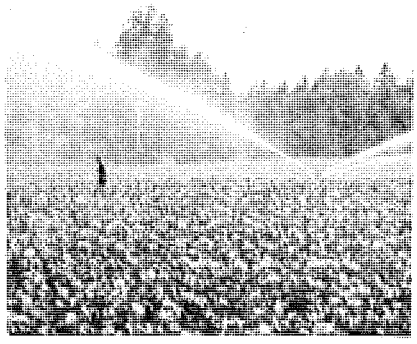
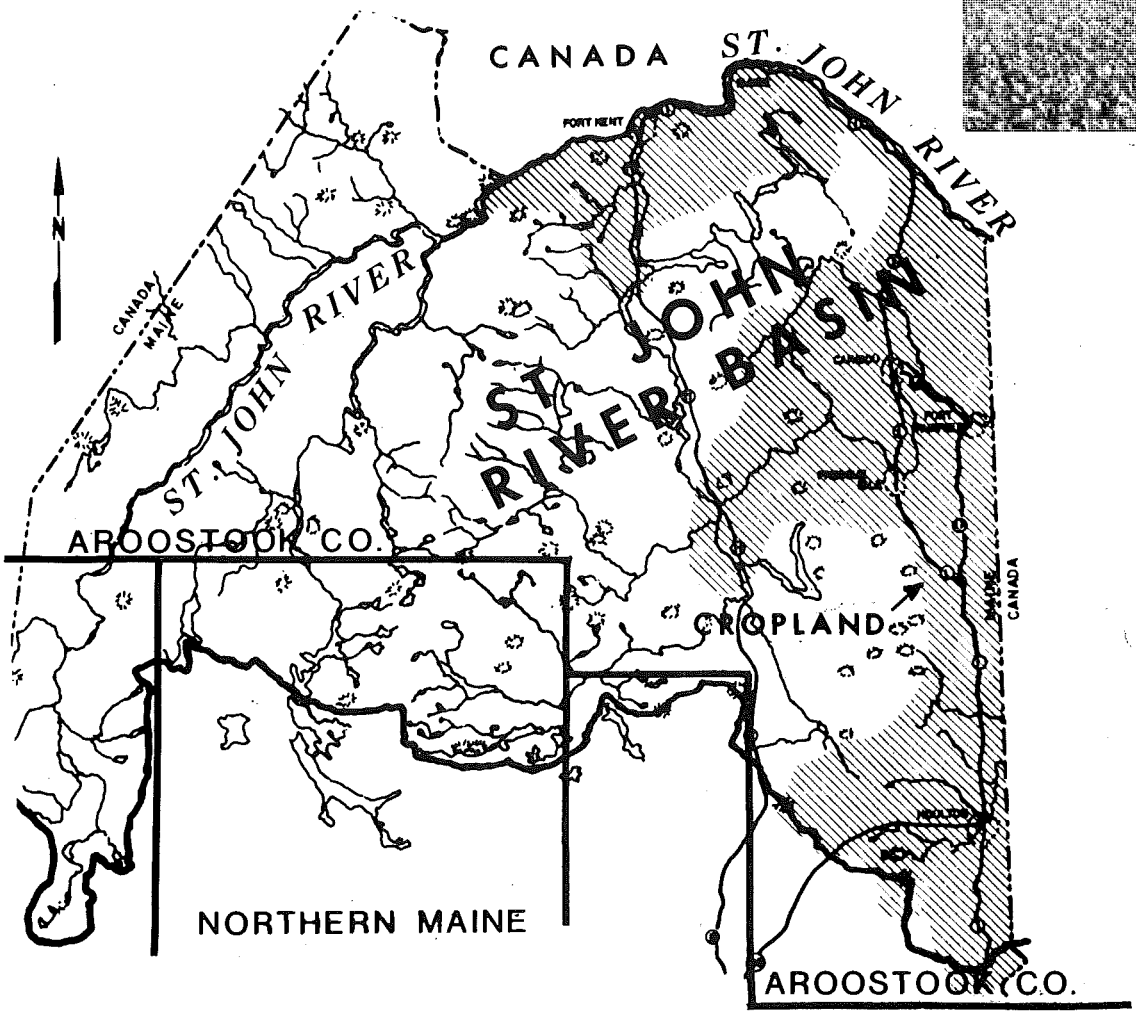
WATER RESOURCES
INVESTIGATION

ST. JOHN RIVER BASIN MAINE

INTERIM REPORT





FEASIBILITY REPORT FOR

CROPLAND IRRIGATION AND CONSERVATION: RESEARCH / DEMONSTRATION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS

MAY 1980

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WATER RESOURCES INVESTIGATION
ST. JOHN RIVER BASIN, MAINE
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MAIN REPORT

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MAIN REPORT

Overview

Introduction

The Saint John River Basin occupies the northern one-quarter of Maine and covers most of Aroostook County, a region producing 85 percent of New England's truck crops, principally potatoes. The severe lack of conservation practices on over 75 percent of the 180,000 acres of cropland in potato rotation has created an environment of pollution from the yearly one million tons of eroding topsoil, pesticides, insecticides and fertilizers. Even more important, declining crop production from deteriorating soils and fluctuating production from inadequate soil moisture and marketing conditions have created an unstable potato industry with the danger of a terminal agriculture. Of the total 246,000 acres of cropland in the region, land in potato rotation is the major source of agricultural pollution. This report concentrates on the needs and impacts of solutions to reduce pollution from land in potato rotation and on the feasibility of irrigating the major crop--potatoes. The potato industry is directly responsible for over one-third of the region's employment and sales, and further, it contributes the greatest impact on socio-economic conditions in the region than any other industry.

Authority

The Corps of Engineers was authorized by Congressional resolutions to investigate the power, flood control, irrigation, water quality, recreation and fish and wildlife needs of the St. John River Basin. The study, initially funded in 1974, has an estimated cost of $3.2 million. This interim report is in partial response to the resolutions and addresses only the feasibility of cropland irrigation and conservation practices and proposes potential solutions to encourage their adoption. Implementation of irrigation and conservation (I-C)

plans is not normally within Corps authority; therefore this study is limited to identifying the problems and alternative corrective measures, and in determining whether further investigation (for example, research and demonstration) is warranted.

Assessment of Land Management Measures

The three year investigation by the Corps and Soil Conservation Service has identified the potential economic feasibility and need for irrigation and conservation measures on cropland in potato rotation. A 46 member advisory committee of Federal, State and local agencies and 20 potato growers assisted with the evaluation of a dual irrigation-conservation approach, and of either approach alone, and then developed a research-demonstration program. Results of the investigation were:

Conservation practices showed significant environmental benefits, about a 62 percent reduction in erosion and sediment loadings in streams and a 65 percent reduction in biocide and nutrient loadings. Conservation would increase potato yields per acre about 15 percent after eight years, with a corresponding quality increase. These benefits are realized while lowering the average soil erosion rate from about 6.3 tons per acre per year to within the erosion goal of less than 3 tons. However, to achieve these environmental and yield improvements requires an improved crop rotation which reduces potato acreage an average 30 percent.

Most potato growers would experience long-term losses in net farm income with this reduction in acreage under the current cost-sharing structure. Existing cost sharing rates for conservation practices are inadequate to promote conservation measures alone, according to the Water Quality Management Plan for the region.

The lack of research and documentation of conservation benefits, and the lack of technical guidelines, restrain the certainty of achieving the economic benefits.

Irrigation without improved conservation measures was evaluated as supplementing the potato crop's normal 50 percent water deficiency with about 5.6 inches of water to produce an estimated 60 percent increase in yield and significant improvements in quality. The returns from one inch of water applied each year would pay for the average farm's annual irrigation costs. Extremely high benefits are obtained for each additional inch of water applied up to the needed amount. The potential benefit to national economic development is an estimated increase by 400 percent in the average annual value of output from goods and services, with a benefit-to-cost ratio of 4.3 to 1.0.

Irrigation measures alone, however, will adversely affect the environment by causing the following increases: about 10 percent in erosion and sediment loadings in streams; 10 percent in biocide loads; and 55 percent in nutrient loads. Irrigation pumps would increase farm energy requirements over 100 percent. The certainty of impacts occurring are limited by the lack of research and technical guidelines and by the actual irrigation data obtained from 11 Maine farms using marginal management practices. A high potential does exist, however, for improved regional development and social well-being over the next few decades from adopting irrigation.

Combined irrigation and conservation (I-C) practices are estimated to increase yields slightly higher than irrigation alone, approaching a 65 percent yield increase with only a 4.6 inch water application. Conservation structures and crop rotation would also reduce potato acreage about 30 percent--diminishing the 400 percent irrigation-only increase in farm output to a 200 percent increase. The benefit-to-cost ratio would then be 3.3 to 1.0.

Combined I-C measures would aid the environment by effecting the following reductions: 59 percent in erosion and sediment loadings in streams, 62 percent in biocide loadings; and 46 percent in nutrient loads. A 75 percent increase in energy would be required for irrigation pumps. The certainty of impacts occurring are limited as previously indicated; however, if adoption of I-C practices occurred at a rate of 5 percent annually in the basin, or 50 farms initially per year, the projected decline in potato production would be stabilized at about current levels.

Proposed Research/Demonstration Program

The potential of combined irrigation and conservation practices to improve the environment significantly, to improve national economic development through increased net farm income and to preserve the agricultural industry, warrants development of a plan to promote I-C adoption through basic research and farm demonstrations (applied research). The purpose of research is to validate crop response to combined irrigation and conservation practices, and prepare technical guidelines to optimize production for the large number of different management and physical conditions which exist on the regions 1,000 potato farms. Recommendations and concerns of the advisory committee have resulted in a tentative plan to be administered by the University of Maine's Agricultural Experiment Station (MAES). The USDA Soil Conservation Service would be actively involved in planning and administering the demonstration, including the monitoring of economic and enviromental impacts. The Cooperative Extension Service would be primarily responsible for the educational program.

The first phase of the plan would last about two years using presently known techniques and existing research facilities. It would consist of demonstrations on three farms to complement research on the preparation of preliminary guidelines and for best management practices, and plans for expanding the demonstration. A research farm would be acquired and set up during the initial phase. Available data from the region's 18 existing irrigating farms would also be acquired.

The second phase would initiate basic research on a research farm in the county. The demonstrations would be expanded to an estimated 20 farms to include significant characteristics of geographic locations, soil types, varieties and different uses of potatoes and various erosion conditions. The expansion would also make the program more meaningful and more visible to farming interests.

Funds estimated at $1.6 million would be needed to initiate the first two year phase. The promotion phase would last about ten years, for a total 12-year duration of research and demonstration at a total estimated cost of $10.1 million.

The Corps' authority for further work on this program terminates with this report. Consequently, Governor Joseph E. Brennan on 19 May 1980 assigned the leadership to the Maine Department of Agriculture under Commissioner Stewart Smith for agency coordination and for searching out implementation funds for an Irrigation and Conservation: Research and Demonstration Program. During the February through May 1980 public review of the draft report, support or/assistance to implement this program was offered by:

U.S. Department of Agriculture
U.S. Water and Power Resources Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Maine Department of Agriculture
Maine Agriculture Experiment Station
Maine State Planning Office
Maine Department of Inland Fisheries and Wildlife
Northern Maine Regional Planning Commission
Maine Potato Commission
Maine Potato Council and potato growers

The New England River Basins Commission placed a "highest priority" on the I-C program for Federal funding.

The plan's objectives are compatible with the water quality goals and recommendations of the United States - Canada International Joint Commission, and with the U.S. Environmental Protection Agency's approved 208 Water Quality Management Plan for the region.

Environmental Assessment

The attached environmental assessment has determined that the initial Phase I development of irrigation and conservation practices on three farms in the study area would not appear to incur significant impacts. Most impacts revealed are beneficial. A Finding of No Significant Impact can be considered to preclude the need for an Environmental Impact Statement at this time. If, however, Federal actions beyond this tentatively proposed research and demonstration program would increase I-C implementation on a larger, more significant scale during Phase II, the impacts, although presumably of still a net benefit, would likely require additional evaluation. An EIS and a Clean Water Act 404 Evaluation would be required if any large impoundments and/or regional irrigation systems are proposed.

Recommendations

The Division Engineer recommends no further action by the Corps of Engineers and that implementation of an Irrigation and Conservation: Research and Demonstration Program should appropriately be pursued by the State of Maine. The Army Corps of Engineers supports the program and offers its assistance through coordination, for the development and enhancement of the region's water resources.

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Introduction

The St. John River Basin is a vast area of forest and agricultural land. Social and economic conditions are largely dependent on agriculture, especially the success or failure of potatoes, the single major crop. Many problems plague the region and its potato industry. Among these are a mono-crop culture, the deterioration of cropland, soil moisture inadequate to produce a consistent high-yield of good quality potatoes, declining crops and yields per acre, a dwindling number of farms, rising production costs, fluctuating crop prices, over-diversified marketing conditions, and high and consistent unemployment.

Study Authority

The St. John River Basin Study was authorized by Congressional resolutions adopted in 1972 for investigating the power, flood control, irrigation, water quality, recreation, and fish and wildlife needs in the St. John River Basin. Following the desires of local interests, the former Representative of the Second Congressional District in Maine William D. Hathaway and Senator Edmund S. Muskie sponsored resolutions adopted by the Committees on Public Works of the United States House of Representatives and U.S. Senate.* The New England Division, Corps of Engineers, was given the responsibility to conduct the study with funds initially appropriated in 1974. The total Federal cost for the study is currently estimated at $3.2 million.

Scope of Study

The total St. John River Study is emphasizing the specific needs for power, flood control, irrigation and erosion pollution. This report is an interim report which addresses only the investigations on cropland irrigation and erosion pollution. Other items requested in the authorizing resolutions will be addressed in a separate report scheduled for completion by fiscal year 1986. The study area is shown on Plate 1.

* Resolutions are included in Appendix 1.

The St. John River Basin is located partly in the northern one-quarter of Maine and partly in the Canadian Provinces of New Brunswick and Quebec. About two-thirds of the basin is in Canada (14,000 square miles) and one-third (7,360 square miles) in Maine. From its headwaters in Maine at Little St. John Lake, the St. John River flows 415 miles to its outlet at Saint John, New Brunswick with about 100 miles forming the international boundary.

The Maine portion of the basin covers most of Aroostook County, known for the potatoes from its northern and eastern sections. The distance from the southern tip of the basin in the county seat of Houlton through the agricultural region to Madawaska at the northern tip is about 135 miles.

The study addressed the feasibility of improving the agricultural industry in the study area and improving the region's environmental quality through a combined program of cropland irrigation and erosion control through conservation. It examined problems contributing to the decline of the region's agricultural industry and deterioration of water quality such as:

- cropland soil erosion
- deterioration of soil due to poor conservation practices
- fluctuating potato prices and production
- inadequate soil moisture during the growing season

The study also analyzed the institutional arrangements needed to implement any program recommended as a result of the study to encourage potato growers to adopt the necessary irrigation and conservation practices.

Study Participants and Coordination

The New England Division, Corps of Engineers, had the principal responsibility for conducting and coordinating the study and plan formulation, consolidating information from studies by other agencies and for preparing this report. The study was coordinated with the State of Maine through the State Planning Office. Major contributors to the study and especially to developing the research and demonstration program are listed in Table 1. Approximately 80 people attended the initial public meeting held on 18 September 1974 at Presque Isle, Maine to exchange information concerning the study, water resources and related problems, and possible solutions. The April 1976 Plan of Survey, which established the procedure for investigating the water resource needs in the St. John River Basin, was reviewed in a meeting with the Corps of Engineers and twelve other Federal and State agencies. The Northern Maine Regional Planning Commission

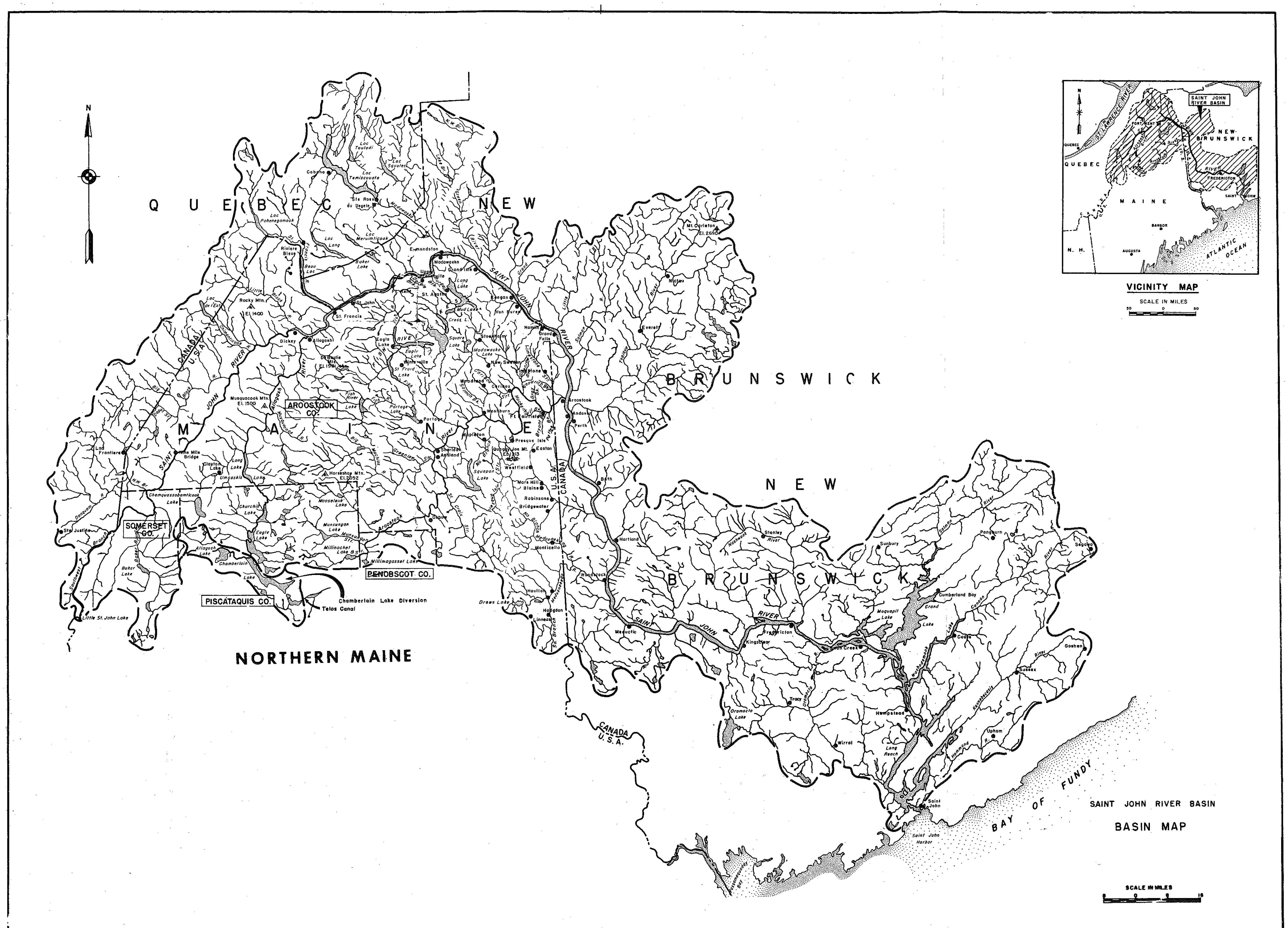

QUEBEC
NEW BRUNSWICK
MAINE
NEW BRUNSWICK
NORTHERN MAINE
SAINT JOHN RIVER BASIN
BASIN MAP
VICINITY MAP
SCALE IN MILES
SCALE IN MILES
AROOSTOOK CO.
SOMERSET CO.
PISCATAQUIS CO.
PENOBSCOT CO.
Chamberlain Lake Diversion
Telos Canal
SAINT JOHN RIVER
BAY OF FUNDY
CANADA
U.S.A.
ATLANTIC OCEAN

PLATE 1

TABLE 1

PARTICIPANTS WHO PROVIDED
MAJOR CONTRIBUTIONS
TOWARD A RECOMMENDED PLAN

Federal

USDA, Soil Conservation Service

State Conservationist
Ass't. State Conservationist
St. John - Aroostook Resource
Conservation and Development
Office
State Economist
State Soil Scientist
State Engineer
State Resource Conservationist
Engineering Technicians
Soil Scientists
District Conservationists:
St. John Valley
Central Aroostook
Southern Aroostook

USDA, Agricultural Research Service

Acting Location Leader
Soil Scientists

USDA, Agriculture Stabilization and Conservation Service

County Committee

USDA, Fish and Wildlife Service

Biologists

State

State Planning Office

Allan Pease, Director
Burt Anderson, Former Resource Planner

Dept. of Agriculture

Frank Ricker, S&W Cons. Comm., Director
Charles Boothby, Former S&W Con.Comm.,Dir.
Harold Anderson, Chmn, SWCD, Cent. Aroos.

University of Maine

Kenneth Wing, Dean, College of LS&Agriculture
Ed Piper, Asst. Dir., Agr.Ext. Station
Wallace Dunham, Prof., Agri.& Res. Economics
Ed F. Johnson, Agr. and Res. Economics
Hugh Murphy, Assoc. Prof. of Agronomy
Robert Rourke, Assoc. Soil Scientist
Roland Struchtemeyer, Prof. of Soils

Dept. of Environmental Protection

Fred LaVallee

Dept. of Inland Fisheries & Wildlife

Fred Hurley, Resource Planner

Cooperative Extension Service

Ed Bates, Director
Area Potato Specialists:
Dwight Stiles, St. John Valley
Jim Robinson, Central Aroostook
Ken Chapman, Southern Aroostook

Northern Maine Regional Planning Commission

James A. Barresi, Exec. Director
Lane Palmer, Planner

Potato Growers

Lewis E. Fenalson, Limestone
Laurence A. Park, Presque Isle
Allen B. Irving, Presque Isle
Maurice P. Callnan, Houlton
Lance Smith, Mars Hill
James F. Carter, Washburn
Ludger A. Pelletier, St. Francis
James Pelletier, Frenchville
Eldon Campbell Jr., Littleton
John Lagerstrom, Presque Isle
Quentin Warren, Easton
Sam Niblet, Easton
Terrance Gregg, Easton
Dan Turner, Easton
Leonard Dube, Soldier Pond
Camille Morneault, Masardis
Gary Bell, Mars Hill
Hershel A. Smith, Mars Hill
Hilston Killcollins, Mapleton
Philip Pelletier, Fort Kent Mills
Clifford Michaud and Tom LaChance, Quellette
Jim Daigle, Fort Kent
Glen Wathen, Fort Fairfield
Donald Chandler, Mapleton
Darrell Chandler, Mapleton
Winston Bagley, Mapleton
Zenon A. Daigle, Fort Kent
Peter B. Burbar, Littleton
Francis Fitzpatrick, Houlton
Sherwood Burton, Mars Hill

(NMRPC) conducted a phone and mail survey throughout the basin to further identify public concerns on water resource issues in the summer of 1975. The USDA Soil Conservation Service (SCS) provided the ground work to proceed with more detailed evaluations of cropland irrigation and conservation (I-C) measures in September 1975 after completing a reconnaissance scope contract with the Corps. The March 1976 Preliminary Report was reveiwed by Federal, State and local agencies who then requested further studies of irrigation and conservation needs. A series of meetings with the Corps and public workshops sponsored by SCS, NMRPC, the Cooperative Extension Service and the Resource Conservation and Development Office were held throughout Aroostook County from July through September 1976 to determined local support for I-C practices and interest for participating in detailed studies. SCS was contracted for interviewing eight irrigating growers, and nine nonirrigating growers including the design and evaluation of nine farm plans for I-C practices from September 1976 to June 1978. Six Advisory Meetings held from November 1977 to January 1978 involving 14 agencies and 46 participants, including 20 potato growers, reviewed the feasibility of I-C practices and provided recommendations and outlines for a research and demonstration program. All major activities and agencies involved in this study are cited in Appendix 1. Draft review comments are attached.

Studies of Others

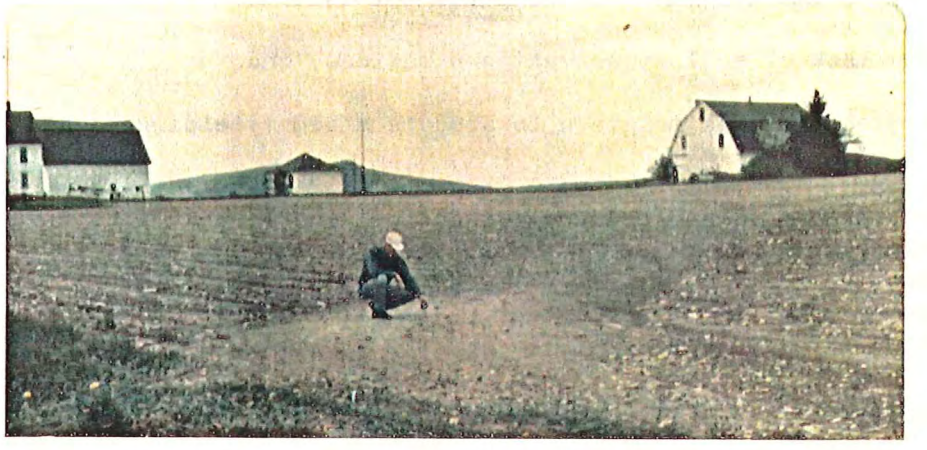
Several other basin studies were on-going during the course of the study. Among these studies were the development of water quality management plans for Aroostook County and the St. John River Basin, and environmental impacts on the Federally authorized Dickey-Lincoln School Lakes project for hydroelectric power and flood control development on the St. John River. The past and on-going studies used as information sources are described in Appendix 1.

Report and Study Process

This report is arranged into eight documents: a main text with an environmental assessment and seven technical appendices. This main report describes the pertinent resources and economy of the study area, identifies specific irrigation and conservation problems and evaluates the formulated solutions. It is intended to be understood by both the general and technical reader. Supplemental technical detail is contained in the appendices.

The report follows the study process of problem identification, formulation of alternatives, impact assessment, and evaluation of irrigation and conservation practices. It summarizes the alternatives considered to implement programs of research and demonstration, and then describes a tentatively recommended plan.

Problem Identification



Cropland erosion deteriorates the resource base--soil, and pollutes the region's waters with sediment, fertilizers and biocides, eventually rendering the land unproductive.

The following section defines the physical area and exact nature of the land management problems of the Aroostook County study area. Public concerns over related management issues were identified through a public involvement program. Planning objectives addressing those concerns and resource management problems are considered in light of the present conditions, and of future conditions if no Federal action is taken.

National Objectives

Corps projects or programs addressing specific needs or opportunities must provide positive contributions to either one or both of the national objectives of economic development or environmental quality. Two interrelated water resource agricultural problems surfaced in Aroostook County are:

- the lack of soil conservation practices, and
- inadequate soil moisture to produce a high yielding potato crop.

If corrected, significant contributions should result to the national economic objective by improving the economic stability and production of farm businesses, and to the environmental objective by reducing the pollution of rivers, streams and lakes from agricultural erosion.

Existing Conditions in Aroostook County

ENVIRONMENTAL SETTING

Basin

The St. John River Basin occupies the northernmost area of Maine and extends into the Provinces of New Brunswick and Quebec in Canada. The total drainage area of the entire basin is approximately 21,360 square miles, of which two-thirds (14,000 square miles) are in Canada, and one third (7,360 square miles) is in the United States.

The St. John River, the main river in the basin, rises in Little St. John Lake in the extreme southwestern corner of the basin on the international boundary between Quebec and Maine. The stream flows in a general northerly direction along the boundary for about 38 miles, then through Maine in a northeasterly direction for about 107 miles to the mouth of the St. Francis River, easterly along the international boundary for about 70 miles to Hamlin, Maine and then through New Brunswick to its mouth at the city of St. John on the Bay of Fundy. The river is not tidal in the United States. The principal tributaries of the St. John River in Maine, in downstream order are: the Allagash, Fish, Aroostook and Meduxnekeag Rivers.

Topography and General Geology

The St. John River Basin is a maturely eroded upland of moderate relief. The topography varies widely throughout the basin. Elevations vary from 200 to 500 feet in the lower part of the basin to 1,000 feet or more farther inland. Several peaks in

Maine and New Brunswick reach elevations of more than 2,000 feet. In areas of resistent rocks, the relief between river valley and peaks ranges up to 1,000 feet, while in other sections, which are underlain by weaker sedimentary rock, the relief varies between 300 and 500 feet. The major portion of the basin is densely forested. The headwater areas of the St. John River Basin in Maine are broad, level, swampy uplands with numerous lakes. Tidewaters extend five miles upstream of Fredericton, New Brunswick. The central part of the Maine portion of the basin has large lakes and extensive, flat, swampy bogs in the valleys between the rolling hills of the Fish and Madawaska River regions.

Climate

The basin has a humid continental climate with short, mild summers and long, cold winters. Average monthly temperatures for the developed area in Maine are about 40°F. Daily temperatures in the summer average between 50°F and 70°F, but occasionally rise into the 90's. In the winter, sub-zero temperatures are frequent. The average monthly precipitation ranges from 2 inches to 4 inches. The average annual precipitation in Maine is about 36 inches, which includes about 100 inches of average annual snowfall. The average frost-free period is 120 days. The average growing season--from planting in mid-May to harvesting in early September--is about 110 days.

Soil

The severe lack of conservation practices accompanied by the intensive production and cultivation of Aroostook County soils has created an environment where land erosion is polluting the rivers, streams and lakes, deterring recreation, endangering fish and wildlife, polluting water supplies and is decreasing crop yields. Of the 246,000 acres of cropland, 1.55 million tons of top soil erode annually at an average rate of 6.3 tons per acre per year. The soils cannot replenish themselves through the natural process at this rate.

Water Quality

Surface water classifications for the Maine portion of the basin are shown on Plate 2. Class A water, the cleanest, is found in the undeveloped regions, while lower classes B-1, B-2 and C are adjacent to the intensely cropped agricultural lands. Class C streams denote additional pollution from domestic and industrial wastes. In 1976, 10 out of 69 organized communities in Aroostook County were served by wastewater treatment facilities and an additional 26 needed facilities. Major industrial dischargers in the county are seven potato processing plants and one pulpmill.

Water Supply

The Maine portion of the St. John River Basin receives 36 inches of precipitation annually, for an average annual water supply of 12,600 million gallons per day (MGD). The total practical development, however, is only about 3,980 MGD. This includes:

- current availability from minimum stream flow (828 MGD),
- potential ground water (395 MGD),
- potential surface storage (2,757 MGD).

Plate 2 displays potential storage sites for only 300 MGD, according to an SCS needs inventory. Soils in Aroostook County consist mostly of glacial till, which is generally a poor aquifer, with wells yielding an average of 10 gallons per minute.

The total domestic, commercial and industrial demand in 1980 will be about 50 MGD; by 2000 an estimated 90 MGD; and by 2020 demand may approach 165 MGD. The current 50 MGD demand on existing and needed public water supply systems can be broken into 10 MGD domestic demand, 1 MGD commercial demand from 18 irrigating farms, and 39 MGD industrial demand. Although there are adequate water resources in the basin to meet future demands, regulation of these resources may be needed to meet daily demands.

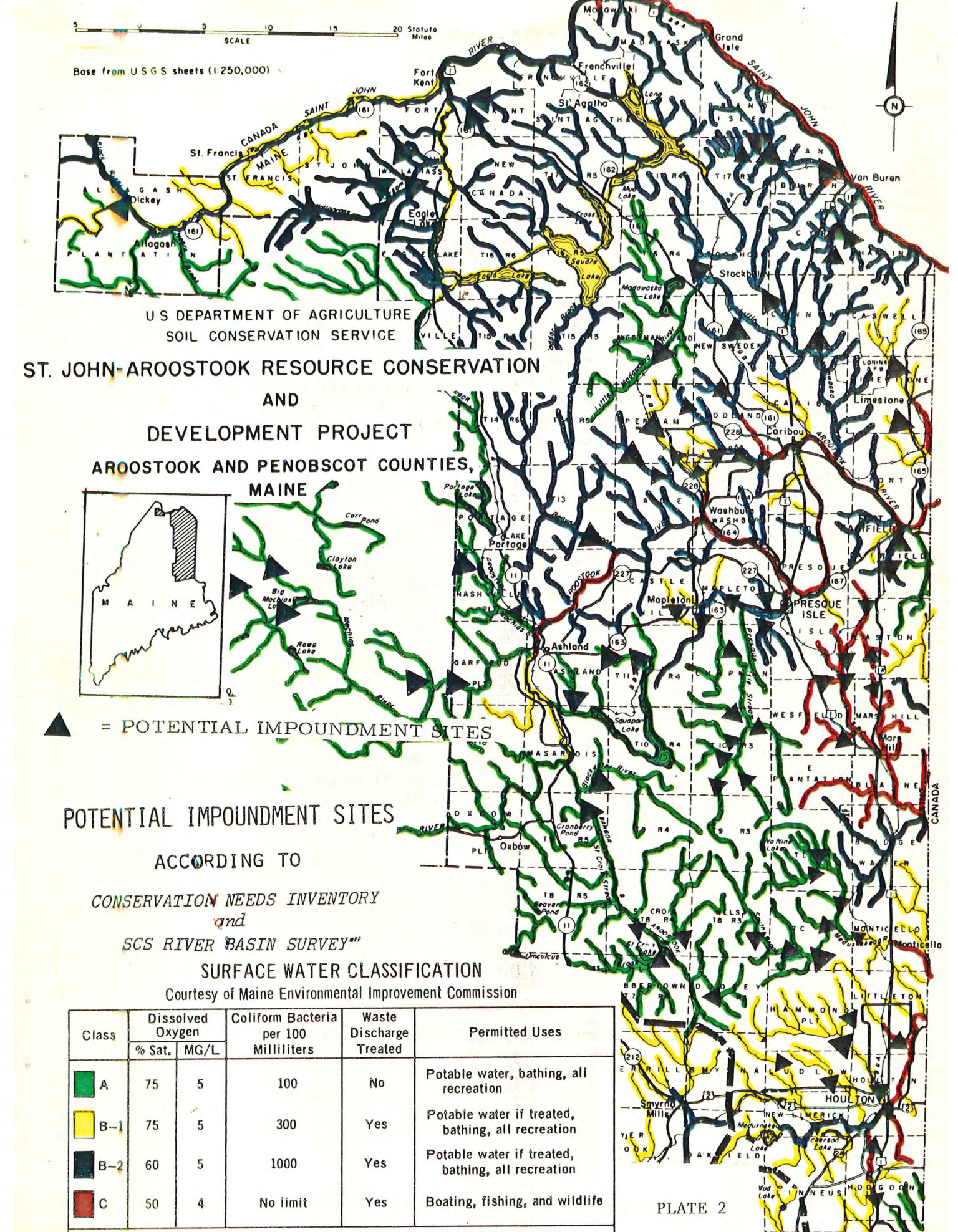
SOCIAL SETTING

Population

Aroostook County's population peaked at 106,064 in 1960; fell to 94,078 in 1970 due to mechanization and decline of the potato industry and in part to the 1961 closing of Presque Isle Air Force Base (1,200 military); gained to 96,300 in 1975 an increase of 2,200 resulting from 8,800 births minus 4,200 deaths and a 2,400 person outmirgation. The population should rise to 98,000 by 1980 and 104,000 by 1990. Aroostook County represents about 10 percent of Maine's population.

Local Government

There are three types of local government in Maine, all of which exist in Aroostook County: the town or city, the plantation and the unorganized territory. Towns are governed through a coordination of either boards of selectmen or town councils and town meetings. Plantations are similar. However, they tend to have fewer elected officials, called assessors. Unorganized territories are not true units of local government and have no power under law. Their functions are served under several



Class	Dissolved Oxygen		Coliform Bacteria per 100 Milliliters	Waste Discharge Treated	Permitted Uses
	% Sat.	MG/L			
A	75	5	100	No	Potable water, bathing, all recreation
B–1	75	5	300	Yes	Potable water if treated, bathing, all recreation
B–2	60	5	1000	Yes	Potable water if treated, bathing, all recreation
C	50	4	No limit	Yes	Boating, fishing, and wildlife

All waste discharge must be treated. All conditions of the Classification must be met.

PLATE 2

different jurisdictions with the State's Land Use Regulation Commission acting as the regulatory body and taxing agent.

Labor Force

The majority of workers receive their skills through on-the-job training with firms engaged in agriculture, manufacturing, and trade and services. Between 1960 and 1970 employment in agriculture, foresting and fisheries declined while manufacturing and services increased. Employment in professional and technical skills and the number of managers, officers, proprietors and clerical workers also increased. The agricultural labor force is significantly seasonal as indicated in Table 2. The total labor force in 1969 fluctuated between 15,000 to 30,000--dependent on agricultural employment. The unemployment rate in the county has remained high at 10 percent during the 1970's with a peak of 16 percent in some parts. Additional information on the labor force and unemployment appears in Appendix 1.

Potato Growers

Potato growers, businessmen compelled to grow the single most profitable crop to survive until an equivalent crop is discovered, are for the most part unlikely to change their agricultural pattern. Potato farming has become the accepted and expected way of life for a large number of families. The hardships of potato farming has caused a significant decline in the number of farms--a loss of almost 70 percent since 1944.

ECONOMIC SETTING

Land Use

Forestry or timber harvesting is the largest land use in Aroostook County closely followed by agricultural cropland. There are about 400,000 acres of cleared land, or 13 percent of the county's area of which an estimated 246,000 acres is cropland divided between:

- 120,000 acres in potatoes
- 60,000 acres in oats
- 34,000 acres in clover
- 12,000 acres in peas
- 20,000 acres in other crops (Hay, millet, buckwheat, mustard seed, dry beans, etc....)

Plate 3 shows the location of cropland and forest land in the eastern half of Aroostook County.

Employment, Wages and Sales

Total employment, gross wages and sales for specified sectors of Aroostook County are shown in Table 2. The agriculture and food sectors, represented primarily by potato production and processing, contribute significantly to the economy and labor force. Almost one-third of total sales and over one-third of gross wages and employment were contributed by the potato industry in 1969. A review of historical data on the county's potato farms and Maine's potato production, acreage, yields, prices, and sales reveals how the industry impacts on the county.

POTATO INDUSTRY

The potato industry in Aroostook County, Maine dates back beyond 1850. Continued growth from 52,000 hundredweight (cwt) of potatoes to a 1946 peak of about 45,000,000 cwt, earned the county the title of "Potato Empire". The county grows 95 pecent of Maine's potato crop. Maine led the nation in potato production until 1957--it is now in third place. Maine's potato farming has been affected by the rising cost of production and the competition from the irrigated west--especially Idaho, Washington and Oregon. It is important to note that the Maine potato market is heavily influenced by the national market and only slightly affected by local markets. This suggests that an increase in local supply may not necessarily affect the prices received by farmers for their crops.

Profitability of potato farming is not only affected by the external forces of the free enterprise system but also by the quantity and quality of production as influenced by weather and farm management. While the number of Aroostook County potato farms has decreased from 4,445 in 1944 to an estimated 1,000 today, the per farm acreage has increased from 37 to 120 potato acres. However, the per acre potato yield has declined. Federal price supports programs between 1946 and 1950 restricted the acreage farmers could plant. As a result, the farmers planted potato rows closer together, used only their best acreage, and discontinued rotation and other established conservation practices to maximize production on minimum acreage. Once price support ended, many of the farmers, in an effort to make a living, continued to cultivate the acreage that should have been placed back in rotation. Heavy machinery, including tractors and harvesters, were also accepted and used in the basin following World War II. This machinery compacted the soil, destroying its tilth and ability to properly release gases and efficiently use precipitation, nutrients and air for good crop growth. Contoured fields and conservation waterways were disregarded as being too

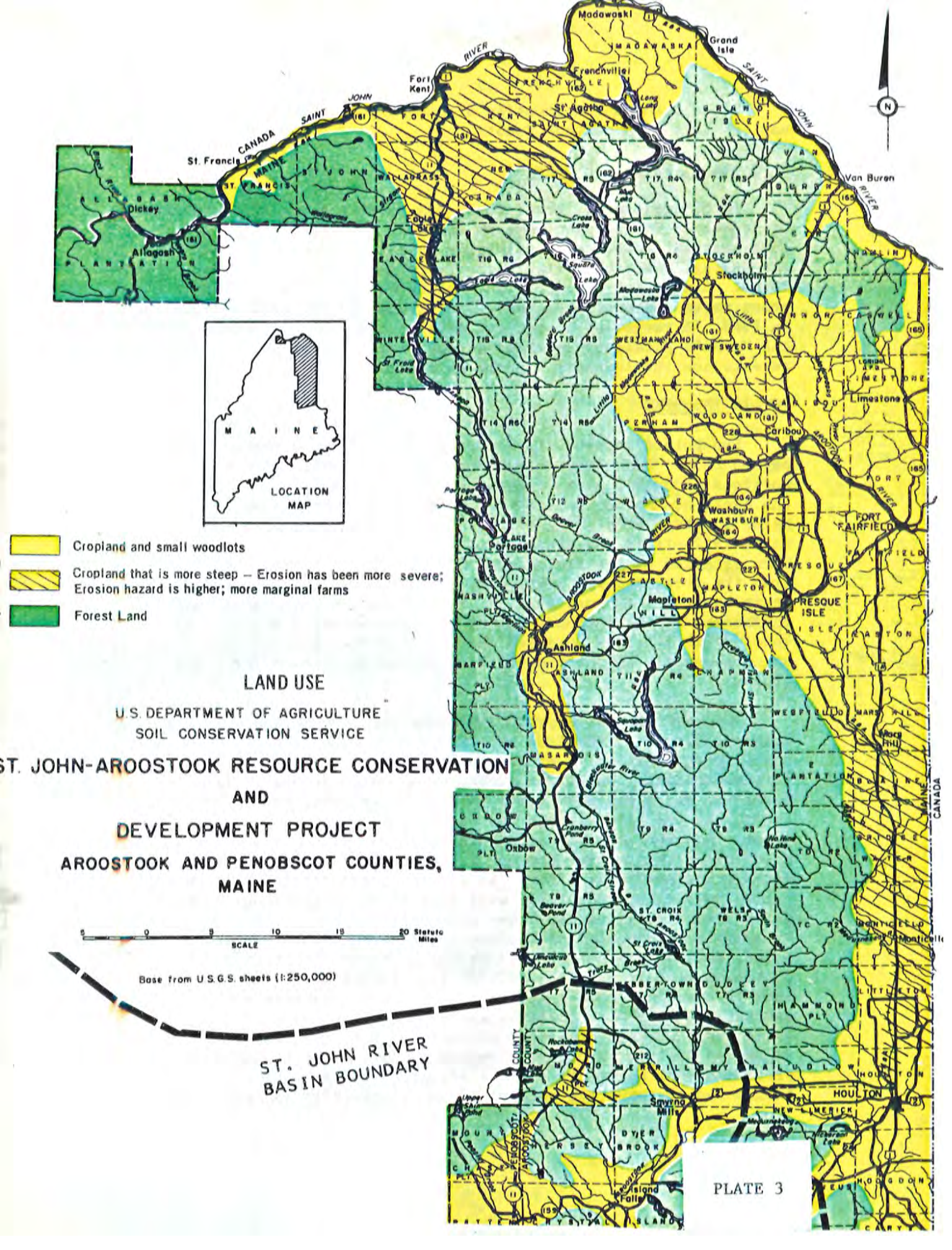

Madawaska
Grand Isle
Fort Kent
Frenchville
St. Agatha
Van Buren
St. Francis
Dickey
Allagash
Eagle Lake
Stockholm
Limestone
Caribou
Washburn
Fort Fairfield
Portage Lake
Mapleton
Presque Isle
Ashland
Oxbow
Houlton
Island Falls
MAINE
LOCATION MAP
Cropland and small woodlots
Cropland that is more steep – Erosion has been more severe; Erosion hazard is higher; more marginal farms
Forest Land
LAND USE
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ST. JOHN-AROOSTOOK RESOURCE CONSERVATION
AND
DEVELOPMENT PROJECT
AROOSTOOK AND PENOBSCOT COUNTIES, MAINE
SCALE
Base from U.S.G.S. sheets (1:250,000)
ST. JOHN RIVER BASIN BOUNDARY
PLATE 3

TABLE 2
TOTAL SALES, GROSS WAGES AND EMPLOYMENT IN SPECIFIED SECTORS OF AROOSTOOK COUNTY, 1969[1]

Sector	Total Sales	Gross Wages	Average Gross Wages	Employment
		Dollars		Number
Agricultural Production[4]	$49,378,450	$11,463,302	NA	NA[3]
Food and Kindred[5] Products	83,796,416	14,075,471	$5,246	2,683
Lumber and Wood Products	29,579,300	10,792,057	5,926	1,821
Paper and Allied Products	64,937,840	9,247,754	9,058	1,021
Chemicals and Allied Products	7,020,213	918,001	5,044	182
Printing and Publishing	1,011,514	321,183	4,282	75
Ordinance and Machinery	2,083,616	475,816	5,116	93
Wholesale-Retail Trade	152,976,000	20,145,000	3,967	5,078
Selected Services	8,762,000	2,179,000	3,405	640
Total	$399,545,349	$69,617,584	$5,049[2]	12,824[2]

[1] Data from Edward S. Micka and Raymond B. Krofta, The Economy of Aroostook County, Maine, Life Sciences and Agriculture Experiment Station University of Maine at Orono, Orono, Maine 1976.

[2] Not including farm workers.

[3] In 1969 there were 2,153 farm operators, with 1,306 hired farm workers working 150 days or more and 26,013 farm workers working less than 150 days.

[4] Represents primarily the product value of potatoes of $44,136,078 sold for food, seed and livestock feed.

[5] Represents primarily the product value of processed potatoes.

cumbersome for the larger machinery. Consequently, the soils experienced maximum intensive cultivation and use without the benefit of good conservation practices.

Maine and Aroostook County appear to be experiencing long term trends in declining potato yields, acreage and production due to soil deterioration and economic conditions. The effect on potato yields per acre has been a decline of almost one percent per year since about 1960. Currently, average yields on land remaining in production have declined toward an average yield of 230 cwt per acre (Graph 3). The actual decline has been masked by the loss of lower yielding acreage since the late 1960's. The yield fluctuations are attributed to the weather, especially available precipitation. The economic factors of production are responsible for the fluctuation and decline of potato acreage currently approaching 4 percent a year (Graph 2). A major factor in the amount of acreage planted is the price farmers received for the prior year's crop. Graph 4 shows that this price also fluctuates annually. The combined effect of fluctuating and declining yields and acreage is a long term decline and fluctuation in total production at a rate of 4.5 percent a year (Graph 1).

Maine's potato sales (Graph 5) largely representative of Aroostook County, are influenced by production and prices. The value of sales at $120 million has not shown a long term declining trend since a rise in prices has offset the production decline. Additional information is included in Appendix 1.

THE GROWTH OF WESTERN COMPETITION

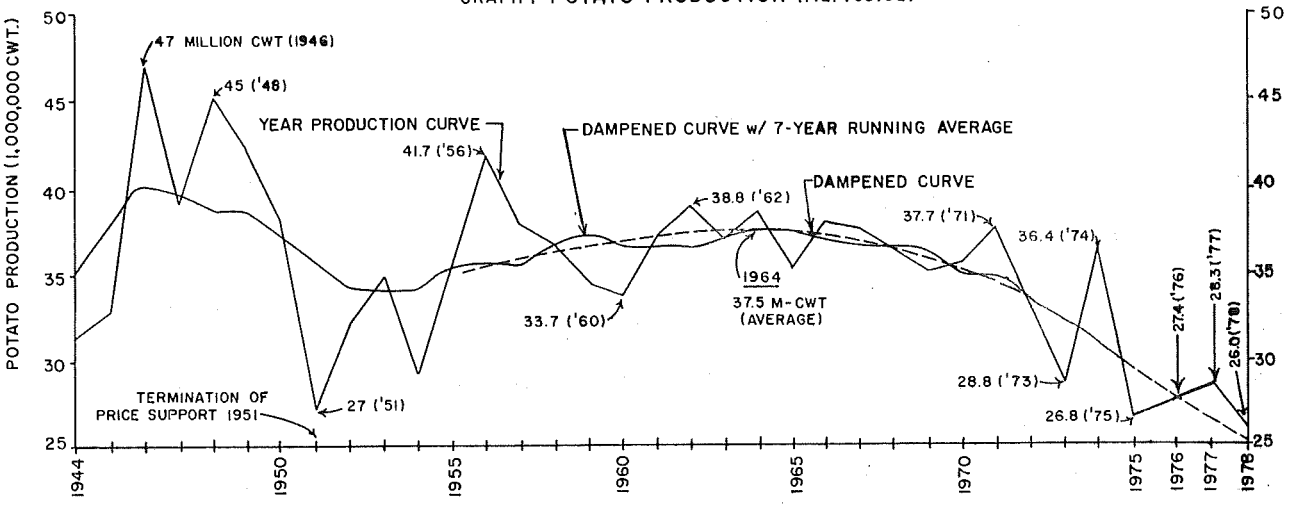
Maine's Commissioner of Agriculture cited the competition of Federal irrigation projects in the west as a major reason for Maine's declining potato industry.

Graph 6 displays the growth of the three Pacific Northwest states which currently lead the nation in potato production. Federal irrigation programs of the Bureau of Reclamation exist on 40 percent of their potato land. Most of the remaining land, 60 percent, was developed for irrigation by private sources. In 1951 their total production was 21 percent of the total U.S. production, increasing to 55 percent in 1978. During this same period, 1951 to 1978, Maine's contribution to U.S. production declined from 30 percent to 8 percent (21 other states averaged a gradual increase).

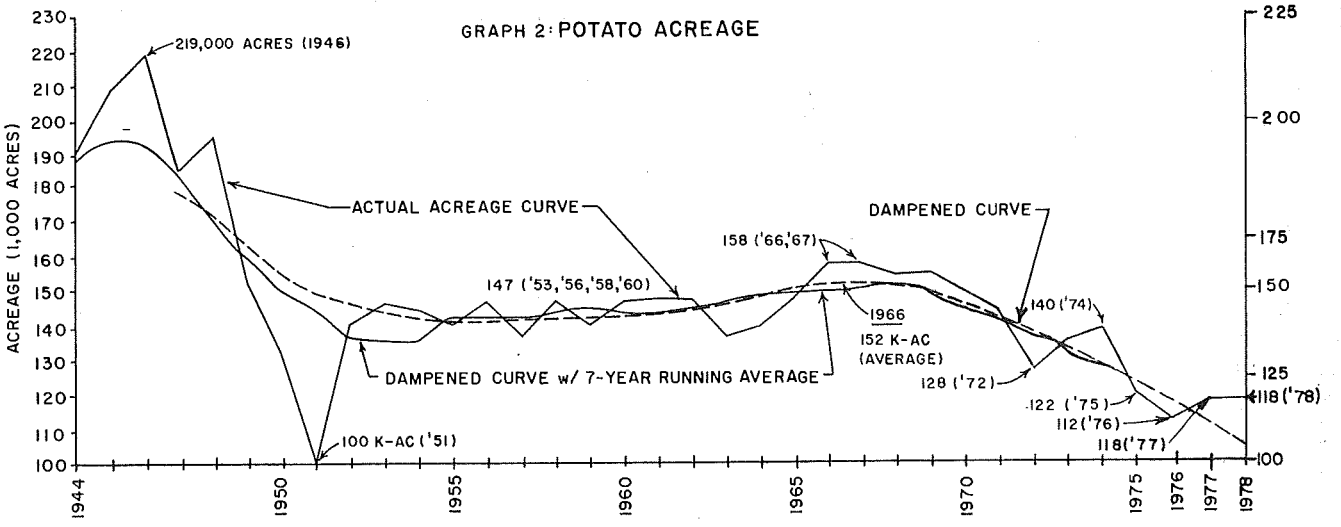
A well organized and effective marketing strategy has aided the Pacific Northwest in increasing sales of its high quality potatoes. Additional information is included in Appendix 1.

ST. JOHN RIVER STUDY: HISTORICAL POTATO STATISTICS, STATE OF MAINE
(LARGELY REPRESENTING AROOSTOOK COUNTY)

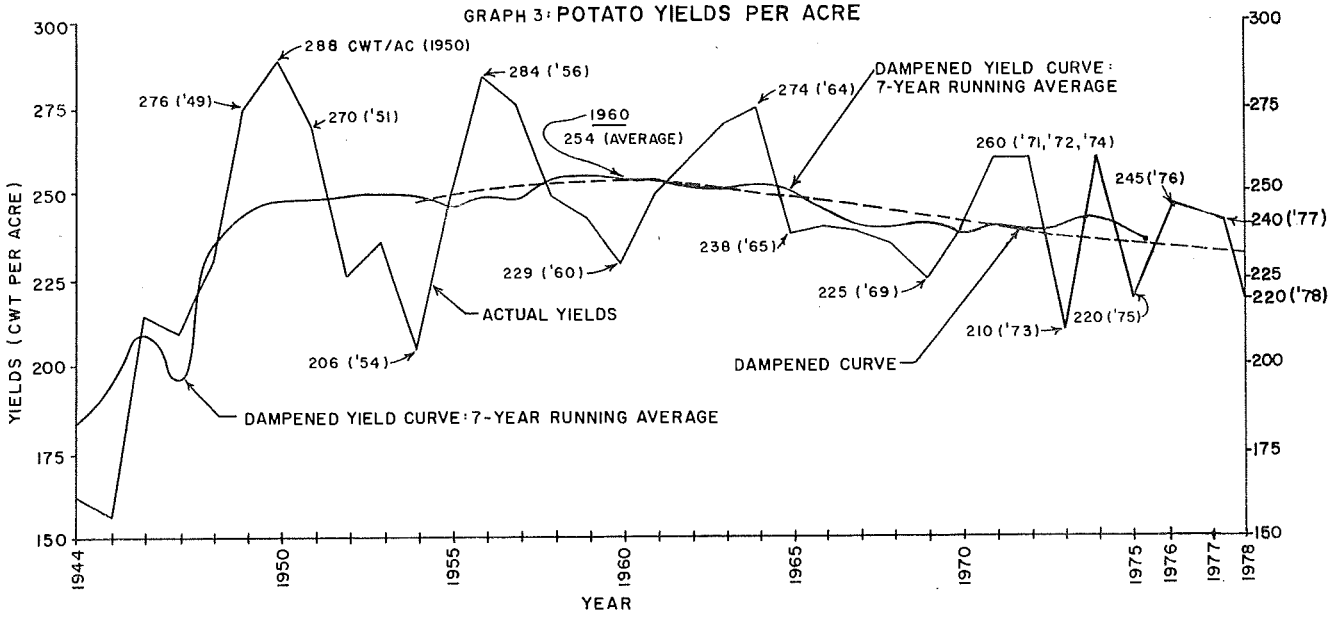
GRAPH 1: POTATO PRODUCTION (Harvested)



GRAPH 2: POTATO ACREAGE



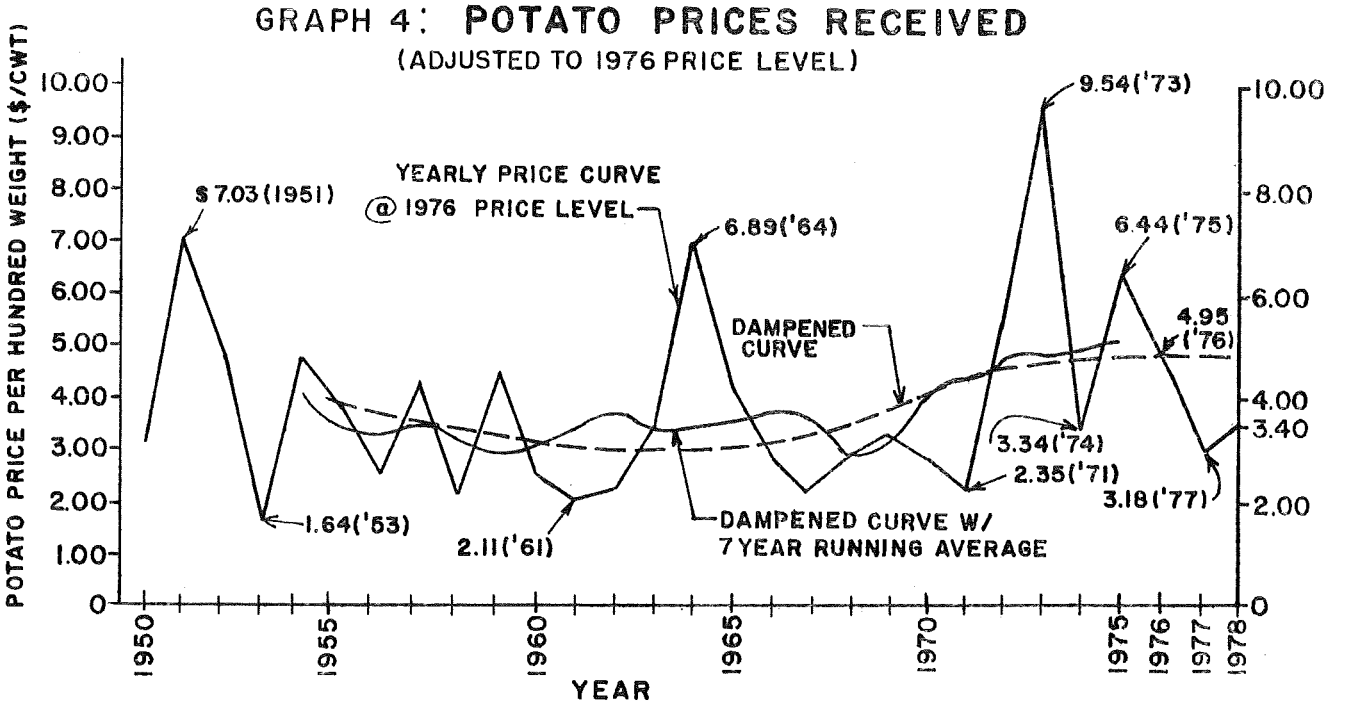
GRAPH 3: POTATO YIELDS PER ACRE



HISTORICAL POTATO STATISTICS, STATE OF MAINE

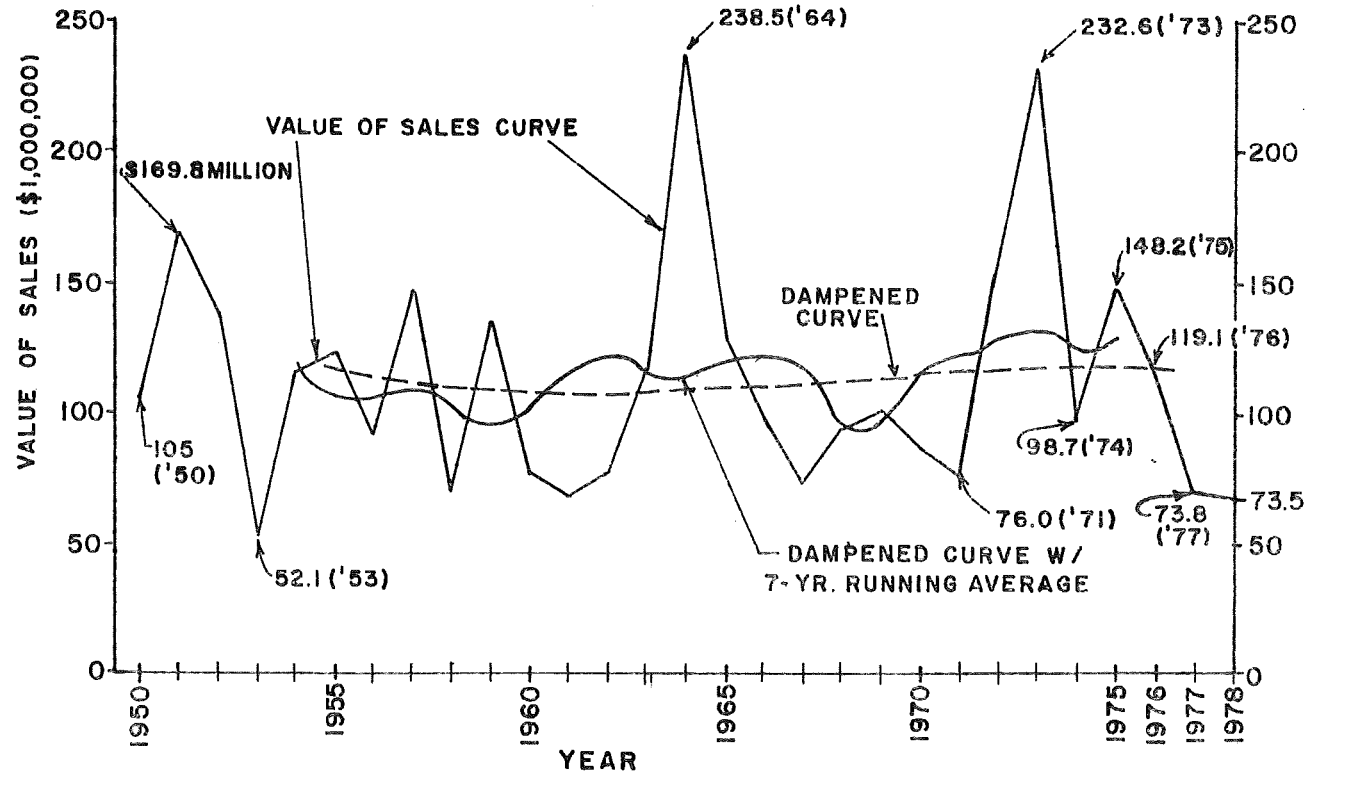
GRAPH 4: POTATO PRICES RECEIVED

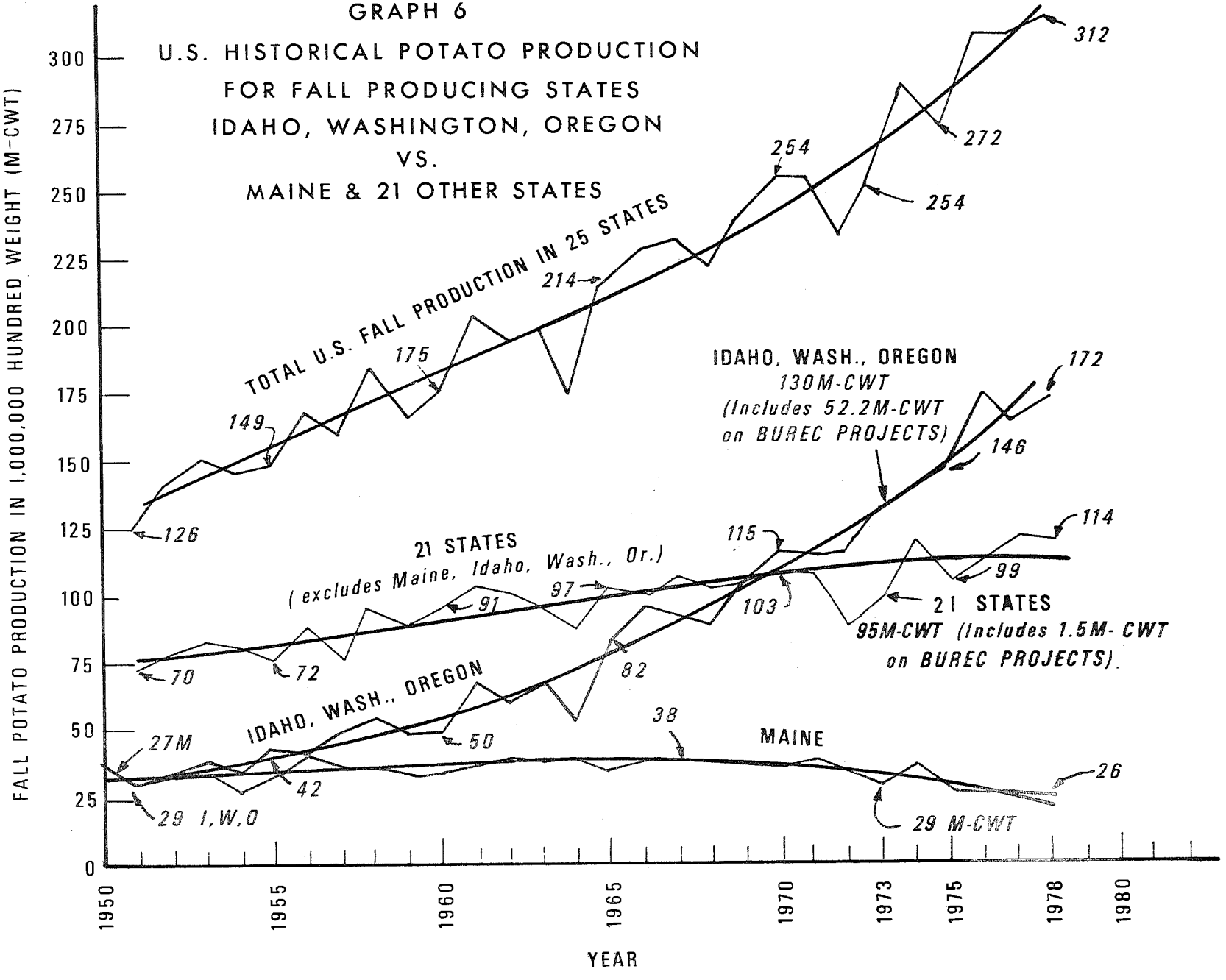
(ADJUSTED TO 1976 PRICE LEVEL)



GRAPH 5: VALUE OF POTATO SALES

(ADJUSTED TO 1976 PRICE LEVEL)




GRAPH 6
U.S. HISTORICAL POTATO PRODUCTION
FOR FALL PRODUCING STATES
IDAHO, WASHINGTON, OREGON
VS.
MAINE & 21 OTHER STATES
FALL POTATO PRODUCTION IN 1,000,000 HUNDRED WEIGHT (M-CWT)
YEAR
TOTAL U.S. FALL PRODUCTION IN 25 STATES
312
272
254
254
214
175
149
126
IDAHO, WASH., OREGON
130M-CWT
(Includes 52.2M-CWT
on BUREC PROJECTS)
172
146
115
114
99
103
21 STATES
(excludes Maine, Idaho, Wash., Or.)
97
91
70
72
21 STATES
95M-CWT (Includes 1.5M- CWT
on BUREC PROJECTS)
82
IDAHO, WASH., OREGON
27M
50
42
38
MAINE
26
29 I,W,O
29 M-CWT
300
275
250
225
200
175
150
125
100
75
50
25
0
1950
1955
1960
1965
1970
1973
1975
1978
1980

FUTURE CONDITIONS IF NO FEDERAL ACTION

The future of Aroostook County will continue to be influenced by the health of its potato industry. If no Federal action results from recommendations in this Corps report, the problems of this industry's declining and fluctuating production may be partially alleviated by programs of others, including:

- The EPA Water Quality Management Plan (208 Plan) for the region recommends increased Federal cost sharing for cropland conservation measures to reduce erosion voluntarily and on a worst-first basis. Mandatory action is recommended on the 14 percent of the region's cropland which is severely eroding. This plan may help to improve production in the long run;

- The Potato Industry's reorganization plan to improve its marketing, promotion and research efforts through a unified Maine Potato Board under the Commissioner of Agriculture may help potato growers improve their yields and obtain higher prices;

- The use of Public Law 83-566 funds by the USDA Soil Conservation Service in obtaining Federal funds to provide watershed protection through the initiation of conservation practices to control runoff and reduce erosion, as was proposed for 1,500 acres of cropland by the Parkhurst Siding-Caribou-Watershed Plan.

The impact of these plans on the county's future were considered in preparing several scenarios of future conditions with no Federal action. From these shall be selected the most probable future which will then be used as a basis to evaluate the plans of improvements that follow.

Agricultural Projections

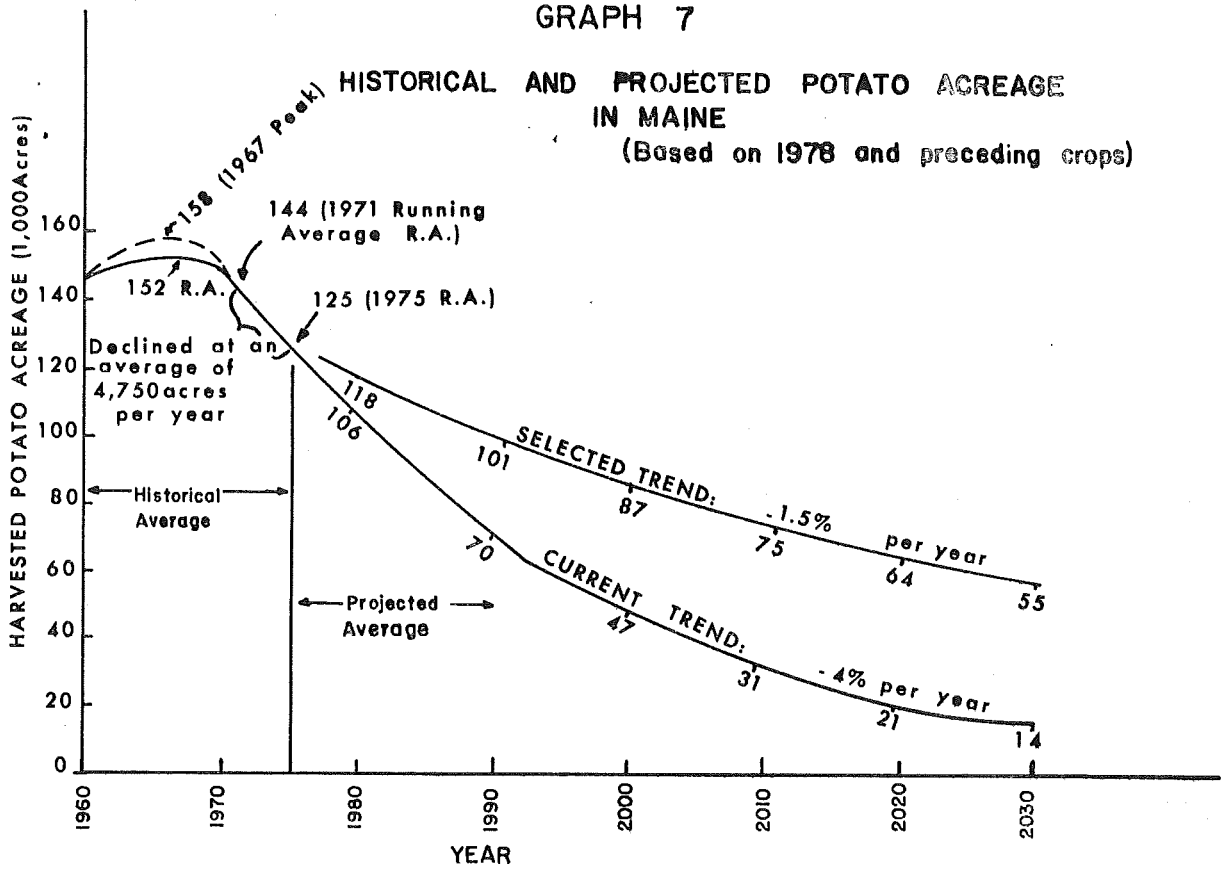
The future of agriculture, specifically potato production, is dependent largely on the economic health of its 1,000 potato growers. In order to analyze the potential future production of these growers, the trend in potato acreage was selected as an indicator. The change in acreage reflects not only the loss or gain in farms but also the change in size of farms to keep pace with a reasonable standard of living.

Potato Acreage

Graph 7 displays historical trends in potato acreage and two scenarios of projected trends. Since 1970, acreage has been

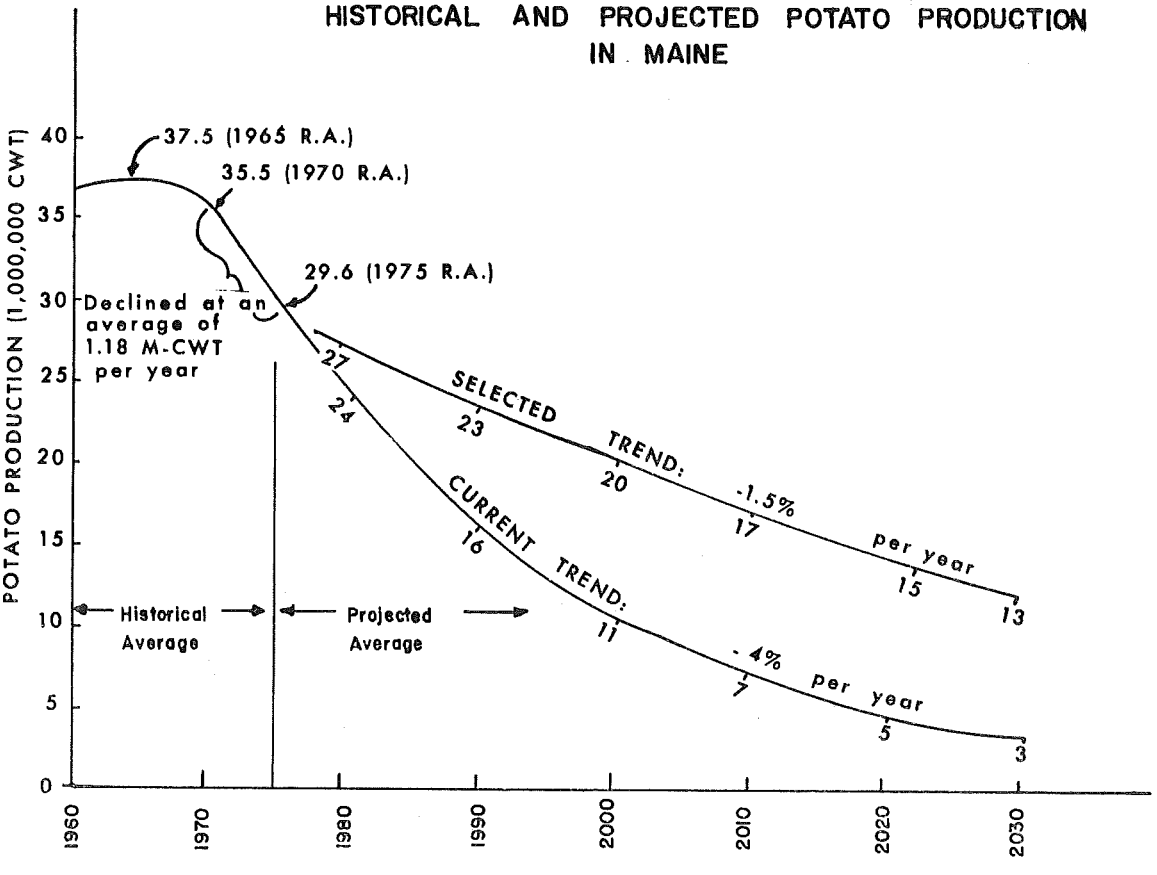
GRAPH 7

HISTORICAL AND PROJECTED POTATO ACREAGE IN MAINE
(Based on 1978 and preceding crops)



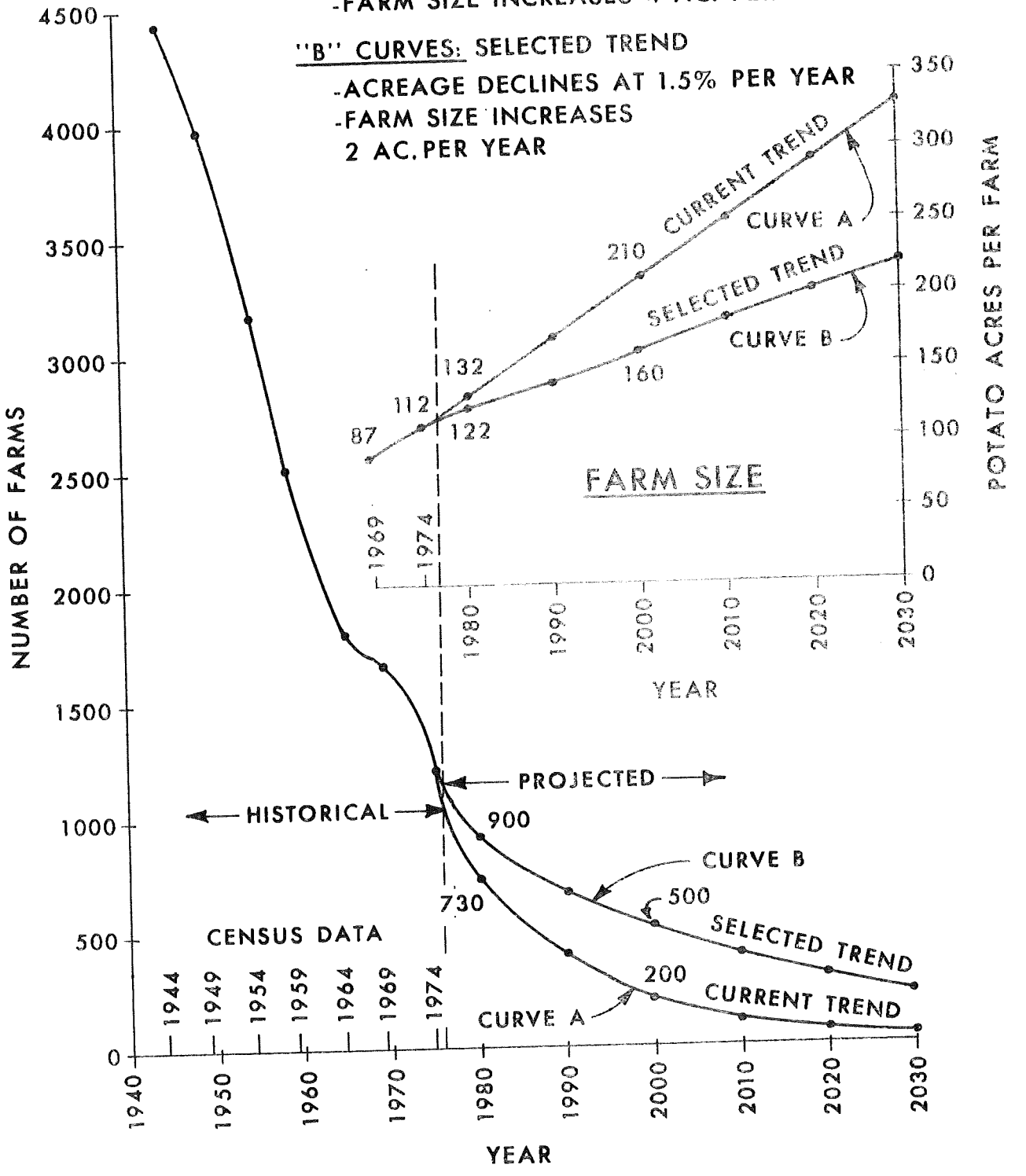
GRAPH 8

HISTORICAL AND PROJECTED POTATO PRODUCTION IN MAINE



GRAPH 9

HISTORICAL & PROJECTED NUMBER & SIZE OF FARMS IN AROOSTOOK COUNTY



averaging a decline of 4,750 acres per year or about 4 percent a year. At this rate of decline, potato production would be relatively nonexistent in the Potato Empire in 25 to 50 years. The danger of a terminal agriculture within this time frame prompted the Commission on Maine's Future to report: "Erosion and depletion of soils is occurring so rapidly that within twenty five to fifty years it may no longer be possible to grow potatoes in much of Aroostook County."*

However, a more optimistic projection with acreage declining at only 1.5 percent per year has been selected for the following reasons:

- Recent public awareness of the erosion problem and plight of Maine's agriculture will prompt private and public action to assist with its production and erosion problems.

- Forty eight percent of the cropland, including about 50,000 acres of potatoes are subject to only slight erosion. It was assumed that this acreage would approximate the minimum acreage remaining in production in 50 years.

- The 1.5 percent decline represented 50 percent of the actual rate at the time the projection was selected in 1976, only three percent per year.

In addition to declining acreage, acreage will also continue to fluctuate at about the current rate of 8 percent from year to year depending on economic conditions.

Potato Farms

The number of potato farms remaining in production depends on the total potato acreage projected for Aroostook County and estimated acreage per farm. As in the past, the size of farms will continue to grow in order to offset economic losses from rising production costs, thus achieve "economy of scale." Graph 9 displays two trends for farm sizes, the current trend and that trend selected for study analysis. If farms increase in size at only 2 acres per year, about half their current rate, and potato acreage declines at the selected 1.5 percent annual rate, then about 230 farms (now 1,000) would remain in production after about fifty years, at an average size of about 220 acres (now 120) per farm.

*Commission on Maine's Future, Final Report, 1 December 1977.

Potato Yields and Quality

It was further assumed that average yields per acre would stabilize at 230 hundredweight per acre (1974-77 average). Although soils are continuing to deteriorate from the lack of conservation practices, the decline in yields is assumed to be masked by the more rapid rate at which lower producing soils are dropping out of production. The loss of these lower producing soils will effectively appear to stabilize the average yield of cropland remaining in production, as is evidenced by the historical running average yields since about 1967, when acreage initiated its decline. Yields will continue to fluctuate from year to year at about the current rate of 14 percent per year depending on available seasonal moisture and frost free periods.

Potato quality is closely allied to yields. Inadequate moisture during the growing season and an untimely frost will affect both the yields harvested and their quality. The average quality in the future is therefore assumed to stabilize with only annual fluctuations.

Potato Production

Graph 8 displays historical production and the scenarios of projected decline in potato production, corresponding to declines in acreage and using a constant 230 cwt per acre yield. Production will continue to fluctuate depending on yields and acreage.

Potato Prices

The prices Maine potato growers receive per cwt of potatoes was assumed to remain constant for each grade of potatoes at a constant price level. Although their prices are primarily controlled by the national market, improved marketing may result from Maine Potato Board actions. However, it is anticipated that prices will remain relatively constant.

Potato Sales

The value of potatoes sold is characterized by the amount of production sold and price received. Like acreage and production, with an average constant price, sales were also assumed to decline at a selected rate of 1.5 percent per year, and will continue to fluctuate annually. At a constant price level, sales fluctuated an average of 52 percent year to year from 1970 to 1976.

Future Conditions if No Federal Action

The future conditions in Aroostook County without any Federal action from this report to alter the management of water and related land resources would experience the following changes after 20 years (from 1980 to the year 2000), the period of time selected to evaluate plans of improvements:

- Potato acreage decreases from 118,000 to 87,000, a loss of 26 percent;

- Potato production decreases from 27 to 20 million cwt, a loss of 26 percent;

- Potato farms decrease from 900 to 500, a loss of 44 percent.

The economic impact on the value of output of goods and services from the loss of production or change in net farm income, over a 20-year evaluation period and a growers long term interest rate of 8.5 percent, is an average annual loss of $1.6 million per year. The economic impact on the region would result from a multiplying effect, as the loss is felt by other sectors of the economy and equals about $4.2 million of average annual loss of goods and services throughout the county, since $1.00 of agricultural output requires about $2.60 of goods and services from the local economy. The process used to arrive at the economic loss and impacts on the environment is explained in the formulation section of this report. Over the 20-year evaluation period there would be a loss of about one-quarter of hired farm labor, 400 per year, and a total loss in all sectors of the economy exceeding 1,000 jobs.

The impact on the physical environment would be the decline of highly eroding potato land from production which would revert back to natural vegetation. Assuming that higher eroding fields are declining, the average erosion rate would drop to about five tons per acre per year. The total annual erosion from cropland in potato rotation would decline about 50 percent from 1.1 to 0.5 million tons. There would be a corresponding reduction in sediment, biocide and nutrient loadings in the regions waters. The overall impact would significantly benefit the environment. The loss of production, income and family farms however, would adversely affect the region's social well-being and regional development. Businesses would be forced out of production, the heritage of the family farm would continue to decline, the regional economy would further deteriorate and the New England region would continue to experience the loss of its last remaining stronghold for truck crops. Additional information is included in Appendix 1.

The trend toward fewer family farms and larger commercial farms is not expected to make a significant difference in the amount of irrigated cropland in the future nor in the conservation measures applied to land remaining in production. This 30-year trend toward fewer but larger farms has seen no significant improvement toward reaching the 3-ton erosion goal county-wide. Past regional studies have projected that cropland irrigation would increase significantly, but this has not occurred. There has been little or no effort, nor is there expected to be any future effort, to promote irrigation assuming there will be no action generated by this report.

Problems, Needs and Opportunities

The potato industry is the backbone of the region's economy and social well-being, directly responsible for over one-third of county's employment and gross sales. Unfortunately, the industry is plagued by dramatic fluctuations in weather and prices, rising production costs, deteriorating soils, and western competition, all taking their toll as witnessed by declining farms, yields, acreage and production. The industry's problems translate directly into regional, State and international problems--an unstable boom and decline economy, the erosion and abandonment of once prime New England farmland, the environmental pollution of Maine and Canadian waters, crop marketing problems and a host of other related impacts.

LACK OF CONSERVATION PRACTICES

Conservation practices applied to croplands help control erosion and improve yields.

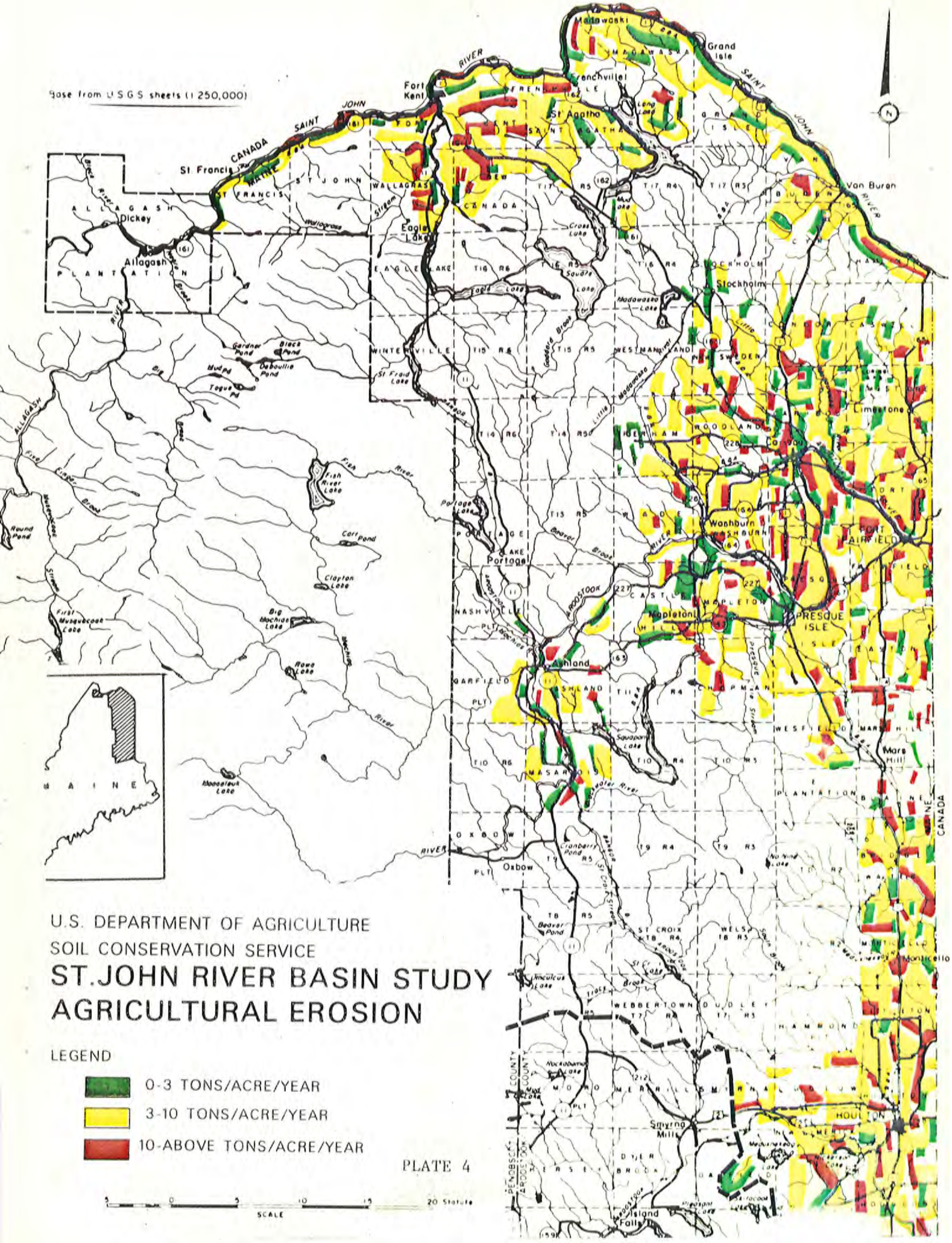
Current Erosion Problem

Recent field surveys of Aroostook County's total 246,000 acres of cropland revealed that 1,550,000 tons of soil were eroding each year due to the lack of conservation practices[1].

- Slight erosion, from zero to 3 tons per acre per year, occurred on 40 percent of the land;
- Moderate erosion, 3 to 10 tons, on 46 percent;
- Severe erosion, over 10 tons, on 14 percent.

Plate 4 shows the locations and severity of agricultural erosion in Aroostook County.

[1] "208" Water Quality Management Plan, [illegible], August 1978.



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

ST. JOHN RIVER BASIN STUDY
AGRICULTURAL EROSION

LEGEND

- 0-3 TONS/ACRE/YEAR
- 3-10 TONS/ACRE/YEAR
- 10-ABOVE TONS/ACRE/YEAR

PLATE 4

SCALE 5 0 5 10 15 20 Statute

The average erosion rate was 6.3 tons per acre per year, over twice as high as the goal established by the Soil Conservation Service which is the rate at which soil replaces itself by the natural process--3 tons per acre per year. Erosion conditions on the 180,000 acres in potato rotation are even more severe than the total cropland average. Problems created by soil erosion include:

- Deterioration of the soil (the region's resource base) and loss of nutrients, potato seed and organic material, causing lower crop yields and eventual rendering of the land unproductive;

- Pollution of receiving streams from sediments, nutrients, pesticides and herbicides;

- Degrading fish spawning beds from smothering and elimination of fish by the abrasive action of sediment particles, and by the growth of oxygen consuming algae;

- An accelerated eutrophication of streams and lakes rendering them unfit for recreation, fisheries or wildlife.

- Deterioration of water quality and subsequent oxygen from nutrient fed weeds, leading to winter fish kills;

- Loss of recreation due to water turbidity and algae growth;

- Pollution of industrial and domestic water supplies;

- The filling in of power dam pools, road ditches and wetlands with sediment, and

- The undermining of the resource base and cultural heritage of the region.

Investigations by Government agencies are just beginning to identify the extent of the erosion damages existing in Aroostook County. These problems will continue and their impacts will be magnified unless cropland conservation practices are utilized.

INADEQUATE SOIL MOISTURE

Investigations conducted by the Corps and the USDA Soil Conservation Service and research by the University of Maine revealed:

- The lack of a significant amount of water each year prevents maximum quantity and quality yields from Aroostook County's potato land;

TABLE 3: REGIONAL IRRIGATION NEEDS OF POTATOES [1/]

For Soil With 3.0 Inch Field Capacity, in Good Condition With Low Runnoff Rates

Region of Aroostook County	Normal Consumptive Use (inches)	Available Natural Moisture [2/]		Net Irrigation Requirement [3/]	
		Normal Year (inches)	Dry Year (inches)	Normal Year (inches)	Dry Year (inches)
Northern [5/]	14.78	9.27	7.89	5.51	6.89
Central	14.88	9.09	7.75	5.79	7.13
Southern	15.73	7.94	6.80	7.43	8.57
Average [4/]	14.96	8.88	7.58	6.08	7.38
Percent of Consumptive Use:		59%	51%	41%	49%

1/ Data was developed by USDA Soil Conservation Service Technical Service Center for specific towns in Aroostook County, based on average precipitation and temperature for each location. Evaluation represents a 110 day season from 15 May to 5 Sept, and assumes soils are in good condition with low runoff rates.

2/ Available moisture includes carry over moisture at planting equal to 1.5 inches plus available precipitation.

3/ Net irrigation is the difference between consumptive use and available moisture.

4/ County average is weighted by cropland in each region: North-20%, Central-59%, and South 21%.

5/ Regional data is the simple average of several towns: North includes Ft. Kent and Van Buren; Central - Caribou Presque Isle,Limestone and Ft. Fairfield; and South - Monticello and Houlton.

- Fluctuations from year to year in the amount of water available, cause drastic fluctuations in potato yields and quality.

Lack of Water

The irrigation requirements for the potato crops in eight towns in Aroostook County as provided by SCS' Technical Service Center are summarized by regions in Table 3. The results show that the basin's potato crop needs about 6 inches of irrigation water in a normal year to produce an optimum high quality crop. Nine inches of naturally available water provide the rest of the crops total requirement, called consumptive use.

Since irrigation maintains a high level of moisture in the soil some rainfall which would have been absorbed by the soil is lost to the crop from runoff. A Corps analysis, to be discussed later, estimated that amount to be between 1 to 2 inches each year. The SCS analysis in Table 3 assumed irrigation conditions on soil that was in good condition with low runoff rates. Actually, Aroostook County's soils, which for the most part have high runoff rates on poor conditioned soil,[1] will receive slightly less natural water than shown for "Available Moisture" in the table. Irrigation is needed to make up for over 40 percent of the crop's annual water deficiency in order to obtain optimum yields and quality.

Irrigation Needs of Common Soil Types

The 3-inch moisture absorption field capacity used in the SCS analysis accurately reflects the average characteristic of all soils growing potatoes in the county. Irrigation requirements vary depending on individual soil types and the field capacities of these soils. As an illustration, Table 4 displays the range of requirements identified with specific soils growing potatoes in Presque Isle, central Aroostook County. Caribou soil is the most common soil growing potatoes in the county--representing about 60 percent of the cropland. Although it has a high field capacity and lower irrigation requirements than other soils, irrigation of Caribou soil has strong economic potential, which will be identified later in the report.

[1] The standard irrigation analysis used by SCS excludes adjustments for poor soil conditions due to the evaluation's complexity, and diversified soil conditions among farms.

TABLE 4

IRRIGATION NEEDS OF COMMON AROOSTOOK COUNTY SOILS
IN PRESQUE ISLE, MAINE
(Analyzed during a 110 day season with a 15.14 inch consumptive use and good soil conditions for normal climatic condition)

Soil Type	Field Capacity (Inches)	Natural Moisture Available (Inches)	(Percent)	Net Irrigation Requirements (Inches)	Ave.No. of Irrigation Applications (No./Year)
Mapleton	2.3	7.91	52	7.23	6.3
Conant	2.7	8.40	55	6.74	5.0
Ave.Condition	3.0	8.77	58	6.37	4.2
Caribou	3.5	9.38	62	5.76	3.3

Current Problem with Fluctuating Moisture

The climate, especially the amount and distribution of rainfall received by the crop, is a major cause of yields fluctuating from one year to the next. For example, over the past 7 years harvested yields fluctuated an average of 32 cwt per acre per year--about a 14 percent fluctuation. A soil moisture balance computer program was developed by the Corps to analyze fluctuations in available moisture with irrigation over a 14 year period, using daily rainfall, daily evaporation and the daily water requirement of the potato plant. The results showed (Table 5) that annual moisture naturally available to the plant fluctuated from a low of 6.6 inches to a high of 10.2 inches. The moisture fluctuated an average of 30% from year to year during the 14 year period. The same evaluation was conducted with no irrigation water being added and the soils used an additional 1 to 2 inches of natural precipitation each year to satisfy consumptive use. The available moisture in this table was also developed assuming soils were in good condition with low runoff rates.

Even in the wettest years there is a need for irrigation. The wettest year of record was 1976, in terms of both low evaporation and high rainfall. The potato still received only 68 percent of the water needed on 3.1 field capacity soil. Caribou soil at 3.5 inch field capacity probably received about 75 percent of the water needed by the crop in 1976.

The frost-free growing period fluctuated from a high of 145 days to a low of 104 days during the 1963 to 1974 time frame. The fluctuations in the frost-free period and available moisture resulted in fluctuating yields, production, sales and socio-economic conditions in the county.

TABLE 5

IRRIGATION NEEDS OF POTATOES, 1963 to 1976 [1/]

Crop Year of Record	114 Day Season All Soils: Potato Consumptive Use (C.U.) Inches of Water	Soils With 3.1 Inch Field Capacity: Natural Moisture Available For Consumptive Use [3/] Inches of Water	Percent of C.U.	Irrigation Needs [4/] Net Inches of Water	Number of Applications
1963	17.89	10.09	56%	6.32	4
1964	15.09	7.55	50%	6.32	4
1965	16.38	8.82	54%	6.32	4
1966	18.21	7.15	39%	11.06	7
1967	16.08	10.21	64%	4.74	3
1968	17.60	6.62	38%	9.48	6
1969	15.69	7.94	51%	6.32	4
1970	16.09	7.68	48%	7.90	5
1971	15.72	8.74	56%	6.32	4
1972	16.86	7.98	47%	7.90	5
1973	14.52	6.62	46%	7.90	5
1974	16.72	9.82	59%	6.32	4
1975	16.30	6.68	41%	7.90	5
1976	13.26	8.98	68%	3.16	2
Average	16.17	8.20	51%	7.00	4.4
Monthly Averages 1963 to 1974					
JUNE	1.54	1.12	73%	0+	0+
JULY	3.87	2.37	61%	1.04	0.7
AUGUST	5.92	3.20	54%	2.65	1.7
SEPTEMBER	5.07	1.58	31%	3.55	2.2
TOTAL	16.40	8.27	50%	7.24	4.6

1/ Climatological data used is available only from Caribou, Maine from 1963 to 1976. Analysis assumes soils are in good condition with low runoff rates, and irrigation would be applied until vines are killed. A 3.1 inch field capacity approximates Plaisted and Monarda soils. The analysis starts on 1 June of each year when 50% of Maine's crop was planted from 1972 to 1975, and stops on 22 September when 50% of vines were killed.

2/ Consumptive use (C.U.) and Irrigation requirements were calculated on a daily basis from a Soil Moisture Balance Program written for the IBM 1130 computer by the Corps. The basic relationship used was: ET = GS * EVAP * FAC 1; where, ET represented Evaporation-Transpiration of the plant each day or C.U. required; GS represents the daily crop growth stage factors from curve No. 18, USDA-SCS Technical Release No. 21, dated September 1970; EVAP represents the daily pan evaporation reported by the National Weather Service for Caribou, Maine; FAC 1 represents a factor of 0.55 relating pan evaporation to evapo-transpiration. Basic assumptions included: the average growing season for the 1972-75 crops was used -- 114 days; on the first day of the season the soils were assumed at field capacity.

3/ Moisture available for C.U. was determined using 100% of the daily precipitation which would replenish the moisture in the soil unless it exceeded field capacity. Moisture in the soil at planting is included.

4/ Irrigation was applied when soil moisture reached 50% of field capacity, (1.55 inches). Each irrigation application was equal to that amount.

There is then a need to lessen fluctuations and deficiencies in the moisture available to northern Maine's potato crop. Irrigation not only improves soil moisture, it also matures the crop earlier making harvesting and yields less dependent on the frost free period.

QUALITY OF MAINE POTATOES

The quality of Maine's potatoes is seriously affected by moisture stress in the soil throughout the growing period. This problem is documented in several research reports prepared at the University of Maine and is readily observed in the field by potato specialists, soil conservationists and irrigating growers. They have cited several reasons for beneficial effects on potato quality resulting from irrigation and conservation management:

- Crop rotation helps prevent diseases by allowing moisture to penetrate the soil, and by improving use of nutrients and the exchange of harmful gases with the air;

- Both irrigation and conservation alleviate moisture stress on the plant and potato tuber by increasing moisture levels in the soil;

- When moisture levels are maintained in the soil while tubers are setting on, a larger number of tubers will grow; otherwise they will slough off;

- More uniform size tubers will be harvested when moisture levels are maintained above 50 percent of field capacity. This will result in fewer culls and a larger percentage of potatoes marketed in better grades--largely due to elimination of misshapes, defects, bruises, rotting, deterioration and scab disease;

- Plants and tubers mature earlier thereby allowing for better harvesting conditions, less bruising, reduction of late blight disease, fewer frozen and rotting potatoes;

- An improved quality reduces weight loss and shrinkage during storage.

More research is needed to define the extent of quality benefits attributed to irrigation and conservation practices. Quality improvements were also emphasized in interviews with the Corps by managers and potato specialists directly involved in potato research and programs in North Dakota and the Pacific Northwest. Several potato seed growers in Aroostook County,

including the State's Seed Farm in Masardis, irrigate primarily to improve the seed quality. Additional information on irrigation and conservation needs is included in Appendix 1.

PLANNING CONSTRAINTS

The Corps does not have the authority to implement an irrigation or conservation program. Recognizing that the Corps' study could only recommend that other entities undertake programs of demonstration and research, the Corps attempted to locate a Federal agency that possesses the authority and funding to take over the study and carry it through to implementation. No Federal agency possesses the necessary authority or funds. In order to respond fully to the study resolutions authorized by Congress, this study therefore continued to assess the feasibility of these practices and to address means for funding and implementation by other entities. The present study is limited to evaluating existing crops in potato rotation based on 1976 marketing conditions and average crop prices and costs.

Planning Objectives

The objectives of the cropland Irrigation and Conservation Study are:

- To determine the economic and environmental feasibility of conservation management, irrigation management and combined irrigation and conservation management on potato farms in Aroostook County; and

- To determine how these practices, if feasible, could be promoted and eventually adopted to stop the reduction in potato acreage. The ultimate goal is to preserve the agricultural industry in the region, while reducing the pollution problem from cropland erosion.

FARM NO. 1 : MAJOR FEATURES OF IRRIGATION AND CONSERVATION PLANS

SCALE : 1 INCH = 400 FEET

NOTE: CROP ROTATION WILL ALTERNATE CROPLAND IN POTATOES AND GREEN MANURE

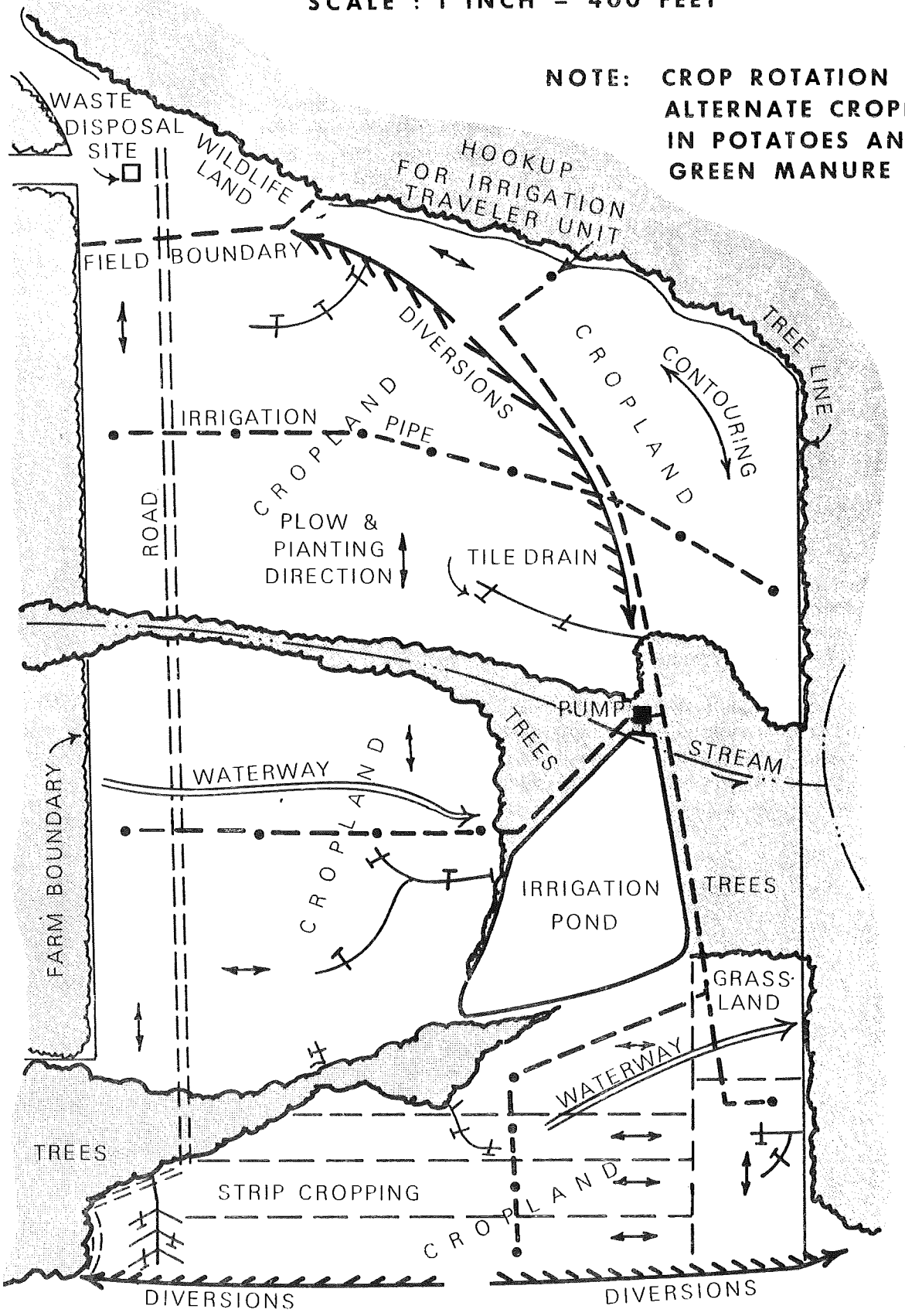


PLATE 5

Formulation of Preliminary Land Management Plans

The process used to formulate alternative irrigation and conservation plans, including their identification, assessment and evaluation, was conducted in compliance with Corps' guidelines and the Water Resources Council's Principles and Standards (P&S) for planning water resource projects. The formulation of alternative plans includes a systematic approach in preparing and evaluating alternative ways of addressing problems, needs, concerns and opportunities. The process itself requires the identification of several plans that meet the planning objectives. These are then assessed for their contributions to national economic development (NED), environmental quality (EQ), social well-being (SWB) and regional development (RD). The result of this formulation process is usually several alternative plans meeting the planning objectives, although each may emphasize greater contributions to the EQ account than NED and vice-versa. At this stage a public review of the alternative plans is conducted to obtain greater public opinion on a tentatively recommended plan, or to identify deficiencies in the alternative plans and evaluations presented. Further revisions are then made, if necessary, before a plan is recommended by the Corps of Engineers.

Management Measures

The USDA Soil Conservation Service was contracted by the Corps to identify land, structural and institutional management measures needed on potato farms to control erosion and to provide irrigation management. Three management plans were formulated and assessed for each farm, including:

- Conservation alone,
- Irrigation alone and
- Combined irrigation and conservation plans.

See Plate 5 for a layout of these measures on one of the nine farms selected for detailed plans. Appendix 5 contains conservation and irrigation plans for each of the nine farms.

Conservation Land Management Measures

Good conservation measures are practiced on less than 25 percent of the regions cropland.

The potato crop places a high nutrient demand on the soil and depletes the organic matter which serves as a sponge to absorb and

hold water providing for good nutrient, water and gaseous exchanges from plant to soil and air. Working the crop with heavy machinery during the season compacts the soil. The soil gradually loses its productivity and ability to allow penetration in heavy rains after continued potato production. It needs a replenishment of the organic matter, nutrients, and a rest from the high demands of potatoes to avoid becoming a medium conducive to viruses and poor potato yields.

Crop rotation is the most commonly employed measure used to control erosion on potato farms and involves annually alternating a row crop, such as potatoes, with a closely grown or cover crop, such as grain or hay. Currently, common local practices are to plant a field two, three or four years in potatoes followed by a year of oats, or else planting continually in potatoes. Rotations recommended are potatoes one year and oats the next, or two years of potatoes followed by one to three years of a cover crop.

While row crops expose the soil to intense rain and erosion, cover crops protect the soil. They provide the soil a chance to generate depleted trace elements and nutrients, replenish organic matter, provide for soil expansion and elimination of potato viruses while protecting the soil from erosion.

In Aroostook County cover crops usually cost the farmer a net loss of about $100 an acre--seldom is there a net return.[1] The problem of entering into a crop rotation by changing from all fields in potatoes (or even two-thirds potatoes) to half potatoes and half cover crop creates a variety of problems for the farmer and no less an economic one. Nevertheless, crop rotation is among the most effective measures to reduce average erosion rates and increase yields per acre in Aroostook County.

Contouring, Cross-Sloping

Contouring and cross-sloping are conservation measures where row crops are planted on or nearly on the contour of the land, as opposed to straight up and down the hill. Contouring is an effective way of slowing the rate of runoff and erosion, while allowing water needed for the crop to penetrate the soil and increase yields. Planting up and downhill is commonly practiced where the width and terrain of fields are more conducive to efficient and faster equipment operations. Since each potato field is traversed about 20 times a season, considerable time and operating costs (i.e. less turning and slowing down) are reduced

[1] In contrast, the potato crop may produce a net return averaging $150 acre, ranging annually from a loss to a gain of $1000 an acre depending on management and seasonal prices.

by traveling the long width of the field regardless of the slope. Up and downhill planting of row crops serves to accelerate the rate of runoff and erosion.

Strip Cropping

This alternates row and cover crops down the slope of a field at several hundred foot intervals. The measure is not commonly practiced in the county because of the disruption of efficient equipment operation and the removal of part of the field from potatoes. The practice can provide similar benefits as crop rotation, while controlling runoff from the potato strips.

STRUCTURAL MEASURES

Diversions and Waterways

Diversions and waterways are grass or rocklined ditches constructed on or adjacent to fields which collect flowing water from the fields during heavy rains. When placed at several hundred foot intervals, diversions protect the field below from additional erosion of topsoil, seed and nutrients. The waterways which collect diversion flows deposit the water safely into adjacent wetlands, grasslands, woods, streams or other areas. These structures are almost always required on conservation plans. The problem with adopting these measures are their construction cost and maintenance, interference with efficient equipment operation, and the land they remove from production. The structures require about a 50 to 60 foot wide strip of land, which includes a 15-foot seeded apron on each side for turning and traveling equipment, and to protect the banks from erosion.

IRRIGATION LAND MANAGEMENT MEASURES

Irrigation of potato crops is practiced on about 18 farms in Aroostook County. Specific guidelines on irrigation measures are not available for potato farms.

The irrigation source, including existing rivers, streams or lakes, farms ponds, and/or wells should be sufficient to provide water needed in a dry year. The distribution system includes a pump, a main line to carry water from source to field, and a network of pipes on the fields with sprinklers. A traveling unit dragging a flexible hose and automatically traversing the field while irrigating with a mounted sprinkler can be used in lieu of a series of sprinklers. Determining when to irrigate and how much water to apply are obstacles for many farmers. Good management requires careful monitoring of the soil to determine in advance when irrigation is needed. The weather must be monitored to find out how much and at what rate water can be applied without

sealing the soil's surface or over-irrigating and damaging the crop. Such technical information is not readily available, as evident from interviews with irrigators and from a literature search of guidelines. Only a few irrigating growers used moisture meters to monitor their soil's water content. The rest used their judgment based on how much rain had fallen, the texture of the soil, and condition of the plants. Even with the moisture meters, exact guidelines have yet to be established on the level of moisture needed at each stage of crop growth. Generally, though soil moisture should not drop below 50 percent. Other problems encountered were the labor needed to set up and move the pipes. A few farmers are successfully managing irrigation, but with limited guidelines and research for management, success is largely hit or miss. Very few growers kept management records to know whether their systems were making money. Management measures required for successful operation depend on a careful selection and design of the system to assure sufficient water and labor, record keeping, and the knowledge of the soils condition and moisture requirements.

Plan Formulation Rationale

The planning process to evaluate the feasibility of irrigation and conservation practices was divided into three separate stages:

Stage 1: Reconnaissance Level

Stage 2: Intermediate Level

Stage 3: Detailed Plans

Stage 1

The reconnaissance level was performed in 1976 at the start of the St. John River Study to determine if further investigations of cropland erosion and irrigation were warranted. The study's April 1975 Plan of Survey reported the reasons for proceeding into Stage 2, including: local reports of the severity of cropland erosion, and the need and potential benefits from adopting irrigation practices. A brief literature search and public meeting provided this information.

Stage 2

The development of intermediate plans involved an intensive literature search to:

- Evaluate historical conditions of the potato industry;

- Develop projected conditions for a no Federal action condition;

- Identify the potential potato yields and their quality with conservation alone, irrigation alone, and for combined irrigation and conservation measures;

- To determine the change in net farm income for improved conservation under conditions of improved crop rotation with structures;

- To assess the economic, environmental, social and regional impacts of combined irrigation and conservation practices if adopted basinwide.

- To determine the minimum benefit-to-cost ratio of an I-C project in the northern region by maximizing costs and minimizing benefits as a first-cut analysis.

The study's March 1976 Preliminary Report concluded with recommendations to proceed into detailed surveys of a small area of cropland in order to study the full potential of irrigation and conservation and the associated social, environmental and economic impacts.

Stage 3

Stage 3 emphasizes the detailed assessment amd evaluation of a small number of farms. Twenty six potato growers responded to inquiries to participate in a pilot study of irrigation and conservation (I-C) practices during public workshops in the summer of 1976. Nine nonirrigating potato farms were selected as study farms based on geographic location and other factors for detailed I-C investigations. The Soil Conservation Service was contracted by the Corps to prepare detailed conservation and irrigation plans for the nine farms. SCS then assessed the potential economic and environmental impacts of the planned I-C practices with assistance from the Corps and the University of Maine.

Eight irrigated potato farms were also sampled for yield increases, economic data and management measures associated with irrigation. SCS was also contracted to conduct and report on advisory meetings to identify the type of program needed to promote I-C practices if the combined practices remained feasible as indicated by preliminary studies.

The Corps prepared a computerized simulation of an operating farm's crop budget for typical cropland conditions to determine

the impacts of a multitude of variables which affect the potato business of an average farm to include impacts which were either not practical or possible to assess for each of the nine nonirrigating farms. The simulation of an average county farm condition assessed the economic, production, erosion, labor and energy impacts from I-C plans. Impacts were assessed for the following types of changes: typical cropland underwent land use changes from crop rotations; equipment experienced inefficiencies from structure interference and row realignment or contouring; yields or acreage declined without improvements; each expense in the crop budget, including production, storage and marketing costs, changed with yield and operating changes; and as conservation measures were applied to reach erosion goals.

This report will first describe the assessment and evaluation of I-C practices followed by the formulation and evaluation of a plan for a research and demonstration program. This document reports on the investigations of Stage 3 in the planning process.

Formulation and Evaluation Criteria

In evaluating possible alternative solutions to conservation and irrigation management practices certain criteria were established during formulation for the technical, economic, environmental and social assessments.

Technical Criteria

The conservation plans for the nine project farms were prepared in keeping with regular practices and design procedures of the Soil Conservation Service. Irrigation plans were designed according to Planning for an Irrigation System, a publication developed by the American Association of Vocational Instructional Materials in cooperation with the USDA Soil Conservation Service, June 1971. Irrigation water requirements for the potato crops were provided by the SCS Technical Service Center based on Technical Release No. 21 entitled Irrigation Water Requirements, USDA-SCS, April 1967. The plans were designed to be complete and feasible to implement. The typical cropland condition was assessed based on unit quantities and values developed from the design of the farm plans.* All plans were assessed assuming measures would be implemented in the first year, rather than staggered over several years. The assessments display numerical values, as developed, without significantly rounding the numbers to depict a degree of accuracy. The precision of most values or the uncertainty associated with impacts are footnoted for each plan on tables entitled "Summary Assessments."

*Production and other budget costs from over a hundred potato farms were also used.

Economic Criteria

The economic data for each farm, including land use, yields, unit returns, production, storage, marketing expenses, and quantities, were obtained from questionnaires and interviews with potato growers for the 1976 crop; although yields and returns were based on averages of historical data.

All plans were assessed at the 1976 price level, and for interest rates and cost sharing policies in effect during the study. As a result the assessments represent the current feasibility of implementing the alternative practices. Interest rates used for grower investments and their value of capital include:

Conservation structures, 7 percent on government loans;

Irrigation investments, 8.5 and 9.5 percent on commercial loans;

Gross benefits or annual change in net farm income, amortized at 8.5 percent,

Short term crop investments, 9.0 percent.

A Federal interest rate of 7 percent was used to amortize the 10 percent Federal cost of conservation structures (7 percent was selected in lieu of 6-5/8 or 7/8, to facilitate the assessment). There was no cost sharing for irrigation.

SCS elected to evaluate the 9 project farms plans over a 15 year period since it was the minimum life of any structure and responded to the short term financial concerns of potato growers; although the capital costs would be paid back over the life of the structure.

Typical cropland plans are evaluated over 20 years, the average life of irrigation structures which is the major investment; in addition, capital costs and major replacements are paid back over this time frame.

Benefits attributed to crop yield increases were based on generally supported and available farm data. OBER's (Office of Business Economics and Economic Research Service) projections were used for the typical cropland conditions to develop a one percent annual increase in irrigated yields due to new technology and improved management after the first project year. For a plan to be economically feasible, tangible benefits must exceed project economic costs, which includes project structural costs, and recognition of lost farm income to the national economy defined as a mitigation payment

to any grower experiencing a long term loss in net farm income from a plan.

Environmental Criteria

Conservation plans were designed to reduce existing erosion to a rate of 3 tons or less per acre per year on all fields, the goal of SCS and EPA's Water Quality Management Plan for the region. Irrigation ponds were designed to allow for fish passage, in keeping with State requirements. The requirements of the National Environmental Policy Act of 1969 were addressed by providing environmental assessments of I-C practice impacts on each farm or for typical cropland. These assessments also address the requirements of the Water Resources Council's Principles and Standards. Existing problems identified in the region's Water Quality Plans are assessed for impacts by irrigation and conservation measures. The Universal Soil Loss Equation was used to estimate cropland erosion. Biocide and nutrient loadings were changed in direct relation to changes in erosion. Nutrient loadings also changed in direct proportion to changes in potato acreage.

Social and Regional Development Criteria

The major social criterion was to determine if these plans increased the level of net farm income significantly to provide the potential of stopping the declining trend in potato farms. Regional development would be improved if plans could stop the decline in potato production.

Plans of Others

The "208" Water Quality Management Plan (Section 208 of the 1972 Federal Water Pollution Control Act) was used as a guide in developing the simulated average farm conditions in Aroostook County. The plan provided existing land use conditions and average land use changes with conservation plans to obtain a 3 ton per acre erosion rate. The 208 assessment of environmental impacts also provided average unit values of sediment, biocides and nutrient quantities reaching area waters. Social impacts discussed in the 208 plan were also applicable to conservation impacts in this report. The 208's evaluation of economic impacts from conservation were not used since it differed from the requirements of the Principles and Standards as discussed in Appendix 2. For example, higher farm operating costs should result from increased yields--and not held constant regardless of yield increase; and yearly changes in net farm income over an evaluation period should be converted to an average annual equivalent to compare to annual project costs--in lieu of comparing todays net income to the level of income eight years in

the future without accounting for the loss of income and interest incurred during that period.

Analysis of Plans Considered in Preliminary Planning (Stages 1 & 2)

Description of Plans

The reconnaissance level of planning (Stage 1 Plan of Survey) concluded that both erosion control and irrigation warranted preliminary studies. The reason was that erosion from agricultural lands was a major cause of water pollution due to the lack of crop rotation and cover crops. Irrigation warranted further study based on a report that the reduced yield of the potato crop was due to the lack of proper irrigation, estimated at one inch of water per acre per week, for a good crop. Substantial economic benefits were reported if growers irrigated.

Intermediate plans (Stage 2) were prepared to evaluate conservation practices to control erosion, investigate irrigation practices to make up water deficiencies in the potato crop, and to assess the history and potential future of potato production. The Soil Conservation Service (SCS) was contracted by the Corps to provide information on the severity and location of erosion, typical costs of controlling it on cropland, potential environmental and social impacts of erosion and Government subsidized programs to encourage the use of conservation practices. SCS's Phase 1 Erosion Study report was used to assess the economic impacts of the following two conservation plans as reported in the Corps Preliminary Report.

(1) A plan to control erosion by converting cropland from continuous potatoes to only 60 percent potatoes and 40 percent cover crop and using structures to improve drainage.

(2) A plan to control erosion by converting cropland from continuous potatoes to only 50 percent potatoes and 50 percent cover crops with structures to improve drainage.

SCS also prepared a Phase 1 Irrigation Report which provided irrigation requirements of potatoes, potential yields with irrigation, and impacts of irrigation practices. Based on this report and supplemental information, a plan was developed to evaluate the economic impact of combined conservation measures needed to control erosion and irrigation measures to supply water to the northern region of Aroostook County, about 8 percent of the Aroostook County's potato cropland. The plan was described as the Irrigation-Conservation Program "First-Cut" Analysis. Only one plan for conservation and one plan for providing irrigation water

to area farms were evaluated. The main objectives of the analysis were to develop minimum benefits and maximize costs and to determine if a favorable benefit-to-cost ratio would result. The plan provided for 23,500 acres of cropland to be placed in potato rotation with 13,300 acres of potatoes irrigated. Benefits were minimized, for example by limiting yield increases, while costs were maximized, for example by irrigating all land from one water source, the St. John River, while bypassing all other potential sources using an extensive underground pipeline network. The irrigation water would be transmitted through 86 miles of pipeline ranging from 12 to 60 inches in diameter to within one mile of all cropland. On-farm systems would distribute the water from that point. All on-farm costs for conservation measures and distribution systems were based on past reports, while the irrigation network cost was developed from a preliminary design.

Comparative Assessment and Evaluation of Plans

The two conservation plans which reduced cropland erosion by improving crop rotations and controlling runoff with structures resulted in long-term economic losses to potato growers. The combined plan for conservation and irrigation measures resulted in a net economic gain of $2 million per year over a 20 year evaluation period, and a benefit-to-cost ratio of 1.26. Preliminary studies indicated that adoption of combined irrigation and conservation measures would also contribute to:

(a) Socioeconomic

- Stabilize the region's economy
- Increase employment opportunity
- Promote crop diversification
- Improve crop production
- Improve crop quality
- Improve basin incomes
- Decrease crop production costs
- Decrease water treatment costs
- Decrease roads' & water supplies' maintenance costs
- Decrease taxes paid by residents
- Increase the value of agricultural land
- Promote community improvement

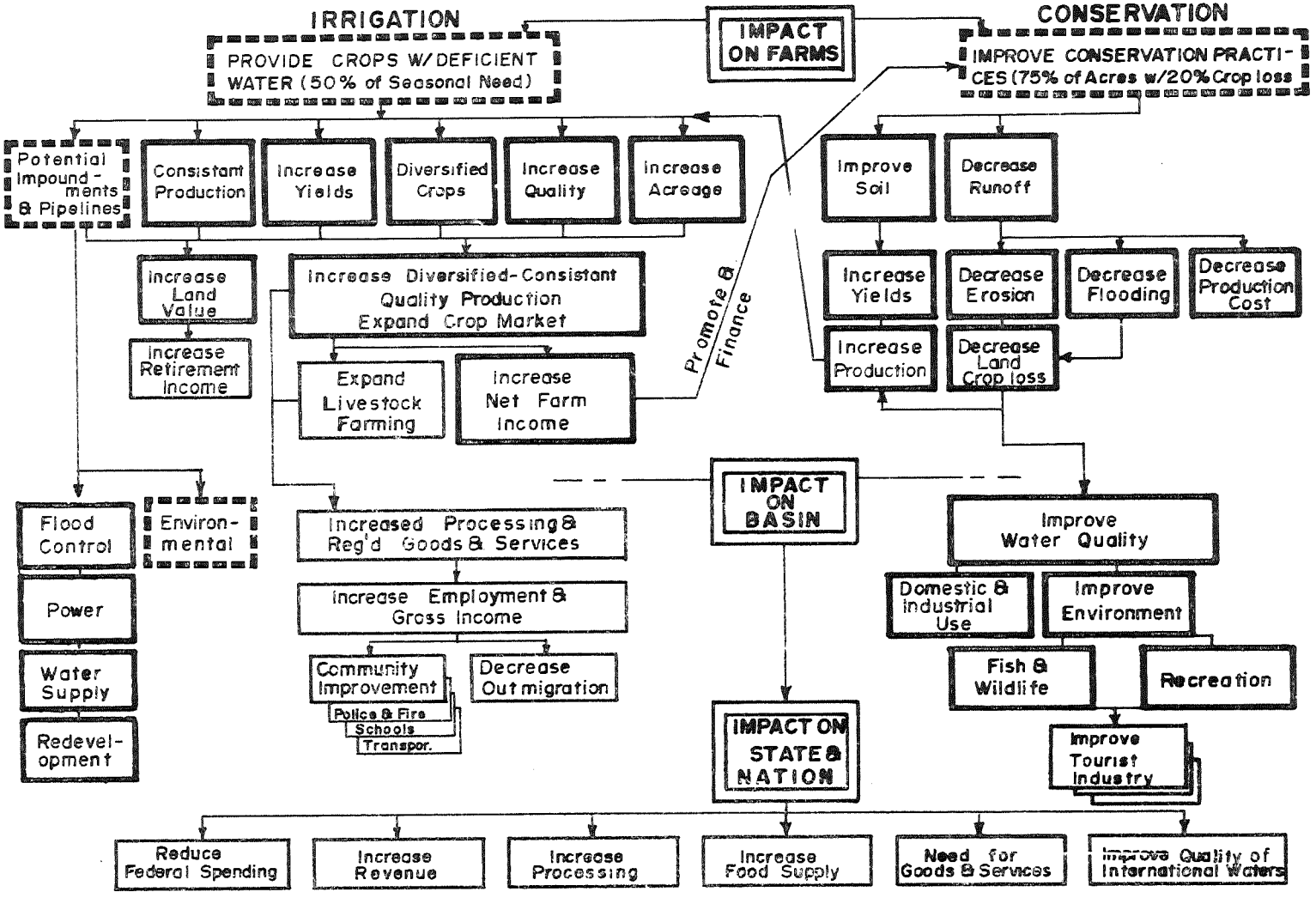
(b) Environmental

- Decrease runoff sedimentation and flooding
- Improve domestic and industrial water supplies
- Improve water related recreation
- Improve water quality for fish & wildlife
- Decrease the deterioration of topsoil
- Preserve the natural resource base -- soil

Conclusions (Screening)

The preliminary investigations identified the potential economic feasibility and need for irrigation and conservation measures on cropland in potato rotation. It was proposed in the study's Preliminary Report that an interim survey report be completed for a small area of cropland which would permit more detailed study of the full potential for irrigation and conservation and the associated social, environmental and economic impacts. The size of the area recommended was one that could be conveniently studied yet large enough and sufficiently representative to surface significant impacts relating to a major I-C program. A suggested size of the project area was one or two percent of the total 300,000 acres in the basin, suitable for irrigation-rotation, i.e., 3,000 to 6,000 acres and comprising of approximately 10 to 20 farms. The detailed study proposal was endorsed by State of Maine and local agencies and potato growers during coordinating meeting and workshops conducted during the summer of 1976. See letters of endorsement by the State Commissioner of Agriculture dated 2 & 7 July 1976 in Appendix 4. Additional information on Stages 1 and 2 is included in Appendix 2.

ST. JOHN RIVER STUDY
IMPACT OF IRRIGATION-CONSERVATION PROGRAM IN THE ST. JOHN RIVER BASIN, MAINE



LEGEND: ——— DIRECT BENEFITS —— INDIRECT BENEFITS - - - - COSTS

PLATE 6

Assessment and Evaluation of Detailed Land Management Plans

Detailed conservation and irrigation plans, prepared and evaluated for nine farms in Aroostook County, are being considered for demonstrating the impacts of irrigation and conservation land management measures to the other potato growers. The following assessments will examine the separable contributions to the nine farms, typical cropland, and to the national and planning objectives from: Plan A conservation only, Plan B irrigation only, and Plan C combined irrigation and conservation plans (I&C) and compare each to existing and future conditions without Federal action. These plans should be reviewed keeping in mind the potential impact on the region if they are promoted and adopted regionwide on the 180,000 acres of land currently in potato rotation. See Plate 6. Appendicies 2, 5, 6 and 7 contain additional information and detailed technical data on these plans.

EXISTING CONDITIONS AND FUTURE WITH NO FEDERAL ACTION

NINE PROJECT FARMS

The Maine Department of Agriculture and others endorsed the direction of the study to proceed with a pilot study to assess I-C practices on 10 to 20 farms in Aroostook County. Following a series of workshops 26 potato growers indicated an interest in participating; although only nine growers were selected for detailed studies to represent the three geographic regions. Only nine growers were used in the study due to funding restraints. Table 6 described conditions on the farms and information on their crops. The nine potato growers owned 1,663 acres of cropland with 1,028 acres (62 percent) planted in potatoes and 635 acres (38 percent) to crops rotated with potatoes. The five predominant potato varieties in Aroostook County (Katahdin, Russet Burbank, Superior, Kennebec and Ontario) are represented on these nine farms. The most common soil is Caribou, which grows about 60-70 percent of Aroostook's potatoes and is well represented on the nine farms. The average field capacity of their soil, or water holding capacity of their soil in the top 18 inches of soil depth available to the potato plant, is 3.0 inches also comparable to the county's average. Their average yield of 246 hundredweight (cwt) per acre is above the county's 230 cwt per acre average. Potatoes are grown for three major uses in the county; seed, tablestock and processing--all represented on the farms.

The nine potato growers annual net incomes from potatoes and rotation crops only were estimated to range from a loss of $9,000 to over $50,000 per year, with a 9-farm total of $250,445. Their annual return over annual expenses ratios ranged from 0.87 to 2.1 with a nine farm average of 1.38, or returns exceeded expenses by

TABLE 6

EXISTING CHARACTERISTICS OF 9-PROJECT FARMS

Farm Number County Location Crops Grown	Crop Acres	Potato 2/ Varieties & Avg. Yield (cwt/Acre)	Potato Use	Soils (%) 3/ & Avg. Field Capacity (Inches of Water)	Total Erosion (Tons/Year) & Avg. Erosion Rate (Tons /Acre/Year)
Farm 1, Central					
Potato	79 Ac	Ontario	Table-	Cg(70)	182 TN
		Russett	stock,	Co(10)	2.3 T/A/Y
		231 C/A	Process	Sg(20)	
				3.2 in.	
Farm 2, Central					
Potato	123 Ac	R. Norlands	Seed	Cg(70)	779 Tons/Y
Corn	50 Ac	Pungo		Co(15)	4.5 T/A/Y
Total	173 Ac	Menona		Mh(15)	
		Green Mts		3.2 in.	
		208 C/A			
Farm 3, Central					
Potato	152 Ac	Superior	Seed,	Cg	829 Tons/Y
Grain	107 Ac	Russett	Process	3.5 in.	3.2 T/A/Y
Total	259 Ac	Ontario			
		277 C/A			
Farm 4, South					
Potato	80 Ac	Superior	Seed,	Cg(40)	850 Tons/Y
Grain	10 Ac	218 C/A	Table-	Mh(60)	5.0 T/A/Y
Beans	80 Ac		stock	2.9 in.	
Total	170 Ac				
Farm 5, Central					
Potato	82 Ac	Katahdin	Table-	Mh	541 Tons/Y
Grain	41 Ac	Kennebec	stock,	2.3 in.	4.4 T/A/Y
Total	123 Ac	203 C/A	Process		
Farm 6, Central					
Potato	230 Ac	Katahdin	Seed	Cg(60)	1,627 Tons/Y
Grain	86 Ac	Chippewas		Co(30)	3.6 T/A/Y
Hay	136 Ac	241 C/A		Mh(10)	
Total	452 Ac			3.2 in.	
Farm 7, North					
Potato	97 Ac	Kennebec	Seed	Sg(40)	283 Tons/Y
Grain	60 Ac	Katahdin		Pg(20)	1.8 T/A/Y
Total	157 Ac	Chippewas		Ag,Sa, Ha	
		278 C/A		2.9 in.	
Farm 8, North					
Potato	101 Ac	Katahdin	Table-	Pg	468 T/Y
Grain	55 Ac	Ontario	stock	3.1 in.	3.0 T/A/Y
Total	156 Ac	Superior			
		242 C/A			
Farm 9, South					
Potato	84 Ac	Katahdin	Seed	Mg(50)	498 T/Y
Grain	10 Ac	Superior		Cg(40)	5.3 T/A/Y
Total	94 Ac	314 C/A		Co(10)	
				2.9 in.	
FARM TOTALS 1/					
Potato	1028 Ac	10-	Table-	Cg(49)	6,057 Tons/Y
Grain	369 Ac	Varieties,	stock	Co(11)	
Hay	136 Ac	Average	Seed,	Mh(18)	3.7 T/A/Y
Other	130 Ac	Yield:	Process	other(22)	
Total	1663 Ac	246 C/A		3.0 inch	

1/ Net Income $250,445 per year; Average per Farm: $27,827, Range $-9,000 to $61,000; Average Budget Return Above Costs: 38%, Range: -13% to 110%.
2/ Varieties (maturing); Early: Menona, Norland; Medium: Kennebec, Superior, Pungo; Late: Russet Burbank, Katahdin, Green Mountain, Ontario; Medium-Late: Chippewas.
3/ Soils: Co-Conant, Sg-Stetson, Mh-Mapleton, Ag-Alagash, Sa-Salmon, Ha-Hadley, Pg-Plaisted Cg- Caribou.

38 percent for these farm businesses. Three growers had annual expenses equal to or exceeding annual returns. A family living allowance was not included in the expenses nor was an allowance for owner or family labor. The three financially unsound farms are still in business since like most of the other six farms, their owners either have supplemental income from other agricultural enterprises or part-time jobs. This income was not included in the evaluation. So as to maintain the privacy of their financial status, data are not displayed for the individual farms.

The total erosion on the nine farms is 6,057 tons per year with an average rate of 3.7 tons per acre per year. This rate is well below the county's average rate for all cropland of 6.3 tons and below the average rate for cropland in potato rotation which may approach 10 tons per acre per year.

The characteristics of the farms are fairly representative of conditions found in Aroostook County, except for their lower average erosion rate (which may explain their slightly higher yield). More information on these farms is available in the appendices.

Typical Cropland

Existing conditions and the future if no Federal action on typical cropland is summarized in Table 6A for a sample of cropland equal in size to the nine farms' 1,663 acres with two-thirds in potatoes and one-third in oats. The total cropland declines at 1.5 percent per year which directly effects reductions in production, sales, income and erosion. The assumption was made that the more severely eroding acreage would decline first and therefore result in higher future reductions in erosion after 20 years than simply the reduction in acreage. The average annual loss in net farm income over the 20 years is estimated at $14,800 per 1,663 acres of cropland in potato rotation. The impact from todays total 180,000 acres of cropland would equal an average annual loss of $1.6 million. Potato returns and expenses are also summarized for latter comparison to Plans A, B and C. The $748 total expense computed per acre of potatoes for the existing condition only approximates the $750 value used in the 208 studies as reported by the 1976 Agricultural Bargaining Council Survey. Potato returns are based on a slightly lower harvested yield and unit return, than the 5 year averages selected by the 208 studies. The economic appendix explains the development of the potato and oats budgets in detail. Cropland descriptions are provided for project years number 1, 8 and 20 since these are significant years for project impacts--the first year of change, the eighth year when reaching full productivity with conservation, and the last year of evaluation.

TABLE 6A

DESCRIPTION OF TYPICAL CROPLAND, EXISTING CONDITIONS & FUTURE IF NO FEDERAL ACTION

	EXISTING CONDITION	IN PROJECT YEAR #1	FUTURE IF NO FEDERAL ACTION (cropland declines at 1.5%/year) IN PROJECT YEAR #8	IN PROJECT YEAR #20
•Cropland (comparable to 9-Farms):	1,663 Ac.	1,638	1,474	1,229
-- in potatoes (67%):	1,109 Ac.	1,092	983	819
-- in oats (33%):	554 Ac.	546	419	410
Percent reductions:	--	1.5%	11%	26%
•Potato production: (1,000 cwt):	255	251	226	188
•Potato sales: ($1,000):	$1,033	$1,017	$ 915	$ 763
•Total net income to farm management per year				
-- per 9-Farms, 1,663 Ac. existing: ($1000)	$ 156.6	$ 154.3	$ 138.8	$ 115.8
		(Average annual loss: $14,800)		
-- per Farm, 185 Ac. existing (123 Ac. of potatoes):	$ 17,400	--	--	--
•Total Annual Erosion: (1,000 tons):	10.5	10.2	8.2	5.7
-- Rate per acre of cropland (tons/Ac.):	6.3	6.2	5.6	4.7
-- Percent reduction from existing:	--	3%	22%	46%
•Potato harvested yield (cwt/Ac.):	230	230	230	230

•FARM BUDGETS: -- POTATOES

-- Potato Returns per Ac. . . . . $932/Ac.

Potato marketed yield (excludes 15% shrinkage, 35 cwt/Ac.) & price received:

U.S. No. 1's:	123 cwt/Ac. @	$5.44/cwt
Irregualrs (over/under size)	53 cwt/Ac. @	$4.09/cwt
Marketed Culls:	19 cwt/Ac. @	$2.41/cwt
Total Marketed:	195 cwt/Ac. @	$4.76/cwt
(price received per harvested yield:		$4.04/cwt)

--Potato Expenses per Ac.

Planting Costs:	$325	Storage & Marketing:	$147
Fertilizer:	$ 94	Other & Miscellaneous:	$115
Harvesting:	$ 67		

Total Potato Expense: $748/Ac.

-- Potato Net Income to Farm Management: Potato Net Income: $184/Ac.

-- Oats Net Loss to Farm Management: Oats Net Loss: $ 84/Ac.

•Return-on-Expense Ratio: 1.18

Plan A Conservation Only

Conservation measures convert eroding cropland into a productive and lasting resource.

NINE-PROJECT FARMS

Under Plan A, the conservation only plan, SCS designed conservation measures for 1,663 acres of cropland on the nine farms to reduce erosion below three tons per acre per year on all fields and improve the condition of the soil. The measures designed by SCS in cooperation with the potato growers included crop rotations, contouring, strip cropping, 16 miles of waterways and diversions and open drains as shown in Table 7. An additional 48 acres of new land (formerly grassland) were brought into production with the introduction of 16.5 miles of subsurface tile drains. Rotation crops used to improve the soil include grain, hay, beans and green manure, which is an unharvested crop such as hay that is plowed into the soil to add organic material.

TABLE 7

DESCRIPTION OF CONSERVATION PLANS & IMPACTS
ON 9-PROJECT FARMS

Farm Number, Crops Grown With Plan	Project Crop Acres (acres)	Conservation Practices Measure	Structure Length (feet)	Land Use Change (acres)	Project Potato Yield & Price Increase (after 2 crop rotation cycles)	Project Total Erosion (Tons/Year) & Avg. Erosion Rate (tons/acre/year) (percent change)
Farm 1: Central Aroostook						
Potato	52	WWY&DIV	3,600	3.7	270 CWT/AC	131 T/Y
Green Manure	25	Tile Drain	3,550	1.6	+17% Yield	1.7 T/A/Y
Total	77	Crop Rotation: 3 year cycle			+9% Price	-28 %
Farm 2: Central Aroostook						
Potato	113	WWY&DIV	8,450	11.6	243 C/A	456 T/Y
Green Manure	56	Tile Drain	3,925	0	+17% Yield	2.7 T/A/Y
Total	169	Access Road	3,450	--	+11% Price	-42%
		Crop Rotation: 2 year cycle				
Farm 3: Central Aroostook						
Potato	131	WWY&DIV	14,750	12.5	324 C/A	367 T/Y
Grain	66	Tile Drain	16,800	15.4	17% Yield	1.4 T/A/Y
Green Manure	65	Crop Rotation: 4 year cycle			5% Price	-56%
Total	262	Strip Cropping				
Farm 4: Southern Aroostook						
Potato	41	WWY&DIV	7,900	8.6	262 C/A	322 T/Y
Grain	40	Tile Drain	3,800	0	20% Yield	2.0 T/A/Y
Green Manure	40	Crop Rotation: 4 year cycle			12% Price	-62%
Beans	40	Strip Cropping				
Total	161					
Farm 5: Central Aroostook						
Potato	65	WWY&DIV	8,500	5.1	248 C/A	234 T/Y
Grain	33	Tile Drain	12,800	5.0	22% Yield	1.9 T/A/Y
Green Manure	25	Crop Rotation: 4 year cycle			14% Price	-57%
Total	123					
Farm 6: Central Aroostook						
Potato	216	WWY&DIV	27,000	24.8	272 C/A	691 T/Y
Grain	108	Tile Drain	18,900	5.0	13% Yield	1.6 T/A/Y
Hay	108	Access Road	4,250		6% Price	-58%
Total	432	Crop Rotation: 4 year cycle				
Farm 7: Northern Aroostook						
Potato	76	WWY&DIV	6,775	5.2	317 C/A	198 T/Y
Grain	76	Tile Drain	4,850	0	14% Yield	1.3 T/A/Y
Total	152	Open Drains	300		4% Price	-30%
		Crop Rotation: 2 year cycle				
		Contouring				
Farm 8: Northern Aroostook						
Potato	114	WWY&DIV	5,800	6.8	288 C/A	374 T/Y
Grain	56	Tile Drain	21,300	21.0	19% Yield	2.2 T/A/Y
Total	170	Open Drains	1,400		9% Price	-20%
		Access Road	6,900			
		Crop Rotation: 4 year cycle				
		Strip Cropping				
Farm 9: Southern Aroostook						
Potato	46	WWY&DIV	2,500	2.8	367 C/A	146 T/Y
Grain	40	Tile Drain	1,000	0	17% Yield	1.6 T/A/Y
Hay	5	Strip Cropping			1% Price	-71%
Total	91	Crop Rotation: 2 year cycle				
9-FARM TOTALS						
Potato	854	WWY&DIV	85,275	81.1	288 C/A	2,919 T/Y
Grain	419	Tile Drain	86,925	48.0	17% Yield	1.8 T/A/Y
Green Manure	211	Open Drains	1,700		8% Price	-52%
Hay	113	Access Road	14,600			
Beans	40	Crop Rotation: 3.2 year average cycle				
Total	1,637					

Complete conservation plans in Appendix 5 show locations of measures and land preserved for wildlife. The installation cost of structures, excluding their design and supervision, is estimated at $183,000 (1976 price level), with a total annual cost of $31,770 (Table 7).

TYPICAL CROPLAND

The typical cropland for Plan A assumes acreage will not decline from the existing condition, but will be reclassified due to an improved 4-year crop rotation and conservation structures. Conservation structures will cover about seven percent of the land with the rest equally divided into potato and cover crops (oats and green manure). The total effect is a 30 percent reduction in potato acreage. The plan closely approximates the 208 plan's assessment to reach the 3-ton erosion goal using the same rotation requirement and similar structural needs. Also, similar structures are needed as on the nine farms, although a more stringent rotation is needed for a greater reduction in erosion. Tile drainage was not considered by the 208 Plan as either a major erosion control practice or as a means to bring a significant amount of land into production, since additional suitable land is unavailable to most farms to offset the loss of potato acreage. For these reasons, the typical cropland condition excluded tile drainage from the assessment. Table 7A describes the typical cropland condition with impacts on land use, production, sales, farm net income and budgets.

IMPACT ASSESSMENT AND EVALUATION

National Economic Development

The contribution of the nine farm plans to national economic development (Table 8) would generate average annual net benefits over a 15 year evaluation period totaling an estimated $36,200. The net benefits are realized from the increased value of goods and services on these farms over and above project costs, and above what these farms are estimated to produce over the no action plan.

The goods and services benefit (or change in gross farm income) is determined from yield and price increases and changes in crop acreage attributed to the conservation measures, less increased production costs over 15-years. Potato yields which increased gradually (to 17 percent average) over two rotation cycles were estimated by SCS based on their experience and sampling farms in the region. The methods of estimating price increases from improved crop quality will be presented under Plan B. Conservation is also credited with the $14,800 per year for stopping declining production from deteriorating soils and loss of acreage as estimated for typical cropland.

TABLE 7A

DESCRIPTION OF TYPICAL CROPLAND AND IMPACTS WITH CONSERVATION PLAN

CONSERVATION MEASURES
-- Crop Rotation Potato-Potato-Oats-Green Manure
-- Contouring
-- Waterways and Diversions: 86,476 ft. (16 miles)

*LANDUSE:	Existing	With Conservation Project Years No.'s 1-20
Cropland in potatoes:	1109 acres	777 acres (47%)
-- in grain (oats):	544 acres	388 acres (23%)
-- unharvested (green manure)	--	388 acres (23%)
--Total cropland	1663 acres	1,553 acres (93%)
*Land in conservation structures	--	110 acres (7%)
TOTAL LAND	1663 acres	1,663 acres (100%)

	Existing	Project Years #1	Project Years #8 - #20
*Potato Production: (1,000 cwt)	255	192	206
-- Change from existing condition:	-	-25%	-19%
*Potato Sales: ($1,000)	$1033	$812	$906
*Total Net Income to Farm Management before borrowing to offset loss of income: ($1,000)	$157	$105	$182
*Total Annual Erosion: (Tons)	10,480 @ 6.3 T/A	3885 @ 2.5 tons/acre	
-- Reduction from existing	-	62%	
*Potato Harvested Yield: (cwt/Acre)	230	247	264
-- Increase from existing condition:	-	7.5%	15%
*Potato Budget for Project Years:			
-- Potato Returns per Acre		$1,046	$1,166

Year #8 U.S. #1's 164 cwt @ $5.44
Irregular 55 cwt @ $4.09
Culls 20 cwt @ $2.41
(9% shrinkage) Total Marketed: 239 cwt @ $4.86 (or 264 cwt @ $4.40)

-- Potato Expenses per Acre		$818	$840

Potato Budget Expenses Per Acre Itemized for Year #8

Planting	$342	Storage & Marketing	$180
Fertilizer	$103	Other	$121
Harvesting	$ 88	Conservation	$ 6

*Crop Net Incomes:

--Potato Net Income per Acre	$228	$326
--Oats Net Loss per Acre	($113)	($108)
--Green Manure Net Loss per Acre	($ 72)	($ 72)

TABLE 8

PLAN A: SUMMARY ASSESSMENT OF CONSERVATION ONLY

	Footnotes	LOCATION OF IMPACTS On 9- Project Farms' 1663 Acres of Cropland	On Typical 1663 Acres of Cropland
1. National Economic Development (NED)			
a. Beneficial Impacts (average annual benefits)			
(1) Value of increased outputs of goods and services: increased net farm income			
(a) Average increase over current condition	(2.5.7.9)	$ 76,600	$ 10,500
(b) Average increase from stopping declining conditions	(2.5.7.9)	14,800	14,800
(2) Total NED Benefits		$ 91,400	$ 25,300
b. Adverse impacts (average annual costs)			
(1) Project Cost: (Federal ($12,300) & Local ($19,500) for 9-Farms)	(1.6.7.9)	$ 31,800	17,600
(2) Lost farm income, includes some mitigation for nonstructural measures	(2.4.7.9)	22,200	22,200
(3) Total NED Costs		$ 54,000	$ 39,800
c. Net NED benefits		$ 37,400	$-14,500
d. Benefit-to-Cost Ratio (BCR)		1.7 to 1.0	0.6 to 1.0
2. Environmental Quality (EQ)			
a. Beneficial Impacts .Effect on intensive landuse*, reduction in potato acreage	(1.5.7.9)	17%	30%
(1) Effects on international basin's water quality* (stream and lake pollution)			
(a) Sediment loads and turbidity reduced	(2.5.8.9)	--	62%
(b) Nutrient and biocide loads reduced	(2.5.8.9)	--	65%
Effect on potato dumps, reduction in discarded potato culls	(2.5.8.9)	--	30%
(2) Effect on preserving topsoil and nutrients, cropland erosion reduced	(2.5.8.9)	52%	62%
(3) Effect on intensive landuse*, reduction in potato acreage	(1.5.7.9)	17%	30%
(4) Effects on annual energy consumption: farm machinery, diesel fuel reduced	(1.5.7.9)	--	5%
(5) Effects on basin's water consumption:	(2.6.7.9)	nil	nil
(6) Effects on air quality*	(1.6.9)	nil	nil
(7) Effects on historical, archeological sites*	(6)	none	--
b. Adverse Impacts			
(1) Effects on landuse - Structures on/adjacent to cropland			
(a) Waterways, diversions, open drains	(1.6.7.9)	16 miles	16.3 miles
(b) Subsurface tile drains	(1.6.7.9)	16.5 miles	nil
(c) New access roads	(1.6.7.9)	2.8 miles	nil
(2) Effect on wildlife, grasslands converted to cropland	(1.6.7.9)	48 acres, slight	nil

	Footnotes	LOCATION OF IMPACTS On 9-Project Farms' 1663 Acres of Cropland	On Typical 1663 Acres of Cropland
3. Social Well-Being (SWB)			
a. Beneficial Impacts (1) Effects on preserving agricultural heritage and family farms	(3.4.7.11)	depends on participation	
(2) Effect on security of farm families, average increase in net farm income with subsidy	(2.4.7.9)	35%	12%
(3) Farms with immediate improvements in standard of living	(1.5.7.9)	1 farm	10%
(4) Farms with short term loss of income but long term economic gains and standard of living improvement	(2.5.7.9)	3 farms	35%
(5) Effect on Public Health and Safety: * improved water quality	(2.5.8.11)	depends on participation	
(6) Effect on plans acceptance for soil conservation and improved water quality	(1.6.9)	general support by agencies	
(7) Relocations required *	(6)	none	--
(8) Effect on recreation activities: improved water quality	(2.5.8.11)	depends on participation	
(9) Effect on community growth: after 10-years increased revenue and production	(2.5.8.11)	depends on participation	
b. Adverse Impacts			
(1) Farms forced to carry additional financial debt over 8-10 years, may lose their farms, may need susidized low interest loans or grants, if mandatory:	(1.5.8.11)	3 farms	35%
(2) Farms severely affected with long term economic losses, may lose their farm unless subsidized by grants:	(1.5.8.11)	2 farms	20%
(3) Effect on Community Cohesion: * if mandatory action with government intervention	(1.4.11)	depends on cost-share programs	
(4) Effect on Community Growth: * initial 10-years loss in revenue and production	(1.4.7.11)	significant	
(5) Effect on plans acceptance: if mandatory	(1.6.11)	max. criticism by farmers	
4. Regional Development (RD) Initial Investments	(1.6.7.9)	$221,000	$95,000
a. Beneficial Impacts (1) Project Investments	(2.5.8.11)	depends on participation	
(2) Effects on preserving cropland after 10-years	(2.5.7.9)	$ 91,200	$ 25,300
(3) Effect on the increased value of output of annual goods and services	(2.5.8.9)	10%	--
(4) Effect on economic base, average annual increased value of rotation crops except potatoes	(2.5.11)	depends on participation	
(5) Effects on preserving cropland	(2.5.11)	depends on participation	
(6) Effects on taxes and government spending after 10-years *	(2.5.11)	depends on participation	
(7) Effect on crop diversity, and balance of trade after 10-years	(1.5.8.9)	--	4.2 man years
(8) Local employment required for construction	(2.5.11)	depends on participation	
(9) Effects on social development after 10-years	(2.5.8.9)	significant	
(10) Effect on increasing farm property value *	(2.5.8.9)	17%	17%
(11) Effect on marketing potatoes, potato quality increases	(2.6.7.9)	17%	15%
(12) Effect on cropland productivity, yields per acre increase			
b. Adverse Impacts			
(1) Effects on annual farm labor,* decrease	(1.5.8.9)	--	15%
(2) Effects on an economic base, average annual decreased market value of potatoes	(2.5.8.9)	nil over 15-years	--
(3) Effects on regional employment, population and migration *	(2.5.11)	depends on participation	
(4) Effects on other industries and balance of trade, initial 10-years *	(2.5.11)	depends on participation	
(5) Effects on taxes and government spending *	(2.5.11)	depends on participation	
(6) Effects on social development, initial 10 years	(2.5.11)	depends on participation	

FOOTNOTES

Timing
1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty
4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

Exclusivity
7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality
9. Impact will occur with implementation. 10. Impact will occur only when specific additional actions are carried out during implementation
11. Impact will not occur because necessary additional actions are lacking.

Section 122
* Items specifically required in Section 122 and ER 1105-2-240.

TABLE 8

PLAN A:
SUMMARY ASSESSMENT
OF
CONSERVATION ONLY

Annual project costs include the amortized investment of conservation structures, including the installation, engineering, design, supervision, administration and interest charges. The average annual loss in farms' 1 and 9 net incomes is shown as an adverse impact to national economic development.

The analysis of typical cropland was based on the detailed evaluation of changes in average crop budgets and project costs for typical cropland.

The benefit-to-cost ratio of conservation on the nine farms averaged a $1.70 annual return on each dollar of annual project cost. The separate feasibility analysis on these farms (Table 9) shows a wide range in economic impacts, including:

- long term net income losses of farms 1 and 9;

- project BCR's range from no benefit to 7.5 while growers experience a range from no return on their cost to a high of 14.1;

- and the first year of their economic gains ranged from the first project year to no gain at all.

The average BCR on the nine farm projects (1.7 to 1.0) is estimated to be higher than the typical cropland average (0.6 to 1.0) primarily due to changes in land use. Several of the nine growers are active participants in their SCS conservation districts and due to measures already applied, only experience an average 3.7 tons per acre per year erosion rate as opposed to the county's average which exceeds 6.3 tons. As a result, their improved rotations result in only a 17 percent reduction in potato land as opposed to a 30 percent reduction for the typical cropland condition. A greater percentage of county farms would likely experience long-term economic losses with conservation plans designed to achieve the 3 ton erosion goal.

Environmental Quality

Biologists of SCS, U.S. Fish and Wildlife Service and the Corps surveyed the nine farms to review environmental assessments prepared during the design of the farms plans. The survey (Appendix 6) concluded that farms would benefit from maintaining soil productivity, erosion reduction and improvements in the safe disposal of chemical containers. Three farms (#3, 5 and 6) will experience improved landscaping from strip cropping in several fields. Wildlife will be adversely affected on farms 3 and 8 with the conversion of grasslands to cropland. The overall reduction in erosion will be from 6,060 tons per year to 2,920 tons--52 percent (Table 8). Reduction of pollutants entering streams and

TABLE 9

CONSERVATION PLAN A: ECONOMIC IMPACTS ON 9-FARMS

(1976 Price Level)

PROJECT IMPACTS

Farm Number	Plan Investments 7/ ($)	Annual Benefits 4/ (increased gross income) ($)	Annual Project Costs ($)	Net Project Benefits ($)	Benefit-to-Cost Ratio (BCR)
1	9,339	(3,900)	1,285 1/	-5,185	none
2	15,802	14,092	2,746	11,346	5.1
3	46,894	7,699	6,790	909	1.1
4	7,323	6,228	890	5,338	7.0
5	29,467	6,006	3,946	2,060	1.5
6	57,715	23,390	8,389	15,001	2.8
7	14,147	2,944	2,178	776	1.4
8	36,791	38,520	5,108	33,412	7.5
9	3,766	(18,347)	438 2/	-18,785	none
Project Total	221,245	76,632	31,770	44,862	2.4
Farm Average	24,583	8,515	3,530	4,985	2.4

FARM BUSINESS IMPACTS

Farm Number	Cropland Acres With Plan	Annual Project Cost To Grower 3/ ($)	Average Annual Increase In Gross Income ($)	Increased Gross Income To Cost Ratio	First Year of Economic Gain (year)	Net Income Lost In First Year ($)
1	77	801	(4,701) 1/	none	NO	11,373
2	169	1,703	12,389	8.3	2	1,631
3	262	4,071	3,628	1.9	9	11,908
4	161	441	5,787	14.1	4	1,559
5	123	2,530	3,476	2.4	8	5,842
6	432	4,850	18,540	4.8	4	7,398
7	152	1,375	1,569	2.1	9	12,878
8	170	3,580	34,940	10.8	1	0
9	91	183	(18,530) 2/	none	NO	26,577
Farm Total	1,637	19,534	57,098	2.9 6/	--	--
Farm Average	182	2,170	6,344	2.9	--	8,796 5/

1/&2/ Does not include mitigation of lost income.

3/ Erosion control structures' capital cost, shared 90% Federal.

4/ Benefits for stopping declining acreage under the no action plan are not included.

5/ The nine-Farm's average current net income is estimated at $27,800 per year.

6/ The nine-Farm's currently average a gross return-on-production cost ratio of 1.4.

7/ Investment includes: the installation costs, 18% for engineering, design, supervision and administration; and 6-5/8% interest during 2-years of construction for waterways and diversions.

harming fish and wildlife from typical cropland was estimated from the reduction in erosion and reductions in potato acreage with its high rates of fertilizer and biocide applications.

The nine farms currently have higher productivity levels with potato yields averaging 246 cwt per acre (which would increase to 288 cwt) as opposed to the county average 230 cwt per acre (which would increase to 264 cwt). This may be due to their lower erosion rate. The major adverse impacts created by the plans are the construction of about 35 miles of structures, principally waterways, diversions and tile drains and the conversion of 48 acres of grassland to cropland.

Fuel consumption on typical cropland would be decreased by about 5 percent due to a 30 percent reduction in potato acreage which is almost offset by: the interference of structures and strips which increases the time necessary to maneuver farm equipment.

Social Well-Being

Significant improvements in the standard of living of four farms should be experienced, while the remaining five farms will be adversely affected with long-term losses of income (over seven years), or forced to accept additional long-term debts, Government grants or changes in their business. At a time when farms are declining and youth are migrating from the region (leaving the farms) to find other jobs, additional short or long-term economic hardships will adversely affect most of the farm families and the cohesion of the communities. If farmers in the region are forced to adopt a 3-ton erosion standard to achieve the national goal of fishable-swimable waters, the entire region will experience about a 10 year decline in economic activity because of losses in productivity and corresponding impacts on social services and well-being. After 10 years, production will exceed the no action plan level of a 1.5 percent decline per year. Conditions in Aroostook County will then begin to improve. The 208 Management Plan considered the possibility of implementing measures to reach the 3-ton standard goal as one alternative, but the impacts of this conservation plan were unacceptable to the participants of their advisory and technical committees due to the mandatory action needed to implement the plan, the adverse economic impacts on farmers, lack of adequate cost sharing and other considerations.

Regional Development

If a large percentage of farms adopted Plan A, the region would benefit slightly from the average increase in farm net income, realized after about 10 years. The total production and

market value of crops will decrease initially but average out to no significant change over the evaluation period. Impacts on community growth, population and Government revenue will be adversely affected during the initial 10 years, with later positive gains as the level of production exceeds the decline of the no action plan. Significant fluctuation in the region's economy from fluctuations in crop production would continue regardless of the number of farms implementing the conservation plan. As displayed in Table 8, regional impacts are largely dependent on the number of farms implementing the plan. No attempt was made during this study to make a projection of regional participation.

IMPLEMENTATION RESPONSIBILITIES

Federal and Non-Federal Responsibilities

The implementation of conservation plans is currently the voluntary responsibility of the individual farmer with technical, financial and educational assistance provided by public agencies. The USDA, Soil Conservation Service (SCS) acting through the State's Soil and Water Conservation Districts provides technical assistance to farm cooperators in the design and implementation of conservation plans. The USDA Agricultural Stabilization and Conservation Service administers Federal cost sharing programs. SCS prepared the nine farm conservation plans in cooperation with the potato growers. Further implementation of these plans is seriously restricted by limits on Federal cost sharing. Due to the immediate adverse economic impacts, these cost sharing limits would need to be changed before most of these farms would consider complete plan implementation.

Cost Sharing

Current levels of Federal cost sharing are limited to $2,500 per farm per year, which would include up to 90 percent for erosion control structures and an allocation for crop rotation of $40 an acre to provide vegetative cover for cropland at least 2 out of 4 years. If the nine farms implemented these plans within the next few years without Federal financing (in order to reach the 3 ton erosion goal set to achieve the national water quality objectives by 1983), they would face a per farm net income loss of $16,536 in the first year.* The Northern Maine Regional Planning Commission (NMRPC) as part of their 208 plan to promote

*This includes the first years loss of income averaging $8,796 primarily from crop rotation, plus 90 percent of the cost for erosion control structures @$7,740 per farm which was allocated in the analysis (Table 9) as a Federal cost.

conservation measures recommends that higher levels of cost sharing be considered.

Recommendations for higher cost sharing limits were not considered in this report for conservation plans. One purpose of presenting the Plan A (conservation only) assessment is to determine if the adverse economic impacts on farm businesses can be offset by economic gains from irrigation management. In addition, if the conservation plan is more desirable than either Plans B (irrigation only) or C (irrigation and conservation) following, then detailed information developed on conservation impacts will aid in the development of cost sharing programs.

Public Views

Results of the region's public opinion survey of 275 households in 1975 concluded that one-third of those surveyed believed soil erosion was polluting rivers and lakes, while half believed that pesticides and fertilizer from farmlands were major polluters. Town councils are divided on the issue of the seriousness of cropland erosion and whether to support mandatory action to clean up the pollution.* Plan A, Conservation alone, was developed to represent the 3-ton erosion goal considered by the "208" plan, and to show its impacts on the farm business before assessing the combined effects from adding irrigation management in Plan C. Conservation agencies generally support the 208 Plan's goal of eventually reaching the 3 ton erosion rate, while the Maine Potato Council is in strong opposition to any mandatory action. The council gave these reasons for voting to oppose any legislation regarding the plan: (1) more growers should have been involved in the planning; (2) more research is needed to find rotation crops which will at least break even financially; (3) and recommendations are unsound due to the lack of technical and financial assistance. The council's comments concluded: "Therefore, potato growers in Aroostook County feel strongly that legislation making certain practices compulsory would be a disaster to the potato industry."

Public comments received during the draft review of this report concur in the need for improved conservation practices to reduce erosion and improve crop yields and quality. Comments are summarized in the "Attachment" to this report. Appendix 4 includes letters of comment.

*Reference: Comments on the 208 Plan

Plan B Irrigation Only

This irrigation pond supplies water for 100 acres of potatoes and provides recreation, fishing, fire protection, and a sediment trap for cropland erosion.

NINE PROJECT FARMS

Plan B would constitute an irrigation only plan. Irrigation is needed in Aroostook County to counter the fluctuations in the quantity and distribution of rainfall. In addition, irrigation can reduce the 50 percent moisture deficiency present in a normal year. Although the crop normally lacks an average 6.1 inches of water, the nine farm irrigation plans were evaluated for a normal year's application of only 4.6 inches. This approach recognizes the possibility that at least one application each year will be missed in anticipation of rain. Growers will also allow the soil to dry out more at the end of the season for various reasons. The systems and water sources were designed by SCS for the land use changes recommended by the conservation plans. Nineteen hand-

moved and/or self-propelled systems were designed to irrigate 828 acres of potatoes and 40 acres of beans using 19 pumps and 24 miles of 4 to 10 inch pipe representing needs of Plan C: Irrigation and Conservation (Table 10). An irrigation only plan would irrigate 1,028 acres and would require more equipment and pond area than Plan C.

The design and cost estimate of each farm plan is in Appendix 5 for 828 acres. Table 11 describes irrigation only conditions assuming the nine farms irrigated all of their existing potato acreage. Potato yields were estimated to increase 45 percent from 247 to 358 cwt per acre. The increase is estimated from the amount of water to be applied in a normal year (4.63 inch average) times the yield value estimated for each inch of water (24 cwt/acre/inch). The value is applicable for water used by the crop. It was selected based on actual irrigation experience displayed in Table 12 and other information discussed during advisory meetings with representatives of the US Department of Agriculture and potato specialists with the University of Maine (Appendix 3). The reasons northern Maine farmers applied an average of 2.4 inches per year of water when more was needed is discussed in Appendices 2 and 7. It is generally due to the lack of irrigation guidelines and management controls, as determined in part by surveying eight irrigating growers (Appendix 7).

Improved potato quality is estimated to account for 35 percent of irrigation benefits. Graph 10 was developed to estimate the price increase attributed to improved quality, or the redistribution of the marketed yield into higher paying grades, especially U.S. Number Ones. Several relationships comparing incremental changes in the quantities of three grade categories and shrinkage to incremental changes in yields were developed from the Maine Farm Planning Guide, research reports and discussions with potato specialists and growers. The graph and relationships are only preliminary indications of the potential benefits of improved quality. Research is needed to develop guidelines for estimating the full array of quality benefits recognized for decreasing: bruising, viruses, scabs, late blight, rotting, deterioration, misshapes, culls, defects, freezing and shrinkage. During interviews with a Bureau of Reclamation project manager and a university research director in North Dakota, the Corps was informed that improved potato quality was a major benefit of their irrigation programs. In addition, in the Red River Valley area of the Garrison Diversion Project, nonirrigated yields averaged 225 to 230 cwt per acre, similar to Maine's, and irrigated yields rose to 400 cwt per acre, similar to the highest estimate among the nine project farms. The potential for irrigation to increase potato yields and quality exists in Maine with impressive economic returns--increasing net farm income an average of 190 percent over future conditions without irrigation for the nine farms.

TABLE 10

DESCRIPTION OF IRRIGATION SYSTEMS & WATER SOURCES FOR PLANS B & C DESIGNED FOR NINE FARMS

FARM NUMBER	ACRES IRRIGATED EACH YEAR 3/		TYPE & NO. OF SYSTEMS 1/	WATER SOURCE 2/	MAXIMUM WATER LIFT IN FEET	TOTAL ENGINE BREAK-HORSEPOWER (BHP)	MAXIMUM DISTANCE WATER PUMPED (FEET)	TOTAL LENGTH OF 4 INCH TO 10 INCH PIPE (FEET)
	Plan B	Plan C	Plan C	Plans B & C	Plans B & C	Plan C	Plans B & C	Plan C
1	79	47	Tm	3.5 Acre, 15 Ft. Deep Pond & Stream	40 Ft.	57 BHP	2,000	5,500
2	123	113	T & Hm	Lake	135	202	4,600	13,270
3	152	131	2 Hm	6 Ac, 13' Pond 1.2 Ac, 10' Pond & Stream	240	421	8,600	16,900
4	80	81	2 Hm	River	120	118	5,900	12,880
5	82	51	Tm	6 Ac, 10' Pond	130	72	5,600	9,090
6	230	216	5 Hm	Lake & 0.5 Ac Pond w/Stream	90	403	10,600 (2 miles)	41,860
7	97	76	3 Hm	River & 0.5 Ac Pond w/Stream	200	187	7,000	12,440
8	101	111	2 Tm's	Lake	40	190	3,400	10,540
9	84	42	Tm	River	130	78	3,900	4,300
TOTAL	1028	868	19 (6Tm,13Hm)	3 Lakes, 3 Rivers, 4 Streams, 6 Ponds	-	1,728 5/	-	126,780 5/ (24 miles)
Aver/Farm	114	96.4	2		125	192	5,700	14,090 (2.7 miles)

1/ Tm refers to traveler self-propelled systems. Hm are hand moved systems. Plan B may need more systems.

2/ Pond refers to empoundments constructed to hold irrigation water. Plan B pond areas may be larger than shown.

3/ Acres will differ from preceding table due to land removed for ponds, strips for traveler units, or other reasons as explained in the appendicies.

4/ Includes 40 acres of beans for Plan C and 80 acres of potatoes for Plan B.

5/ Plan B would require more total horsepower and pipe to irrigate 24 percent more acreage.

TABLE 11 PLAN B: ECONOMIC SUMMARY OF IRRIGATION ONLY ON 9-PROJECT FARMS FOR POTATO CROPS IN A NORMAL YEAR (1976 Price Level)

FARM NUMBER	1	2	3	4 1/	5	6	7	8	9	FARM 3/ AVERAGE (WEIGHTED BY ACRES)	PROJECT TOTAL
Basic Data											
Location in Aroostook County	Central	Central	Central	South	Central	Central	North	North	South		
Irrigated Potato Acres 4/	79	123	152	80	82	230	97	101	84	114	1,028
Average Net Water Applied (in.)	4.7 "	4.7 "	4.4 "	6.0 "	5.1 "	4.2 "	4.8 "	4.4 "	5.6 "	4.63 "	--
Average Number of Applications	2.9 ea.	3.0 ea.	2.5 ea.	4.1 ea.	4.4 ea.	2.6 ea.	3.5 ea.	3.0 ea.	3.9 ea.	3.0 ea.	--
Average Soil Field Capacity (in.) (cwt/ac)	3.2 "	3.2 "	3.5 "	2.9 "	2.3 "	3.2 "	2.9 "	3.1 "	2.9 "	3.1 "	--
Current Average Yield (cwt/ac)	231	208	277	218	203	241	278	242	314	247	--
Yield Increase	113	113	106	144	122	101	115	106	134	111	--
Percent Increase	49%	54%	38%	66%	60%	42%	41%	44%	43%	45%	--
Total Irrigated Yield (cwt/ac)	344	321	383	362	325	342	393	348	448	358	--
Current Aver. Potato Price($/cwt) 2/	3.07	3.16	3.15	3.11	3.03	4.18	4.90	5.39	3.98	3.91	--
Price Increase	21%	27%	9%	26%	28%	18%	9%	17%	4%	17%	
CAPITAL INVESTMENT 4/											
Irrigation Systems	$72,500	$88,300	$137,700	$65,100	$75,500	$249,400	$93,400	$87,800	$83,600	FARM AVG. (NOT WEIGHTED)	TOTAL
Developed Water Source	35,300	0	25,500	0	32,200	5,600	5,100	0	0		$ 953,300
Total Investment	$107,800	$88,300	$163,200	$65,100	$107,700	$255,000	$98,500	$87,800	$83,600		103,700
											$1,057,000
PROJECT ECONOMIC ANALYSIS 4/											
Benefits: (Increased net income 5/ over production costs)	$39,700	$69,800	$61,100	$52,700	$47,900	$144,000	$65,700	$84,900	$45,500		$ 611,300
Project Costs: (amortized investment and O & M)	12,200	14,700	22,900	10,800	13,200	35,600	15,900	11,700	12,500		149,500
Net annual benefits:	$27,500	$55,100	$38,200	$41,900	$34,700	$108,400	$49,800	$73,200	$33,000		$ 461,800
Benefit-to-Cost Ratio (BCR):	3.3	4.8	2.7	4.9	3.6	4.0	4.1	7.3	3.6		4.1
OTHER ECONOMIC CONSIDERATIONS											
Increased Net Income/Acre	$350	$448	$251	$530	$428	$467	$519	$722	$389	$467	(weighted avg.)
Average application of water needed to break-even financially each year:											
Inches of Water	1.5"	0.7"	1.3"	0.9"	1.2"	0.9"	0.9"	0.5"	1.5"	0.9"	(weighted avg.)

1/ Farm No. 4's plan was also designed for irrigating 40 acres of beans, which is excluded from this analysis.

2/ Potato prices and production costs do not reflect values for crop storage or marketing.

3/ Number may not "add" due to rounding.

4/ The irrigated potato acres represent existing potato acres. The investments, annual benefits and annual costs were changed from the report on the nine farms to represent an irrigation only condition. Investments, benefits and costs were changed in direct proportion to the change from planned irrigated acreage (with I&C practices) to existing potato acres. System costs would be substantially lower if pipe is not buried and if lower unit costs are used in the estimate as reported by another distributor. Operating labor costs would increase if the systems are made more labor intensive.

5/ Benefits exclude stopping declining conditions.

TABLE 12

ACTUAL IRRIGATION EXPERIENCE WITH POTATOES IN MAINE

Farm #, Soil, Potato Variety (Year)	Potato Yield Increase (CWT/AC)	Net. Irrigation Water Applied (Inches)	"Irrigation Efficiency" 4/ Yield Increases per Acre per inch (CWT/Acre/Inch)
NORTHERN MAINE 1/			
(1) Caribou Loam, Russet Burbank Variety			
1956	66	2.7"	24
1957	32	1.9"	17
1958	33	0.8"	41
(2) Caribou Loam, Russet Burbank			
1959	31	1.2"	26
(3) Stetson Gravelly Loam, Katahdin			
1956	66	2.5"	26
1957	79	1.4"	56
1958	42	2.0"	21
1959	88	2.4"	37
#1-3 Average:	55	1.9"	31
SOUTHERN MAINE 1/			
(4) Sandy Loam , Katahdin and Chippewa Varieties			
1956	107	6.2"	17
1957	118	2.9"	41
1958	111	2.1"	53
1959	52	3.4"	15
(5) Sandy Loam, Katahdin and Kennebec			
1956	148	3.4"	44
1957	55	2.3"	24
1958	52	1.4"	37
1959	51	1.2"	42
(6) Sandy Loam, Katahdin			
1956	80	5.3"	15
1957	87	4.5"	19
1958	12	1.6"	8
#1-6 Average:	73	2.7"	26
NORTHERN MAINE 2/			
(7) Caribou Loam, Katahdin and Superior Varieties			
1975	66	2.0"	33
1975	41	2.0"	20
1974	41	2.0"	20
1974	33	2.0"	16
(8) Stetson & Plaisted, Superior			
1975	132	4.0"	33
1973	83	5.3"	16
(9) Stetson Gravelly Loam, Katahdin			
1975	86	3.0"	29
(10) Caribou Loam, Russet Burbank			
1973	60	2.5"	24
#7-10 Average:	68	2.9"	24
CENTRAL MAINE 3/ Old Town, ME			
(11) Melrose Sandy Loam, Katahdin Variety			
1956	87.0	2.8"	31
1957	86.2	2.6"	33
1959	27.0	1.4"	19
1960	66.4	4.2"	16
#11 Average:	66.7	2.8"	25

1/ Source: "The Economics of Irrigating Potatoes in Maine" by Winston E. Pullen and William F. Schrumpf, Maine Agricultural Experiment Station Bulletin 603, April 1962. Methods used for recording water applied appeared to be net water -- amount received by the crop.

2/ Source: Questionaires completed by potato growers for the St. John River Study and presented in Appendicies. Water reported appeared to be net water.

3/ Source: "Some Effects of Irrigation and Soil Compaction on Potatoes", American Potatoes Journal, R.A. Struchtemeyer, E. Epstein, W.J. Grant; Maine Agricultural Experiment Station; NE Branch, Soil and Water Conservation Div. Agr. Research Service, USDA, 1963. Yields were adjusted from Bu. to CWT, (60 lbs/Bu), and irrigation amounts adjusted 80-percent for net water.

4/ Computed for St. John River Study to estimate the value of an inch of net irrigated water.

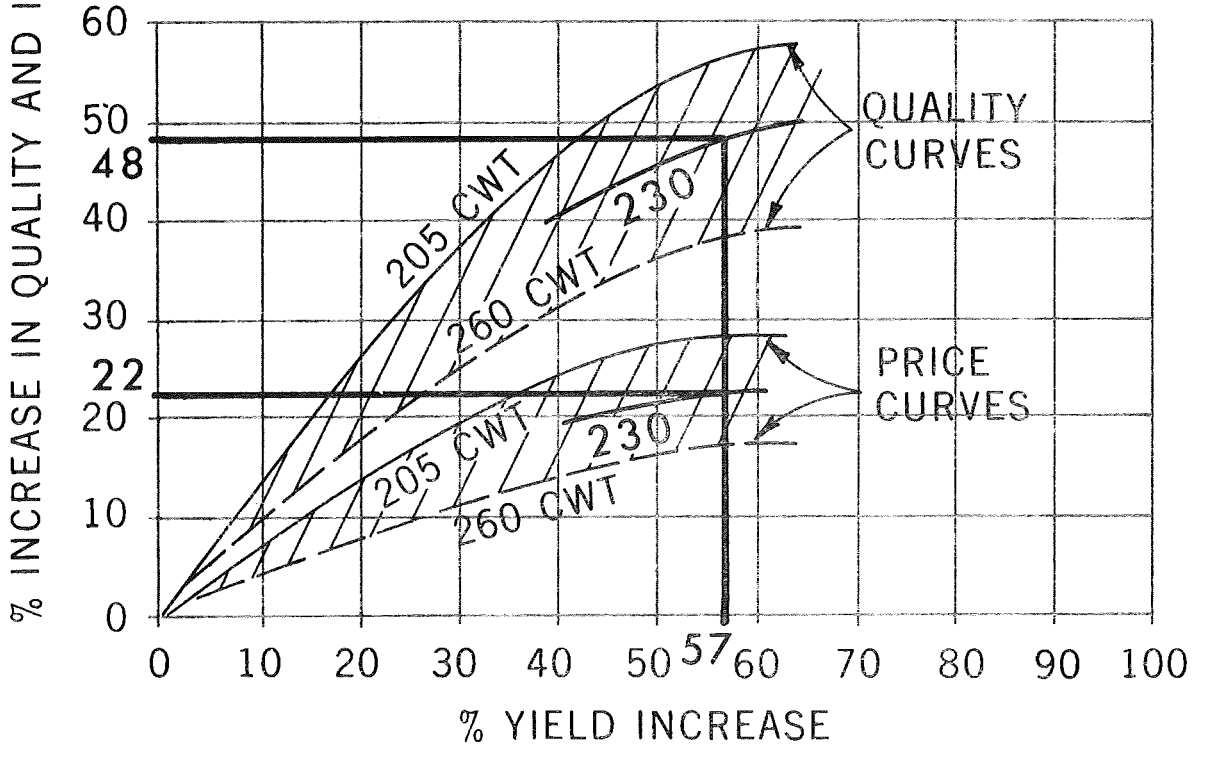
GRAPH NO. 10

REPRESENTATION OF POTATO PRICE AND QUALITY INCREASES ESTIMATED FOR CORRESPONDING YIELD INCREASE

Given: Initial or Base Yield & % Yield Increase.

EXAMPLE

A 57% increase in 230 Cwt/Ac would average a 48% increase in QUALITY or ratio of US#1's to total yield. The result of all grade changes (US#1, Irregulars & Culls) would increase the average PRICE/cwt by 22%.



TYPICAL CROPLAND

Table 12A describes irrigation measures needed on typical cropland and impacts on production and other factors. Potato yields were estimated to increase due to an annual application of 5.6 inches of water. One additional inch is applied when compared to the nine farm average to compensate for water lost due to the higher erosion or runoff rates on typical cropland lacking conservation measures. Significant changes in production, sales and farm budgets result from irrigation, when compared to existing conditions.

IMPACT ASSESSMENT AND EVALUATION

Table 13 summarizes selected impacts estimated for irrigation only based on extensive studies described in the appendices. Although the results are based on best available data, additional basic and applied research is needed to more precisely determine these impacts for a large variety of conditions.

National Economic Development NED

The economic impacts generated by irrigation only are summarized in Table 13 and developed in Appendix 7. The benefit-to-cost ratios are very favorable.

Two economic break-even analyses were conducted to evaluate the feasibility of irrigation and sensitivity of irrigation yield increases and price increases (from improved quality). Graph 11 displays an analysis showing that the average farm will pay for its irrigation fixed and operating costs each year during the first application of water--after 0.9 net inches are applied or at the end of the first application with 1.5 inches, if benefits to improve quality are ignored. Although 4.63 inches is estimated to be needed in a normal year, applications between 0.9 to 4.63 will make profits for the average farm. A second analysis revealed that if in a normal year a grower applied 4.63 inches, he would only need to increase his yield by 5.4 cwt per inch of water applied (or 8.3 cwt ignoring the quality increase) to break even on his costs. Table 12 of actual irrigation experience shows that the lowest any one grower in northern Maine had averaged was 22 cwt per inch of water. The analysis revealed a strong potential for northern Maine potato growers to increase yields and their profits, while dampening annual fluctuations in production caused by water deficiencies. This holds true for the most common soil, Caribou, in good condition with the least potential for irrigation, due to its high water holding capacity. Farm 3 displays the potential returns on just Caribou soil with a BCR of 2.7. Break-even graphs are provided for all nine farms in Appendix 7.

TABEL 12A

DESCRIPTION OF TYPICAL CROPLAND AND IMPACTS WITH IRRIGATION PLAN

*IRRIGATION STRUCTURES (Estimate based on unit quantity of Nine Project Farms):	
-- Number of Systems and Pumps	23
-- Miles of 4 to 6 inch Pipe	28.6
-- Number of Farm Ponds	7
*LANDUSE -- Cropland in potatoes (irrigated)	1,109 Acres
-- in grain (oats)	554 Acres
TOTAL	1,663 Acres
*Irrigation Water Applied to Potatoes:	5.6 Inches/Acre/Year

	Project Years		
	#1	#8	#20
*Annual Potato Production: (1,000 cwt)	403	423	456
-- increase from existing conditions	58%	66%	79%
*Annual Potato Sales: ($1,000)	$1,962	$2,077	$2,279
*Annual Net Income to Farm Management: ($1,000)			
-- per 9-Farms	$690	$780	$939
-- increase from existing condition	340%	500%	600%
*Total Annual Erosion: 11,500 tons @ 6.9 tons per acre			
-- increase from existing conditions: 10%			
*Potato Harvested Yield: (cwt/Acre)	363	381	412
-- increase from existing conditions	58%	66%	79%
*Potato Budget			
-- Potato Returns per Acre:	$1,770	$1,874	$2,055
In year #8 U.S. #1's	314 cwt @ $5.44		
Irregular	33 cwt @ $4.09		
Culls	14 cwt @ $2.41		
(5% shrinkage) Total Marketed	361 cwt @ $5.19		
or	381 cwt @ $4.92		
--Potato Expenses per Acre:.	$1,106	$1,128	$1,166

In year #8

Planting	$326	Storage & Marketing	$270
Fertilizer	$146	Irrigation	$177
Harvesting	$ 77	Other	$132

*Crop Net Incomes:			
--Potato Net Income per Acre:	$664	$746	$889
--Oats Net Loss per Acre:	($84)	($84)	($84)

TABLE 13

PLAN B: SUMMARY ASSESSMENT OF IRRIGATION ONLY

	Footnotes	LOCATION OF IMPACTS On 9-Project Farms 1663 Acres of Cropland (1028 Ac, Potato)	On Typical 1663 Acres of Cropland (1014 Ac, Pot)
1. National Economic Development (NED)			
a. Beneficial Impacts (average annual)			
(1) Value of increased output of goods and services			
(a) Average increase over current condition	(1.5.7.9)	$611,300	$821,000
(b) Average increase from stopping declining conditions	(2.5.7.9)	14,800	14,800
(2) Total Net Benefits		$626,100	$835,800
b. Adverse Impacts (average annual)			
(1) Total NED Cost (project cost)	(1.6.7.9)	$149,500	$196,000
c. Net NED Benefits		$476,600	$639,800
d. Benefit-to-Cost Ratio (BCR)		4.1 to 1.0	4.3 to 1.0
2. Environmental Quality (EQ)			
a. Beneficial Impacts			
(1) Effect on potato dumps, reduction in discarded potato culls	(1.5.8.9)	--	20%
(2) Net water storage per irrigated unit of potatoes compared to Pacific Northwest	(1.5.7.9)	--	15%
b. Adverse Impacts Effect on intensive landuse*: increased fertilized and production on potato land	(1.6.7.9)	significant	significant
(1) Effect on scenery, irrigation system length of 4 to 6 inch diameter pipe	(1.6.7.9)	29 miles	28.6 miles
(2) Effect on preserving top soil & nutrients, cropland erosion increased	(1.5.8.9)	--	10%
(3) Effects on international basin's water quality * (stream and lake pollution)			
(a) Sediment loads and turbility increased	(1.5.8.9)	--	10%
(b) Nutrient loads increased	(1.5.8.9)	--	56%
(c) Biocide loads increased	(1.5.8.9)	--	10%
(4) Effect on energy consumption per year			
(a) Farm machinery, diesel fuel, increased	(1.5.7.9)		9%
(b) Total increase if irrigation pumps use diesel fuel	(1.4.7.9)		135%
(5) Conversion of wetlands, cropland, forest, et al. to farm irrigation ponds	(1.6.7.9)	18 Acres, slight	--
(6) Intermittant reduction of stream flows from ponds	(1.6.9)	yes	yes
(7) Disturbance of nesting birds from pump noise	(1.5.9)	slight	slight
(8) Effects on historical, archeological sites *	(6)	none	--
(9) Effects on scenic, recreational or wilderness areas *: erosion increased	(1.6.9)	depends on participation	
(10) Effects on basin's water consumption, net irrigation water applied per potato acre	(1.5.7.9)	4.6 inches	5.6 inches
(11) Effects on air quality *, if pumps use fuel	(1.6.7.9)	slight	slight
(12) Effect on intensive landuse *: increased fertilizer and production on potato land	(1.6.7.9)	significant	significant
3. Social Well-Being (SWB)			
a. Beneficial Impacts (1) Effects on preserving agricultural heritage and family farm	(3.4.7.11)	depends on participation	
(2) Effect on security of farm families, average increase in net farm income	(1.5.7.9)	190%	400%
(3) Farms with immediate improvements in standard of living	(1.5.7.9)	9 Farms	99%
(4) Effect on dampening annual fluctuations in production and income	(1.5.7.9)	significant	significant
(5) Effect on community cohesion with farm prosperity and stabilized revenues *	(1.5.11)	depends on participation	
(6) Effect on community growth with increased production *	(1.5.11)	depends on participation	
(7) Effects on public safety *: improved fire protection from farm ponds	(1.6.8.9)	slight	slight
(8) Relocations required *	(6)	none	--
b. Adverse Impacts			
(1) Effects on public health and safety: *degraded water quality	(1.6.8.11)	depends on participation	
(2) Effects on recreation areas: *degraded water quality	(1.6.8.11)	depends on participation	
(3) Effects on plan's acceptance by Federal, State and local agencies	(6)	lacks support due to increased pollution	
4. Regional Development (RD)			
a. Beneficial Impacts (1) Project Investments	(1.6.7.9)	$1,057,000	$1,279.000
(2) Effect on the increased value of output of annual goods and services	(1.5.7.9)	$626,100	$835,800
(3) Effect on increased annual farm labor *	(1.5.8.9)	--	70%
(4) Effect on economic base, average annual increased market value of potatoes	(1.5.8.9)	90%	--
(5) Local labor required for construction of farm ponds	(1.5.8.9)	--	6.7 man years
(6) Effect on other industries*from increased potato production sold for seed, tablestock or processed	(1.5.8.9)	70%	--
(7) Effect on balance of trade	(2.5.11)	depends on participation	
(8) Effect on regional employment, population and migration*	(2.5.11)	depends on participation	
(9) Effect on social development	(2.5.11)	depends on participation	
(10) Effect on taxes and government spending*	(2.5.11)	depends on participation	
(11) Effects on preserving cropland	(2.5.11)	depends on participation	
(12) Effect on marketing potatoes, potato quality increases	(1.5.8.9)	39%	60%
(13) Effect on potato land productivity, yields per acre increase	(1.5.7.9)	45%	58%
b. Adverse Impacts			
(1) Effect on environmental enchancement	(1.5.11)	depends on participation	
(2) Effect on improving farm property value *	(2.5.8.9)	due to increased erosion, slight	

FOOTNOTES

Timing
1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty
4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertianty is less than 10%.

Exclusivity
7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account

Actuality
9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

Secion 122
* Items specifically required in Section 122 and ER 1105-2-240.

TABLE 13

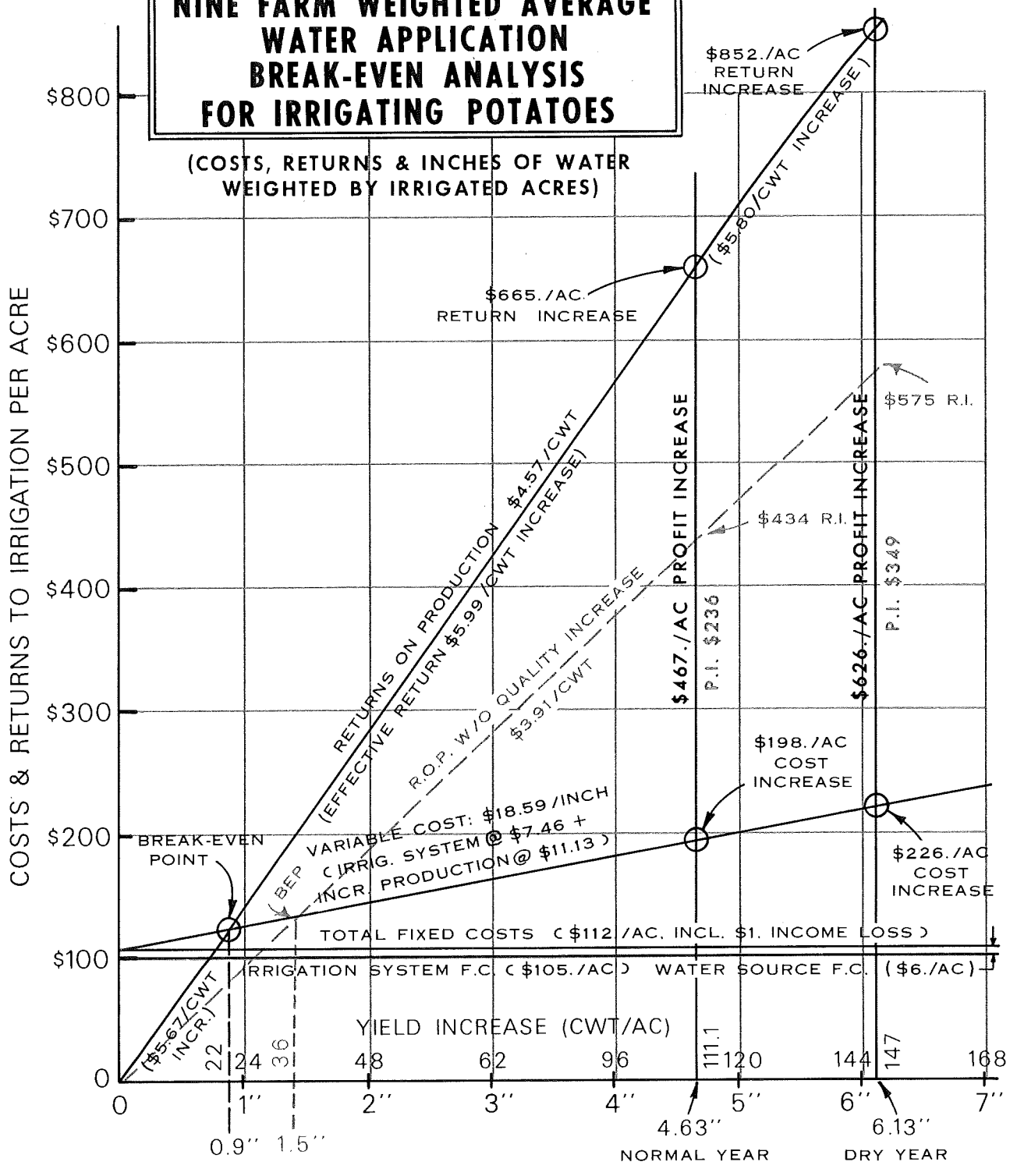
PLAN B:
SUMMARY ASSESSMENT
OF
IRRIGATION ONLY

GRAPH NO. 11

ST. JOHN RIVER I-C STUDY

NINE FARM WEIGHTED AVERAGE WATER APPLICATION BREAK-EVEN ANALYSIS FOR IRRIGATING POTATOES

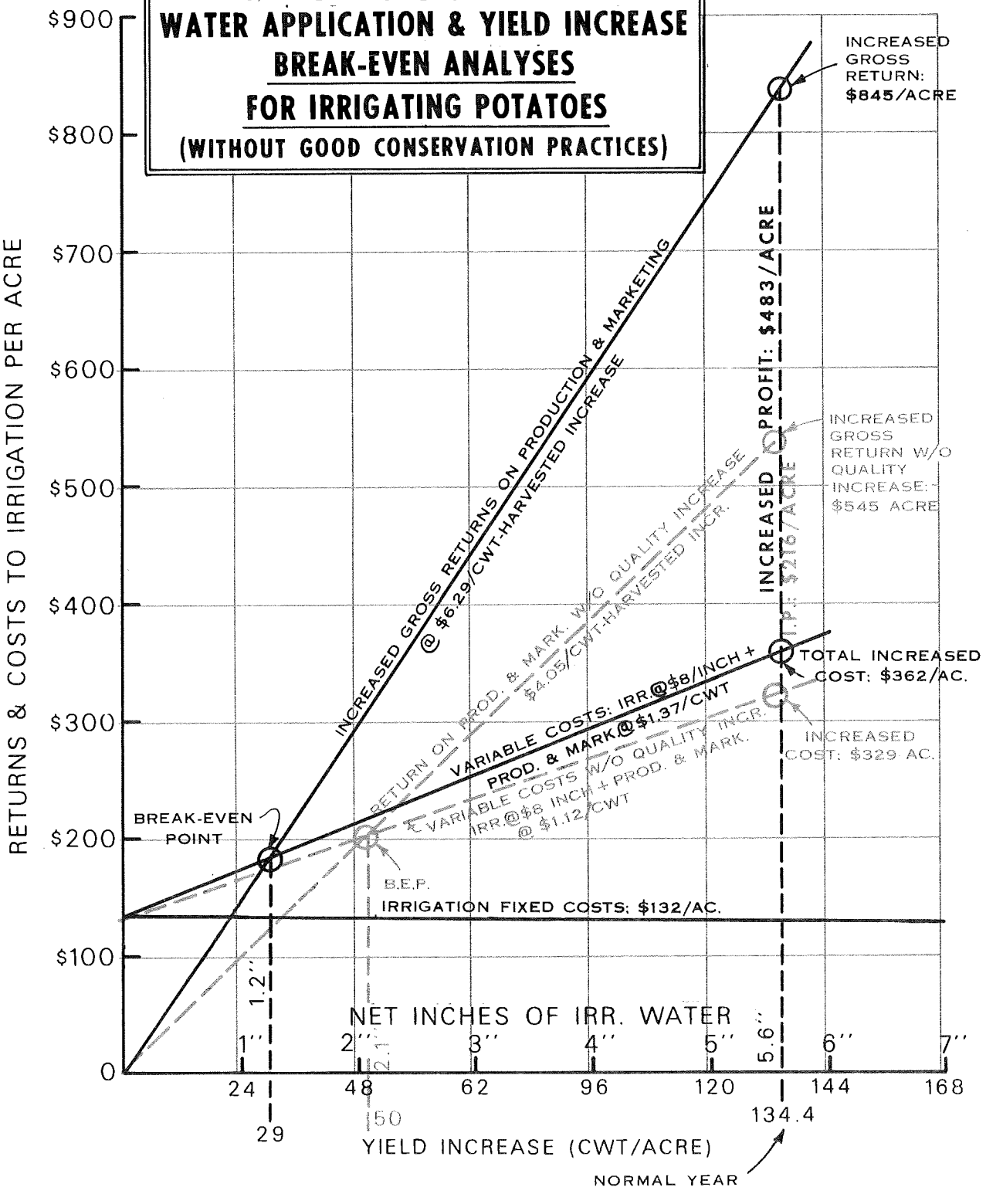
(COSTS, RETURNS & INCHES OF WATER WEIGHTED BY IRRIGATED ACRES)



NED. CORPS OF ENGINEERS
WALTHAM, MASS.

GRAPH 11A

ST. JOHN RIVER I-C STUDY
TYPICAL CROPLAND ANALYSIS
WATER APPLICATION & YIELD INCREASE
BREAK-EVEN ANALYSES
FOR IRRIGATING POTATOES
(WITHOUT GOOD CONSERVATION PRACTICES)



NED, CORPS OF ENGINEERS
WALTHAM, MASS.

A break-even graph is also provided for the typical cropland analysis (Graph 11A). It shows that on average cropland, a normal application of 1.2 inches will break-even; while 2.1 inches is required if the quality increase is ignored. The respective yield increases required to break-even with and without the quality increase are 29 and 50 cwt per acre.

Crop Response to Irrigation

The two most sensitive factors used to determine the economic feasibility of irrigation are (1) the amount of water applied to the potato crop and (2) the average crop response to yield and quality from each inch of water applied. Table 13A provides a sensitivity analysis to show a wide range of possible effects of these factors. In addition, a description of the type of management controls which might accompany variations in the water applied and crop response is included.

The range in normal or average water applications and use of the irrigation system which could be experienced on most farms depending on management controls is shown in Column 2 for one to six inches. Six inches of water applied to the crop is the average amount of irrigation water estimated to be needed on Aroostook County's potato crop in a normal year, based on data provided by the SCS Technical Service Center. The 4.63 inches is the average estimated for the nine farms which assumes one application of about 1.5 inches would be missed each season. Because of their soil and geographic location, these nine farms are assumed to represent average county irrigation requirements and economic impacts for irrigation only. Table 12 of actual irrigation experience shows as wide a range in net water applied to the crop as does the sensitivity analysis. Crop response to irrigation can be linked to many factors including, for example, soil condition, conservation and crop rotation, the timeliness of applying the application when its most needed, the timing with respect to impending rain, the rate of application and amount, and the variety of potato irrigated.

Column (4) displays a range of crop responses in yield per acre per inch of net water applied and used by the crop including 30, 24 and 15 cwt per acre per inch. The upper limit of 30 cwt was selected since it approximates the average of the high crop responses for each of the 11 irrigated farms in Table 12. The upper limit also approximates the average crop response of natural moisture, assuming the crop currently receives an average of 7-inches of natural water to produce 230 cwt per acre, or 33 cwt per acre per inch. The lower limit of 15 cwt in Table 13A approximates the lowest crop response of the eight irrigated farms who in Table 12 display more than one year's results. The mid-range of 24 cwt in Table 13A was selected to evaluate the economic

Table 13A: Crop Response to Irrigation Management: Sensitivity Analysis

Management Control and Use of Irrigation System (Characterized by amount of net water applied & used by crop)	Average Net Water Applied (Inches per season)	Crop Response to Timely & Efficient Applications & Soil Conditions	Yield Response per Inch (cwt/increase per inch applied)	Total Yield Increase (cwt/Ac)	Irr. Cost per Acre [1] ($/Ac)	Benefits [2] to Increase Yield & Quality ($/Ac)	Benefit-Cost [4] Ratio With Yield & Quality Benefit (BCR)	Benefits [3] to Increase Yield Only ($/Ac)	Benefit-Cost [4] Ratio With Yield Benefit Only (BCR)
Management control excellent, system ready after planting; soil and guidelines closely monitored and adhered to; rarely misses needed applications.	6"	Excellent	30	180	$157	$961	6.1	$621	4.0
	6"	Good	24	144	"	768	4.9	496	3.2
	6"	Fair	15	90	"	480	3.1	310	2.0
Management control excellent; system ready after planting; soil closely monitored, and guidelines closely adhered to, seldom misses an application when needed.	5"	Excellent	30	150	$149	$800	5.4	$517	3.5
	5"	Good	24	120	"	640	4.3	413	2.8
	5"	Fair	15	75	"	400	2.7	258	1.7
Management control good to excellent depending on soil; system ready to go on moments notice, soil moisture monitored; guidelines followed. May miss an application.	4.63"	Excellent	30	139	$147	$769	5.2	$479	3.3
	4.63" [5]	Good	24	111	147	613	4.2	382	2.6
	4.63"	Fair	15	69	147	381	2.6	238	1.6
Management control is good to very good depending on soil, system set up at beginning of season and used when soil usually needs moisture.	4"	Excellent	30	120	$142	$674	4.7	$425	3.0
	4"	Good	24	96	"	530	3.7	330	2.3
	4"	Fair	15	60	"	331	2.3	207	1.5
Management control is fair to good depending on soil, system normally used last half of season during dry periods.	3"	Excellent	30	90	$134	$497	3.7	$310	2.3
	3"	Good	24	72	"	398	3.0	249	1.9
	3"	Fair	15	45	"	249	1.9	155	1.2
Management control may be lacking, system used during drought period usually toward end of season	2"	Excellent	30	60	$127	$331	2.6	$207	1.6
	2"	Good	24	48	"	267	2.1	166	1.3
	2"	Fair	15	30	"	166	1.3	103	0.8
Management control is lacking and system is seldom used except during extreme drought period	1"	Excellent	30	30	$119	$166	1.4	$103	0.9
	1"	Good	24	24	"	133	1.1	83	0.7
	1"	Fair	15	15	"	83	0.7	52	0.4

[1] Irrigation cost per Acre is the sum of fixed Costs ($112/acre) plus Variable Costs ($7.46/Inch/Acre)

[2] Benefits to increased yield and quality are the difference between Increases returns less production costs: for water applications of 4.63 inches or less increased returns are $5.99/cwt yield increase; over 4.63 inches, increased returns are $5.80/cwt yield increase. Increased production costs are $11.13 per 24 cwt increase.

[3] Benefits to increased yields only are the difference between Increased Returns (@ $3.91/cwt increase) less increased production costs (@ $11.13 per 24 cwt increase.)

[4] Benefit to cost ratios (BCR) are benefits divided by project or irrigation costs.

[5] Values do not compare with 9-farms due to their yield reduction for erosion, and rounding off numbers.

feasibility of irrigation on the nine farms and represents a lower than average value of the eleven irrigated farms. The benefits and costs displayed in columns 6, 7 and 9 are based on average unit returns and costs developed for the nine farms as footnoted on the table.

Good management is imperative in the favorable feasibility of irrigation. Table 13A displays a wide range in the benefit-to-cost ratio which could be expected from irrigation. The specific ratio achieved would depend largely on management control. For example, a grower who lacks technical guidelines and seldom uses his system except under condition of extreme droughts averaging one inch of water applied each year may hit or miss a good crop response. His benefit-to-cost (BCR) ratio might range from a low 0.7 to a high of 1.4 as shown in column 8. However, if he only knows the change in yield and doesn't evaluate the crop's change in quality, the feasibility of irrigation may appear to only provide a BCR from a low of 0.4 to a high of 0.9 as in column 10. On the other hand, Table 13A shows that if technical guidelines are available and adhered to, good management control over irrigation would normally provide excellent results, with BCR's ranging from 3.0 to 6.0 (Column 8).

Comparative Analysis

The economic analyses for the typical cropland analysis and nine project farms can be compared to two other studies of irrigation experience by the University of Maine and the Soil Conservation Service. In order to make the comparisons, only changes in potato budgets are analyzed for changes in returns-over-costs. Changes due to quality improvements are not included in the benefits. Results in Table 14 indicate that comparable costs may be overestimated or benefits underestimated for the nine farm and typical cropland analyses, when compared to actual experience which shows higher rates of return.

TABLE 14
COMPARABLE STUDIES ON IRRIGATION ECONOMICS
OF POTATOES

Comparable Study	Increased Budget Returns-over Increased Costs (Ratio)
St. John River Study	
. 9-Project Farms Analysis	2.2 Average
. Typical Cropland Analysis	1.9
USDA Soil Conservation Service (Corps contract)	
. 4-Farms Irrigating from 1973-75 (Appendix 7)	3.0 Average
University of Maine, Pullen & Schrumpf Study	
6 Farms Irrigating From 1956-59	2.8 Average

Environmental Quality

The environmental appraisal of the nine farm's irrigation plans concluded that implementation would immediately increase productivity and achieve attractive economic benefits. However, impacts on local environment from construction of farm ponds, access roads and use of pumps would include: displacement of wetlands and forest habitat, wildlife disturbance from pump noise (especially waterfowl) and reduced flow in small streams. In addition, the Corps analysis of natural precipitation available to the crop with and without irrigation revealed a 10 percent increase in runoff attributed to irrigation which would increase the amounts of sediment, nutrients and biocides entering the region's waters. Research is needed to determine the predictability of using the irrigation system for timely applications of liquid fertilizers and biocides which could have the effect of reducing stream loadings of these pollutants.

Gas or diesel fueled irrigation pumps would consume more fuel than the other farm equipment combined unless electrical motors are used. The potential exists on several rivers to develop multipurpose projects which could provide hydroelectric power, irrigation and flood control storage. Approximately 25 percent of the 120,000 potato acres in the basin may need to irrigate from existing rivers such as the St. John, Aroostook, Fish, Prestile or Meduxnekeag Rivers. Cropland irrigation, if practiced by a large percentage of farms along these rivers, may significantly reduce low summer flows. Upstream storage may be required.

Northern Maine receives sufficient rainfall during the year (36 inches) to provide an irrigation crop's total water requirement without transferring between river basins. In addition, only about 40 cubic feet (c.f.) of water per marketed cwt of potatoes would need to be stored. In the Pacific Northwestern State of Idaho, the leading potato producer, the average potato requirement is about 260 c.f. per cwt due to its lower seasonal rainfall and higher evaporation rates.

The high economic return estimated for irrigation and more stabilized annual production would improve the economic health of potato farms. These improvements should help to stop the decline in family farms and extend the longevity of the region's agricultural culture.

Social Well-Being

Farm net income is estimated to increase from an average of $27,800 to $43,000 per project farm in the first year with irrigation--an increase of 56 percent. The higher levels of income and increased requirements for goods and services will benefit the tax base of local, State and Federal Governments. Depending on the future level of participation in irrigation management, the increased revenues could provide increased social services, as well as benefit farm families.

Regional Development

Aroostook County would experience significant and beneficial impacts from increases in net income, market value of potatoes and employment, depending on the future acceptance of irrigation.

IMPLEMENTATION RESPONSIBILITIES

Implementing irrigation plans is the responsibility of the individual potato grower. The USDA Soil Conservation Service (SCS) and the Cooperative Extension Service offer limited technical assistance in identifying the moisture characteristics of a soil; however, a published technical guide for irrigation management is not available to optimize returns.

Cost Sharing

There are no Federal or State cost sharing programs available to assist an individual grower in financing an irrigation system or to develop a water source. However, this assistance is available from USDA for two or more growers to develop a single water supply. This assistance is not available to the nine individual growers needing a farm pond for their own use.

Public Views

The 1975 public opinion survey conducted by the Northern Maine Regional Planning Commission for the Corps showed that of the 171 Aroostook County residents responding 57 percent believed that irrigation would be good for farm crop production, while 19 percent didn't believe it would be and 24 percent did not know. Most of those who believed irrigation was needed thought that more water supplies should be developed for irrigation. A survey was not conducted for potato growers alone.

Federal, State and local agencies are concerned that irrigation would further deteriorate the water quality, unless good conservation measures are applied. Due to the lack of educational and research programs, interviews during the study disclosed that the public, most growers and agencies are unaware of irrigation related economic potential. Farmers who have considered irrigating in the past are met by problems of financing and guidelines for management decisions. Loans have reportedly been refused to growers based on the "unproven" technical feasibility of irrigation. Irrigation investments are equivalent to the value of the grower's farm. This reason and the lack of information on irrigation's feasibility explains why the practice may not be widely adopted.

Public comments received during the draft review (Attachment and Appendix 4) of this report concurred in the potential economic feasibility and adverse environmental impact of irrigation alone without good conservation measures. Research and on-farm demonstrations are needed to validate crop response to irrigation, to evaluate environmental impacts and to prepare technical quidelines for optimum production.

Plan C Irrigation and Conservation

This Stetson soil, originally one of the poorest structured and least productive of the region, has consistently marketed about 80 percent higher potato yields after applying irrigation and conservation measures. Even today, after 31 years of irrigation, this soil still exceeds the county's average yield by one-half and is harvested 2 to 3 weeks early.

NINE PROJECT FARMS

Plan C combines irrigation and conservation management measures to determine whether the economic benefits from irrigation are sufficient to offset the short- and long- term economic losses associated with conservation plans. In addition, the plan will determine whether conservation measures are able to

reduce the adverse water quality impacts associated with irrigation.

The nine project farms include conservation measures planned for 1,632 acres of cropland with 828 acres in irrigated potatoes as shown in Table 15. Potato production is estimated to average an annual 29 percent increase over 15 years. The crop's market value would increase 54 percent (or $520,000) per year due to a 66 percent increase in yields per acre and a 19 percent increase in the price received per hundredweight. This occurs despite the potato acreage decreasing by about 19 percent from current conditions due primarily to improved crop rotation.

The total investment for the purchase, installation, engineering, design, supervision and administration costs of structures and systems is estimated at $1,028,600. The plan's average annual costs include: the investment amortized over the project life at a 9.5 percent interest rate for irrigation and at 7.0 percent for conservation structures, and include also the $136,000 annual operation and maintenance costs of structures including the application of 4.6 inches of water.

The plan is estimated to reduce erosion 47 percent (or 2,846 tons) per year. The average erosion will decline from a current rate of 3.6 tons to 2.0 tons of erosion per acre per year, which would meet the desirable 3 ton erosion limit on all fields.

TYPICAL CROPLAND

Table 15A displays the combined irrigation and conservation measures needed on typical cropland. A major impact is a 30 percent reduction in potato land, although production is still increased 8 percent due to potato yields per acre increasing 54 percent. The amount of water applied to potatoes is the same as the average of the nine farms--4.6 inches.

IMPACT ASSESSMENT AND EVALUATION

Table 16 summarizes selected impacts of Plan C which are documented in the Appendices and are based on the best available information. As with the other plans, additional basic and applied research are needed to precisely determine impacts for a large number of conditions.

National Economic Development

The value of increased output for goods and services from the nine farms is the major benefit to the I-C plan, totalling an average annual gain in gross farm income of $564,500 as shown in Tables 15 and 16. In addition, the plan is credited with stopping

TABLE 15

PLAN C: ESTIMATED IMPACTS OF IRRIGATION AND CONSERVATION PLANS ON 9-PROJECT FARMS IN A NORMAL YEAR AFTER 2-CROP ROTATIONS (1976 Price Levels)

FARM NUMBER Location:	9-PROJECT FARM TOTAL/AVERAGE Aroostook County	1 Central	2 Central	3 Central	4 South	5 Central	6 Central	7 North	8 North	9 South
				CURRENT LANDUSE						
Potato acres	1028	79	123	152	80	82	230	97	101	84
Other crop acres	635	0	50	107	90	41	222	60	55	10
Total acres	1663	79	173	259	170	123	452	157	156	94
				PROJECT LANDUSE						
Irrigated Potato acres	828	47	113	131	41	51 1/	216	76	111	42
Other crop acres	804	25	56	131	120	72 1/	216	76	59	49
Total acres	1632	72	169	262	161	123	432	152	170	91
				POTATO YIELDS & CHANGES						
Current yield (cwt/acre)	246	231	208	277	218	203	241	278	242	314
Project estimated yield (cwt/Ac) 5/	405	383	356	430	406	370	373	432	394	501
Yield increase	159	152	148	153	188	167	132	154	152	187
Percent increase	66%	66%	71%	55%	86%	82%	55%	56%	63%	60%
Price per cwt increase	19%	23%	28%	11%	26%	28%	20%	11%	19%	5%
				OTHER CROPS CHANGES						
Percent yield increase/acre	17%	--	--	17%	20%	22%	13%	14%	19%	17%
Percent price increase/unit	7%	--	--	5%	12%	14%	6%	4%	9%	1%
				POTATO PRODUCTION (IN 1000 CWT)						
Current	251.3	18.2	25.6	42.1	17.4	16.6	55.0	25.6	24.4	26.4
Project Average over 15-years	324.0	18.8	39.0	53.8	15.8	21.2	78.1	32.2	43.1	22.0
Percent increase	29%	3%	52%	28%	-9%	28%	42%	26%	77%	-17%
				MARKET VALUE OF POTATOES (IN $1000)						
Current	$967.7	$56.0	$80.8	$132.7	$54.2	$50.4	$231.6	$125.3	$131.7	$105.0
Project average over 15-years	$1,489.9	$69.2	$157.1	$186.9	$61.9	$80.5	$389.3	$174.8	$278.6	$91.5
Percent increase	54%	24%	94%	41%	14%	60%	68%	40%	112%	-13%
				MARKET VALUE OF OTHER CROPS (IN $1000)						
Current	$53.0	0	0	$9.6	$16.2	$2.8	$16.9	$0.4	$6.2	$0.9
Project average over 15-years	$65.1	0	0	$6.8	$20.3	$2.8	$19.5	$3.6	$7.9	$4.2
Percent increase	23%	--	--	-29%	25%	0%	15%	800%	27%	370%
				PROJECT CAPITAL INVESTMENTS (IN $1000)						
Irrigation System & Supply	$841.0	$16.2	$81.1	$140.7	$33.3	$66.9	$239.4	$77.2	$96.5	$41.8
Conservation Structures	187.6	7.9	13.3	39.7	6.2	25.1	48.7	12.0	31.5	3.2
Total investment	$1028.6	$24.1	$94.4	$180.4	$39.5	$92.0	$288.1	$89.2	$128.0	$45.0
				PROJECT ECONOMIC ANALYSES (IN $1000) 3/						
Project Average Annual :										
· Benefits: Increased gross farm income	$564.5	$19.9	$76.0	$59.7	$32.8 2/	$33.9	$156.7	$54.2	$125.9	5.4 3/
· Costs	150.9	8.5	16.2	26.5	6.4	12.2	41.8	14.6	18.0	6.7
· Net benefits	$413.6	$11.4	$59.8	$33.2	$26.4	$21.7	$114.9	$39.6	$107.9	(-$1.3)
· Benefit-to-cost ratio	3.7	2.3	4.7	2.3	5.1	2.8	3.7	3.7	7.0	0.8
· First year of economic gain	#1	#1	#1	#1	#1	#1	#1	#1	#1	NONE
				CROPLAND EROSION						
Current erosion, tons/year	6057	182	779	829	850	541	1627	283	468	498
Project erosion, tons/year 4/	3211	144	502	404	354	257	760	218	411	161
Erosion reduction	2846	38	277	425	496	284	867	65	57	337
Percent reduction	47%	21%	36%	51%	58%	52%	53%	23%	12%	68%
Erosion rate, tons/acre/year										
· Current rate	3.6	2.3	4.5	3.2	5.0	4.4	3.6	1.8	3.0	5.3
· Project rate	2.0	2.0	3.0	1.5	2.2	2.1	1.8	1.4	2.4	1.8
				IRRIGATION						
Net Water Applied, inches/acre (estimated for normal year)	4.63"	4.7"	4.7"	4.4"	6.0"	5.1"	4.2"	4.8"	4.4"	5.6"

1/ Includes 14 acres of potatoes not included in irrigation plan due to location of land.

2/ Excludes benefits and costs to irrigate beans initially evaluated for farm.

3/ Benefits exclude the additional net income saved by stopping declining production. Costs exclude $1,030 to offset income lost to Farm #9 out of total project loss of $1,300.

4/ Includes 10-percent increase over the conservation plan's total erosion.

5/ Attainment of these yields are based on the assumptions that the estimated irrigation water required over average year will be applied and receive a crop response of averaging at least 24 cwt increase per inch each of application as reported.

TABLE 15A

DESCRIPTION OF TYPICAL CROPLAND AND IMPACTS WITH I & C PLAN

*I-C MEASURES			
-- Crop Rotation: Potato-Potato-Oats-Green Manure			
-- Contouring			
-- Waterways & Diversions: 86,476 ft. (16 miles)			
-- Number of Systems & Pumps			10
-- Miles of 4 to 6 Inch Pipe			13 miles
-- Number of Farm Ponds			7
*LANDUSE		Project Year #1 - #20	
*Cropland in potatoes (irrigated)		777 Acres (47%)	
-- in grain (oats)		388 Acres (23%)	
-- in unharvested green manure		388 Acres (23%)	
-- Total Cropland		1,553 Acres (93%)	
*Land in Conservation Structures		110 Acres (7%)	
TOTAL LAND		1,663 Acres (100%)	
*Irrigation Water Applied to Potatoes:		4 to 6 inches	
		Project Years	
	#1	#8	#20
*Potato Production: (1,000 cwt)	276	303	327
-- Increase from existing conditions:	8%	19%	28%
*Potato Sales: ($1,000)	$1,339	$1,498	$1,640
*Total Net Income to Farm Management per Year: ($1,000)			
-- per nine Farms	$390	$517	$629
*Total Annual Erosion: 4,350 tons @ 2.8 tons per acre			
--Reduction from existing:		59%	
*Potato Harvested Yield: (cwt/Acre)	355	390	421
-- Increase from existing condition:	54%	70%	83%
FARM BUDGET			
-- Potato Returns Per Acre:	$1,723	$1,928	$2,111
In Year #8 U.S. #1's	326 cwt @ $5.44		
Irregulars	30 cwt @ $4.09		
Culls	13 cwt @ $2.41		
(5% Shrinkage) Total Marketed	369 cwt @ $5.22		
	(or 390 cwt @ $4.94)		
--Potato Expenses per Acre:	$1,129	$1,174	$1,212
In Year #8			
Planting $342	Other	$138	
Fertilizer $149	Conservation	$6	
Harvesting $ 97	Irrigation	$165	
	Storage and Marketing	$277	
*Potato Net Income per Acre	$594	$754	$899
*Oats Net Loss per Acre	($113)	($108)	($108)
*Green Manure Net Loss per Acre	($ 72)	($ 72)	($ 72)

TABLE 16

PLAN C: SUMMARY ASSESSMENT OF IRRIGATION & CONSERVATION

	Footnotes	LOCATION OF IMPACTS: On 9-Project Farms 1663 Acres of Cropland	LOCATION OF IMPACTS: On Typical 1663 Acres of Cropland
1. National Economic Development (NED)			
a. Beneficial Impacts (average annual)			
(1) Value of increased output of goods & services			
(a) Average increase over current conditions	(1.5.7.9)	$564,500	$477,000
(b) Average increase from stopping declining conditions	(2.5.7.9)	14,800	14,800
(3) Total NED Benefits		$579,300	$491,800
b. Adverse Impacts (average annual)			
(1) Project annual costs	(1.6.7.9)	$150,900	$146,000
(2) Lost farm income, includes some mitigation for nonstructural measures	(2.4.7.9)	1,000	1,000
(3) Total NED Cost		$151,900	$147,000
c. Net NED Benefits		$427,400	$344,800
d. Benefit-to-Cost Ratio (BCR)		3.8 to 1.0	3.3 to 1.0
2. Environmental Quality (EQ)			
a. Beneficial Impacts			
(1) Effects on international basin's water quality * (stream & lake pollution)			
(a) Sediment loads reduced	(2.5.8.9)	--	59%
(b) Nutrient loads reduced	(2.5.8.9)	--	46%
(c) Biocide loads reduced	(2.5.8.9)	--	62%
(2) Effects on preserving top soil & nutrients, cropland erosion reduced	(2.5.8.9)	--	59%
(3) Effect on intensive landuse, potato acres decreased	(1.5.7.9)	17%	30%
(4) Effect on potato dumps, reduction in discarded potato culls	(1.5.8.9)	--	40%
(5) Net water storage per irrigated unit of potatoes compared to Pacific Northwest	(1.5.7.9)	--	10%
(6) Effects scenic, recreational or wilderness areas affected: * erosion reduced	(2.6.9)	depends on participation	
b. Adverse Impacts			
(1) Effect on annual energy consumption			
(a) Farm machinery, diesel fuel increases	(1.5.7.9)	--	19%
(b) Total increase, if irrigation pumps use diesel fuel	(1.4.7.9)	--	75%
(2) Effects on landuse & scenery structures on or adjacent to cropland			
(a) Waterways, diversions, open drains reduce cropland	(1.6.7.9)	16 Miles(81 Acres)	16 Miles
(b) Subsurface tile drains, improve drainage & add cropland	(1.6.7.9)	16.5 Miles(48 Acres)	nil
(c) Relocated or new farm access roads	(1.6.7.9)	2.8 Miles	nil
(d) Irrigation system, length of 4-6 inch diameter pipe	(1.6.7.9)	23 Miles	13 Miles
(3) Effects on fish & wildlife, conversion of wetlands, crop & forest lands to irrigation ponds, tradeoff one habitat for another	(1.6.7.9)	18 Acres, slight	--
(4) Effects on stream flows, intermittant reductions	(1.6.9)	7 Each, slight	--
(5) Effect on disturbing bird nesting from pump noise, if fuel used	(1.5.9)	slight	slight
(6) Effect on wildlife, grasslands converted to cropland	(1.6.7.9)	48 Acres, slight	slight
(7) Effects on air quality,* if pumps use fuel	(1.6.7.9)	slight	slight
(8) Effects on basin's water consumption, net irrigation water applied per potato acre	(1.6.7.9)	4.6 Inches	4.6 Inches
(9) Effects on historical, archeological areas *	(6)	none	

	Footnotes	LOCATION OF IMPACTS: On 9-Project Farms 1663 Acres of Cropland	LOCATION OF IMPACTS: On Typical 1663 Acres of Cropland
3. Social Well-Being (SWB)			
a. Beneficial Impacts (1) Preservation of agricultural heritage and family farms	(3.4.7.11)	depends on participation	
(2) Effect on security of farm families, average increase in net farm income with subsidy	(1.5.7.9)	163%	220%
(3) Farms with immediate improvements in standard of living	(1.5.7.9)	8 Farms	90%
(4) Effect on dampening annual fluctuations in production and income	(1.5.7.9)	significant	significant
(5) Effect on plans acceptance by Federal, State, local agencies & farmers	(1.6.10)	general support (tenative)	
(6) Effect of improved water quality on recreation & consumption	(1.5.8.9)	depends on participation	
(7) Effect on community cohesion with farm prosperity and stabilized revenues *	(1.5.11)	depends on participation	
(8) Effect on community growth with increased production *	(1.5.11)	depends on participation	
(9) Effect on public safety *: improved fire protection from farm ponds	(1.5.8.9)	slight	slight
(10) Effect on promoting irrigation and conservation practices on other farms	(2.5.10)	significant	
(11) Effect on public health * with improved water qulaity	(2.5.8.11)	depends on participation	
b. Adverse Impacts			
(1) Farms affected by long term economic loss (Revised conservation plan may eliminate this impact)	(1.5.8.9)	1 Farm	10%
4. Regional Development (RD)			
a. Beneficial Impacts (1) Project Investments	(1.6.7.9)	$1,062,000	$962,000
(2) Effect on the increased value of output of annual goods and services	(1.5.7.9)	$579,300	$491,800
(3) Effect on increased annual farm labor*	(1.5.8.9)	--	35%
(4) Effect on economic base, average annual increased market value of potatoes	(1.5.8.9)	54%	--
(5) Effect on economic base, average annual increased market value of other crops	(1.5.8.9)	23%	--
(6) Effect on other industries*from increased potato production, sold for seed, tablestock or processed	(1.5.8.9)	29%	--
(7) Effect on balance of trade, and crop diversity	(2.5.11)	depends on participation	
(8) Effect on social development	(2.5.11)	depends on participation	
(9) Effect on environmental enchancement	(2.5.11)	depends on participation	
(10) Effect on taxes and government spending *	(2.5.11)	depends on participation	
(11) Effect on preserving cropland	(1.5.8.9)	--	9.2 man-years
(12) Local labor required for construction	(2.5.8.9)	significant	
(13) Effect on increasing farm property value *	(2.5.11)	depends on participation	
(14) Effect on regional employment, population, and migration	(1.5.8.9)	43%	50%
(15) Effect on marketing potatoes, potato quality increases	(1.5.7.9)	66%	63%
(16) Effect on potato land productivity, yields per acre increase			

FOOTNOTES

Timing
1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 15 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation.)

Uncertainty
4. The uncertainty associated with the impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertianty is less than 10%.

Exclusivity
7. Overlapping entry; fully monetized in NED account.
8. Overlapping entry; not fully monetized in NED account.

Actuality
9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

Section 122
* Items specifically required in Section 122 and ER 1105-2-240.

TABLE 16

PLAN C:
SUMMARY ASSESSMENT
OF
IRRIGATION & CONSERVATION

declining production and further loss of $14,800 of average annual net income as estimated from the typical cropland analysis. Project costs for the nine farms are based on the designs and cost estimates in Appendicies 5 and 7 for each farm. The mitigation cost is required to offset farm number nine's average annual loss of $1,000 (Rounded from $1,030). This economic loss to the economy is assumed similar for typical cropland.

After deducting costs from benefits, the average annual net contributions of Plan C to National Economic Development are: $427,400 for the nine farms and $344,800 for typical cropland--with very favorable benefit to cost ratios of 3.8 and 3.3, respectively.

Environmental Quality.

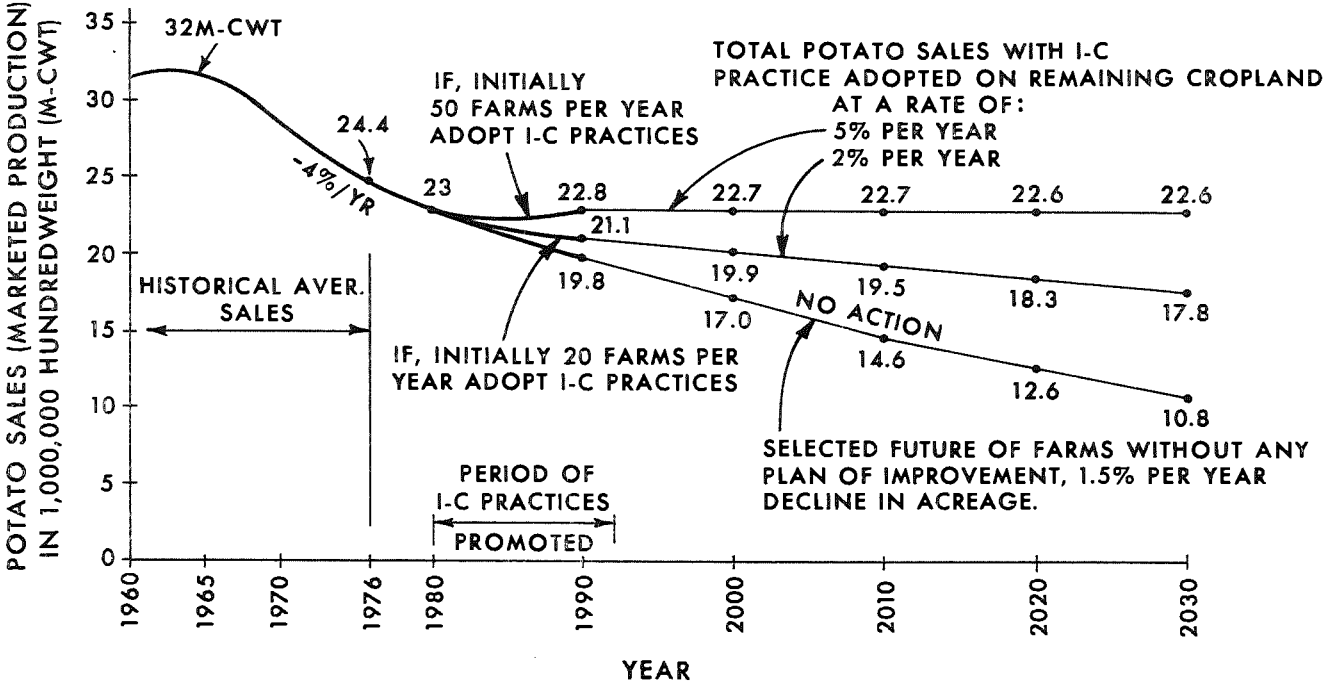
Environmental impacts are documented in Appendix 6 for typical cropland and the nine farms. The plan for typical cropland is estimated to retain 120 acres of prime cropland in production by improving productivity and reducing deterioration of the topsoil. Conservation practices are estimated to reduce the current level of erosion and sediment loadings by 59 percent with a 62 percent reduction in biocide pollutants. Roughly 50 percent higher applications of fertilizer per acre of potatoes to achieve a 66 percent increase in potato yields will be offset by the reduction in potato acreage and erosion and contribute to an estimated 46 percent increase in nutrient loads in streams. Research is needed to define how conservation can optimize the use of fertilizers and how crop rotation by naturally increasing the nutrient levels, decreases the need for commercial fertilizers. The possibility of more frequent applications of small amounts of liquid fertilizer through the irrigation system rather than one large dose at planting should be researched for both the economic and environmental benefits.

Fuel consumption to operate farm machinery will increase an estimated 19 percent as larger yields are harvested and operating inefficiencies are introduced from the interference of conservation measures. With the additional fuel required for operating the irrigation pumps, total farm energy consumed will increase 75 percent.

Land use on the nine farms would be altered as 81 acres of cropland are converted to conservation structures, and grasslands are tile drained to bring 48 acres into production. Farm roads and irrigation pipes which cross woodland or other natural habitats would create a slight adverse impact.

GRAPH 12

FUTURE IMPACT ON MAINE'S POTATO SALES IF I-C PRACTICES ARE ADOPTED



Irrigation ponds and withdrawals from streams would create slight impacts on stream fisheries, wetlands, crop and forest lands. Several ponds covering 18 acres could be stocked and landscaped as a trade-off of natural habitats. Intermittent withdrawals of irrigation water from seven rivers or streams will have slight impacts on river flows. The design of farm ponds provided for fish passage. The noise from diesel pumps will adversely affect wildlife and nesting birds unless adequate mufflers are installed or electric pumps are used.

Social Well-Being

The immediate increase (163 percent) in stabilized net farm income will improve the standard of living for eight farm families and help improve the longevity of their small family farm heritage. Improvement in the water quality of streams on or adjacent to the farms may improve esthetics and recreation. Participants in the advisory meetings endorsed the potential of the plan to encourage adoption of conservation measures. The plan has not received any opposition. The impact of Plan C on the county will depend on future participation and acceptance.

Regional Development

Additional goods and services of $579,300 will add to Aroostook County's annual sales of $400 million. The increase in farm potato production (about 29 percent) and increases in other crops would increase farm labor about 33 percent or about 5 man-years of labor on the nine farms each year. A future acceptance of I-C measures in Aroostook County could cause significant beneficial impacts.

The potential of combined I-C practices however, to stabilize declining trends in potato production, if adopted gradually over the next 20 or 30 years, could be significant. Graph 12 displays impacts on Maine's potato sales from two rates of adoption of I-C practices on cropland remaining in production over the next 50 years. Initially about 50 farms per year (5 percent of cropland) would need to adopt I-C practices in order to stabilize the region's marketed production, as potatoes from the remainder of the county's farms continued to decline at 1.5 percent per year. Stabilizing the economy and preventing further deterioration of its economic base would be a significant benefit. The average impact over the 50 year period would be about 50 percent increase in sales, employment and overall regional activity in all sectors of the economy as well as in environmental enhancement. The conversion of about 30 percent of potato land to rotation crops would create additional opportunities for development of livestock and processing markets by raising other crops such as oats, hay, wheat or vegetables.

IMPLEMENTATION RESPONSIBILITIES

Federal and Non-Federal Responsibilities

The implementation responsibility of irrigation and conservation, similar to that of Plans A and B, belongs to the potato growers with technical assistance provided by Federal, State and local agencies. Available technical assistance also, is extremely limited by lack of research and technical guidelines, which restrain the successful promotion or adoption of these practices.

Cost Sharing

Only limited cost-sharing of conservation and irrigation structures is available through Federal and State agricultural programs as indicated for Plans A and B. The Water Quality Management plan for the region stated that existing cost-sharing rates for conservation practices are inadequate to promote conservation measures alone. However this plan has shown that for eight out of nine farms, existing rates may be adequate for most farms if irrigation practices are combined with conservation improvements.

Public Views

Public views on plans to combine irrigation and conservation practices are presented later in the report following discussions and implementation. The plan has received support from government and private agencies and growers by letters during the draft review of this report (Attachment and Appendix 4).

Comparison of Detailed Land Management Plans

There are about 1,000 potato growers in Aroostook County with no two farms producing under identical conditions. Similarly, no single plan of improvement will likely meet all needs. The management plans evaluated for conservation and irrigation indicate a strong potential to improve the prosperity of potato enterprises and decrease erosion and pollution. The lack of education and sound reliable guidelines though, prohibit the universal adoption of I-C measures. The first step in promoting I-C practices then is to more precisely determine I-C benefits, costs, impacts and limitations, possibly through a combined program of research and demonstration.

Comparison of Management Practices

Aroostook County is the last remaining stronghold for vegetables and potatoes in the New England region. But with a life expectancy of around 50 years, an immediate goal of the region is to preserve this agriculture. To accomplish this goal requires substantial increases in net farm income, stabilized fluctuations in production and preservation of the region's economic base--agricultural production which is based on its soils.

The 208 Water Quality Management Plan for the county recognizes that cropland conservation practices are the only solution to improve environmental quality; however, the economic impact in the absence of adequate cost-sharing could be devastating to the region's economy.

The conservation management plan (Plan A) assesses the impact in meeting the 208's water quality goals. Plan A, which reflects the attainment of a 3-ton erosion standard on all fields, benefits only one farm (10%) by increasing net income in the short-term, as shown in Table 17. Plan B (Irrigation Only) and Plan C (Irrigation and Conservation) significantly contribute to the national economic development by increasing the value of goods and services exceeding Plan A. Plans B and C, raise the $250,000 net income level of the nine farms by about 160 percent, with increases in net income occurring on most farms immediately.

Among the three plans Plan A produces the greatest benefits in terms of enhancing the environmental quality by significantly reducing cropland erosion and eliminating sediment, nutrient and biocide pollutants from the region's waters. It has a negligible impact on energy consumption and offers a moderate improvement in potato land productivity. At the other extreme, Plan B,

TABLE 17

COMPARISON OF LAND MANAGEMENT PLANS A,B AND C

	PLAN A Conservation Alone		PLAN B Irrigation Alone		PLAN C Irrigation and Conservation	
A. PLAN DESCRIPTION						
	Location of Impact		Location of Impact		Location of Impact	
	On 9-Project Farms	On Typical Cropland	On 9-Project Farms	On Typical Cropland	On 9-Project Farms	On Typical Cropland
B. PLAN EVALUATION						
1. National Economic Development Account (NED) Net NED Benefits	$ 37,400	($14,500)	$476,600	$639,800	$427,400	$344,800
2. Environmental Quality Account (EQ)						
a. Effect on cropland erosion and sediment loads in streams	-47%	-62%		+10%	--	-59%
b. Effect on nutrient loads in streams	--	-65%	--	+56%	--	-46%
c. Effect on biocide loads in streams	--	-65%	--	+10%	--	-62%
d. Effect on energy consumption	--	-5%	--	+135%	--	+75%
3. Social Well-Being Account (SWB)						
a. Farms with increased income, short term	1 farm	10%	9 farms	99%	8 farms	90%
b. Effect on farm net income	+35%	+12%	+190%	+400%	+163%	+290%
4. Regional Development Account (RD)						
a. Effect on farm labor, 1st year		-15%		+70%		+35%
b. Effect on market value of potatoes	nil	nil	+90%	+140%	+54%	+70%
c. Effect on potato land productivity	+17%	+15%	+45%	+58%	+66%	+63%
C. PLAN RESPONSE TO ASSOCIATED EVALUATION CRITERIA						
1. Acceptability - supported by	Effects not well-known, generally supported by Federal/State agencies. Mandatory action opposed by growers.		Effects not well-known, no general support due to environmental impacts.		Effects not well-known, generally supported by potato growers and specialists, Federal/State agencies envolved in the study.	
2. Completeness	Lack of technical guidelines, research and education restricts the adoption and successful use of these practices.					
3. Certainty	Economic benefits and environmental effects are based on an extensive analysis. Costs are based on actual design. Strength of yield increases with conservation are based on relatively recent research for crop rotation; and for all measures on local experience and a 1940 report. Strength of irrigation economic feasibility based on documented experience on 11 farms, limited research, break-even analyses and the magnitude of benefits.					
4. NED Benefit/Cost Ratio	1.7	0.6	4.1	4.3	3.8	3.3
D. RANKING OF PLANS TO SATISFY THE NATIONAL OBJECTIVES						
NED	2		Does not meet		1	
EQ	1		both planning or		2	
SWB	2		national		1	
RD	2		objectives.		1	
E. IMPLEMENTATION RESPONSIBILITY						
Current responsibility	Potato grower with technical and financial assistance provided by conservation agencies.		Potato grower with technical and financial assistance provided by USDA to develop a community water supply only for groups of farms.		Same as Plans A & B	

irrigation alone, is estimated to significantly increase the biocide and nutrient loadings while only slightly increasing cropland erosion and sediment loads. However, an increased erosion rate from moisture addition would eventually deteriorate the soil and render it useless to future generations.

The increase in energy consumption is significant; however, the region's untapped hydroelectric power would have the potential to meet the needs of irrigation pumps without significantly changing current fuel consumptions for farm production.

Plan C would produce a trade-off for Plan A's adverse economic impacts created on over half the nine farms and for the adverse environmental impacts caused by Plan B. Combined irrigation and conservation practices would achieve the 3 ton erosion standard on all fields with about a 59 percent reduction in cropland erosion and sediment loadings. Reductions in biocides (i.e., pesticides, herbicides and insecticides) would result from reduction in potato land from crop rotation. Further reductions in both biocide and nutrient loadings may be possible by improving the timing and method of applications (i.e., using the irrigation system). Research is needed, however, to define the degree of impacts and necessary mitigation measures for a variety of soil and management conditions.

Northern Maine is an agricultural region influenced by the health of its potato industry. Regionwide adoption of Plan A's crop rotation would have immediate adverse impacts throughout the county and on most economic sectors by reducing potato sales by 20 percent. The evaluation of Plans A, B and C, assumed voluntary actions by potato growers with current levels of conservation cost-sharing and no cost-sharing of irrigation measures. As in the past, regionwide adoption of conservation measures alone without substantially increased levels of cost sharing is not likely to occur. A regionwide sales increase of 50 to 100 percent under Plans B and C would only occur after intensive research, educational and promotional efforts.

The certainty that the degree of impacts will occur must first be demonstrated by basic and applied research for a wide variety of conditions. When this is accomplished then potato growers, service agencies and planners will have the guidelines needed to determine the best plan for each situation and for the region as a whole. As it stands, combined irrigation and conservation practices have a strong potential to achieve the goal of preserving agriculture, and to obtain national and planning objectives, therefore warranting consideration for a program of research and demonstration.

Formulation of Preliminary Research and Demonstration Plans

Monitoring soil moisture is just one of many management practices which must be understood and promoted before I-C plans would be adopted throughout the region.

The second objective of the irrigation and conservation studies, after determining the potential feasibility (first objective) of these for management practices, is to determine whether these practices should be promoted in Aroostook County and if so how best to proceed in order to obtain the ultimate goal of preserving the agriculture and improving the environment. SCS was also contracted by the Corps to conduct and report on advisory meetings to answer these questions. The Corps of Engineers lacks the authority to proceed further toward the implementation of single-purpose agricultural programs. This section summarizes the concerns and assesses recommendations made by the Federal, State and local advisory committees and the SCS report on how to proceed toward implementation of a program.

Problem Identification

Advisory Meetings

Six advisory meetings were held from November 1977 to January 1978 at the University of Maine in Orono and in Aroostook County with 46 participants representing Federal, State, and local agencies, including 20 potato growers. The minutes of these meetings are included with the SCS report in Appendix C. The committee was asked to provide advice and counsel on the following items if I-C practices warranted further action.

How to finance a demonstration, including the source of funds, cost-sharing, payback and guarantee provisions.

How and what to monitor and evaluate during a demonstration.

How to implement a program, including Federal, State and local responsibility and program duration.

How many farms and significant characteristics are needed for a valid demonstration.

In addition, the committee provided comments on the formulation and evaluation of irrigation and conservation practices which were incorporated into the assessments for Plans A, B and C previously presented.

Problems, Needs and Opportunities

The University of Maine, College of Life Sciences and Agriculture reported that past and on-going research has made much progress toward advancing crop breeding, weed control and nutrition; however, the limiting factor today is frequently water, which restrains high crop production and high potato quality (Appendix 3). Both the irrigation and conservation (I-C) practices are needed to obtain optimum high quality potato production. Technical guidelines are not available to show farmers the value of irrigation or the value of the different conservation practices and how they must be managed to produce favorable results. The university provided the following questions which must be answered before optimum levels of production are reached with I-C practices:

- At what level of soil moisture should irrigation begin for each stage of plant growth?
- What quantity of water should be applied and at what rate under existing soil conditions and with improved conservation measures?
- What is the long-time influence of I-C interaction on soil erosion, crop yields and crop quality?

More detailed questions are addressed in Appendix 3.

Although "rules of thumb" are currently being used to estimate the response of crops to I-C practices for general situations more precise guidelines are needed by farm managers which define such items as quantities of fertilizer, biocide and water applications, seed spacing, levels of yields and quality expected over crop rotation cycles for the different conditions found in the county. These include 25 soil series (or types), over 100 potatoes varieties, 3 geographic climates, 6 erosion groups and 1,000 management situations. Research is therefore needed to develop technical guidelines for managing irrigation and conservation practices and their specific benefits under an array of interrelated conditions.

Reasons noted for abandoning irrigation research by the University of Maine in the past are:

- A lack of demand by growers for irrigation information, since only a few actually irrigated;

- General belief that sufficient water is received to produce a good potato crop;
- Lack of funds to conduct needed research;
- Higher priorities for other programs with Federal funding;
- Higher priorities for other programs believed to have more immediate needs.

Research on conservation has been limited to crop rotation.

Research and technical guidelines alone will not result in the adoption of I-C practices due to the "greenhouse" or controlled conditions under which research is conducted. Applied research or farm demonstrations are essential since, as SCS indicated, farmers listen and believe other farmers. Demonstrations would provide an opportunity to address problems and concerns characteristic of actual farm management, such as labor requirements, fuel shortages, large scale management, optimum equipment size, different soil types and runoff, and pollution and efficiencies in management decisions. The major regional problems addressed in an earlier section include:

- rapidly declining crop acreage and farms
- fluctuating potato production and regional economy
- high cropland erosion and stream pollution

These problems should be combatted with a combined research and demonstration program to prepare the technical guidelines and promote adoption of I-C practices among the 1,000 potato growers in Aroostook County. Graph 12 following page 51 displays that a 5 percent participation per year in the I-C program would stabilize potato sales.

Planning Objectives

The planning objectives for implementation are:

1. Outline a research program for Aroostook County potatoes which will establish technical guidelines for best management practices (BMP) over a 10-20 year period to:

- maximize and stabilize yield and quality of potatoes through irrigation and conservation practices; and
- determine the long time influence on soil erosion, crop yields and quality.

2. Outline a farm demonstration project for Aroostook County which will:

- assist in developing BMP's under a large array of significant conditions;
- evaluate impacts on farm economics, techniques of irrigation-conservation and environmental effect; and
- promote 50 farms per year to adopt irrigation and conservation practices from among the 1,000 potato growers to stop the annual decline in potato sales or marketed production, and to obtain an erosion rate on fields in potato rotation not to exceed 3 tons of erosion per year.

Planning Constraints

The major constraint on implementation planning was the precedent setting nature of the I-C research and demonstration program. No Federal agency could be identified as having the authority or funds to conduct demonstrations on individual farms which would promote irrigation and conservation for combined economic and environmental development in the Northeast. In addition the combined participation of Federal and State agencies to fund and administer a new type of program requires a decision document describing the program and outlining the needs and costs. Since this draft report is needed as a decision document by these agencies for the I-C program, specific funding arrangements were not established, although alternatives were discussed. State and Federal agency heads will be requested to comment on their interest and agency's ability to share in the funding of the tentatively recommended program during their review of this draft report.

Programs of Others

Existing Programs in Maine

The Soil Conservation Service recommended after much discussion and review with individuals, groups, State and Federal agencies and the University of Maine during the contracted I-C studies with the Corps, that research and demonstration should be a complimentary undertaking. In addition, these agencies should be considered for direct participation and/or funding of an I-C program. Table 18 describes the purpose and relationships of various groups to an I-C program.

TABLE 18

RELATIONSHIPS OF EXISTING AGENCIES AND PROGRAMS
TO AN IRRIGATION-CONSERVATION
RESEARCH/DEMONSTRATION PROGRAM

1. The State Cooperative Extension Service (CES), which has three county agency offices in the basin, is responsible for the agriculture extension education program. Three potato specialists serve the purpose of educating to improve agriculture. A research/demonstration would further the extension's contribution.
2. The Maine Agricultural Experiment Station (MAES) works to carry out research to improve agricultural technology. Limited research in irrigation-conservation has been conducted occasionally by the station in Aroostook County. This study has and will continue to be collaborated with staff members under a research/demonstration arrangement.
3. The three Soil and Water Conservation Districts (SWCD) in the county help farmers plan and apply conservation practices. Research/demonstration would be complimentary to the SWCD program.
4. The University of Maine carries out a program of academic education in agriculture. A research/demonstration would be supportive through providing much valuable educational data.
5. The Maine State Planning Office and the Northern Maine Regional Planning Commission's are vitally concerned about the future of basin agriculture as shown by their interest and participation in the formulation of the demonstration. Basin potatoes are essential to the welfare of the State and region. These agencies sponsor and develop programs to improve agriculture and the environment.
6. USDA agencies such as the Soil Conservation Service, Farmers Home Administration, Agricultural Stabilization and Conservation and the Agriculture Research Service have cooperated in promoting potatoes and other agricultural crops. Research/demonstration is identified as a means to extend the benefits of service to help stabilize what seems to be essentially a potato monoculture.
7. The Maine Potato Council and Maine Potato Commission are fully supportive of efforts to improve potato quality and quantity.
8. The Maine Department of Agriculture carries out a program of promoting and extending the economics of all agriculture within the State. The Commissioner and his staff expect a demonstration to significantly expand potato production through its technical and financial help.
9. The U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and the Maine Department of Environmental Protection and Inland Fisheries and Wildlife are concerned about environmental pollution of the regions waters from agricultural runoff. These agencies sponsor and fund programs to enhance the environment.

Corps of Engineers Studies and Projects

The Corps is currently conducting power and flood control investigations in the basin as separate elements of the St. John River Study. The studies show that there are potential multipurpose power, flood control, and irrigation storage projects on the St. John, Aroostook and Meduxnekeag Rivers. If potato croplands adjacent to these rivers irrigated from the river, natural summer flows may be adversely affected. Roughly 25 percent of the region's cropland may be able to use these sources though, by turning to upstream storage. But the uncertainty associated with the adoption of irrigation excludes irrigation storage projects from detailed studies.

The Federally authorized Dickey-Lincoln School Lakes multipurpose project on the St. John River could provide irrigation water by only slightly modifying the operation of the project, and if institutional agreements are reached with Canada and others, as outlined in the project's Environmental Impact Statement.

Water and Power Resources Service (formerly Bureau of Reclamation)

The U.S. Department of Interior, Water and Power Resources Service (W&PRS) was contacted by the Corps to identify implementation measures for their irrigation demonstration and research programs. Information on the size of demonstrations, cost sharing and sponsors for projects in Colorado and North Dakota was obtained from several W&PRS project and regional managers and a state university research director. Reasons for conducting their agricultural irrigation demonstrations are:

- to obtain information to evaluate the feasibility of irrigation for basinwide projects,
- to show local farmers the value of irrigating their croplands before completing large irrigation projects
- to solve problems specifically oriented to applied research, and
- to obtain research information for establishing guidelines to optimize production prior to applied research.

W&PRS obtains Congressional authority to use planning and construction funds to conduct demonstrations evaluating water resource development of Federally sponsored projects in lands

under their jurisdiction in 17 western states. The projects are usually contracted to and/or administered by a state university experiment station. The Soil Conservation Service and Cooperative Extension Service usually participate in these projects when dissemination of information to local farms is needed or conservation measures are being evaluated.

The number of farms involved in demonstrations varied depending on their purpose--from one to three farms to evaluate a specific problem in one geographic location, to as many as 10 demonstration farms to evaluate irrigation only on a variety of soils and crops for promotion in a large geographic region, as with the Garrison Diversion project in North Dakota. The demonstrations lasted between 5 to 15 years. The cost sharing of demonstration projects varied significantly depending on the funds available from public and private sources. The estimated cost for professional people during the initial research effort for the Garrison Diversion project exceeded an estimated $200,000 per year, although the on-going cost in 1977 was estimated at half that amount. In three Colorado projects reviewed, the Bureau of Reclamation (BuRec) financed from 40 to 100 percent of the cost of demonstrations. The project receiving 40 percent Federal financing was financed 60 percent by the University, with some of the financing coming from the sale of the demonstration farm's products.

Another example of cost-sharing on potato research alone was the almost equal cost-sharing of $680,604 of research in 1971-72 by the Washington State University, U.S. Department of Agriculture and the Washington State Potato Commission.*

In all cases irrigation equipment was leased for use during the BuRec demonstrations. In some cases the equipment was leased by BuRec. In others it was sponsored by water districts or universities, while BuRec financed the development of the water source. Cooperating growers in some cases were provided the cost of operating their leased systems as compensation for using their farms for guided tours.

Formulation of Preliminary Plans

The Soil Conservation Service provided summaries of the pertinent items used to formulate preliminary research and demonstration plans during the advisory meetings (see Table 19). As

*11th Annual Proceedings, Washington State Potato Conference and Trade Fair, February 1972.

TABLE 19

Formulation Procedure of Preliminary
Research and Demonstration Plans

1. Provide for the acquisition and operation of a representative basin farm which can be utilized exclusively for basic irrigation-conservation research.
2. Plan for a sufficient number and distribution of farms to evaluate and prove the value of irrigation-conservation in the basin.
3. Develop a demonstration project over a sufficient time span to prove that irrigation-conservation will repay the large investments necessary for properly equipped and managed irrigation-conservation. Farm demonstrations must continue for at least two crop rotation periods, i.e., 6 years for a 3 year rotation and 8 years for a 4 year rotation, to ultimately show the total benefits of the combine program after the full impact of conservation is realized.
4. Provide for technical assistance necessary to plan, apply and operate a farm program for irrigating and using conservation practices to maximize yields and reduce field soil losses to not more than 3 tons/acre/year.
5. Provide for management assistance to assure that farm records will provide detailed data on yields. Data should be identified for the following parameters:
   a. Selected soil types and slopes with different crop rotations.
   b. Selected erosion conditions.
   c. Selected potato varieties to show yields for long growing, medium growing and short growing seasons.
   d. Operations using portable pipe irrigation systems versus operations using self-propelled systems.
   e. Selected sampling of varieties to show quality ratings for harvested yields.
   f. Selected farms to show cost associated with stream impoundment source of water.
   g. Selected nonirrigation check plots to show costs and yields.
6. Bookkeeping is needed to completely record and evaluate data for all parameters.
7. Timely information and education programs are needed to disseminate data and information to all other potato farmers in Aroostook County.
8. Environmental assessments of impacts of irrigation-conservation parameters which should be assessed are as follows:
   a. Records of soil loss and places of deposition with special attention to sediments entering streams.
   b. Records of chemical use and waste disposal with special attention to kind and amounts leaching from fields or disposal sites.
   c. Water quantity and quality monitoring of streams or impoundments associated with water source. Data on water yield and consumption will be kept to chart an input-output relationship. Streams will have baseline data collected to show predemonstration chemistry, BOD Biochemical Oxygen Demand, color and temperature. Regular checks will be made to provide data on changes associated with management events.
   d. Wildlife baseline data will be gathered before the demonstration to show (1) stream fisheries, (2) upland wildlife, (3) migratory fowl. Regular checks will be made to provide data on changes associated with management events.
9. Estimate the investment and operating costs of the programs.
10. Identify alternative organizational arrangements to administer and fund the programs.

a guide for determining the optimum size of a demonstration, the advisory meetings established the desirable and most significant characteristics to be demonstrated and the number of combinations which may be found on each farm. The result was that about 20 farms would be needed to assure that the demonstration would be meaningful to the greatest number of farms by satisfying the following combinations of conditions: representation in the three geographic regions (north, central and southern Aroostook County); demonstration on three soil types (with high, medium and low field capacities) in each region; evaluation of three potato maturing varieties (early, medium and late maturing) on each soil with two potato uses (seed and processing) represented; and combinations of the three major soil erosion categories (0 to 3, 3 to 10, and 10+ tons of erosion per acre per year) (See Table 20). Major economic impacts would be evaluated from potato yields on a range of soil types (with diverse irrigation requirements), varieties, uses and erosion or soil conditions. Project costs would be evaluated for the different irrigation requirements and conservation practices required on the range of soils and erosion conditions. Environmental impacts would be evaluated for the range of irrigation and erosion conditions as well as for the different water source developments needed on each farm. A total of 162 combinations of physical conditions would be desirable on 20 farms.

The meetings reviewed an array of cost sharing possibilities for both growers and government contributions. A major provision desired by the growers was a guarantee that net income would not be lost as a result of the project. Discussions also addressed administrative roles of various agencies and problems which might be encountered with manpower ceilings and other program limitations.

Comparative Assessment of Alternative Plans

SCS provided a list of alternative plans considered during the advisory meetings, as shown in Table 21. Due to the committee's support for both basic research and demonstration programs for irrigation and conservation, all alternatives were excluded from major consideration except for alternative number 10.

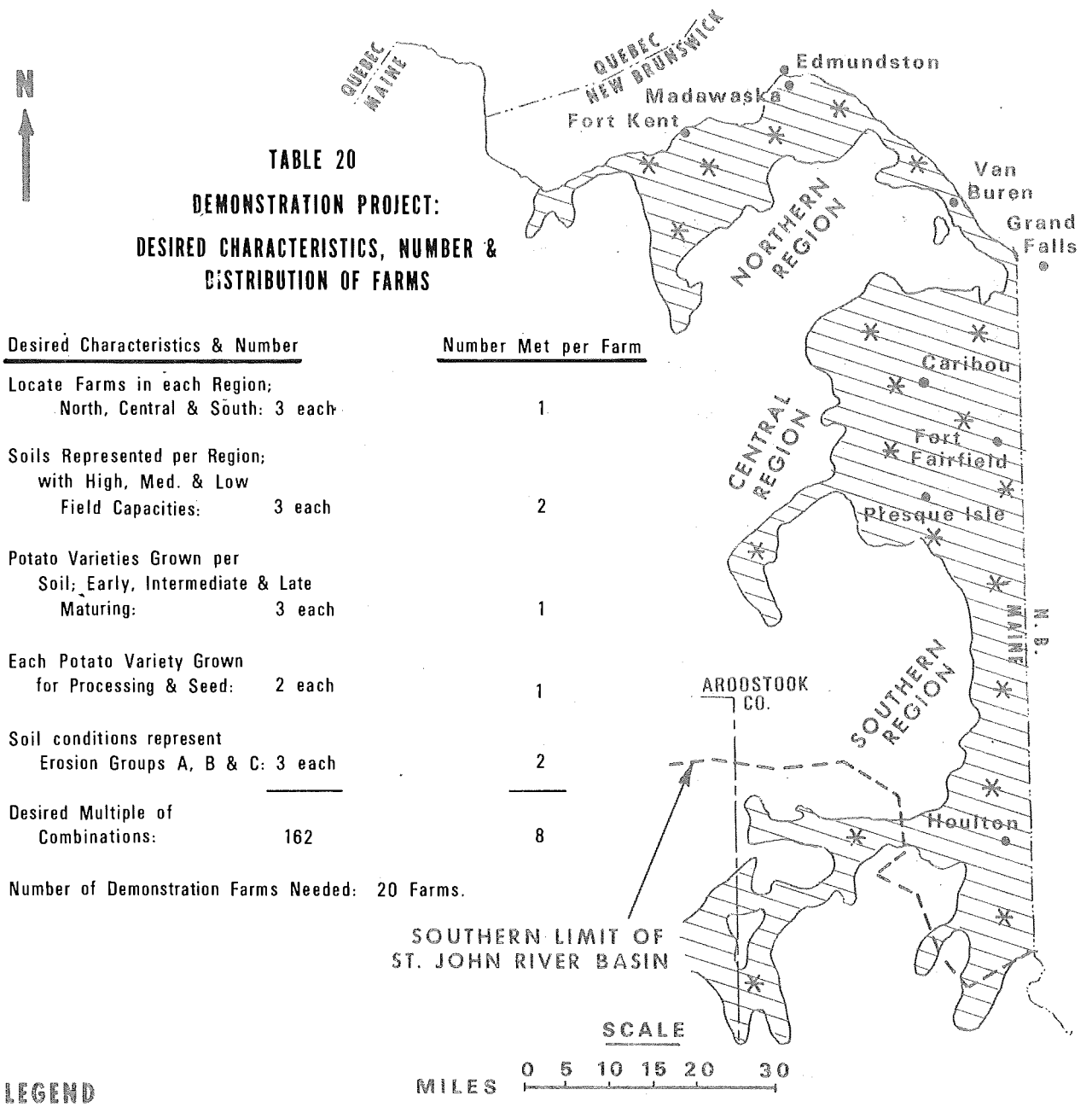
TABLE 20

DEMONSTRATION PROJECT:

DESIRED CHARACTERISTICS, NUMBER & DISTRIBUTION OF FARMS

Desired Characteristics & Number		Number Met per Farm
Locate Farms in each Region; North, Central & South:	3 each	1
Soils Represented per Region; with High, Med. & Low Field Capacities:	3 each	2
Potato Varieties Grown per Soil; Early, Intermediate & Late Maturing:	3 each	1
Each Potato Variety Grown for Processing & Seed:	2 each	1
Soil conditions represent Erosion Groups A, B & C:	3 each	2
Desired Multiple of Combinations:	162	8

Number of Demonstration Farms Needed: 20 Farms.



LEGEND

CROPLAND

* APPROXIMATE DISTRIBUTION OF 20 DEMONSTRATION FARMS & 1 RESEARCH FARM

ST. JOHN RIVER BASIN IN MAINE

TABLE 21

ALTERNATIVE RESEARCH/DEMONSTRATION PLANS CONSIDERED

1. Conclude that use of data and information generated from an irrigation-conservation study would not be significant. Do not proceed with research or demonstration.
2. Conclude that only additional basic research is needed in irrigation. Use existing Agricultural Research Service (ARS) and Maine Agricultural Experiment Station (MAES) programs.
3. Conclude that only additional basic research is needed in conservation. Use existing ARS and MAES programs.
4. A combination of plans 2 and 3 using ARS and MAES programs.
5. Set up basic irrigation research on selected farms - less than 5 acres/farm.
6. Set up two or three farms or a combination of basic and applied research farms to demonstrate results to an interested public. This can be done in many different ways, i.e.:
   a. Use an area (10-40 acres) on selected farms. Program basic research but apply conservation-irrigation to a cropping system applicable to site conditions.
   b. Same as plan 6a but on three entire farms to demonstrate management problems and needs as well as research results. Select three farms to represent north, central and south county areas.
   c. Other mixes are possible.
7. Select from existing irrigating farms. Provide technical and financial assistance to adapt irrigation system(s) and apply conservation to demonstrate I-C. Carry out basic I-C research on MAES farm at Presque Isle to complement the on-farm experience.
8. Select 20 farms that would include needed variables, i.e., soils, erosion, region, varieties, conservation treatment, etc. Conduct an eight year demonstration.
9. Select three farms from north, central and south regions. About half of each farm would be irrigated. A complete conservation program would be implemented. In addition, a fourth farm would be acquired and programmed for basic I-C research.
10. This alternative is the same as plan 9 except that additional demonstration farms would be established after basic guidelines are developed.

Plans 1 through 5 considered either no action or basic research only. These plans were discarded for the following reasons:

> The feasibility of combined irrigation and conservation practices already demonstrated both economic and environmental benefits for potato farms and the region and therefore warranted further research and/or farm demonstrations.
>
> Basic research alone on either conservation or irrigation would not be responsive to promoting these practices, according to the advisory committee. The use of existing ARS and MAES programs will be considered further.

Plan 6 considered using several selected farms for both basic and applied research. This plan was discarded since research professionals indicated during the meetings that the control necessary for basic research could not be obtained on private farms.

Plan 7 considered demonstration only on existing irrigating farms and research on the existing experiment farm. It was discarded for two reasons: (1) The existing MAES experiment farm in Presque Isle lacked a reliable water source which could be developed for irrigation and; (2) It could not be assumed that the required number (whether 3 to 20) of existing irrigation farms would agree to provisions of applying complete conservation plan and adapting their systems to the plan. This provision could be a viable alternative in the final design and selection of demonstration farms as a means to reduce the cost of renting irrigation systems and developing a water source, as well as capitalizing on the experience of these irrigators. Different incentives will need to be developed for these irrigators, such as payment for their fuel to operate their systems in exchange for the provisions of the demonstration.

Plan 8 considers only demonstration on 20 farms. It was discarded since basic research was excluded.

Plan 9 includes demonstration on three farms and basic research on an acquired fourth farm. This plan was initially supported since the three farms could be managed without excessively exceeding existing SCS and university resources. However, it was discarded since it was not totally responsive to the desires of local potato growers or the provision that an estimated 20 farms would be needed for a successful demonstration.

Plan 10 represents a compromise of the desires of potato growers, university representatives and U.S. Department of Agriculture personnel. The plan considers a three farm

demonstration as a Phase I gradually expanding to an estimated twenty farms, during Phase II depending on marginal benefits of each additional farm and its characteristics. In addition, a separate farm would be acquired for basic research. The compromises represented by the plan include the following:

1. The size of the demonstration will be limited initially to three farms, one in each region of Aroostook County. This provides for the verification or preliminary assumptions such as the initial benefits from potato yield and quality increases and operating and production costs. It will also provide preparation time before expanding to include more farms. This provision compromises the proposal for a three farm demonstration with the proposal for a 20 farm project.

2. Each farm not currently irrigating will be considered for irrigating using one system on about half of the planned potato acreage. Potato growers on the other hand desired all potato acreage be irrigated to determine total impact on farms management. SCS and university officials felt only a portion of each farm should be irrigated to provide the needed comparison to nonirrigated yields. Currently, irrigators purchase only one system initially, followed several years later by additional systems if satisfied. Providing one system to each of two farms would probably provide more meaningful variations in data and better promotion opportunity than providing two systems to one grower, where the cost and number of systems may be a constraint on the demonstration.

3. The plan also combines the alternatives of either research alone and demonstration alone by providing for both.

Plan 10 is presented in greater detail in the following section. Only this plan surfaced as a program which would be supported by the representatives of the University of Maine, U.S. Department of Agriculture and potato growers.

Assessment and Evaluation of Tentively Selected Plans

A research and demonstration program would establish guidelines and promote adoption of best management practices to preserve the future of agriculture.

The preliminary plan for research and demonstration is an outline of recommendations received from the 46 member Federal, State and local advisory committee. The plan calls for 10 years of basic research and a demonstration program involving 3 private potato farms initially, gradually expanding to an estimated 20 farms. The plan would be implemented in two phases; a "preparation phase" lasting about two years and a "promotion phase" lasting an estimated 10 years.

Research Program

The first two years of research would be used to develop preliminary technical guidelines using existing research facilities in Maine and existing literature. In addition, a research farm would be acquired in central Aroostook County and be devoted to basic research. The University of Maine, College of Life Sciences and Agriculture, provided an outline of estimated costs to develop the research farm and conduct the research program. The research farm should include at least 150 tillable acres with storage facilities, operational equipment, conservation structures, irrigation and drainage systems. The capital cost is estimated at $445,000 (October 1979 price level). The operating costs per year include salaries and overhead at $255,000, and costs on the individual research plots for planting, harvesting, fertilizing, seed and insect control, data collection and data analyses at $135,000, for a total of $390,000 per year (see Appendix 3). The basic research would commence in the third year after the farm was operational and continue for eight years, during the Promotion Phase. Toward the end of this phase the research program would be evaluated for a 10 year continuance to determine long-term impacts of irrigation and conservation interactions.

The University estimated that the personnel required to staff the research program includes three professional staff (an agronomist, agricultural engineer and a crop physiologist); and ten support personnel (a farm superintendent, 3 technicians, 4 farm laborers, an administrative clerk and a clerk-typist); and seasonal labor as required.

Demonstration Program

The demonstration program involves the selection of three farms under the preparation phase for implementing combined irrigation and

conservation plans for applied research using currently known techniques. During these first 2 years, initial yield and quality increases of potatoes and benefits and costs would be evaluated and feasibility verified before proceeding into the promotion phase. The three farms would complement the research program for the preparation of preliminary guidelines. Irrigation equipment should be operational during the first year. Conservation measures would be applied over the first two years and all structures in operation by the third year. Administration of the demonstration includes: plan reviews, supervision for implementation, monitoring and reporting results and an educational program. A guarantee fund would also be established for participating potato growers in the event they should experience a loss of income resulting from the project.

Selection of Demonstration Farms

The demonstration program includes the selection of potato farms for applied research and implementation of irrigation and conservation plans. Candidates considered for the first phase involving three farms were the nine project farms previously reviewed and the 18 potato farms currently irrigating. Three project farms, (# 2, 8 and 9) were selected for several reasons:

Conservation plans had been designed for these farms with irrigation systems laid out according to the conservation plan, which may not be the case with the existing irrigators.

The initial phase required extensive cooperation of selected growers. The three potato growers selected are active cooperators with Soil and Water Conservation Districts, and have more to gain from participation than existing irrigators.

The Soil Conservation Service recommended three farms (all having available water supplies without development) from among the nine project farms to represent the three geographic regions.

The leasing and operational performance of new systems would provide up-to-date costs and management requirements for irrigation, considering new technology.

These three new irrigators, although trained in irrigation management, would have the same degree of irrigation experience, or lack of it, as the other 1,000 potato growers for whom the demonstration is being conducted.

Farm 2 was selected to represent central Aroostook County, with 169 acres of cropland requiring conservation measures to reduce erosion 36 percent. One irrigaton system will provide water to 60 acres of potatoes, or almost one-half of the planned 113 acres of potatoes. Irrigation water will be obtained from an existing lake. The installation of conservation structures is estimated at $16,600 at the October 1979 price levels. The irrigation system would be leased annually at about 20 percent of its $62,800 estimate capital cost, or $12,600 per year (1979 P.L.).

Farm 8 would represent the northern region with conservation measures applied to 170 acres of cropland to reduce erosion 12 percent. One irrigation system will provide water from an existing lake to 55 acres of potatoes, only half of the planned 111 potato acres. The conservation structures and tile drainage would cost $39,400, with the $54,200 irrigation system leased at $10,800 per year.

Farm 9 representing the southern region would require conservation measures on 91 acres of cropland to reduce erosion 68 percent. One irrigation system could irrigate all of this farm's 42 acres of potatoes; however, check plots will not be irrigated so that comparisons of irrigated versus nonirrigated yields, erosion rates and other parameters can be compared. The farm will use a river as a water source. Conservation structures are estimated to cost $4,000, and the $53,500 irrigation system would be leased for about $10,700 per year. This plan will be reevaluated for a less stringent rotation to reduce the growers loss of income under the plan's current design.

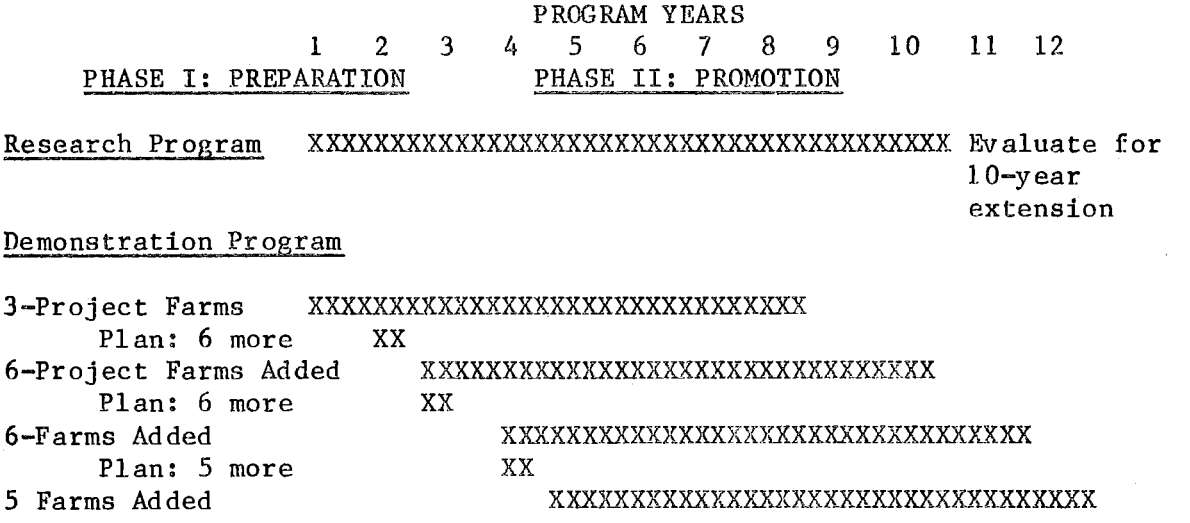
In addition to the implementation of combined I-C plans on the three nonirrigating farms, negotiations with an estimated 18 existing irrigators should be initiated to obtain their cooperation for monitoring their irrigation operations and benefits and costs during these first two years. The possibility of their participation for combined I-C practices should also be reviewed.

Assuming the demonstration will enter the promotion phase to expand the number and characteristics of demonstration farms, the selection of an estimated 17 additional farms would consider the remaining 6 project farms, the 18 irrigating farms, and the other 15 nonirrigating growers who participated in the advisory meeting with interest for the demonstration. The criteria for selection will be based on the merits of each farm contribution toward the promotion and evaluation of I-C practices.

Duration of Demonstration

The duration of each farm's involvement in the demonstration is currently estimated at 8 years, or the period of time to complete two full crop rotations and to achieve maximum yields and benefits on a four year crop rotation. Assuming 10 years as a reasonable period of time for the promotion effort, the additional 17 farms would need to enter the program during the third, fourth and fifth years of the demonstration as shown in the following chart. The total demonstration would then consist of 2 years of preparation and 10 years of promotion under this scheduling. The estimated administration and funding of the demonstration will be based on this tentatively selected schedule.

A Tentative Scheduling for Implementation



Outline of Work for Demonstration

The Soil Conservation Service prepared detailed outlines for the work to be conducted during the demonstrations which are included in Appendix 3. Two outlines were prepared, one for a 3-farm and one for a 20 farm demonstration. Seventeen categories of work were included on each outline along with estimated costs. Table 22 itemizes the categories of work and summarizes costs for the initial three farms, and in parentheses for each additional farm based on the 20-farm outline. The administration and management item recognizes the administrative costs of contracting and paying for work, monitoring and controlling the project, and coordinating the project with other agencies and groups. Farmers would have to be contacted periodically, especially at the beginning of the

TABLE 22

DEMONSTRATION ADMINISTRATIVE OUTLINE AND COST SUMMARY
FOR FIRST 3 FARMS AND (EACH ADDITIONAL FARM)

(October 1979 Price Level)

	PROJECT YEARS					
	YEAR #1		YEAR #2 THRU #7		YEAR #8	
	3-Farms	Additional Farm	3-Farms	Additional Farm	3-Farms	Additional Farm
1. Admin & Mngmt Demo.	$32,100	($780)*	$32,100 18,000	(Yr #2 only) ($780)	$18,000	($780)
2. Contact Cooperators	4,700	(830)*	--	--	--	--
3. Environmental Assessment	3,100	(1030)*	3,100	(1030)	3,100	(1030)
4. EIS (if necessary)	6,400	(750)*	--	--	--	--
5. Conservation Plan Review	1,900	(640)*	--	--	--	--
6. Apply Plans	6,500	(2150)	6,500	(2150) (Yr. #2 & 3)	--	--
7. Maintenance	---	--	500	(170)	500	(170)
8. Irrigation Plan Review	5,400	(1780)*	--	--	--	--
9. Install Irrigation System	7,900	(1080)	--	--	--	--
10. Irrigation System Operations	14,000	(4650)	14,000	(4650)	14,000	(4,650)
11. Monitor Environmental Impacts	4,200	(1400)*	4,200	(1400)	4,200	(1,400)
12. Record Costs	4,500	(1500)	4,500	(1500)	4,500	(1,500)
13. Record Physical Data	9,200	(1500)	9,200	(1500)	9,200	(1,500)
14. Annual Report	4,600	(560)	4,600	(560)	4,600	(560)
15. Publicity & Education	8,500	(220)	8,500	(220)	8,500	(220)
16. Final Report	---	--	--	--	4,600	(560)
17. Secretarial	3,400	(560)*	3,400	(560)	3,400	(560)
TOTALS	$116,400	(19,430)	$90,600 $76,500 $70,000	($14,520)#2 ($14,520)#3 ($12,370)#4-#7	$74,600	($12,930)

8 YEAR TOTAL: First 3 Farms $638,100 @ $212,700 per farm.

EACH ADDITIONAL FARM

Remaining 6 Sampled Farms (for 8-years)	$110,880/Farm	SAY: $111,000/Farm
Remaining 11 Farms (for 9-years)	$114,180/Farm	SAY: $114,000/Farm

*These costs are incurred ($7,770) in the planning year for each additional farm for which irrigation and conservation plans have not been prepared. Only $3,300 of these costs would be repeated in the first project year of these farms for a total of $14,960 in the 1st project,year.

All costs shown include a 15-percent contingency and 35-percent overhead.

project, to prepare agreements and review plans and how work should be accomplished. An environmental assessment (or formal impact statement, if necessary) would be prepared for evaluating practices during the project. Conservation plans would be reviewed and updated for the sampled farms (or prepared for new farms) with assistance provided to apply the plans and to schedule and maintain the practices. Irrigation plans would be reviewed and updated for the sampled farms (or prepared for new farms) with technical assistance provided to install and operate the systems. Monitoring environmental impacts from the collection of erosion and runoff data would provide a summary of needed data for the environmental assessments. This will help determine the optimum plan for future expansion of I-C practices.

Farm budget and crop data would be recorded and analyzed for annual reports and for guarantee provisions. The project would receive extensive publicity to promote the practices on other farms. A final report would be prepared after each farm or group of farms completes its demonstration.

Research and Demonstration Funding Schedule

A schedule for Federal/State funding of the research and demonstration program is provided in Table 23 as an example of the magnitude of annual funding. Although funds for the 2-year preparation phase are closely estimated, the final schedule would be developed while the demonstration is in progress and decisions are reached on program expansion or modifications. All costs are adjusted to the October 1979 price level.

The 2 year preparation phase of the research and demonstration program would cost about $1.6 million, which includes capital and operating costs for research and demonstration's administration, leasing of one irrigation system per farm, installation of conservation structures and a guarantee fund. Excluded are the participating potato grower's share of operating and maintaining the irrigation system and maintenance of conservation structures shown in Table 24. The estimated cost for the 10-year promotion phase is $8.5 million which includes the continued research and demonstration on 3 farms, and the addition of 17 demonstration farms. Table 24 summarizes costs for the program, which has a total estimated cost over 12-years of $10.1 million (October 1979 price level).

Implementation Responsibilities

The organizational structure to administer the research and demonstration project was a major subject of the two advisory meetings held in January 1978 at the University of Maine. The two

TABLE 23

I-C RESEARCH/DEMONSTRATION FUNDING AND IMPLEMENTATION SCHEDULE OF FEDERAL/STATE COSTS (Costs in $1000 at October 1979 Price Level)

PRELIMINARY SCHEDULE

PHASE I: PREPARATION		COMPLETE PHASE I	PHASE II: PROMOTION										
PROJECT YEAR:	1	2	3	4	5	6	7	8	9	10	11	12	TOTALS
					RESEARCH PROGRAM								($1000)
Research Program	$835	$390	$390	$390	$390	$390	$390	$390	$390	$390			$4345 Sub Total $4345
SELECTED 3 FARMS					DEMONSTRATION PROJECT								
Administration:	116	91	76	70	70	70	70	75					638
Irrigation system:	34	34	34	34	34	34	34	34					272
Conservation:	25	25	10										60
Guarantee Fund:	33												33
TOTAL	1043	540											Sub Total $1003
PHASE I TOTAL COST:	$1,583,000												
PHASE II: Continue: Research, Demonstration on three farms, and expanded program for Promotion.													
ADD SIX REMAINING SURVEYED FARMS:													
Administration:			116	87	87	74	74	74	74	78			664
Irrigation Systems:			66	66	66	66	66	66	66	66			528
Water Source Cost:			66										66
Conservation:			65	65	26								156
Guarantee Fund:			66										66
													Sub Total $1480
ADD SIX NEW FARMS:													
Administration:			47	90	87	87	74	74	74	74	78		685
Irrigation Systems:				66	66	66	66	66	66	66	66		528
Water Source Cost:				66									66
Conservation:				66	65	26							156
Guarantee Fund:				66									66
													Sub Total $1501
ADD FIVE NEW FARMS:													
Administration:				39	75	73	73	62	62	62	62	65	573
Irrigation Systems:					55	55	55	55	55	55	55	55	440
Water Source Cost:					55								55
Conservation:					55	55	20						130
Guarantee Fund:					55								55
													Sub Total $1253
PROJECT TOTALS: for FEDERAL/STATE COSTS:	$1043	$540	$936	$1104	$1186	$996	$922	$896	$787	$791	$261	$120	$9582

TABLE 24

COSTS OF I-C: R/D PROGRAM
(Tentative)

October 1979 Price Level

		Phase I	Phase II
Total Federal/State Costs:			
F/S Research Cost -	Capital Cost of Research Farm & Equipment	$445,000	--
	Operating Cost @ $390,000/year	780,000	$3,120,000
	Sub Total: Research each phase	$1,225,000	$3,120,000
	TOTAL RESEARCH COST	$4,345,000 (for 10-years)	
F/S Demonstration Costs -			
	Administration, Planning, Monitoring, Publicity	$207,000	$2,353,000
	Lease Irrigation Systems	64,000	1,700,000
	Construct Farmponds for Water Source	0	187,000
	Construct Conservation Structures	50,000	452,000
	Guarantee Fund	33,000	187,000
	Sub Total: Demonstration each phase	$354,000	$4,879,000
	TOTAL DEMONSTRATION COST	$5,233,000* (for 12-years)	
TOTAL F/S Program Cost -	Total each phase	$1,579,000 (over 2-years)	$7,999,000 (over 10-years)
	TOTAL FEDERAL/STATE ESTIMATED COST:	$9,578,000 (for 12-years)	

*Demonstration costs may be reduced if existing irrigating farms participate or if all or part of the guarantee fund is not used.

Total Grower Costs:			
G/Demonstration Cost -	Maintenance of conservation structures	$9,000	$190,000
	Operation and maintenance of irrigation systems and farm ponds	14,000	322,000
	Sub Total: Grower Costs	$23,000	$512,000
	TOTAL GROWER COST	$535,000	
Total Program Costs:			
	Research	$1,225,000	$3,120,000
	Demonstration	377,000	5,391,000
	Sub Totals, each phase	$1,602,000	$8,511,000
	PROGRAM TOTAL: (for 12-years)	SAY: $1,600,000	SAY: $8,500,000
		$10,100,000	

major agencies which appropriately could administer the Research/Demonstration (R/D) project are the University of Maine and the U.S. Department of Agriculture. The University of Maine's Agricultural Experiment Station (MAES) currently conducts potato research on a farm in Aroostook County. The USDA SEA - Agricultural Research* could also administer the R/D project, if authority is provided by the Congress of the United States. It was proposed at the last advisory meeting that the Maine Agricultural Experiment Station be the lead agency for the demonstration/research project with assistance in the development of irrigation and conservation planning, implementation and evaluation provided by the USDA Soil Conservation Service. Research assistance would be provided by the USDA Agricultural Research Service. An Advisory Committee represented by several interested agencies would provide guidance during the planning and implementation of the R/D project. Letters of interest and support for an irrigation and conservation program were received from the State of Maine and USDA Soil Conservation Service (see Appendix 4). In July 1976 prior to the start of detailed studies, the State Department of Agriculture provided two letters endorsing a demonstration project. In May 1980, Commissioner Stewart N. Smith accepted the leadership role to pursue program implementation. A tentative list of agencies identified for participation in an advisory capacity includes:

- Maine Department of Environmental Protection (DEP)
- University of Maine (UM)
- State Department of Agriculture (DOA)
- Soil and Water Conservation Districts (SWCD's) from the St. John Valley, Central and Southern Aroostook
- Maine Potato Council (MPC)
- USDA, Soil Conservation Service (SCS)
- USDA, Agricultural Stabilization and Conservation Service (ASCS)
- USDA, Farmers Home Administration (FMHA)
- USDA, Science and Education Administration - Agricultural Research (SEA-AR)*

* Formerly the USDA Science and Education Administration - Agricultural Research (SEA-AR) was the Agricultural Research Service (ARS).

- Participating Farmers

- State Inland Fisheries and Wildlife (F&W)

- Northern Maine Regional Planning Commission (NMRPC)

Table 25 prepared by the SCS displays a working relationship. Project implementation could also be initiated through several other Federal or State agencies considered during this study provided the authority and funding was provided. Although SCS and the University of Maine were considered the most appropriate organizations to administer or have major roles in this agricultural orientated research/demonstration project, the other Federal agencies considered were:

- The U.S. Environmental Protection Agency, because of the environmental benefits of the project.

- The U.S. Department of the Interior, Bureau of Reclamation, because of their authority for similar work although not within the Eastern United States.

- The U.S. Department of the Army, Corps of Engineers because of their resources activities and involvement in the study.

Other State agencies considered were:

- The Northern Maine Regional Planning Commission, with funding and authority from the New England Regional Commission and Economic Development Administration, due to their interest in regional development, water resources planning and water quality studies.

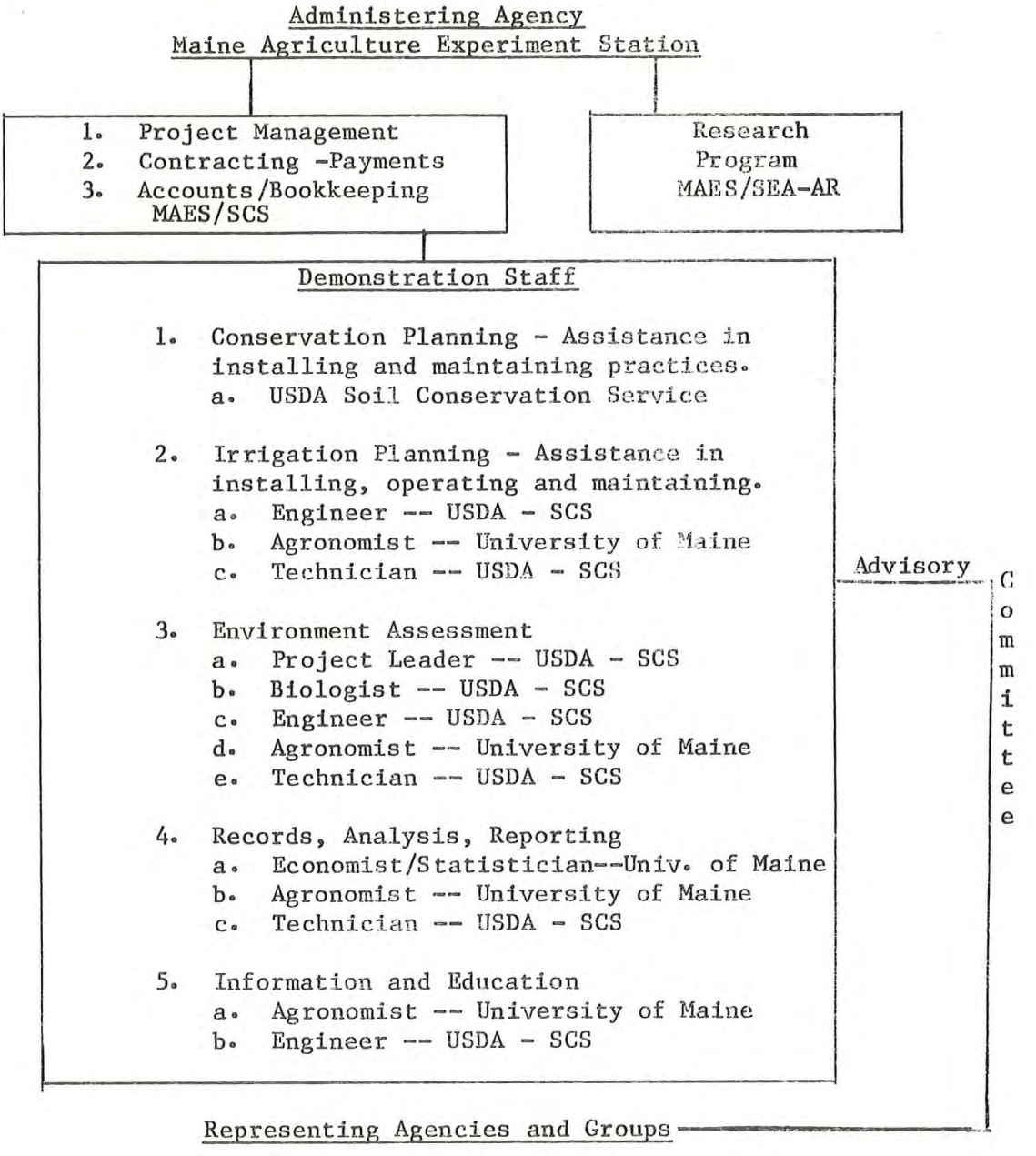
- The Maine Department of Agriculture through their Soil and Water Conservation Districts who are involved with conservation planning on area farms.

The project hosts a wide variety of improvements to the economy, environment and social well-being of this economically depressed region, and therefore lends itself to active participation by several Federal and State agencies. The final authority to administer the project remains subject to approval by the State of Maine and if authority for Federal involvement is required, the U.S. Congress.

TABLE 25

Organization Chart
(Conceptual)

The following chart displays a working relationship for administration, management and staff necessary to effectively carry out an interagency procedure for implementing, monitoring and evaluating the irrigation-conservation research/demonstration project when implementation funds are received.



Source of Funding

The Corps of Engineers was authorized by Congress to investigate the water quality and irrigation needs (among other needs) of the St. John River Basin in northern Maine. Corps authority and funding for this investigation is terminated with this Interim Report. No additional authority or funds are available to the Corps to carry the proposed Irrigation and Conservation Project to implementation or construction. In addition, no other Federal agency has been identified with the authority to implement an irrigation and conservation demonstration project as part of its regular program activities. The Department of the Interior's Water and Power Resources Service has such authority and conducts similar demonstrations, but only within its jurisdiction of 17 western states.

The funding for this precedent-setting demonstration/research project would come from a single or combination of sources, if the State of Maine through the Maine Department of Agriculture continues to support and pursue implementation of the program.

The State of Maine would be responsible for initiating further action to implement the research/demonstration project. Consequently, the State could consider initiating requests for funding from the U.S. Congress and/or consider providing funds from State revenues. This project proposal only recently was presented for State and Federal review and therefore a State decision on financing the project has not been made. The project may require two or more years if congressional funds are requested and eventually approved. Possibly the State could pool funds from several existing Federal and State programs. Input could be arranged from the normal program of conservation planning and application of Soil Conservation Service and the educational program of the Cooperative Extension Service.* Additional funds would be needed to finance the irrigation plans, research program and most of the administrative and guarantee costs of the demonstration. The Maine State Planning Office has agreed to review the demonstration as a priority with the New England Regional Commission with funding through the Economic Development Administration since the project relates to economic development. Other potential sources for Federal funding would include:

The U.S. Environmental Protection Agency (EPA)

Farmers Home Administration (FmHA)

Office of Water Research and Technology (OWRT)

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*USDA SCS letter dated 25 April 1980 (Attachment and Appendix 4).

Consideration for Congressional authorization and funding to the Corps of Engineers is a possibility if other sources do not materialize.

A New England Priority for Federal Funding

The Maine State Planning Office was instrumental in obtaining a regional priority for Federal funding in Fiscal Year 1980 for this I-C program. As a member of the New England River Basin Commission (NERBC) CCJP Committee which is responsible for overseeing the development of a "comprehensive, coordinated joint plan" for New England's resources and in guiding the development of New England's annual priority report, the Maine State Planning Office presented the I-C program as one of Maine's primary resource concerns which resulted in the I-C Research/Demonstration program as a New England research priority. The CCJP Committee consists of representatives from:

The six New England states

New York

Army Corps of Engineers

Department of Agriculture

Department of Energy

Department of Housing and Urban Development

Environmental Protection Agency, and

Department of the Interior

The Schedule of Priorities: 1980-84 report identified "Priority recommendations for selected Federal waters and related land resource programs in New England" for consideration and action of priority programs by the Office of Management and Budget, the Congress and the Administration.*

The introductory preface for the State of Maine reads in part as follows:

*The NERBC priority report for 1981-85, dated July 1979 continued the I-C program in the "Planning-Related Research" group with a rating of "highest priority".

"Maine. One of Maine's primary resource concerns is that of improved agricultural management practices and water resource use (Chapter IV, #10). The state is particularly interested in having the Soil Conservation Service undertake a demonstration project to achieve increased potato production in Aroostook County through cost-effective soil conservation techniques and irrigation measures. Critical soil erosion in that area may dramatically decrease its potato crop unless methods are found to reduce soil loss and to increase the yield on available corplands..."

The report proceeds to identify New England's regionwide priority for several categories of needs. The research category identifies the program as priority number 10, as follows:

"A growing interest in reviving and supporting New England's food production capabilities has led to a need for increased research into improved agricultural practices, such as irrigation and erosion control, on the production of crops on the region, as well as into the effects these practices will have on New England's water resources. Demonstration projects concerning agricultural practices, such as one proposed for the Aroostook Valley in northern Maine, should investigate the use of irrigation to increase production, the efficacy of erosion control measures, and the effects of increased water use on regional resources.

"Potential sponsors of agricultural demonstration projects include the Agricultural Research Service, which conducts research on a broad array of agricultural techniques under the Research and Marketing Act of 1946 and on agricultural pollution under the Agriculture and Related Agencies Appropriation Act of 1976, and the Soil Conservation Service, which provides technical assistance to farmers and communities under the Soil Conservation and Domestic Allotment Act. Once again, individual relationships of agricultural practices and water resources could be performed by the Water Resources Research Institutes, funded in part by OWRT."*

*Under the recent reorganization of USDA, the Agricultrual Research Service (ARS) has been placed under the Science and Education Administration with the designation of Agricultural Research (SEA-AR).

Public Views

The following summarizes public views indicated during the study and as a result of the public review period of this (draft) report. Letters of comments received during the review period (12 February to 19 May 1980) are included in Appendix 4 and condensed in the Attachment to this report. Also included in Appendix 4 are pertinent correspondence received during the study, and comments received at meetings held during the review period.

Senator William S. Cohen indicated his support and actions to assist in implementing the program in a letter dated 9 May 1980 to Mr. Al Irving, a potato grower. His staff aid, Mr. Ed Johnston, from Presque Isle offered Congressional assistance to implement the program during the 29 April 1980 meeting of Maine's Land and Water Resources Council. (Also see letters of inquiry from former Senator Edmund S. Muskie and Congresswoman Olympia J. Snowe in Appendix 4.)

The USDA, Soil Conservation Service in Maine demonstrated active support for the I-C:R/D program and study by sponsoring and/or conducting public workshops and advisory meetings. The Administrator of SCS endorsed the I-C:R/D program and offered USDA's assistance for implementation in a coordinated USDA reply.

Correspondence from Federal agencies endorsing and/or offering assistance for program implementation was also received from: the Environmental Protection Agency, Fish and Wildlife Service and the Water and Power Resources Services.

The New England River Basin Commission's CCJP Committee of Federal and State agency representatives demonstrated support for the I-C:R/D program by establishing it as a regional priority for Federal funding. The State identified it as a primary resource priority.

Governor Joseph E. Brennan by letter dated 19 May 1980 endorsed the program and requested the Maine Department of Agriculture to be the lead agency for coordination and to search for implementation funds. Commissioner Stewart L. Smith, Maine Dept. of Agriculture, confirmed his lead role for implementing the program in a 19 May 1980 letter to the Corps' project manager.

The Maine Department of Agriculture, in addition to participation during the study and advisory meetings, provided two letters of support in 1976 when a demonstration program was first proposed. The commissioner indicated that a demonstration program, "...emphasizing use of on-the-farm water resources for irrigation, coupled with good conservation measures would have the full endorsement of this department."

The University of Maine has indicated support for the I-C:R/D program through the active participation during advisory meetings of its department heads in the College of Life Sciences and Agriculture, Cooperative Extension Service and Agricultural Experiment Station, who replied in support of the program.

The Maine State Planning Office has continually demonstrated support for an I-C demonstration program with its active involvement during the study, participation of the State director and resource planners during the advisory meetings, and its efforts to obtain funding for the program. Mr. Allen Pease's 15 May 1980 letter endorses the I-C:R/D program and offers assistance to further evaluate and implement the program.

The Maine Inland Fisheries and Wildlife in addition to attending advisory meetings offered support and assistance for the program.

The Northern Maine Regional Planning Commission actively participated in work shops and advisory meetings. Mr. James A. Barresi, Executive Director, offered the Commission's support and assistance for implementation.

The Maine Potato Commission's research committee voted to support the program on 26 March 1980 and Mr. Edwin Plissey, Executive Director, endorsed the need for demonstrations in his letter.

Mrs. Dorothy P. Kelly, Executive Vice President of the Maine Potato Council in her letter endorsed the Irrigation and Conservation Program.

Eleven nonirrigating potato growers and an engineering firm provided letters in support of the program and/or offered their assistance or farms for the demonstration.

No opposition to the I-C:R/D program has been voiced by any agency, interest group or individual.

Conclusions

The three year St. John River Study of cropland conservation and irrigation needs of northern Maine has concluded that:

1. The potato industry in the basin or in Aroostook County has a direct and significant impact on the social well-being and regional development of the area, representing over one-third of the county's employment and gross sales. The industry also has a direct impact on the future of agriculture in Maine and New England since it produces 85 percent of New England's truck crops.

2. The Maine potato industry's future is in danger of extinction. Production, currently declining at 4.5 percent annually suffers from:

- Deterioration of its resource base -- soil -- from erosion and lack of conservation practices

- Unstable economic conditions due to fluctuating potato production, potato quality, potato prices and rising costs

- Growing competition especially from the irrigated crops of the Pacific Northwest States.

However the industry's rate of decline, if no Federal action results from this report, would probably slow down due to public awareness and concern.

3. Conservation practices are needed to:

- Reduce erosion of the 180,000 acres in potato rotation from a current annual rate exceeding 6.3 tons per acre to within the 3-ton goal established by the Soil Conservation Service and approved EPA Water Quality Management Plans

- Improve potato quality and increase yields per acre.

4. Irrigation is needed to:

- Reduce the normal 50-percent water deficiency and stabilize seasonal fluctuations in moisture available to the potato crop

- Significantly increase and stabilize potato yields and quality

- Improve the economically depressed conditions for the region's 1000 potato growers.

5. The lack of information available on program related benefits (i.e., yield increases and improved potato quality), limits the certainty of the degree of economic impacts occurring under either a conservation, irrigation or combined irrigation-conservation program.

However, study costs for conservation and irrigation structures and systems are based on the detailed design and cost estimates of nine study farms. The magnitude of irrigation benefits, however, strengthen the certainty that net benefits will remain positive for most farms implementing irrigation and combined I-C plans.

6. The information for the environmental impacts came from sampling two basin locations for pollutant loadings and selecting data representing typical farm conditions. Cropland erosion rates, were developed for each of the nine study farm plans, as well as for all farm land in the county using the Universal Soil Loss Equation.

7. Conservation practices to reach the 3-ton erosion goal are estimated to:

- Reduce erosion and sediment loads by an average of 62 percent.

- Reduce biocide and nutrient loads in the region's waters by 65 percent

- Improve potato quality and increase yields by 15 percent through crop rotation and other measures

- Thus reduce the rate of lake eutrophication and improve the region's fisheries, water quality, water supplies and environment by reducing polluted runoff.

However, benefit-cost ratios realized in implementing conservation measures averaged 1.7 to 1.0 on nine sampled farms with less than average erosion, and an unfavorable 0.6 to 1.0 on typical county cropland.

The evaluation of nine farms with less than average erosion showed that conservation costs would adversely affect most potato businesses. However, if these financial losses could be sustained or subsidized, many businesses would benefit in the long term. Over 15 years, net farm income would increase by an average 23 percent, with most benefits realized after two crop rotation cycles.

On typical cropland, which requires more extensive conservation measures, net farm income would increase by an average 1- percent ($1900) over 20 years under current Federal cost-sharing. Increased profits would not be realized on a typical sample of cropland until after four

crop rotation cycles (17 years), primarily because of the 30 percent reduction in potato acreage due to crop rotation and converting land to drainage structures. The average annual market value of potatoes would not change significantly. Average annual net losses to National Economic Development are estimated at $14,500 per 1663 acres of typical cropland, a decrease of 9 percent over the current level of estimated net income from that land ($156,000).

8. Irrigation on typical cropland without conservation management is estimated to:

- Reduce potato moisture deficiency withan average four time yearly application of water totaling 5.6 inches

- Increase yields by 58 percent, from an average of 230 cwt per acre per year to 363 cwt

- Significantly improve potato quality

But would also:

- Cause a 10 percent increase in runoff, erosion, biocide and sediment loads in streams

- Increase by 56 percent the nutrient loads from the larger applications of fertilizer necessary for higher crop yields

- Thus accelerate the eutrophication of lakes, further deteriorating water quality and adversely affect the environment.

The development of farm ponds is expected to replace one habitat for another. More widespread adoption of irrigation may reduce river flows and require the development of community water supplies on streams and rivers. Farm consumption of energy would increase about 135 percent from irrigation pump use.

Since the benefit and cost of irrigation would break even after the first water application, each additional application needed would produce significant benefits. The benefit-cost ratio for both typical farms and the nine sampled farms is estimated at 4.3 to 1.0. Due to the difference in original income levels, the nine farms experienced only a 190 percent increase in income, compared to a 400 percent increase for the typical cropland farms.

On typical cropland, average annual net benefits to National Economic Development were estimated at $639,800 per 1663 acres of cropland, an increase of about 410 percent over the current level of farm net income. Regional development would be improved by a 140

percent increase in the market value of potatoes. The nine farms would experience significant first year economic gains.

9. Combined irrigation and conservation practices are estimated to:

• Reduce potato moisture deficiency with normallyan average of three applications of water per year totaling 4.6 inches

• Improve potato quality and increase yields by 63 percent from 230 cwt to 390 cwt per acre on typical cropland after two crop rotations

• Reduce erosion and sediment loads by 59 percent to achieve the 3-ton erosion goal

• Reduce biocide loads by 62 percent and nutrient loads by 46 percent

• Thus, reduce the rate of eutrophication of lakes and improve water quality, water supplies, fisheries and environment by reducing polluted runoff from cropland

• Farm energy consumption would increase about 75 percent.

Benefit-cost ratios from implementing combined I-C practices averaged 3.8 to 1.0 for the nine sampled farms and 3.3 to 1.0 for farms with typical cropland.

The nine farms with less than average erosion and higher average net income were estimated to increase their net income by 130 percent. Eight of the farms would experience immediate improvements in their standard of living with net incomes increasing in the first year. One farm would experience a long term economic loss from crop rotation unless subsidized for his loss.

• On typical cropland, annual net income would increase an average of 200 percent over 20 years under current Federal cost-sharing for conservation structures and no cost-sharing for irrigation. Even with a 30 percent reduction in potato land, net farm income would increase in the first year under normal conditions with I-C practices. Average annual net benefits to National Economic Development were estimated at $345,800 per 1663 acres of cropland, an increase of about 220 percent over the current level of farm net income. A 70 percent increase in the market value of potatoes on typical cropland would provide for regional development.

10. The potential of combined I-C measures to contribute benefits to National Economic Development, Environmental Quality, Social Well-Being and Regional Development warrants further Federal, State

and local effort to promote these practices and to prepare guidelines for planners and potato growers. Guidelines are needed to explain how I-C measures must be managed to produce favorable results for the large variety of conditions which exist on the regions farms. I-C measures have the potential to stop the decline in the potato industry if five percent of the cropland receive the measures each year -- initially 50 farms per year.

11. Federal and State agencies participating in the advisory meetings recognized the necessity to determine the best management practices for irrigation and conservation plans for the vast array of situations in the region and to validate crop response to these practices. Their recommendations were used to develop a tentatively selected plan for consideration for Federal, State and local implementation and cost sharing, in order to define impacts more precisely for an array of situations, develop technical guidelines, and demonstrate impacts through basic research and applied research on neighboring farms.

The tentatively selected plan for research and demonstration is summarized in Table 26. Under this plan, the Irrigation-Conservation Research/Demonstration program would be initiated with a funding of about $1.04 million the first year followed by about $540,000 the second year to the University of Maine's Agricultural Experiment Station and USDA Soil Conservation Service. The funds would initiate I-C demonstrations on three potato farms, one in each region of Aroostook County. A research farm would be acquired in the county and developed for initiating basic research by the third year. In the interim, existing Maine facilities and other sources would be used to establish preliminary technical guidelines for best management practices (BMP), in cooperation with the three demonstrating farms. Monitoring and evaluating the mitigation of environmental impacts would guide in developing BMP's.

After preliminary guidelines are developed, the promotion phase would be initiated to expand the demonstration to an estimated 20 farms with more complete guidelines prepared with their cooperation for a wide variety of significant situations. The research and demonstrations would compliment each other during the preparation of guidelines and promotion of irrigation and conservation practices, over about a 12 year period at a total cost of about $10.1 million.

12. The Corps of Engineers does not have the authority to implement an irrigation or conservation program of research and demonstration. Therefore, the Corps involvement in I-C studies is terminated with this report. Public review of the draft report generated favorable comments. The Maine Department of Agriculture accepted the lead role to pursue implementation of the program.

TABLE 26

DESCRIPTION OF IRRIGATION - CONSERVATION: RESEARCH/DEMONSTRATION PROGRAM
TENTATIVELY RECOMMENDED PLAN

	PHASE I: PREPARATION	PHASE II: PROMOTION
PURPOSE	(1) to evaluate best management practices (BMP) for agriculture (2) to monitor and evaluate irrigation measures for environmental impacts (3) to prepare for program expansion (4) to establish preliminary technical I-C guidelines with research and demonstration on 3-farms (5) to acquire and setup a research farm	(1) to continue evaluation of BMP's for more conditions (2) to continue evaluation of environmental impacts for more conditions (3) to commence with basic research on experiment farm (4) to expand demonstration to an estimated 20-farms (5) to develop technical guidelines (6) to promote I-C practices
FARMS ENVOLVED AND LOCATION	3-Potato farms (No's. 2, 8 & 9) located in central, north & south regions (resp) of Aroostook County.	1-Research farm in central and 20-Demo. farms throughout Aroostook County (incl. No's. 2, 8 & 9)
DURATION	2-years	10-years (estimated)
CROPLAND FOR CONSERVATION MEASURES	430 Acres	3,490 Acres (estimated)
POTATO LAND FOR IRRIGATION	157 Acres	920 Acres (estimated)

PROGRAM ECONOMICS (1979 Price Level)

·Federal/State Costs:		
Research	$1,225,000	$3,120,000
Demonstration	354,000	4,879,000
Sub total	$1,579,000	$7,999,000
TOTAL ESTIMATED FEDERAL/STATE COSTS OVER 12-YEARS:		$9,578,000
·Local Grower's Costs:		
Demonstration	$ 23,000	$ 512,000
Sub total each phase:	$1,602,000	$8,511,000
	SAY: $1,600,000	SAY: $8,500,000
TOTAL ESTIMATED PROGRAM COSTS OVER 12-YEARS:		$10,100,000

LEAD AGENCIES

The University of Maine's Agricultural Experiment Station (MAES) would be lead agency for the R/D project and solely responsible for the research. MAES will assist in the administration, design, monitoring and evaluation of the demonstration project.

USDA Soil Conservation Service will be responsible for developing the irrigation and conservation plans for the demonstration farms.

University of Maine Cooperative Extension Service will be responsible for the educational program.

ADVISORY COMMITTEE (Proposed)

- USDA Science and Education Administration (SEA)
- USDA Agricultural Stabilization and Conservation Service
- USDA Farmers Home Administration
- US Environmental Protection Agency
- State Department of Agriculture
- University of Maine
- State Department of Environmental Protection
- State Inland Fisheries and Wildlife
- State Soil and Water Conservation Districts
- Northern Maine Regional Planning Commission
- Maine Potato Council(or Proposed Maine Potato Board)
- Participating farmers
- Local interest groups and others

POTENTIAL SOURCES OF FUNDING

- ·Office of Water Research and Technology, Department of Interior
- ·New England Regional Commission (Economic Development Admin.)
- ·U.S. Environmental Protection Agency
- ·Farmers Home Administration
- ·USDA Soil Conservation Service
- ·USDA Science and Education Administration
- ·State Revenues (specific appropriations)
- ·Cooperative Extension Service
- ·Maine Potato Council (Potato Tax)
- ·Potato growers (Project Farms)
- ·Congressional Authorization and funding to the Corps of Engineers

ENVIRONMENTAL ASSESSMENT
FOR
PROPOSED CROPLAND IRRIGATION AND CONSERVATION
RESEARCH/DEMONSTRATION PROGRAM
ST. JOHN RIVER BASIN, MAINE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

Summary

The St. John River Basin feasibility study of cropland irrigation and conservation (I&C) needs and potential has resulted in a tentative recommendation for a research and demonstration project in Aroostook County in northern Maine. It would be implemented in two phases: a two-year preparation phase to research and verify potential effects of the plan on three existing farms and setting up of a research farm in the region; followed by a 10-year promotional phase that would expand implementation of I-C practices to an estimated 20 farms or about 8,000 acres of potato cropland -- about 2 percent of the total potato cropland in the study area. This assessment is intended to satisfy the requirements of the National Environmental Policy Act for any activities conducted during the first 2-year phase of this recommended demonstration project.

A conservation plan is one that implements various farming practices to reduce erosion and maintain soil productivity. An irrigation plan is one that artificially maintains optimum moisture content during the growing season. Conservation plans would reduce erosion and associated sediment, biocide and nutrient contamination of the area waters as well as increase productivity of the land. No significant adverse impacts would result from a conservation plan. Rather, conservation alone would be considered as enhancing environmental quality of the area and would be preferred environmentally as the EQ (Environmental Quality) plan. Irrigation would optimize soil moisture, provide significantly greater productivity within the area and maximize economic benefits. As such, irrigation alone is considered the NED (National Economic Development) plan. The tentatively preferred plan is a combination of both irrigation and conservation (I-C). In this way environmental benefits of conservation and economic benefits of irrigation are both realized.

The institutional arrangements to implement, monitor, evaluate, and promote an I-C project were coordinated through six advisory meetings in November - December 1977 and January 1978. These meetings involved 46 individuals representing 14 agencies, organizations and groups, including 20 potato growers. These meetings were utilized to establish the recommended size of the demonstration project, research needs, the financing, and agencies needed to administer the project. Detailed information on the public participation is included in Appendicies 1 and 3. There was no significant controversy expressed during these meetings concerning the selected plan.

Need For and Objectives of the Study

Need for the study is apparent through analysis of the declining potato production and soil conditions in Maine. Declining production has created an unstable, "Boom and Bust," potato economy in Maine. Deteriorating soil from high erosion rates contribute to this decline. Soil erosion also degrades the area's aquatic resources.

The St. John River Basin Study was authorized by Congressional resolutions (Appendix 1) to investigate power, flood control, irrigation, water quality, recreation, and fish and wildlife needs in the St. John Basin. This report is in partial response to these resolutions and addresses only the feasibility of cropland irrigation and conservation practices to stabilize and enhance the regional productivity and decrease the erosion and associated water quality, recreational, and economic factors in the study area. The objectives of the project are to promote I-C practices through demonstration of the economic and environmental benefits accrued to such implementation. The ultimate goal would be area-wide implementation of I-C practices to stop the decline of agriculture and to improve the environment and socio-economic conditions.

Alternatives

During the course of this study two basic methods of resolving potato growers' problems (economic and environmental) were analyzed. The two basic methods considered were irrigation and conservation; each was analyzed separately and together, and compared with the no-action possibility. The results of environmental assessments of impacts of these alternatives is presented in Table 27, Comparison of Alternative Management Possibilities - Effects on Natural Resources. The no-action plan assumes that existing trends and declining acreage and erosion would continue, although at reduced rates. Irrigation plans assume only irrigation would be implemented on farms without regard to adequate conservation practices and entail withdrawing water from existing water bodies (stream or rivers) where appropriate without significantly inhibiting flows; or, if expanded beyond phase 2 creating small, or regional impoundments to store irrigation waters; and transferring by either diesel or electric powered pumps, water averaging about 5.6 inches per year (40 percent of the crop's needs) to potato fields via sprinkler systems.

Conservation plans would implement such strategies as runoff diversions, grassed waterways, contour plowing and planting, crop rotation or strip cropping -- all intended to reduce erosion to 3 tons per acre* and enhance the productivity of the soil. Sub-surface tile drainage, woodlot management, buffer strips, potato cull and pesticide container disposal and roadway relocations may also be provided at many sites on some of the farms as part of the conservation plans. Irrigation and conservation applied concurrently would provide features of both and require that irrigation be provided only on fields where erosion rates are predicted (with appropriate conservation measures) to be 3 tons or less per acre per year.

*Achieving a 3-ton erosion rate is the goal established by the USDA Soil Conservation Service and adopted by the regions Water Quality Plans.

TABLE 27. ST. JOHN I&C STUDY; COMPARISON OF ALTERNATIVE MANAGEMENT POSSIBILITIES -- EFFECTS ON NATURAL RESOURCES

ALTERNATIVE MANAGEMENT POSSIBILITIES ON POTATO FARMS

RESOURCES EVALUATED	COLUMN A NO ACTION	COLUMN B IRRIGATION	COLUMN C CONSERVATION	COLUMN D BOTH I & C
(1) Potato Acreage	120,000; decrease by 1.5%/yr.	NIL*	30% decrease	Same as (C)
(2) Recreation	NIL	Potential increase in impoundment based recreation availability	Increase quality of fishery	B & C
(3) Wildlife	Gradual increase in habitat	Adversely affected by pump noise & displacement by impoundments	Slight increase in habitat from increased cover crops	Increase in habitat -- B & C
(4) Vegetation	Inverse of (1-A)	Displacement for irrigation facilities' impoundments (& lines)	Same as (3-C)	B & C
(5) Aesthetics	NIL	Localized - irrigation pipes & pump noise	Increase greenery - strip cropping & contours instead of up-down slope	B & C
(6) Soil Quality	Variable	Little change	Significantly improve poor soils	Same as (C)
(7) Erosion	Avg. is greater than 6.3 tons/acre	Increase by 10%	Reduce by 62%. Goal not to exceed on any field 3.0 tons/acre per year.	Reduce by 59%. Same goal as (C)
(8) Aquatic	Continue degradation: erosion and leacheate from potato dumps (culls)	Continue degradation: erosion increases: potato culls decrease 20%	Improve: erosion reduced and potato culls decrease 30%	Improve: erosion reduced and culls decrease 40%
(9) Water Quality:				
• Turbidity	Many streams are presently & will continue to be degraded by runoff from potato fields which contain sediments, nutrients & biocides in excess of tolerable limits for aquatic life	Increase by 10%	Reduce by 62%	Reduce by 59%
• Nutrients		Increase by 56%	Reduce by 65%	Reduce by 46%
• Biocides		Increase by 10%	Reduce by 65%	Reduce by 62%
(10) Fisheries	Variable - poorest adjacent to & downstream of potato fields	Impoundments would increase some habitat & destroy stream habitat	Improve	Net Improvement
(11) Hydrologic	NIL	Intermitantly reduced flows	NIL	Less than (B)
(12) Air Quality	NIL	Irrigation pumps may have exhaust fumes (Very localized)	NIL	(B)
(13) Energy(Farm Use)	Reduced use due to reduced production & potato acreage	Increase by 135%	Reduce by 5%	Increase by 75%
(14) Economics: (Benefit-Cost Ratio)	------	4.3 : 1.0 (Average)	0.6 : 1.0 (Average)	3.3 : 1.0 (Average)

* NIL = No Impact Likely

Affected Environment

The study area is basically Aroostook County, Maine, within the St. John River Basin -- the northeastern extremity of the United States (Main Report, Plates 1 and 2). The climate of this area is categorized as humid continental (represented by long cold winters and short mild summers). Precipitation averages about 36 inches per year which includes about 100 inches of snow. Potato farmland is generally located on the uplands -- on the well drained glacial till soils of the gently rolling hills that dominate the landscape.

The dominant natural vegetation of the area is forest, consisting primarily of northern hardwood species. Human population of the area is of very low density. With the exception of potato growing and lumber operations, the area is relatively undeveloped and consequently supports a high quality of fishing and hunting opportunity.

Historically this area was the major producer of potatoes in the United States. In more recent years, various factors including competition from the northwestern states (Idaho, Washington and others) and declining productivity of the Maine's soils have considerably reduced potato production in Maine. Nevertheless, potato production remains the most significant element in the economy and land use activity of the study area.

Potato growing has also had a significant effect on the natural resources of the study area. In addition to the displacement of forest, off-site effects are extensive, primarily because potato growing induces significantly increased erosion and introduction of nutrients and biocides into the aquatic environment. Stated simply, erosion means a loss of topsoil: not only is this a loss of valuable natural resource containing organic matter and nutrients necessary for plant growth (under natural conditions as much as 250 years are required to replace one inch of topsoil) (Conservation News, Volume 44, number 14, July 15, 1979) and the average replenishment of soil in the study area is estimated to be about 3 tons per acre per year), but also the sediments laid down by moving water accumulate at the mouthes of rivers, clog roadside ditches and drainage systems, fill reservoirs, adversely affect water temperature and pollute domestic and industrial water supplies. Stream flows and bottom characteristics change, disrupting fish and wildlife habitat. This erosion is also accompanied by toxic pesticides and chemical fertilizers. Nitrogen, phosphorus and other fertilizers create excessively "well-nourished" (eutrophied) water bodies leading to decaying algae, green scums, and disagreeable odors. Aquatic oxygen supplies are locally reduced to the extent that many fish species cannot survive.

Environmental Effects of Proposed Action

A presentation of the impacts associated with the alternative management measures including the no-action possibility were presented in Table 27. Expected effects of the tentatively selected plan, to implement Phase I of the I-C:R/D program for combined irrigation and conservation management are summarized below.

Adverse Impacts

1. Pumps would create additional demand for energy;

2. If gas-powered, pumps would creat noise - possibly detrimental to wildlife species and aesthetically annoying to humans; and,

3. Irrigation would cause an intermittant reduction in stream flows in the summer and thus may cause a higher concentration of pollutants which enter downstream.

Beneficial Impacts

1. Conservation measures would significantly reduce the rate and volume of cropland runoff, thus reduce cropland erosion and preserve the region's resource base -- soil;

2. Siltation (sediment) as well as nutrient and biocide in bottomlands and in waterways, loadings in streams and leachate from potato dumps would significantly decrease -- associated biological enhancement would result;

3. In some cases, wildlife habitat may be created by decreased tillage of potato land, or increased acreage in cover crops;

4. Aesthetic quality of potato farmlands' landscape would be enhanced by increased diversity of cover and reduced erosion; and,

5. Longevity of family farms and of agriculture would be extended due to a significant increase in the profitability of potato farming.

The initial Phase I of development would be implemented on only part of three existing farms. A total of 323 acres would be involved in this project (See Main Text, Table 6 for Farms 2, 8, 9, and Appendix 3). These plans would not require impoundments. During Phase II of the project an estimated 17 farms, or about 3,600 acres would be added to the demonstration. Beyond this, if the results are favorable, a promotion effort of management strategies in Phase II may encourage more widespread use of I-C practices.

Conclusion

Finding of No Significant Impact

Through review of this assessment, it has been determined that the initial Phase I development of irrigation and conservation practices on three farms in the study area would not appear to incur significant impacts. Most impacts revealed are beneficial. A Finding of No Significant Impact can be considered to preclude the need for an Environmental Impact Statement at this time. If, however, Federal actions beyond this tentatively proposed research and demonstration program would increase I-C implementation on a larger, more significant scale during Phase II, the impacts, although presumably of still a net benefit, would likely require additional evaluation. An EIS and a Clean Water Act 404 Evaluation would be required if any large impoundments and/or regional irrigation systems are proposed.

Recommendations

The future of New England's truck crops depends on a struggling agricultural economy in northern Maine and its once prospering potato industry. Rapidly declining acreage, production and number of farms as well as deteriorating soils and erosion-polluted waters are major problems in Aroostook County.

Cropland conservation practices are definitely needed but costs deter their widespread application to reduce erosion and meet water quality goals. Potato land irrigation has strong potential to significantly increase net farm income and potato yields and quality. A program promoting combined irrigation and conservation practices among the region's 1,000 potato farmers could benefit socioeconomic and environmental conditions.

Preserving agriculture requires the close cooperation of Federal, State and local agencies and potato growers to define the final Irrigation and Conservation: Research and Demonstration (I-C:R/D) Program, search out all available financial and institutional resources and implement an effective program to reverse declining trends. Since the Corps' authority for further work on this program terminates with this report, Governor Joseph E. Brennan on 19 May 1980 assigned the leadership to the Maine Department of Agriculture under Commissioner Stewart N. Smith for agency coordination and for searching out implementation funds for an I-C: R/D Program (see letter, page 99). Support or assistance to implement this program has been offered by:

U.S. Department of Agriculture
U.S. Water and Power Resources Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Maine Department of Agriculture
Maine Agriculture Experiment Station
Maine State Planning Office
Maine Department of Inland Fisheries and Wildlife
Northern Maine Regional Planning Commission
Maine Potato Commission
Maine Potato Council, and potato growers.

Accordingly, the Division Engineer recommends no further action by the Corps of Engineers and that implementation of an I-C: R/D Program should appropriately be pursued by the State of Maine. The Army Corps of Engineers supports the program and offers it assistance through coordination, for the development and enhancement of the region's water resources.

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

ATTACHMENT

SUMMARY OF PUBLIC COMMENTS ON DRAFT REPORT

The following public comments were received from February through May 1980 in response to the review of the draft Feasibility Report for Cropland Irrigation and Conservation: Research/Demonstration Program. The complete letters are included in Appendix 4, as are comments expressed during meetings held on 25, 26, 27 March 1980 in Orono, Presque Isle, Fort Kent, Caribou and Augusta, Maine; and on 15 and 29 April in Washington, D.C and Augusta.

CONGRESSIONAL

United States Senate; William S. Cohen, Senator: Letter to Mr. Al Irving, Potato Grower, Presque Isle, Maine

I have received your recent letter concerning the Cropland Irrigation and Conservation Research and Demonstration program for Aroostook County. I have also received the study, and it is presently being reviewed by my staff.

I, as well as you, believe the project to be of utmost importance to the future of the potato industry in Maine. I am hopeful that funding sources can be developed to immediately begin implementation, especially on the original farms. As you mention, the project will be complex since the terrain, soil conditions, and types differ so readily from one area to another.

I am presently working with my staff in investigating potential funding sources for the completion of the project. I will keep you informed on developments, and I hope that you will let me know if I can be of assistance. I look forward to hearing from you again.

FEDERAL AGENCIES

U.S. Department of Agriculture; Norman A. Berg, Administrator, Soil Conservation Service, Washington, D.C.

"It is apparent that irrigation and soil conservation, separately and combined, are physically and economically viable in the potato growing areas of Aroostook County. Also, potato farming is the dominant feature of the local agricultural economy. In view of this, the U.S. Department of Agriculture (USDA) would participate in such a research and demonstration program. The Department's participation would be contingent upon available Federal funding and cooperative actions by the State and local governments to carry out those aspects of the proposal that are outside the authorities of USDA. It is our view that active State and local government participation is essential to the success of such a program. Federal programs and actions alone are not sufficient."

"Current USDA programs which could contribute to implementing the proposal would be Science and Education Administration agricultural extension and research, Agricultural Stabilization and Conservation Service cost sharing assistance on conservation practices, Soil Conservation Service technical assistance on conservation practices and irrigation and Farmers Home Administration loans on conservation practice and irrigation installations. Rates and types of assistance beyond these ongoing USDA programs would require new legislative authority and funding."

"We believe that if the State and local governments want to see the proposed program implemented, they should take the leadership in generating the necessary involvement, actions and funding by all parties to make it successful in the proposed time frame."

U.S. Environmental Protection Agency; William R. Adams, Jr., Regional Administrator, Boston, Mass.

"Based upon our earlier funded Section 208 areawide planning effort in northern Maine, we are supportive of all efforts to control the agricultural runoff problem and its impact on water quality. The proposed research and development program appears to be a promising step towards implementing a solution."

"Our ability to participate in funding the proposal has not changed since our letter to Colonel Chandler on March 2, 1977. The Environmental Protection Agency does not have the authority or funding to carry out the project. We will continue to coordinate our efforts with those of your staff, the State of Maine, the Northern Maine Regional Planning Commission, and the agricultural community."

U.S. Dept. of the Interior, Fish and Wildlife Service; Gordon E. Beckett, Supervisor, Concord, N.H.

"In general, the Feasibility Report adequately addresses most of our major environmental concerns as set forth in our Planning Aid Letter of February 23, 1978. However, we have the following comments on the tentatively selected plan and recommend that they be incorporated into project design and implementation."

"The study is a long-range analysis of economic, environmental, and social well-being effects of wide adoption of irrigation conservative practices. It is, to date, a hypothetical analysis and does not have a firm empirical base, since very limited research has been done in Maine to show the value and impact of irrigation or conservation. Therefore, we recommend that the project include a statistically valid number of farms on which only conservation measures are implemented. This would provide valuable data concerning the benefits of soil conservation measures alone and permit generation of statistically valid data on the impacts of irrigation when combined with conservation practices on the remainder of the demonstration farms."

"On page 69 of the Main Report it states that "Irrigation equipment should be operational during the first year. Conservation measures would be applied over the first two years and all structures in operation by the third year." We interpret this to mean that irrigation would be initiated before conservation measaures are fully in place, thus possibily increasing soil erosion and attendant sediment, biocide, and nutrient loads in the area's streams for a period of one to two years. Therefore, we recommend that irrigation not be implemented until conservation measures are substantially in place."

"Water for the irrigation portion of the plan would be obtained from a variety of sources including existing ponds and streams and construction of new ponds either on or off streams. Water withdrawal during the normal low stream flow period could significantly reduce stream flows and put unwarranted stress upon aquatic organisms. Therefore, we recommend that an aquatic base flow (ABF) be established for the area streams to protect indigenous aquatic organisms by preventing water withdrawal that would reduce stream flow below the ABF."

U.S. Dept. of the Interior, Water and Power Resources Service (formerly, Bureau of Reclamation); Rodney J. Vissia, Ass't. Comm., Engineering and Research, Denver, Colorado

"While we have no specific comments on the program, we find that in general, use of R&D farms to gather data and demonstrate proper soil conservation and irrigation practices is worthwhile. With increasing energy costs, irrigated farming requiring pumping is becoming less cost effective, even with the normally substantial increase in crop production. Where irrigation is optional, which we assume it would be in this case, many farmers may choose not to adopt it because of high capital costs, energy costs, and extra labor required."

"Within our limits of manpower and workload, we would be glad to provide additional information and limited technical assistance to the potential sponsors of this program."

STATE AND LOCAL AGENCIES

Office of the Governor; Joseph E. Brennan, Governor: Letter to Stewart N. Smith, Commissioner, Dept. of Agriculture

I would like your Department to undertake the lead role in the coordination of agency discussion and the search for implementation funding for the Cropland Irrigation and Conservation: Research/Demonstration Program in the St. John River Basin as developed by the Corps of Engineers. Please designate contact people for the Corps of Engineers from your Department personnel.

There appears to be many potential benefits to be gained for the agricultural community through the implementation of this program. I am sure further study will point out potential problems and detriments, as well as benefits which could result from implementation.

Maine Department of Agriculture; Stewart N. Smith, Commissioner, Augusta, Maine

Based on the action taken at the Land and Water Resources Council meeting of April 29, 1980, I agree that the Department of Agriculture is the most logical choice to take the lead in coordinating state agency discussion of the Cropland Irrigation and Conservation: Research/Demonstration Program in the St. John River Basin project and the initiation of the search for funding to begin implementation of the plan.

To achieve that end, I have appointed Joseph Harrington, Director of Plant Industry, and Frank W. Ricker, Executive Director of the Soil and Water Conservation Commission as coordinators of this effort. Any further questions you may have as to progress, etc., may be directed to one or the other. Joe can be reached at (207) 289-3851 and Frank at (207) 289-2666.

Please do not hesitate to contact them regarding progress in State agency discussions of the program and implementation funding potentials.

Maine Dept. of Agriculture, Seed Potato Board; Joseph L. Harrington, Sec. (Dir. of Plant Industry), Augusta, Maine

"The interim report issued by your office emphasizes the need of combined conservation of soil resources along with adequate supplemental irrigation if the St. John River Basin, also referred to as Aroostook County Maine, is to remain a viable agricultural area. Maximum economical yields of high quality potatoes is essential if the area is to remain competitive and agriculturally prosperous."

"This is to urge adoption of Plan C on nine project farms as early as possible. Results of these nine farms could well demonstrate to the rest of the area the profitability of irrigation along with practical conservation practices."

"The Army is to be commended on a thorough comprehensive report."

State Planning Office; Mr. Allen G. Pease, Director, Augusta, Maine

We have reviewed the "Draft Feasibility Report for Cropland Irrigation and Conservation: Research/Demonstration Program" that has been recently prepared as an interim report of the St. John River Basin Water Resources Investigation.

The proposed approach to combined cropland irrigation and conservation appears to be feasible solution to a variety of major economic and environmental problems in the St. John Basin.

We endorse the proposed research/demonstration project and will work in cooperation with the Maine Land and Water Resources Council to do whatever we can to facilitate its further evaluation and implementation.

University of Maine, College of Life Sciences and Agriculture and State Experiment Station; David E. Leonard, Associate Director, Orono, Maine.

"The staff of the Maine Agricultural Experiment Station played an active role in helping with outlining the problem areas and developing the proposed research/demonstration program. In response to concerns for the very serious problems associated with potato production in Maine, this Station has committed more resources to potatoes than any other agricultural commodity. The research outlined in the draft proposal identifies critical research areas that need to be addressed, and you can expect the continued support of this Station in efforts to implement the Program. If the Program is funded, this Station will take an active role in providing the necessary research inputs."

Dept. of Inland Fisheries and Wildlife; Glen H. Manuel, Commissioner, Augusta, Maine.

"Of the plans proposed, we favor Plan A (Conservation Practices on Cropland) strongly. This plan will have the most favorable results relative to reducing sedimentation and biocide and fertilizer pollution of our Aroostook County waterways."

"Plan B (Irrigation only) will, in our opinion, cause an increase of sedimentation and biocide and fertilizer pollution of our waterways."

"Plan C (Irrigation and Conservation Practices) has our cautious support at least on the experimental three farm basis. This plan should reduce sedimentation and biocide and fertilizer pollution, but it may also have adverse effects since irrigation water will have to be taken from ponds and/or waterways. We expect an expanded program of this type will lead to dam building. There is also the very real possibility that irrigation will reduce low summer flows in some waterways. These projects should be evaluated on a case by case basis."

"We understand that of the three experimental farm projects in this plan two will draw water from existing lakes and one from a river. Again these water demands will require close scrutiny as to potential biological impact. We agree that an expansion of Plan C should be accompanied by an EIS."

"The research team will include a USDA/SCS Biologist. We would like to review his plans for biological monitoring to be certain there will be sufficient data collected for us to make an evaluation at the completion of the study."

"We appreciate the opportunity to comment on your plan and would appreciate being kept informed of any decisions or new developments."

Northern Maine Regional Planning Commission; James A. Barresi, Executive Director, Caribou, Maine.

"The Northern Maine Regional Planning Commission has reviewed the "St. John River Basin Cropland Irrigation and Conservation Report--September 1979" and endorses the need to conduct actual demonstrations to validate several aspects of the research. Since Mr. Robert Hunt's presentation to the Maine Potato Industry during his visit in the latter portion of March, 1980, the Commission has taken some additional time for reviewing the document. We have found that if such recommendations as stated in the report were found to be feasible, it would have a tremendous benefit to all aspects of our faltering agricultural economy."

"From an environmental standpoint, it appears that erosion and agricultural chemical problems could be substantially reduced, which is consistent with the long range water quality planning efforts of the Commission, and the improvement in quality of product should go a long way towards revitalizing the potato marketing shortcomings of recent years. However, it must also be cited here that under the current economic conditions, it will undoubtedly be difficult for many of the Aroostook County farmers to come up with the necessary capital to finance their participation in the irrigation and conservation plan."

"If the Northern Maine Regional Planning Commission can offer further support to the implementation of this project, please feel free to contact our offices."

Maine Potato Commission; Edwin S. Plissey, Executive Director, Presque Isle, Maine

"I was very impressed with the engineering reports provided to Bernard Shaw dealing with the economic potential of cropland irrigation in Northern Maine. We agree that on-farm demonstrations are the route to go to prove the need and economic feasibility of cropland irrigation here."

Maine Potato Council; Dorothy P. Kelley, Executive Vice President, Presque Isle, Maine

"I feel Plan C on the nine project farms would do the most for a feasibility study as these farms are located in different areas throughout the county and would, therefore, involve different soils and topography.

I feel the conservation practices are very necessary as the irrigation in itself will not stop soil erosion. The improvement of yields on less acreage will surely allow for increased rotation which would also increase yields and decrease erosion.

I would surely like to see the proposal tested, and weighed against energy cost and increased yields."

POTATO GROWERS

Laurence A. Park, Presque Isle, Maine

"I am in support of the Cropland Irrigation and Conservation: Research/Demonstration Program. Listed as No. 2 farm in the program, I am familiar with the intense and detailed work that went into this investigation. Having been with the soil and water technicians who walked over and mapped the farm, and having been with Mr. Hunt, I believe a very thorough and detailed study has been made of this program. I also believe these people are knowledgeable about the production of potatoes, the water needs and conservation requirements to preserve our land. This is very evident by the Interim Report."

"Through this pilot demonstration I believe it could be shown that adequate water will increase yields, improve quality, reduce plant disease, and lower unit cost by minimizing plant stress in times of low rainfall."

Alan B. Irving, Presque Isle, Maine

"The study will be of no use unless the demonstration part of the program is implemented. I understood originally they were planning to demonstrate at least nine farms on the start and then a few years later possibly more. It is my understanding that the present plan is to demonstrate only 3 farms and then possibly later a few more until finally 20 farms may be demonstrated. In Aroostook County there are approximately 2500 farms being farmed by approximately 1000 growers. I feel the government should demonstrate on all original 9 farms immediately plus the other 11 farms as soon as they can be prepared. This would be a very small demonstration when considering the many different types of soils and the thousands of different types of farms in Aroostook County."

"I am sure this year and especially lately you have heard of all the problems that we have in the potato industry in Maine. I am inclosing a chart which I took out of the March issue of the Spudman magazine which I feel shows one of the big problems in Maine. As you will notice in 1979, Maine was the second largest potato acreage state in the nation, but when it came to yield per acre we are tied with four other states for 10th place. Washington State which is in the first place received a yield of 475/cwt/acre compared to 250/cwt/acre out of Maine which is almost twice as many potatoes to sell per acre. According to the feasibility study this gap of yield per acre could close with better conservation and with the use of irrigation. Plus these practices would improve the quality of the Maine potato. This could help solve a lot of the problems that we are now having in Maine."

"I was born and brought up on a farm in Aroostook County, Maine and have farmed the last 15 years in the Presque Isle area. I am very interested in the future of the Maine potato industry. My farm was picked for one of the demonstration farms and I am very excited about the future possibilities in Maine. I feel also we have to be very realistic to the immediate problems and if we do not get construction started immediately on these projects we may not have any farmers left to demonstrate to."

"I would appreciate any help you can give to cause the immediate implementation of these demonstrations."

Terrace Gregg, Easton, Maine

"This letter is to show my support for the three-year St. John River Basin investigation of the irrigation and conservation needs in Aroostook County."

"The results of this investigation reaffirm my approximate ten-year belief that Aroostook County potato growers should be irrigating. An irrigation program made an intrical part of a farm operation would result in bigger yields and better quality potatoes. By better quality, I am referring to better shaped tubers and tubers more uniform in size. This would generate more profit to farms and as a result, should stimulate better rotation. Most growers realize they are cropping their land too hard by trying to raise a certain amount of potatoes. If a certain amount of potatoes could be produced from less acres, more acres could be set aside for rotation. Rotating better would make the land more productive and reduce soil loss due to erosion. The money saved from farming less acres of potatoes would be greater than the cost of irrigating."

"I would like to participate in the on-farm demonstrations should they come about. There is a lake and a brook within very reasonable distances from my land. Both have more than adequate amounts of water to use in irrigation. I have land very close to a unique situation. McCain Foods of Easton has a processing plant and land bordering my land. McCain Foods pump waste water from their lagoons to their land just to get rid of the water and its pollutants. I am told by several responsible people that the pollutants in this water will do nothing to harm crops. If anything, there may be some beneficial pollutants carried in the water. Fred Vahlsing raised potatoes and was the previous owner of the McCain plant. I am told that Mr. Vahlsing irrigated potatoes with this lagoon water quite successfully. If I had the facilities to irrigate, I would persue the possibility of using this lagoon water further. I have talked to some of the McCain people about this possibility, and they are very receptive since the water and its pollutants are just a problem for them."

"I feel I have experience that could help make the on-farm demonstration a success. I was brought up on a farm that raised potatoes in Aroostook County. While at the University of Maine at Orono majoring in Plant and Soil Sciences, I worked three winters, part-time, and one summer, full-time, for the Agriculture Research Service."

"During the winter months, I worked under Dr. Elliot Epstein and Walter Grant on water stress situations in potatoes in the green house and growth chambers. One summer I managed a small irrigation experiment station in Aroostook County for Dr. Epstein and Mr. Grant. Significant increases in yield and quality were achieved with three one-inch applications of water. The interest I acquired in irrigation while working for IRS prompted me to go to Idaho for one summer. In Idaho I worked on a farm that raised 650 acres of barley and 850 acres of potatoes. With irrigation, we applied one inch of water to the barley every six days and to the potatoes every five and a half days. I supervised seven workers and we are responsible for irrigating 50 percent of the farm."

"I want to thank you very much for the good work the Corps of Engineers has done on this irrigation study. I certainly hope that money can be found to get this kind of project going. Irrigation can work in Aroostook County and would certainly help a lot of potato farmers in the area."

Zenon A. Daigle, Fort Kent, Maine

"I am interested in your conservation plan and I am willing to offer my farm as a demonstration farm. Considering the dry spells of the past two years, which definitely reduced our yield, the water irrigation and diversion practices would be beneficial to the control and quality of growing potatoes in this area."

"My farm has an excellent water source available on high ground. If ponds were constructed, this water could be used without too much pumping required. This would save energy and could be opeated without excessive cost."

"The reason why this development was never done before is due to the lack of finances on my part. Thank you."

E.J. Campbell, Jr., Houlton, Maine

"Knowing that I am No. 9 in the study results, I am in hope that the on-farm demonstration will have a strong potential to improve the economic stability of potato farming in Northern Maine. For the third consecutive year, Maine potato farmers face crushing financial losses due to low prices. Canadian imports of potato into Eastern Markets are 70% higher than a year ago."

"For example, North Dakota acreage is up 28%; Washington State acreage, up 186%; Idaho acreage, up 96%; and "Maine" during the same 25 year period, "down" 18%. I think Maine has done more than its share to reduce the national production of potatoes. This dramatic increase in potato acreage in the western states is primarily due to federally funded irrigation projects. Similar projects have not been implemented in Maine, to my knowledge."

"Something is needed in Aroostook County; I think this conservation practice has great potential to help the economics of this, my county."

Sam Niblett, Easton, Maine

"I have followed the Army Corps of Engineers' study in Aroostook County, Maine regarding irrigation of the potato crop. I have seen what irrigation can do on the Hilston Kilcollins farm here in northern Maine and his yield and quality have been excellent. I have a good potential water supply and a neighbor on each side of me who would cooperate in this project but financing of this magnitude is out of the question. If help is available in obtaining an irrigation system which I feel would help to give me a better net return on my potato operation, I would appreciate it."

Philip D. Pelletier, Frenchville, Maine

"We, my brother and I, would really like this project pulled through for more reasons than one. We own farm #8 and in studying your statistics, we realize that ours was the most feasible one to operate with a zero net income lost in the first year."

"With a maximum water lift of about forty feet, and the access to the lake, our cost of pumping will be substantially lower than the other farms."

Being an island, having irrigation and conservation on it, there would be a substantial change in the amount of water pollutants going into the lake.

"In irrigating, not only does the yield go up but also the quality by about 48%. A 44% increase in yield and a 48% increase in quality combined is bound to bring up the net income even in a very poor priced year."

"A self propelled system is recommended for our farm. This is also preferred by us, but I do wish a few acres of land leveling would be included in the project. We have some ledge that if ripped would reduce the elevation quite a few feet."

"Let's hope that the economics of potato production go up in the next few years so that we will be able to afford to buy and operate our units."

James F. Carter, Washburn, Maine

"I feel that the personal who did this study were not only very complete but had a good grasp of the local conditions."

"I am owner operator of Farm #6 in the study. At this plans conception, I became very interested in it as I have always felt that irrigation would greatly aid not only in yields but also percentage of marketable tubers. Prior to this plan, I started a plan on my own with construction of a pond for water supply. But lack of capital has preented its completion. Also with irrigation in mind, I have moved over 5000 feet of hedge row and currently have completed over 2500 feet of sod waterways as designed in the farm plan that was provided by this study. It is my intention to complete the work designed in the farm plan but it will take a few years as money is not readily available. I also might add that I felt the farm plan was excellent, not only from a conservation stand point, but also for field layout and ease of management."

"Currently, I have been sticking to a tighter rotation program and my yields have increased each year. Last year was my best crop I have ever had and I will be shipping in excess of 275 cwt./acre. Yet I feel that with the ability to add water this figure could be raised by another 50 cwt./acre."

"After studying the reports on this project I would like to add a few comments. With the rapid increase in cost I am sure that many figures in the report are out of date. Yet if one considers extra yields that with irrigation the cost per unit of production would drop. This would also be true with per unit energy cost. And advancements in irrigation the past few years could reduce capital outlay by the use of self moving giant guns that are replacing wheel roll and hand moved units in many areas of the East."

"I have a BS degree in Agr. for the Univ. of Maine, have served as a Tank Company Commander and S-4 of the 1st Bdg, 1st AD, been president of the Maine Potato Council and various other industry organizations. Currently I am on the Steering Committee of the National Potato Council, Board of Directors of the Washburn Trust Company. In 1973 I was chosen Outstanding Young Farmer for the State of Maine. I feel that the experience received by myself in the organizations as well as that gained by traveling to other farm areas selling seed potatoes and on the farm itself would be of benefit in bringing this study to a satisfactory and profitable ending. With a positive attitude toward the potential agricultural growth in Aroostook County I would recommend that this project be moved ahead with all possible speed."

OTHER COMMENTS

Hydroresources and Associates, Inc.; James E. Michaud, P.E., President, Grand Isle, Maine

"Being from Aroostook County and aware of some of the current and past farming problems enables me to appreciate the importance and significance of irrigation, good crop management, and conservation. As an associate member of the St. John Soil and Water Conservation District, I have heard not only the S.C.S. but also the farmers' viewpoints."

"One of the basic problems with the current conservation program is the "too little-too late" type of approach to solving erosion, pollution, etc., problems due to lack of adequate funding."

"The irrigation program with the conservation measures as spelled out in the interim report demonstrates that it is a very worthwhile undertaking to help the farming community - and I do strongly support the implementation of the program. My only reservation is the schedule of events of implementation. Are we trying to do something "too little-too late"? Irrigation has had limited exposure in the County, but I am sure we can learn from our friends from the western part of the country who I am sure have considerable experience with different types and methods of irrigation - we do not need to re-invent the wheel again."

"I personally would like to see the demonstration period shorter - perhaps down to only 1 or 1-1/2 full crop rotations instead of the two full crop rotations that the researchers desire. More project farms should be added from different sections of the County."

"In summarizing, the "Cropland Irrigation and Conservation: Research/Demonstration Program" should be implemented and as quickly as possible."

COMMENTS FOLLOWING MEETINGS

The following persons provided written comments following meetings held in Orono, Presque Isle and Fort Kent, Maine to discuss the draft report. Their comments are included in Appendix 4:

Mr. David E. Leonard, Assoc. Director, Maine, Agricultural Experiment Station
Mr. Roland Struchtemeyer, Professor of Soils, University of Maine.
Mr. Laurence A. Park, Presque Isle, Potato Grower; identified as farm number I-C #2.
Mr. Arthur Gray, Easton, Potato Grower
Mr. Winston Bagley, Mapleton, Potato Grower
Mr. Sam Niblett, Easton, Potato Grower
Mr. Dan Turner, Fort Fairfield, Potato Grower
Mr. Alan B. Irving, Presque Isle, Potato Grower; identified as farm number I-C #3.
Mr. Phillip D. Pelletier, Frenchville, Potato Grower; identified as farm number I-C #8.

Appendix 4 also includes the minutes of meetings held in Washington, D.C. and Augusta, Maine to discuss the draft report and tentatively recommended program.

STATE OF MAINE
OFFICE OF THE GOVERNOR
AUGUSTA, MAINE
04333

JOSEPH E. BRENNAN
GOVERNOR

May 19, 1980

Stewart Smith, Commissioner
Department of Agriculture
State House
Augusta, Maine 04333

Dear Stewart:

I would like your Department to undertake the lead role in the coordination of agency discussion and the search for implementation funding for the Cropland Irrigation and Conservation: Research/ Demonstration Program in the St. John River Basin as developed by the Corps of Engineers. Please designate contact people for the Corps of Engineers from your Department personnel.

There appears to be many potential benefits to be gained for the agricultural community through the implementation of this program. I am sure further study will point out potential problems and detriments, as well as benefits which could result from implementation.

Sincerely,

JOSEPH E. BRENNAN
Governor

JEB:mas

cc: Col. Max Schieder
Dept. of the Army
New England Division Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Robert Hunt

Maine Department of Agriculture

Stewart N. Smith, Commissioner

Station 28
State Office Building, Augusta, Maine 04333
Telephone 207/289-3871

May 19, 1980

Mr. Robert G. Hunt
Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Hunt:

Based on the action taken at the Land and Water Resources Council meeting of April 29, 1980, I agree that the Department of Agriculture is the most logical choice to take the lead in coordinating state agency discussion of the Cropland Irrigation and Conservation: Research/Demonstration Program in the St. John River Basin project and the initiation of the search for funding to begin implementation of the plan.

To achieve that end, I have appointed Joseph Harrington, Director of Plant Industry, and Frank W. Ricker, Executive Director of the Soil and Water Conservation Commission as coordinators of this effort. Any further questions you may have as to progress, etc., may be directed to one or the other. Joe can be reached at (207) 289-3891 and Frank at (207) 289-2666.

Please do not hesitate to contact them regarding progress in state agency discussions of the program and implementation funding potentials.

Sincerely,

Stewart N. Smith
Commissioner

SNS:jr

CC: Craig Ten Broeck
Joe Harrington
Frank Ricker
Governor Joseph E. Brennan