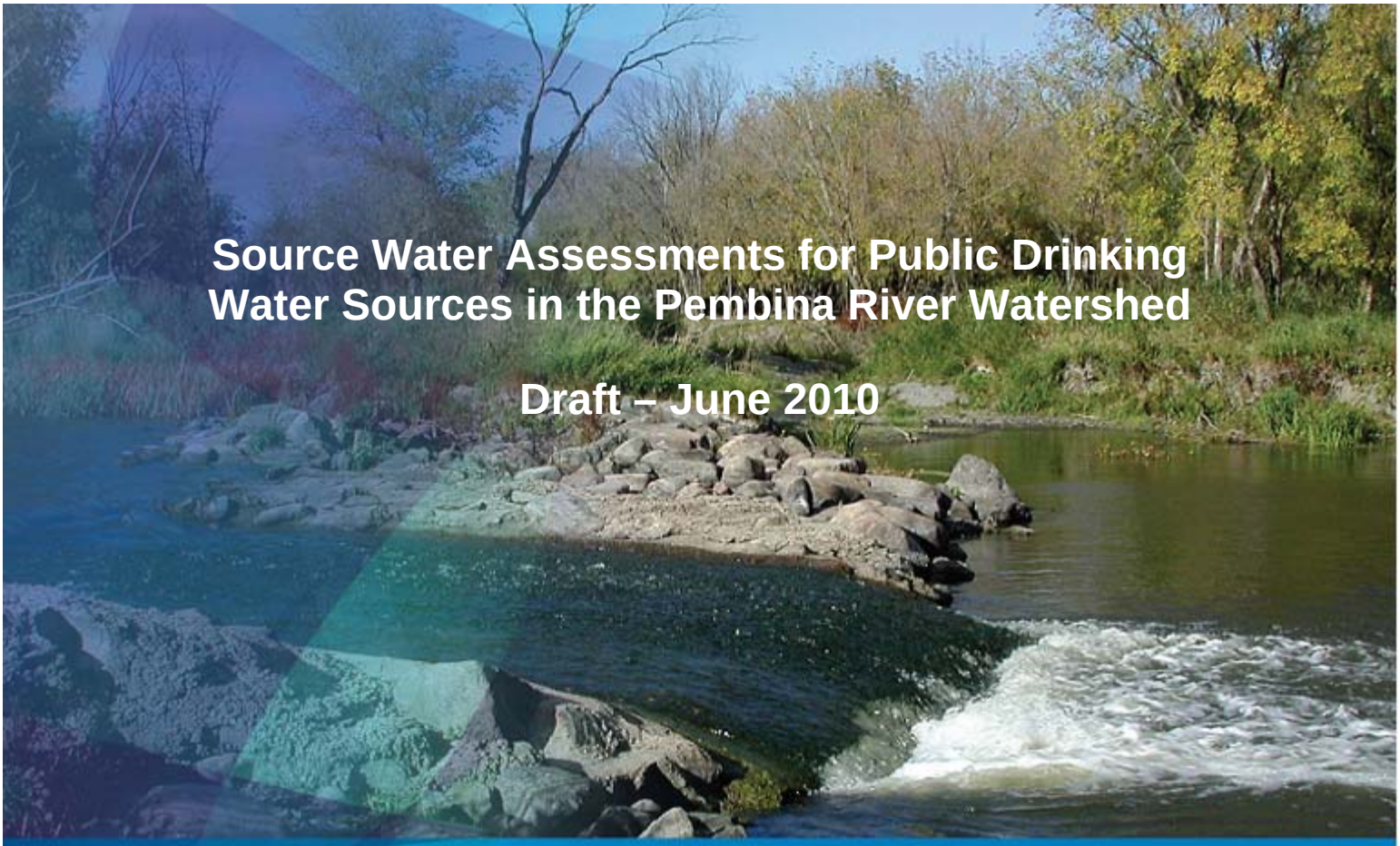


Source Water Assessments for Public Drinking Water Sources in the Pembina River Watershed

Draft – June 2010

Table of Contents

Source Water Protection

Clean, potable drinking water is critical for human life and, therefore, a necessity for prosperous sustainable communities. Protecting water at its source, or before it arrives at our treatment facilities, is a preventative approach to water management. It is more ecologically responsible and may be less expensive and to prevent contamination to our source waters, than to try and remediate water quality in treatment facilities.

While source water protection measures may not be appropriate in certain circumstances, source water protection can be a viable means of achieving water treatment objectives, particularly where expensive technological upgrades may otherwise be required, or the secondary benefits of source water protection are desirable.

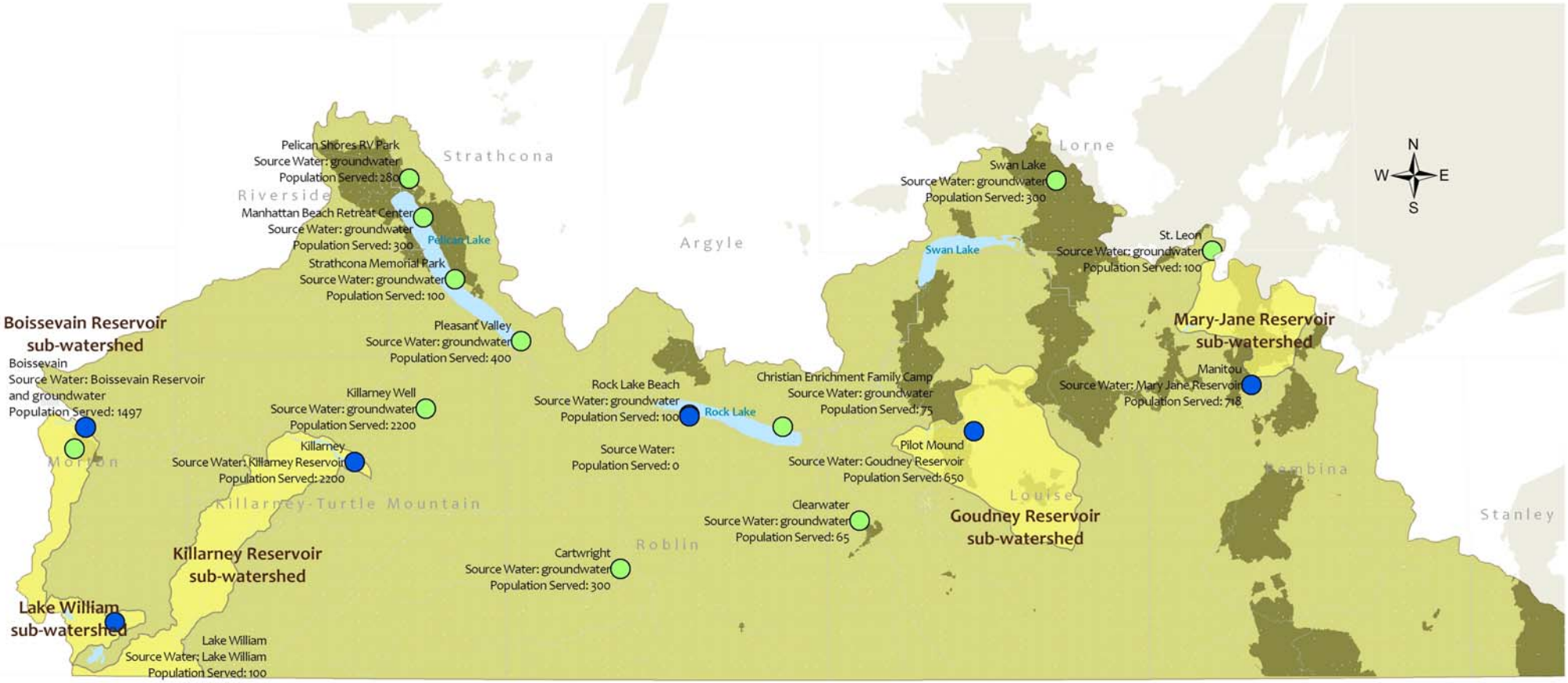
Source water protection provides an integrated approach to watershed management, and provides benefits beyond those realized at the water treatment plant. The implementation of source water protection plans will help improve the health of streams, lakes and aquifers from which drinking water is drawn. Recreational and wildlife values for a given area may also improve, however it may become more difficult or more expensive to operate certain types of industry or waste treatment within the protection area.

In Manitoba, source water protection is in its infancy, and this plan is one of the first to be formally developed. Input from all levels of government, local residents, and industry is critical to the development of an effective plan. As part of integrated watershed management plan development, a preliminary source water assessment was completed for each public water source in this watershed.

The integrated watershed management plan for the Pembina River watershed includes recommendations to address potential sources of contamination which pose a threat of contamination to a public drinking water system.

Public Drinking Water Sources

In Manitoba, the Office of Drinking Water defines a public water system as a potable supply of drinking water with 15 or more connections. The Pembina watershed contains 15 public drinking water systems, 9 of which withdraw their water from a groundwater source, six from surface water sources, and one from both. Some of these public drinking water systems use multiple wells to withdraw water for a single community.



Focus areas for the protection of drinking water in the Pembina River watershed.

1:345,000

Kilometers

0 3.5 7 14

North American Datum 1983
Universal Transverse Mercator Zone 14U

Legend

- Surface Water Sources
- Groundwater Source Zone (1.5 km review area)
- Private Wells
- Public drinking water source subwatershed zones. This area contributes flows to a lake supplying public drinking water. Surface water quality improvements will be targeted to these sub-watersheds.
- Areas that have less than 6 metres of overburden thickness over the aquifer. These areas are more susceptible to groundwater contamination. Groundwater quality programming will be targeted to these areas.

Boil Water Advisories

There is a history of boil water advisories in the Pembina river watershed. Rock Lake Beach campground is currently under a long-term boil water advisory. Strathcona Park and Pilot Mound have both been under temporary boil water advisories within the last 5 years. The community of Ninette, which is serviced by private or semi-private wells, is also under a long- term boil water advisory.

Source Water Protection Zones

Source water protection zones for groundwater sources included a 1.5 kilometer circular buffer around the wellhead. Source water protection zones for surface water sources included the entire sub watershed. Source waters are considered to be most vulnerable to contamination from these areas.

Source Water Assessments

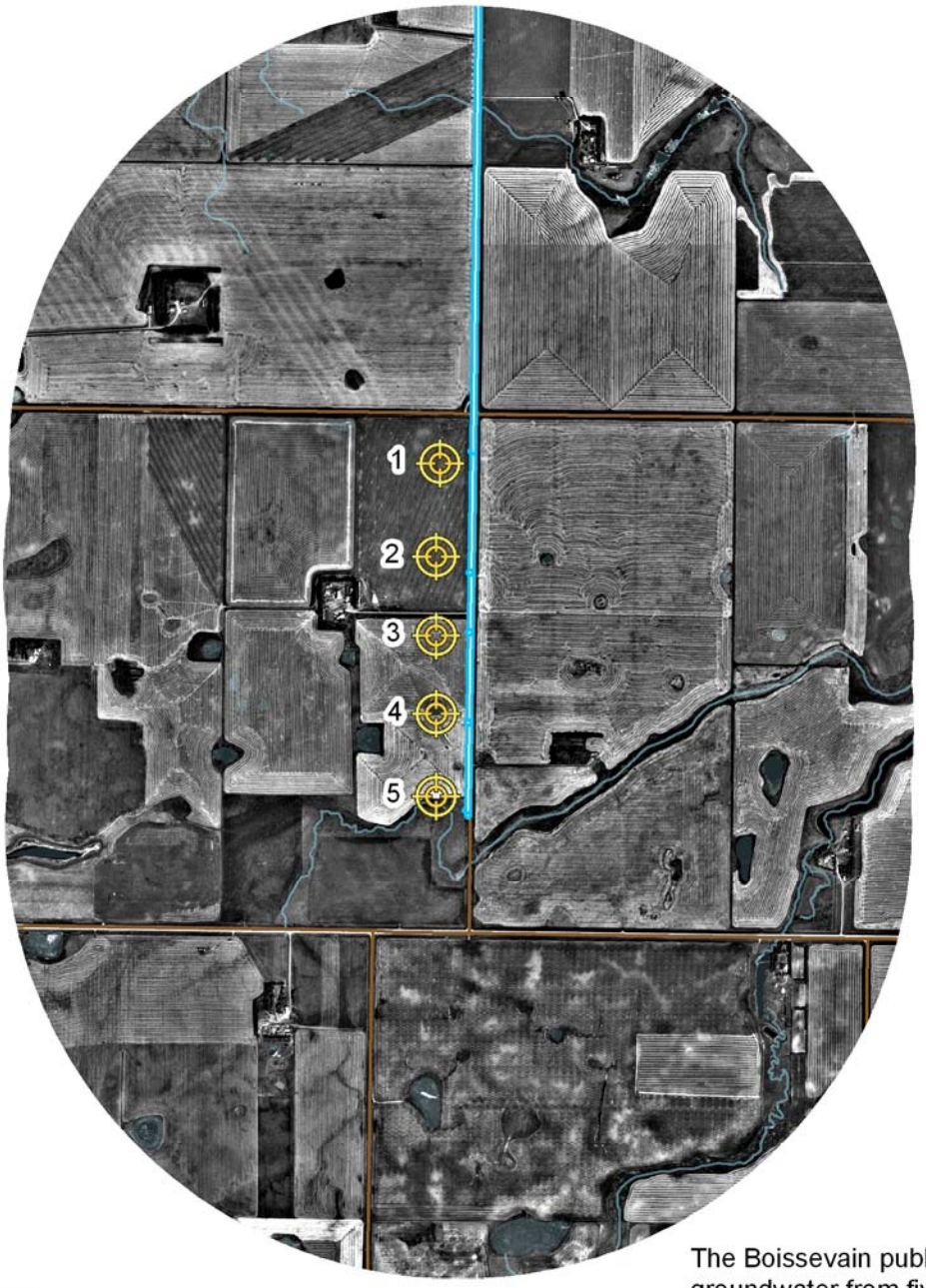
For public drinking water systems that are sourced by groundwater, source water protection includes but is not limited to ensuring that the well location, construction, and maintenance techniques are sufficient to prevent against flooding or other surface water infiltration; identifying the level of protection provided by natural overburden type, thickness and composition, and assessing groundwater flow direction in an area and extrapolating that to a protection zone; and finally, identifying and addressing potential impacts within the protection zone.

Throughout the development of the Pembina River integrated watershed management plan, members of the source water protection committee conducted preliminary source water assessments in the immediate area around the public water systems to identify potential sources of contaminants. Recommendations were developed to address the issues that pose a threat of contaminating the public drinking water sources.

Potential pollutant sources examined in this assessment include:

- Roadways
- Wastewater treatment plants
- Manure storage areas
- Railways
- Oil Wells
- Contaminated sites
- Chemical, fuel, petro-chemical storage locations
- Industry
- Mining operations
- Waste disposal sites
- Agricultural drains
- Population centres

Boissevain Public Water System Groundwater Source



Kilometres
0 0.25 0.5 1

The Boissevain public water system treats groundwater from five wells drilled in 1988. This public water system uses both groundwater and surface water.

Public drinking water supply for the town of Boissevain.

The orthophoto illustrates land use within 1.5 km radius of the wells

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090817
Projection: UTM, NAD83, Zone 14

Manitoba

Boissevain - Groundwater - Public Water System

Source: Groundwater (sandstone aquifer)
Number of wells: 5
Well Depth

- **Well 1:** 32.3 m (105.9 ft)
- **Well 2:** 28.0 m (91.9 ft)
- **Well 3:** 24.4 m (79.9 ft)
- **Well 4:** 29.8 m (97.9 ft)
- **Well 5:** 21.3 m (70.0 ft)

Depth to Groundwater:

- **Well 1:** 5.5 m (18.0 ft) in Nov 1988
- **Well 2:** 7.0 m (23.0 ft) in Nov 1988
- **Well 3:** 7.0 m (23.0 ft) in Nov 1988
- **Well 4**: 4.6 m (15.0 ft) in Nov 1988
- **Well 5:** 4.9 m (16.0 ft) in Nov 1988

Depth of Casing

- **Well 1:** 19.7 m (64.5 ft)
- **Well 2:** 17.8 m (58.5 ft)
- **Well 3:** 10.4 m (34.0 ft)
- **Well 4:** 17.7 m (58.0 ft)
- **Well 5:** 9.1 m (30.0 ft)

Well Owner: Town of Boissevain
Population Served: 1500
Date of Well Construction:

- **Well 1:** 1988
- **Well 2:** 1988
- **Well 3:** 1988
- **Well 4:** 1988
- **Well 5:** 1988

Is the source treated?: Yes
Is the source chlorinated?: Yes
Are the wellheads enclosed in a shed/wellhouse? No
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? Yes
Does surface water pool around the surface of the well? Yes, at well 2.
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition: Medium – Low permeability material is variable in thickness and makes up a small proportion of the sediments above the screen.
Vulnerability Based on Well Construction: Low

Comments: The five groundwater wells are located along a municipal road. The wellheads are vulnerable to damage from vehicles travelling along the right-of-way, and producers harvesting hay adjacent to the road.

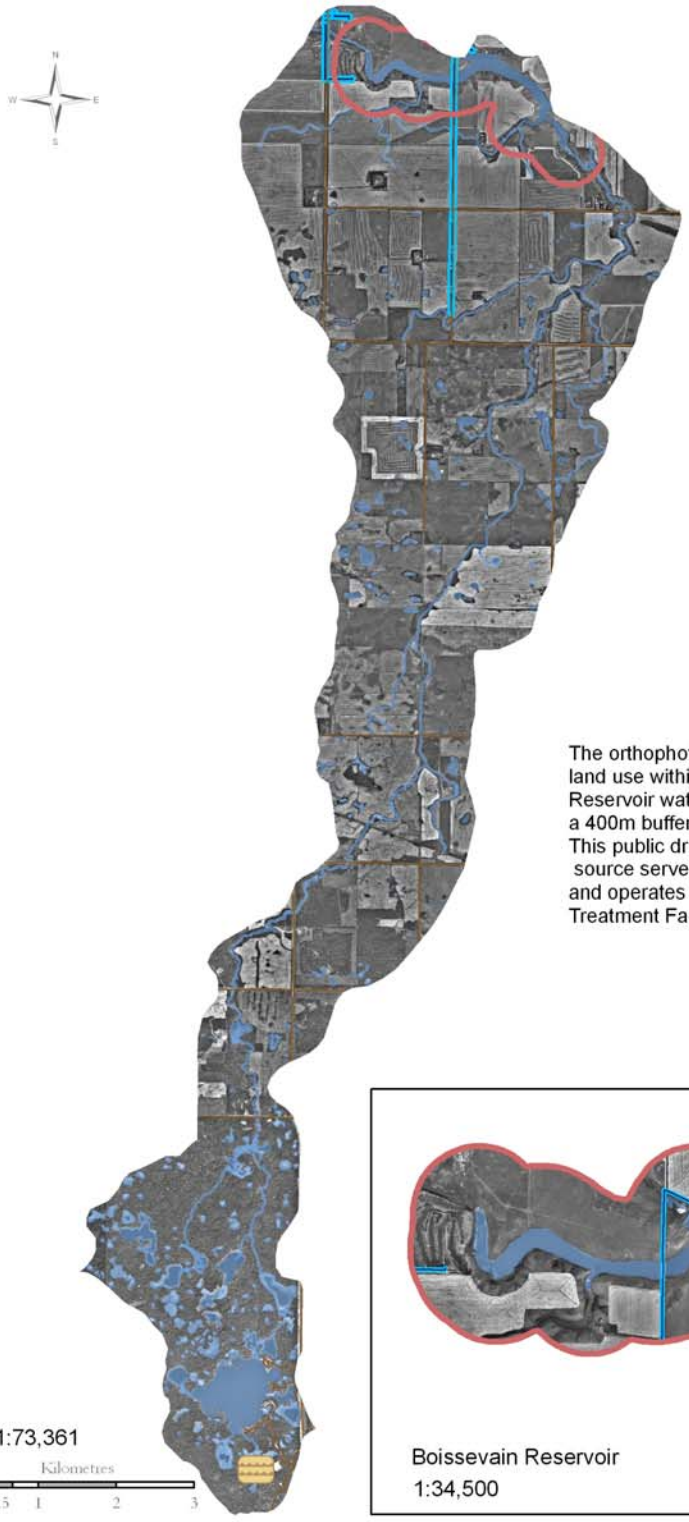
Land use in the area surrounding the Boissevain public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land	~5 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes in land use.
Septic systems	500 m - 1.5 km	Five yard sites within 1.5 kilometers of the wells.	None.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in the area.	Seal all abandoned wells within 1.5 km.
Transportation routes	5 m – 1.5 km	Includes paved and gravel roads. Improve drainage at well 2.	Improve drainage function to ensure that water does not pool around well heads.
Farm yards	300m – 1.5 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.
Overland flooding	10 m	Overland flooding – may infiltrate well, or nearby abandoned wells	

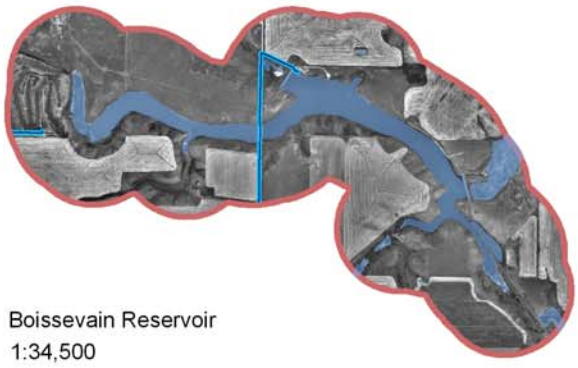
Recommended actions for all potential pollutant sources:

1. Improve drainage function to ensure that water does not pool around well head #2.
2. Seal all abandoned wells within 1.5 km of the well head.

Boissevain Reservoir Public Water System
Surface Water Source



The orthophoto illustrates land use within the Boissevain Reservoir watershed. It also shows a 400m buffer around the lake. This public drinking water source serves 2500 people and operates a Class 3 Water Treatment Facility.



Public drinking water supply for the town of Boissevain.

The orthophoto illustrates land use within the Boissevain Reservoir subwatershed

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090817
Projection: UTM, NAD83, Zone 14

Manitoba

Boissevain- Surface Water - Public Water System

Source: Boissevain Reservoir
Owner: Town of Boissevain
Population Served: 2500
Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes

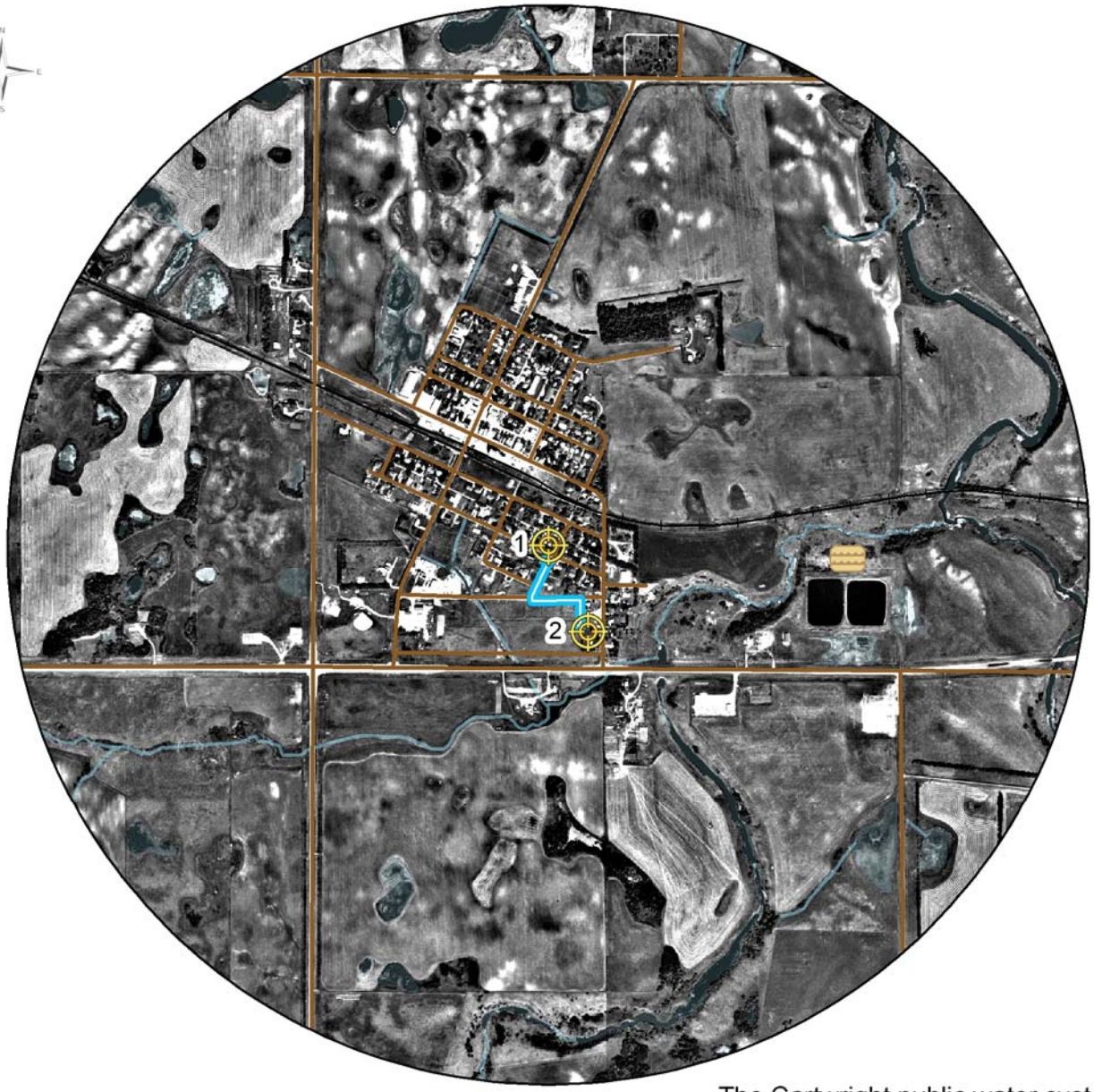
Land use in the area surrounding the Boissevain reservoir.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land	~5 m – 10 km	Annual cropping, hayland and pasture land are common in this area.	Reduce nutrient inputs. Ensure livestock do not have direct access to reservoir.
Septic systems	500 m - 1.5 km	Numerous yard sites in this area.	None.
Wastewater treatment plant	>10 km	Turtle Mountain Provincial Park manages a wastewater treatment lagoon in this sub watershed.	None. Monitor any changes.
Transportation routes	5 m – 1.5 km	Includes paved and gravel roads.	None. Monitor any changes.
Farm yards	300m – 1.5 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.
Overland flooding		Overland flooding may introduce pollution into the reservoir.	None. Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Reduce nutrient inputs from the sub watershed.

Cartwright Public Water System Ground Water Source



Kilometres
0 0.25 0.5 1

The Cartwright public water system treats groundwater from two wells drilled in 1962 and 1996. The public water system is a class 2 Water Treatment Facility and provides drinking water water to 300 people.

Public drinking water supply for the town of Cartwright.

The orthophoto illustrates land use within 1.5 km of the wells

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090817
Projection: UTM, NAD83, Zone 14

Manitoba

Cartwright – Public Water System

Source: Groundwater (sand and gravel aquifer)
Number of wells: 2
Well Depth

- Well 1: 56.2 m (184.5 ft)
- Well 2: 19.7 m (64.5 ft)

Depth to Groundwater:

- Well 1: 2.0 m (6.4 ft) in 1962
- Well 2: 2.2 m (7.2 ft) in 1996

Depth of Casing:

- Well 1: 50.1 m (164.5 ft)
- Well 2: 22.3 m (73.0 ft)

Well Owner: Village of Cartwright
Population Served: 300
Date of Construction:

- Well 1: 1962
- Well 2: 1997

Is the source treated?: Yes
What type of treatment is used?: Greensand filtration/Nanofiltration membrane/Chlorination
Is the source chlorinated?: Yes
Is the wellhead enclosed in a shed/wellhouse?

- Well 1: Yes
- Well 2: No

Is there controlled access to the wellhouse? Yes
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? Yes
Does surface water pool around the surface of the well? No
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition: Low
Vulnerability Based on Well Construction: Low

Comments: Install a fence barrier to create a five meter buffer around well head #2. A vehicle service station is located approximately 100 meters from the well.

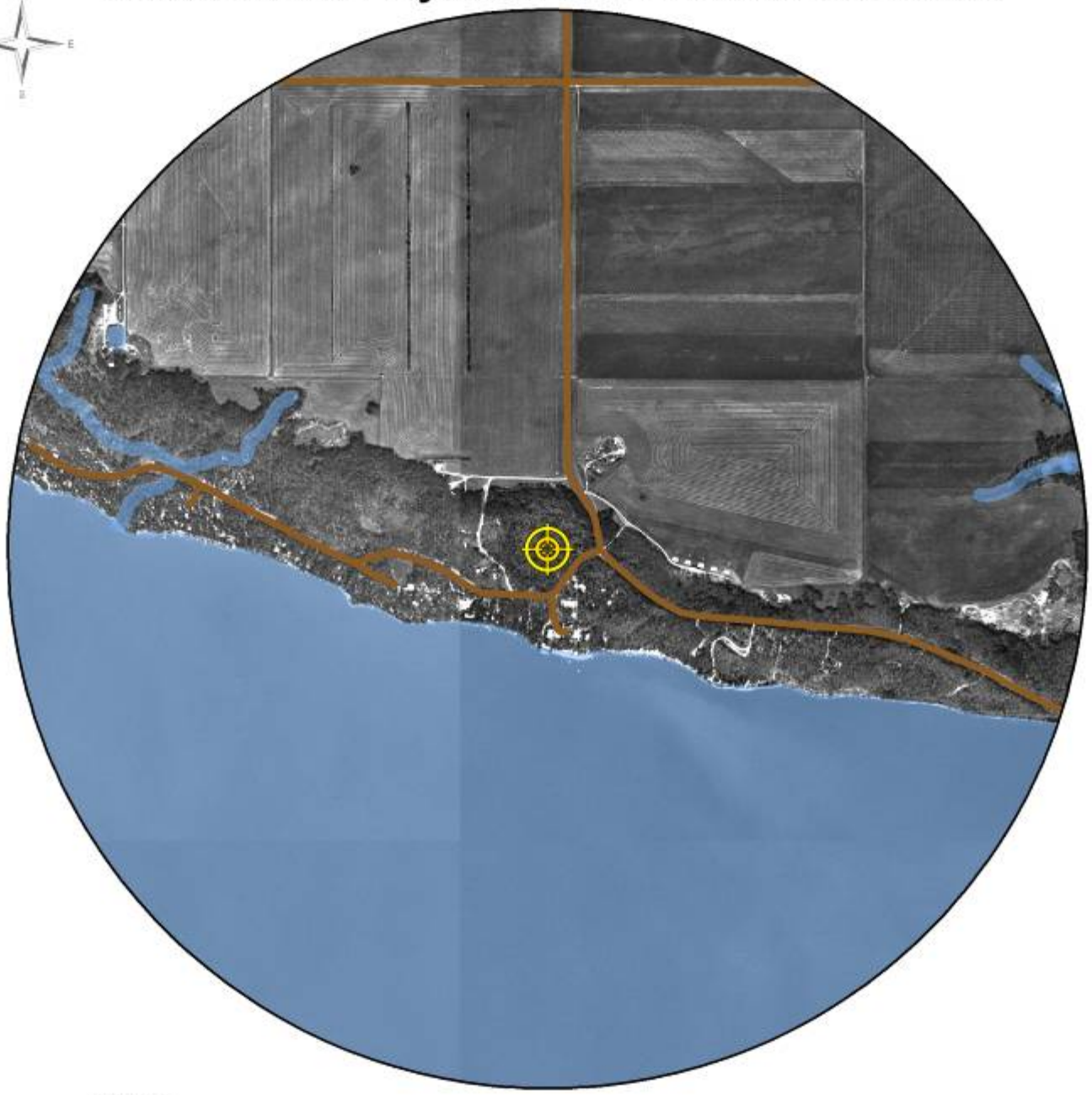
Land use in the area surrounding the Cartwright public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Points	Comments	Recommended Action
Crop/Pasture land and livestock operations	~200 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community of Clearwater used septic tanks and fields for on-site waste water management.	None.
Village of Cartwright	~ 30 m – 1 km	Urban related activities –higher traffic area. Industrial activities.	Ensure all industrial wells are in good condition.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in Cartwright and surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Wastewater treatment plant	600 m	A two cell waste water treatment plant is releases downstream into Gimby Creek.	None. Monitor any changes.

Recommended actions for all potential pollutant sources:

- Install a fence barrier to create a five meter buffer around well head #2.
- Ensure all industrial wells are in good condition.

Christian Enrichment Family Camp
Public Water System Groundwater Source



Public drinking water supply for Christian Enrichment Family Camp.

The orthophoto illustrates land use within 1.5 km of the well

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090817
Projection: UTM, NAD83, Zone 14

Manitoba

Christian Enrichment Family Camp - Public Water System

Source: Surface water (natural spring)
Number of wells: 1
Well Depth: Not applicable
Depth of Casing: Not applicable
Well Owner: Christian Enrichment Family Camp
Population Served: ~ 75
Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes
Is the wellhead enclosed in a shed/wellhouse? No
Is there controlled access to the wellhouse? Yes
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? Not applicable
Does surface water pool around the surface of the well? Not applicable
Does the well casing extend at least 16 inches above mounded earth? Not applicable
The sanitary seal is secure and in good condition? Not applicable
Vulnerability Based on Overburden Thickness and Composition: Not applicable
Vulnerability Based on Well Construction: Not applicable

Comments: None.

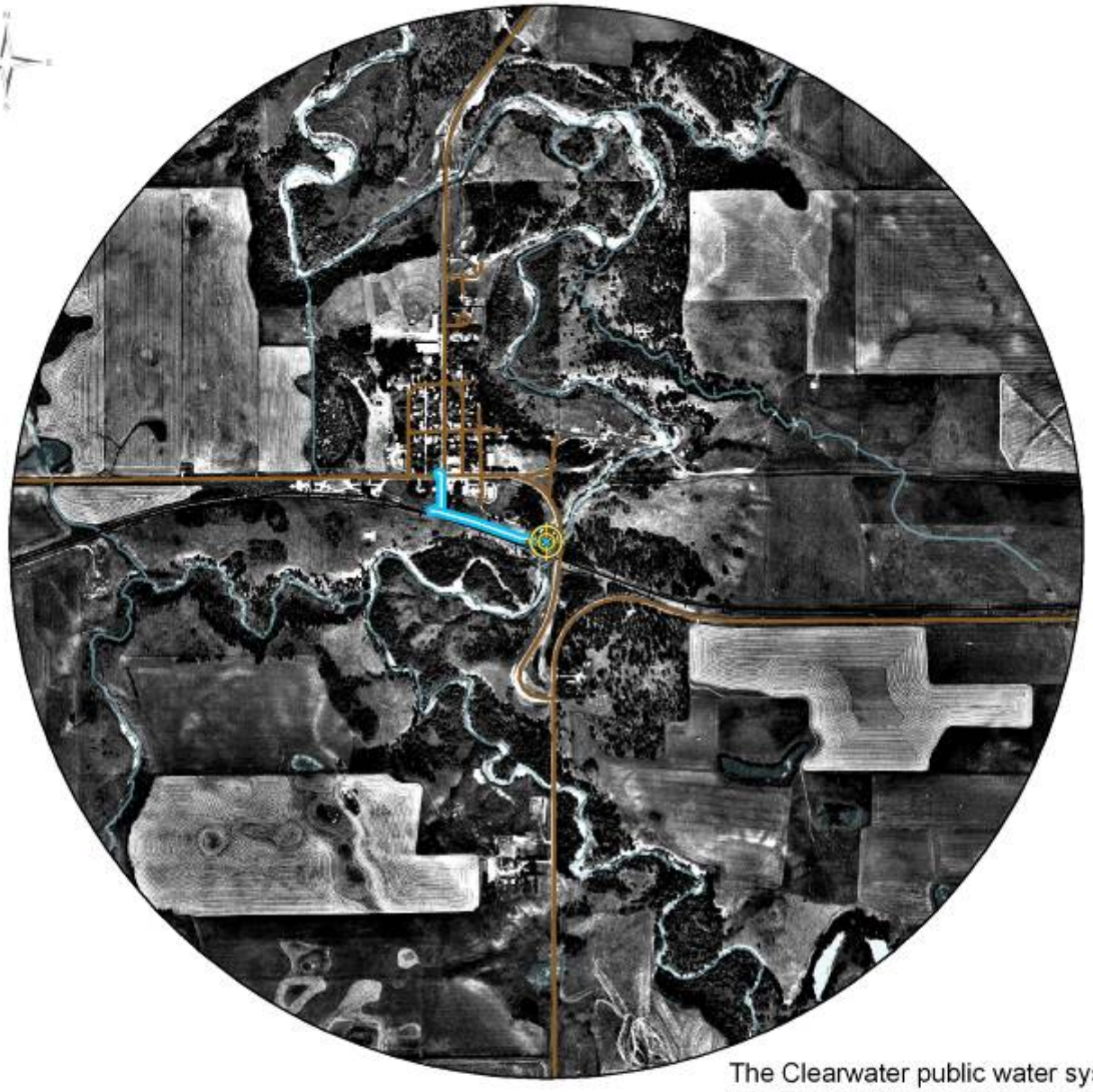
Land use in the area surrounding the Christian Enrichment Camp public water system source.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Cropland	~200 m – 1.5 km	Annual cropping is common in this area.	None. Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community use septic tanks for on-site waste water management.	Monitor any changes.
Abandoned wells / Improperly maintained active wells		Abandoned wells may be present in the surrounding area	Seal all abandoned wells within 1.5km.
Livestock process plant	500 m		None. Monitor any changes.
Gravel quarry	300 m		None. Monitor any changes.
Transportation routes	50 m – 1.5 km	Includes gravel roads.	None.

Recommended actions for all potential pollutant sources:

1. Seal all abandoned wells within 1.5 km of the natural spring.
2. Develop a new well to obtain water for this public water system.

Clearwater Public Water System Groundwater Source



The Clearwater public water system treats groundwater from a GUDI well drilled in 1998. The public water system provides drinking water to 65 people.

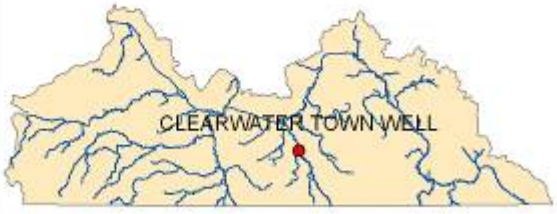
Kilometres
0 0.2 0.4 0.8

Public drinking water supply for the town of Clearwater.

The orthophoto illustrates land use within 1.5 km radius of the well

- Surface Water Drinking Sources
- Municipal Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed



Date: 20090630
Projection: UTM, NAD83, Zone 14

Manitoba

Clearwater - Public Water System

Source: Groundwater (shale aquifer)
Number of wells: 1
Well Depth: 11 m (36 ft)
Depth of Casing: 4.6 m (15 ft)
Well Owner: RM of Louise
Population Served: ~ 65
Date of Construction: 1998
Is the source treated?: Yes
What type of treatment is used?: Greensand filtration/Chlorinated
Is the source chlorinated?: Yes
Is the wellhead enclosed in a shed/wellhouse? No
Is there controlled access to the wellhouse? Yes
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? Yes
Does surface water pool around the surface of the well? No
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition: : High – Well is influenced by surface water and is vulnerable to changes in surface water quality.
Vulnerability Based on Well Construction: High – Well is influenced by surface water and is vulnerable to changes in surface water quality.

Comments: Since this groundwater source is designated as GUDI (Groundwater Under Direct Influence), this well is vulnerable to contaminated surface water from Cypress Creek. The area directly upstream of the wellhead site should be monitored to ensure that a healthy riparian area is maintained. Any eroding sites should be fixed and livestock access should be managed. The municipality may want to consider drilling a new well that will not be influenced by surface water. A new plant is scheduled to be constructed by the spring of 2011. Construction includes a new groundwater source.

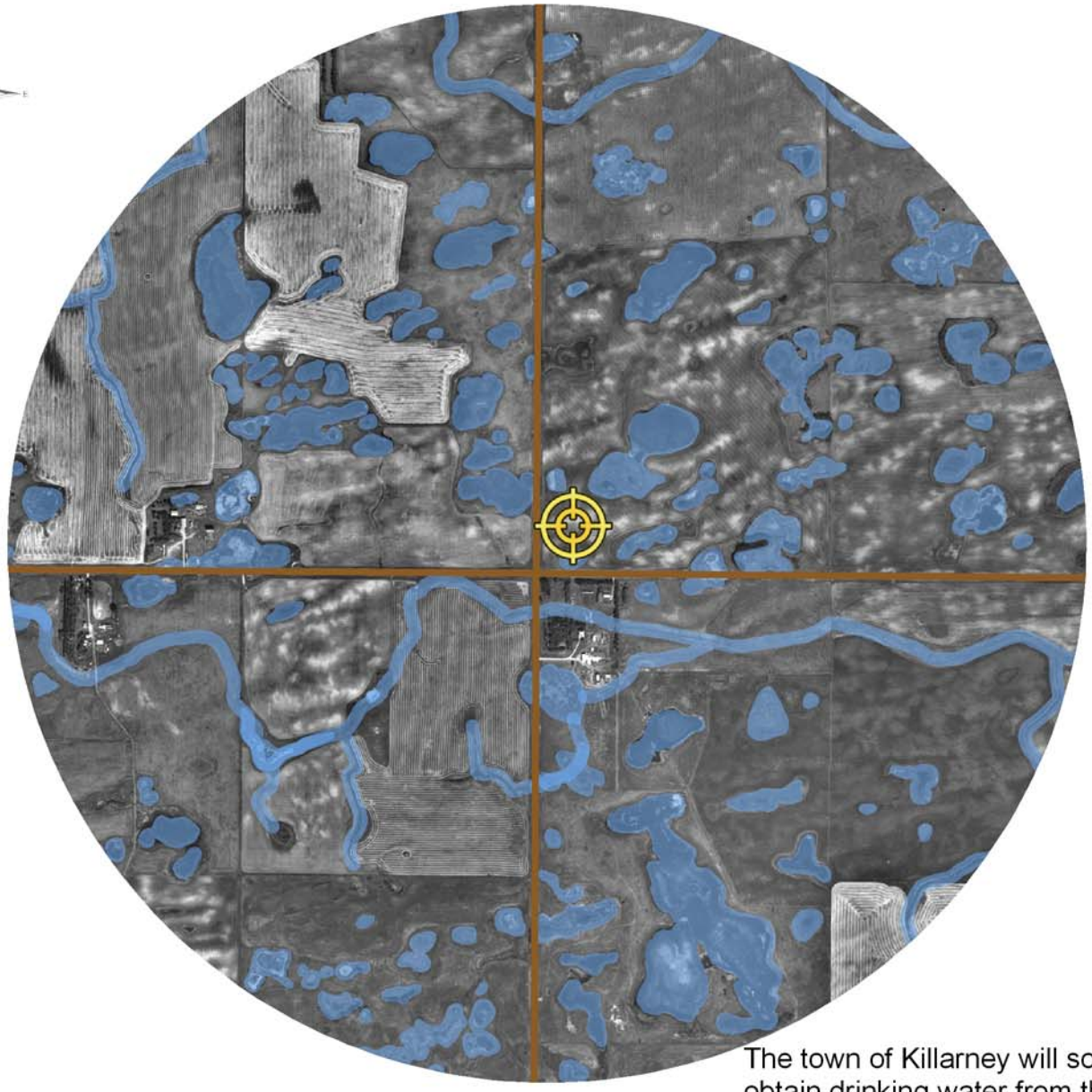
Land use in the surrounding area of the Clearwater public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and Livestock Operations	Across the road ~100 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community of Clearwater used septic tanks and fields for on-site waste water management.	None.
Town of Clearwater	~ 30 m – 1 km	Urban related activities –higher traffic area	None.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells are present in the Town of Clearwater and surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.
Cypress Creek – overland flooding	10 m	Overland flooding – may infiltrate well, or nearby abandoned wells	None. Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Consider developing a new well that is not directly influenced by surface water.
2. Seal all abandoned wells within 1.5 km of the well head.

Killarney Public Water System Groundwater Source



Kilometres
0 0.25 0.5 1

The town of Killarney will soon obtain drinking water from this groundwater source. This water source will replace the drinking water currently obtained from Killarney Lake.

Public drinking water supply for the town of Killarney.

The orthophoto illustrates land use within 1.5 km radius of the well

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090817
Projection: UTM, NAD83, Zone 14

Manitoba

Killarney - Public Water System – Proposed Groundwater

Source: Groundwater
Number of wells: 1
Well Depth: to be determined
Depth of Casing: to be determined
Well Owner: RM of Killarney/Turtle Mountain
Population Served: 2200
Date of Construction: 2010
Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes
Is the wellhead enclosed in a shed/wellhouse? No
Is there controlled access to the wellhouse? Yes
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? Yes
Does surface water pool around the surface of the well? No
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition: Low
Vulnerability Based on Well Construction: Low

Comments: This proposed well has been licensed and is expected to be operational in 2011.

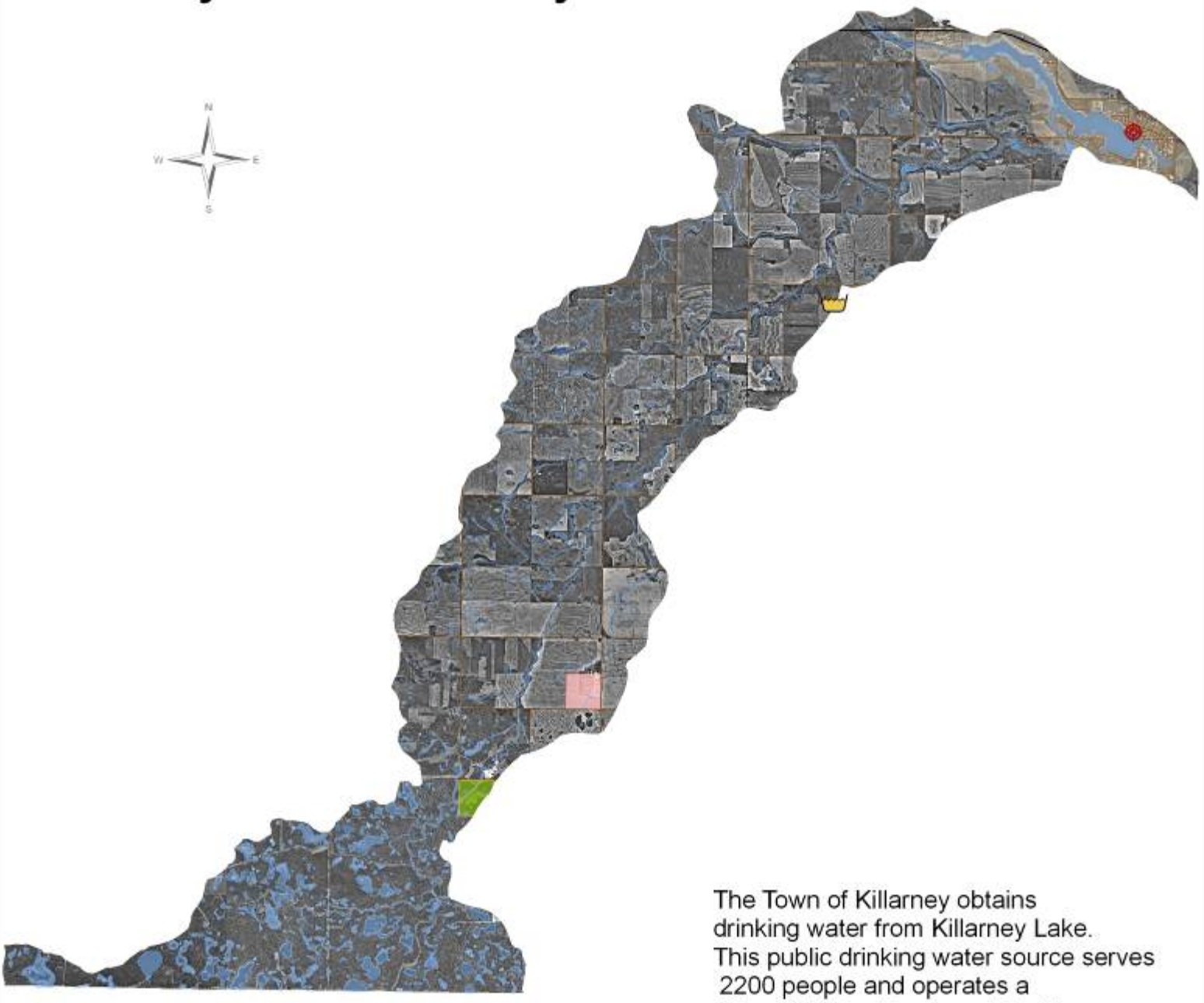
Land use in the area surrounding the proposed Killarney public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land	~100 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes.
Septic systems	200 m - 1.5 km	3 yard sites within 1.5 km of the well head.	None.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in the surrounding area.	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes gravel roads	None. Monitor any changes.
Farm yards	200 m - 1.5 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.

Recommended actions for all potential pollutant sources:

1. None at this time.

Killarney Public Water System Surface Water Source



The Town of Killarney obtains drinking water from Killarney Lake. This public drinking water source serves 2200 people and operates a Class 2 Water Treatment Facility.

Public drinking water supply for the town of Killarney.

The orthophoto illustrates land use within the Killarney Lake watershed

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090817
Projection: UTM, NAD83, Zone 14

Manitoba

Killarney - Public Water System

Source: Killarney Lake
Owner: Town of Killarney
Population Served: 2200
Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes

Comments: The town of Killarney will soon be sourcing drinking water from a nearby well, and will no longer be sourcing water from Killarney Lake.

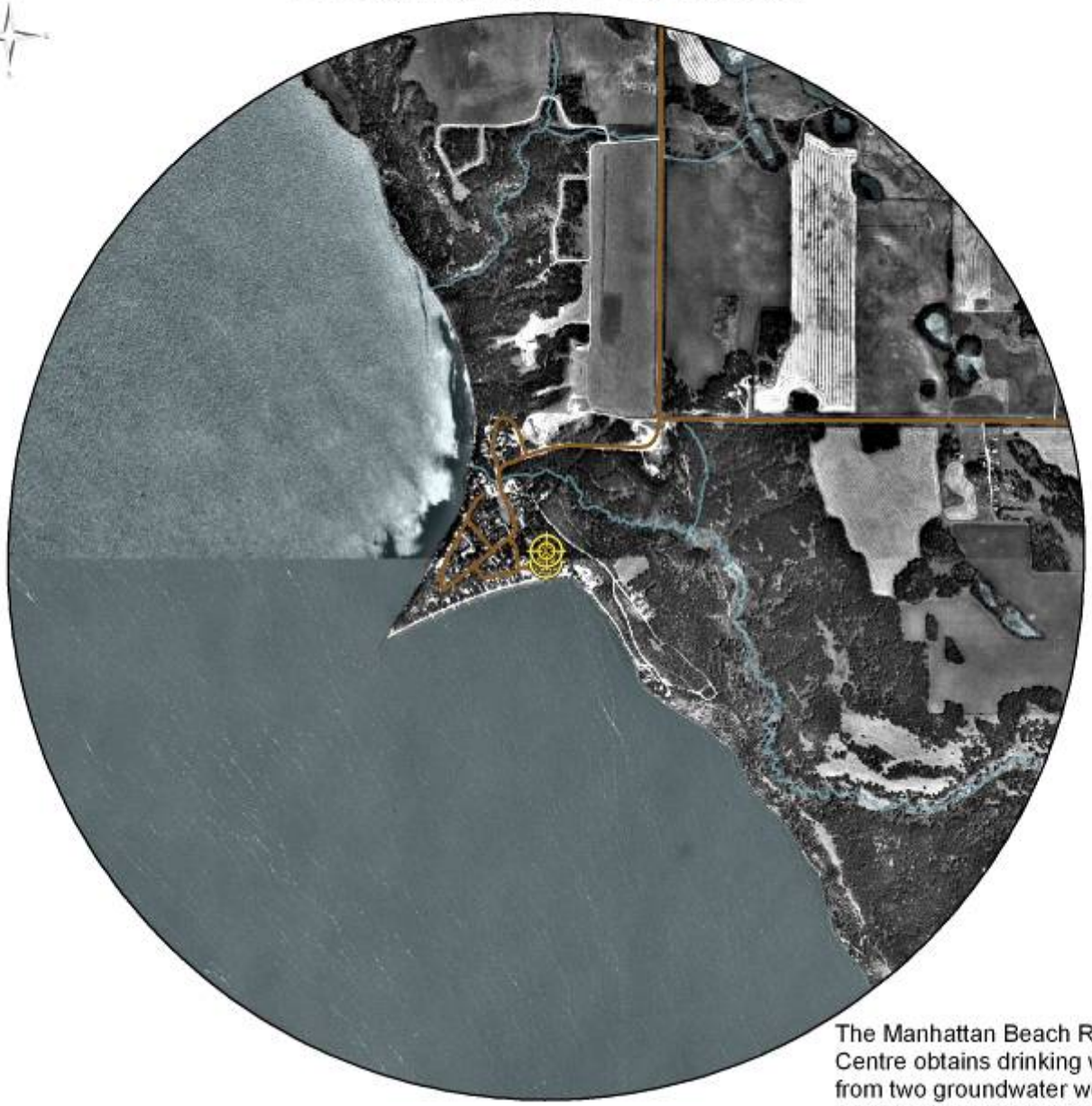
Land use in the sub watershed of Killarney Lake.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	~100 m – 20 km	Annual cropping, hayland and pasture land are common in this area. An intensive livestock operation is located <10 km upstream of Killarney lake.	Reduce nutrient inputs into this subwatershed.
Septic systems	50 m - 1.5 km	Residences in the area around Killarney Lake use septic tanks and fields for on-site waste water management.	Develop an effective septic system educational campaign. Deliver an enhanced inspection program of waste-water systems on residential properties in sensitive areas to ensure water quality is being protected
Town of Killarney		Urban related activities –higher traffic area	None.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Farm yards	1.0 km – 20.0 km upstream	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.

Recommended actions for all potential pollutant sources:

1. Reduce nutrient inputs from the sub watershed.
2. Deliver an enhanced inspection program of waste-water systems on residential properties in sensitive areas to ensure water quality is being protected.

Manhattan Beach Public Water System
Groundwater Source



The Manhattan Beach Retreat Centre obtains drinking water from two groundwater wells installed in 1992 and 2000. This public drinking water source serves 300 people.

Kilometres
0 0.25 0.5 1

Public drinking water supply for the Manhattan Beach Retreat Centre.

The orthophoto illustrates land use within 1.5 km radius of the wells

- Surface Water Drinking Sources
- Municipal Wells
- Rural Water Pipelines
- Lakes & Rivers
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090630
Projection: UTM, NAD83, Zone 14

Manitoba

Manhattan Beach Retreat Centre - Public Water System

Source: Groundwater (sand and gravel)
Number of wells: 2
Well Depths:

- **Well 1:** 11.6 m (38 ft)
- **Well 2:** 12.5 m (41 ft)

Depth of Casings:

- **Well 1:** 5.5 m (18 ft)
- **Well 2:** 7.6 m (25 ft)

Well Owner: Manhattan Beach Retreat Centre
Population Served: 300
Date of Construction:

- **Well 1:** 1992
- **Well 2:** 2000

Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes
Is the wellhead enclosed in a shed/wellhouse?

- **Well 1:** Yes
- **Well 2:** No

If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the wells? Yes
Does surface water pool around the surface of the well? No
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition:

- **Well 1:** High - Overburden will provide very little protection
- **Well 2:** Medium – Overburden will provide some protection

Vulnerability Based on Well Construction: Low

Comments: A large septic holding tank is located within 10 m of both well heads. Efforts should be make to ensure the tank does not develop a leak.

Land use in the area surrounding the Manhattan Beach Retreat Centre public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Points	Comments	Recommended Action
Crop/Pasture land	~500 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes.
Septic systems	10 m - 1.5 km	Cottages and buildings in the community of Manhattan Beach use septic tanks for on-site waste water management.	Consider relocating nearby septic tank further from the well heads.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in the Manhattan Beach Retreat Centre and surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.
Pelican Lake	50 m	Overland flooding – may infiltrate well, or nearby abandoned wells	None. Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Consider relocating nearby septic tank further from the well heads.
2. Seal all abandoned wells within 1.5 km of the well head.

Manitou Public Water System Surface Water Source

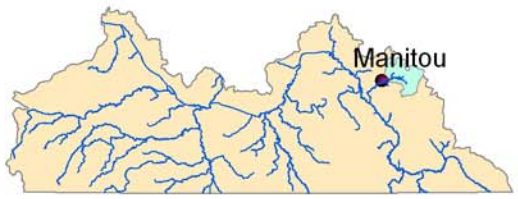
The Town of Manitou obtains drinking water from the Mary Jane Reservoir. This public drinking water source serves 718 people and operates a Class 3 Water Treatment Facility.

Public drinking water supply for the town of Manitou.

The orthophoto illustrates land use within the Mary Jane Reservoir watershed

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed



Date: 20090817
Projection: UTM, NAD83, Zone 14

Manitoba

Manitou - Public Water System

Source: Mary Jane Reservoir
Owner: Town of Manitou
Population Served: 718
Is the source treated?: Yes
What type of treatment is used?: Lime-soda ash softening/ Rapid gravity filtration/Chlorinated
Is the source chlorinated?: Yes

Comments: None.

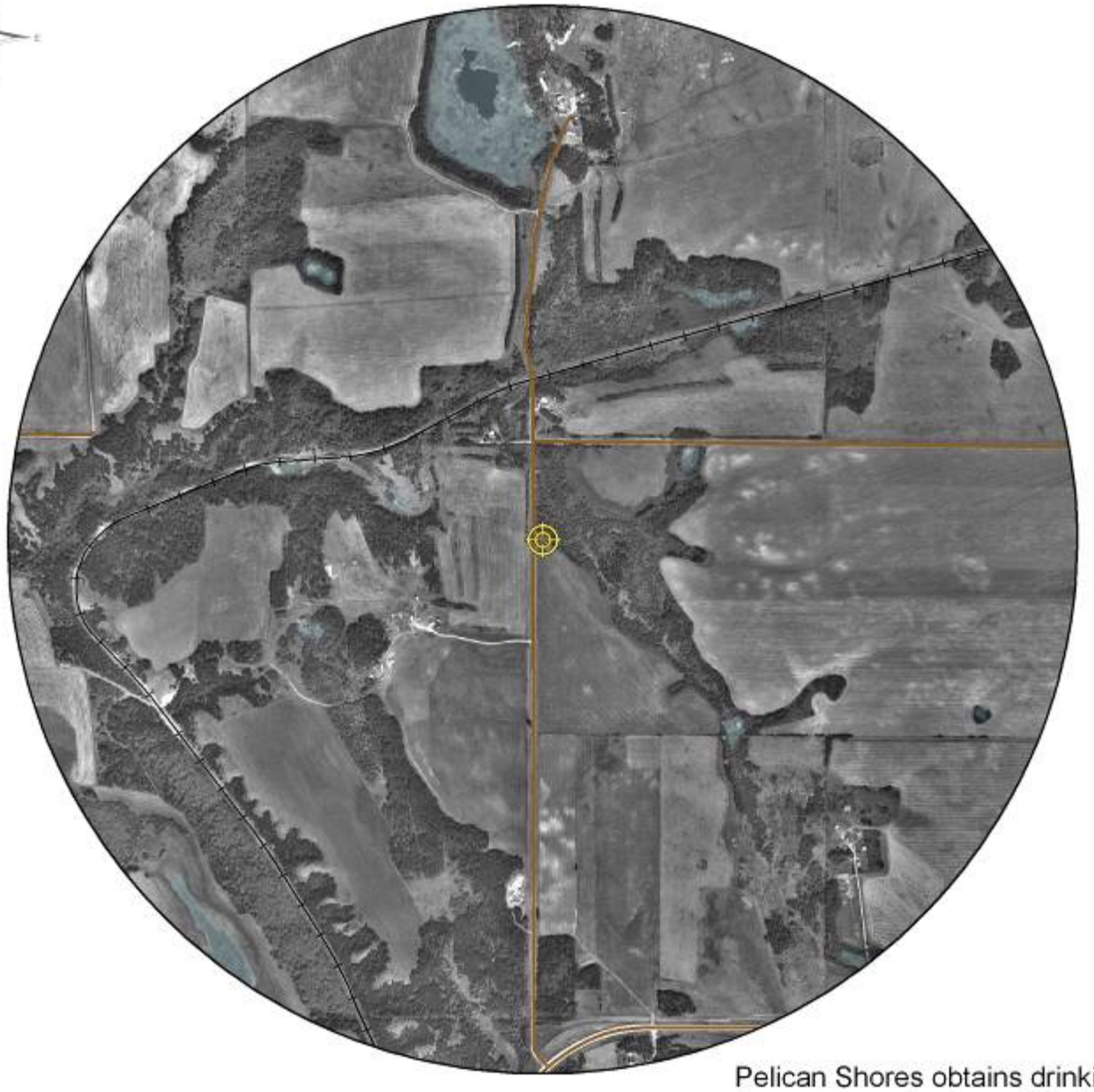
Land use in the sub watershed of the Mary Jane Reservoir.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	Across the road ~100 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area. One intensive livestock operation is found in this watershed.	Reduce nutrient inputs in this subwatershed.
Septic systems	500 m - 1.5 km	Residences in this subwatershed use septic tanks, fields, sewage ejectors for on-site waste water management.	None.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Farm yards	~1.0 km – 10 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.

Recommended actions for all potential pollutant sources:

1. Reduce nutrient inputs from this sub watershed.

Pelican Shores RV Park Public Water System
Groundwater Source



Kilometres
0 0.25 0.5 1

Pelican Shores obtains drinking water from a groundwater well installed in the early 1900s. This public drinking water source serves 280 people.

Public drinking water supply for Pelican Shores RV Park.

The orthophoto illustrates land use within 1.5 km radius of the well

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090630
Projection: UTM, NAD83, Zone 14

Manitoba

Pelican Shores RV Park - Public Water System

Source: Groundwater
Number of wells: 1
Well Depth: unknown
Depth of Casing: unknown
Well Owner: Pelican Shores
Population Served: 280
Date of Construction: Early 1900's
Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes
Is the wellhead enclosed in a shed/wellhouse? No
Is there controlled access to the wellhouse? Yes
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? Yes
Does surface water pool around the surface of the well? No
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition: Low
Vulnerability Based on Well Construction: High – Well is very old and may be vulnerable.

Comments: Beaver activity on a nearby stream may cause flooding and surface water contamination of the well head.

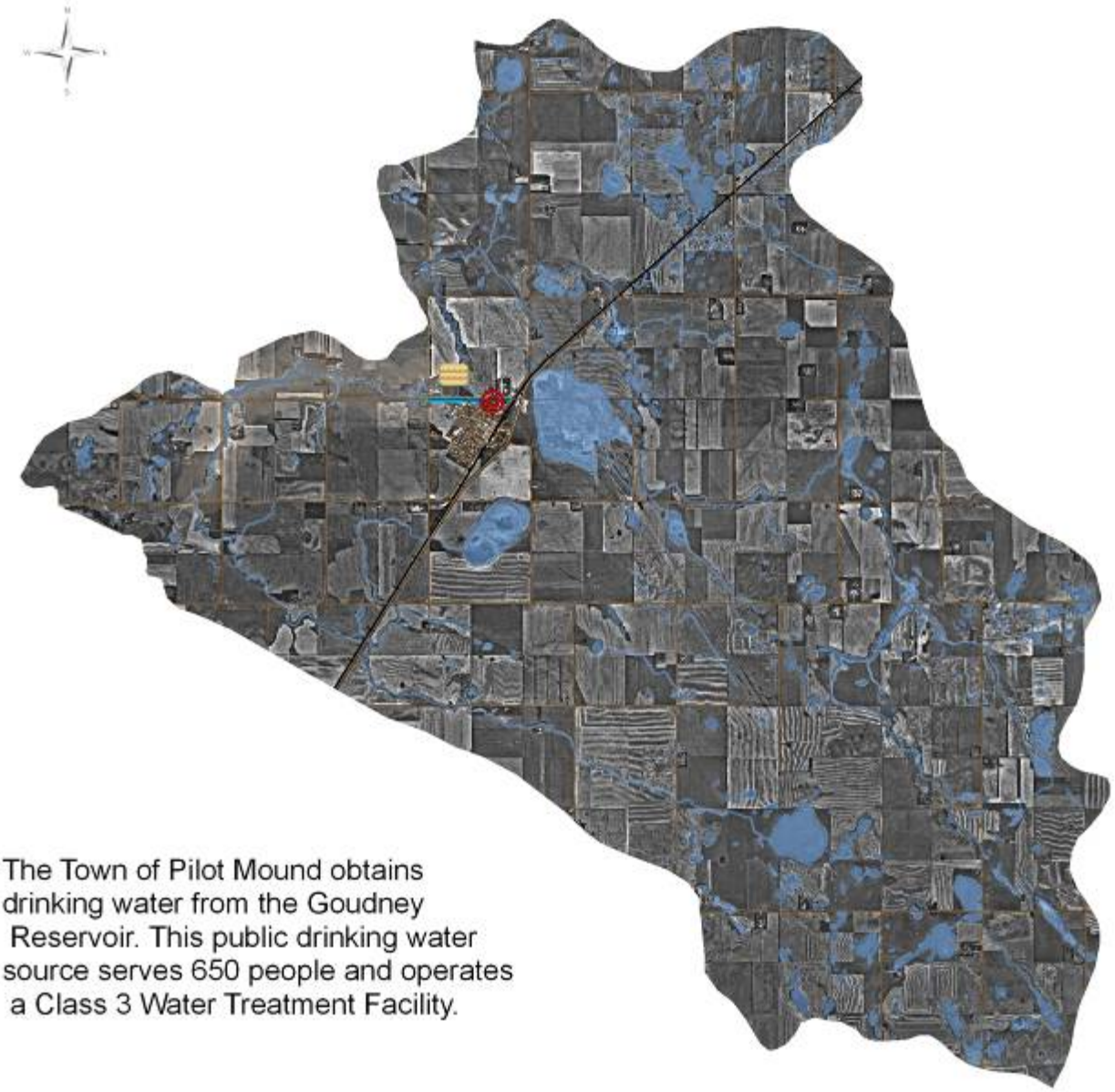
Land use in the area surrounding the Pelican Shores RV Park public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	Across the road ~200 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes.
Abandoned wells / Improperly maintained active wells		Abandoned wells may be present in the surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes gravel roads and a railway.	None.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.
Creek – overland flooding	10 m	Overland flooding – may infiltrate well, or nearby abandoned wells	High

Recommended actions for all potential pollutant sources:

1. Control beaver activity on adjacent waterway to prevent flooding of the well head.
2. Consider developing a new well that is not directly beside a creek.
3. Seal all abandoned wells within 1.5 km of the well head.

Pilot Mound Public Water System
Surface Water Source



The Town of Pilot Mound obtains drinking water from the Goudney Reservoir. This public drinking water source serves 650 people and operates a Class 3 Water Treatment Facility.

Kilometres
0 1.25 2.5 5

Public drinking water supply for the town of Pilot Mound.

The orthophoto illustrates land use within the Goudney Reservoir watershed

- Surface Water Drinking Sources
- Municipal Wells
- Rural Water Pipelines
- Lakes & Rivers
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090630
Projection: UTM, NAD83, Zone 14

Manitoba

Pilot Mound - Public Water System

Source: Goudney Reservoir
Owner: Town of Pilot Mound
Population Served: 650
Is the source treated?: Yes
What type of treatment is used?: Lime-soda ash softening/Rapid gravity filtration/Chlorinated
Is the source chlorinated?: Yes

Comments:

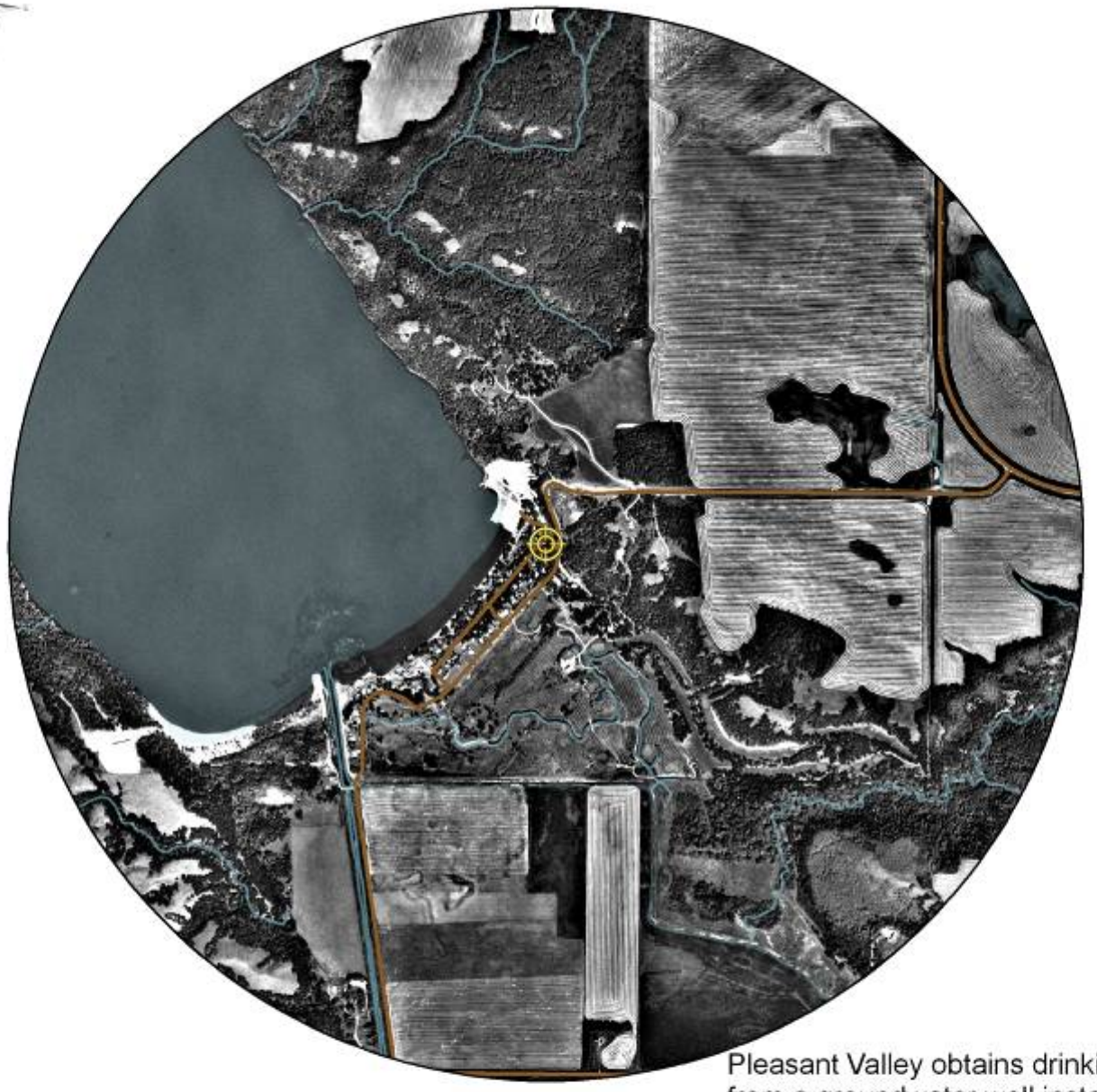
Land use in the sub watershed of the Goudney Reservoir.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	~100 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	Reduce nutrient inputs from sub-watershed.
Septic systems	500 m - 1.5 km	Homes in community of Pilot Mound use septic tanks and fields for on-site waste water management.	None. Monitor any changes.
Town of Pilot Mound	~ 30 m – 1 km	Urban related activities –higher traffic area	None. Monitor any changes.
Wastewater treatment plant	~ 30 m – 1 km	Wastewater treatment plant is located northwest of Goudney reservoir.	Reduce nutrient inputs from sub-watershed.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads.	None. Monitor any changes.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None. Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Reduce nutrient inputs from sub-watershed.

Pleasant Valley Public Water System
Groundwater Source



Kilometres
0 0.25 0.5 1

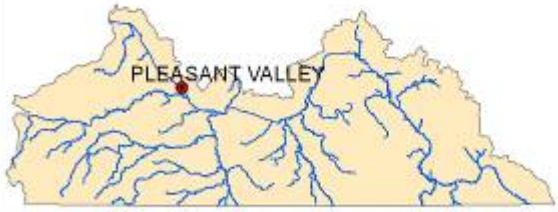
Pleasant Valley obtains drinking water from a groundwater well installed in 1991. This public drinking water source serves 400 people.

Public drinking water supply for Pleasant Valley.

The orthophoto illustrates land use within 1.5 km radius of the well

- Surface Water Drinking Sources
- Municipal Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed



Date: 20090630
Projection: UTM, NAD83, Zone 14

Manitoba

Pleasant Valley - Public Water System

Source: Groundwater (sand and gravel aquifer)
Number of wells: 1
Well Depth: 11.6 m (38 ft)
Depth of Casing: 7.0 m (23 ft)
Well Owner: Pleasant Valley Cottage Association
Population Served: 400
Date of Construction: 1991
Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes
Is the wellhead enclosed in a shed/wellhouse? Yes
Is there controlled access to the wellhouse? Yes
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? Yes
Does surface water pool around the surface of the well? No
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition: High – Well is in a sand and gravel aquifer and thus is vulnerable to nearby land use changes.
Vulnerability Based on Well Construction: Low

Comments: None

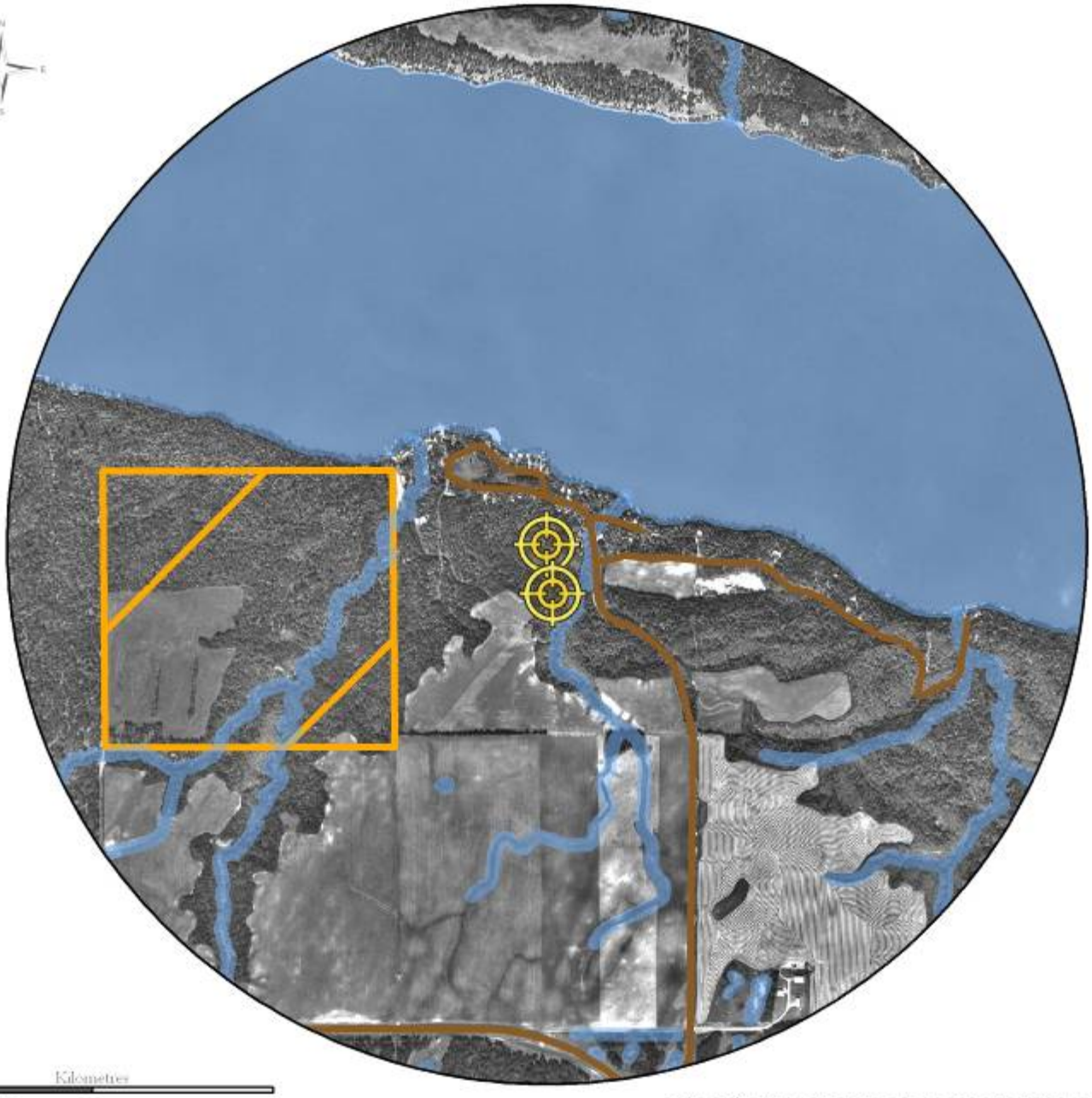
Land use in the surrounding area the Pleasant Valley public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and	~400 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community of Pleasant Valley use septic tanks and for on-site waste water management.	None. Monitor any changes.
Pleasant Valley	~ 30 m – 1 km	Urban related activities –higher traffic area	None.
Abandoned wells / Improperly maintained active wells		Abandoned wells may be present in the surrounding area	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Golf Course	~.5 km	Likely includes storage of chemicals, fuel and potentially fertilizer.	None. Monitor any changes.
Pelican Lake – overland flooding	50 m	Overland flooding – may infiltrate well, or nearby abandoned wells	None. Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Seal all abandoned wells within 1.5 km of the well head.

Rock Lake Beach
Public Water System Groundwater Source



Kilometres
0 0.25 0.5 1

The Rock Lake Beach campground draw water from two wells. This public water system is under a long term boil water advisory.

Public drinking water supply for the community of Rock Lake Beach.

The orthophoto illustrates land use within 1.5 km radius of the wells

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090817
Projection: UTM, NAD83, Zone 14

Manitoba

Rock Lake Beach - Public Water System

Source: Groundwater
Number of wells: 2
Well Depths:

- **Well 1:** unknown
- **Well 2:** unknown

Depth of Casings:

- **Well 1:** unknown
- **Well 2:** unknown

Well Owner: Rock Lake Beach Cottage Association
Population Served: 100
Date of Construction:

- **Well 1:** ~1990
- **Well 2:** ~1970

Is the source treated?: No
What type of treatment is used?: None
Is the source chlorinated?: No
Is the wellhead enclosed in a shed/wellhouse? No
Is there controlled access to the wellhouse? No
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? No
Does surface water pool around the surface of the well? No
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition: Unknown
Vulnerability Based on Well Construction: Unknown.

Comments: This public water system is under a long-term boil water advisory.

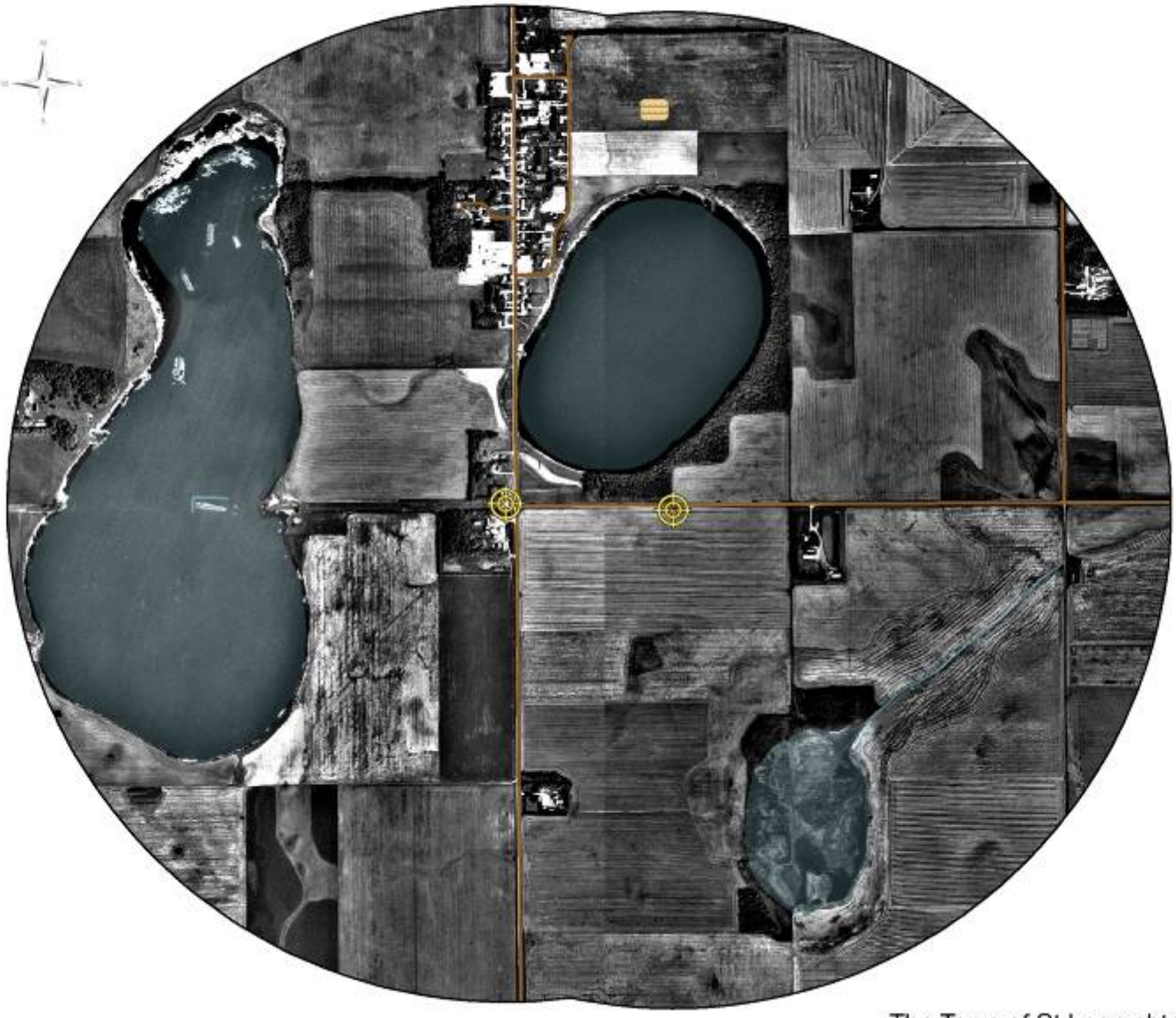
Land use in the area surrounding the Rock Lake Beach public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and livestock operations	~200 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community of Rock Lake Beach use septic tanks for on-site waste water management.	None.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in the surrounding area.	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None.
Farm yards	~1.5 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.
Rock Lake – overland flooding	50 m	Overland flooding – may infiltrate wells or nearby abandoned wells	

Recommended actions for all potential pollutant sources:

1. Consider developing a new well.
2. Seal all abandoned wells within 1.5 km of the well head.

St. Leon Public Water System Groundwater Source



The Town of St Leon obtains drinking water from two wells. The first was installed in 1974 and the second was installed in 1988. This public drinking water source serves 100 people.

Kilometres
0 0.25 0.5 1

Public drinking water supply for the town of St. Leon.

The orthophoto illustrates land use within 1.5 km radius of the wells

- Surface Water Drinking Sources
- Municipal Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090630
Projection: UTM, NAD83, Zone 14

Manitoba

St. Leon - Public Water System

Source: Groundwater (shale aquifer)
Number of wells: 2
Well Depths:

- **Well 1:** 49.3 m (161.9 ft)
- **Well 2:** 52.7 m (172.9 ft)

Depth to Groundwater:

- **Well 1:** 11.3 m (37.0 ft) in 1974
- **Well 2:** 13.1 m (43.0 ft) in 1988

Depth of Casing:

- **Well 1:** 49.3 m (161.9 ft)
- **Well 2:** 31.1 m (101.9 ft)

Well Owner: RM of Lorne
Population Served: ~ 100
Date of Construction:

- **Well 1:** 1974
- **Well 2:** 1988

Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes
Is the wellheads enclosed in a shed/wellhouse? No
Is there controlled access to the wellhouse? Yes
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? No
Does surface water pool around the surface of the well? No
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition: Medium – Wells may be vulnerable to changes in surface land use activity.
Vulnerability Based on Well Construction: Medium – Area adjacent to well head may benefit from a permanent grass buffer.

Comments: Upgrade both well head sites with a new casing and fencing. Create a five metre vegetated buffer around the well 2.

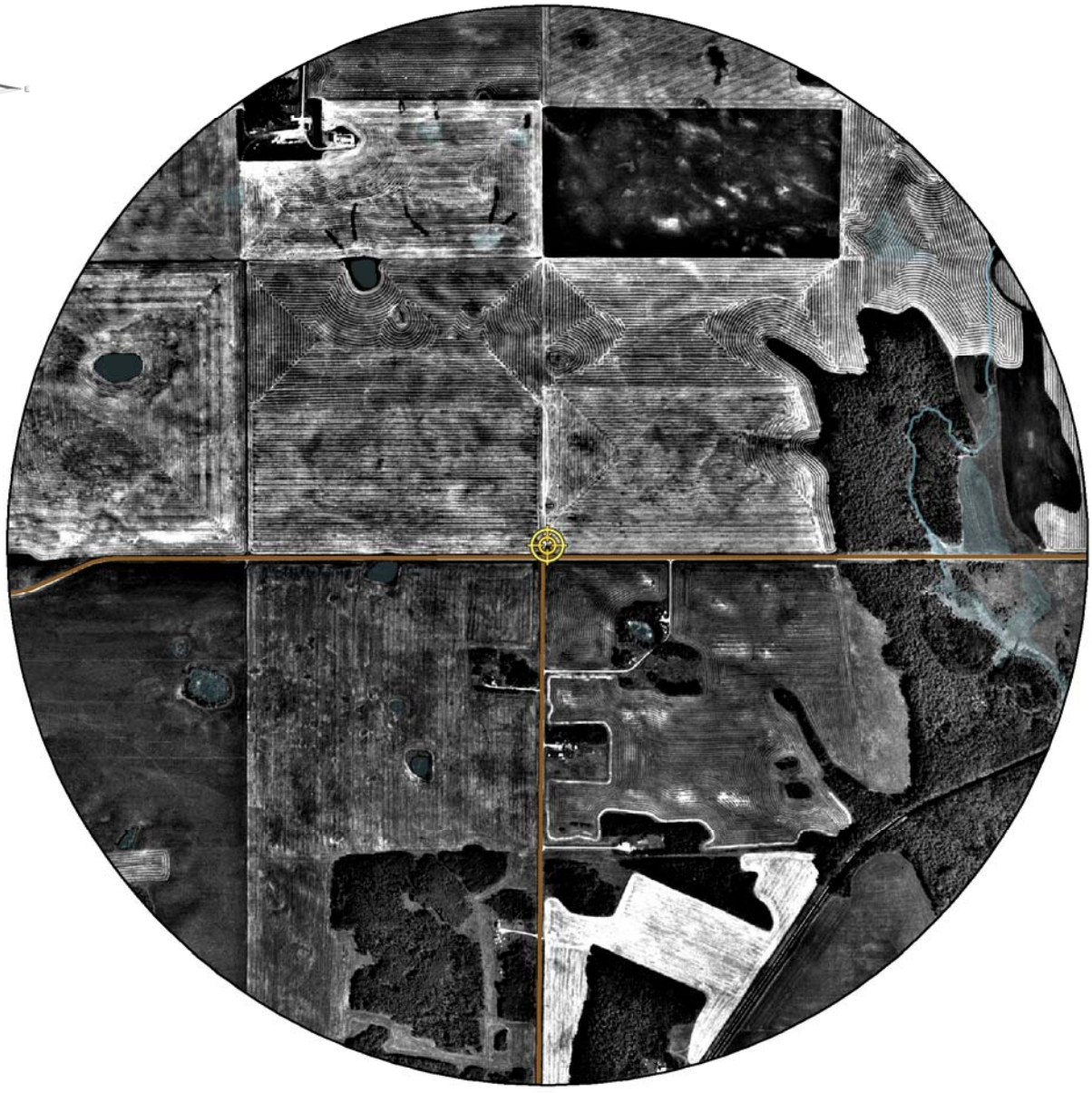
Land use in the area surrounding the St. Leon public water system wells.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land and Livestock Operations	~5 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes.
Septic systems	500 m - 1.5 km	Homes in community of St. Leon use septic tanks and fields for on-site waste water management.	None.
Town of St Leon	~ 30 m – 1 km	Urban related activities –higher traffic area	None.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present in St Leon and surrounding area.	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads	None
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.
Wastewater treatment plant	~1.0 km		None. Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Upgrade both well head sites with a new casing and fencing. Create a five metre vegetated buffer around the well 2.
2. Seal all abandoned wells within 1.5 km of the well heads.

Swan Lake Public Water System Groundwater Source



The Town of Swan Lake obtains drinking water from a well installed in 1977. This public drinking water source serves 300 people.

Kilometres
0 0.25 0.5 1

Public drinking water supply for the town of Swan Lake.

The orthophoto illustrates land use within 1.5 km radius of the well

- Surface Water Drinking Sources
- Municipal Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090630
Projection: UTM, NAD83, Zone 14

Manitoba

Swan Lake - Public Water System

Source: Groundwater (sand and gravel)
Number of wells: 1
Well Depths: 15.2 m (50 ft)
Depth of Casing: 9.9 m (32.4 ft)
Well Owner: RM of Lorne
Population Served: ~ 250
Date of Construction: 1977
Is the source treated?: Yes
What type of treatment is used?: Greensand filtration/Chlorinated
Is the source chlorinated?: Yes
Is the wellhead enclosed in a shed/wellhouse? No
If there is no wellhouse, is there a permanent grass buffer at least 5 m in circumference around the well? No
Does surface water pool around the surface of the well? No
Does the well casing extend at least 16 inches above mounded earth? Yes
The sanitary seal is secure and in good condition? Yes
Vulnerability Based on Overburden Thickness and Composition: High – Well may be vulnerable to changes in surface land use activity.
Vulnerability Based on Well Construction: Medium – Area adjacent to well head may benefit from a permanent grass buffer.

Comments: The road allowance directly adjacent to the roadway can be used for pesticides and fertilizer mixing, which may make the well head susceptible to contamination.

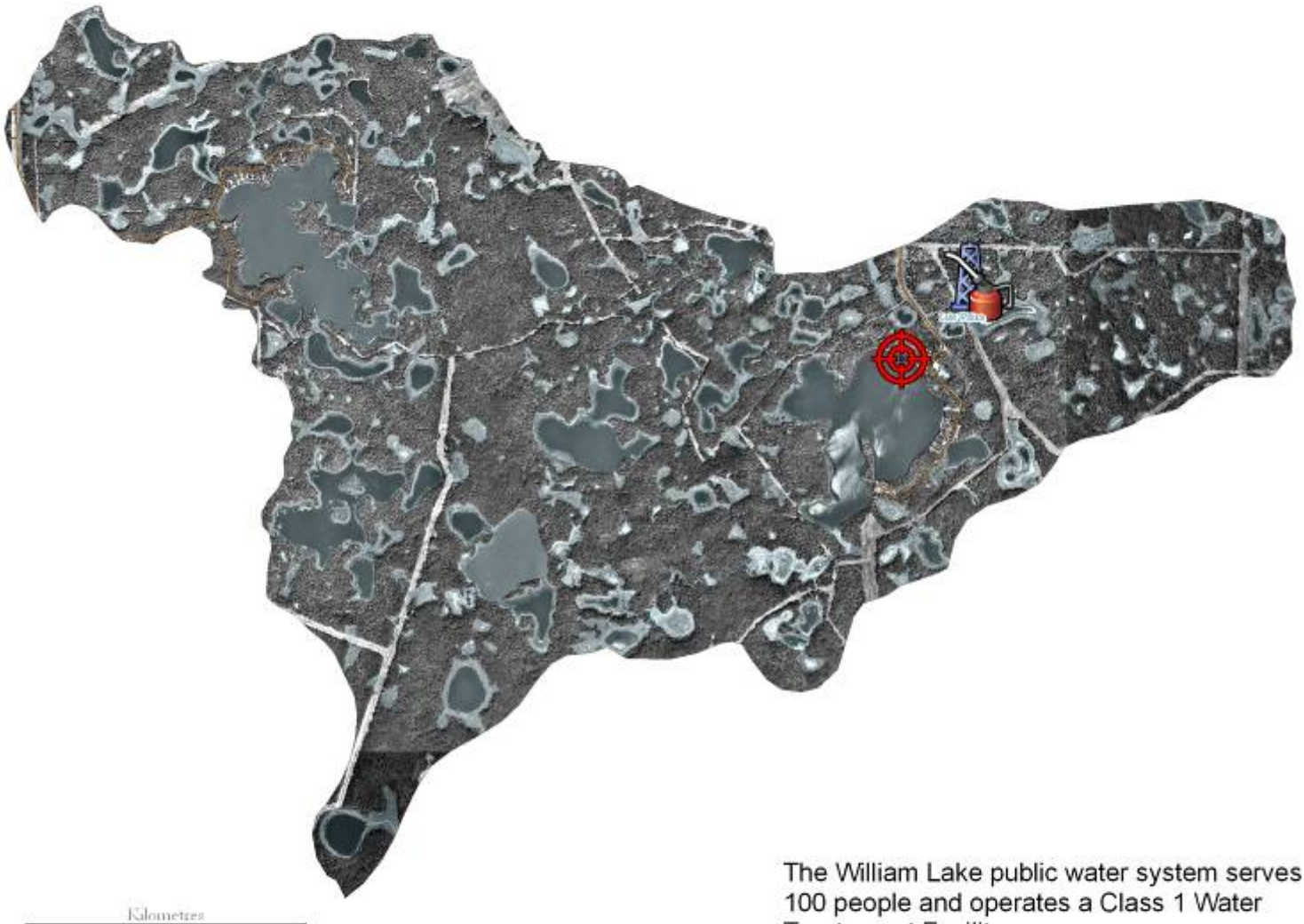
Land use in the surrounding area the Swan Lake public water system well.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Crop/Pasture land	~5 m – 1.5 km	Annual cropping, hayland and pasture land are common in this area.	None. Monitor any changes.
Septic systems	500 m - 1.5 km	Homes south of the well head.	None.
Abandoned wells / Improperly maintained active wells	~ 30 m – 1 km	Abandoned wells may be present the surrounding area.	Seal all abandoned wells within 1.5km.
Transportation routes	50 m – 1.5 km	Includes paved and gravel roads. Road allowance adjacent to well head may make well head susceptible to contamination.	Install a fence barrier to create a five meter buffer around well head.
Farm yards	~1.0 km	Likely includes storage of chemicals, fuel and potentially fertilizer/manure. Also, will likely include household storage of hazardous materials	None.
Intensive livestock operation (hogs)	~1.4 km	Appears to be decommissioned.	None. Monitor any changes.

Recommended actions for all potential pollutant sources:

1. Install fence barrier to create a five metre buffer around well head.
2. Seal all abandoned wells within 1.5 km of the well head.

William Lake Public Water System Surface Water Source



Kilometres
0 0.5 1 2

The William Lake public water system serves 100 people and operates a Class 1 Water Treatement Facility.

Public drinking water supply for William Lake Provincial Park.

The orthophoto illustrates land use within the subwatershed.

- Surface Water Drinking Sources
- Groundwater Wells
- Rural Water Pipelines
- Lakes & Rivers
- Waste Water Treatment
- Manure Storage
- Oil Wells
- Provincial Parks
- Wildlife Management Areas
- Roadways
- Railways

Pembina River Watershed

Date: 20090817
Projection: UTM, NAD83, Zone 14

Manitoba

William Lake - Public Water System

Source: Surface water
Owner: Manitoba Conservation – Park Branch
Population Served: 100
Is the source treated?: Yes
What type of treatment is used?: Chlorinated
Is the source chlorinated?: Yes

Comments: An oil well is located ~ 0.5 km northeast of William Lake.

Land use in the subwatershed of William Lake.

Potential Pollutant Source	Distance to Source Withdrawal Point	Comments	Recommended Action
Pasture	~100 m – 1.5 km	Community pasture land surrounds this area.	None. Monitor any changes.
Septic systems	500 m - 1.5 km	William Lake campground uses septic tanks to hold waste water.	None.
Oil well	0.5 km north east		None. Monitor any changes.

Recommended actions for all potential pollutant sources:

1. None identified.