WCSM input to Westlake watershed characterization report

Surface water management in the Westlake watershed tends to consist largely of agricultural drainage in the northern part of the watershed near Magnet and Freedale, where there are man-made drains to accommodate agricultural needs with a flow pattern from south to north. Similarly, there is significant agricultural drainage infrastructure in the southern part of the watershed, east of PTH 50, and south of the community of Alonsa, where flow patterns are mostly west to east. The rest of this watershed is typically characterized by natural retention areas with various small to large-sized lakes and natural waterways, with just a few man-made drains (such as Lonely Lake Drain). In this portion of the watershed are located some man-made enhancements to the natural retention areas.

Because artificial drainage for agricultural purposes is such a significant surface water management feature in portions of the watershed, agricultural drainage in more general terms will be described prior to a description of the surface water management in the Westlake watershed more specifically.

Agricultural Drainage: General Description

<u>Need for Drainage:</u>

Agricultural cereal and specialty crops such as wheat, canola, peas and sunflowers can be successfully grown only in the parts of Manitoba where the climate and soil conditions are favourable, and where there is adequate drainage to remove the excess rainwater’s from periodic heavy summer rainstorms. If excess summer rainwater’s pond on the cropland for too long, the agricultural plants are deprived of oxygen and are damaged or destroyed. The climate is favourable and the soils are of sufficient fertility in large portions of southern Manitoba, in what is generally called “agro Manitoba”. These portions include much of western and southern Manitoba, and the southern 2/3’s of the Interlake region. However, only a part of agro-Manitoba has natural features which result in the removal of summer rainwaters in a timely manner. In much of agro-Manitoba, the natural draining away of excess summer rainwater’s is slow or virtually non-existent. In many of these areas, the soils are relatively dense, so there is limited percolation of excess rainwater downward into the soil column. As well, the topography might be quite flat, or has a ridge and swale or similar nature, so the only significant natural drainage that occurs is on the relatively small areas along ridges, or near the natural streams. For these reasons, thousands of miles of artificial drains have been constructed in these areas over the last 150 years, in order to augment the limited natural drainage that occurs. Of the 4.7 million hectares of cropland in Manitoba, 1 million hectares could sustain no crop production without artificial drainage, and an additional 1.2 million hectares of crop land benefits to varying degrees from that artificial drainage. This artificial drainage, by reducing damages to croplands, has the added benefit of reducing the payments made by Federal-Provincial crop insurance programs.

The artificial drains also have a number of secondary benefits. In the spring time, the drains help drain away snowmelt runoff, thereby reducing the risk of flooding to some rural residences and communities. As well, the length of time that the snowmelt runoff ponds against the embankments of municipal or provincial roads is greatly reduced, thereby minimizing the damage to these embankments. These same secondary benefits occur following unusually heavy summer rainstorms, where the drains are overwhelmed and significant flooding and ponding occurs on the landscape.

Waterways in Manitoba are classified from 1st order to 7th order, with 1st order being the smallest and 7th order being the largest. Municipalities, towns and villages typically maintain all 1st, 2nd, and some 3rd order artificial drains, whereas the Province of Manitoba typically manages and maintains most of the 3rd order and higher order artificial drains.

Drainage Standard:

When Provincial waterway drains are enlarged, the principal issue to resolve is the size that the drain should be enlarged to; the methodology or formula used for determining that size is commonly called the design standard. This same issue arises in some rehabilitation (also called reconstruction) projects, when the land use in the area serviced by the drain has changed since the drain was originally constructed or since the last time the drain was rehabilitated. In such situations, the guiding principle is to have an economically sound balance between the cost of the enlargement and the benefits of that enlargement; the benefits are the reduction in the damages to the adjacent crops. These damages occur due to excess summer rainwaters ponding on the cropland, and the damages are reduced when excess summer rainwaters are removed more quickly by larger drains which have larger water-carrying capacities. However, even in areas with larger drains, damages to the agricultural cropland from summer flooding still occur periodically. In a wet cycle, those damages will occur more often. In an exceptionally wet, rainy year like 2009, damages will be widespread and extensive; the drainage system is not designed to protect against such wet summers and to convey unusual flood events.

A number of factors come into play in the determination of the cost-benefit balance. One factor is related to crop type. The benefits are larger for higher-value crops like peas, sunflowers and sugar beets, as compared to lower value crops like hays and forages. As well, many special, high-value crops are more quickly damaged by excess rainwater's ponding on the cropland, so, to be viable; they must be drained by a drainage network with a higher water-carrying capacity. Cereal crops are less quickly damaged, and forage crops even less quickly. Another factor is related to soil type. Excess summer rainwater's percolate downward quite slowly where there are dense soils. Therefore, areas with dense clay soils require larger drains, because so little of the rainwaters percolate downwards. A third factor is related to topography. Areas that are especially flat require larger drains because the velocity of the water within the drains in flat areas is quite low. In steeper areas, the velocity is higher, and so smaller drains can convey the same amount of water.

Responsibility for Drainage**:**

Responsibility for agricultural drains is split among farmers, municipal governments, four conservation districts (i.e. Whitemud, Turtle River, Alonsa, and Cook's Creek), and the Provincial government. In all cases, responsibility for the drains includes responsibility for the bridge or culvert road crossings on the drains. The exception to this is crossings for Provincial Roads (PR's) and Provincial Trunk Highways (PTH's), which are the responsibility of Manitoba Infrastructure and Transportation (MIT). Agricultural producers are responsible for maintenance and new construction of drains located on their land; this includes funding of those works. The four conservation districts have authority over and are responsible for maintenance and new construction of off-farm drains located within their districts. Outside of these four conservation districts, municipalities have authority over the off-farm drains which feed into the larger collector drains; these municipal drains are the 1st and 2nd order drains, and some 3rd order drains. Outside of the four conservation districts, the Provincial Government is responsible for the network of larger drains that serve as collectors for the local governments' drains. The largest of the Provincial drains typically exit into rivers or lakes. The drains under Provincial jurisdiction are formally designated as "Provincial waterways". Most natural streams like the Red River and the Assiniboine River are not Provincial waterways, and are also not the responsibility of the local governments. Regarding the larger drains within the four conservation districts, these drains had been Provincial Waterways until the late 1980's and early 1990's, when the authority for these drains had been transferred to the four conservation districts. Currently, the Province is in the process of evaluating whether the jurisdiction and responsibility for these drains go back to the Province.

Drainage Licensing**:**

All work on upgrading or constructing of drains by agricultural producers and municipal governments is subject to the provisions of *The Water Rights Act*. All works under Provincial jurisdiction are exempt from this Act, including all Provincial waterways and all road-side ditches constructed by MIT. However, they are constructed and maintained under the intent of the Act. This Act is intended to minimize or eliminate any negative impacts of drainage works on downstream landowners or jurisdictions, and any negative environmental impacts.

Maintenance and Reconstruction:

In all of Manitoba, there are approximately 4,350 km (2,700 miles) of Provincial waterway drains, and 650 bridge crossings and 1,500 large culvert crossings related to these drains. This infrastructure has a replacement value of well over $1 billion.

Like all physical structures, the drains and crossings that make up the Provincial waterways network require periodic maintenance. Maintenance activities include things like mowing the vegetated side slopes and banks, mowing or removing larger vegetative growth in the drain bottom, removing debris and areas of silt in the drain bottom, re-shaping short reaches of slumping and sliding side slopes and banks, repairing eroded road grades at culvert crossings, repairing damaged culverts, and repairing or replacing damaged planks or other elements of bridge crossings.

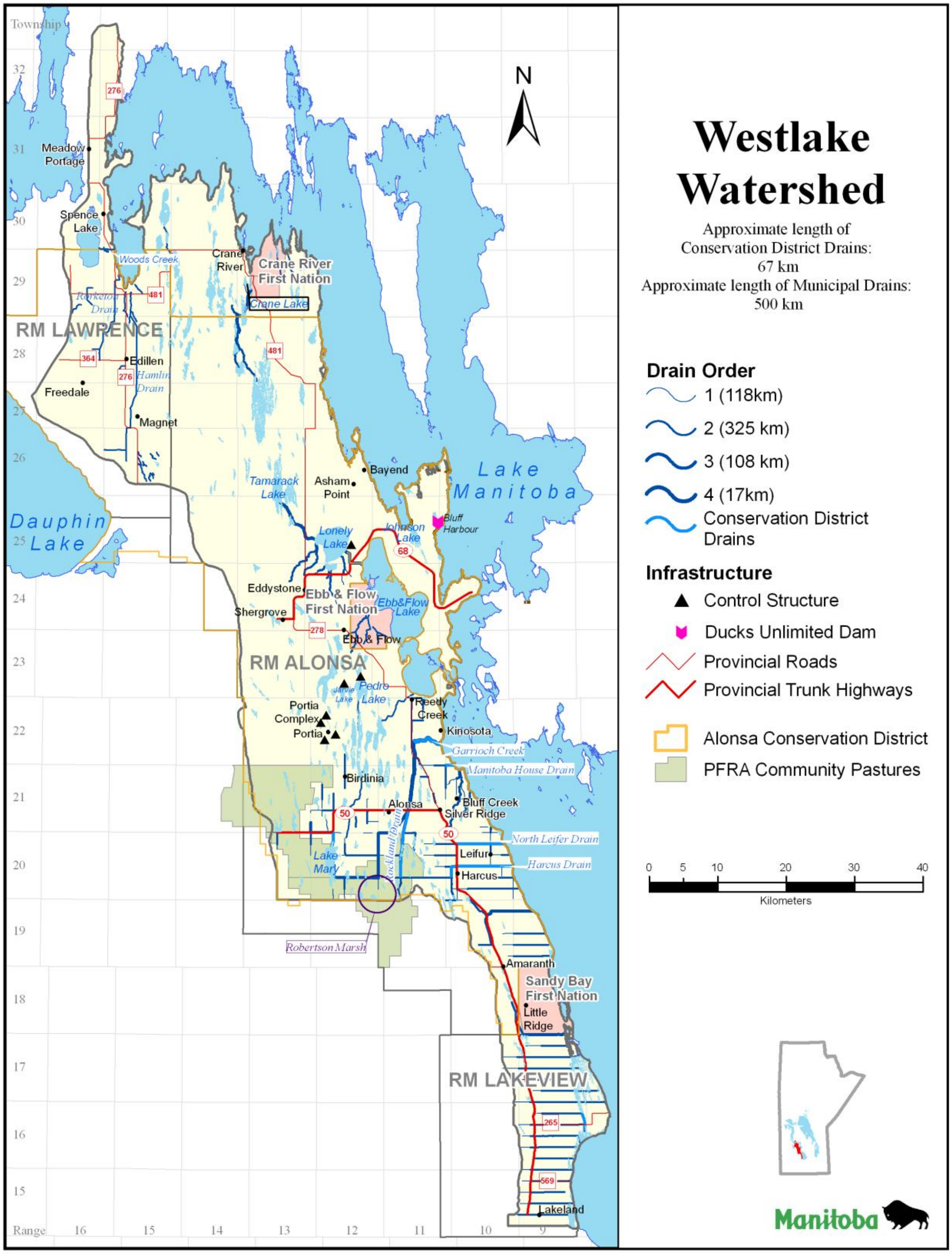
Sometimes drains deteriorate to such a point that normal maintenance activities are not sufficient to restore their water-carrying capacity and proper functioning. This can happen because of the effects of things like unusually destructive summer or spring flood events. When such deterioration occurs, the drains must be reconstructed to restore their water-carrying capacity. Reconstruction activities include works such as the removal of channel-bottom silt; the removal of the soil from caved-in and sliding bank slopes, then the re-shaping of the drain's side slopes; and the replacement of bridges or culverts that have badly deteriorated and cannot be repaired, or that do not meet modern load ratings or width and dimension requirements of the modern, larger and heavier farm equipment. As with maintenance works, reconstruction works on culvert and bridge crossings can be needed for address public health and safety concerns, and so may need to be undertaken irrespective of the condition of the agricultural drains that they cross.

Environmental Criteria in Drain Reconstruction:

In the reconstruction of Provincial waterways, a number of environmental criteria are considered. Drain flow velocities are kept low enough to prevent erosion from occurring in the drainage channel (drop structures may be needed to effect this, and rock rip rap may be placed where velocities might still be erosive). Drain side slopes are made 1 vertical to 3 horizontal, or flatter, to reduce the chance of slumping of the drain channel's sides.

Features required by the Department of Fisheries and Oceans are incorporated into the drain upgrade (e.g., larger culvert crossings, rock rip rap placed within the channel). Drains are upgraded from downstream to upstream, to ensure that downstream reaches can accommodate any increased flows due to upstream improvements.

<u>**Surface Water Control Infrastructure in Westlake Watershed**</u>



This watershed is located on the western shore of Lake Manitoba. The land generally slopes in a northeasterly direction to Lake Manitoba. In this watershed, there are numerous low Lake Agassiz beach ridges oriented in a northwesterly direction, with swales located between the ridges. These ridges form barriers to flow that would normally flow in a northeastern direction, and to drainage of low-lying marshy tracts between the ridges. Some of these ridges are composed of sand and gravel and are ancient beaches that continue for long distances. Other low ridges are boulder clay. The Kinosota ridge, for example, acts as a north-south route with dry land, with access to Lake Manitoba; PTH 50 is located on this ridge. Surface water runoff is initially concentrated in the swales between the ridges, in the majority of this watershed. Once the depressions in the swales are filled with surface water, intermittent streams are formed, which generally convey runoff northward. If a swale encounters an obstruction such as beach ridge, a delay in flow is caused until sufficient head is built up to overcome the obstruction or change its course of direction.

Natural waterways, waterways that have been artificially enlarged and reconstructed, and man-made drains have been categorized by order numbers by the Provincial water resource specialists. The smaller order numbers are for smaller waterways and drains, and the larger order numbers are for the larger waterways and drains. There are about 118 km of 1st order, 325 km of 2nd order, 108 km of 3rd order, and 17 km of 4th order waterways and drains in this watershed. Alonsa Conservation District (ACD) manages 3rd order and higher drains in this watershed. There are about 67 km of ACD drains and 500 km of municipal drains in the watershed. If the Province decides to resume jurisdiction for the larger drains in the watershed, the actual length of these drains will need to be calculated at that time.

There are man-made drains (and the natural waterways that have been artificially enhanced and reconstructed) in different parts of the watershed, to convey excess summer time agricultural flows, to enable the production of agricultural crops, livestock operations, and enhance farming practices generally. Such drains are needed because, as noted earlier, the natural drainage is very poor in most areas of the watershed. As in many parts of this region and other parts of Manitoba, excessive vegetative growth in the drains and waterways, as well as beaver dams, often reduces the conveyance capabilities of the drains and waterways. The majority of the man-made and natural drains in the central and northern parts of this watershed are comprised of the Rorketon Drain, Hamlin Drain, Crane River, Lonely Lake, Sucker Creek, and Reedy Creek. The primary purpose of most of the man-made drains is to accommodate agricultural flows. For example, in the northwest portion of this watershed, Hamlin Drain and Rorketon Drain carry agricultural flows to the north into Lake Manitoba. In the southern part of this watershed, the man-made drains flow from west to east (east of PTH 50), such as Bruce Drain, Manitoba House Drain, North Leifer Drain, Harcus Drain, Kjartanson Drain, Smalley School Drain, and Carriere Drain. Some of these west-east drains have excessive erosion in the steeper reaches near to Lake Manitoba, and some require gradient control drop structures to reduce the drain gradients and water velocities. The Amaranth Marsh Drain flows parallel to PTH 50 on the west side, then crosses through the highway and flows east to Lake Manitoba.

In this watershed, there are a number of drains that were reconstructed to allow for lake outlets to convey high lake water more efficiently, to minimize crop and other damages along the lakes. For example, in the central eastern part of this watershed, Lagimodiere Drain is an outlet channel for Tamarack Lake, carrying flows to Lonely Lake; Lonely Lake Drain conveys the outflows from Lonely Lake to Ebb and Flow Lake. There are some drains that convey flows into Lonely Lake, such as Infrastructure Drain and Malenvin Drain. Sucker Creek and Reedy Creek convey flows into Ebb and Flow Lake. In the PFRA community pasture area (south west of the town of Alonsa), Garrioch Creek conveys excess flows from Lake Mary.

This watershed has three Indian Reserves (Ebb and Flow, Crane River, and Sandy Bay), with each having drainage infrastructure passing through or beside the reserves. Ebb and Flow Indian Reserve is in the central-eastern part of this watershed. Sucker Creek flows through this reserve and exits into Ebb and Flow Lake. Crane River Indian Reserve is in the northern eastern part of this watershed. Crane River flows along the western boundary of this reserve and merges into Crane Bay. Sandy Bay Indian Reserve is in the southern-eastern part of this watershed and beside Lake Manitoba. A portion of Amaranth Marsh Drain flows through this reserve.

Retention: The topography of much of the watershed is ridges/swales and the watershed contains many areas of marsh and bog. Because of this topography, there are many natural water retention lakes in this watershed such as Lake Mary, Pedro Lake, Ebb and Flow Lake, Lonely Lake, Tamarack Lake, Primes Lake, Salt Lake, Sykes Lake, Martin Lake, Micawber Lake, Oliver Lake, Steeprock Lake, Claude Lake, Yankee Lake, Ronald Lake, Johnson Lake, and Reykjavik Lake. Some of the natural retention lakes have been enhanced by man-made structures and infrastructure, as described below.

Lonely Lake is a large (about 21 square km) shallow (1.25 m maximum depth) lake with very gentle sloping silt and clay shoreline. At Lonely Lake, the Provincial government built an overflow weir and a control structure in the beach ridge at the lake's outlet. The weir was designed and constructed by the Province for the Alonsa Conservation District. The weir is a sheet piling and rock fill structure. The control structure consists of three arch corrugated metal pipes, each with a stop-log chamber. A pilot channel was excavated from within the lake to the control structure and from there to the outlet channel to facilitate periodic drawdown. About 11,000 m of level ditching was excavated in the peripheral marshes situated at the north and south ends of the lake. This ditching provides stretches of open water and enables periodic drawdown of these marshes. This control of water on Lonely Lake enables Ducks Unlimited (DU) to proceed with habitat improvement for waterfowl in the area. In addition, the regulation of the Lake provides a degree of flood control that has enhanced the surrounding lands for hay and grazing.

DU developed the Portia Complex in this watershed, which consists of eight basins: Long Lake, Last Lake, Pedro Lake, Horsejaw Lake, Jarvies Lake, Pedro Lake, Bulas Lake, and West Bulas Lake. Water is supplied to the complex by runoff from a gross drainage area of about 200 km^2. Drainage originates from the south, east and west of the complex. The complex is divided into 13 independently controlled cells. Each cell has a variable water level control structure to permit operations such as full gravity draw down and refill. Flow from the control structure is handled by Reedy Creek in the east half of the complex and Sucker Creek in the western portion. There are control structures at Jarvie and Pedro Lakes for habitat improvement for waterfowl in the area. The water levels are controlled using fixed crest weirs to pass high flows and stop-logged culverts to provide a variable control feature at low flows. A fish screen was placed at the outlet structure of Pedro Lake to keep out predatory fish and carp.

DU also built a dam at Bluff Harbour to control the extreme water level fluctuations on this area. In addition to this dam, about 3,000 m long dike was constructed. The height of the dike varies from about 0.3 m to 4 m, where the dike crosses the inlet channel. A variable type control was located through the dam which consisted of 50 to 900 mm diameter round pipes fitted with slide gates and removable carp screens.

Flooding: As in most other parts of Manitoba, there are many low-lying areas within this watershed that are adversely affected by springtime flooding due to snowmelt and, sometimes, coincident rainfalls, and by summertime flooding following unusually heavy rainfalls. Such flooding has caused significant damages to roads and road crossings in the past, and to some especially low-lying buildings and structures. Significant summer floods have also negatively affected agricultural cropland, and livestock operations through things like reductions in animal grazing days, damaging hay fields and hay stacks, and delaying hay production. Excessive vegetative growth and beaver dams aggravate flooding problems along drains and waterways, and high lake levels following significant spring or summer runoffs can cause flooding problems to adjacent lands.

One of the more significant spring flood events occurred in the spring of 1979. A significant runoff event occurred as a result of rainfall occurring near the peak of snowmelt runoff. With snowmelt reducing the available surface water storage capability of this watershed, the rain greatly exacerbated runoff conditions. Consequently, severe flooding occurred. A number of roads and crossing infrastructure was damaged and washed out. The areas and drains impacted were Lonely Lake area, Cayer area, Sucker Creek, Harcus Drain, Smalley School Drain, Crane River, and Reedy Creek, as well as other areas.

With respect to summer flooding due to unusually heavy rainstorms, the most recent occurrence of such summer flooding occurred in September of 2009. A relatively small but very intense rainstorm brought up to 275 mm of rain to an area between Dauphin Lake and Lake Manitoba. The Cayer area of the RM of Alonsa was the hardest hit with reporting 275 mm, with 125 mm falling in a 70 minute period. This is about twice the 100 year return period rainfall for 70 minutes in the area. The torrential rain had caused heavy runoff, with water overtopping municipal roads in many areas. PR 481 from Eddystone to Cayer had been closed due to flooding. PTH 68 remained open but heavy flows in ditches along the highway was overtopping many roads and lanes. Low fields in the heavy rain area were flooded.

Some areas along Lake Manitoba are sometimes negatively affected when lake levels are high. The lake levels are regulated to some degree by Faiford Dam, but in years when inflows from Lake Winnipegosis, local tributaries (like the Whitemud River) and the Portage Diversion high, lake levels go up and cause some flooding of some adjacent lands.

Criteria to Prioritize Proposed Drainage Projects

In an attempt to make the prioritization of drain improvement and infrastructure work more explicit, transparent and open, each proposed project should be evaluated via a specific set of criteria. These criteria should be based on the needs of the residents serviced by the infrastructure works (rehabilitation, reconstruction, enlarging) and the integrity of the ecosystem. Recognizing that different criteria should have more or less influence on the prioritization process, the criteria are given various point values. The higher the point value, the greater influence the specific criteria will have in determining the project priority. *These criteria are not intended to be used to prioritize routine maintenance. The intent of these criteria is for larger capital projects that are a part of a strategic multi-year plan.* The suggested prioritization criteria are as follows:

	Prioritization Criteria	Zero points for:	Maximum Points	
			Value	For:
1	Negatively impact anyone downstream, and impact is not ameliorated	If "yes", cannot proceed		
2	Significant water quality damage, which cannot be ameliorated	If "yes", cannot proceed		
3	Significant aquatic habitat damage, which cannot be ameliorated	If "yes", cannot proceed		
4	Ability to accomplish project	If "no", cannot proceed		
5	Cooperative partnership in place	No	30	Partnership
6	Identified within the SWMP	No	30	In SWMP
7	Does the drain meet the design standard for the land use, soil capability, soil type and topography in the drain's catchment area?	At or above design standard	30	Much below design standard
8	Benefit/cost value (i.e., best value for money)	Small benefits &/or high costs	50	Large benefits &/or low costs
9	Extent and frequency of crop damages that have occurred on adjacent croplands	Limited, and infrequent	50	Extensive and frequent
10	Benefitting area	Very small	50	Large
11	Feedback received from local governments, affected farmers, and staff of MAFRI and Manitoba Crop Insurance about flooding problems and crop losses	Limited feedback	30	Extensive feedback and complaints
12	Water retention/holdback component	None.	30	Significant project.
13	Emergency response to natural events	No	50 or higher	Yes
14	Length of time issue has been present	Recent	10	Very old
15	Are residences, other buildings, or transportation systems flooded?	None	30	Significant no./amount
16	Part of system plan (i.e. upstream tributary drains to same standard?)	Tributaries are below standard	30	Tributaries are at design standard
17	Distance from outlet (that is, location within watershed)	Upstream end	30	Downstream end
18	Are works part of a multi-year project?	No	10	Yes
19	Useful life remaining for the culvert and bridge crossings (and other structures like weirs) on the drain	Over 10 years	10	Under 5 years
20	Project addresses environmental concerns/ issues/ problems?	No	20	Yes
21	Benefits aquatic habitat (e.g., removes barrier, or adds more productive habitat features)	No	50	Yes
22	Benefits water quality (e.g., reduces channel erosion, or traps sediments)	No	50	Yes
23	Potential for some groundwater impact?	Much impact	50	No impact

Definition of Prioritization Criteria

Distance from Outlet – The length of watercourse from the project site to the furthest downstream point within the watershed. This parameter is measured in kilometres.

Water Retention/Holdback Component – A project is ranked higher if it includes work to detain a volume of water that will be held back for a determined length of time and then released into the drain network.

Drain Standard –The appropriate design standard given the current land-use of the impacted area.

Negatively impact anyone downstream – Related to any potential damages that will occur as a result of the project. This criteria is one of the on/off 'switches', in which the project cannot proceed if the answer to the criteria is "yes" (that is, if there are downstream negative impacts that are not ameliorated).

Ability to Accomplish Project – An indication of the viability of the project in terms of taking it to completion. This criteria is one of the on/off 'switches', in which the project cannot proceed if the answer to the criteria is "no" (that is, if the project cannot be accomplished).

Cooperative Partnership in place – An assessment of whether an established and effective relationship exists between potential project partners. This parameter is measured as a yes or no.

Identified within the SWMP – An assessment of whether the project was originally identified as a key issue within the process of developing the integrated watershed management plan for the area through consultations with the public and municipalities. This parameter is measured as a yes or no.

Length of Time Issue has been Present – A measure of the number of months the problem has existed. This parameter is measured in months.

Benefit-cost value – A measure of the magnitude of the actual benefits of the project compared to the cost of the infrastructure works. For a typical agricultural drainage project, the benefit is a reduction in damages to the agricultural crops in the benefitting area, over the life of project. An accurate benefit-cost value is difficult to calculate because the agricultural benefits are difficult to estimate, as they are related to the extent and frequency of crop damages and the value of those crop damages. Where there are other benefits, like improvements to water quality or fish habitat, or a reduction in a negative impact on groundwater or a reduction in erosion, or a reduction in flood flows downstream, those benefits can also be very difficult to quantify.

For agricultural drain improvement projects, these parameters can be useful in estimating benefits-cost values.

Assessed Value – Is based on an area weighted average of the total land assessment value for the area impacted by the drainage project. An area weighted average can be useful as it will best reflect the true assessment value of the land based on the value of the majority of the land (i.e. a small parcel of very high value land will not outweigh a much larger parcel of low value land or vice-versa). This value is measured in dollars.

Area of Impact – The area upon which the project will have an influence or benefit. This value is measured in square kilometres.

Project Cost – An estimate of the total project cost. This value is measured in dollars.

Potential for Some Groundwater Impact – Groundwater located under areas of less overburden thickness is at a higher risk of contamination. Based on this knowledge a project occurring in an area of shallow overburden would receive a lower priority than a project occurring on deep overburden.

Benefits Water Quality – An assessment of the potential for the project to increase or decrease the quality of the water passing through the drain network. This parameter is measured as a range of potential impact.

Benefits Aquatic Habitat – A measure of how much a project improves the aquatic habitat of a waterway. This measure would likely be higher, depending on the quality of the watercourse and its ability to sustain a healthy fish population or provision of appropriate spawning habitat.