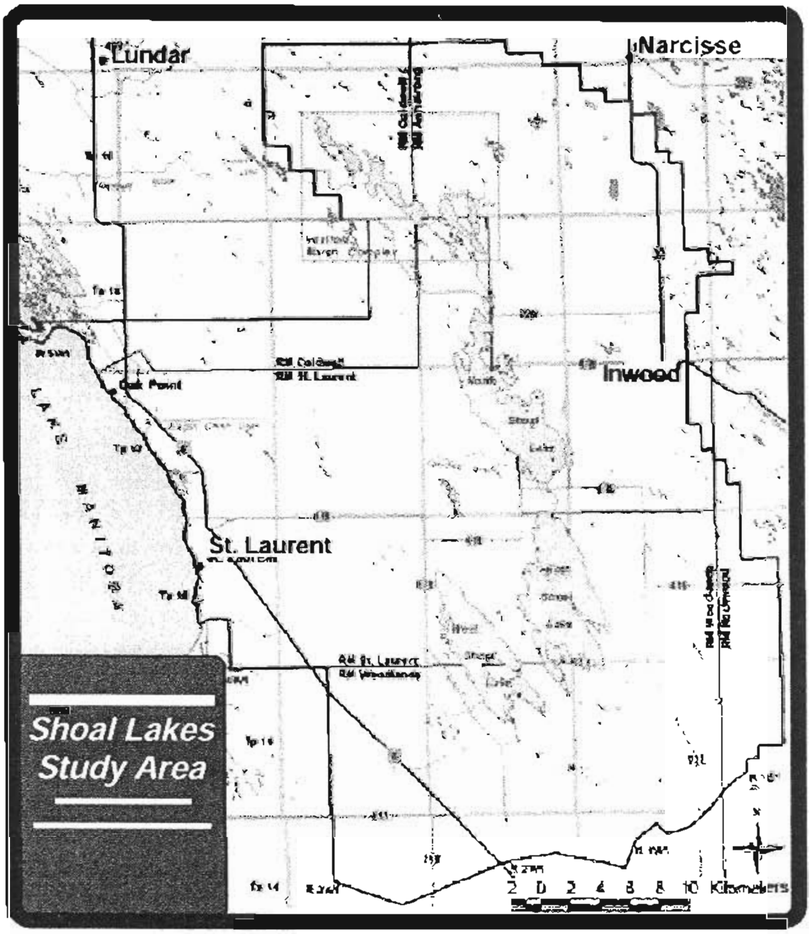
Shoal Lakes
Water Management Options

Preliminary Investigation



A report to the
Western Interlake Water Management Association
by
The Ad Hoc Study Group on Shoal Lakes Water Management

Final Report – August, 2002

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Executive Summary

The Shoal Lakes is a land-locked system of three lakes located approximately 40 miles northwest of Winnipeg in the southwestern portion of Manitoba's Interlake region.

While groundwater contributes water to the lakes, the main source of water is overland runoff. Accordingly, water levels are very susceptible to cyclical variations in rainfall and snowmelt runoff. During wet periods, lake levels rise, flooding adjacent land. Flooding around the lakes has occurred to some degree in 10 of the 26 years between 1976 and 2001.

Much of the area surrounding the lakes is used for agricultural purposes, primarily pasture and hayland. During periods of high water, pasture and hayland is lost to flooding. Often, cattle must be relocated or sold because of a lack of pasture, lost hay production, or a combination of both. Provincial and municipal roads in the area have also been be flooded, resulting in closures and costly repairs.

Until the water level management issue in the Shoal Lakes is addressed, approval of further land drainage in the basin at large will not be considered. As a result, local residents and municipalities are very frustrated and seek a swift resolution to the problem.

Beginning in the late 1990s, concerns over flooding and other water management issues in the area were expressed to the regional water manager for Manitoba Conservation. In 2001, local residents, led by the Western Interlake Water Management Association, requested that options for controlling lake levels be examined. An ad hoc committee, comprising of representatives of the government agencies involved and Ducks Unlimited, was subsequently established to investigate and prepare a feasibility report.

Three options for controlling lake levels in the Shoal Lakes were examined. Each involves constructing drainage outlets from the Shoal Lakes to Lake Manitoba. This investigation was preliminary in nature, intended only to determine whether any of the options warrant further, more detailed study.

In the benefit-cost analyses, only benefits to agriculture and local infrastructure were considered. Potential benefits to wildlife, other resources and the community at large were not included in the calculations due to the lack of readily-available information.

One of the three options has a benefit-cost ratio less than 1.0 and likely does not warrant further investigation. However, two options have benefit-cost ratios that are essentially at 1.0 and are worthy of further examination, especially considering that wildlife and other non-agricultural benefits have not been included in this preliminary investigation.

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1.0 Background

The Shoal Lakes are located about 40 miles(65 kilometres) northwest of Winnipeg in the southwestern portion of Manitoba's Interlake region. Communities in the area include Woodlands to the south and Inwood on the northeast. Rural municipalities sharing land around the lakes and contributing runoff include Armstrong, Coldwell, St. Laurent and Woodlands, and to a much lesser extent, Rockwood.

The lakes are a land-locked complex of three main water bodies – North, West and East Shoal lakes. Although groundwater contributes to water levels in the lakes, water is supplied to the lakes primarily through overland runoff. Accordingly, water levels in the lakes are affected by cyclical variations in annual rainfall and snowmelt. During high water, agricultural land adjacent to the lakes is flooded.

The municipalities most impacted by high water in the Shoal Lakes include, in order of magnitude, St. Laurent, Armstrong, Woodlands and Coldwell.

1.1 The Problem

In most recent memory, significant flooding occurred in 1979 and again in 2001 which has continued into 2002. In the five years leading up to the high levels in 2001, flooding was also experienced, although of less severity. Overall, flooding of some degree has occurred during 10 of the past 26 years. On the other hand, periods of low water have occurred recently during the decade prior to 1996. (Figure 1.2)

A survey conducted by Manitoba Agriculture and Food regional staff in 2001 determined that approximately 13,000 acres(ac) [5,263 hectares (ha)] of agricultural lands, both public and private, were flooded that year. A second survey was conducted specifically for Crown Lands used for agriculture around North Shoal Lake. This survey identified a total of 9,000 animal unit months (AUMs) of forages in hay and pasture lost to flooding in 2001, approximately 8000 ac (3,240 ha), on 86 separate quarters of land. About 25 producers were directly impacted.

Continual flooding has killed desirable grass species in the flood-prone zone. As a result, losses of pasture and hay will continue for a few years after floodwaters recede, until the grasses are able to re-establish.

While climatic variations appear to be the main catalyst for flooding, the issue has been somewhat exacerbated by drainage activities. For more than a century, local municipalities, in an effort to improve the agricultural worth and capability of the land for their ratepayers, have been directing water from farmland into the lakes.

The majority of the land surrounding the lakes is used as pasture and/or hay production – primarily native grasses, but also some seeded varieties. During wet years, the capacity of pastures to carry livestock can be greatly reduced which can result in having to move cattle to other areas, or in some cases, having to reduce herd size. Financial losses to cattle producers can occur when livestock are sold either before they are in prime condition for market or during unfavourable market conditions.

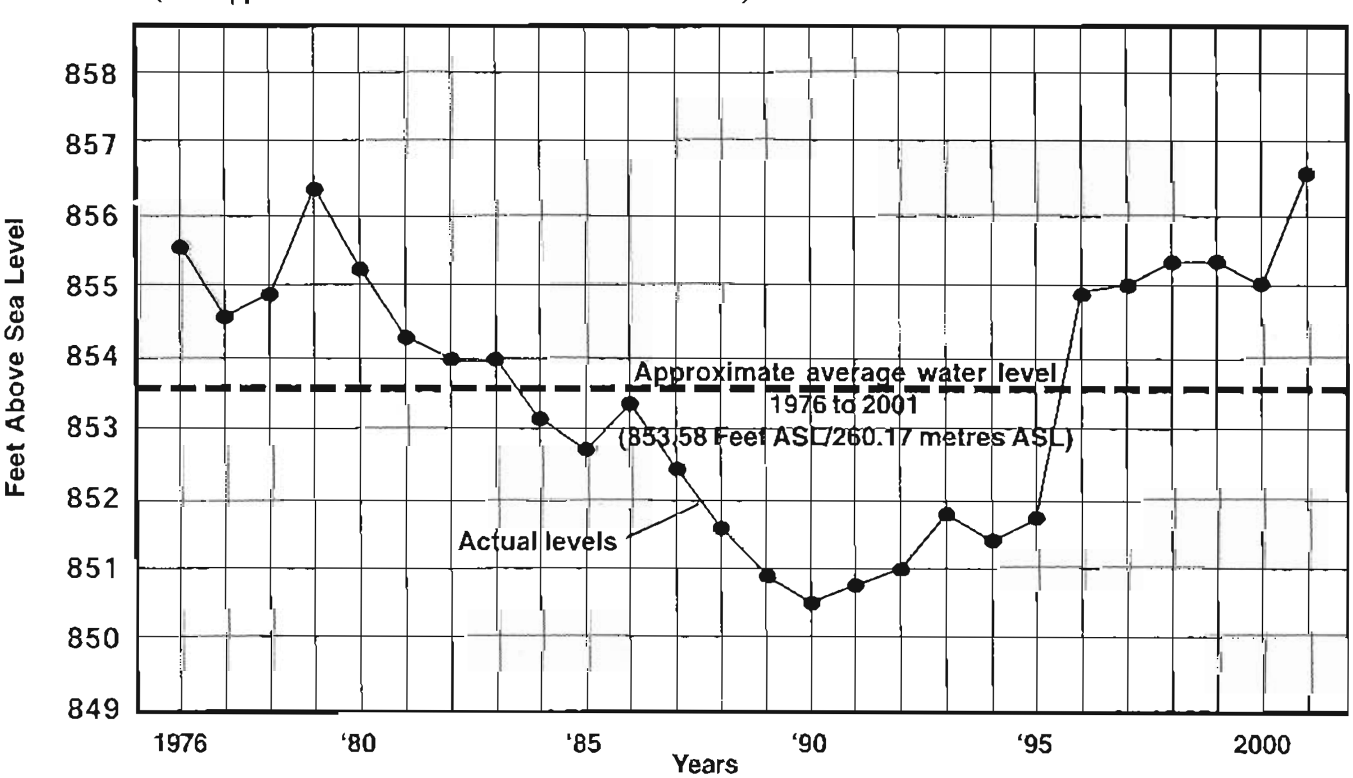
Loss of hayland also places financial stress on cattle operations either through having to the supplement existing hay supplies by purchasing additional feed for overwintering, or through the untimely sale of livestock. In addition, continual flooding has killed the desirable grass species in the flood-prone zone. As a result, losses of pasture and hay will continue for a few years after floodwaters recede, until the grasses are able to re-establish.

During flood years, several roads in the area (PRs 643, 415, 229 and 518 and PTH 6 as well as municipal roads) are impacted by high water. Road closures often take place due to flooding and soft road conditions. This causes disruption and inconvenience to local people attempting to reach pastures and fields and in general movement around the area. After each flood, municipalities and the Province expend funds replacing culverts and gravel, and in some cases having to conduct extensive repairs to the road beds themselves. Flood fighting and repair costs to provincial roads in 2001 alone approached $300,000.

In 1986, Ducks Unlimited Canada (DU) established the Vestfold project to manage the marsh for waterfowl production. The Vestfold project is a marsh complex located immediately to the north of North Shoal Lake, and under natural conditions, drains into North Shoal Lake. The complex has been divided into four cells that have been designed to allow water level management through the use of pumps.

However, due to right-of-way concerns, no pumping occurred in 2001 and 2002. The continual buildup of water in the project has resulted in the flooding of land surrounding the project and the addition of water to North Shoal Lake. A more detailed discussion of the Vestfold Marsh Complex appears in Section 2.5.

Figure 1.2: North Shoal Lake Water Elevations (summer levels)
(See Appendix B for details and metric conversions)



It is the area immediately surrounding the Shoal lakes that is most obviously impacted by high water and subsequent inundation. But, it has been assumed that a larger portion of the drainage basin would benefit from actions that manage water levels in the lakes themselves by allowing enhanced land drainage in the watershed. The rural municipalities of Woodlands and Armstrong would like to direct additional water into the lakes to address flooding concerns elsewhere the basin. However, they may not as long as the issue of controlling water levels in the lakes is outstanding. In fact, all drainage projects in the area are on hold pending this review. The local landowners are extremely frustrated and upset.

1.2 The Study Group

In the summer of 1998, local producers approached the regional water manager of Manitoba Conservation and members of the Western Interlake Water Management Association requesting that an investigation be conducted regarding possible solutions to the flooding problem around the lakes. Subsequently, an informal Ad Hoc study group consisting of representatives from Manitoba Government and Federal Government agencies and Ducks Unlimited Canada was established for that purpose. (See Appendix A for Study Group)

The Study Group set out to identify possible water management options and to conduct a preliminary investigation to determine whether further, more detailed studies were warranted. The study focused on three options for managing water levels by providing drainage outlets to Lake Manitoba. These options are described and discussed in Chapter 3.0.

1.3 Provincial Water Strategy and Policies

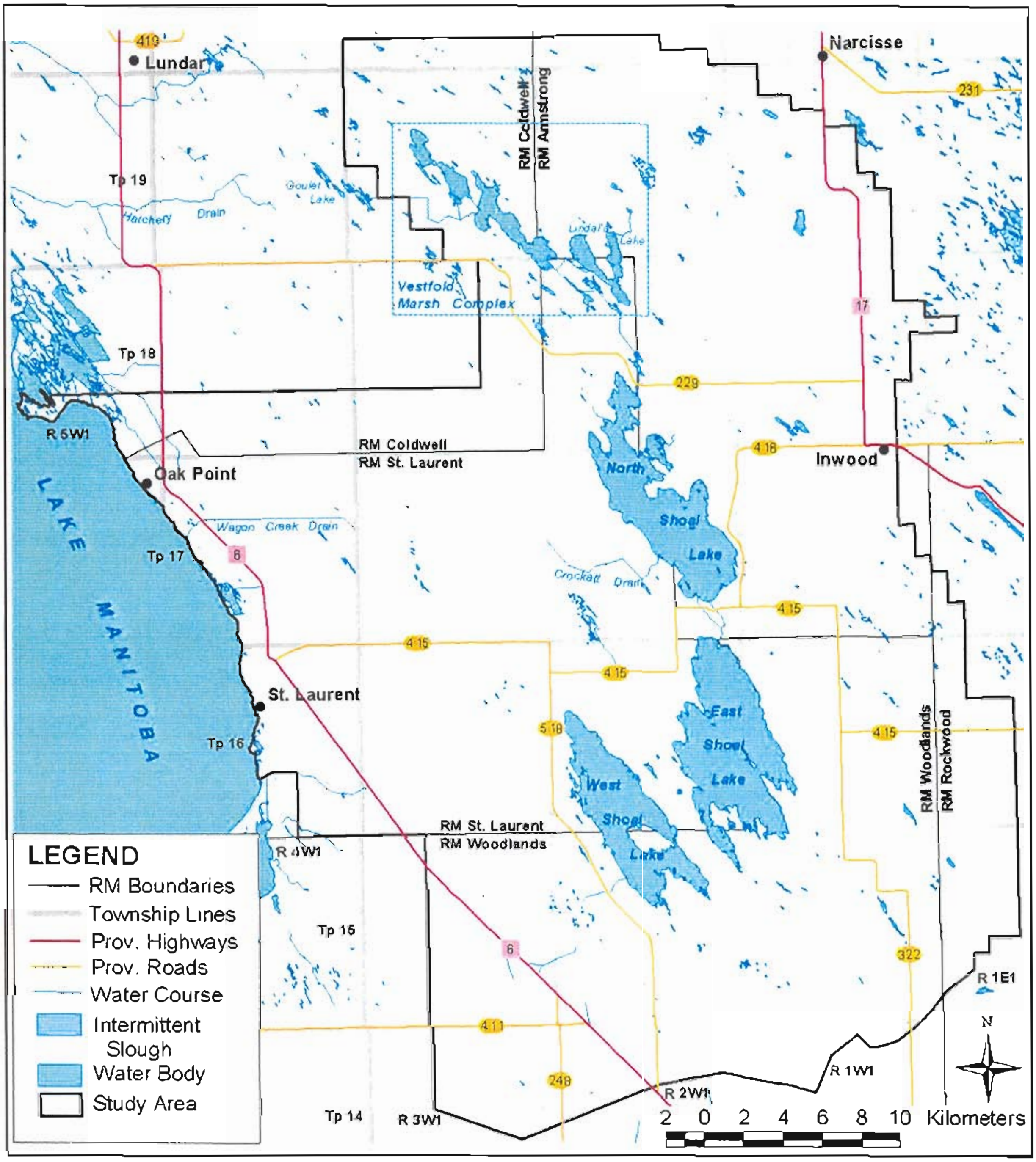
The principle of this study is in keeping with the Province of Manitoba's Water Strategy, which encourages the watershed approach to water management. Manitoba's water conservation policies are to conserve and manage the lakes, rivers and wetlands of the province so as to protect the ability of the environment to sustain life and provide environmental, economic and aesthetic benefits to existing and future generations.

Putting these water policies into practice includes, among other actions:

- developing integrated resource planning to allow for habitat and resources conservation measures to be incorporated early in the planning process,
- developing a watershed planning framework and guidelines that make conservation a priority,
- encouraging the maintenance and establishment of on-farm water retention, while ensuring downstream users and impacts on fish habitat are taken into consideration, and
- preparing watershed and basin plans that will address flooding issues.

The process places a priority on providing all Manitobans with an opportunity to participate in the development of water management strategies. The ad hoc Shoal Lakes Water Management Study Group recognizes these principles and precepts and encourages their application to any water management strategy that may be developed for the Shoal Lakes.

For a summary of Manitoba's Water Policies, see Appendix C.



Shoal Lakes Study Area

2.0 The Project Area

2.1 General Description

The area is located about 40 miles (65 kilometres) northwest of Winnipeg in the south-western Interlake region. It is part of the Lundar Ecodistrict of the Lake Manitoba Plain Ecoregion, Prairies Ecozone. (*Source: Terrestrial Ecozones, Ecoregions and Ecodistricts of Manitoba. Land Resource Group, Agriculture and Agri-Food Canada, 2000.*) The landscape is generally flat, interrupted by shallow, generally parallel undulations oriented in a north to south direction. This "ridge and swale" topography is a result of a combination of glacial influences and bedrock characteristics. It also forms an impediment to natural surface drainage.

The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is around 36°F (2.2°C), ranging from a mean temperature of 66°F (18.9°C) in July to –6°F (-21.1°C) in January. The average growing season is 181 days, although the frost-free period is about 110 days.

The mean annual precipitation is approximately 19 inches (482.6 millimetres), of which less than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average yearly moisture deficit is about 7.5 inches (190.5 millimetres).

Natural vegetation on imperfectly drained soils is largely sedges and willows, with salt-tolerant plants where salts are close to or at the surface. Where drainage is slightly better, trembling aspen, willows, some bur oak mixed with areas of meadow and other grasses are found. Well drained shallow till areas support stunted trembling aspen, bur oak, beaked hazel nut and prairie grasses, while deeper till areas may have some scattered white spruce. Many stands of trembling aspen and bur oak have been impacted by cattle grazing and shrub fires.

Poorly drained soils have slough grasses, reeds and sedges, and salt-tolerant plants where salinity is a problem.

Although limestone bedrock is exposed or near the land surface in a few areas in the northeastern portion of the watershed, it is generally covered by glacial till which in turn has a relatively thin blanket of silts and clays. These silts and clays were deposited approximately 8,000 to 12,000 years ago when the area entire area was covered by glacial Lake Agassiz.

2.2 Soils and Land Use

2.2.1 Soils

Averaged over the area, soils throughout the drainage area surrounding the Shoal Lakes complex are generally poor to imperfectly drained. This wetness combined with stoniness, high carbonates and shallow soil profiles limits their agricultural productivity. Nearly 60 per cent of the land is classified as agricultural capability classes 3 and 4, 9 per cent as Class 2 and the remainder as Class 5 or lower.

In the immediate vicinity of the Shoal Lakes, soils are highly to extremely calcareous and poorly to very poorly drained. Agricultural capability around the lakes is dominated by agricultural capability classes 5, 6 and 7 (See Figure 2.1 - Agricultural Land Capability).

The Agricultural Capability map is based on the Canada Land Inventory seven-class system which groups soils according to limitations and risk for agricultural use. These risks and limitations are progressively higher from Class 1 to Class 7. Organic soils are not rated as they have limited agricultural value in their native state. Each class (except Class 1) will have sub-class modifiers that describe the limitations and risks. Class 1 soils have no limitations for agricultural production.

Generally, classes 1, 2 and 3 soils are suitable for the sustained production of annual crops. Class 4 is marginal for annual crop production. Class 5 is suitable for hay and pasture and improvements are feasible. Class 6 is capable of producing native hay and for pasture, but improvements are not feasible. Class 7 is not suitable for agriculture production.

Manitoba Crop Insurance ratings are H, I and J, with J being most prominent nearer the lakes. Crop Insurance ratings are based on the relative productivity of the land within a region. Class A lands are the most productive and Class J lands are the least productive. These ratings are based on historical production data for each area within the province.

2.2.2 Land use

Since settlement began in the area in the 1880s, the primary land use in Shoal Lakes basin area has been agriculture. Around the lakes, cow-calf production is the main agricultural activity. These operations are conducted on a combination of Crown land leased for grazing or haying, and deeded land. There is a heavy reliance on native grasses for pasture and hay (See Figure 2.2 - Land Use: 1994 LandSat Imagery.)

Land use data used for the study was derived from LandSat 7 satellite imagery. Remore sensing techniques are used to classify the image into 16 land use classes. These classes were further aggregated into seven classes. Resolution of the imagery is 30 metres.

The image that was used from the Shoal Lake study area was taken on May 29, 1986 and updated with an image from October 26, 1994. The imagery was acquired from RadarSat International and classification was completed by the Manitoba Centre for Remote Sensing.

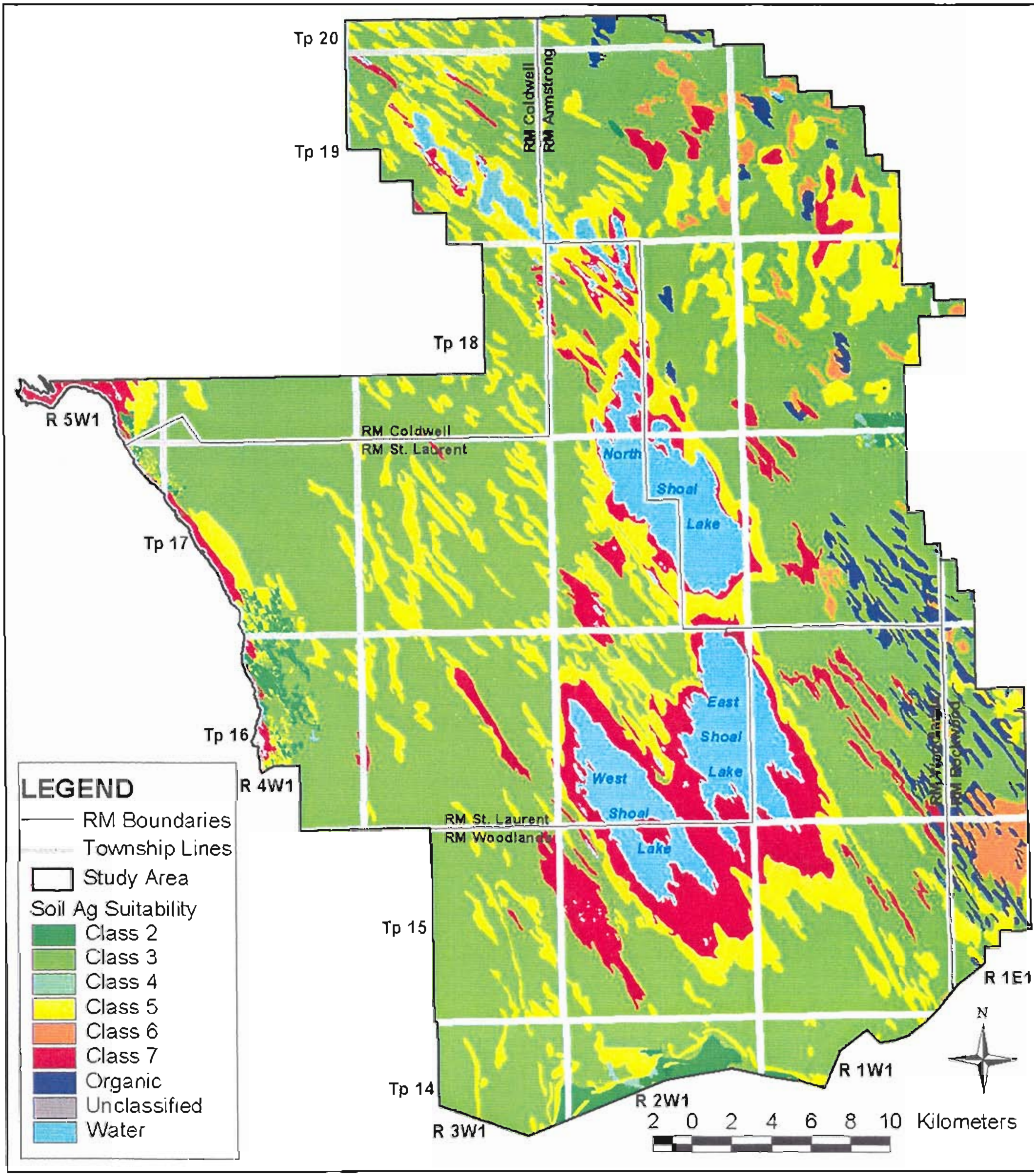


Figure 2.1: Agricultural Land Capability

Note: Due to recent changes in the Agricultural Capability guidelines, many of the soils described as Class 3P on the map are now rated as Class 4P.)

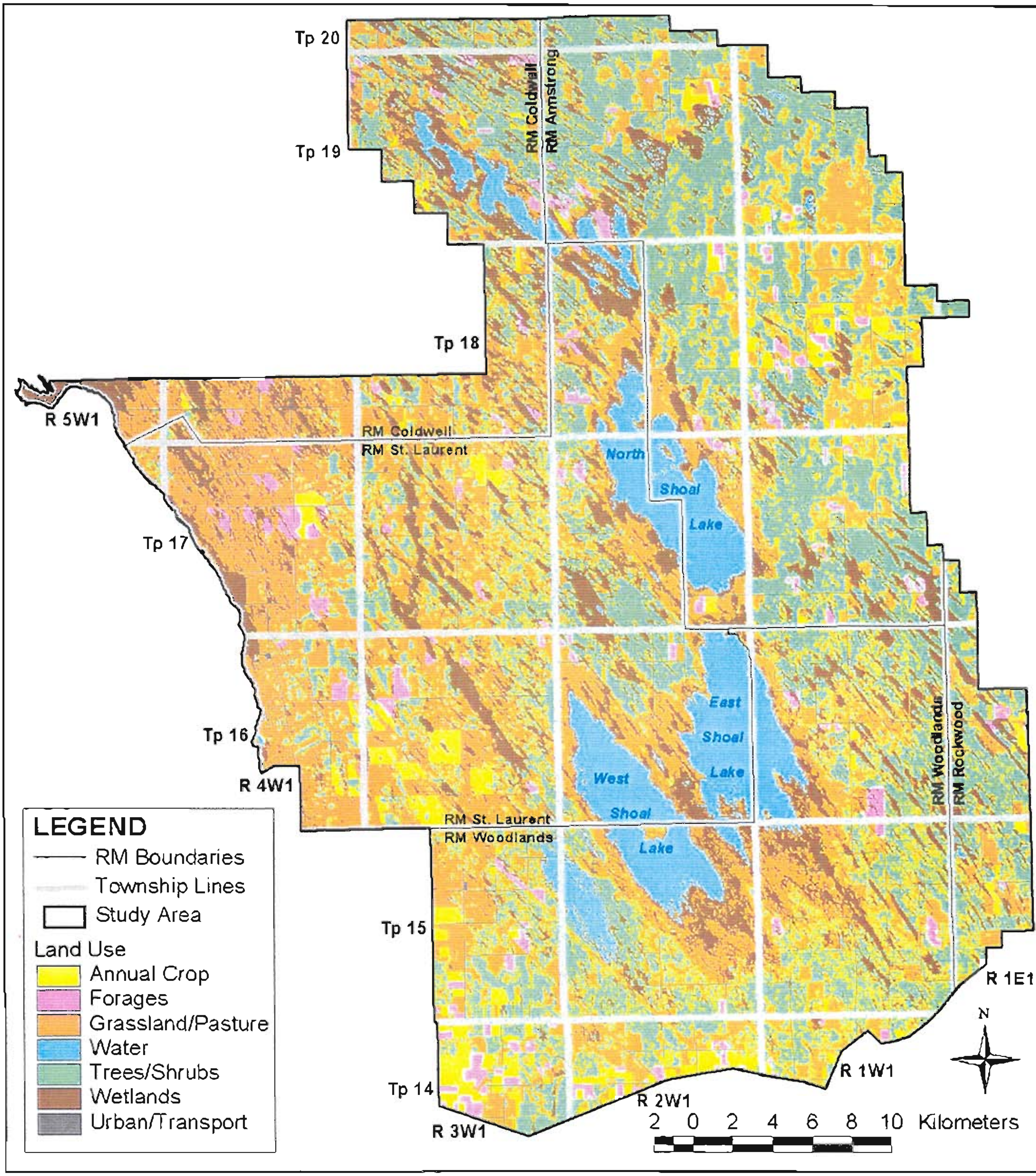


Figure 2.2: Land Use – 1994 LandSat Imagery

2.3 Water Resources

When the Shoal Lakes area was surveyed in 1872, the lakes we recognize today were one body of water. As late as 1913, the Shoal Lakes were still connected to each other by open water. Evidence of abandoned shorelines can still be seen in some areas far back from the current shoreline.

From the early years, drainage and water management was a challenge facing municipalities in the area. Over the decades, in an effort to improve the land base for its ratepayers over the years, local municipalities conducted extensive land drainage which has contributed more water to the lakes. From 1897 to 1900, major channels such as the Argyle Ditch and the Meridian Ditch were constructed. During the first decade of the 20th century, other projects including the Swamp Lake drain and the Long Lake drain were undertaken. In 1913, major upgrades to the Norquay Drain began. The Norquay had been originally dug by hand in the 1880s. Drainage improvements continued over the years with the establishment of other channels such as the Crockatt Drain, Wagon Creek Drain and the Walker Drain.`

There are five rural municipalities surrounding the Shoal Lakes complex which have some impact on the water management of the area. These are Armstrong, Coldwell, St.Laurent, Rockwood and Woodlands. All five municipalities contribute water to the North Shoal Lake drainage area (which includes East Shoal) while only two (St.Laurent and Woodlands) have lands which drain into West Shoal Lake.

2.4 Wildlife and Fish

2.4.1 Wildlife

Historical accounts claim bison, mule deer and elk were present in the Shoal Lakes area during the early days of settlement. During the early to mid-1800s, the area was a popular place for early settlers and residents of the Red River Settlement for waterfowl and big game hunting. The area has also supported wild fur trapping, with muskrat being the dominant species.

The ridge and swale topography of the area provides fine habitat for many different types of flora and fauna. The mix of habitat including agricultural fields also provides excellent habitat for big game. Elk and high density populations of deer were observed in the study area in 2000 and 2002 during aerial surveys.

In 1917, 241 species of birds and several species of animals were recorded in the vicinity. At least three of these bird species – the Greater Prairie Chicken, Whooping Crane and Trumpeter Swan – no longer exist in the area. Many other species abundant at the time are currently present in limited numbers only.

In 1924, the 38-section (98 square kilometre) West Shoal Lake Game and Bird Sanctuary was established in an attempt to conserve the birds and associated habitat. The action was, at least, a temporary success. According to estimates at the time, one-half million geese rested daily at the sanctuary during the 1926 spring migration. The lakes continue to be an important waterfowl migratory stop.

The area has been described as nationally important for waterfowl and shorebird staging, as well as nationally important habitat for breeding colonial water birds. Habitat for goose breeding has been ranked as regionally important. Habitat for duck and goose moulting is listed as locally important.

2.4.2 Species of Concern

The study area is known to have 15 known species of concern (Manitoba Conservation Biodiversity Conservation Database). Two of these are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), namely Piping Plover and the Small White Lady's Slipper.

Two of the species of concern in the area are listed as endangered species - the Piping Plover and the Small White Lady's Slipper.

In 1987, one study indicated that 75% of the Piping Plovers in Manitoba used the south shore of West Shoal Lake during the breeding season. A total of 80 birds were observed during research activities in 1985. As water levels in the lake became higher, a corresponding drop in the number of Plovers has been noted. In most recent years, no Plover nests have been recorded along West Shoal Lake.

In addition to the species of concern, nine areas of remnant tall grass prairie have been identified in the Shoal Lakes area.

2.4.3 Fisheries

According to anecdotal references, fish were taken commercially from the lakes at one time. In 1891, 1072 cwt (48,600 kg) of fish were caught for use in the St. Laurent area. The species is unknown.

Current fisheries use of the Shoal Lakes consists of minnow and leech bait blocks. Bait fishing is a significant activity on the lakes. Both horse and jumbo ribbon leech populations are viable for commercial harvest. Minnow bait species encountered are fathead minnow and a variety of stickleback species. Manitoba Conservation had previously stocked the area a few times with Northern Pike in the 1980s, but it is unclear as to survival rates of the stocking program.

2.5 Vestfold Marsh Complex

This complex is a series of wetlands located at the extreme north end of North Shoal Lake. They are subject to large fluctuations in water levels similar to the Shoal Lakes. Usually wet meadows or hay fields separate this area from North Shoal Lake. In wet years (1979 and 2001), the two water bodies are joined as a single lake. In the great majority of years water levels in Vestfold wetlands are low since the surface runoff is small compared to the potential evaporative loss when the lakes are full. In an abnormally wet year or during a series of wet years, the water level will rise until it spills towards Shoal Lake (its natural outlet). It then takes several dry years before the water level drops enough to return the complex to separate water bodies.

Ducks Unlimited divided the wetlands into four cells in 1986 by constructing earthen dykes and individual water controls. See Figure 2.3 - Vestfold Marsh Operating Levels. At Full Supply level, the water area is 6,259 ac (2,533 ha) and at 4,752 ac (1,923 ha) at Operating Level. The management scheme was to allow movement of water between the four cells by pumps to optimize water levels for wetland plant growth. In wet years excess water could still flow south to the Shoal Lakes but an artificial outlet was constructed to allow some of this water to be pumped west into Goulet Lake and the Hatchery Drain. A stoplog weir at the south end of the complex prevents high water levels from flowing back into Vestfold from North Shoal Lake when water is being pumped towards Goulet Lake.

Figure 2.3: Vestfold Marsh Operating Levels

	Area at Full Supply Level Acres (Hectares)	Area at Operating Level Acres (Hectares)	Full Supply Level Feet (Metres)	Operating Level Feet (Metres)
Cell 1	1284.6 (519.9)	816.4 (330.4)	856.30 (261.00)	854.66 (260.50)
Cell 2	1952.2 (790.0)	1456.2 (589.3)	856.30 (261.00)	854.66 (260.50)
Cell 3	2064.6 (835.5)	1522.4 (616.1)	857.12 (261.25)	855.48 (260.75)
Cell 4	957.3 (387.4)	957.3 (387.4)	856.30 (261.00)	856.30 (261.00)
Total	6258.6 (2532.8)	4752.3 (1923.2)		

The boundaries of the four cells roughly follow the natural landscape. They are Lindals Lake (Cell 3) and a shallow wetland on the west side of the lake (Cell 4) and two cells (Cells 1 and 2) located to the west of the Irwin/Buffalo Ranch Road. A pump house was constructed on the Irwin/Buffalo Ranch Road that enables water to be moved between any of three cells (Cells 2, 3 & 4) to help manage water in dry years. A larger pump house in located west of this location and it is able to move water between Cells 1 and 2 or discharge excess water through a channel into Goulet Lake and through Hatchery Drain into Lake Manitoba.

However, due to right-of-way concerns, no pumping has occurred in 2001 and 2002. The continual buildup of water in the Vestfold project has resulted in the flooding of land surrounding the project and the addition of water to North Shoal Lake.

3.0 Water Management Options

The combined drainage area of the entire Shoal Lakes watershed is approximately 676 square miles, or 432,500 ac (175,023 ha). The area includes two sub-watersheds – the North Shoal Lake drainage area (Watershed #108), which includes East Shoal Lake, and the West Shoal Lake drainage area (Watershed #109).

However, while the North Shoal Lake watershed drains almost exclusively into the lake system, a significant portion of the West Shoal Lake watershed drains directly into Lake Manitoba and does not contribute to water levels in the Shoal Lakes. For purposes of this investigation, the total land area contributing water to the Shoal Lakes complex has been calculated as being about 350,000 ac (141,637 ha).

The intent of this preliminary investigation is to identify and evaluate structural options for managing water levels in the Shoal Lakes complex. It is assumed this action would alleviate flooding in the immediate area of the lakes and to improve the potential for land drainage in a larger portion of the basin.

As a base from which to calculate costs and evaluate these proposals, a lake water elevation of 854.5 feet (260.45 metres) above sea level (ASL) in North Shoal Lake was chosen as the study target level. This elevation was chosen from a review of historic data and discussions with Manitoba Conservation department staff familiar with the area.

The study target level of 854.5 feet (260.45 metres) above sea level in North Shoal Lake was chosen from a review of historic data and discussions with Manitoba Conservation staff familiar with the area.

Table 3.1 illustrates actual lake levels in North Shoal Lake over the 26-year period of record (1976-2001) and compares them to the study target level of 854.5 ft (260.45 m) ASL. As shown, water levels in North Shoal Lake were at or above the target level in 11 of the 26 years. (1977 is considered to be at the target level.) During the remaining 15 years, water levels were below the target level.

Two of the drainage options examined feature outlets directly from North Shoal Lake. Since North Shoal Lake is the highest in elevation of the three lakes (although only slightly), it has been assumed that these options would only provide benefit to the North Shoal Lake drainage area.

A third option considers an outlet on West Shoal Lake. The elevation of the inlet for this option (852.0 ft/259.69 m) is expected to allow management of East Shoal Lake at 853.0 ft (259.99 m) and North Shoal Lake at the target elevation of 854.5 ft (260.45 m) because of their interconnectiveness. There are various culverts through PR 415, PR 229 and PR 518 which allow water to flow between the three lakes.

An economic analysis of each of these options has been conducted and the results are presented in Chapter 4.0.

Table 3.1: Actual Summer Water Levels vs Study Target Level
(See Appendix B for metric conversions)

Year	Actual Summer Water Level (Feet above sea level)	Amount Above (+) or Below (-) the Target Level (854.5 ASL)
1976	855.60	+1.10
1977	854.54	+0.04
1978	854.92	+0.42
1979	856.38	+1.88
1980	855.26	+0.76
1981	854.30	-0.20
1982	854.03	-0.47
1983	854.01	-0.49
1984	853.11	-1.39
1985	852.73	-1.77
1986	853.33	-1.17
1987	852.43	-2.07
1988	851.69	-2.81
1989	850.97	-3.53
1990	850.55	-3.95
1991	850.75	-3.75
1992	851.00	-3.50
1993	851.88	-2.62
1994	851.43	-3.07
1995	851.73	-2.77
1996	854.91	+0.41
1997	855.05	+0.55
1998	855.37	+0.87
1999	855.42	+0.92
2000	855.04	+0.54
2001	856.62	+2.12

3.1 Option 1 – North Shoal Lake, Northern Outlet

This channel would exit North Shoal Lake along the section line between sections 5 and 8, Twp 18, Rge 2W. From there it would extend westward under Ideal Road and along Shoal Lake Road approximately 14 miles (22 kms) to the community of Oak Point. There it would join an existing channel and empty into Lake Manitoba.

This channel would be designed to begin operation at a water elevation of 854.5 ft (260.45 m) ASL in North Shoal Lake. An estimated 2.29 million cubic yards (yd^3) (1.75 million cubic metres [m^3]) of excavation would be required as well as the installation of 12 road crossings and a number of field crossings. There would be a control structure at the inlet. Total estimated cost is $3,586,000.

Total drainage area of Option 1 is 191,013 ac (77,298 ha). A summary of land use and agricultural capability for the area is presented in Tables 3.2 and 3.3. Table 3.4 summarizes the percentage of the drainage area for this option by municipality.

Table 3.2: Land Use (1994) - Option 1

Type	Area		Percent
	Acres	Hectares	
Annual crops	3,770	1,526	2.0
Forages	4,261	1,724	2.2
Grass/Pasture	64,165	25,966	33.6
Trees/Shrubs	61,819	25,017	32.4
Water/Wetland	54,627	22,106	28.6
Urban/Transport	2,371	959	1.2
Total	191,013	77,298	100

Table 3.3: Agricultural Capability - Option 1

Rating	Area		Percent
	Acres	Hectares	
Class 2	783	317	0.4
Class 3-4	121,056	48,988	63.4
Class 5-7	52,757	21,350	27.6
Water/Organic	16,417	6,643	8.6
Total	191,013	77,298	100

Table 3.4: Approximate Drainage area by Municipality - Option 1

Municipality	Area		Percentage of drainage area
	Acres	Hectares	
Armstrong	101,165	40,939	53
Coldwell	45,447	18,391	24
St.Laurent	44,064	17,831	23
Rockwood	339	137	Less than 1
Woodlands	0	0	0
Total	191,013	77,298	100

3.2 Option 2 – North Shoal Lake, West Outlet

This outlet would begin on the west shore of North Shoal Lake between sections 20 and 29, Twp 17, Rge 2W, extend west under Ideal Road and along Wagon Creek Road to meet the Wagon Creek Drain, approximately eight miles (13 kms). From there the water would flow along Wagon Creek Drain to Lake Manitoba, another six miles (9.6 kms). This channel would begin operation at a water elevation of 854.5 ft (260.45 m) ASL in North Shoal Lake. There would be a control structure at the inlet.

Construction from North Shoal Lake to Wagon Creek Drain requires 1,376,000 yd^3 (1,052,000 m^3) of excavation. Excavation of approximately six miles (9.6 kms) of the Wagon Creek Drain along Wagon Creek Road to Lake Manitoba involves 325,700 yd^3 (249,000 m^3).

Total estimated cost of this option, including 12 road crossings and a number of field crossings is $2,688,000.

The total drainage area of Option 2 is 209,298 ac (84,698 ha). A summary of land use and agricultural capability for the area is presented in Tables 3.5 and 3.6. Table 3.7 summarizes the percentage of the drainage area for this option by municipality.

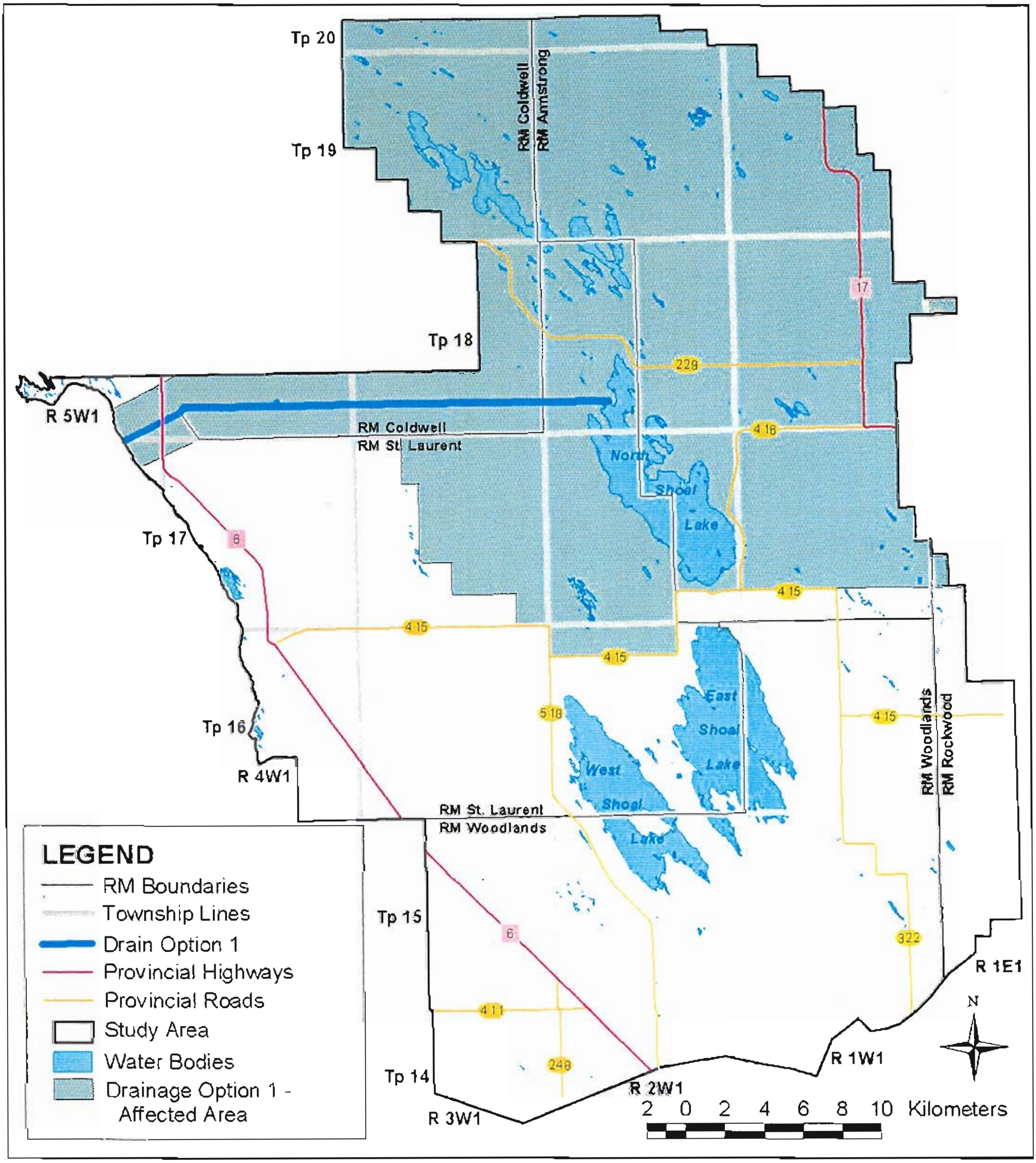


Figure 3.1: Drainage Option 1

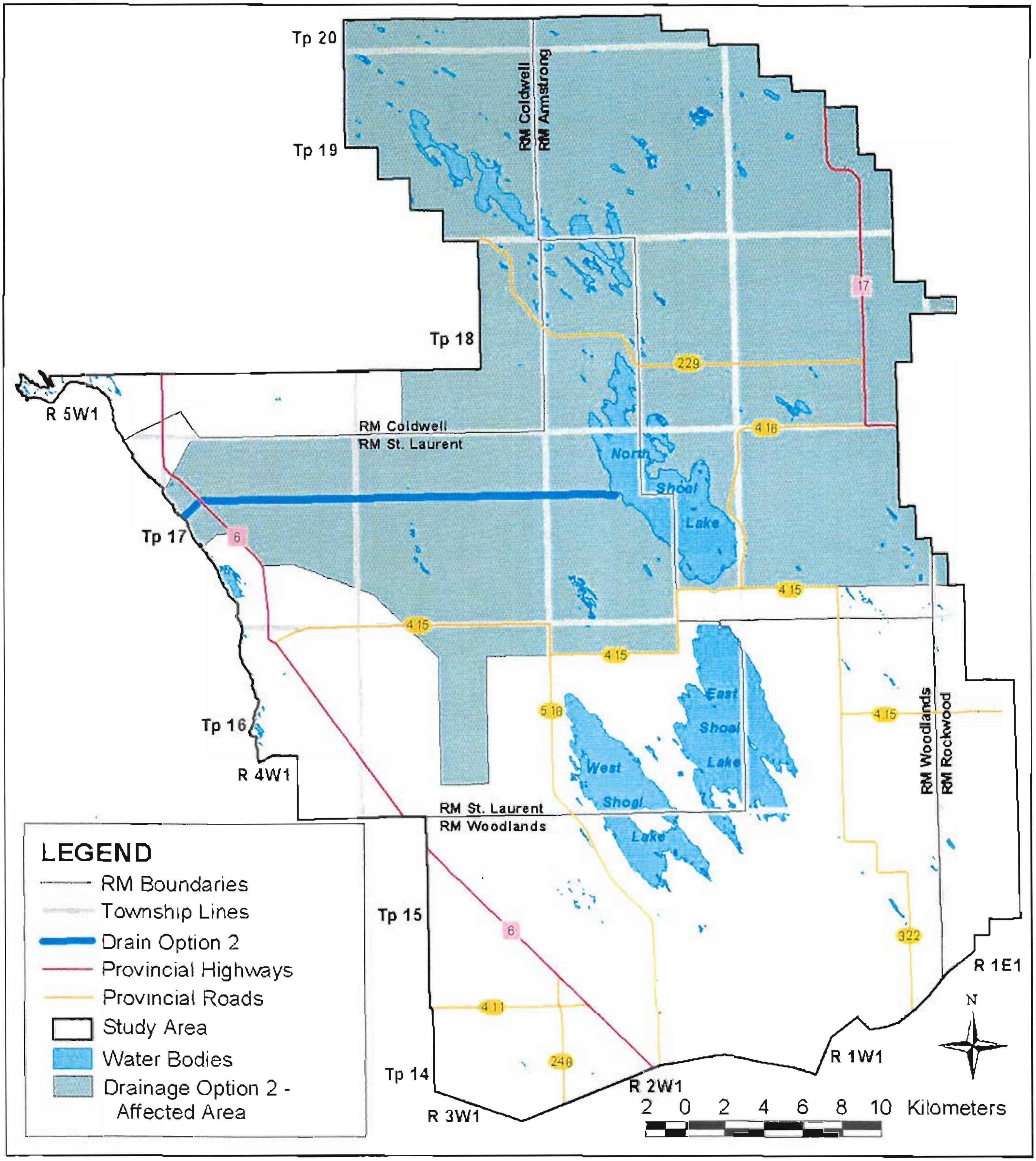


Figure 3.2: Drainage Option 2

Table 3.5: Land Use (1994) - Option 2

Type	Area		Percent
	Acres	Hectares	
Annual crops	4,810	1,947	2.3
Forages	4,993	2,021	2.4
Grass/Pasture	73,883	29,898	35.3
Trees/Shrubs	64,877	26,254	31.0
Water/Wetland	58,197	23,551	27.8
Urban/Transport	2,538	1,027	1.2
Total	209,298	84,698	100

Table 3.6: Agricultural Capability - Option 2

Rating	Area		Percent
	Acres	Hectares	
Class 2	670	271	0.3
Class 3-4	135,225	54,722	64.6
Class 5-7	56,986	23,061	27.2
Water/Organic	16,417	6,644	7.9
Total	209,298	84,698	100

Table 3.7: Approximate Drainage area by Municipality - Option 2

Municipality	Area		Percentage of drainage area
	Acres	Hectares	
Armstrong	101,165	40,939	48
Coldwell	34,890	14,119	17
St.Laurent	72,904	29,503	35
Rockwood	339	137	Less than 1
Woodlands*	0	0	0
Total	209,298	84,698	100

* The RM of Woodlands may receive some benefit from this option since it would allow the municipality to direct drainage waters into West Shoal Lake.

3.3 Option 3 – West Shoal Lake Outlet

The channel inlet would be located between sections 30 and 19, Twp 16, Rge 2W on West Shoal Lake. Then it would extend under Ideal Road about 2 ½ miles (4 kms) west along Gaudry Road to meet Wagon Creek Drain, then along Wagon Creek Drain to Lake Manitoba south of Oak Point. Total distance is about 16 miles (25 kms).

Construction from the lake to Wagon Creek Drain requires the excavation of 1,020,240 yd^3 (780,000 m^3) of earth. Upgrading approximately seven miles (11 kms) of Wagon Creek Drain from there to Wagon Creek Road requires 2,098,032 yd^3 (1,604,000 m^3) of excavation. Excavation of approximately six miles (9.6 kms) of channel along Wagon Creek Road to Lake Manitoba involves an additional 325,692 yd^3 (249,000 m^3). There would be a control structure at the inlet.

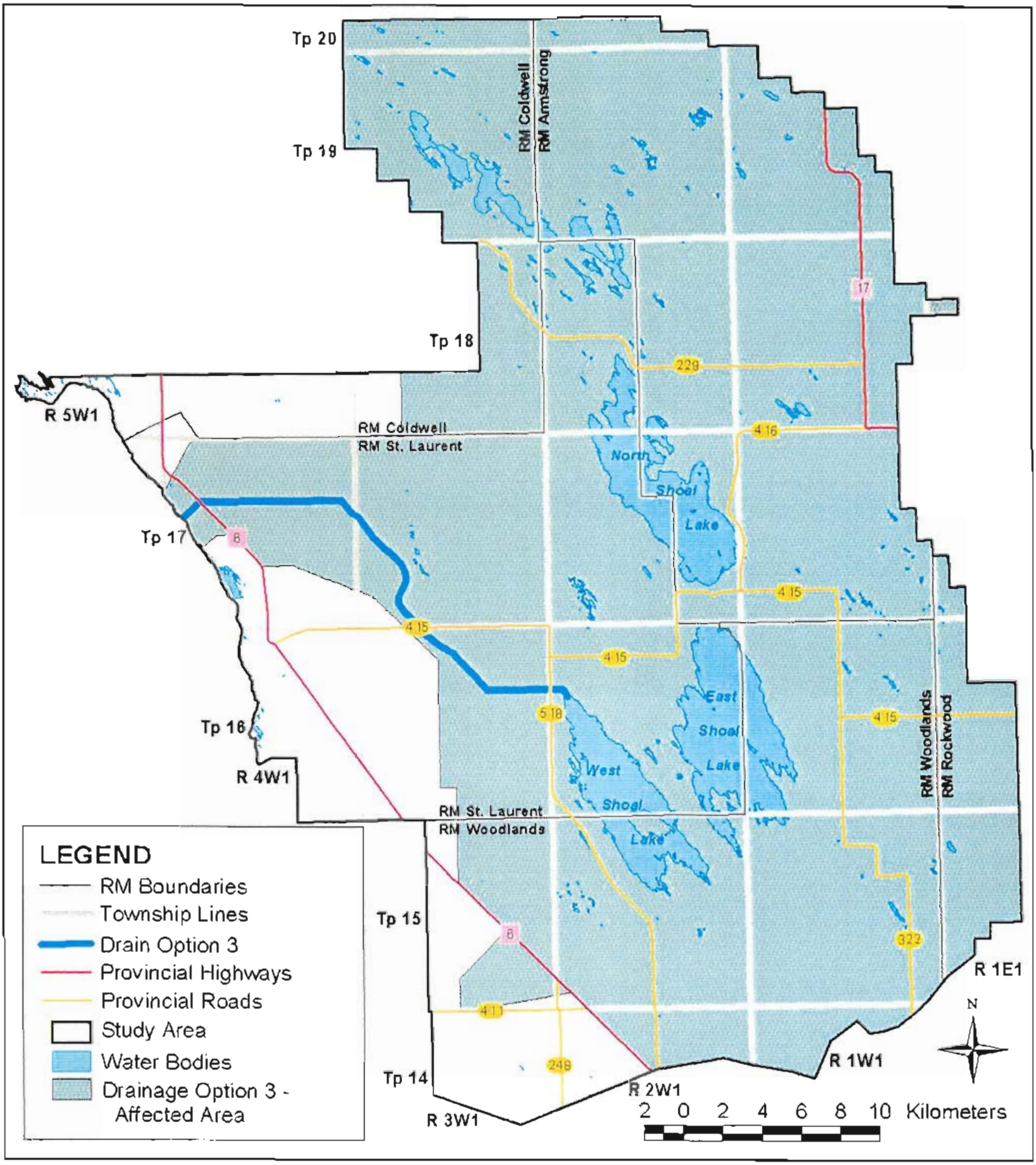


Figure 3.3: Drainage Option 3

The channel inlet would be designed to control water levels in West Shoal Lake at 852.0 ft (259.69 m) ASL. Operation of West Shoal Lake at this elevation would allow water levels in North Shoal Lake to be managed at 854.5 ft (260.45 m), and in East Shoal Lake at 853.0 ft (259.99 m).

The total estimated cost of construction, including 12 road crossings and a number of field crossings, is $4,114,000.

The total drainage area of Option 3 is 350,114 ac (141,683 ha). A summary of land use and agricultural capability for the area is presented in Tables 3.8 and 3.9. Table 3.10 summarizes the percentage of the drainage area for this option by municipality.

Table 3.8: Land Use (1994) - Option 3

Type	Area		Percent
	Acres	Hectares	
Annual crops	7,073	2,862	2.0
Forages	6,858	2,775	2.0
Grass/Pasture	123,212	49,861	35.2
Trees/Shrubs	101,758	41,179	29.1
Water/Wetland	107,232	43,395	30.6
Urban/Transport	3,981	1,611	1.1
Total	350,114	141,683	100

Table 3.9: Agricultural Capability - Option 3

Rating	Area		Percent
	Acres	Hectares	
Class 2	1,940	785	0.6
Class 3-4	208,479	84,367	59.5
Class 5-7	101,589	41,111	29.0
Water/Organic	38,106	15,420	10.9
Total	350,114	141,683	100

Table 3.10: Approximate Drainage area by Municipality - Option 3

Municipality	Area		Percentage of drainage area
	Acres	Hectares	
Armstrong	106,500	43,098	30
Coldwell	34,890	14,119	10
St.Laurent	101,363	41,019	29
Rockwood	15,996	6,473	5
Woodlands	91,365	36,974	26
Total	350,114	141,683	100

4.0 Project Benefits

4.1 Agriculture

The estimation of agricultural benefits for the proposed water control options was difficult due to the unavailability of detailed information. Subsequently, a number of assumptions were required in the analysis.

4.1.1 Agricultural Flood Damage Surveys

Manitoba Agriculture and Food (MAF) regional staff undertook two separate assessments of flood damages resulting from the high water levels in 2001. An August survey of Shoal Lakes area producers indicated that approximately 13,000 acres (ac) of agricultural lands were flooded, both public and private. These were lands not inundated in previous years. The acreage breakdown was as follows:

Native pasture	5,825 acres
Native hay	6,080 acres
Tame hay	1,010 acres
Tame pasture	120 acres
Total	13,035 acres

Editor's note: The analysis of benefits and costs for this study was conducted based on Imperial units (e.g. acres) and will be presented in that form. Acreage amounts and associated benefits/costs per acre may be converted to metric units (hectares/$ per hectare) using the formula: 1 hectare equals 2.4711 acres.

The second assessment was a specific survey of Crown Lands used for agriculture around North Shoal Lake. This survey identified 9,000 animal unit months (AUMs) of forages in hay and pasture lost to flooding in 2001, approximately 8000 ac, on 86 separate quarters of land. About 25 producers were directly impacted.

4.1.2 Valuation of Agricultural Damages

High water levels can lead to substantial reductions in agricultural production from lands in the Shoal Lakes area. This production is almost entirely in the form of pasture and hay for cattle. Reduced production causes uncertainty for farms that rely on these forages. Farmers must make untimely reductions in herd size and/or make emergency costly arrangements for alternative pasture and feed sources in flood years. This limits net farm income and development opportunity.

The survey of Crown Land parcels was used to estimate monetary damages per acre from the 2001 high water levels, as follows:

AUMs lost	9,000 AUMs
Tons of forage lost	3,600 tons
Acres of agricultural lands flooded	8,000 acres
Total value of forages ($49/ton[1])	$176,400
Average loss per acre	$22.05/acre
	Rounded to $22.00 per acre

(1 ton equals 2.5 AUMs)

[1] *2001 value for native hay, Manitoba Crop Insurance Corporation. An average transportation cost is included in this value by MCIC to compensate for the total cost of replacing lost or damaged production.*

Those farmland acres under water, waterlogged or inaccessible so that no production of any value could be achieved were assessed a damage of $22/acre, as calculated above. This totaled about 25,000 acres, and a total damage estimate of nearly $600,000.

Where there was a lesser damage because a partial crop could still be harvested, or pasture accessed later in the season, a value of $11/acre was assumed. Nearly 95,000 acres fell into this category for an estimated damage of just over one million dollars.

Acres were based on the land use situation from 1994 satellite imagery, with the total acreage affected estimated at approximately 120,000 acres. In this manner, a total damage of $1.6 million was estimated. This amount was also considered appropriate to represent the 1979 situation which had water levels only slightly lower than 2001.

To determine average annual damages to agriculture under the existing water regime, estimates were made of the damages and frequency of occurrence for three different levels of flooding:

Severe Floods: as represented by 1979 and 2001
Moderate Floods: as represented by 1976
Minor floods: as represented by 2000

No acreage data was available for the lower water levels associated with the floods of 1976 and 2000. The 1976 flood was subsequently assumed to cause one-half of the damages associated with the 2001 flood, $ 0.8 million, while the 2000 flood was assumed to be one-quarter of the 2001 flood damage, $0.4 million.

A review of the water level data for North Shoal Lakes (See Appendix B) provided a basis to estimate the probability of occurrence in any particular year for the three flooding situations - minor, moderate and severe (Table 4.1).

Table 4.1 Probability of Occurrence of Selected Floods

Elevations in feet (metres) above sea level (ASL)	Years in Period of Record	Probability of occurrence in any particular year	Total agricultural damages equal to or greater than
Total years in period of record (1976 to 2001)	26		
Number of years with agricultural damages	14	0.54	
Number of years with water levels of 855.0 ft (260.60 m) ASL or higher (2000 situation or worse)	8	0.31	$0.3 million
Number of years with water levels of 855.6 ft (260.79 m) ASL or higher (1976 situation or worse)	3	0.12	$0.6 million
Number of years with water levels of 856.4 ft (261.03 m) ASL or higher (1979/2001 situation or worse)	2	0.08	$1.6 million

Based on the damage amounts and the probabilities of occurrence presented above, an average annual damage of $375 thousand was estimated for agriculture[2].

[2] *A frequency-damage curve was prepared. To estimate average annual damages, the "area under the curve" was measured, and for this situation, average annual damages were in the order of $375,000. It is assumed that agricultural damages begin to occur at elevation 854.0 ASL.*

4.1.3 Project Benefits to Agriculture

Each proposal would reduce the level and frequency of flooding around the lakes, essentially controlling all but the largest floods for their benefiting area. Only floods of the serious magnitude (e.g. 1979 and 2001) would not be totally eliminated. Since it was not practical to develop detailed project design and hydrologic performance estimates, some assumptions were made in calculating agricultural benefits associated with each option.

For Option 3, the proposal that would benefit the largest area, it was subsequently assumed that a serious flood would only affect about 25,000 acres, and that the remaining damage would be at the reduced level of $11/acre. Assuming further that only floods having a probability of occurrence of less than 0.1 in any particular year would lead to a quantifiable agricultural damage, the average annual damages that cannot be prevented would be approximately $125,000.[3] Hence, the damages avoided, or project benefit, from Option 3 is equal to $250,000 ($375,000 minus $125,000). For Options 1 and 2, their benefiting area was 55% and 60% respectively of Option 3, and project benefits are reduced accordingly.

It was also assumed that agriculture productivity would be enhanced through the construction of any of the options. The reduced threat of flooding may encourage producers to apply better management practices such as improved crop varieties and the increased use of crop inputs. This factor has been assumed to provide an additional benefit equal to 5% of the flood damage reduction benefit.

4.2 Resources

Annual benefits related to wildlife, fisheries and other resources have not be estimated at this time.

4.3 Highways and Transportation

Annual benefits to Provincial highways and transportation systems are estimated at $25,000 for all of the options, based on average expenditures that would be avoided from savings in road and water crossing repair due to flooding. Additional benefits to local people and municipalities because of reduced damage to local infrastructure was estimated at one-half of the benefit to the Provincial system.

4.4 Project Benefit-Cost Comparisons

The Shoal Lakes area has experienced periods of both high and low water levels over the recent period of record. With any of the water control projects in place, the frequency and severity of damaging high water levels would be greatly reduced. This benefit, however, is provided at substantial capital cost, in the order of $2.6 to $4.1 million depending on the option selected. Table 4.2 presents preliminary estimates of costs and the design water level targets of each of the three options.

[3] As calculated using a revised frequency damage curve to represent remaining agricultural damages with the project in place.

Table 4.2 Project Costs and Design Targets

	Capital Cost (preliminary)	Design Water Level Target
Option 1	$3,586,000	To control water level in North Shoal Lake at 854.5 ft (260.45 m) ASL
Option 2	$2,688,000	To control water level in North Shoal Lake at 854.5 ft (260.45 m) ASL
Option 3	$4,114,000	To control water level in West Shoal Lake at 852.0 ft (259.69 m) ASL, and East and North Shoal Lakes at 853.0 ft (259.99 m) and 854.5 ft (260.45 m).

Table 4.3 Benefit-Cost Summary

		Option 1	Option 2	Option 3
Benefits	Average annual benefit			
	Agriculture - flood damage reduction	$137,500	$150,000	$250,000
	- enhanced productivity	$6,875	$7,500	$12,500
	Resources	-	-	-
	Transporatation - Provincial	$25,000	$25,000	$25,000
	- local	$12,500	$12,500	$12,500
	Total average annual benefits	$181,875	$195,000	$300,000
	Present Worth of All Benefits	$3,320,296	$3,559,905	$5,476,778
Costs	Capital	$3,586,000	$2,688,000	$4,114,000
	Annual operating and maintenance	$71,720	$53,760	$82,280
	Present Worth of operating and maintenance	$1,309,315	$981,439	$1,502,098
	Present Worth of All Costs	$4,895,315	$3,669,439	$5,616,098
Net Benefit		($1,575,019)	($109,533)	($139,320)
Benefit-Cost Ratio		0.68	0.97	0.98

Standard benefit-cost analysis procedure was used to assess the economic feasibility of the three water control alternatives. Project benefits are the reduction in damages or potential net returns that would be realized. To compare project capital costs to benefits, the present worth (capitalized value) of all future benefits was calculated, using a 50-year project life and an interest rate of 5%. Costs of annual operating and maintenance expenditures should also be taken into account, and was assumed at 2% of capital cost. The benefit-cost summary for the three options is shown in Table 4.3 above.

Option 1 has a benefit-cost ratio of substantially less than 1.0, indicating it should not be considered to be economically feasible based on the assumptions and analysis described in this report.

Options 2 and 3 both have ratios essentially equal to 1.0, that is, project benefits are sufficiently large to cover costs. Therefore, they could be considered marginally feasible from an economic perspective. However, there is no surplus net benefit in case of, for example, increased project costs, or benefits that have been overestimated. The choice between these two, and whether or not further consideration for implementation is merited, should therefore be based on factors such as budget availability, unquantified benefits and costs, and the reasonableness of assumptions underlying the analysis.

5.0 Conclusions

The intent of this preliminary investigation was to determine whether any options for controlling water levels in the Shoal Lakes are economically viable enough to warrant further, more detailed examination. Three options were considered as described earlier in this report.

The cost of constructing each option was compared to the estimated benefits to agriculture and the infrastructure in the area to determine a preliminary benefit-cost ratio. Ratios less than 1.0 indicate that costs exceed benefits; more than 1.0, benefits exceed costs. In this investigation, one project showed a benefit-cost ratio considerably less than 1.0 while the remaining two had ratios essentially equal to 1.0. However, it is important to note that benefits to wildlife and other resources have not been considered in these analyses. In addition, there may be benefits associated with opportunities such as rural residential and other non-agricultural developments that have not been considered in this evaluation. Also, a number of assumptions have been made in the calculations that may be re-considered with further review.

Option 1, with a benefit-cost ratio in the order of 0.70, is likely not worthy of further consideration. However, Options 2 and 3, with ratios essentially equivalent to 1.0 warrant more detailed consideration.

The included municipalities, through an organization such as the Western Interlake Water Management Association, should consider public consultation on this issue. The purpose of this action would be three-fold. First, it would determine whether the will exists among ratepayers to pursue the matter further. Secondly, it would establish the level of financial commitment locally to fund the project. Finally, it would allow public comment and input concerning the proposed projects, and perhaps result in identifying one of the proposals as the single focus for further consideration.

If local support is evident and confirmed, the Province should be approached to determine its level of participation. Before a particular solution to the flooding issue is chosen, an environmental assessment of any proposals is required. Funding for this undertaking would need to be secured prior to its commencement. Other prospective partners, such as Ducks Unlimited Canada, could also be approached and asked to contribute to the process.

An environmental assessment would examine the proposals in greater detail than has been conducted to this point, and include benefits that would accrue to wildlife, other resources and to the community at large.

Appendix A

Shoal lakes Water Management Investigation Ad Hoc Study Group

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Appendix B

Shoal Lakes Water Levels
North Shoal Lake, near Inwood
Summer Levels

Year	Target level*		Actual levels*		Deviation from Target Level		Change from Previous Year	
	Feet	Metres	Feet	Metres	Feet	Metres	Feet	Metres
1976	854.5	260.45	855.60	260.79	1.10	0.34		
1977	854.5	260.45	854.54	260.46	0.04	0.01	-1.06	-0.33
1978	854.5	260.45	854.92	260.58	0.42	0.13	0.38	0.12
1979	854.5	260.45	856.38	261.02	1.88	0.57	1.46	0.44
1980	854.5	260.45	855.26	260.68	0.76	0.23	-1.12	-0.34
1981	854.5	260.45	854.30	260.39	-0.20	-0.06	-0.96	-0.29
1982	854.5	260.45	854.03	260.31	-0.47	-0.14	-0.27	-0.08
1983	854.5	260.45	854.01	260.30	-0.49	-0.15	-0.02	-0.01
1984	854.5	260.45	853.11	260.03	-1.39	-0.42	-0.90	-0.27
1985	854.5	260.45	852.73	259.91	-1.77	-0.54	-0.38	-0.12
1986	854.5	260.45	853.33	260.09	-1.17	-0.36	0.60	0.18
1987	854.5	260.45	852.43	259.82	-2.07	-0.63	-0.90	-0.27
1988	854.5	260.45	851.69	259.60	-2.81	-0.85	-0.74	-0.22
1989	854.5	260.45	850.97	259.38	-3.53	-1.07	-0.72	-0.22
1990	854.5	260.45	850.55	259.25	-3.95	-1.20	-0.42	-0.13
1991	854.5	260.45	850.75	259.31	-3.75	-1.14	0.20	0.06
1992	854.5	260.45	851.00	259.38	-3.50	-1.07	0.25	0.07
1993	854.5	260.45	851.88	259.65	-2.62	-0.80	0.88	0.27
1994	854.5	260.45	851.43	259.52	-3.07	-0.93	-0.45	-0.13
1995	854.5	260.45	851.73	259.61	-2.77	-0.84	0.30	0.09
1996	854.5	260.45	854.91	260.58	0.41	0.13	3.18	0.97
1997	854.5	260.45	855.05	260.62	0.55	0.17	0.14	0.04
1998	854.5	260.45	855.37	260.72	0.87	0.27	0.32	0.10
1999	854.5	260.45	855.42	260.73	0.92	0.28	0.05	0.01
2000	854.5	260.45	855.04	260.62	0.54	0.17	-0.38	-0.11
2001	854.5	260.45	856.62	261.10	2.12	0.65	1.58	0.48

*All elevations are expressed in feet/metres above sea level. Metric values have been rounded.

Appendix C

Manitoba Water Policies Summary

1. WATER QUALITY

To protect and enhance our aquatic ecosystems by ensuring that surface water and ground water quality is adequate for all designated uses and ecosystem needs.

Policy 1.1 - The "Manitoba Surface Water Quality Objectives" shall be adopted and implemented to protect water uses for Manitobans.
Policy 1.2 - Water quality shall be enhanced through the management of water resources.
Policy 1.3 - Water quality enhancement programs shall be designed to restore environmental quality, as well as deliver economic, cultural, and heritage benefits to Manitobans.
Policy 1.4 - The quality of wastewater discharges shall be improved and non-point sources of pollution decreased to achieve water quality objectives.
Policy 1.5 - Pollution control programs shall be designed in consultation with affected user groups and, where possible, implemented in such a manner as to cause minimum disruption to established land and water uses.

2. CONSERVATION

To conserve and manage the lakes, rivers, and wetlands of Manitoba so as to protect the ability of the environment to sustain life and provide environmental, economic, and aesthetic benefits to existing and future generations.

Policy 2.1 - River, lake, and shoreland habitat and the general environmental, subsistence, and economic values of rivers, lakes, and wetlands shall, where possible, be conserved.
Policy 2.2 - Soil conservation, wetland retention, and the application of appropriate land use practices shall be promoted primarily by the provision of incentives, but with regulation where required, not only as essential elements of water conservation and protection, but also as key measures to reduce siltation impacts, downstream flooding, and non-point source pollution.
Policy 2.3 - Those waterways whose cultural, natural, and/or recreational values are of provincial or national significance shall be given special consideration.
Policy 2.4 - Water retention, and control and timing of runoff, shall be promoted as part of watershed management.

3. USE & ALLOCATION

To ensure the long-term sustainability of the province's surface water and ground water for the benefit of all Manitobans.

Policy 3.1 - Economic well-being and sustainability shall be the goal in the allocation and utilization of Manitoba's water resources for consumptive and instream uses.
Policy 3.2 - Water management priorities shall be determined through a basin planning process that takes into account the protection of potable water supplies, environmental integrity, existing commit-ments, and economic requirements.

Policy 3.3 - Ground water development and utilization shall be managed so that the long-term sustainability of aquifers is achieved and existing uses are not negatively impacted.
Policy 3.4 - Surface water shall be man-aged to ensure sustainability of supplies.
Policy 3.5 - Transfer of untreated water across the Continental Divide (to or from the Hudson Bay drainage area) shall be opposed. Transfers within the Hudson Bay drainage area shall be minimized and only considered after a complete assessment of the environmental, social, and economic impacts on the donor and receiving basins.

4. WATER SUPPLY

To develop and manage the province's water resources to ensure that water is available to meet priority needs and to support sustainable economic develop-ment and environmental quality.

Policy 4.1 - Demand management pro-grams shall be implemented to conserve water and reduce the requirements for new water supply infrastructure.
Policy 4.2 - Irrigation, industrial, and other development proposals involving direct or indirect water use shall consider impacts on existing and potential water uses as well as impacts on the environment.
Policy 4.3 - The cost of developing, oper-ating, and maintaining the water resource infrastructure shall be apportioned among the beneficiaries in accordance with their share of the benefits.
Policy 4.4 - Pristine and potable water sources shall be afforded special protection.

5. FLOODING

To alleviate human suffering and mini-mize the economic costs of damages caused by flooding.
Policy 5.1 - Development on land subject to flooding or other water related hazards shall occur only under planning guidelines which prevent human suffering and property damage, limit public costs and liabil-ities, and address environmental impacts.
Policy 5.2 - Economically viable measures to alleviate personal and property damage to existing development in flood prone areas shall be fostered.
Policy 5.3 - The negative impacts of changes to water level and flow regimes caused by hydro-electric development projects shall be mitigated to the extent possible.

6. DRAINAGE

To enhance the economic viability of Manitoba's agricultural community through the provision of a comprehen-sively planned drainage infrastructure.

Policy 6.1 - Drainage works shall be designed to remove excess rainfall from cropland during the growing season.
Policy 6.2 - The standard of drainage shall be based on the production capability of the soil and on technical, economic, and environmental criteria, recognizing watershed, community, and farm impacts.
Policy 6.3 - Maintenance of existing drainage systems shall be of higher priority than reconstruction.
Policy 6.4 - Reconstruction of drainage systems to improve productivity and to reduce erosion and deposition shall be given a higher priority than expansion into new agricultural lands.
Policy 6.5 - Drainage projects shall be planned and executed so that projects in one area do not adversely affect another area.

Policy 6.6 - The protection of wetlands shall be a consideration in planning and developing drainage projects.
Policy 6.7 - Water retention, and control and timing of runoff, shall be promoted as part of watershed management.

7. EDUCATION

To enhance the awareness and knowledge of Manitoba's water resources.

Policy 7.1 - Schools: -Students of all ages shall be provided with information on the significance of Manitoba's water resources.
Policy 7.2 - General Public: Education on water matters shall be achieved in part through the sharing of information, demonstration projects, and the involvement of the general public.
Policy 7.3 - Forum for Scientific and Technical Input: A forum shall be developed to obtain input from the scientific, technical, and professional communities on water management issues.
Policy 7.4 - Community Leaders and Elected Representatives: Community leaders and elected representatives shall be provided with the information they need to make sound water management decisions.