activities, detailed plans are not always completed. Unless an area is located in an environmentally sensitive or controversial
area, no detailed environmental planning is undertaken. Thus, land drainage and related conflicts will continue to be dealt with in an ad hoc manner through the referral process. As such, the present legislative and administrative structure is not adequate to successfully implement government drainage policy.

5.3 Project Effectiveness

The goal of this criterion is to determine whether or not the objectives of the project have been achieved. This includes an analysis at two levels: the project level and the policy level.

5.3.1 Project Objectives

The major project objective was to decrease flooding and enable farmers to access their land early enough each year to allow spring planting, thereby increasing productivity. ARDSA program objectives are (Canada 1977):

To increase the production capability of the under-developed land resource, within the framework of those primary products which show market and production potentials.

To evaluate the success of the project objectives, landowners were asked a series of questions. When requested to indicate project advantages, only 8% (1; n=13) said there had been none. Facilitation of cultivation by 54% (7; n=13) and earlier spring planting by 38% (5; n=13) were the most frequent responses. Potential crop increases (43.1%; n=13) and an increase in growing area (32.3%; n=13) were the next most common answers. Only 8% (1; n=13) indicated a reduction in the time and cost of working the land, suggesting that if the project succeeded as anticipated, the farm would require a greater investment in both time and money. Finally, only one landowner actually experienced an increase in productivity in the first year, and since this person had also increased fertilizer application it is difficult to determine the real cause of the increase. The other landowners (12.92%; n=13) did not notice much difference in production levels. On a more positive note, 54% (7; n=13) indicated that flooding was reduced significantly. Thus, although the first objective, that of reducing flooding, seems to have been successful, the success of the second, increased productivity, is doubtful. In 1984, 82% (18; n=22) of the basin residents were still not using the newly-drained land. Since this analysis was done
only one year after the project completion, it is important to remember that perhaps the project objectives will still be achieved in subsequent years. In order to determine this, landowners were questioned concerning their future land use plans. As indicated in section 5.17, few landowners (9.41%; n=22) had the intention of undertaking actions to enhance the potential success of the project.

An important factor affecting attainment of project objectives is the existence of barriers, either legislative, administrative, or physical, which impede project success. They also indicated that gravel removal at the mouth of Somenos Creek was poorly done. Lack of coordination with other regional activities was cited as a barrier in the case study. Of particular concern was the isolation of the Richards Creek–Somenos Creek Drainage Improvement Plan from other plans in the area, specifically, plans for the Cowichan River. Residents felt that the plans for the Cowichan would have a significant impact in their basin and on project benefits, and that this was not adequately addressed in the project. Other correspondence and minutes sustain this supposition (Johanson and Tutty 1982; Blanchet 1982). This point was also brought up by DFO. They stated that if the Cowichan is aggrading at a rate of 0.15 ft per year, the proposed Somenos Lake water level improvements of 5 in would be eliminated in three years unless dredging occurred. The project consultants indicated that they had considered this in their initial feasibility study and that improved acreage was calculated on the assumption that no dredging would take place on the Cowichan. Thus, if dredging does occur, benefitting area will be higher than initially predicted.

5.3.2 Policy Objectives

On a broader scale, the success or failure of the project reflects, to a certain extent, the success or failure of the ARDSA program to fulfill government policy objectives. The drainage committee responsible for final decisions concerning drainage funding has indicated that approval depends largely on whether plans meet the stated objectives of the overall drainage program. As stated in the subsidiary agreement (Canada 1977):

... a region which exhibits a low level of farm income is subject to policy measures which attempt to improve the standard of living in the region as a whole.

A related policy objective states that:
Canada and the province have agreed on a new development opportunity that includes selected agricultural and rural development programs required to increase the economic potential of rural regions in British Columbia.

Chapter 2 also outlined some of the more theoretical policy goals underlying rural water projects subsidies. Thus, to evaluate the success of the project in terms of the overriding policy, one must examine a number of objectives. These include: whether regional income was increased, whether there was an equitable distribution of that income among landowners, and, whether the overall regional economic potential was increased. The first, that of increasing the income in the region as a whole, has been successful, if one considers the cost-benefit analysis results. Total benefits exceeded total costs, and those benefits will, theoretically, result in increased farm income. However, at the time this analysis was completed, 70% (9; n=13) of the farmers had not experienced any change in income, and did not anticipate any. Thirty percent (4; n=13) indicated that although they had not yet experienced any increase in their standard of living, they did expect one over the next few years. But the next question, that of benefit distribution, deserves careful scrutiny. This study reveals that the project benefit distribution is highly concentrated. The percentage of project benefits going to each landowner under the three scenarios is shown in table 6. Under the most probable scenario, 92% of the benefits accrue to five properties. Of these five, one is owned and three are rented by the same man. Thus, 92% of project benefits accrue to 23% of landowners, with 83% going to one person. Although benefits are slightly more evenly distributed under the other two scenarios, a large proportion still accrue to only a few landowners. Comparison of the percentage of total benefits to each property versus the actual benefitting land owned by each landowner (table 7) indicates little correlation between the two. Questionnaire results show that 47% (6; n=13) of the landowners believed that they benefitted from the project, 23% (3; n=13) did not think they benefitted at all, and 31% (4; n=13) did not know and indicated that they were relatively indifferent since they were not paying for the project. The study suggests a situation of highly diffused costs and concentrated benefits, indicating that the policy goal of income redistribution may be more effectively achieved through other means, such as a user-pay system where benefitting properties provide at least part of the cost of drainage.
Table 6

Distribution of project benefits among landowners

<table>
<thead>
<tr>
<th>landowner</th>
<th>benefits</th>
<th>%</th>
<th>benefits</th>
<th>%</th>
<th>benefits</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastula</td>
<td>1 029 626</td>
<td>31.81</td>
<td>961 250</td>
<td>42.21</td>
<td>961 250</td>
<td>59.28</td>
</tr>
<tr>
<td>Bishop</td>
<td>135 997</td>
<td>4.20</td>
<td>99 493</td>
<td>4.37</td>
<td>80 266</td>
<td>4.95</td>
</tr>
<tr>
<td>Doty</td>
<td>251 972</td>
<td>7.79</td>
<td>184 773</td>
<td>8.11</td>
<td>149 521</td>
<td>9.22</td>
</tr>
<tr>
<td>Kloosterman</td>
<td>208 483</td>
<td>6.44</td>
<td>155 584</td>
<td>6.83</td>
<td>155 584</td>
<td>9.60</td>
</tr>
<tr>
<td>Kloosterman</td>
<td>174 139</td>
<td>5.38</td>
<td>105 453</td>
<td>4.63</td>
<td>31 075</td>
<td>1.92</td>
</tr>
<tr>
<td>Robison</td>
<td>134 568</td>
<td>4.16</td>
<td>84 362</td>
<td>3.70</td>
<td>24 860</td>
<td>1.53</td>
</tr>
<tr>
<td>Vink</td>
<td>193 457</td>
<td>5.98</td>
<td>119 513</td>
<td>5.25</td>
<td>35 218</td>
<td>2.17</td>
</tr>
<tr>
<td>Young</td>
<td>264 549</td>
<td>8.17</td>
<td>140 604</td>
<td>6.17</td>
<td>41 434</td>
<td>2.56</td>
</tr>
<tr>
<td>James</td>
<td>297 931</td>
<td>10.28</td>
<td>230 473</td>
<td>10.12</td>
<td>142 174</td>
<td>8.77</td>
</tr>
<tr>
<td>Krysler</td>
<td>84 597</td>
<td>2.61</td>
<td>32 726</td>
<td>1.44</td>
<td>-27 846</td>
<td>0.00</td>
</tr>
<tr>
<td>Hayes</td>
<td>97 196</td>
<td>3.00</td>
<td>37 134</td>
<td>1.63</td>
<td>-33 313</td>
<td>0.00</td>
</tr>
<tr>
<td>Comer</td>
<td>10 800</td>
<td>0.33</td>
<td>4 126</td>
<td>0.18</td>
<td>-3 555</td>
<td>0.00</td>
</tr>
<tr>
<td>Woodward</td>
<td>28 799</td>
<td>0.89</td>
<td>11 003</td>
<td>0.48</td>
<td>-9 480</td>
<td>0.00</td>
</tr>
<tr>
<td>Paddle</td>
<td>62 998</td>
<td>1.95</td>
<td>24 609</td>
<td>1.08</td>
<td>-20 737</td>
<td>0.00</td>
</tr>
<tr>
<td>Bradshaw</td>
<td>113 395</td>
<td>3.50</td>
<td>43 323</td>
<td>1.90</td>
<td>-37 326</td>
<td>0.00</td>
</tr>
<tr>
<td>Doman</td>
<td>113 395</td>
<td>3.50</td>
<td>43 323</td>
<td>1.90</td>
<td>-37 326</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Rural development projects financed by the government should also satisfy other government program policy objectives in addition to fulfilling agricultural development goals. To evaluate the case study in this respect, the federal land use policy was examined. The goal of this policy is the "wise and sound management of the nation's land resources." Another part of this policy states that "for all significant land-related projects for which federal funds are provided, the Environmental Assessment and Review Process, or a provincial equivalent, should apply." Also, "the impact of policies and programs on watersheds, aquifers, recharge and storage areas, and other land critical to the quality and quantity of the nation's water supply will be considered, and that appropriate action will be taken to ensure their protection" (Canada 1985b). In relating the
Table 7

Percent of Benefits Accrued vs. Percent Benefitting Land

<table>
<thead>
<tr>
<th>landowner</th>
<th>highest possible</th>
<th>optimistic</th>
<th>most probable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastula</td>
<td>12.47</td>
<td>32</td>
<td>42</td>
</tr>
<tr>
<td>Bishop</td>
<td>1.53</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Doty</td>
<td>2.84</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Kloosterman</td>
<td>2.84</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Kloosterman</td>
<td>3.28</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Robison</td>
<td>2.63</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Vink</td>
<td>3.72</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Young</td>
<td>4.38</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>James</td>
<td>4.16</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Krysler</td>
<td>10.28</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Hayes</td>
<td>11.82</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Comer</td>
<td>1.31</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Woodward</td>
<td>3.50</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Paddle</td>
<td>7.66</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Bradshaw</td>
<td>13.79</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Doman</td>
<td>13.79</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>total</strong></td>
<td><strong>100.00</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

correlation coefficient: 0.2462, 0.2443, 0.1655

case study to this policy, two points can be noted. First, British Columbia does not have the equivalent of the Environmental Assessment and Review Process for land drainage projects. The provincial environmental impact assessment process, as outlined in the Environmental Management Act, considers impacts of energy projects under the Energy Project Review Process, and mines under the Mine Development Review Process. Other projects may come under scrutiny if they are located in an area under order-in-council requiring mandatory environmental impact assessment. Otherwise, impacts are evaluated through the referrals process. This informal project referral method within government ministries is not always adequate in ensuring that concerned agencies are consulted and
have sufficient lead time to provide input (Canada 1981). Secondly, there are no provisions in the provincial process for an assessment of cumulative impacts, which are important in land drainage where the cumulative loss of large wetland areas can have significant impacts on provincial 'storage and recharge' areas.

5.3.3 Summary

The Richards Creek–Somenos Creek Drainage Improvement Plan was successful in fulfilling project objectives because interview results indicate that productivity increased significantly in the first few years following project completion, and flooding was reduced.

The success of the project in implementing government policy, however, is doubtful. Although some landowners benefit from the project, most do not. Results indicate that 100% of project costs were paid for by the public purse, and 83% of benefits accrued to only one landowner. As a result, the project will most likely have little effect on the regional economy, other than increasing the income of a select few landowners. The project does not appear to satisfy federal land use policy goals.

5.4 Resolving Resource Conflict

This criterion evaluates the ability of the planning process to deal with resource conflict. As noted in chapter 2, resource conflict as a result of water management for agricultural purposes is quite common, especially where drainage projects threaten to affect other resource users significantly. Environmental impact assessment and management is an important aspect of resource conflict resolution. If environmental impacts are carefully considered and planned for, and if other land uses are adequately considered, resource conflict is minimized.

This criterion is divided into a number of sections. The first examines the environmental impacts of the project. Next, public involvement in land drainage is discussed. The extent to which alternate land uses in the area were considered is also addressed. Finally, the fisheries conflict is analysed.
5.4.1 Environmental Impacts of the Drainage Improvement Plan

It is difficult to evaluate the Richards Creek–Somenos Creek Drainage Improvement Plan environmental impacts in other than a very cursory sense, since no biophysical data were collected. There was no analysis of the cumulative drainage impacts or the effects of wetland loss on a provincial or even regional scale. To determine the major local environmental impacts of the project, farmers were interviewed. Fifty-four percent of respondents (7; n=13) indicated there had been duck and pheasant hunting in the area prior to project construction. Although it is difficult to determine the project impact on these species without reliable data, other studies suggest that draining wetlands can have a significantly negative effect on waterfowl habitat. The area around Somenos Lake harbors a significant waterfowl population. Most land in this area is administered by the Fish and Wildlife Branch. During the early project planning stages, Ducks Unlimited surveyed and designed dykes for approximately 65 acres to protect waterfowl habitat. These dykes were never completed. Somenos Lake is surrounded by a broad area of transitional wetland. An early report suggests that Somenos Lake and the surrounding wetlands form one of the most important freshwater waterfowl areas on the British Columbia coast, supporting thousands of ducks, geese, and swans. At least ten waterfowl species are known to nest in the area.

Another project impact has been the disappearance of beaver along the creeks. Beaver dams were destroyed prior to project construction to reduce flooding. Respondents also indicated that the dams aggravated the flooding problem significantly. One interviewee stated that downstream flooding had increased slightly as a result of the project. Landowners and engineer’s reports show that bank failure occurred during construction, resulting in increased sediment load and turbidity in the creek. Thus, although there were no major environmental impacts as a result of the project, available information suggests a number of small, localized impacts.

There were also a number of long-term, indirect project impacts that were not addressed in project planning. Somenos Lake is nearing a saturation point in terms of its ability to handle pollutants (Blanchet 1982b). Increased pollutants could result in serious eutrophication. The goal of land drainage is increased productivity and more intensive
agriculture, both of which are associated with an increased use of fertilizer, which could significantly enrich Somenos Lake. Another indirect impact is increased irrigation water demand due to increased agricultural activity. Since the Somenos system water is already completely allocated, some landowners expressed a concern that there would be an irrigation water shortage if more intensive water use is induced by the project.

5.4.2 Public Involvement in Land Drainage

Effective public consultation is essential where there is resource conflict. Most large-scale projects in British Columbia require some form of public input, although this requirement is often discretionary. Small-scale projects such as land drainage, on the other hand, where impacts are not perceived to be as drastic, are rarely subject to the careful public scrutiny accorded larger projects. This lack of public involvement can be attributed to two causes. The first is that those affected by the project are usually only residents in relatively small areas surrounding the proposed project. Secondly, small-scale projects do not attract media and environmental interest group attention unless major wetlands are involved. Thus, there is rarely a demand for public input into the decision-making process. This study indicates that there is no public involvement in land drainage apart from those directly affected by the project, and then only in relation to approvals and permits. Although the Cowichan Indian Band was present at some meetings, this was only because they were awarded the contract for gravel-clearing at the mouth of Somenos Creek. The decision as to who is affected and who is not affected by the project is made by the engineer in charge of the project. Therefore, anyone with an interest in the project who has not been identified as being an affected landowner is limited in terms of his or her input into the process. The only forum for unaffected public interest groups to participate is the public hearing procedure outlined in the Water Act. But since it is left to the comptroller's discretionary power to call a public hearing for any project which requires a water license, the only method whereby individuals or interested parties can appeal the comptroller's decision is under the Environmental Management Act. Again, appeals rights are restricted to those directly affected by projects: the Ministry of Lands, Parks and Housing (MLPH), and MAF. This situation limits the influence that outside interests can have on the process. Although in many instances, outside input is neither essential nor desired, there are cases where significant cumulative reduction in
wetland areas will attract public and media and outside interest group attention where public input can be useful from a broad social perspective. Current institutional arrangements in British Columbia discourage such public involvement.

5.4.3 The Fisheries Conflict

The following section analyses conflict resolution between land drainage and fisheries interests. Criteria to be used include: the clarity of objectives of the two fisheries departments, the understanding of the concept of mitigation by those involved, the basis for establishment of mitigative measures, fisheries department involvement in the planning process, mitigative measure implementation, and the availability of monitoring and maintenance programs to determine the effectiveness, and ensure the success, of mitigative measures.

5.4.4 Clarity of Fisheries Habitat Objectives

Opinions on the actual and potential fisheries capabilities of the Somenos system varied. Early reports (Blanchet 1982b) suggest that the Somenos system had minimal value as a salmonid stream and served only as a conduit to other more important streams. The same report also stated that the lower part of Richards Creek had little fisheries value. At the time of the project planning, DFO did not have specific habitat objectives in the study area. Reports and minutes of the project meetings indicate that federal fisheries had no idea of the importance of the area as a habitat or spawning ground, although it was known the the Somenos system supported stocks of chum and coho. There were insufficient data to make any predictions of the project impacts on the fishery resource, and this, combined with a lack of information on habitat importance, made it difficult for informed discussion to take place.

5.4.5 Mitigation Criteria

Mitigation plans for both fisheries and wildlife were prepared by the engineering firm responsible for project design. The fisheries plan included an economic fisheries resource evaluation and suggested a number of mitigative measures that should be incorporated into project design to minimize fisheries impacts. Economic resource
evaluations were based on escapement data and potential coho estimates, and suggested that the fisheries resource value was over $140,000 per annum. Suggested mitigative measures included a 7.5-m leave strip dedicated to natural habitat, a restrictive covenant to prevent clearing and cutting of trees and shrubs near the creeks, and pond and shade-raft developments along the creeks. The basis for suggested mitigative measures was an assumption, by the engineer, that increased stream temperatures would have a negative effect on fish survival. Thus, mitigative measures were designed to preserve shade and control stream temperatures. Settling ponds were suggested as a means of trapping excess sediment produced during construction.

5.4.6 Understanding the Mitigation Concept by those Involved

A clear understanding of the concept of mitigation by those involved in project planning is important if agreement is to be reached concerning effective mitigative measures. In the case study, there was strong disagreement among the agencies as to the role of mitigation. WCT and MAF both felt that DFO mitigative requirements amounted to enhancement rather than impact control. They stated that "both Federal and Provincial Fisheries have used their position of strength to enforce demands in excess of mitigation" (Metzger 1982b).

5.4.7 Fisheries Involvement in the Planning Process

DFO only becomes involved in project planning if its input is requested through the informal government referrals process. Ideally, if all potential problems are identified and discussed during early planning stages, conflict would be significantly reduced at later stages. The fisheries departments, although identified as key agencies, were not closely involved in planning during the first two years. The degree of input that the fisheries department had was restricted to commenting on, and approving, the proposed drainage works. Early input included recommendations by fisheries on preservation of overwintering habitats. Although the fisheries departments did not have a specific policy for the study area when the project was initiated, it was stated that project approval was "highly unlikely" (Blanchet 1982c). Initial fisheries representation at project meetings during the planning stage consisted only of the local fisheries officer (table 8). Subsequent attendance included regional and provincial representatives.
### Table 8

**Interest Group Attendance at the Richards Creek-Somenos Creek Drainage Improvement Plan Meetings**

<table>
<thead>
<tr>
<th>Date</th>
<th>MAF</th>
<th>ARDA</th>
<th>DNC</th>
<th>MOE</th>
<th>F&amp;W</th>
<th>DFO</th>
<th>WCT</th>
<th>CIB</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
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<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>04/02/81</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>11/05/81</td>
<td>2</td>
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<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>27/05/82</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
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<td>0</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>13/10/82</td>
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<td>0</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>30/11/82</td>
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<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>03/03/83</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>09/06/83</td>
<td>0</td>
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<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

1 Cowichan Indian Band

Involvement by middle and upper management staff from DFO only resulted when it became evident that the conflict would not be resolved at the field level. MAF staff had requested help from their minister in dealing with the fisheries problem, and their minister had responded that senior fisheries managers were better able to understand the sensitivity of these matters. The fisheries conflict was finally resolved when it was established that the critical fisheries habitat was on the Van Eeuwan property and could
be adequately protected.

Once mitigatory measures were agreed upon, they were easy to implement since they involved only minor construction on the Van Euwan property, in addition to the dedicated greenbelt and restrictive covenant. Monitoring to ensure compliance and effectiveness is an important aspect of mitigation which is frequently ignored. In the case study, the absence of initial population data made it difficult to evaluate mitigation success or failure with any degree of certainty. No monitoring plans were discussed.

5.4.8 Summary

Conflict resolution mechanisms did not function efficiently during the evaluation and approval of the Somenos–Richards Creeks drainage project. The planning and decision-making process did not adequately consider cumulative, long-term, and indirect environmental impacts.

Public involvement in drainage was minimal. Although this did not cause serious problems in the case study, it may become significant at some point in the future if a contentious issue arises with respect to other drains.

Analysis of the fisheries conflict points to a number of difficulties with present institutional arrangements. Lack of clear fish habitat objectives, insufficient information availability for informed discussion, lack of agreement on the concept of mitigation, vague criteria for the establishment of mitigative measures, and late fisheries agencies involvement in the planning process all led to significant delays in project approvals and the creation of a confrontational environment between fisheries and other planning agencies.
CHAPTER 6
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter summarizes the major conclusions of the study. Recommendations are made to increase the economic efficiency and equity, decision-making, and conflict resolution in land drainage in British Columbia.

6.1 Criterion 1: Project Economic Analysis

British Columbia land drainage economic feasibility studies are not required to incorporate some important factors essential to effective and efficient decision-making and resource allocation. These include direct and indirect environmental costs, and market and sensitivity analysis of certain variables. Benefit assumptions tend to be overly optimistic and they fail to reflect potential future conditions. Assumptions are not outlined explicitly and, as a result, replication of results is impossible.

Although the Agricultural and Rural Development Subsidiary Agreement outlines the requirements for the economic feasibility studies of proposals, criteria for acceptance or refusal of these are unclear. In the case study, project funding was provided despite the fact that the cost-benefit was severely criticized by an ARDSA committee and Agriculture Canada. Indeed, no effort was made to improve the analysis following the identification of deficiencies.

This independent study indicates that when factors missing in the original economic evaluation are incorporated, cost-benefit ratios are significantly lowered. The ratios varied from 1.62 to 7.53, depending on assumptions made. The most likely scenario, at a discount rate of 10%, a realistic estimate of the present real cost of capital over time, had a cost-benefit ratio of 2.49. The results also show that the more rapidly the transition to revenue-maximizing land use, the greater the potential project benefits. If agricultural land is devoted to low value uses and land use intensification is low, the potential benefits will be low. Where initial productivity is low and the land requires substantial investment by individual landowners before maximum benefits can accrue, benefits will be even lower.
Certain factors affecting the outcome of cost-benefit analyses have been identified. These include local incentive for development, legislative and economic incentives, installation of tile drainage, and degree of postproject maintenance. Local propensity by farmers to manage their land effectively is low, and only 5 or 6 basin residents were full-time farmers. The remaining were either retired or had other jobs. This has a significant effect on the initiative to develop land, and should be addressed in project economic analyses and government funding approval. Legislative and economic incentives to encourage farmers to develop their land appear to be adequate, although 85% (6; n=8) landowners indicated that they were unaware of their existence. The interest and knowledge of the study area landowners concerning tile drainage benefits is also low. Maintenance programs, although present, are administered by the municipality or individual landowners. Follow-up provisions are lacking to ensure that maintenance is carried out and that anticipated benefits are experienced.

6.2 Criterion 2: Administrative and Legislative Simplicity

The present land drainage legislative and administrative structure has some drawbacks in its ability to effectively implement government policy objectives. Legislation is complex, and due to the multiplicity of government agencies responsible for different aspects of drainage planning and decision-making, there is little opportunity for coordinated action. Under the present system, the major regulating body is the MOE Water Management Branch. As such, final project approval or rejection depends on the comptroller's decision. Considering the complexity of land drainage economic and environmental issues, this may be an ineffective method of determining whether or not a project should be permitted to proceed, with too much emphasis placed on a single agency. Approval processes are lengthy and may result in substantial agricultural productivity losses.
6.3 **Criterion 3: Project and Policy Effectiveness**

Interviews with landowners in 1984 indicated that the objective of decreased flooding was partially successful; seven landowners (37%; n=22) experienced a significant reduction in flooding after two years. However, productivity did not increase substantially following project completion. Ninety-one percent of respondents (20; n=22) did not experience increased production levels and 82% (18; n=22) of the farmers were not using the newly-drained land. Indeed, only 41% (9; n=22) of landowners intended to take advantage of the improved agricultural conditions sometime in the future. Three years following project completion, only one landowner had done so.

Policy objectives for the ARDSA program include increasing the standard of living in certain regions through economic development, and increasing the economic potential of rural regions. Implicit policy goals include income redistribution. This study suggests that overall project benefits exceed costs, achieving the goal of pareto-optimality or economic efficiency. Society has been made better off as a whole by the project and no one is worse off. However, to evaluate the real success of the subsidy of over $425 000, it is important to consider the number of people directly benefitting from the expenditure. This study points to an extremely high concentration of benefits. Under the most probable scenario, 92% of the benefits will accrue to only five properties. Of these five, one is owned and three are rented by the same person. In effect, one landowner captured 83% of project benefits. Interview results also indicate that two years after project completion, 9 landowners (70%; n=13) had not experienced any increase in income. Research also points to the fact that extensive land drainage subsidization and establishment of agriculture on wetlands may contradict other federal policies, particularly the federal land use policy. There is no provision for cumulative drainage impact assessment and no legislated impact assessment procedure for small-scale projects other than the provincial government referrals process. Drainage programs apparently proceed in relative isolation of other governmental policies.
6.4 **Criterion 4: Resolving Resource Conflict**

Although the environmental impacts appear to have been relatively small-scale and localized, lack of research and data at the time of project implementation make it difficult to discuss these impacts with any degree of accuracy. The only significant environmental concern was the potential detrimental effect on fish. Environmental impacts could have been more adequately dealt with in the case study. Potential cumulative impacts were totally disregarded. There was no attempt to evaluate impacts in a systematic fashion through pre- and postproject data collection, although there was adequate lead time available prior to project construction, had this been desired.

Because most land drainage projects are relatively small-scale, there is little demand for public involvement. In the case study, the only people to be consulted during project planning were the landowners. At present, it is not necessary to involve the public extensively in land drainage since most projects are local and small-scale. But public interest groups should be permitted to participate in the process. Under the present system, this is not possible.

At the time of project planning, DFO and the provincial fisheries ministry did not have specific habitat objectives in the study area, and had no idea of the importance of the creeks for either habitat or spawning grounds. There are insufficient data available to determine project impacts, making it difficult for informed discussion to take place. Fisheries mitigation plans concentrated on controlling stream temperatures and ensuring adequate shade. A major difficulty in resolving the fisheries conflict was the disagreement among the various agencies as to the role of mitigation. The consulting engineers and MAF officials felt that mitigative requirements identified by DFO amounted to enhancement rather than mitigation. It was felt that the federal and provincial fisheries agencies were attempting to enforce demands in excess of mitigation. Because active fisheries involvement did not occur until two years after project planning began, their input was limited to commenting on and approving proposals, relegating them to a reactionary rather than an anticipatory or strategic planning role.
6.5 Recommendations

This study suggests that a number of changes could be made to existing legislation and institutional arrangements to ensure that major land drainage issues are adequately addressed in the future. The following recommendations concentrate on incremental policy change, suggesting alterations to the existing legislative and institutional structure to improve the degree to which governmental goals and objectives are met. The crux of this alternative is that the policies do not change but the methods whereby these policies are implemented are altered so that there is a closer link between policy statements and actions undertaken. Under existing circumstances this is the most desirable alternative for a number of reasons. Successful implementation of policy change requires sufficient technical knowledge and a clear understanding of those groups who will be most affected by the change. This includes an understanding of how a decision will affect market conditions as well as an understanding of the costs and benefits and a strategy for compensating those who lose. In the land drainage example, funding policy has resulted in a situation of concentrated benefits and extremely diffused costs, and any proposed change to this system is not likely to be acceptable to the present beneficiaries. As well, there is little incentive for change since policy costs are diffused and not felt by any specific user group.

- Cost-benefit feasibility studies should incorporate all environmental costs associated with a proposed development. Indirect, long-term impacts, where impossible to quantify, should be identified and their significance established. This could be done through changes to the Municipal Act.
- An accepted cost-benefit analysis methodology should be adopted. This would ensure replicability of results as well as consistency in project to project evaluation. The methodology should be included in ARDSA and controlled by the ARDSA drainage committee.
- Funding criteria should be outlined to ensure that marginal projects are not approved. These could also be incorporated in ARDSA. Specific cost-benefit requirements should be identified that must be fulfilled before funding is approved.
- Benefit calculations should be based on realistic assumptions of long-term
intended land use changes by affected landowners. This could be accomplished through the use of a questionnaire similar to the one on which this study was based.

Most of the above changes could be incorporated into the subsidiary agreement section dealing with program implementation procedures. They would ensure that economic feasibility study requirements are more specific.

To ensure that project benefits accrue as anticipated:

- There should be ample encouragement for farmers to transfer from preproject to postproject land uses as quickly as possible. More effort is needed to inform farmers of the availability of various programs and incentives.

- Initial land productivity is important in evaluating possible benefits. This is a serious consideration and should be reflected in ARDSA funding policy. In the case study, productivity was so poor to begin with that the probability of increased productivity without substantial investment on the part of landowners was minimal. The ARDSA program should target those areas of the province where there is a high probability of project success, based on soil quality evaluated according to its present and future potential.

- Farmers should be informed as to effective land management techniques to decrease flooding or increase productivity by other than capital-intensive methods such as land drainage. Seymour (Blanchet 1982b) observed:
  
  Farmers often bring about their own flooding problems by overmanaging the land to the point of clearing all vegetation to the stream edge and thus allowing aggressive species like willow, alder, hardtack, and various sedges, rushes, and grasses to dominate stream margins and reduce the flooding capability of low gradient streams.

- Farmers should be encouraged to invest in tile drainage whenever feasible to ensure that the potential benefits associated with stream channelization are realized. Although the significance of tile drainage has not yet been established in British Columbia, other studies indicate that this is probably the single most important factor in determining project benefits (Topecon Group Ltd. 1971, 1). Thus, landowners should be made aware of the significance and potential benefits to be gained from tiling.
• Maintenance programs, now controlled by the municipality or district initiating
the project, should be required on a contractual basis to ensure that they are
undertaken. Regular monitoring is essential to ensure that maintenance is
carried out and that the project does not revert to preproject conditions. This
could also be done by the ARDSA committee, after minor legislative changes.

• Stream gravel removal operations and dredging should be governed in the
same manner as maintenance programs, particularly if they are essential to
realize anticipated project benefits.

Analysis of drainage benefit distributions, and factors affecting these distributions,
could be valuable in determining in what way policies should be altered to more
effectively achieve their objectives. Some methods to ensure that benefit distributions
are more equitable are summarized as follows:

• As the situation stands, a project could still be subsidized even if only one
landowner’s benefits exceed project cost. It is recommended that this be
altered so that a project proceeds only if it can be shown that the majority of
landowners will benefit.

• Landowners’ occupation and age profiles should be considered in project
approval. Information concerning such characteristics could be acquired in the
same questionnaire used to determine project benefits. If a significant
percentage of landowners are hobby farmers, or retired and no longer working
the land, the social desirability of drainage subsidies should be questioned.

• To ensure that projects do not conflict with other land use policies, cumulative
drainage impacts should be considered in project analysis. This might include
an analysis of how much each project contributes to total wetland loss in the
region and how much has previously been destroyed. Additional legislation
within the existing framework requiring the completion of environmental
impact assessments for small drainage projects is one way of dealing with
this question. Another method would be the development of class impact
assessments as was suggested in the Ontario case. The benefits of a class
environmental assessment procedure are numerous. Avoidance of a number
of small costly impact assessment reports is made possible. As well, this
proposal is more economically efficient than individual assessments in terms of time and financing.

- Establishment of quantitative data collection techniques to determine drainage impacts is essential if provisions are to be made for environmental impacts in planning. If this were done, guidelines could be established which describe actions to be taken during land drainage planning and construction to minimize impacts.

- Pooling of data on indirect, long-term impacts is needed to aid in decision-making.

- Fisheries agencies, both provincial and federal, should clarify their objectives with respect to habitat management. Priorization of habitat areas as to their importance would be valuable in reducing time spent negotiating with different resource agencies.

- Before any discussion of mitigation occurs, the involved agencies should identify what they perceive the role of mitigation to be and what they hope to accomplish in demanding certain measures.

- Mitigation criteria should be clarified.

- All affected agencies should be involved early in the planning process to facilitate conflict resolution.

- Informed discussion is often difficult when the referral process is used to identify resource values such as fish or wildlife habitat. By the time the other agencies are aware of a proposed project, it is often too late to adequately assess potential impacts on their area of interest. This was particularly true in the case of fisheries where there was little information on the project area prior to the proposal. If the agencies affected were involved at an earlier stage in the planning process, some conflicts may be easier to resolve.

6.6 Final Conclusion

As discussed earlier, incremental change appears to be the appropriate tool to deal with land drainage policy in British Columbia. The most feasible solutions center on legislative and institutional changes at the regional and provincial levels. Further
evaluation, particularly post-audit cost-benefit assessments of a number of completed drainage projects would aid in determining whether or not the highly concentrated benefits observed in the case study are characteristic of other drainage schemes in the province. Should this prove to be the case, a second policy alternative, that of abolishing federal-provincial subsidies and reinstating the user-pay system similar to that which existed under the Somenos Drainage Board, would be a more acceptable alternative to ensure equity.

6.7 Postscript

In order to test the predictions of the independent cost-benefit predictions in this study, updated productivity values were obtained from landowners in October 1986, two years after the initial estimates were made and three years after project completion. The results reemphasize the conclusions arrived at in the study. First, although the project was economically efficient, benefits tended to be extremely concentrated. Updated values indicate that one landowner controls close to 30% of the land in the valley. This is the only land on which agricultural use has intensified in the past three years. Although there have been no major investments on the land, reduction in flooding has increased the production of potatoes, the most significant crop in the valley, by 40%, to 12-14 tons annually. The potato farmer is the only landowner to have benefitted substantially from the project. This question of benefit distribution was not addressed in the project evaluation. All other landowners are either still not using the land or are no longer using it. Thus, 88% of the benefits still accrue to one person. Predictions of the overall project benefits dropped from $1,451,793 to $1,353,852 for a cost-benefit ratio of 2.32 at a discount rate of 10% as opposed to 2.49 in the initial prediction.
APPENDIX A

Questionnaire for residents in the Richards Creek/Somenos Creek Area

I am a student from Simon Fraser University. I am undertaking a study of the Richards Creek-Somenos Creek Drainage Improvement Plan, and I have would like to ask you a few questions.

Name of property owner
Lot and concession

1. How long have you lived here?

2. Do you own the farm?      rent the farm?      have another leasing arrangement?      other (specify)

3. What is the total acreage of your farm?

4. Is this your permanent residence?    
   yes     no
   If no, where is your permanent residence?

5. What is primarily produced on your land?

6. What were the main agricultural problems you faced prior to the construction of the project?    
   93% required drainage
   7% had no agricultural problems—were not affected

7. What have been the major advantages of the drainage improvement plan on your land?    
   8% none
   8% crop yield increase
   31% potential crop yield increase
   23% growing area increased
   8% reduced time and cost to work land
   38% earlier spring planting
   54% facilitation of cultivation

8. What have been the major disadvantages of the drainage improvement plan on your land?    
   75% none
   8% decreased water supply
   16% increased downstream flooding

9. Did you have tile drains on your property prior to the construction of the project?    
   100% no
10. Did they operate efficiently?  
   yes___ no___

11. Did the project improve the efficiency of your tile drains?  
   yes___ no___

12. Do you plan to install more tile drains on your property as a result of the project?  
   yes___ no___

13. If you didn't have any tile drainage on your property prior to the completion of the project, will you install some now? If so, why and if not, why not?  
   8% maybe 
   92% no, stating that tile drains were too expensive or not necessary

14. What will your investment be for this work?  
   ___________________________________________________________
   ___________________________________________________________

15. Will you, or did you get financial aid for this work?  
   8% no, the rest were unaware of possible funding 
   If yes, from whom and how much?  
   ___________________________________________________________

16. Were you advised of any action required by you as part of the project?  
   yes___ specify______________  
   no___

17. Have you performed any maintenance on your property adjacent to the creek since the project was completed?  
   31% yes, new bridges, dug out side ditches  
   69% no 
   If yes, what kind and how much did it cost?  
   ___________________________________________________________

18. Was any spoil deposited on your property?  
   yes___ no___

19. How do you determine whether the productivity of the land has improved?  
   ___________________________________________________________
   ___________________________________________________________

20. Indicate the approximate number of acres of improved agricultural land as a result of the project  
   acres poorly drained before project _______________________________________
   acres improved _________________________________________________________
   acres poorly drained after project completion ________________________________
   Could you point out the area affected on the map?
21. Do you think that you benefited from the drainage improvement plan?  
   47% yes  
   23% no  
   31% indifferent

22. Do you plan, or have you made, any alterations to your cropping pattern since the completion of the project?  
   13% yes  
   87% no

   If so, what kind of changes and how much did they cost?  
   ____________________________________________________  
   ____________________________________________________

23. Have you made any other land use changes?  
   100% no

   If so, what kind and how much did they cost?  
   ____________________________________________________  
   ____________________________________________________

24. Have these changes increased the benefits of the project?  
   yes____ no____

   Explain ____________________________________________
   ____________________________________________________

25. Did crop yields change as a result of the project?  
   8% yes  
   20% no  
   13% no longer farming  
   59% couldn’t tell

26. Indicate crops and yields prior to and following the project

<table>
<thead>
<tr>
<th>crop</th>
<th>acreage</th>
<th>yield</th>
<th>$ value/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>before project</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>following the project</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   If you have any other specific figures, please mention.
27. If you have experienced any crop yield changes, could this be attributable to factors other than the drainage project?

Of the 8% who believed in a real or potential crop increase, all felt that this was a direct result of the project although one landowner indicated that he had increased his use of fertilizer.

28. Have you altered the application of fertilizers or pesticides?

8% yes
92% no

29. Can you seed earlier in the spring now?

47% yes
53% no

30. Have you altered your crop rotation?

100% no

If yes, describe the change and why.

31. Do you have a well on your property?

yes____ no____

What is the depth of the well?

The average water level?

32. Did the water fall after the project?

yes____ How much?____

no____

33. If yes, will it cost you anything to improve water availability as a result of this change?

yes____ How much?____

no____

34. Does the creek dry up during the summer?

yes____ For how long?____

no____

Does it flood in the spring?

yes____ Where?____

no____

35. Did you have any swamp or marshland on your property that has disappeared as a result of the project?

33% yes

13% no

53% not sure (meaning they are not certain whether it is gone permanently
36. Are there any drained areas that you are not using?
   80% yes
   20% no

   If yes, why?

37. Did you lose acreage as a result of the project?
   73% yes
   27% no

   Explain

38. Were the reasons for losing the land justified?
   13% yes
   13% no
   74% unsure

   Explain

39. Do you feel that the loss was justified in view of the increased benefits of having well drained land?
   18% yes
   82% no/unsure/indifferent

40. Have there been any wildlife changes in the area since completion of the project?
   100% yes beavers have disappeared

41. Was there any hunting in the area before the project?
   54% yes
   29% no
   14% unsure

   Is there any hunting now?
   43% yes
   43% no
   14% unsure

42. Were there any fish in the creek before the project?
   72% yes
   14% no
   14% unsure

43. Are there any fish in the creek now?
   72% no
   14% no
   14% unsure
44. Did fishermen use the creek?  
   29% yes  
   71% no

45. Did any beaver live along the creek?  
   100% yes

If so, are they still there now?  
   100% no

46. Did they cause flooding problems?  
   100% yes

47. Are there any man-made barriers which adversely affect drainage or prevent you from draining your land?  
   100% yes
1) all felt that government approvals took too long
2) one said there was a lack of coordination among farmers, in that unless all agreed to dig deeper side ditches, the neglect of one or two could have a negative impact on the others
3) one felt that the engineering was not properly done and the stream silted up too quickly
4) drainage would never be successful until the Cowichan was dredged
5) two suggested that gravel clearing at the mouth of Somenos Creek had not been properly done

48. Will you have to buy or build any new equipment (buildings, pumps or fences, etc) as a result of the project?  

<table>
<thead>
<tr>
<th>item</th>
<th>cost</th>
<th>reasons for purchase</th>
</tr>
</thead>
</table>

49. Have you had or will you have any other expenses as a result of the project?  
   yes____ no____

If so, how much?  

50. Do you spend more or less time working on the farm as a result of the project?  
   more____
   no change____
   less____

51. Do you have an off-farm job?  
   19% yes
   81% no, but of these, only 38% were farming full time

52. How much do you feel that your farm income has changed as a result of the drainage project?  
   71% no change
   28% not yet, but potentially
53. Did you sign the approval forms for the project?
   100% yes

54. If you did support the project, would you have supported it if it had not been subsidized?
   55% yes
   9% no
   36% undecided

55. What benefits did you expect from the project?
   increased crop productivity and reduced flooding were the reasons cited by all landowners

56. Did all these benefits occur?
   37% yes, speaking only of the flooding

57. Do you think that all of the benefits will pay for the project?
   42% yes
   58% no

58. Do you think that your benefits will be equal to, or greater than, the value of what you are paying?
   19% greater than
   25% less than
   56% unsure/undecided

59. What is your share of the cost of the project?
   100% said that taxes was the only cost

60. At the time of the project approval were you
   32% supportive
   14% opposed
   14% indifferent

61. In retrospect, are you
   69% supportive
   12% opposed
   19% indifferent

62. A series of statements will be read. Indicate if you
   SA strongly agree
   A agree
   U undecided
   D disagree
   SD strongly disagree


a. The project was initiated because of local interest in ensuring adequate drainage for agriculture.
   14% strongly agree
   86% agree

b. The project was initiated because of the availability of public funding.
   29% strongly agree
   57% agree

c. The project will be beneficial to the community.
   43% strongly agree
   57% agree

d. The project should not have gone through.
   8% strongly agree
   8% agree
   46% undecided
   8% disagree
   30% strongly disagree

e. The project occurred only because a few of the basin residents considered it desirable.
   57% agree
   43% disagree

f. Unless tile drainage is installed, the area influenced by the project is restricted to acreage close to the new drains.
   29% agree
   71% undecided

g. The project will pay for itself in terms of increased agricultural productivity.
   14% agree
   43% undecided
   29% disagree

h. Acreage near the project should pay more of the cost of the project because of its favored position.
   43% agree
   57% undecided

i. The project would not have taken place if government funding had not been available.
   14% strongly agree
   57% agree
   29% undecided
j. The project had a negative environmental impact on the local area.
   29% agree
   71% undecided

k. Everyone would have been better off if the project had not gone through.
   29% undecided
   71% strongly disagree

l. The project will alleviate spring flooding.
   57% strongly agree
   43% agree

m. The project will increase downstream flooding problems.
   17% agree
   33% undecided
   17% disagree

63. Do you feel that there were any unnecessary delays, setbacks or other problems with the project?
   100% yes
   all landowners felt that the fisheries demands significantly delayed the project.

64. Do you feel that there is adequate technical and legal information or advice concerning farmland drainage or other construction assistance available to farmers?
   25% felt that there was but they were unsure as they had never required it, 75% did not know.

65. What do you think could be done to make it easier for farmers to deal with all levels of government?
   100% said that the permit system was complex and made it difficult to get things done
   75% felt that DFO made unreasonable demands
   12.5% mentioned the inefficiency in government and the fact that agencies could never agree on anything

66. Do you think that a guideline of steps to follow when undertaking drainage or construction on your property would be helpful in avoiding delays?
   one landowner said this was no really applicable in large drainage projects since construction is undertaken by outside agencies, not the landowners

67. Which government agency was easiest to deal with?
   all landowners felt that MAF was easiest to deal with
68. Which government agency was the most difficult to deal with?
    75% said fisheries was the most difficult to deal with because their
    demands were unreasonable

69. Additional comments or opinions would be appreciated.
    one landowner commented on the low productivity in the valley and
    the fact that the land requires lots of investment to increase crop
    quality in addition to drainage
### APPENDIX B

**ASSUMPTIONS FOR BENEFIT CALCULATIONS**

**HIGHEST POSSIBLE SCENARIO**

<table>
<thead>
<tr>
<th>Landowner</th>
<th>Year</th>
<th>On-farm costs and production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastula:</td>
<td>1-2</td>
<td>potatoes 15 tons/acre</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>30 acres tile drained</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>27 acres tile drained</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 acres produces 17 tons/acre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27 acres produces 15 tons/acre</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>57 acres produces 17 tons/acre for life of the project</td>
</tr>
<tr>
<td>Bishop:</td>
<td>1</td>
<td>land clearing</td>
</tr>
<tr>
<td></td>
<td>2-4</td>
<td>7 tons/acre potatoes produced</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>all acreage tile drained</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>production increases to 15 tons/acre</td>
</tr>
<tr>
<td></td>
<td>11-25</td>
<td>production increases to 17 tons/acre</td>
</tr>
<tr>
<td>Doty:</td>
<td></td>
<td>same as Bishop</td>
</tr>
<tr>
<td>Kloosterman:</td>
<td>13 acres in potatoes at 7 tons/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>identical to Bishop except no land clearing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on remaining acreage (15 acres)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>land clearing</td>
</tr>
<tr>
<td></td>
<td>2-4</td>
<td>poor hay, cereal hay, and good hay</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>acreage tile drained</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>acreage in potatoes, 7 tons/acre</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>production increases to 15 tons/acre</td>
</tr>
<tr>
<td></td>
<td>16-25</td>
<td>production increases to 17 tons/acre</td>
</tr>
<tr>
<td>Robison:</td>
<td></td>
<td>same as Kloosterman's 15 acres</td>
</tr>
<tr>
<td>Vink:</td>
<td></td>
<td>same as Kloosterman's 15 acres</td>
</tr>
<tr>
<td>Young:</td>
<td></td>
<td>same as Kloosterman's 15 acres</td>
</tr>
<tr>
<td>James:</td>
<td></td>
<td>4.5 acres in blueberries</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>4.5 acres produces 6000 lbs/acre</td>
</tr>
<tr>
<td></td>
<td>2-5</td>
<td>4.5 acres produces 8000 lbs/acre</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>5 acres tile drained</td>
</tr>
<tr>
<td></td>
<td>6-8</td>
<td>4.5 acres produces 12,000 lbs/acre</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>4.5 acres produces 12,000 lbs/acre</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>4.5 acres produces 12,000 lbs/acre</td>
</tr>
</tbody>
</table>
.5 acres produces 8,000 lbs/acre
11–25: 5 acres produces 12,000 lbs/acre

15 acres—same as Kloosterman’s 15 acres

Krysler:  
1: land clearing  
2: no change  
3: all acreage in poor hay  
4: all acreage in cereal hay  
5–25: all acreage in good hay

Hayes:  
same

Comer:  
same

Woodward:  
same

Paddle:  
same

Bradshaw  
same

Doman:  
same

**OPTIMISTIC SCENARIO**

Pastula:  
1–10: production of 15 tons/acre  
11–25: production of 17 tons/acre

Bishop:  
1: land clearing  
2–10: potatoes at 7 tons/acre  
11–15: production increases to 15 tons/acre  
16–25: production increases to 17 tons/acre

Doty:  
same as Bishop  
13 acres—similar to Pastula except that initial production is 7 tons/acre

Kloosterman:  
15 acres  
1: land clearing  
2,3,4: poor, cereal and good hay  
5–10: good hay  
11–15: transfer to potatoes at 7 tons/acre  
16–20: production increases to 15 tons/acre
21-25: production increases to 17 tons/acre

Robison: same as Kloosterman

Vink: same

Young: same

James: 4.5 acres blueberries
    1-5: production 6000 lbs/acre
    6-10: production 8000 lbs/acre
    11-25: production 12000 lbs/acre

Krysler: 15 acres—same as Kloosterman’s 15 acres
    1-2: nothing
    3: land clearing
    4-5: poor hay
    6-10: cereal hay
    10-25: good hay

Hayes: same

Comer: same

Woodward: same

Paddle: same

Bradshaw: same

Doman: same

MOST PROBABLE SCENARIO

Pastula: same as under optimistic scenario

Bishop: 1: land clearing
    2, 3, 4: poor, cereal, and good hay
    5: tile drainage installed
    6-10: transfer to potatoes
    7 tons/acre
    11-15: 15 tons/acre
    15-25: 17 tons/acre
Doty: same as Bishop

Kloosterman: 13 acres—same as under the optimistic scenario

15 acres
1: land clearing
2,3,4: poor, cereal, and good hay
5-25: good hay

Robison: same as Kloosterman's 15 acres

Vink: same

Young: same

James: 4.5 acres blueberries
1-5: production 6000 lbs/acre
6-25: production 8000 lbs/acre

15 acres—same as Kloosterman's 15 acres

Krysler: 1-4: nothing
5: landclearing
6-10: poor hay
11-25: cereal hay
### APPENDIX C

Landowners in the Richards Creek-Somenos Creek Drainage Basin

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bishop, David E.</td>
<td>329 Sabina Place, Victoria, B.C.</td>
</tr>
<tr>
<td>Bradshaw, C.E.</td>
<td>6803 Norcross Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Comer, J.</td>
<td>6992 Tom Windsor Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Doman Industries</td>
<td>2739 James, Duncan B.C.</td>
</tr>
<tr>
<td>Doty</td>
<td>Mays Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Hayes, Donald</td>
<td>7004 Mays Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Ingham, J.H.</td>
<td>7658 Richards Trail, Duncan, B.C.</td>
</tr>
<tr>
<td>James, E.</td>
<td>7087 Mays Road, Duncan, B.C.</td>
</tr>
<tr>
<td>King, V.</td>
<td>2035 Herd Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Kloosterman, S.</td>
<td>7071 Mays Road, Duncan B.C.</td>
</tr>
<tr>
<td>Krysler, S.</td>
<td>7156 Tom Windsor Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Lipp, H. and C.</td>
<td>P.O. Box 171, Victoria, B.C.</td>
</tr>
<tr>
<td>McDowell G.T. and Whittaker, J.R.</td>
<td>Box 1243, Squamish, B.C.</td>
</tr>
<tr>
<td>Miller and Horne</td>
<td>Norcross Road, Duncan, B.C.</td>
</tr>
<tr>
<td>MDC</td>
<td>7030 Trans-Canada Highway, Duncan, B.C.</td>
</tr>
<tr>
<td>Paddle, W.H.</td>
<td>Norcross Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Pastula, G.</td>
<td>7303 Richards Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Robison, J.</td>
<td>7619 Richards Trail, Duncan, B.C.</td>
</tr>
<tr>
<td>Van Eeuwan, H.W.</td>
<td>7219 Richards Trail, Duncan, B.C.</td>
</tr>
<tr>
<td>Vink, A.</td>
<td>7321 Mays Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Woodward, E.D.</td>
<td>2442 Herd Road, Duncan, B.C.</td>
</tr>
<tr>
<td>Young, E. A.</td>
<td>Mays Road, Duncan, B.C.</td>
</tr>
</tbody>
</table>
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