2014

Hespler Kroeker Irrigation Project Environment Act Proposal

Hespler Enterprises Ltd.

Kroeker Farms Ltd.

PBS Water Engineering Ltd.

5/18/2014

PBS Water Engineering Ltd.

Submission Sheet

The Hespler Kroeker Irrigation Project Environmental Act Proposal, was prepared by PBS Water Engineering Ltd. for the Proponents; Kroeker Farms Ltd. and Hespler Enterprises Ltd. The report reflects the opinion of PBS Water Engineering Ltd. based on information and data available at the time of the report preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. PBS Water Engineering Ltd. accepts no responsibility for damages suffered by any third party as a result of decisions and actions based on this report

Prepared by:

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P. B. Shewfelt, Msc., P.Eng.

Accepted for:

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Kroeker Farms Ltd.

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Hespler Enterprises Ltd.

Executive Summary

Hespler Enterprises Ltd. and Kroeker Farms Ltd. are proposing to jointly construct an irrigation system capable of providing water to 26 fields, encompassing some 1477 ha. The purpose of the Project is to secure their potato production against drought, and to implement a production system that secures the quality of their produce. Cereals, oilseeds, legumes and specifically wheat and corn will be some of the crops grown in rotation with the irrigated potatoes. These other crops will not be irrigated.

The Project proposes to store spring snowmelt water from Shannon Creek and Thornhill Coulee in two or three reservoirs located beside the creeks (e.g. off stream reservoir) or in an optional small dam on a minor tributary to the Thornhill Coulee. Application has been made to Manitoba Water Stewardship to divert up to 740 cubic decameters annually from these two waterways. Water will be pumped from the creeks to fill the reservoirs using high volume pumps. Water will be pumped and distributed to the irrigated areas using underground PVC piping. Three phase power is being considered for the pumping systems. Highway and creek crossings will be directionally bored. RM road crossings will be open cut where possible. Given the size of the proposed water diversion, the project is considered a Class 2 development in relation to The Environment Act.

The project will be developed over a 3-5 year construction period. Engineering will continue in June, 2014, with further site investigations. Construction of the first storage reservoir would begin in August, 2014, pending environmental and Water Rights approvals. The RM of Stanley has approved a reservoir in NW 34-3-5W (Site A) for Conditional Use Permit. A public hearing was convened on May 8th, 2014. Neighbours to the project site were consulted. Construction of pipelines and pump works would be started in fall, 2014. Additional storage sites, further pipeline and pumping would be constructed and commissioned over the projected construction period.

The existing environment is largely agricultural and the loamy, non-stony soil landscape is well suited for potato production. The major constraint to the growing climate for potatoes is having adequate moisture for optimum growing conditions. Average moisture deficits are in the 100 mm range.

The landscape and geology largely are reflections of the glacial Lake Agassiz. The lacustrine sediments include pockets of relatively impervious clay, which is suited to water storage; but maintain surficial loams associated with near-shore environments, ideal for horticulture production. The 26 parcels of land are considered prime agricultural land with and 96% of the land is rated Good to Excellent for suitability for irrigation. One parcel requires a Phase II assessment as recommended by Stantec, prior to irrigation.

Given the nature of the Project area, and after review with Manitoba Center for Biodiversity, it is concluded that the area is highly unlikely to have rare and endangered plants and/or birds, mammals, amphibians, reptiles or invertebrates.

The impacts of the Project on Fisheries are mitigated by the following considerations. The habitat value of the Shannon and Thornhill Coulees are marginal to poor. The proposed withdrawals will be made during the rising limb of the spring freshet, when migration upstream is blocked by snow and manmade structures. Minimum in stream flows will be maintained during pumping to support the recessional limb of the hydrograph. It is not proposed to screen the intakes on the creeks. Given the limited width and intermittent nature of the streams, navigation is not considered a primary activity in the area.

The socio economic effects of the project are either positive or mitigable. The construction project will create local jobs during construction, as well as help secure existing staff complements associated with Kroeker Farms Ltd. and Hespler Enterprises Ltd. Given that the producers currently grow potatoes on much of the identified land, it is not anticipated that significant increase in traffic will occur.

Potential adverse impacts of the Project during construction and/or operation can be mitigated as follows:

- Employing an appropriate sediment and erosion control plan on all construction sites.
- Employing Best Management Practices for growing of irrigated potatoes on the specific fields approved herein.
- Gearing any near water construction (e.g. intakes, stream crossings) to avoid timing windows specified by DFO.
- Provision of minimum instream flows during pumping to fill the reservoirs. Location of the monitoring could be at the former Water Survey of Canada flow monitoring station for the Shannon Creek at Highway 3.
- Comply with regulations respecting Storage and Handling of Gasoline and Associated Products.

The project is not considered to be a significant increase to Greenhouse Gas contributions, given that the farming activity is largely ongoing, construction is short term, and where possible renewable Hydro power will be employed for pumping.

Kroeker Farms Ltd. and Hespler Enterprises Ltd. are committed to sustainable potato production and to implementing steps to ensure that they are protecting the local environment during design, construction, operation and repairs.

- Implement measures identified in the Environment Act License related to monitoring and environmental protection.
- Build into each construction contract environmental protection and worker safety measures.
- Establish standard operating procedures for implementation of recommended BMPs for irrigated potato production.
- Maintain equipment, environmental controls and monitoring devices in good working order.
- Provide access to environmental monitoring data on request.
- Correct any noted deficiencies in a timely manner.
- Protect the environment against hazards.
- Report significant environmental incidents to Manitoba Conservation and Water Stewardship for guidance in finding appropriate remedies.

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Appendices

Figures

Tables

1.0 Introduction and Background

1.1 Proponents

Kroeker Farms Ltd. and Hespler Enterprises Ltd. are producers of potatoes for the processing, table, chipping, seed and organic markets. These companies have been growing potatoes in the project area, which is shown in Figure 1, for many years. They have a history of working closely with their neighbours and land owners within the project area. The two companies are jointly referred to as "the Proponents" herein.

For further information about Kroeker Farms Ltd.

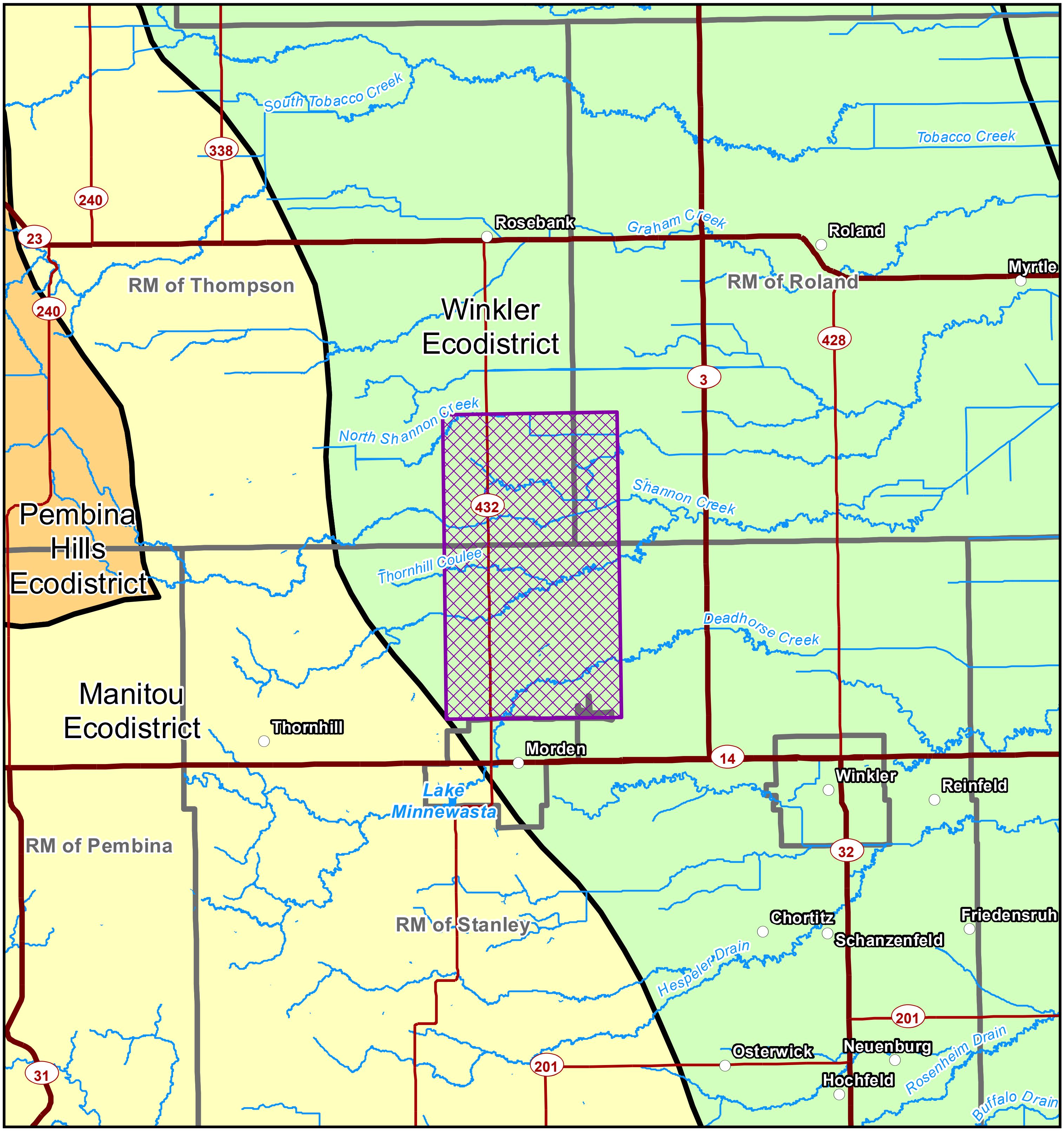
Kroeker Farms Limited
325 Roblin Blvd E
PO Box 1450
Winkler, Manitoba
Canada R6W 4B4
T 204 325 4333
F 204 325 8630
For comments or inquiries:

harwin@kroekers.com
www.kroekerfarms.com

For further information about Hespler Enterprises Ltd.

Hespler Enterprises Ltd.
PO Box 2700
Stn Main
Winkler, Manitoba
Canada R6W 4C3
T 204 325 9591
F 204 325 5952
For comments or inquiries:

wayne@hesplerfarms.com



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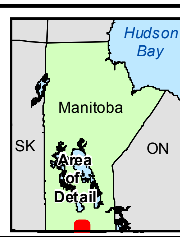
Legend

- StudyArea
- Rural Municipality
- Ecodistrict
- Waterbody
- Towns
- Watercourse
- Provincial Highway
- Provincial Road

Ecoregion

- Aspen Parkland
- Lake Manitoba Plain
- Southwest Manitoba Uplands

Hespler Kroeker Study Area



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Acknowledgements:
Original Drawing by Northern Allied Services Ltd.
Soil Landscape Data and Imagery provided by Manitoba Land Initiative (MLI),
Province of Manitoba.

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NAS

MAP SCALE	DATA SCALE	
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DATE	PROJECT	FIGURE NO.
May 25, 2014	HK	1

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1.2 Project Overview

The project area is shown in Figure 1. The project area is north of Morden along PR 432 and includes land along the Shannon Creek and as far south as the Deadhorse Creek. The proposed water source for the irrigation project is the Shannon Creek watershed above Highway 3.

In order to secure production against the risk of drought, and to meet the quality requirements of their customer base, the Proponents need to develop the capacity to irrigate their production. Irrigation offsets the projected peak moisture deficit to potato production of 125 to 150 mm (5 – 6 inches), which has implications for potato size, yield and quality. The Proponents plan to irrigate up to 1200 acres of land a year in rotation (i.e. 3 year or 4 year rotation). The total water requirement is 740 cubic decameters (i.e. 600 acre feet).

The project will involve withdrawal of water from the Shannon Creek and its' main tributary the Thornhill Coulee during spring snowmelt and storing in up to three reservoirs; named Site A, Site B and Site C. Water will be distributed to up to 3649 acres of land through buried pressure pipelines, pumping facilities, and moveable on farm irrigation systems.

The Proponents currently own and operate irrigation projects in the immediate area (i.e. along North Shannon and Graham Creeks) that service similar land and production systems. The Proponents are experienced potato growers and operators.

Kroeker Farms Ltd. and Hespler Enterprises Ltd. make use of the most current irrigation technologies, including highly efficient low pressure linear and center pivot irrigation systems, and travelling boom carts, as well as irrigation scheduling technologies, such as weather and soil moisture irrigation scheduling techniques. Precision control of inputs and risks is required to maintain profitable sustainable production.

1.3 Previous Studies and Licenses

This study area was included in the original Agassiz Irrigation Association master plan, circa 1993. Since then several reservoirs have been built in the vicinity along the Shannon and Graham creeks by both Hespler Enterprises and Kroeker Farms. The most recent Environmental Act Proposals/Licenses issued to these two farms are September 2013 License 3062 (Hespler Enterprises Ltd.); October 2010 License 2939 (Agassiz Resource Management Ltd./Kroeker Farms); September 15, 2000 License 2480 (Agassiz Resource Management Ltd.).

1.4 Project Alternatives

Available water sources in the area include groundwater, such as the Winkler Aquifer, treated water, such as Cities of Winkler, Morden, and regional water supplies, such as Pembina Valley Water Cooperative. None of these water sources are either available or affordable for irrigation development of the scale required. The sole readily available source of water in the project area, is the local snowmelt runoff that traverses the study area within the Shannon Creek watershed (Figure 1).

2.0 Regulatory Submissions and Approval Status

2.1 Local Permits

2.1.1 RM of Stanley Conditional Use Permit

Hespler Enterprises Ltd. and Kroeker Farms Ltd. have applied for Conditional Use Permit for the Site A. A public hearing was held May 8th at the RM of Stanley office. Notice of the meeting is included in Appendix B. Approval notification and conditions are also provided. Additional reservoir sites (B and C) will require conditional use permits at such time a decision is made to proceed. Site B is located in RM of Stanley. Site C is located in RM of Roland. Separate submissions will be made to the RM's of Stanley, Thompson and Roland regarding the location of irrigation pipelines within their ROW, and the details of road crossings and valve markings.

2.1.2 Building Permits

Morden, Stanley, Thompson, Winkler (MSTW) planning district will be consulted regarding permits for construction of permanent buildings and other structures regarding their approvals (e.g. pump houses).

2.2 Provincial Permits

2.2.1 Provincial Water Rights License Applications

Kroeker Farms Ltd. and Hespler Enterprises Ltd. have applied (April 9, 2014) for Development Permits through the Water Stewardship Division of Manitoba Conservation for withdrawal of up to 740 cubic decameters (600 acre feet) as per Appendix A. Kroeker Farms Ltd. have a current license jointly with Agassiz Resource Management Ltd. in SW 11-4-5W (148 cubic decameters; 120 acre feet); a copy of that license is contained in Appendix A.

2.2.2 Manitoba Infrastructure and Transportation Permits

There is no anticipated impact on MIT water infrastructure due to the development of the off stream reservoirs. Submissions will be made to MIT for access to install filling pumps and connecting fill piping from the Shannon Creek and Thornhill Coulees, where MIT dykes exist. An initial meeting was held on May 15, 2014.

If Site B in-stream reservoir is chosen, the impact assessment would include understanding any backwater on the PR 432 culvert crossing in W 32-3-5W.

The pipeline distribution system will include crossings of Provincial Roads and Drains. Individual applications will be made for all crossings and for location of pipeline delivery systems in MIT right of way.

2.2.3 *Provincial Environment Act License Applications*

The Manitoba Environment Act applies to projects having significant impacts on the environment. The proposed Hespler-Kroeker Irrigation Project is considered a Class 2 project as it proposes to withdraw in excess of 200 cubic decameters of water. The Project requires a valid and subsisting licence from Manitoba Conservation and Water Stewardship Environmental Approvals Branch. This report forms the basis of the application. An copy of the existing EAL 2480 on Shannon Creek, issued to Agassiz Resource Management Ltd./Kroeker Farms Ltd., is provided in Appendix C.

2.2.4 *The Water Protection Act*

This act pertains to nutrient management requirements for the proposed irrigated potato fields within the study area. The regulations encourage nutrient management planning and prescribes Nutrient Management Zones (N1-N5) which dictate the nutrient management practices that must be employed in growing a crop. The Act also defines the Nutrient Buffer zones around water sources (surface, ground). The buffer applies to any water body on the fields being proposed for irrigation and potato production. This EAP will define the Nutrient Management Zones for each field being proposed for irrigation (Stantec, 2014).

2.2.5 *The Heritage Resources Act*

A heritage site refers to a location that is protected under the provisions of the Heritage Resources Act, due to its known archaeological significance. In addition, human remains discovered outside a formal burial grounds are considered to be protected by the Act. The Act prescribes the processes to be followed by the Proponents and Authorities.

Correspondence the Heritage Resources Branch is included in Appendix D.

2.2.6 *Provincial Drainage Permits*

Application will be made to Manitoba Conservation for a drainage license to allow for improved drainage around the reservoir dykes. The improved drainage will remove ponded water from the toe of the dykes and intercept downslope water movement off the adjacent uplands. The drainage will be HDPE tile drains c/w filter sock and will exit by gravity to existing waterways (i.e. Thornhill Coulee and Shannon Creek).

In addition, application will be made to construct the small dam at Site B if it is deemed feasible and desirable as an option to the off stream reservoir option.

2.3 Federal Regulations

2.3.1 Federal Department of Fisheries and Oceans Authorization

The Federal Fisheries Act was amended in June, 2012 (http://www.dfo-mpo.gc.ca/pnw-ppe/changes-changements/index-eng.html). Under the Fisheries Act, harmful alteration, disruption or destruction (HADD) is only allowed with an authorization.

If, after a project review, it is determined that a project will cause serious harm to fish that ***are part of or that support a commercial, recreational or Aboriginal fish*****ery**, the proponent can apply for an Authorization (Paragraph 35(2)(*b*) *Fisheries Act* Authorization from the Minister of Fisheries and Oceans).

- Applicant's Guide to Submitting an Application for Authorization under Paragraph 35(2)(*b*) of the *Fisheries Act*

Follow up to this Environment Act Proposal will include consultation with Department of Fisheries. The Federal law regarding protection of fish habitat will be reviewed with respect to the withdrawals, sediment control, and intake development.

Under provisions of the current act intakes that don't change the width of the water body are exempt. Additionally, the DFO recently issued guidelines on the classification of fishery habitat in Southern Manitoba that indicate ***the limited potential habitat value of the Shannon Creek and Thornhill Coulees*** at the proposed withdrawal points with ***respect to commercial, recreational or Aboriginal fisheries***.

2.3.2 Navigation Protection Act

The Federal law regarding navigable waterways was reviewed with respect to the intake design.

> *For the purposes of the NPA, "likely to substantially interfere with navigation" means that the work will, for example, significantly change the way vessels pass down a navigable waterway or may make passage dangerous to the public. When a work is assessed as substantially interfering with navigation, section 6 of the NPA applies.*

It is not anticipated that the streams in question are navigable, and it is assumed that the Shannon Creek and Thornhill Coulees are minor waters not intended for navigation and are therefore exempt. Neither the Shannon Creek of the Thornhill Coulee are listed in the schedule of waters under the newly proposed Navigation Protection Act, which has not yet been fully enacted by Parliament. The list is provided at the following web site.

https://www.tc.gc.ca/media/documents/mediaroom/proposed list_of_scheduled_waters.pdf

2.3.3 Migratory Birds Convention Act

Disturbance or destruction of migratory bird nest or eggs is prohibited pursuant to this Act.

2.3.4 Species at Risk Act

The Act is intended to prevent human activity from impacting species of special concern specific to the area of the project, in order to help prevent endangered or threaten their extinction. The Manitoba Conservation Data Center was informed of the project and asked for an opinion on Species at Risk at the three major construction sites, namely Site A, Site B and Site C. Copy of the correspondence is included in Appendix E.

2.4 Other Permits and Considerations

2.4.1 Enbridge Pipeline

Enbridge is currently planning to construct a pipeline within the project study area. Application will be made to Enbridge to cross that pipeline at one location, namely in 22-3-5W.

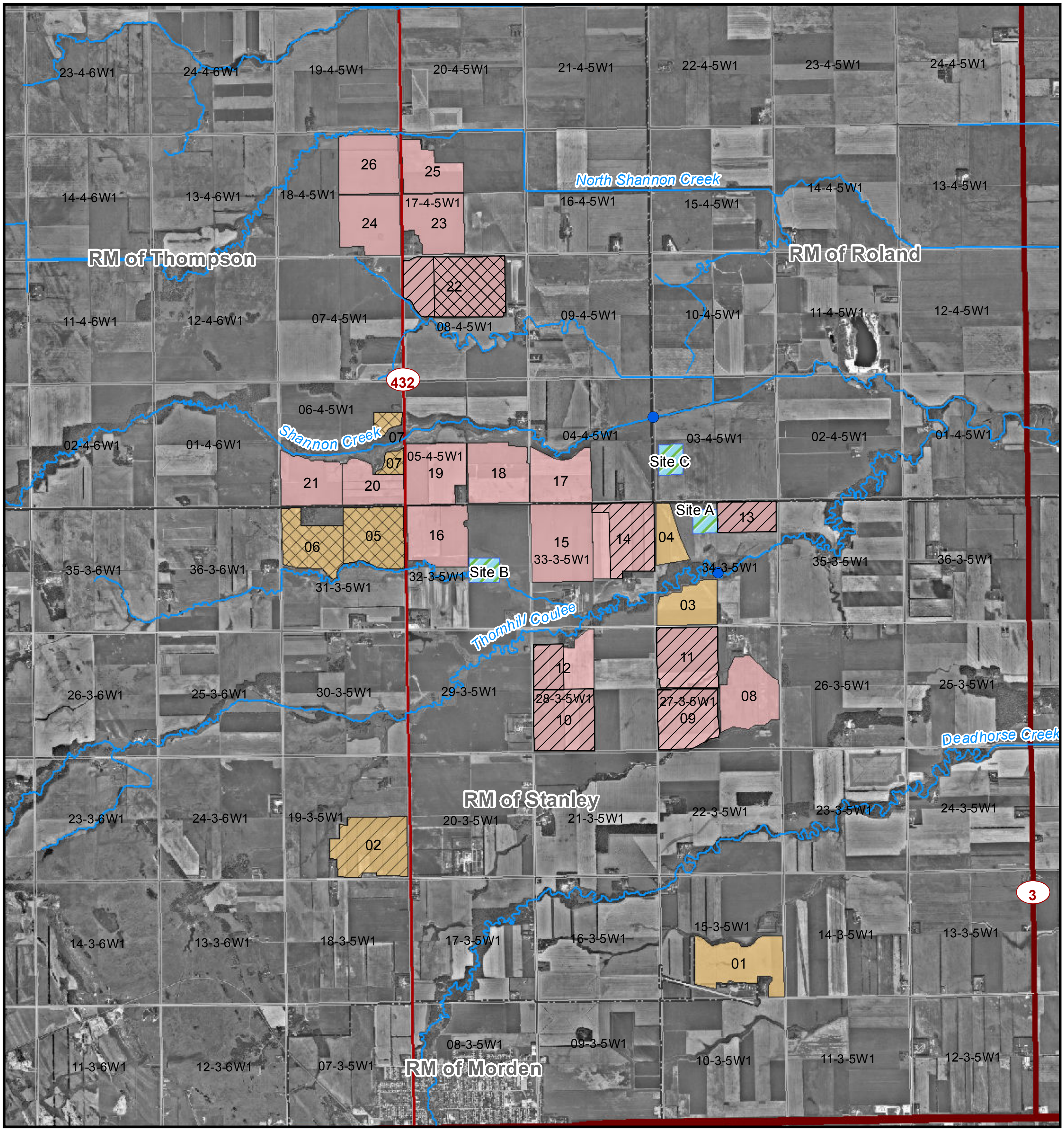
2.4.2 Local Conservation Groups

Pembina Valley Conservation District was notified of the Site A Feasibility Study report, and will be given copies of reports on Site B for review and comments

2.5 Consultations and Submissions

Site A Feasibility Report was submitted to RM of Stanley for Conditional Use Permit (April 8, 2014). A hearing was held May 8th, 2014. Copies of the Site A report are available at the RM office for public review. Appendix B shows the hand out distributed at the RM meeting. Copy of the feasibility reports on the three projects are available on request. Two of the neighbours have been actively and directly consulted by PBS Water Engineering Ltd. on behalf of the proponents. Copies of the feasibility report were provided to the land owner to the north, Mr. Ken Wiebe of W5 Farms Ltd., and to Irv Dalke, the land owner to the SE of the Site A reservoir. The neighbour directly east of Site A is Kroeker Farms Ltd. The neighbour directly west rents land to Kroeker Farms Ltd. and attended the RM Conditional Use Hearing. The Thornhill Coulee is directly south of the Site A project.

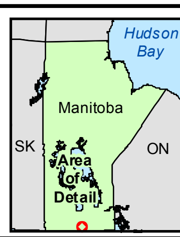
PBS Water Engineering Ltd. is responsible for filing these applications on behalf of the Proponent. Stantec (2014) has responsibility for assessing and certifying the land suitability for irrigation. Any licenses will be issued jointly in the name of the Proponents whom will have sole responsibility to meet license conditions.



Legend

Hespler Fields	Rural Municipality	Tiled Fields	Planned for Tiling	Provincial Highway
Kroeker Fields	Fields Assessed	Proposed Reservoirs	Withdrawl Points	Provincial Road

Hespler Kroeker Irrigation Project
Irrigated Landbase



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Soil Landscape Data and Imagery provided by Manitoba Land Initiative (MLI), Province of Manitoba.

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MAP SCALE	DATA SCALE
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May 25, 2014	HK	2

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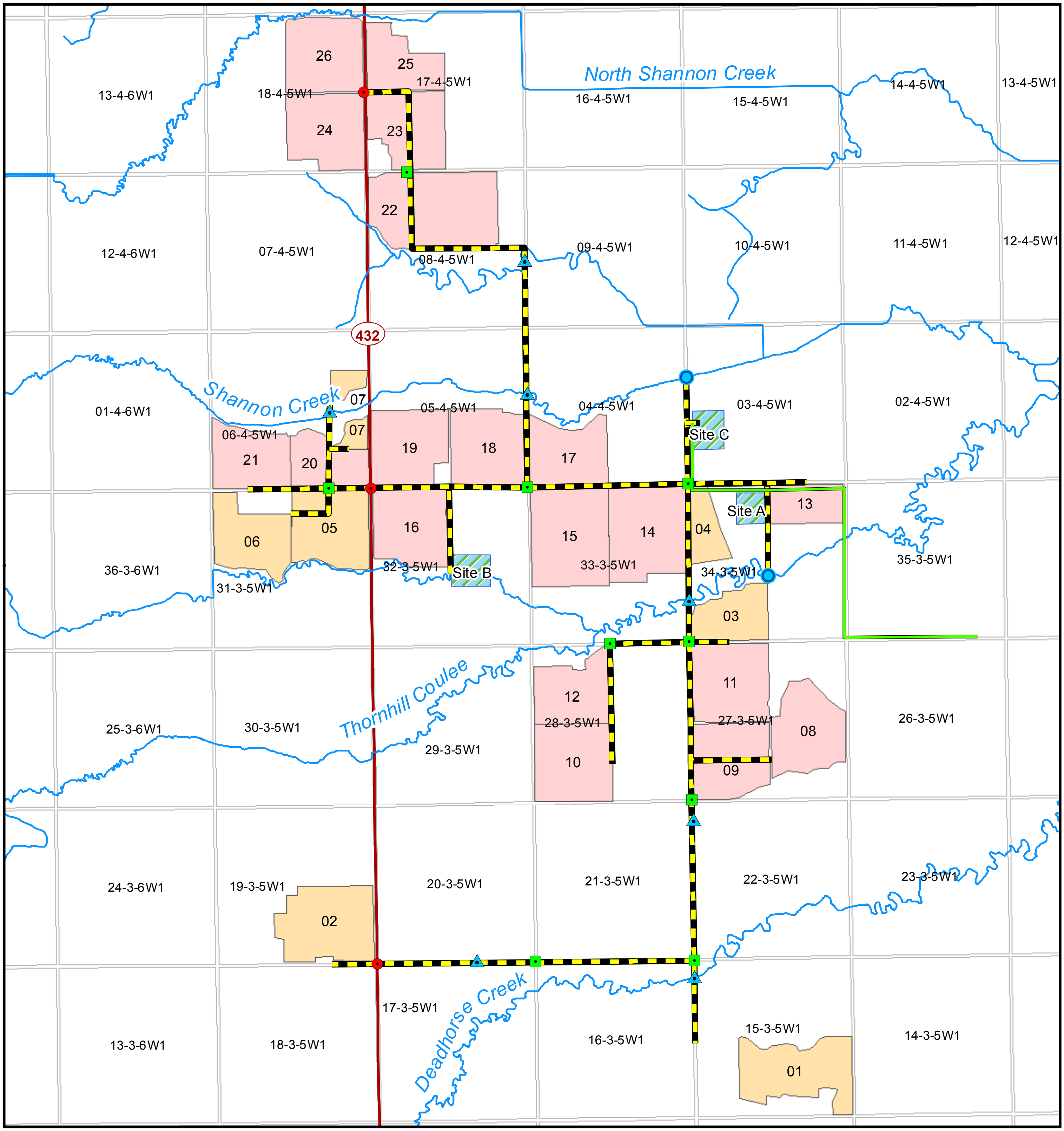

Legend

Highway Crossings
Creek Crossings
Pipelines
Hespler Fields
Pipe Connection
RM Road Crossings
Hydro
Proposed Reservoirs
Kroeker Fields
Provincial Road

Hespler Kroeker Pipeline Layout

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Acknowledgements:
Original Drawing by Northern Allied Services Ltd.
Soil Landscape Data and Imagery provided by Manitoba Land Initiative (MLI), Province of Manitoba.

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MAP SCALE 1:55,000			DATA SCALE 1:20,000	
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3.0 Description of Proposed Development

3.1 Project Summary

The Project will store up to 740 cubic decameters (i.e. 600 acre feet) of water in 2 or 3 reservoirs, referred to as Site A, B, and C. Water from the reservoir(s) will be piped in a common underground pipeline to up to 26 parcels of land, encompassing over 1477 ha (3649 acres) of cultivated crop production. In any given year up to 9 parcels will be irrigated using modern sprinkler irrigation systems. A maximum irrigated acreage is 485 ha (1200 acres).

Power sources will be electric and/or diesel power.

The system will be jointly managed by Hespler Enterprises Ltd. and Kroeker Farms Ltd.

3.2 Project Area

The project area is highlighted in Figure 1, located north of Morden on either side of PR 432 and along the Shannon Creek and Deadhorse Creek watersheds. The project area straddles three RMs, namely Stanley, Thompson and Roland. The project area is located completely with the Lake Manitoba Plain as represented by the Winkler Eco District.

3.3 Land Base and Irrigation System Components

The land base to be irrigated is described in Table 1 and shown in Figure 2. The project components are illustrated in relation to the land base in Figure 2 and Figure 3. Those components include, irrigated land base, water delivery system, water storage, water diversion, power supply. The following sections describe the proposed development components and reference the additional development information as required in the Environmental Act Proposal Guidelines.

3.3.1 Irrigation Systems

Each of the quarter sections or portions of will be irrigated using an on farm irrigation system, including but not limited to:

- Center pivot irrigation systems
- Linear irrigation systems
- Travelling boom carts
- Travelling guns

Each individual system is considered an irrigation parcel. There are 26 parcels (Figure 2) encompassing 1477 ha (3649 acres).

The maximum on farm irrigation will be 485 ha (1200 acres) per year, at a maximum duty of 150 mm (6 inches), for a total demand of 740 cubic decameters (600 acre feet).

3.3.2 Water Delivery Systems

Water will be delivered to each irrigation parcel by means of pressurized pipeline. The proposed pipeline route is shown in Figure 3. This pipeline will be constructed of pressure rated PVC pipe, shallow buried using chain trenchers and backhoes. Turnouts to pipeline laterals and to irrigation parcels will consist of galvanized steel pipe fittings. Wet creek crossings and paved roads will be directionally bored. Dry waterway crossings and RM roads will be open cut where feasible and acceptable. All road crossings will be lined to ensure public safety.

3.3.3 Water Storage

As the demand of water is in June to September period and spring snowmelt runoff occurs in March, April and May; there is a need to build water storage facilities. Three water storage sites are under active consideration. These sites are designated and located as per Figure 2 and 3, as follows:

Site A – NW 34-3-5 W

Site B – 32-3-5 W

Site C – SW 3-4-5 W

Pre-feasibility and feasibility studies have been completed on these three sites. Further pre-design work, including test drilling is required to confirm feasibility, storage capacity and engineering design details. All off stream cut/fill reservoir sites will be engineered with the following elements:

- Seepage control including clay keyway and clay liner
- Seepage interception and liner monitoring using a tile drainage system
- Wave and erosion protection, including flat slope, grass, gravel and freeboard.
- No penetrations (pipes) below full supply level

For Site B, consideration is still being given to construction of a small dam. The small dam will be designed in accordance with the PFRA Small Dam Design Manual and Canadian Dam Safety Association guidelines.

Pre-design and final design engineering is planned for Site A in spring, 2014. Further site investigations are scheduled for spring, 2014 for Sites B and C. Total planned storage is 740 cubic decameters (600 acre feet).

3.3.4 Water Diversion

Water to Sites A and C will come from the Shannon Creek in W 3-4-5 W and the Thornhill Coulee in NW 34-3-5W. Water to Site B would come from a tributary to the Thornhill Coulee and supplemented with pumping from Shannon Creek and Thornhill using the proposed irrigation pipeline network.

Filling pump systems will be high volume low head transfer pumps. Power to drive the filling pumps will come from tractor PTOs.

3.4 Land Use and Access

Table 1 provides a summary of the field locations and the Proponent and owner relationship. Table 1 itemizes the cultivated acres of the field in question and the proposed irrigation system.

Table 1 - Project Field Number, Land Location, Access, Cultivated Acres and Irrigation System

Field Number	Land Location	Land Owner	Potato Producer/ Irrigator	Access (Own, Lease, Agreement)	Acres	Irrigation System
1	S 15-3-5W	Hespler	Hespler	Owned	171	Linear/Boom
2	S 19-3-5W	Hespler	Hespler	Owned	179	Pivot/Linear
3	SW 34-3-5W	Hespler	Hespler	Owned	96	Boom/Gun
4	NW 34-3-5W	Hespler	Hespler	Owned	60	Boom/Gun
5	NE 31-3-5W	Hespler	Hespler	Owned	152	Pivot/Linear
6	NW 31-3-5W	Hespler	Hespler	Owned	129	Pivot/Linear
7	E 6-4-5W	Hespler	Hespler	Owned	43	Boom/Gun
8	E 27-3-5W	Dalke/ 4669712	Kroeker	Lease	149	Pivot
9	SW 27-3-5W	Kroeker	Kroeker	Owned	148	Pivot/Linear
10	SW 28-3-5W	Shore	Kroeker	Lease	160	Pivot/Linear
11	NW 27-3-5W	Kroeker	Kroeker	Owned	159	Pivot/Linear
12	NW 28-3-5W	Shore	Kroeker	Lease	126	Pivot/Linear
13	NE 34-3-5W	Kroeker	Kroeker	Owned	78	Pivot
14	E 33-3-5W	Shore	Kroeker	Lease	191	Pivot/Linear
15	W 33-3-5W	Shannondale	Kroeker	Lease	205	Pivot/Linear
16	NW 32-3-5W	Henderson	Kroeker	Lease	152	Pivot/Linear
17	SW 4-4-5W	L.J. Farms	Kroeker	Lease	128	Pivot/Linear
18	SE 5-4-5W	L. J. Farms	Kroeker	Lease	155	Pivot/Linear
19	SW 5-4-5W	Kroeker	Kroeker	Owned	149	Pivot/Linear
20	SE 6-4-5 W	W5 Farms	Kroeker	Lease	97	Pivot/Linear
21	SW 6-4-5W	W5 Farms	Kroeker	Lease	123	Pivot/Linear
22	N 8-4-5W	High Ridge/ Kroeker	Kroeker	Lease	252	Pivot/Linear
23	SW 17-4-5W	Leatherdale Storey	Kroeker	Under discussion	143	Pivot/Linear
24	SE 18-4-5W	Leatherdale	Kroeker	Under discussion	148	Pivot/Linear
25	NW 17-4-5W	Kroeker	Kroeker	Owned	105	Pivot/Linear
26	NE 18-4-5W	Leatherdale Storey	Kroeker	Under discussion	151	Pivot/Linear
Site A	NW34-3-5W	Hespler	Joint	Owned	30	Reservoir
Site B	32-3-5 W	Petkau	Joint	TBA	50	Reservoir
Site C	SW 3-4-5W	W5 Farms	Joint	TBA	30	Reservoir

3.4.1 Certificates of Title and Mineral Rights

Certificates of Title for the land base were compiled to document land ownership, a listing is included in Appendix F. A copy of the certificates will be attached to the application form. Mineral rights will be reported if required, as they are not impacted by the projects. Site A Certificate of Title is included in Appendix F.

3.4.2 Existing Land Use

All of the land proposed for development, other than Site B, is currently cultivated for agricultural purposes. This does not include the water delivery system (pipeline) crossings of natural features such as creeks. Potential creek crossings are illustrated on Figure 3.

The Site A and C reservoirs are proposed for 100% cultivated land. The Site B reservoir is currently pastured valley bottom, which is periodically cultivated for annual crop production.

The Site B reservoir is located in a small tributary to the Thornhill Coulee per Figure 2.

3.4.3 Land Use Designation

All land to be developed is designated as Agricultural non-restricted except for Field 1, which is Agricultural restricted, due to its proximity to the City of Morden airport.

The project does not proposed to change the existing cultivated land base other than to provide irrigation to some proportion of the land depending on the irrigation system. There is no planned increase to cultivated acres. No change to riparian zone and vegetation as a function of the irrigation systems.

The Site A and C reservoirs will be developed on cultivated land and as such require Conditional Use Permits. Site B will be developed on flat valley bottom which is currently in pasture/cultivated; and does not contain any wooded vegetation.

3.5 <u>Development Schedule/Phases</u>

The following describes the currently proposed development schedules associated with the major components of the work.

3.5.1 Irrigation Systems

Irrigation systems will be purchased starting in fall, 2014 and extending approximately a three year period until the water storage and delivery systems are fully developed.

3.5.2 Delivery Systems

The pipeline delivery systems will be scheduled to start construction in the fall of 2014, or spring of 2015.

3.5.3 Water Storage Systems

Site A is proposed for development in summer and fall, 2014, with first filling in spring, 2015. Site C is proposed for development in summer and fall, 2015, with first filling in spring, 2016. Site B is currently a backup site to Site A or Site C should either prove to be unfeasible or excessively costly to build.

3.5.4 Water Diversion

Water diversion facilities (e.g. creek access) will be developed in fall, 2014 for Site A and fall, 2015 for Site C or Site B, which ever proceeds.

3.5.5 Engineering

Engineering is ongoing.

Site A feasibility report was completed April 4, 2014. Site C pre-feasibility report was finalized May 12, 2014. Site B feasibility report will be completed in June, 2014.

Site A pre-design and final design will be completed in June and July, 2014. Further Site B and C pre-design investigations will be completed in June, 2014. Site B or Site C final design will be completed in fall/winter 2014/2015.

PBS Water Engineering Ltd., Bicycle Consulting Ltd., VRK Consulting Ltd. and PFRA Ltd. have formed a partnership to complete the required engineering investigations, reports and designs. PBS Water Engineering Ltd. and partners will assist the owners through the construction and commissioning phases.

3.6 Operation Phase

First operation of the project will be filling of Site A reservoir in spring, 2015. First operation of irrigation systems will be summer, 2015.

Additional storage, irrigation systems and distribution pipeline will be brought on line over a three to five year period.

Off stream reservoirs will become part of an existing Dam Safety program initiated by Agassiz Resource Management Ltd. and carried out in consultation with engineering consulting firms. Further details can be made available through VRK Consulting Ltd. The Dam Safety program will include annual inspection and monitoring of the embankments and associated elements (e.g. liners, crest, stability, and tile drainage interceptor).

3.7 Repair, Renewal, Decommissioning Phase

The project is designed to be sustainable over the long term. The life expectancy of the components is as follows:

Pumps – 20 years

Hydro - 30 years

Off Stream Reservoirs – 50 years

Pipelines - 50 years (PVC); 25 years (steel fittings)

Irrigation systems - 25 years (aluminum)

Tile drainage – 50 years (HDPE)

The project will components will be maintained to ensure maximum life expectancy, and as required will be replaced. Where possible (e.g. steel, aluminum) parts will be recycled. PVC pipeline will be abandoned in place and replaced with new pipe. Off stream reservoirs will be drained and liner and excavation will be renewed; based on past projects net siltation is not expected to be a large issue.

3.8 Funding

The project is 100% funded by Hespler Enterprises Ltd. and Kroeker Farms Ltd. in a joint venture.

4.0 Environmental Settings

4.1 Physical Environment

The project is located in the Shannon Creek Watershed in Southern Manitoba Red River Valley north and east of Morden, Manitoba.

Figure 1 shows the approximate western extent of the Shannon Creek Watershed in the Pembina Hills and Manitou Eco Districts. The Shannon Creek drains surface water from these uplands associated with the Manitoba Escarpment to the west, and from local field drainage within the project area, per Figure 2.

4.1.1 Terrain, Soils and Landscape

Figure 4 shows that the project area is contained within the Red River Valley physiographic sub-unit of the Manitoba Plain (i.e. Section D1.2) (Smith, Michalyna, 1971). The Manitoba Plain represents the lowest level plain on the Prairies. It is underlain by limestone bedrock and covered by glacial till and lacustrine clays and silts deposited by Lake Agassiz (Smith et al., 1998).

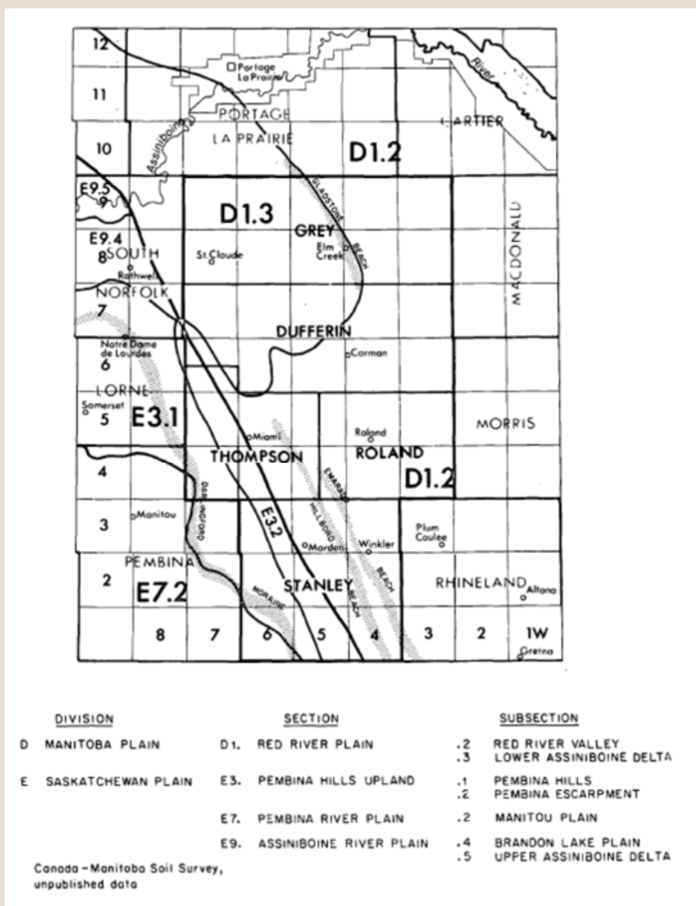


Figure 4 - Physiographic Map of the MSTW Area (Smith, Michalyna, 1971)

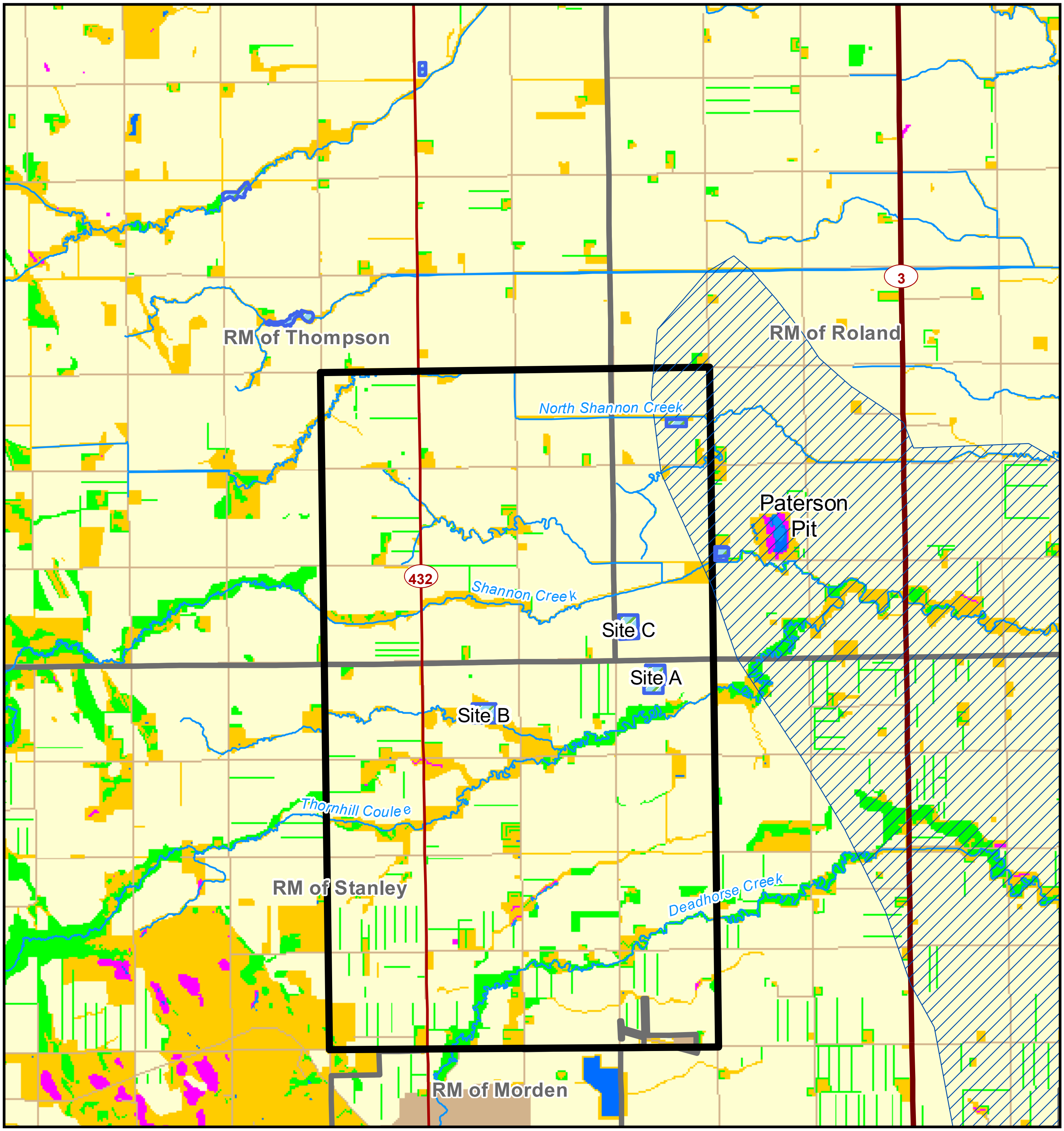
PBS Water Engineering Ltd.

Smith, Michalyna (1971) describe the soils, landscape and terrain of the project area. The topography is smooth level to very gently sloping. Surface runoff is slow, as is internal drainage due to low permeability. The soil parent material overlying the deep bedrock at this location is characteristic of lacustrine sediments associated with glacial Lake Agassiz. The surficial soils range in texture from moderately coarse sandy to very fine clayey and are dominantly somewhat poorly drained. Within the study area (Figure 5) the significant surface features are the oversized valleys along the Thornhill Coulee, the channelized Shannon Creek running west to east and the Hillsboro Beach ridge (Figure 4) which traversing the project area from southeast to northwest. The relic beaches represent the successively lower water levels of Lake Agassiz (Smith et al.,1998).

The terrain, landscape and soils are major factors in the feasibility of the proposed irrigation project. The project area is noted to have some of the most productive soils in the Province (Smith, Michalyna, 1971) with excellent yields of grains, oilseeds and horticultural crops (e.g. potatoes). The major limitations to crop production are maintaining adequate surface and subsurface drainage, maintaining soil fertility and tilth, and prevention of wind and water erosion of these fine soils. Generally speaking 75% of the soils in the Morden-Winkler area are considered suitable for irrigation (Smith, Michalyna, 1971); with the main limitation being slow permeability and high water table. For the project, site specific mapping is warranted, and is included herein for each parcel being considered for irrigation.

The suitability of the soils and landscape for high value agriculture has led to the current land use Figure 5 within the project area. Planted shelterbelts are utilized to minimize soil erosion and create micro climates for crop production. Riparian zones, are often grazed grass lands; due to their typically wetter soils, and unsuitability for cultivation. Some remnants of natural bush is present on selected reaches of the Thornhill Coulee as shown in 34-3-5 W and 33-3-5 W (Figure 5).

Paterson Pit to the north and east of the project area represents a major source of sand and gravel for the area; and is a window to the Winkler Aquifer (Figure 5). The footprint of the Winkler Aquifer is outlined in Figure 5 as well and described in the next section.



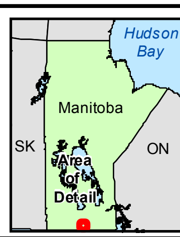
Legend

Rural Municipality
Study Area
Provincial Highway
Provincial Road
Reservoirs
Winkler Aquifer

Land Cover Classes

Water
Exposed/Developed Land
Shrubland
Wetland
Annual Cropland
Deciduous Trees

Hespler Kroeker Land Cover Types



NORTH

0 500 1,000 2,000 3,000

Meters

Acknowledgements:
Original Drawing by Northern Allied Services Ltd.
Soil Landscape Data and Imagery provided by Manitoba Land Initiative (MLI), Province of Manitoba.

PREPARED BY PBS Water Engineering Ltd. NAS

MAP SCALE 1:90,000		DATA SCALE 1:20,000	
DATE May 23, 2014		PROJECT HK	FIGURE NO. 5
DRAWN SB	CHECKED PBS	APPROVED PBS	

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4.1.2 Geology of the Project Area

The geology of the proposed reservoir sites and to an extent the area are reported as Phase I level assessments contained within Feasibility studies for Sites A, B and C (PBS, 2014). Typically nearshore lacustrine and alluvial materials (clays, silts and sands) overlay lacustrine clay, which in turn overlays glacial till and finally black shale bedrock. Table 2 provides a typical Phase I report, specifically for Site A in NW 34-3-5W.

Localized geologic features modify this general stratigraphy. Within the project area this includes a beach ridge running from NW 34-3-5 W to NW 17-4-5W (named the Hillsboro Beach on Figure 4). The second major feature of the area is the Winkler Aquifer, which is a sand and gravel aquifer that is eroded through the lacustrine clay, the till and into the underlying shale. The footprint of the Winkler Aquifer is outlined on Figure 5. A schematic of the Winkler Aquifer and its relationship to the land/geology 1 mile west is shown in Figure 6, in the next section.

The majority of the project irrigated area is above the Hillsboro beach ridge (Figure 4) and is entirely west of the Winkler Aquifer footprint (Figure 5) and it's primary recharge area which is located closer to Highway 3 and Paterson Pit (Figure 5). The two reservoir sites, namely Site A and Site C are located just below the Hillsboro Beach ridge. At the Site A and Site C locations the lacustrine clay identified in Table 2 is anticipated to be approximately 2 – 2.5 m below ground surface (PBS, 2014). Additional pre-design investigations are scheduled for June, 2014, in order to confirm the thickness of the lacustrine clay.

The reservoirs are considered to be contained geologically against deep seepage by the lacustrine clay, this has proven to be an effective barrier. Local drainage and seepage downslope on the beach ridge could be an issue that needs to be engineered for (PBS, 2014).

Table 2 – Phase I Geologic Stratigraphy for Site A in 34-3-5 W1 (PBS Water Engineering, 2014)

PROJECT NAME: **Site A**	
PROJECT LOCATION: **N1/2 34-03-05W1**	
WATER REQUIREMENT: **Water Storage ?? acre-feet**	NTS SHEET: **62 G/8**
STATIC WATER LEVEL:	RM: **Stanley**
AIR PHOTO REFERENCE:	

Unit Thickness:

Drift Units:	Depths	Expected Geology	Recommendation
Alluvial Clay		This site lies just to the north of a creek resulting in some alluvial erosion and deposit within the surveyed area. Alluvial deposits are expected to be primarily clay but may have layers/inclusions of silt. Thickness will likely be greatest adjacent the creek and lessen with distance and follow patterns visible in the air photo	If detailed information on the alluvial deposits is required then an EM38 might be warranted.
Near Shore Silty to Sandy Clays	From 0 to 3 to 10m	This area is blanketed by nearshore deposits consisting of sandy silt to silty sand. Locally these deposits have been eroded by creek/surface water actions	Nearshore deposits underlie the area. These can be saturated in spring and after prolonged wet periods which needs to be considered for excavation
Beach Ridge Sand/Gravel		A beach ridge forms the west edge of the study area. It is an elevated NNW/SSE trending feature comprised of sand/gravel.	Should be avoided. Also the toe of the beach ridge, or remnants may extend to the east
Lacustrine Clay	3-10 to 40m	Lacustrine clay associated with Lake Agassiz underlie the area and represent the bottom of any possible reservoir construction at this site	Underlie the area and represents the lower most unit for this investigation.
Glacial Till	40 to 50m	Potential for pockets of sand/gravel within the till	Beyond depth of concern for this project
Bedrock Units:			
Favel and Ashville Formation	50+ m	Dark grey to black shale	Beyond depth of concern for this project

4.1.3 Groundwater

The groundwater in the project area can be characterized as follows. Deep wells into the shale bedrock are typically saline (Michalayna, Smith, 1971) and hence remain undeveloped. Shallow groundwater associated with the near shore sediments, perched on top of the lacustrine clay, varies in quality depending on the position in the landscape and the time of year. During spring snowmelt this perched water can cause issues with agricultural production, causing near surface water tables and hence imperfect drainage. This water table falls during the growing season, due to crop evapotranspiration, to levels below 2 m; only to be recharged in the fall with rain or during the next spring season (Cordeiro, 2013). These water tables are typically unreliable for water supply and of low capacity with respect to recharge.

Significantly, the RM's of Thompson and Stanley have developed rural water pipelines to service the farms in the project area, due to the lack of potable groundwater. The only other source of potable water is the Winkler Aquifer. However, to a large extent the Winkler Aquifer is utilized only by those farms, rural acreages and small businesses directly over its footprint and of course is a major water source for nearby City of Winkler.

Figure 5 shows the footprint of the northerly extent of the Winkler Aquifer in relation to the project boundary. The primary recharge to the Winkler Aquifer is outside the project area to the east and north, adjacent to the Paterson Pit located in SW 11-4-5W (Figure 5). Figure 6 illustrates the cross section of a covered portion of the Winkler Aquifer. The Reservoir Sites A and B are approximately 1 mile to the west of the Aquifer Boundary (Figure 5).

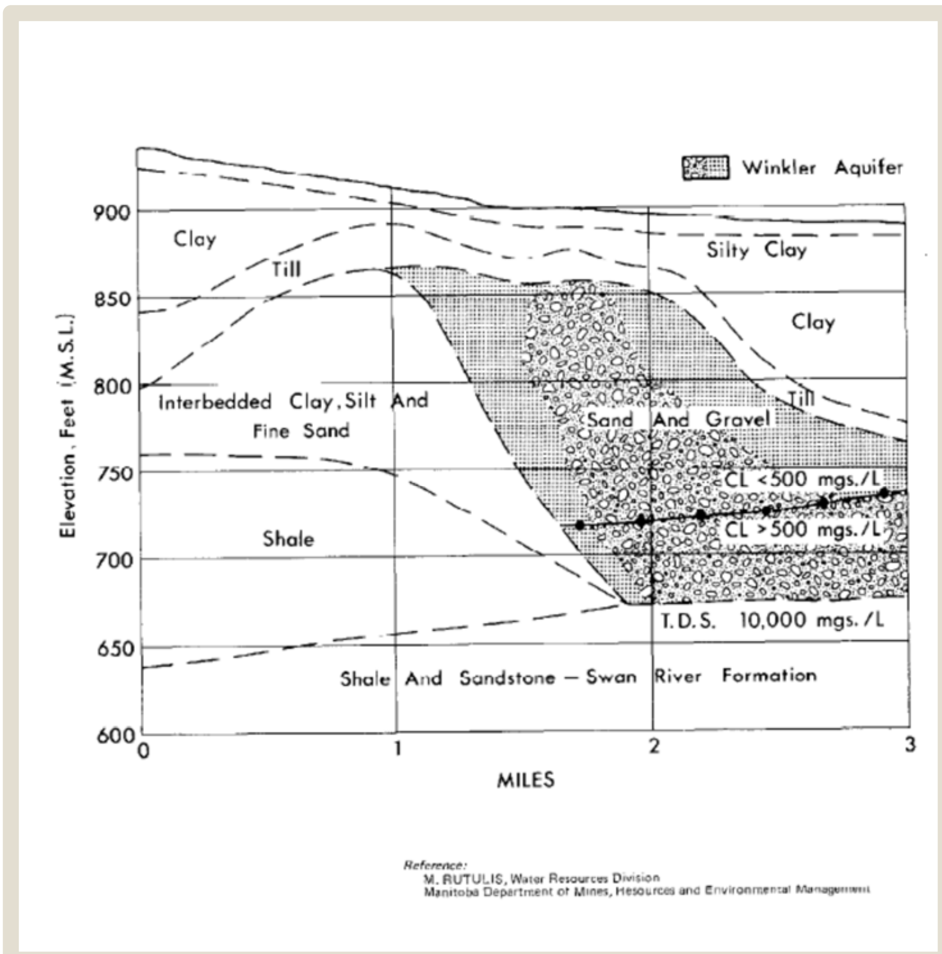

Figure 6 - Cross Section of the Winkler Aquifer (Smith, Michalyna, 1971)

4.1.4 Climate and Meteorological Conditions and Eco-climate

The Morden CDA is a long term climatic station maintained in conjunction with Environment Canada. Reported climatic parameters (Michalayna, Smith, 1971)

Temperature 3.3^{0}C (mean annual)

Precipitation 530 mm (mean annual)

Rainfall 336 mm (mean annual)

During the growing season, potato crop evapotranspiration generally exceeds available precipitation. Based on climate data available from Manitoba Agriculture Food and Rural Development (Table 3); the water deficit ranges from as little as 75 mm (3 inches) or less in half of the years to 150 mm (6 inches) or more in 1 year out of 10. This information has been utilized to estimate project water demand.

Table 3 – Growing Season Precipitation, Potato Water Demand and Water Deficit (MAFRD).

Variable	Risk Level	Description	Water (inches/mm)
Growing Season Precipitation	50	In 1 of 2 years precipitation will be less than given values	9.5-10.5 (240 to 270)
	25	In 1 of 4 years precipitation will be less than given values	7.1-7.5 (180 to 190)
	10	In 1 of 10 years precipitation will be less than given values	4.6-5.5 (115 to 140)
Potato Water Demand	50	In 1 of 2 years water demand for potatoes at maturity will exceed the given value	14.6 – 15.5 (370 to 395)
	20	In 1 of 4 years water demand for potatoes at maturity will exceed the given values	16.1 – 17.0 (410 to 430)
	10	In 1 of 10 years water demand for potatoes at maturity will exceed the given values	17.1 – 18.0 (435 to 460)
Potato Water Deficit	50	In 1 of 2 years water deficit will be exceed the given values	3.1 – 4.0 (80 to 100)
	25	In 1 of 4 years water deficit will exceed the given values	4.1 – 5.0 (105 to 125)
	10	In 1 of 10 years water deficit will be exceed the given values	5.1 – 6.0 (130 to 150)

Reference --- http://www.gov.mb.ca/agriculture/weather/climatic-information-for-potatoes-in-mb.html

Table 4 (Michalayna, Smith, 1971), reveals that water balance as represented by the ratio of precipitation to potential evaporation, ranges from a weekly high of 0.87 (precip/PE) in the first week of September to a weekly low of 0.37 (precip/PE) in the last week in July. Short term moisture deficits are made up from soil moisture; but extended dry periods can quickly deplete available soil moisture and bring the crop under stress. Crop stress has impacts on potato yield, tuber diseases, tuber quality and by definition. The need for irrigation is clearly supplemental to the existing precipitation and soil moisture reserves, but none the less has been shown to be critical to optimal production conditions and to moving to more uniform product quality.

<u>Table 4 – Weekly Potential Evaporation (PE) and Water Balance (Precip/PE) (Smith, Michalyna, 1971)</u>

Long-term Weekly Means of Maximum and Minimum Temperatures
and Weekly Totals of Precipitation for the Period May 1st to September 30th*

Week Ending	Maximum Temperature		Minimum Temperature		Precipitation Inches		PE** Inches	Water Balance Precipitation / PE
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
May 7	60.1	13.5	37.2	9.6	0.49	0.66	1.04	0.47
14	62.4	12.4	37.3	8.8	0.43	0.53	1.02	0.42
21	66.5	11.7	41.3	7.8	0.40	0.45	1.11	0.36
28	68.9	11.7	44.2	8.0	0.69	1.07	1.23	0.56
June 4	71.3	11.4	47.6	8.2	0.88	1.01	1.33	0.66
11	72.2	10.4	49.1	7.5	0.70	0.76	1.27	0.55
18	74.9	9.3	51.6	7.1	0.61	0.61	1.28	0.48
25	75.6	8.6	52.6	6.5	0.69	0.66	1.29	0.53
July 2	78.0	8.4	54.6	6.6	0.64	0.71	1.35	0.47
9	80.0	8.2	56.3	6.6	0.77	0.77	1.39	0.55
16	81.6	8.2	57.4	6.5	0.69	0.75	1.43	0.48
23	82.6	7.6	58.4	5.8	0.56	0.60	1.39	0.40
30	82.3	8.1	56.9	6.4	0.52	0.61	1.40	0.37
Aug. 6	82.0	8.2	57.1	5.7	0.81	0.82	1.35	0.60
13	80.3	8.9	55.4	6.7	0.56	0.64	1.27	0.44
20	79.6	8.9	54.1	6.9	0.51	0.71	1.22	0.42
27	77.3	9.6	53.4	7.4	0.48	0.63	1.09	0.44
Sept. 3	74.1	9.6	51.5	6.9	0.82	1.17	0.94	0.87
10	71.7	10.5	48.8	7.8	0.42	0.60	0.86	0.49
17	68.6	10.1	45.8	8.0	0.37	0.40	0.71	0.52
24	64.6	10.4	42.8	7.5	0.48	0.63	0.54	0.89
30	61.5	12.9	38.9	8.3	0.29	0.35	0.38	0.76

Other Weather Parameters

Average Precipitation May 1st to September 30th	–	12.7 inches
Average Annual Precipitation	–	20.3 inches
Corn Development Units (C.D.U.) May 15 to date of first killing frost in autumn	–	2497

*C. F. Shaykewich, Dept. of Soil Science, Univ. of Manitoba. Values were calculated using daily data from the Morden Research Station, C.D.A., for the period 1931 to 1968.

**PE = Potential evapotranspiration is the maximum quantity of water capable of being lost as water vapor in a given climate, by a continuous stretch of vegetation covering the whole ground and well supplied with water. PE was calculated on a daily basis by means of a formula that involved daily values of maximum temperature, temperature range, energy at the top of the atmosphere and vapor pressure deficit estimated from maximum and minimum temperatures.

4.1.5 Soil-Landscape Limitations

The soil-landscape in its natural and modified forms dictate limitations for the intended purpose of the project, namely irrigated potato production. The soil-landscape limitations are discussed in the context of the proposed agricultural systems. These limitations ultimately guide the land suitability assessment for irrigation (Stantec, 2011). Parcel by parcel mapping was undertaken for the 26 fields and a professional agronomist assessment of the intended irrigation of these soil was completed by Stantec (2014).

A standalone report (Stantec, 2014) is provided with this Environment Act Proposal and it presents the results of the individual parcel assessment. A general discussion of the limiting factors of soils within the project zone is a precursor to reporting the assessments.

4.1.5.1 Soil Drainage and Salinity

The majority of soils in the Winkler – Morden area are by definition imperfectly drained (Smith, Michalayna, 1971). The imperfect drainage results from the geology of the relatively impervious lacustrine clay soils that underlay the surficial fine sandy loams. Given this fact producers have firstly attempted to enhance surface drainage and more recently have graduated to installing subsurface drainage, in these soils. Subsurface drainage only operate during the spring and fall or unusually high rainfalls, and are designed to drain saturated root zones to promote crop and soil health. The result is more vibrant crops, a reduction in hotspots of salt and nutrient build up, and overall reduction in surface runoff and associated water erosion of soils. Figure 2 highlights the fields that have or are planned for tile drainage.

Soil salinity is closely related to internal drainage, ponding of water, crop productivity, and landscape position (e.g. topography, drainage). Where salinity exists it is usually associated with higher water tables, upward capillary rise and evapotranspiration of salts, and the associated impacts on crop productivity and uptake of water. Recent studies (Cordeiro, 2013) have verified that the shallow groundwater table contributes extensively to crop production. One can conclude that preventing early season drown out aids in improving late season water table drop due to crop water use. Improving crop uniformity will generally imply that salt build up in the root zones will be reduced over time in tile drained lands as the salt flux recedes to lower depths. Unpublished data from Kroeker's main farm south of Winkler, confirm that this is in fact what happens.

The agronomic assessment takes into account the existing or mapped salinity levels and recommends the need for additional mitigation strategies which could include Phase II investigations (e.g. Veris mapping), site specific irrigation (e.g. avoiding certain areas of a field), or site specific drainage improvements (e.g. targeted surface or tile drainage). Field 20 has been identified for Phase II study.

Kroeker Farms Ltd. have long recognized the impact of variable landscape conditions and where feasible have implemented land levelling and tile drainage to eliminate landscape hot spots, make productivity more uniform and thereby make better use of crop inputs, including nutrients, water and pesticides. This production system can clearly improve the sustainability and environmental performance.

4.1.5.2 Soil Erosion

The fine nature of the soils of the project area, and in particular those with increased percentages of fine sand and silt make them susceptible to wind and water erosion. Producers have recognized this fact since settlement of this land. This fact is supported by the significant number of mature shelterbelts within the project area. The agronomic assessment includes a recommendation for consideration of erosion BMPs for those soils most susceptible (see Table 9; Stantec, 2011; Stantec, 2014).

4.1.5.4 Soil Water and Nutrient Holding Capacity

The ability of soils to hold significant quantities of water and nutrients with the soil matrix allows the plant to draw on these as needed for growth. Individual soil zones have specific water holding capacities that relate to soil structure and texture. The agronomic analysis presents information to allow consideration of these factors. Firstly, water holding capacity is reported for each and every field. Water holding capacity can be utilized to determine the frequency and amount of irrigation required to maintain optimum crop growth. The soils of the project area generally have medium water holding capacities as documented in the Stantec (2014) report. The nutrient management regulations make use of the soils texture and other information to judge and recommend nutrient management practices that are appropriate for the soil-landscape in question. Soil-landscapes that are level to sloping and have reasonable soil water holding capacities will have a higher nutrient management rating. This is generally true of the project area.

4.1.6 Soil-Landscape Suitability Assessments

4.1.6.1 Agricultural Capability

The soils of the project area are considered prime agricultural land (Smith, Michalayna, 1971). Table 5 shows that the Project area is rated as 99.5% within Class 1 – 3 for agricultural productivity. The small area of Class 5 soils should likely be farmed in an alternative fashion, and is also generally also unsuited for potatoes and irrigation.

Table 5 - Agricultural Capability of Project Soils

Soil Agricultural Capability Class	*Area (Ha/Acres)*	*Proportion of Total Area (%)*
1	***807.5 (1995)***	***54.7%***
2	***338.6 (836)***	***22.9%***
3	***323.5 (799)***	***21.9%***
4	***0 (0)***	***0%***
5	***7.4 (18)***	***0.5%***
6	***0***	***0%***
7	***0***	***0%***
Total	***1477(3648)***	***100%***

4.1.5.2 Irrigation Suitability

The soils of the project area have been compiled and rated by Stantec (2014) for irrigation suitability in accordance with a guideline developed in conjunction with AAFC and Manitoba Agriculture Food and Rural Development (Stantec, 2011). The basis of this is the irrigation suitability guidelines published by Agriculture and Agri-Food Canada.

Soils are suited for irrigation if they are rated excellent or good. Table 6 reveals that 96% of the Project soils are rated excellent or good. Limitations may apply to 3% of the soils landscapes, but can be irrigated with precautions. One field (20) has been identified for follow up PRIOR to be recommended for irrigation. Approximately 1% of the soils landscapes studied should not be irrigated, and will be treated as such.

Table 6 - Irrigation Suitability Class of Project Soils

Irrigation Suitability Class	*Area (Ha/Acres)*	*Proportion of Total Area (%)*
Excellent	***367.1 (907)***	***24.9%***
Good	***1050 (2593)***	***71.1%***
Fair	***47.4 (117)***	***3.2%***
Poor	***12.6 (31)***	***0.8%***
Total	***1477 (3648)***	***100%***

4.1.5.3 Suitability for Irrigated Potato Production

The soils of the project area have been compiled by Stantec (2014) for irrigated potato production in accordance with a guideline developed in conjunction with AAFC and Manitoba Agriculture Food and Rural Development (Stantec, 2011). The basis of this is the irrigated potato production guidelines published by Manitoba Agriculture Food and Rural Development.

Soil landscapes rated as Class 1 – 3 are well suited for potato production. Table 7 reveals Class 1 – 3 represent 97.5% of the Project acres studied. Approximately 2.5% of the Project soils studied are marginally or totally unsuitable for irrigated potato production and will be treated as such.

Table 7 - Potato Irrigation Suitability Class of Project Soils

Potato Irrigation Suitability Class	*Area (Ha/Acres)*	*Proportion of Total Area (%)*
1	***297.9 (736)***	***20.1%***
2	***73.1 (180)***	***5.0%***
3	***1069 (2640)***	***72.4%***
4	***10.9 (27)***	***0.7%***
5	***26.2 (65)***	***1.8%***
Total	***1477 (3648)***	***100%***

4.1.5.4 Beneficial Management Practices

The soils landscape assessment guideline (Stantec, 2011), provides a list of Best Management practices that can be incorporated by producers in order to address the noted limitations associated with irrigated potato production. These BMPs are part and parcel of the strategy to minimize environmental impact while maximizing production. Progressive farms like the Proponents are well aware of BMPs and have adopted them as part and parcel of their production methods. These BMPs are also crucial to maintaining contracts with processors and clients whom are requiring their products be grown in a manner that respects the environment (e.g. Unilever, 2010).

4.1.6 Surface Water

The major water source to the Project area is the Shannon Creek. The Shannon Creek watershed at the easterly edge of the project is represented by the Water Survey of Canada gauging station 050F021 and 050F022 (Figure 7). The Shannon Creek at this location has a drainage area of between 270 to 300 square kilometers (depending on the gauging station); draining water from the Escarpment to the west and flowing easterly towards the Red River near Morris. By the time the Shannon Creek has reached Morris its' drainage area has doubled to 617 square kilometers.

The Shannon Creek is intermittent in nature with large flows in spring associated with snow melt runoff and rainfall. Summer flows are typically curtailed by the significant excess of potential evaporation over precipitation (Table 4) and the lack of significant runoff, except in extreme rainfalls. Flow hydrographs on the Shannon Creek are impacted by the storage and release of water associated with the back flooding of Lizard Lake (Figure 7). This water retention project releases water after being held for several weeks past the spring snowmelt peak. This later spring release also has a noticeable impact of the water quality (e.g. turbidity) of the flow on the Shannon Creek in comparison to the Thornhill Coulee.

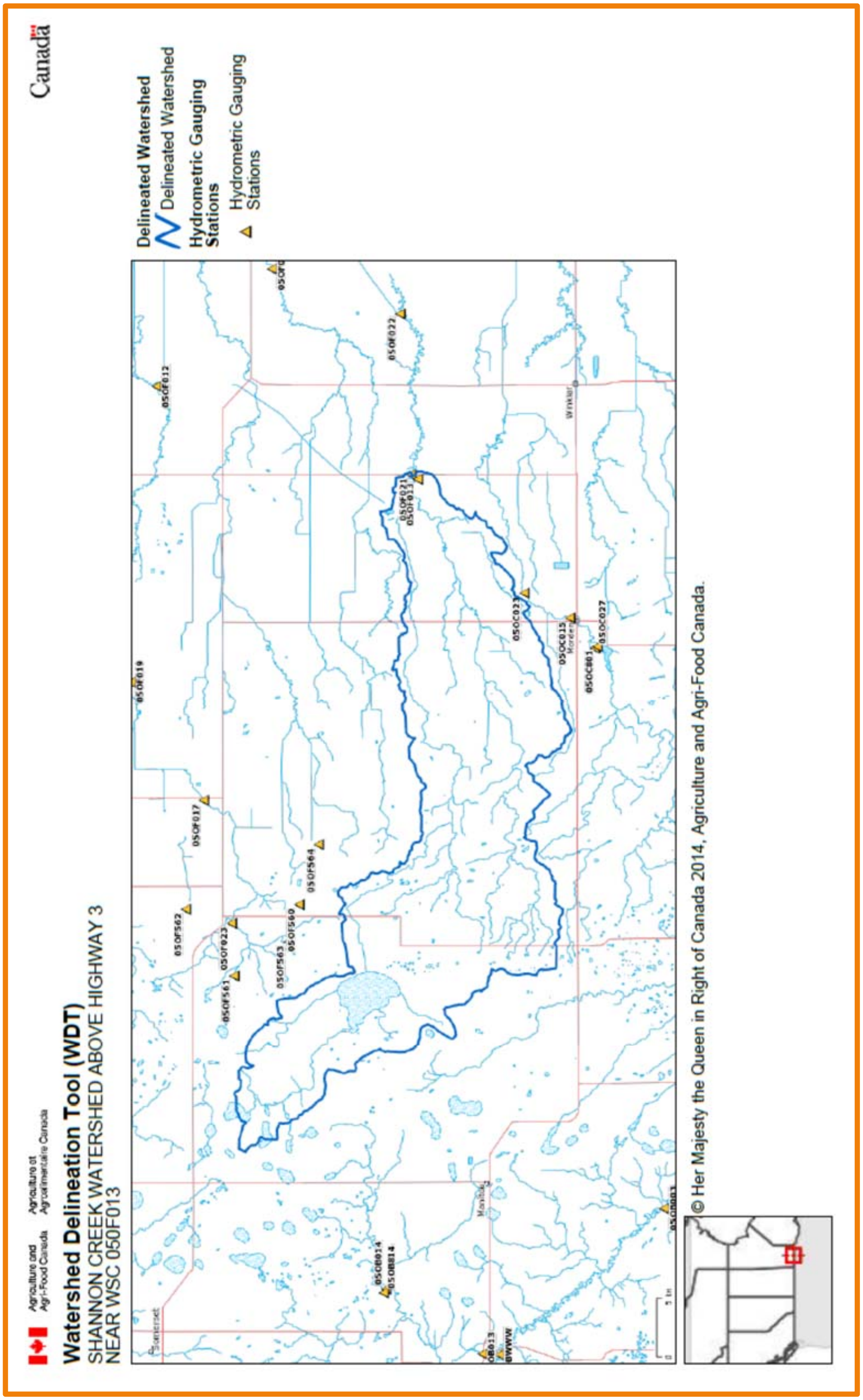

Figure 7 - Shannon Creek Watershed near Highway 3 - 270 KM2
(AAFC, Watershed Delineation Tool)

The average Mar – May spring runoff on the Shannon Creek from 1970 to 1992 was 8400 cubic decameters. Peak flows at WSC 050F022 (Figure 8) are in the order of 70 cubic meters per second; which equates to 6100 cubic decameters per day. These peak flows are the channel forming considering their energy levels and are the flows that define the size of the downstream drainage system to the Red River.

Water Stewardship and Agassiz Irrigation Association signed a development agreement in 1995 detailing water available for development. The general rule agreed to was allocation of up to ½ of volume available in 8 years out of 10. For the Shannon Creek at Highway 3 this volume is approximately 410 acre feet. (Personal Communication, Asit Dey, Manitoba Water Stewardship, May 12, 2014). The Memorandum of Understanding allows for consideration of allocation additional water up to that flow available 7 years out of 10. The memorandum also allows for increasing the stored volume by 50% over the allocation to allow for carry over from wet years. The available storage is 1.5 x 410 = 615 acre feet.

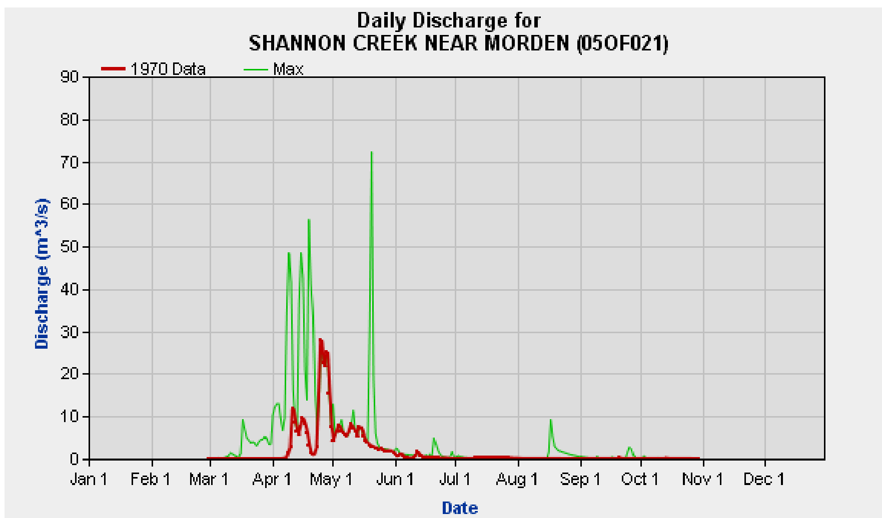

Figure 8 - 1970 Runoff Shannon Creek Near Morden (050F021) and Maximum Dailies 1970 - 1987

The flashy nature of the Shannon Creek is depicted in the hydrographs from 1988 to 1992 at the WSC Gauging Station O5OF022 Figure 9 a - e hydrographs. During consultations around the formation of the Agassiz Irrigation Association Inc. in the 1990's it was agreed with fisheries experts, that the allocation strategy would be to withdraw as much as possible on the rising limb of the hydrograph, in order to maintain the recessional limb. This is accomplished by sizing the withdrawal pumps as large as practical. In addition, consideration to maintaining a minimum in-stream flow was made (AIA, 1996). Figure 9 shows that the peak daily discharge over a five year period from 1988 – 1992 varied between 0.8 and 7.0 cubic meters per second. The daily volume of water for that peak day would be from 70 dam3 (56 acre feet) per day to 600 dam3 (490 acre feet) per day.

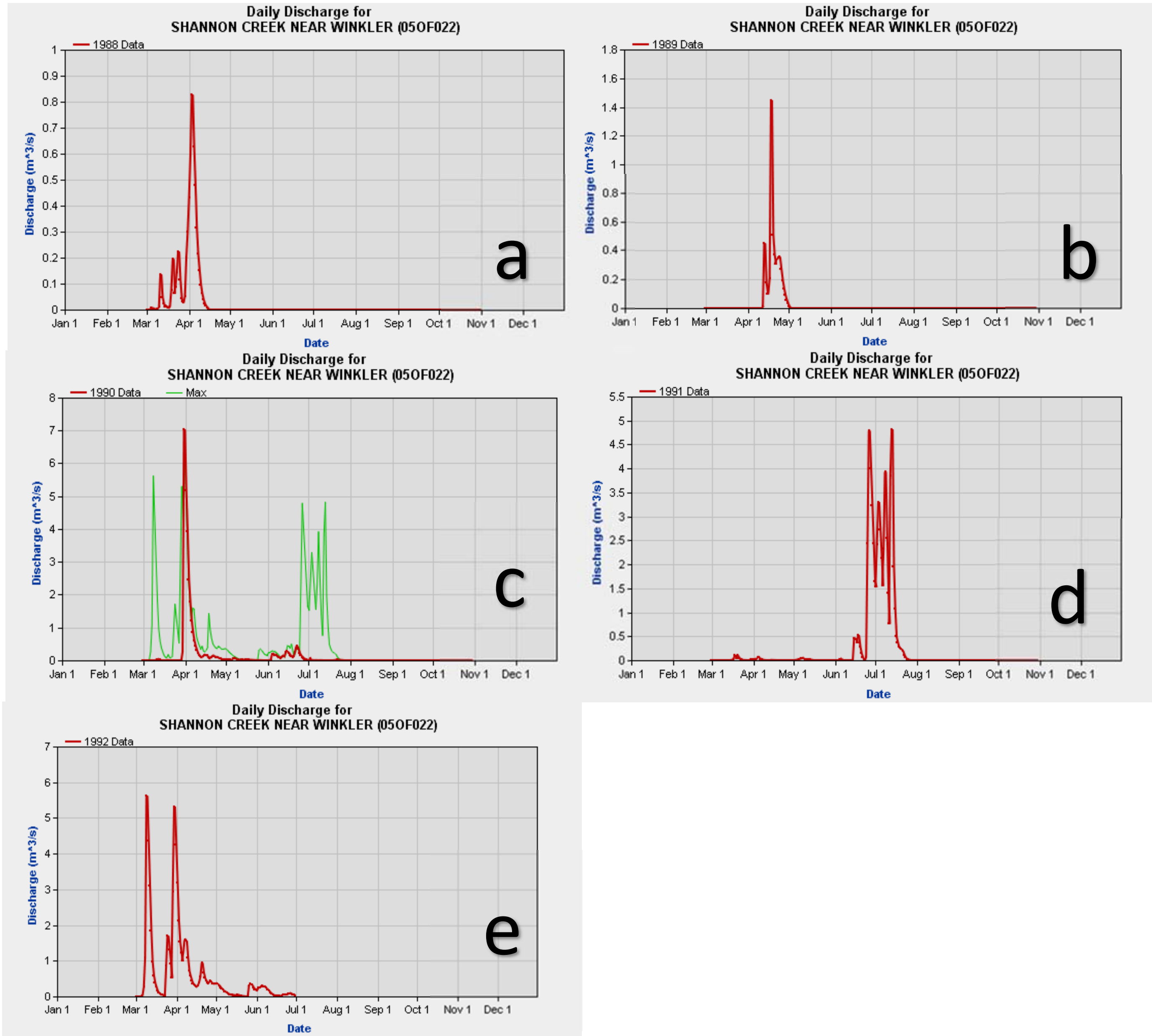

Figure 9 a to e - Shannon Creek Near Winkler (O5OF022) Daily Flows 1998 - 1992

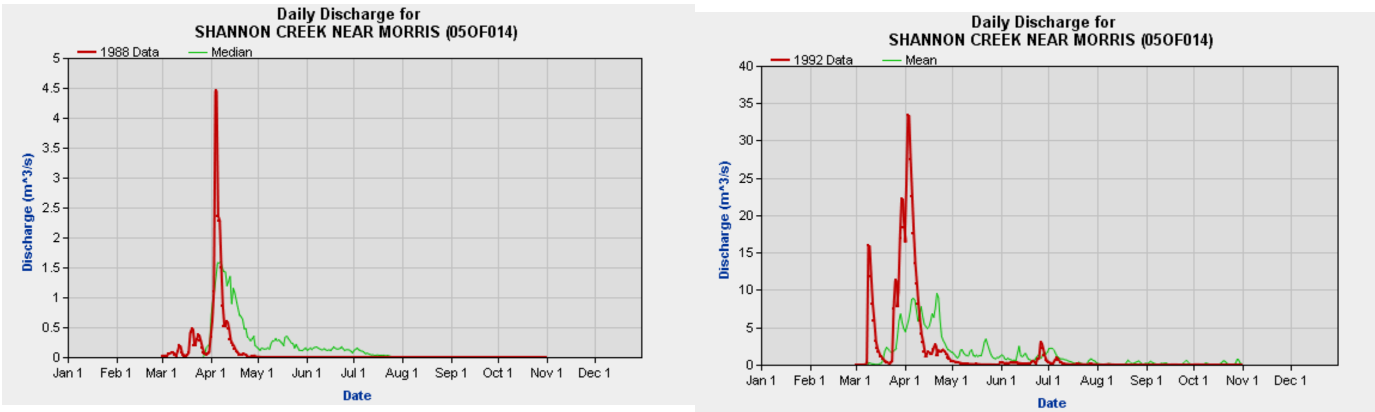

Figure 10 – Shannon Creek Near Morris (050F014) Daily Flows 1990 and 1992

Figure 10 illustrates, in comparison with Figure 9, that water peaks downstream towards the Red River are maintained, and are coincident in nature, larger by factor of up to 5 and delayed by up to a week. The nature of the Shannon Creek watershed is that snow and ice block the waterways, culverts and bridges after a long winter, and water must make its way from upstream to downstream prior to any connection being made to overwintering fisheries (e.g. the Red River and Lake Winnipeg). This reinforces the importance of the recessional limb.

Table 8 presents the tabular data for Figure 9c – 1990 Shannon Creek near Winkler. The Table reveals the large and quick initial rise in flow, with a 30 fold increase over a day (e.g. coinciding with breaking through the snow packed channel). This initial peak is followed by a short period of high flows (e.g. 10 days above 0.3 m3/sec) and a longer drawn out recessional limb which keeps water flowing in the slower, flatter downstream reach (e.g. 40 days between 0.01 and 0.3 m3/s). Spring rains in June, revive the flow for a period of about a month in June and early July. Consultations in the 1990's by Agassiz Irrigation Association (AIA, 1996) determined that fisheries experts considered the recessional limb the most important part of the hydrograph with respect to maintaining opportunities for spawning. If, as observed, the water works its way through snow and ice from upstream to downstream, this makes sense. Water withdrawal rates need to be geared to take advantage of the larger spring freshet flows (e.g. above 0.5 m3/sec) and the short time frame (e.g. between 5 to 10 days). Maintaining a downstream flow during withdrawal will ensure continuity to the recessional limb of the hydrograph (AIA, 1996).

Table 8 - Typical Daily Discharge Hydrograph for Shannon Creek Near Winkler – 1990

(Green highlights potential withdrawal period; yellow highlights extended recessional limb of the hydrograph)

1990	Mar	Apr	May	Jun	Jul
1	0 B	7.05 B	0.019	0	0.012
2	0 B	5.20 B	0.018	0	0.015
3	0 B	3.93 B	0.023	0.006	0.057
4	0 B	2.48 B	0.023	0.007	0.012
5	0 B	1.78 B	0.018	0.203	0.005
6	0 B	1.23 B	0.013	0.193	0.003
7	0 B	0.875 B	0.059	0.164	0.005
8	0 B	0.610 B	0.076	0.176	0.003
9	0 B	0.450 B	0.052	0.122	0.002
10	0 B	0.317 B	0.032	0.095	0.003
11	0.013 B	0.213 B	0.018	0.077	0.003
12	0.022 B	0.152	0.012	0.105	0.001
13	0.037 B	0.119	0.020	0.140	0
14	0.020 B	0.089	0.020	0.115	0
15	0 B	0.134	0.015	0.242	0 A
16	0 B	0.169	0.017	0.284	0 E
17	0 B	0.156	0.021	0.236	0 E
18	0 B	0.145	0.021	0.175	0 E
19	0.007 B	0.102	0.017	0.130	0 E
20	0.006 B	0.072	0.014	0.112	0.002 E
21	0.003 B	0.110	0.011	0.135	0.007 E
22	0.002 B	0.141	0.009	0.270	0.013 E
23	0 B	0.135	0.007	0.462	0.021 E
24	0 B	0.106	0.005	0.349	0.016 E
25	0 B	0.100	0.003	0.232	0.012 E
26	0 B	0.082	0.004	0.159	0.009 E
27	0 B	0.067	0.003	0.111	0.005 E
28	0.001 B	0.051	0.002	0.074	0.001 E
29	0.004 B	0.033	0.001	0.044	0 E
30	0.010 B	0.024	0	0.022	0 E
31	0.275 B		0		0 E
Mean	0.013	0.871	0.018	0.148	0.007
Max	0.275	7.05	0.076	0.462	0.057
Min	0.000	0.024	0.000	0.000	0.000
Total	0.4	26.122	0.553	4.44	0.207
Total Dam^3	34.6	2260	47.8	384	17.9

Lizard Lake is a significant feature contained in the upper Shannon Creek watershed, which influences flood peaks, total volume of discharge and timing of flows in the creek. The normal operation of this back flood project influences the minimum flow rates on the Shannon Creek and should be coordinated with any downstream withdrawals, to the benefit of the downstream fisheries.

A recent newspaper article (http://www.pembinatoday.ca/2011/10/06/lots-to-learn-from-lizard-lake) described the Lizard Lake project operation as follows:

Construction of the ring-diked central or marsh cell (see Figure 11) ensured the continued presence of the wetland and wildlife habitat.

Surrounding this, a back-flood or temporarily flooded cell of about 1,560 acres was created. Each spring, the temporary flooding within the back-flood allows optimum growth of the grasses and sedges, providing an abundance of hay when the water level is lowered. This temporary water also provides important pair, loafing and feeding sites for waterfowl.

Attesting to its biodiversity, a variety of animals are part of this eco-system including geese, ducks, mink, muskrats, beaver, terns, rails and bitterns.

In normal runoff years, its operation consists of setting the control structures, allowing the back flood cell to fill to the desired level. Controls in the ring dike are adjusted, allowing water back into the marsh cell by means of gravity flow to the desired operating level.

This operating level on the marsh cell may vary from year to year. Any excess water flows out of the back-flood controls and down the outlet ditch. In years of normal or greater than normal spring runoff, desired levels on both cells are attained.

Water from the back-flood cell is normally released starting in late May in order to allow the hay land to dry out sufficiently for hay operations in mid-summer. Water is released at a rate so as not to exceed the flow capacity of the ditch. If flow capacity is exceeded, then water will spill outside of the ditch and may cause problems for downstream landowners.

Figure 11 - Photo of Lizard Lake (accessed May 6, 2014)

http://www.pembinatoday.ca/2011/10/06/lots-to-learn-from-lizard-lake

4.2 Terrestrial Environment

The majority of the Winkler Eco District (Figure 1) is cropland (Smith et al., 1998). The value of the remaining natural habitat is limited due to its' disperse nature and lack of continuity. The project area is mainly confined to the cultivated areas of the project footprint (Figure 5), including all irrigated lands, Site A, Site C and most of the planned pipelines, which will be typically located on easement (Figure 3). Creek crossings and intakes will impinge on riparian zones. Road crossings are mainly through maintained road/drainage ditches.

4.2.1 Vegetation

Michalayna, Smith (1971) and Smith et al (1998) describe the native vegetation of the area.

> *The native vegetation within the Red River Valley is dominantly mixed tall prairie grasses, meadow prairie grasses and herbs. This has largely disappeared due to cultivation (Smith et al, 1998). Groves of white elm, Manitoba maple and green ash occur along many of the better developed streams and creeks through the area (Smith et al., 1998). Bur oak is found on banks not prone to flooding. Poorly drained areas support slough and marsh grasses, willows, cattails and sedges. (Smith et al., 1998).*

Crops and planted shelterbelts have largely replace the native vegetation except along the existing stream channels and oversized valleys and particularly along the Thornhill Coulee (Figure 5). Along the tributary to the Thornhill Coulee where site B is proposed, the vegetation is largely grazed pasture land; devoid of any wooded vegetation (Figures 12 and 13). There are a few stretches of native wooded riparian zones; particularly, along the Thornhill Coulee in NW 34-3-5W (Figure 14). Along the Shannon Creek stretches have been reconstructed in order to pass water more efficiently (Figures 15 and 16).

Common grass and grass like species reported in the Winkler-Morden area (Smith, Michalyna, 1971), included blue grass, cord grass, june grass, sedges, spear grass, and wheat grass. Commonly reported herbaceous plants (Smith, Michalyna, 1971) included prairie crocus, asters, banberry, cinquefoil, fireweed, sage, strawberry, thistle, violets and wormwood.

4.2.2 Wildlife

The region includes habitat for white-tailed deer, coyote, rabbits, ground squirrels, and waterfowl. (Smith et al., 1998). The MSTW Planning Study contained as part of Bylaw 4-05 contains a description of the wildlife with the majority of the study area (e.g. RM of Thompson and RM or Stanley) (http://www.mstw.ca/PDF/MSTW_Development_Plan_ByLaw_4-05.pdf):

> *The Canada Land Inventory rates the Planning District as having moderate limitations for the production of waterfowl because of either adverse topography, poor water holding soil capacity, poor distribution or interspersion*

of marshes or basins or a combination thereof. This should not suggest however, that the Planning District does not provide habitat to other wildlife species. In fact, the Escarpment **(i.e.upslope from the Project in the Manitou Eco District in Figure 1)** *is the most critical wildlife habitat in the Planning District, as it provides varied habitats to wildlife, ranging from wetlands, oak-aspen forest to sheltered river valleys. It is important for deer and wild turkey habitats since the slopes are attractive for warmth and winter shelter. The transition between the Escarpment and arable cropland is also noted for sharp-tailed grouse, ruffed grouse, fox, coyote and various songbirds, while the Tobacco Creek, Shannon Creek, Dead Horse Creek and the Pembina River provide for vegetated wildlife habitat, with potential for songbirds, shorebirds, small game and furbearers such as muskrat, beaver, mink and weasel.*

4.2.3 Species at Risk

Contact was made with Chris Friesen of the Manitoba Conservation Data Base to determine the potential for existence of Rare and Endangered Species. Copy of the correspondence is included in Appendix E. There are no expected occurrences of Species at Risk in the Project Area. The project is mainly being constructed on cultivated land as detailed above. Section 4.3 discusses aquatic species at risk.

Figure 12 - Thornhill Coulee Tributary - Site B - 32-3-5W

Figure 13 - Thornhill Coulee Tributary - Site B - 32-3-5W

Figure 14 - Thornhill Coulee - SW 34-3-5W - Wooded Reach

Figure 15 - Shannon Creek - PR432 - Looking East - Channelized

Figure 16 - Shannon Creek - NE 3-4-5 W - Looking East - Channelized and Dyked

4.3 Aquatic Environment

Previous Environment Act Licenses in this vicinity were reviewed with respect to Federal Department of Fisheries and Oceans (DFO) requirements, and the license clauses pertaining to fisheries. Minimum in stream flows were not identified in most of the recently issued licenses in the vicinity of this project on the Shannon Creek. Appendix C contains the subsisting EAL 2480 on Shannon Creek downstream of the existing withdrawal point.

In the summary to the EAL 2480 it was noted (http://www.gov.mb.ca/conservation/eal/archive/2000/summaries/4542.pdf):

> *With respect to intake screening, it is believed that the project location is well upstream of the fisheries area of interest. DFO has jurisdiction over intake screens, so will approve any necessary screen design directly.*

Previous applications by Agassiz Irrigation Association in the mid -1990's (AIA, 1995) considered the withdrawal of water on intermittent streams coming off the Manitoba Escarpment and came to the conclusion that no fish screens were required due to the distance of the projects from the Red River.

Previous licenses issued to AIA Inc on the Hespler Drain (e.g. EAL 2093) (AIA, 1995) for a similar drainage area accepted an in-stream flow of 0.36 m3/sec (Appendix C).

4.3.1 DFO Classification Maps

The project area is traversed by Shannon Creek and its tributary Thornhill Coulee (Figure 1). The Deadhorse Creek passes through the southerly portion of the project area, but no water withdrawal is proposed at this time. The North Shannon Creek traverses the northerly portion of the project area, but no water withdrawal is currently proposed at this time. Portions of the Shannon Creeks has been reconstructed or modified to increase capacity and to dyke them from overland flooding of adjacent farm lands (Figure 15 and 16). Both the Shannon Creek and Thornhill Coulee's are diked along the reaches where water withdrawal would be made for Site A and Site C. Site B is located in an oversized valley which is generally grassland (Figure 12 and 13; Figure 5). The existing creek at this location has very limited habitat capacity, given its' limited watershed, clay substrate, lack of riparian zone and limited channel capacity.

The Government of Canada and the Province of Manitoba convened the Manitoba Drain Maintenance Committee to better understand the nature of agricultural drains as supporting fish communities. Subsequently, in January, 2014, the Department of Fisheries and Oceans (Milani, D.W. 2013) released classifications of streams throughout Manitoba, including the area of interest along the Thornhill Coulee, the Shannon Creek within the project area. Appendix G provides a copy of figures and questions and answers with respect to the reference.

Milani (2013) summarizes five years of field surveys (2002-2006) and develops a first iteration of classified fish habitat maps. The classified fish habitat maps break the habitat of agricultural waterways into 5 habitat types, A,B,C,D or E, based on gross measurements of fish habitat complexity and the fish species presence (captured or expected) (***Commercial, Recreational, Aboriginal or SARA listed*** Fsh species vs. **Forage** Fish species vs. ***No Fish***).

Generally ***A and B habitat types support Commercial, Recreational, Aboriginal or SARA species*** with Type A habitat being complex and Type B habitat being simplified. Habitat ***Type C and D drains support Forage Fish species*** with Type C habitat being complex and Type D habitat being simplified. Habitat Type E drains can be simple or complex but provide indirect fish habitat.

The maps provide a quick risk assessment for the potential of impacts to fish and fish habitat in Agro-Manitoba from a variety of works that occur in and near water, to be supplemented with local knowledge.

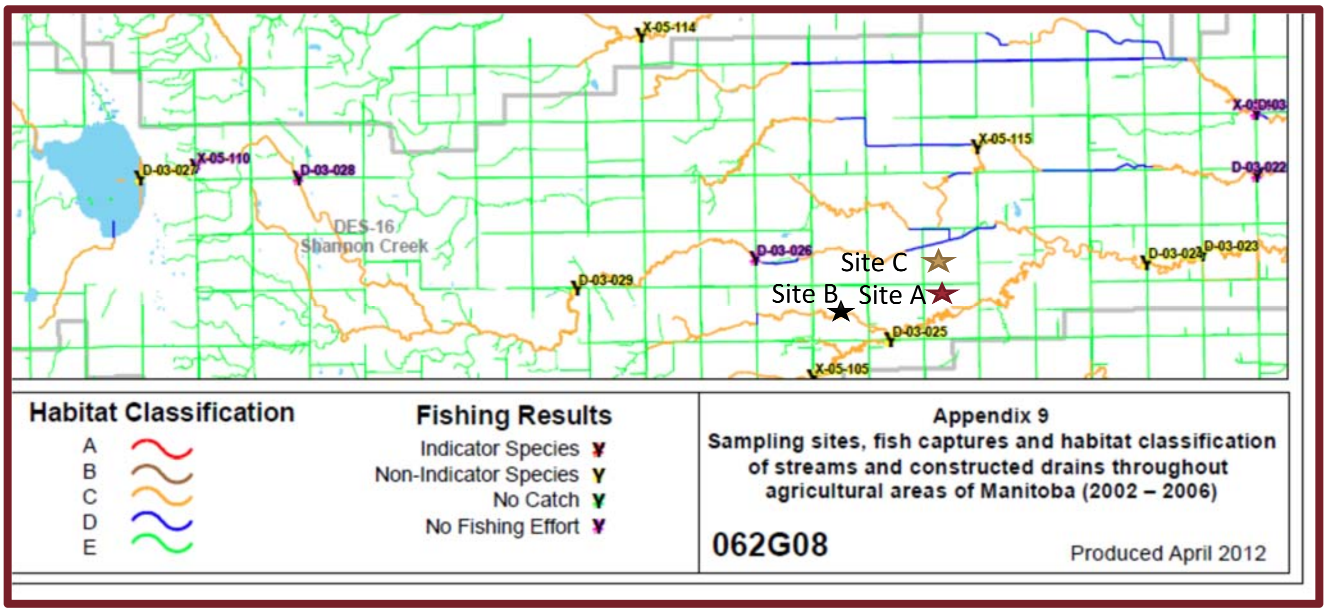

Figure 17 - DFO Habitat Classification of Streams and Constructed Drains in the Shannon Creek Watershed (see Appendix H for full map).

According to Figure 17, Site A and B are currently considered to be Class C habitat while Site C is considered Class D habitat. Site C is adjacent to a channelized, diked, straight reach of the Shannon Creek (Figure 16). Site B is a meandering deep narrow clay channel in an oversized, grassland valley bottom; that has limited drainage area and little to no non-clay substrate (Figures 12 and 13). The Thornhill Coulee tributary at Site B is also dry for the majority of the year, having little to no sustained groundwater inflow. The Thornhill Coulee at Site A is a more complex portion of the creek that is heavily wooded and largely non- channelized. There are some dikes and or waste piles along the floodplain edge of the Thornhill Coulee at Site A to protect adjacent agricultural land.

Milani (2013) provides further detailed information on methodologies, techniques, channel photos and fishing results. This extensive report is clearly the best information currently readily available for making an initial determination of impact of the project. Figures 12 – 16 provide some visual context that supports the interpretations.

4.4 Socio Economic Environment

The Project area is largely agricultural in nature. Some small industries co-exist along-side working farms. There is also some rural residential in particular along the southern boundary of the project area. The City of Morden airport is also located adjacent to one of the irrigated fields (ie. Field 01, Figure 2).

The project area is traversed by the PR 432 which is a main artery to the City of Morden and from there to the City of Winkler via Highway 3 and 14. The project area is approximately 2 miles east of the Highway 3 which runs north to Carman. The corridor between Morden and Winkler is a twinned highway, designed to convey heavy truck traffic. The main travel routes for the Project area includes these highways which lead from the Project area to the City of Winkler and to the Village of Schanzenfeld; as this is where potato storage sheds owned by the Proponents are located.

Building activity for RM of Stanley for 2011 was $106 M as reported by the MSTW (http://www.mstw.ca/building_permit_stats/2011%20Permit%20Report.pdf). The Project will generate significant economic activity and will have total expenditures in the order of $4 M. A significant portion of the expenditure (approaching 50%) will be spent on goods and services from outside the MSTW planning area. Estimated expenditures are as follows.

Reservoirs	$1.8 M
On Farm	$1.2 M
Pipelines	$1.0 M
Power	$0.1 M
Pumps	$0.3 M

Currently there is a lack of three phase power in the Project area. The preferred power source based on environmental impact is Hydro power; but capital costs will have to be evaluated to determine payback on investing in Hydro power vs. Diesel engines.

Both Hespler Enterprises Ltd. and Kroeker Farms Ltd. are long time producers operating in the MSTW area. They each employ full time staff, as well as short term (seasonal) employees. The Project is geared to enhance the environmental and economic security of these farm operations, and to maintain and enhance their employment opportunities. Incremental employment due to the project is associated with construction (short term) and operations (long term).

4.5 Public Safety and Human Health

Public safety is a primary concern for both Hespler Enterprises Ltd. and Kroeker Farms Ltd. This starts with on farm safety for their employees, but extends to off farm safety associated with truck traffic from the project area to the potato storage sites. Kroeker Farms Ltd. main storage is on the east side of Winkler and Hespler Enterprises Ltd. main storages are on Highway 3 west of the City of Winkler and near the village of Schanzenfeld. All truck drivers are provided with ongoing safety training including defensive driving, standard operating procedures and scheduled performance reviews.

The Winkler Morden area has been developing off stream reservoirs of this nature since the early 1990's. The nearest reservoir is 1 mile east of the proposed Site C. All reservoir sites would be designated with signage warning of dangers and prohibiting trespassing. There are no reports of safety issues with existing reservoirs.

All irrigation pipelines are mapped with GPS and as – constructed plans can be filed with the RM of Stanley, RM of Roland and RM of Thompson. The majority of pipeline will be located on easement on private property. Where necessary, the Rural Municipalities will be approached to allow the pipelines to be buried in their road allowances. Pipelines will be duly marked on each ½ mile (per their location).

Pipeline crossings are of special consideration for irrigation projects. All road crossings include a liner pipe, which will have equal or greater pressure rating to the carrier pipe; which is intended to contain pipeline water breaks to outside the travelled road, and prevent sink holes on the traffic area. All creek crossings will be marked on either site of the creek. All other crossings will adhere to appropriate regulations (e.g. Transport Canada), and will require approval by authorizing agency.

Riser pipes are used to bring water to the edge of fields and to allow for venting of air and water. All riser pipes (turnouts, air valves, valves) are protected with wooden bollards which are painted white and include reflectors and signage. Special care needs to be taken where known off road activity is occurring (e.g. snowmobiles).

Intake systems to the Creeks (Thornhill Coulee and Shannon Creek) are marked to maintain safety for users of the public waterways (e.g. canoes).

The raw water being pumped in the pipelines poses no risk to human health as it is not modified in any form. Backflow prevention devices will be provided on farm where fertigation systems are employed, to prevent uncontrolled discharge of fertilizer in the event of pipeline breaks.

The irrigation systems are automated and are complete with safety shut offs to prevent them from moving off farm.

The remaining farming processes (e.g. planting, spraying, harvest) are carried out in accordance with Provincial farm safety regulations; and both Hespler Enterprises Ltd. and Kroeker Farms Ltd. have ongoing safety programs for their employees.

All contractors operating on the construction sites will be required to be COR certified or equivalent (Construction Safety Association of Manitoba, 2014).

4.6 Protected Areas and First Nations

The nearest Protected areas to the Project area are the Pembina Valley Provincial Park, the Deerwood Wildlife Management Area, and the Wellington Wildlife Management Area, Lizard Lake (Ducks Unlimited). All of these are well outside the Project Area (Figure 1). There are no local improvement districts, a portion of the area is designated Rural Policy Area – Limited Development Area; specifically Field 01 near the Morden Airport (Figure 2).

The MSTW Planning Report (MSTW, 2007) also highlights these areas and the constructed Lake Minneswasta as significant local features, but well outside of the Project area (Figure 1):

> *Of special note, Lake Minnewasta, which originated with the damming of the Dead Horse Creek, is located in the southwest quadrant of the Town of Morden and also extends into the RM of Stanley. It provides for various outdoor nature-related and recreational activities. Furthermore, the Pembina Valley Provincial Park as well as the Pembina Valley, Deerwood and Wellington Wildlife Management Areas serve to protect and manage fish and wildlife habitat as well as sensitive areas.*

The nearest First Nations are Swan Lake to the west, Roseau River to the east and Long Plain to the North. All are greater than 30 miles from the project site and have no known interest or impact on the project.

4.7 Heritage Resources

Contact was made with Manitoba Historic Resources Branch in in order to ascertain what existing heritage resources exist within the project area. A copy of the correspondence is included in Appendix D. There has been no response at time of printing. The Proponents will follow up after submitting this report.

There is published and marked Historical sites in the rural areas, mainly demarking school districts and other more recent cultural resources. None of these occur at the three proposed reservoir sites. Pipeline construction will avoid such marked sites. More ancient sites associated with Aboriginal activities are less documented and always possible. A book titled *Uncovering Early Aboriginal History in Southern Manitoba* (2011), will be consulted. It is a 128 page book with 74 illustrations comprising maps, artifact photos and drawings, and "people pictures" showing living scenes and imagery based on the findings at a recently excavated site near the Pipestone Creek in Southwest Manitoba and other sites in southern Manitoba and elsewhere. The volume describes the objectives of conducting excavation of archaeological sites in general. It relates what happened at a certain locale on the prairie landscape.

Under provisions of *The Heritage Resources Act* (1986), land developers may be called upon to provide for, at their own cost, the mitigation of impacts on Manitoba heritage resources. The Proponents are aware of this responsibility.

5.0 Environment Effects

Potential impacts of the development on the environment, are described in detail in this section, including recommendation of mitigation measures and subsequent significance of the impact on the environment of the Project area.

5.1 Impact and Mitigation on Physical Environment

5.1.2 Impact on Geology and Groundwater

There is no planned groundwater withdrawal. The reservoirs will not leak into the Winkler Aquifer, and the project area is located to the west of the Winkler Aquifer footprint. The irrigated lands will follow Best Management Practices regarding wind and water erosion and Provincial Nutrient Management Guidelines based on individual field by field basis. The shallow surficial groundwater is poor quality, drought prone and has been replaced by rural water pipelines from Pembina Valley Water Coop and from Lake Minnewasta. The deep shale groundwater is protected from contamination by overburden of lacustrine clay and till, and in any case is poor quality.

The only unique geologic features within the project area are the Hillsboro Beach, the Winkler Aquifer and Paterson Pit. None of the proposed reservoir sites will negatively impact these features, as they are not with in the planned footprint of those sites. Care will be taken with pipeline construction to identify any potential downslope groundwater movement in trenches (e.g. clay plugs).

Care is provided (see Sections below) to prevent contamination of surface water sources (e.g. Shannon Creek) that may or may not interact with the Winkler Aquifer.

There are no significant impacts anticipated on geology and / or groundwater as a result of the proposed construction or operation activities.

5.1.2 Impact Surface Water Hydrology and Water Quality

Surface water will be diverted and stored in the planned reservoirs. The reservoirs will be engineered by qualified professional engineers registered with the Association of Professional Engineers and Geoscientists in Manitoba.

Water diversion rates will vary at a rate of up to a maximum of 1.25 cubic meters per second. Diversions would last for about 4 – 5 days in length. The water to be diverted is largely spring freshet runoff from snowmelt and rainfall. Allocation will be made by Manitoba Conservation and Water Stewardship from available water allocation budgets, based on careful consideration of economic and environmental uses of water. The projects will be issued Development Permits prior to construction. The projects will be issued Water Rights licences after construction. All Water Rights license conditions will be adhered to by the Proponents.

The Project will have little impact on the large channel forming flows and associated downstream flooding along the Shannon Creek below Highway; with maximum diversion rates at less than 2% of peak daily flows. Minimum in stream flows will be maintained in accordance with any EAL and Water Rights Licenses issued. After review of Figures 8, 9 and 10, and Table 4, it is suggested that 0.2 cubic meters per second would be a reasonable minimum in-stream flow during pumping. The minimum in-stream flow would help to maintain downstream flow during withdrawals and support the duration of the recessional limb of the hydrograph downstream of the Project area.

The impact of tile drainage and irrigation on runoff are described in the section on Impact and Mitigation on Soil-Landscape Resource. This section also describes the impact of irrigation and drainage on nutrient management.

Measures to prevent sediment runoff from project construction sites is described under the section Impact on Fisheries and on Impact on Soil Erosion and Transport.

Backflow prevention will be included on all irrigation systems, and in particular those employing fertigation systems; to prevent backflow of fertilizer into the distribution pipelines. Discharge from irrigation pipeline to waste (e.g. ditches) will be controlled and only undertaken during filling, commissioning and draining of the pipelines.

There are no significant impacts anticipated on surface water hydrology or water quality as a result of construction or operation activities.

5.1.3 Impact and Mitigation on Soil – Landscape Resource

Stantec (2011) established guidelines for assessing the suitability of soil-landscapes for irrigated crop production. In accordance with that guideline individual field by field assessments were made for the 26 parcels of land being considered for irrigation development. The field specific Phase I reports were generated by Northern Allied Services and Kroeker Farms GIS personnel; and certification of irrigation suitability and recommendation of Best Management Practices was completed by professional pedology staff from Stantec (2014).

Stantec (2014) contains the full individual parcel reports. Table 9 provides a summary of the assessment for each field and the recommendation with respect to suitability for irrigation. Tables 6, 7, and 8 detail the percentage of land suitable for agriculture, growing potatoes and irrigation, based on statistics generated by Northern Allied Services. Significantly, 96 % of soils landscapes have no limitations for irrigation, 3% can be irrigated with precautions and 1% of soils landscapes will be removed from consideration for irrigated production.

The Stantec (2011) guideline includes procedures for identification of Phase II investigation requirements and the standards for carrying out and reporting on those Phase II investigations. One field (20) was identified in the Phase I studies (Stantec, 2014) requiring follow up related to Phase II level investigations.

Assessment of irrigation suitability includes consideration of the impact of additional water on soil drainage. A large portion of the study area is considered imperfectly drained. There are some soils associated with the beach ridges in the project area (e.g. Hochfeld), that are currently well drained.

For the imperfectly drained soils producers are actively planning tile drainage as shown in Figure 2. The main benefit of tile drainage in the Red River Valley is relief of high water tables in early spring, and allowing for earlier planting, easier access for implementation of Best production practices, and prevention of crop drown out (Sands, 2013). A side benefit to the environment will be to reduce surface runoff (Sands, 2013) and associated sediment and phosphorus loading to the streams. Reduced flood peaks will result in reduction in downstream flooding, and longer recessional limb on the hydrograph of the Shannon Creek. The longer recessional limb is also supported by a net increase in total water yield of close to 10% (Sands, 2013) for average conditions. This should help to improve conditions for downstream fisheries.

Individual BMPs for protection of the soils landscapes have been studied as part of the agronomic assessment (Stantec, 2014). Table 9 gives a summary of recommended BMPs by field in summary format. The detailed assessments are contained in the standalone report by Stantec (2014).

The next three sections provide further with respect to the implementation of BMPs and anticipated outcomes.

There are no significant impacts anticipated on soil landscapes as a result of irrigation and drainage activities. BMPs are described in more detail below and in Stantec, 2011 and Stantec, 2014.

5.1.4 Impact on Soil Erosion and Transport

Wind and water initiated soil erosion is a factor in the near shore fine sandy loams that dominate the soil-landscape of the Project area. Producers have traditionally implement BMPs to account for this fact. Traditional BMPs implemented in the Project area include, shelterbelts, annual barriers, and cover crops and reduced tillage of crops in rotation with potatoes. The implementation of tile drainage is a relatively new measure to reduce the potential for soil erosion due to water, as it increases the available storage of infiltrated water and reduces surface ponding and runoff. In addition, on tiled land saturation levels are reduced, conditions for soil compaction are reduced and water infiltration is increased; adding to crop water utilization and again reducing water erosion.

As the Project is not proposing to develop new land and much of the land being proposed for irrigated potato production is already being farmed for potatoes under dry land conditions, it could be argued that the incremental impacts of the Project on Soil Erosion and Transport are negligible to improving.

Specific BMPs that will be incorporated include, but are not limited to:

- Residue Management and Tillage
    - Minimum tillage practices will be adopted where feasible.
    - Anchoring of potato vines with light disking
    - Crop rotation will include high residue crops such as wheat and corn

- o Stubble and trash (e.g. corn stalks) will be managed to minimize fall tillage, promote incorporation and/or maintain stubble
  - o In extreme situations straw will be spread to increase trash on field after potato harvest (e.g. where cover crops not possible and erosion potential significant)
- Fall Cover Crops
  - o Both Kroekers and Hespler plant fall cover crops whenever possible after potato harvest (e.g. on early harvested fields); typically fall rye or barley would be utilized.
- Shelterbelts and Permanent Cover
  - o Shelterbelt planting will be maintained where feasible (e.g. edge of field, block plantings) depending on the nature of the irrigation system and field shape.
  - o Permanent grass cover will be maintained along edges of waterways
- Irrigation and Drainage
  - o Irrigation of dry soils in spring in extreme conditions to mitigate wind erosion risk.
  - o Prevent over irrigation (e.g. saturate soils) by monitoring leaching
  - o Employ tile drainage to improve soil potential for infiltration and adsorption of water
  - o Irrigate at application rates below the infiltration rate of the field specific soil.
  - o Use of dammer-diker system to create surface water storage in rows to improve soil capacity to infiltrate larger rainfalls and reduce runoff

Construction activities must also account for erosion of bare soil exposed or modified during construction of the proposed reservoirs and pipelines. Best construction practices to be followed are documented in Appendix H and discussed further under the section on Impact on Fisheries. Contractors will be required through contract specifications to follow the prescribed measures for erosion and sediment control.

Given the implementation of the Best Management Practices as outlined above and as summarized in Table 9, Stantec, 2014 and Appendix H, there are no significant incremental impacts on Soil Erosion and Transport anticipated as a result of the Project.

5.1.5 Soil Nutrients

The Phase I soils mapping by Stantec (2014), includes mapping of the soil zone designation in accordance with the Manitoba Nutrient Management Regulations. This legislation dictates the allowable soil nutrients for a given soil-landscape and is intended to guide sustainable production systems that will minimize leaching.

Two factors will further influence the nutrient balance in the crop and potential for leaching. In recent years production of potatoes has recognized the yield and quality benefits of spoon feeding nitrogen fertilizer to the potatoes as demand requires it.

Fertigation systems have become a common element of irrigation systems designs. Fertigation allows lower starter nitrogen applications, and timing the application to avoid early season rains and leaching events. The implementation of tile drainage has led to more uniform crop production, ensuring fewer hotspots of underutilized nutrients, and lowering chance of nutrient leaching. Combined with advanced methods such as variable rate nutrient systems there is an advanced capacity today to better farm each and every acre and input for optimum productivity.

University of Minnesota (2008) documents Best Management Practices for Nutrient Management on Irrigated Potatoes (see Appendix I). The active link is

http://www.extension.umn.edu/agriculture/nutrient-management/nitrogen/docs/08559-potatoesMN.pdf

The suite of BMPs available for producers include the following:

- Application rates for Nitrogen Fertilizer should be based on recommended rates for potato variety and yield anticipated; see Appendix I for rates for Russets and Red Norland as example; these would be modified for Manitoba climate.
- Account for spring soil nutrient status determined from soil sampling.
- Follow Nutrient Management Regulations for the individual field nutrient management zones (Stantec, 2014).
- Plan Nitrogen application to achieve high efficiency of N use and minimal leaching to shallow groundwater and tile outflow.
    - Split application of N during planting and hilling
    - Fertigation of N during remainder of year where equipment is utilized
    - Petiole analysis of potato crop after emergence to track nutrient status of plant and indicate demand for split applications.
    - No nitrate in starter N
- Do not overirrigate causing leaching. Track performance using groundwater monitoring and tile outflows. Consider University of Minnesota Irrigation Water Management Considerations for Sandy Soils; AG-FO-3875 (see Section 5.1.6 below).
- Keep comprehensive field by field record keeping, consistent with the mapped soils zones (Stantec, 2014).
- IF manure is utilized (e.g. for Kroeker organic fields):
    - Test manure for nutrient content
    - Calibrate manure application equipment
    - Apply manure uniformly through the field
    - Incorporation of manure
    - Follow Manitoba Nutrient Management Regulations related specifically to manure
- Establish fall cover crops to utilize residual nitrogen (and to maintain soils health, and increase moisture infiltration in spring (Kahimba et al. 2008). Kahimba et al. (2008) found that during the spring, the cover crop treatment warmed and thawed earlier enabling more snow melt infiltration.

Given the implementation of the Best Management Practices as outlined above and as summarized in Table 9 and Stantec, 2014, there are no significant incremental impacts on unintended loss of Soil Nutrients anticipated as a result of the Project.

5.1.6 Impact of Water Conservation Methods on Water Usage

Managing irrigation systems for optimal use of allocated water resources requires a detailed assessment of crop water demands, field soil and topographic variability, irrigation and monitoring equipment technologies, and advanced agronomic techniques.

Variable rate irrigation technology is still in the experimental stage (Evans et al., 2013), but none the less is being actively pursued by manufacturers and producers in many jurisdictions. To date the incremental investment has not proven its return to the producer. The future promise of this technology is for better utilization of available water resource; which is limited and increasingly expensive to develop. The Proponents are committed to using the latest irrigation technologies as it becomes feasible.

Irrigation scheduling relies on first understanding the soil-landscape and the available water holding capacity. The University of Minnesota Publication – Irrigation Water Management Considerations for Sandy Soils in Minnesota (AG-FO-3875) provides an excellent summary of the concepts and technologies for managing water in the types of soils within the project area.

The concepts that must be understood are summarized here in reference to the information contained in the individual field by field agronomic/irrigation suitability assessments

5.1.6.1 Soil Texture

Soil texture is a major determining factor in the ability of a soil to hold water. Detailed soils survey information was available for every field in the project area, leading to very good mapping of the soil polygons for each of the project fields. The first step in good water management is to establish zone maps as included in Stantec (2014). Soil landscape determines infiltration rates, which are documented on each of the soils assessments for the fields in the project area. The irrigation systems will be designed to ensure that application rates do not exceed infiltration rates and that there is no surface runoff and ponding as a result of irrigation.

5.1.6.2 Drainage and Infiltration

The majority of the soils in the project are rated as imperfectly drained. Irrigation on these soils will be to some extent mitigated by capillary rise (Cordiero, 2013). The impact for water conservation is to require effective adjustments to the irrigation scheduling methods. Typically, soils in the Winkler Area require less water than other areas of the Province due to this effect.

A percentage of the project soils are considered well drained. These soils (e.g. Hochfeld) may require additional moisture to make up for lack of shallow groundwater.

The elevation of the water table can be determined by a couple of methods. Tile drainage flow indicates water table within the depth of tile. For deeper measurements test piezometers may be required. Typically, the shallow water table is regenerated each and every spring. However, situation may exist where the initial water table is significantly lower than the tile (e.g. preceding conditions). In this instance one could anticipate a higher irrigation demand as represented in Table 3 and 4.

5.1.6.3 Available Water Holding Capacity

The Available Water Holding Capacity determines the amount of irrigation that a soil can hold. This is usually reported in inches per foot or mm per meter. Available Water Holding Capacity is measured as the difference between field capacity and permanent wilt point. This is the total amount available to the plant and is multiplied by the plant rooting depth and an allowable depletion factor to determine the amount of water that can be replaced by irrigation.

The irrigation interval is simply the allowable water depletion divided by the rate of evapotranspiration less water supplied through capillary rise. Irrigation systems must be designed to meet the peak water demands associated with maximum root depth, maximum evapotranspiration and minimum precipitation. Short term deficits drive this design (e.g. Table 4). Variable application rates can be utilized to account for reduced evapotranspiration rates, more frequent irrigations (less amounts), changes in soils texture and AWHC, and landscape position (e.g. proximity to capillary fringe).

5.1.6.4 Irrigation Scheduling Approaches

University of Minnesota (2008) documents the basic irrigation scheduling approaches:

- Feel method;
- Check book method;
- Soil water measurement (e.g. tensiometers, TDR);

Currently the producers practice the feel method. The check book method (for example the Alberta Irrigation Management Model (Alberta Agriculture and Rural Development, 2014)) is not well suited to the Project area because it does not account for capillary rise (Ayers et al., 2006). The soil water measurement technology has recently taken on renewed interest due to the number of companies now offering real time telemetric solutions. This technology can improve the performance of the irrigation scheduler.

5.1.6.5 Technology – Sensors and Telemetry

New technology is available to producers, to supplement and calibrate their field knowledge of soil water status. Real time irrigation sensors are being actively marketed by a number of Canadian, Us and International Companies. These technologies not only provide real time instantaneous data, but allow producers to see spatial and temporal trends as well as to document responses to rain and irrigation events, and the impacts of capillary rise. An online example is provided by the McCrometer and Adcon companies on the McCrometer web site. (http://www.mccrometer.com/news_media/case_studies/studies_connect-black-gold.asp)

Hespler Enterprises Ltd. and Kroeker Farms Ltd. are leaders in the evaluation of this technology in the context of the project area soils. Both producers have been actively involved with AAFC and U of Manitoba researchers, and local agro-meteorological companies to evaluate the utility of this technology. While it is early in the process, there is no doubt that this type of data has led to an increased understanding of the water balance in these soils. An example of this approach is provide in Codiero (2013) which is a PhD thesis issued in Fall, 2013 from the BioSystems Engineering department at the University of Manitoba, based on data from Hespler Enterprises Ltd. farm.

Given the implementation of the Best Management Practices as outlined above and as summarized in Table 9and Stantec, 2014, there are no significant impacts on Conservation and Beneficial Use of Water Resources resulting from over-irrigation anticipated as a result of the Project.

Table 9 - Proposed Irrigated Fields, Irrigation Suitability and Recommended BMPs for Major Considerations

EAP Field	Land Location	Irrigation Rating	Nutrient Management				Soil Erosion Management				Soil Salinity Management				Drainage Management				Irrigation Management				Other		Tiled
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	(Yes/No)
1	S 15-3-5W	Recommended	X	X	X		X	X							X				X						N
2	S 19-3-5W	Recommended	X	X	X		X	X											X						Y
3	SW 34-3-5W	Recommended	X	X	X		X	X							X				X						N
4	NW 34-3-5W	Recommended	X	X	X		X	X							X				X						N
5	NE 31-3-5W	Recommended	X	X	X		X	X							X				X						N
6	NW 31-3-5W	Recommended	X	X	X		X	X							X				X						N
7	E 6-4-5W	Recommended	X								X	X			X				X						N
8	E 27-3-5W	Recommended	X	X	X		X	X							X				X						N
9	SW 27-3-5W	Recommended	X	X	X		X	X											X						Y
10	SW 28-3-5W	Recommended	X	X	X		X	X											X						Y
11	NW 27-3-5W	Recommended	X	X	X		X	X											X						Y
12	NW 28-3-5W	Recommended	X	X	X		X	X											X						Y
13	NE 34-3-5W	Recommended	X	X	X		X	X											X						Y
14	NE 33-3-5W	Recommended	X	X	X		X	X											X						Y
15	W 33-3-5W	Recommended	X	X	X		X	X							X				X						N
16	NW 32-3-5W	Recommended Precautionary	X	X	X		X	X							X				X						N
17	SW 4-4-5W	Recommended	X								X	X			X				X						N
18	SE 5-4-5W	Recommended	X	X	X		X	X							X				X						N
19	SW 5-4-5W	Recommended	X	X	X		X	X							X				X						N
20	SE 6-4-5 W	Phase II Reqd	X								X	X		X	X				X						N
21	SW 6-4-5W	Recommended Precautionary	X	X	X		X	X			X	X			X				X						N
22	N 8-4-5W	Recommended	X												X				X						Y
23	SW 17-4-5W	Recommended	X												X				X						N
24	SE 18-4-5W	Recommended	X												X				X						N
25	NW 17-4-5W	Recommended	X												X				X						N
26	NE 18-4-5W	Recommended	X				x	x							X				X						N

Nutrient Management
1. Nutrient Management Planning
2. Fertigation
3. Split Application
4. Other

Soil Erosion
1. Residue Management
2. Fall seeded cereal crop
3. Reduced Tillage
4. Other: Permanent cover crop

Soil Salinity
1. Subsurface drainage improvements
2. Salinity monitoring program
3. Permanent cover crop
4. Other

Drainage Management
1. Subsurface drainage improvement
2. Surface drainage management
3. Drainage assessment
4. Other

Irrigation Management
1. Irrigation Scheduling
2. Soil Moisture Monitoring
3. Other

Other
1. Other
2. Other

5.2 Impact and Mitigation on Terrestrial and Aquatic Environments

5.2.1 Impact Terrestrial Habitat and Wildlife

There is no planned alteration to habitat, other than the optional Site B. At Site B, the creation of a small dam would add to the wetland habitat, which according to the MSTW report (MSTW, 2007) is limited in the project area. Site A and C will also add significant open water habitat within the project area. Figure 5 highlights the lack of wetland habitat and the significance of the proposed water bodies within the Project area.

There will be little to no loss of trees, other than potentially for the intake site at Site A to the Thornhill Coulee and the proposed Creek crossings along wooded portions of Thornhill Coulee and Shannon Creek. Creek Crossings are proposed to take place within the RM Road Allowances and every attempt will be made to keep damage to riparian zones to a minimum. The habitat at these locations are already disturbed in any case due to RM roads and other utilities (e.g. rural water lines).

There are no significant impacts anticipated on Terrestrial Habitat and Wildlife as a result of construction or operation activities.

5.2.2 Impact on Species at Risk

The reaches of the Shannon Creek and Thornhill Coulee have been classified as NOT supporting Species at Risk (i.e. Class C and D). The Manitoba Conservation Data Center has identified that no Species at Risk have been reported in the project area.

There are no significant impacts anticipated on Species at Risk as a result of construction or operation activities.

5.2.3 Impact Fisheries

Both the Shannon Creek and Thornhill Coulees in the Project area are considered to be class C or D and ***do not*** support ***Commericial, Recreational , Aboriginal or SARA fish*** species.

Furthermore, according to the DFO web site, a project does not require DFO review if it meets the following criteria:

> *Water Extraction*
>
> *Surface water extraction for commercial bottling, drinking and sanitary, industrial use, thermal/nuclear generation, agricultural irrigation and other uses.*
>
> *There is no reduction in the width of nearby water bodies.*

All of the off stream reservoirs will only extract water during spring freshet and will not impact the stream width on the Shannon and Thornhill Coulees.

Site B is in a tributary to the Thornhill Coulee with very limited habitat value and significant potential for a small dam.   Site C is on a stretch of the Shannon Creek that is highly channelized and of very limited habitat value.

None the less DFO will be contacted for a review of the project, and/or the DFO guidelines for minimizing impact of construction activities on Fisheries will be followed including but not limited to.

General activities around water

- Plan activities near water such that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, or other chemicals do not enter the watercourse.
- Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance and keep an emergency spill kit on site.
- Ensure that building material used in a watercourse has been handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish.

Construction of intakes

- Clearing of riparian vegetation should be kept to a minimum: use existing trails, roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. When practicable, prune or top the vegetation instead of grubbing/uprooting.
- Minimize the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or the bed of the waterbody below the ordinary high water mark. If material is removed from the waterbody, set it aside and return it to the original location once construction activities are completed.
- Immediately stabilize shoreline or banks disturbed by any activity associated with the project to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site.
- Restore bed and banks of the waterbody to their original contour and gradient; if the original gradient cannot be restored due to instability, a stable gradient that does not obstruct fish passage should be restored.
- If replacement rock reinforcement/armouring is required to stabilize eroding or exposed areas, then ensure that appropriately-sized, clean rock is used; and that rock is installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.
- Remove all construction materials from site upon project completion

Using PTO Driven Tractors for Filling

- Ensure that machinery arrives on site in a clean condition and is maintained free of fluid leaks, invasive species and noxious weeds.
- Whenever possible, operate machinery on land above the high water mark, in a manner that minimizes disturbance to the banks and bed of the waterbody.
- Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water.

During Creek/Drain Crossings

- Limit machinery fording of the watercourse to a one-time event (i.e., over and back), and only if no alternative crossing method is available. If repeated crossings of the watercourse are required, construct a temporary crossing structure.
- Use temporary crossing structures or other practices to cross streams or waterbodies with steep and highly erodible (e.g., dominated by organic materials and silts) banks and beds. For fording equipment without a temporary crossing structure, use stream bank and bed protection methods (e.g., swamp mats, pads) if minor rutting is likely to occur during fording.
- Time work in water to respect timing windows to protect fish, including their eggs, juveniles, spawning adults and/or the organisms upon which they feed.
- Minimize duration of in-water work.
- Conduct in-stream work during periods of low flow, or at low tide, to further reduce the risk to fish and their habitat or to allow work in water to be isolated from flows.
- Schedule work to avoid wet, windy and rainy periods that may increase erosion and sedimentation.
- Design and plan activities and works in waterbody such that loss or disturbance to aquatic habitat is minimized and sensitive spawning habitats are avoided.
- Design and construct approaches to the waterbody such that they are perpendicular to the watercourse to minimize loss or disturbance to riparian vegetation.
- Avoid building structures on meander bends, braided streams, alluvial fans, active floodplains or any other area that is inherently unstable and may result in erosion and scouring of the stream bed or the built structures.
- Undertake all instream activities in isolation of open or flowing water to maintain the natural flow of water downstream and avoid introducing sediment into the watercourse

During Construction of Reservoirs and Pipeline Distribution Systems

- Develop and implement an Erosion and Sediment Control Plan for the site that minimizes risk of sedimentation of the waterbody during all phases of the project. Erosion and sediment control measures should be maintained until all disturbed ground has been permanently stabilized, suspended sediment has resettled to the bed of the waterbody or settling basin and runoff water is clear. The plan should, where applicable, include:
    - Installation of effective erosion and sediment control measures before starting work to prevent sediment from entering the water body.
    - Measures for managing water flowing onto the site, as well as water being pumped/diverted from the site such that sediment is filtered out prior to the water entering a waterbody. For example, pumping/diversion of water to a vegetated area, construction of a settling basin or other filtration system.
    - Site isolation measures (e.g., silt boom or silt curtain) for containing suspended sediment where in-water work is required (e.g., dredging, underwater cable installation).
    - Measures for containing and stabilizing waste material (e.g., dredging spoils, construction waste and materials, commercial logging waste, uprooted or cut aquatic plants, accumulated debris) above the high water mark of nearby waterbodies to prevent re-entry.
    - Regular inspection and maintenance of erosion and sediment control measures and structures during the course of construction.
    - Repairs to erosion and sediment control measures and structures if damage occurs.
    - Removal of non-biodegradable erosion and sediment control materials once site is stabilized.

Design of Intake Systems

- Ensure that all in-water activities, or associated in-water structures, do not interfere with fish passage, constrict the channel width, or reduce flows.
- Consider whether screening of water intakes is required given that the streams in question are none fish bearing and the timing is such that water extraction occurs prior to spawning. IF it is determined fish spawning will occur during the withdrawal period, then consider screening water intakes or outlet pipes to prevent entrainment or impingement of fish. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself.

Should screens be required the DFO generic guidelines for screening will be followed.

There are no significant impacts anticipated on Fisheries as a result of construction or operation activities.

5.3 Impact and Mitigation on Socio Economic Conditions

5.3.1 Impact and Mitigation on Heritage Resources

There are no known impacts on Heritage Resources at this juncture of the planning studies. Final investigations for each reservoir site will follow recommendations of Heritage Resources Branch regarding potential significance.

5.3.2 Economic Activity and Employment

Both the farming companies involved offer full time employment within the RM's of Stanley, Thompson, and Roland, as well as Rhineland, and the City of Winkler, and the nearby Village of Schanzenfeld.

Construction activity will involve local construction companies, regional and local suppliers, international, national, regional and local manufacturers.

5.3.3 Traffic

The project are current generates traffic from the project area to the City of Winkler, the Morden – Winkler Corridor, and the Village of Schanzenfeld. Highways utilized include PR432, Highways 3, 14 and 32. The implication of construction of the project will mean a short term increase in traffic during construction within the Project area (Figure 1). The current levels of traffic associated with seeding, crop protection and harvest will be maintained or increased slightly due to additional crop production. However, this increase will not be noticeable.

Given the nature of traffic congestion through the City's of Morden and Winkler on PR432, Highway 3, and Highway 32; every effort will be made to reroute truck traffic around these congestion areas during high traffic periods. Company drivers are given standards of operation for this purpose.

5.3.4 Utilities

Existing utilities will not be interrupted as a result of the construction of the project. All utilities will be located in the field prior to any / all site investigations, underground construction and boring. Highways crossings on PR432 will be pre-approved by MIT and will be lined to prevent piping of the roadway. Crossings of rural water pipelines will be made above them at right angles. MTS and Hydro underground cables will be avoided where feasible or crossed below at right angles. Proposed Enbridge pipeline will be crossed at right angles above with adequate cover to the oil pipelines. All oil pipeline crossings are subject to approval of the Utility in question. There are no planned railway crossings.

Manitoba Hydro will be approached regarding provision of three phase power to Site A and C, once and if they are determined feasible. Current plan is to bring power from SE 35-3-5W to the east and south of Site A per Figure 3. Approximately 3 miles of three phase power would be required, along with transformation.

5.3.5 Recreation and Parks

There are no recreation facilities or parks impacted by the project.

5.3.6 Impact on Human Health and Safety

The project has some considerations regarding Human Health and Safety. Operators will be trained by the Proponents on the safe operation of pumps, reservoirs and irrigation systems, and on the proper transport, storage and use of fuel and chemical products, to ensure no waterways are contaminated. Fuel storage on sites will meet Manitoba regulations (e.g. double wall, anti-syphon). Spill response will be developed, in particular around any potential to contaminate Shannon Creek.

All on farm practices are subject to regular farm practices; regarding safe handling of fuel, chemicals and fertilizers.

All irrigation systems utilizing fertigation will employ backflow prevention.

All truck drivers are given stringent standard operating procedures and routing instructions, and their performance is monitored.

All construction sites will be Cor certified or equivalent (Construction Safety Association of Manitoba, 2014).

All reservoirs will be designed and constructed to the approved engineering standards qualified engineers registered with the Association of Professional Engineers and Geoscientists of Manitoba. The Proponents will implement a dam safety program, including annual inspection and emergency response plans for the water storage structures.

There are no significant adverse impacts on Human Health and Safety as a result of construction or operation activities.

There are no significant impacts anticipated on Socio Economic issues as a result of construction or operation activities.

5.4 Pollutants, Hazardous Wastes and Fuel Products

The irrigation project will not release significant pollutants or hazardous wastes. Pollutants would be limited to exhaust emissions from diesel engines required to operate filling and distribution pumps. Active consideration is being given to Hydro-electric pumps which would make use of clean renewable energy. Smaller diesel generators are utilized to power the mobile center pivot and linear irrigation systems. Due to the need for this power unit to be mobile Hydro-electricity is not currently a viable option. Solar power systems have been tested for smaller size irrigation systems for remote locations where fuel costs are prohibitive. Booster pumps may be required for the irrigation pipeline system and for certain on farm irrigation systems, including travelling guns and boom carts. The travelling reel is typically powered by gas engine.

Fuel for all pumping and power equipment will be transported, stored and utilized in accordance with all Provincial regulations. Tractors used to power PTO intake pumps will be refueled in a means to prevent contamination of the watercourse.

Standard operating procedures for fuel handling and safety will developed to ensure employees follow the requirements of the Environment Act License. Spill response procedures will be developed.

Sediment and erosion control measures were documented elsewhere.

There are no significant release of Pollutants or Hazardous Wastes as a result of construction or operation activities.

5.5 Climate Change Implications

MSTW recently undertook to understand Green House gas production by both residential and commercial sources within the four region (CLER, 2010). Short term increase in greenhouse gas production will be associated with the construction project. The incremental ongoing emissions from this project will be associated with operation of the reservoir filling, the irrigation pumping system and the on farm irrigation systems power sources.

The system will be operated to apply approximately 4 inches of water which will take an average of 300 to 400 hours per year. Re-filling will take place over an approximately 5 day period (5 x 80 acre feet = 400 acre feet per year).

The following are examples of the incremental energy consumption of the project.

1. Filling 2 x 150 HP tractors running for 5 days.
2. Pumping 400 hours x 7 x 60 hp.
3. Irrigation 400 hours x 7 x 10 hp.

IF all of these were diesel units they would certainly generate additional CO_2. However, given the amount of hours, the HP, and the number of units, this is insignificant within the Project area and the Region (e.g. in comparison to truck and car traffic alone).

None the less, the Proponents recognize the following strategies to reduce these emissions:

1. Switching to Hydro-electric power.
2. Water conservation to ensure optimal water application.
3. Planting trees in form of edge of field shelterbelts.

The construction activities will also generate additional CO_2. These emissions are generally speaking unavoidable and can only be mitigated by keeping all equipment in good working order.

The proponents are committed to examining climate change implications of their operations and implementing affordable technology to reduce the impact of the project on Green House gas production.

There are no significant long term increase of Greenhouse Gases as a result of construction or operation activities.

5.6 Impact on Aboriginal Rights

There are no known implications with respect to Aboriginal Rights arising from implementation of the project. There are no Aboriginal communities in the project area. There is no known Aboriginal hunting, fishing or trapping in the project area. There is no known cultural or traditional activities in the project area. Manitoba Heritage Resources has be consulted regarding any further field work that may be required to assess the historical Aboriginal use within the Project areas to be disturbed.

There are no significant adverse impacts on Aboriginal Rights as a result of construction or operation activities.

6.0 Environmental Risk Management and Mitigation Measures and Follow Up

The proponents are committed to managing the environmental risk during all phases of design and construction, to implement mitigation measures and to follow up with regulatory agencies as indicated in the sections below.

In general, the proponents are prepared to commit to all environmental protection measures and mitigations specified within the Environment Act License, the Water Development Permit, the Water Resource Administration Act, and the RM of Stanley, Roland and Thompson Conditional Use Permits, and those dictated by other regulatory bodies (e.g. DFO, Historic Resources Branch).

6.1 Design

6.1.1 Consultation of DFO on intakes

DFO will be consulted on intake site development for Site A.

6.1.2 Review of MIFs with Manitoba Water Stewardship

Manitoba Water Stewardship will be consulted on Minimum In Stream Flows.

6.1.3 Investigation of Potential Heritage Resources on Construction Sites

Manitoba Historic Resources Branch will be consulted on potential for Historic Resources on the proposed reservoir sites. Incorporate recommendations into design and or construction phases.

6.1.4 Detail Sediment and Erosion Control Plans

Detailed sediment and erosion control plans will be included in all contracts.

6.1.5 Detail Specifications for Backflow Prevention

Detailed backflow prevention equipment will be specified for all fertigation systems by the Project Engineer.

6.1.6 Intakes and Creek Crossings

Develop riparian zone protection plans for intake(s) and pipeline crossings on wooded portions of the Thornhill Coulee and Shannon Creek.

6.2 Construction

6.2.1 Detailed Contract Specifications

All contracts will be governed by detailed contract specifications and inspected by the engineer of record.

6.2.2 Safety

All contracts will contain a workplace safety component meeting intent of Cor.

6.2.3 Erosion and Sediment Control

All methods proposed by Contractors will be reviewed and approved by the engineer of record.

6.3 <u>Operational</u>

6.3.1 Soil and Water BMPs

Employ BMPs for soil erosion, nutrient management and irrigation water management. Report on all water use with accurate records of fields irrigated and amounts of water used, diverted and otherwise employed.

6.3.2 Fuel BMPs

Employ fuel management BMPs in accordance with EAL requirements.

6.3.3 Traffic BMPs

Training of all staff as to company Standard Operating Procedures on truck routes, truck safety and public safety.

6.3.4 Dam Safety

Establish a Dam Safety monitoring and evaluation plan, to be overseen by a Professional Geotechnical Engineer

6.4 <u>Repair, Renewal, Decommissioning</u>

6.4.1 Pipelines

Replace worn underground PVC pipelines. Abandon damaged pipes in place.

6.4.2 Mechanical and Electrical Equipment

Replace worn equipment. Recycle parts as feasible or dispose in landfill.

6.4.3 Reservoirs

Maintain reservoirs in good shape. Renew liner system. Remove silt as required and place on nearby agricultural fields. Breach dykes and fill in reservoirs IF no longer utilized or maintained in good order.

7.0 Conclusions and Closure

PBS Water Engineering Ltd. has compiled the data and information presented in this Environmental Act Proposal report, in accordance with the requirements of Manitoba Conservation and Water Stewardship, using the best information available at the time of writing. The report will form an attachment to the Environment Act Licence Application for the Hespler–Kroeker Irrigation Project.

On the basis of the studies undertaken to date and the commitment of the producers to employ best known practices and technologies during construction and operation, the project is not anticipated to result in significant or immitigable adverse impacts on the local biophysical environment. The development is expected to be consistent with the current land use, adding value and stability to the land base for agricultural production purposes. Economic activity, including securing long term employment in the region will result. Both producers are committed to long term sustainability of the soil landscape employing management techniques consistent with the soil landscape mapping by Stantec (2014) and the recommended BMPs for erosion, nutrient management, and water management, using the latest and best available technologies.

On the basis of the information gathered and presented, PBS Water Engineering Ltd. feels that the conditions and the requirements of the Environment Act Guidelines have been met. The producers are committed to following the letter of the law with respect to any Development Permits and Licenses that will be granted to them as part of this Project planning.

This report is prepared for the expressed purpose of Hespler Enterprises Ltd. and Kroeker Farms Ltd. Any third party use of this report, any reliance or decision made based on it, are the responsibilities of the third parties.

The information and conclusions of this report as presented are the opinion of PBS Water Engineering Ltd. based on the Project as described and an office assessment of the environment which it is located.

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