Whitemud River Watershed Integrated Watershed Management Plan - Water Quality Report

Prepared by:

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Water Quality Investigations and Routine Monitoring:

This report provides an overview of the studies and routine monitoring which have been undertaken by Manitoba Water Stewardship's Water Quality Management Section within the Whitemud River watershed.

There are two long term water quality monitoring stations (1973 – 2009) within the Whitemud River Watershed. These include the Whitemud River at PTH 16 at Westbourne and Boggy Creek (Whitemud River) at Neepawa. There are also seven other stations on the Whitemud River not part of the long term water quality monitoring program in which some historic data were available.

The Whitemud River watershed area is primarily characterized by agricultural crop land, urban and rural centres. All these land uses have the potential to negatively impact water quality, if not managed appropriately. Cropland can present water quality concerns in terms of fertilizer and pesticide runoff entering surface water. The Springhill Farms hog processing plant has the potential to present water quality concerns in terms of wastewater effluent and industrial runoff. The town of Neepawa and other rural municipalities present water quality concerns in terms of wastewater treatment and effluent.

The tributary of most concern in the Whitemud River watershed is the Whitemud River, as it is the major tributary in the watershed. Currently, there are two long term water quality monitoring stations on the Whitemud River which are sampled monthly (including quarterly samples) for general chemistry, nutrients, metals and bacteria, additionally quarterly samples include pesticide monitoring.

Water Quality Index Calculations:

The Canadian Council of Ministers of the Environment (CCME) Water Quality Index is used to summarize large amounts of water quality data into simple terms (e.g., good) for reporting in a consistent manner (CCME, 2001). Twenty-five variables are included in the Water Quality Index (Table 1) and are compared with water quality objectives and guidelines contained in the Manitoba Water Quality Standards, Objectives, and Guidelines (Williamson 2002 and Table 1).

The Water Quality Index combines three different aspects of water quality: the 'scope,' which is the percentage of water quality variables with observations exceeding guidelines; the 'frequency,' which is the percentage of total observations exceeding guidelines; and the 'amplitude,' which is the amount by which observations exceed the guidelines. The basic premise of the Water Quality Index is that water quality is excellent when all guidelines or objectives set to protect water uses are met virtually all the time. When guidelines or objectives are not met, water quality becomes progressively poorer. Thus, the Index logically and mathematically incorporates information on water quality based on comparisons to guidelines or objectives to protect important water uses. The Water Quality Index ranges from 0 to 100 and is used to rank water quality in categories ranging from poor to excellent.

- Excellent (95-100) - Water quality never or very rarely exceeds guidelines
- Good (80-94) - Water quality rarely exceeds water quality guidelines
- Fair (60-79) - Water quality sometimes exceeds guidelines and possibly by a large margin
- Marginal (45-59) - Water quality often exceeds guidelines and/or by a considerable margin
- Poor (0-44) - Water quality usually exceeds guidelines and/or by a large margin

Table 1: Water quality variables and objectives or guidelines (Williamson 2002) used to calculate Water Quality Index (CCME 2001).

Variables	Units	Objective Value	Objective Use
Fecal Coliform MF	Bacteria/100mL	200	Recreation
pH	pH Units	6.5-9.0	Aquatic Life
Specific Conductivity	uS/cm	1000	Greenhouse Irrigation
Total Suspended Solids	mg/L	25 (mid range)	Aquatic Life
Dissolved Oxygen	mg/L	5 (mid range)	Aquatic Life
Total or Extractable Cadmium*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Copper*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total Arsenic	mg/L	0.025	Drinking Water, Health
Total or Extractable Lead*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Dissolved Aluminum	mg/L	0.1 for pH >6.5	Aquatic Life
Total or Extractable Nickel*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Zinc*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Manganese	mg/L	0.05	Drinking Water, Aesthetic
Total or Extractable Iron	mg/L	0.3	Drinking Water, Aesthetic
Total Ammonia as N	mg/L	Calculation based pH	Aquatic Life
Soluble or Dissolved Nitrate-Nitrite	mg/L	10	Drinking Water, Health
Total Phosphorus	mg/L	0.05 in Rivers or 0.025 in Lakes	Nuisance Plant Growth
Dicamba	ug/L	0.006 where detectable	Irrigation
Bromoxynil	ug/L	0.33	Irrigation
Simazine	ug/L	0.5	Irrigation
2,4 D	ug/L	4	Aquatic Life
Lindane	ug/L	0.08	Aquatic Life
Atrazine	ug/L	1.8	Aquatic Life
MCPA	ug/L	0.025 where detectable	Irrigation
Trifluralin	ug/L	0.2	Aquatic Life

The Water Quality Index for the Whitemud River fell within the category of 'Good', with the exception of 1998 and 2005 where the Water Quality Index fell within the category of 'Fair' (Figure 1). This indicates water quality occasionally exceeded water quality guidelines for some variables. While numerous variables are used to calculate the overall Water Quality Index, the percentage of variables that exceeded their objective in the Whitemud River at Westbourne from 1990 to 2008 ranged from 13 to 30 per cent. Total phosphorus is typically responsible for driving down the Water Quality Index (to be discussed in greater detail below). While some water bodies contain naturally elevated concentrations of nutrients due to watershed characteristics, many human alterations impact nutrient loading to the Whitemud River.

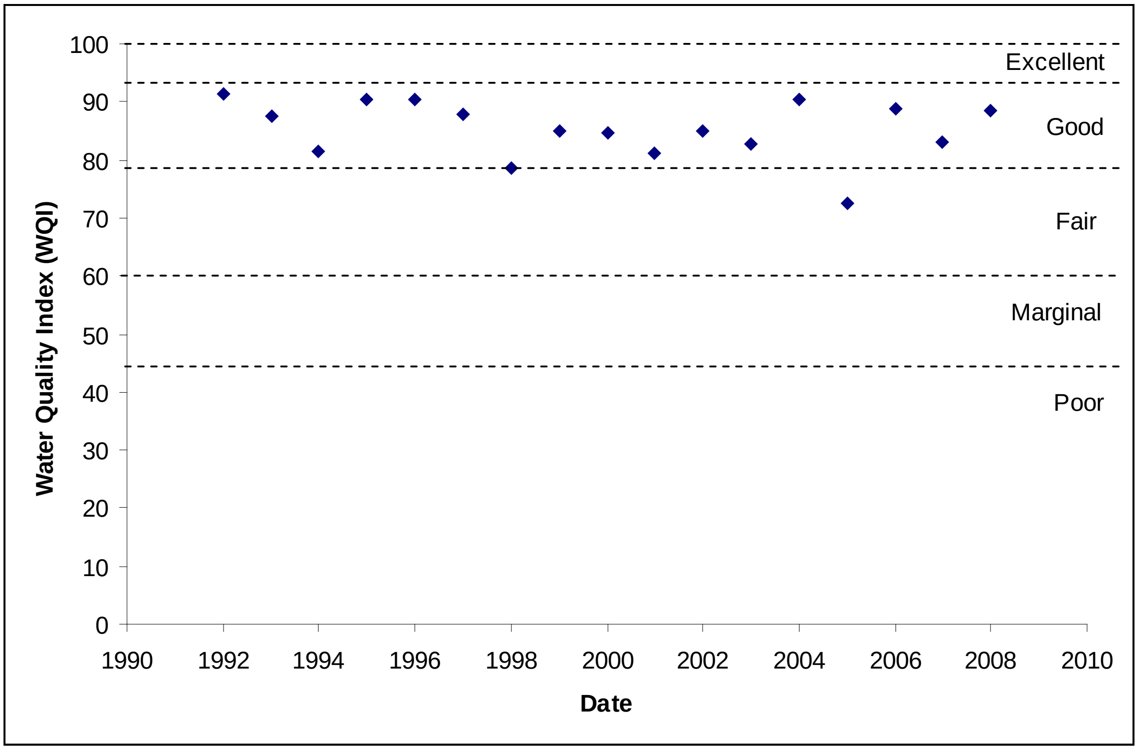

Figure 1: Water Quality Index calculated from 1990 to 2008 for the Whitemud River at Westbourne.

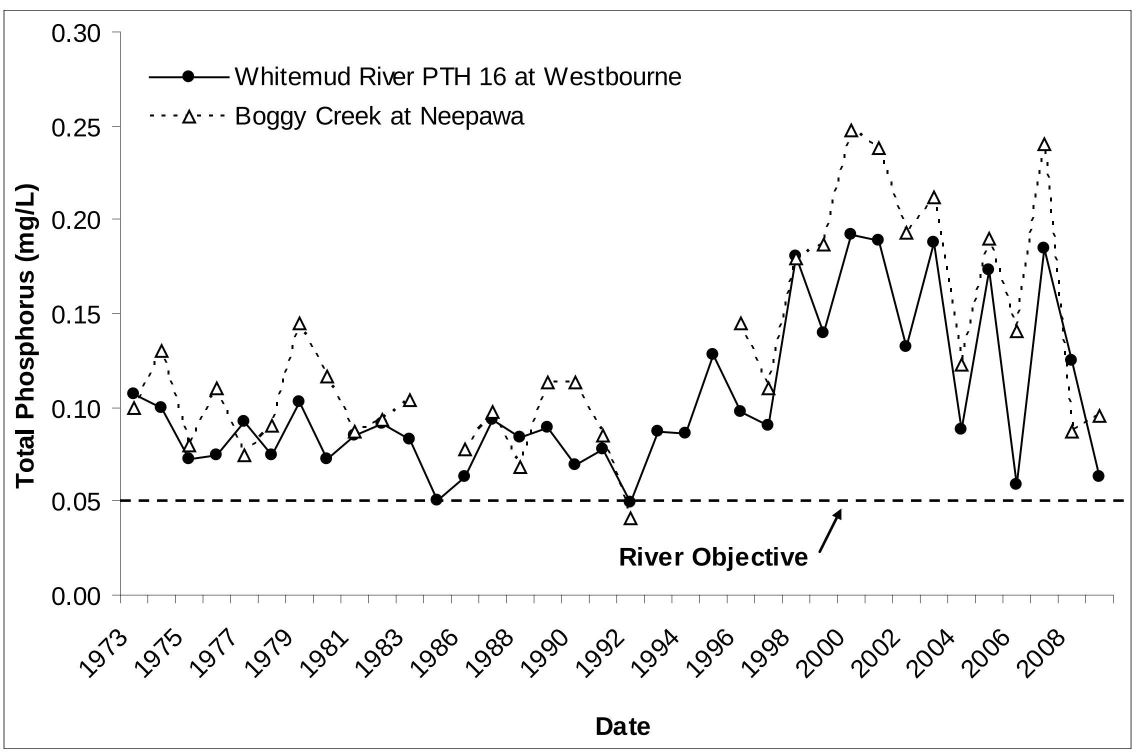

Figure 2: Yearly total phosphorus (mg/L) concentrations from two long term water quality monitoring stations in the Whitemud River watershed between 1973 and 2009.

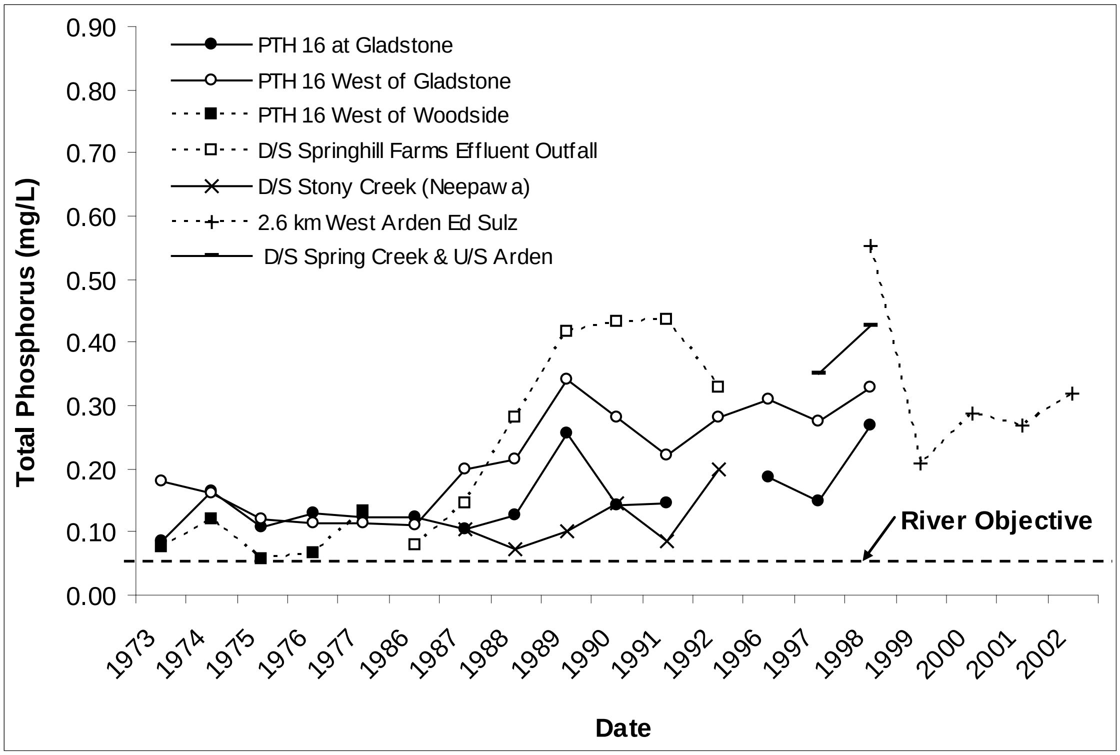

Figure 3: Yearly total phosphorus (mg/L) concentrations from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

Figures 2 and 3 illustrate yearly means of total phosphorus concentrations in the Whitemud River watershed. Typically, total phosphorus concentrations were well above the Manitoba Water Quality Guideline for rivers of 0.05 mg/L (Williamson 2002). In figure 2, total phosphorus concentrations between 1998 and 2007 were significantly greater than historic levels (1973-1997), with an observed decline in concentrations from 2007-2009. In Figure 3, total phosphorus concentrations showed a steady increase from 1973 to 2002. As part of the Lake Winnipeg Action Plan, Manitoba is implementing several strategies to better manage plant nutrients. Part of this Action Plan includes the development of more appropriate site-specific or regional-specific water quality objectives or guidelines for nutrients. In the meantime, the narrative guidelines will be retained for nutrients such as nitrogen and phosphorus until more site specific objectives are developed. It is generally recognized, however, that narrative guidelines for phosphorus likely do not apply to many streams in the Canadian prairie region since other factors such as turbidity, stream velocity, nitrogen, and other conditions most often limit algal growth. As well, relatively high levels of phosphorus in excess of the narrative guidelines may arise naturally from the rich prairie soils. It should be noted that most streams and rivers in southern Manitoba exceed this guideline, in some cases due to the natural soil characteristics in the watershed and/ or due to inputs from human activities and land-use practices.

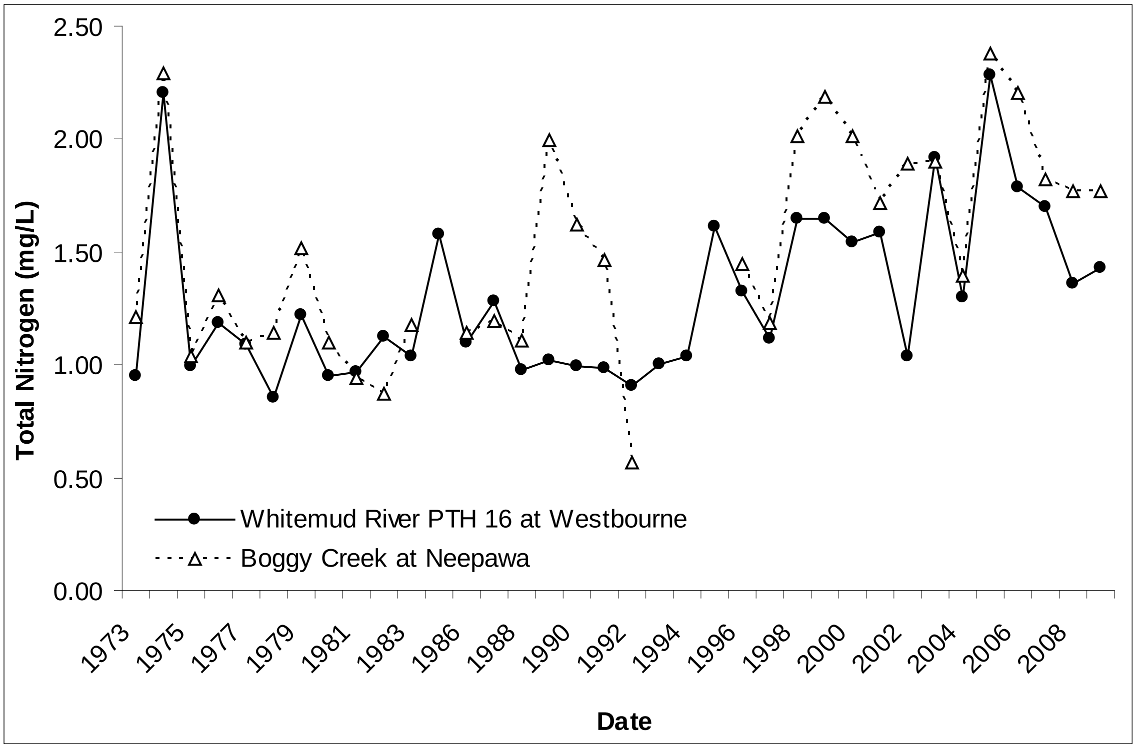

Figure 4: Yearly total nitrogen (mg/L) concentrations from two long term water quality monitoring stations in the Whitemud River watershed between 1973 and 2009.

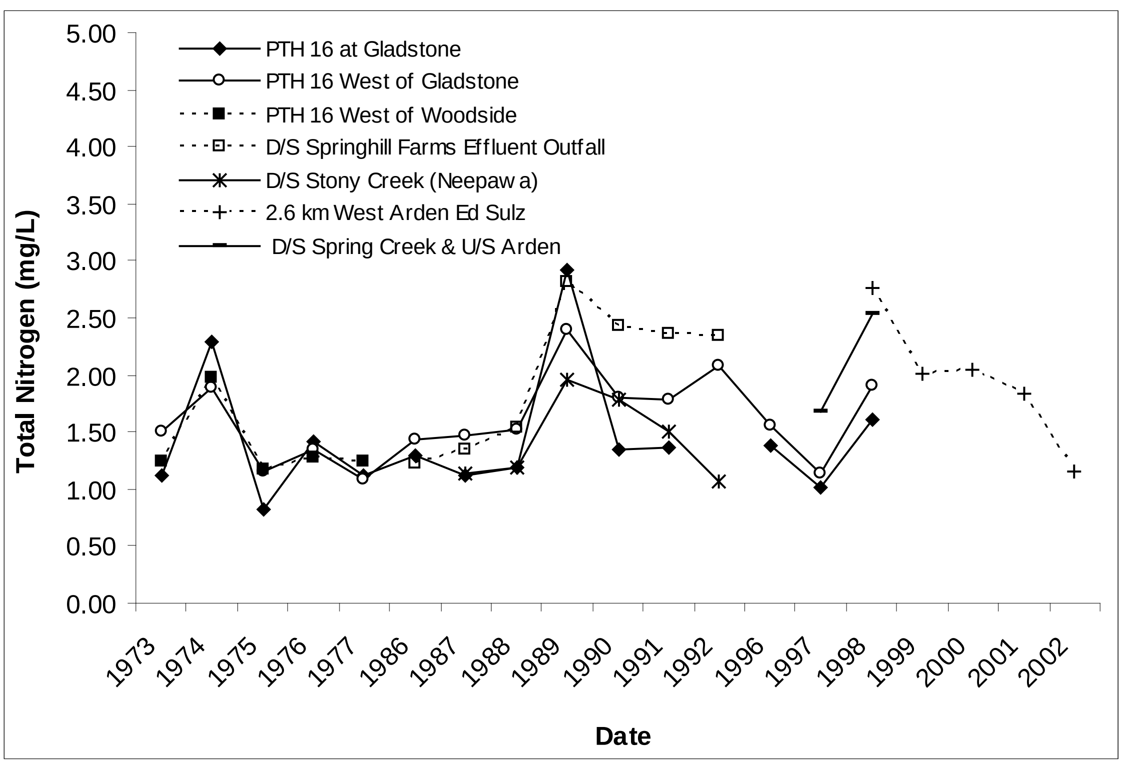

Figure 5: Yearly total nitrogen (mg/L) concentrations from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

The narrative objective for total nitrogen states nitrogen should be limited to the extent necessary to prevent nuisance growth and reproduction of aquatic rooted, attached and floating plants, fungi, or bacteria, or to otherwise render the water unsuitable for other beneficial uses (Williamson 2002). Nitrogen and phosphorus are two essential nutrients which stimulate algal growth in Lake Manitoba and its watershed. Figures 4 and 5 illustrate yearly means for total nitrogen concentrations in the Whitemud River watershed. Total nitrogen concentrations from the Whitemud River and Boggy Creek locations (Figure 4) show a distinct increase between 1973 and 2009. Total nitrogen concentrations from the seven other historic monitoring sites on the Whitemud River (figure 5) also show an increase between 1973 and 2002, but the increase in concentration is less pronounced than in figure 4. As observed in figure 4, the most significant increase in total nitrogen concentration occurred after 1999, of which sites in figure 5 do not have data for.

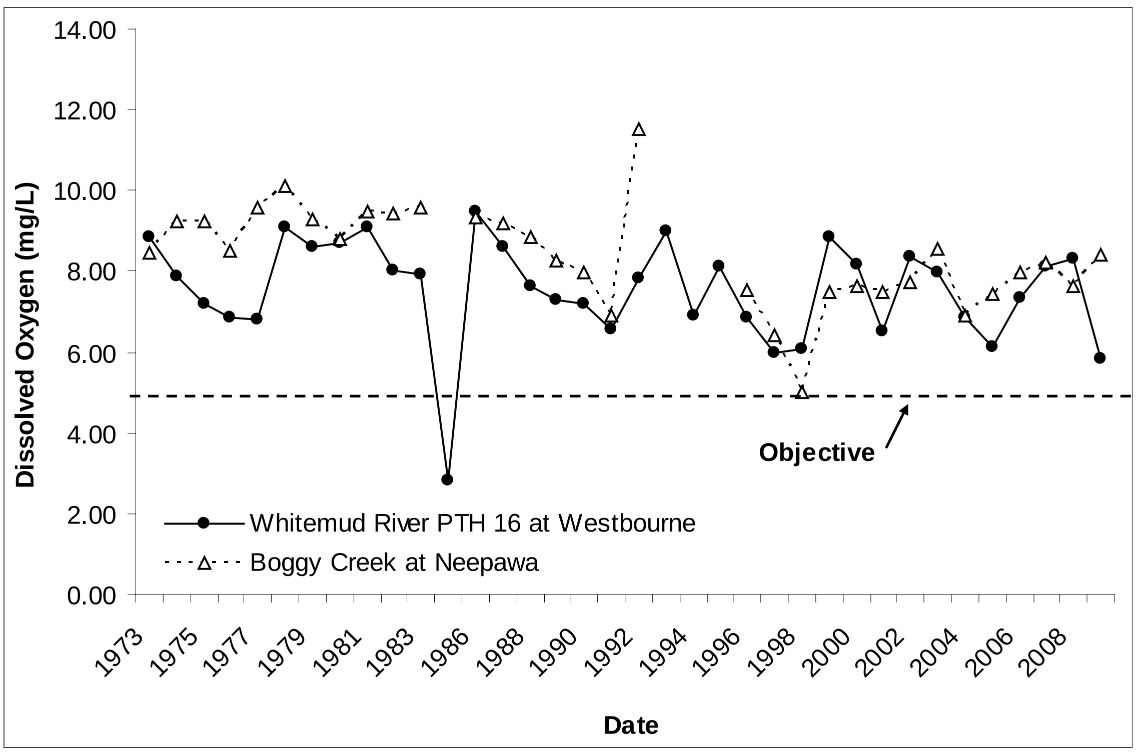

Figure 6: Yearly dissolved oxygen (mg/L) concentrations from two long term water quality monitoring stations in the Whitemud River watershed between 1973 and 2009.

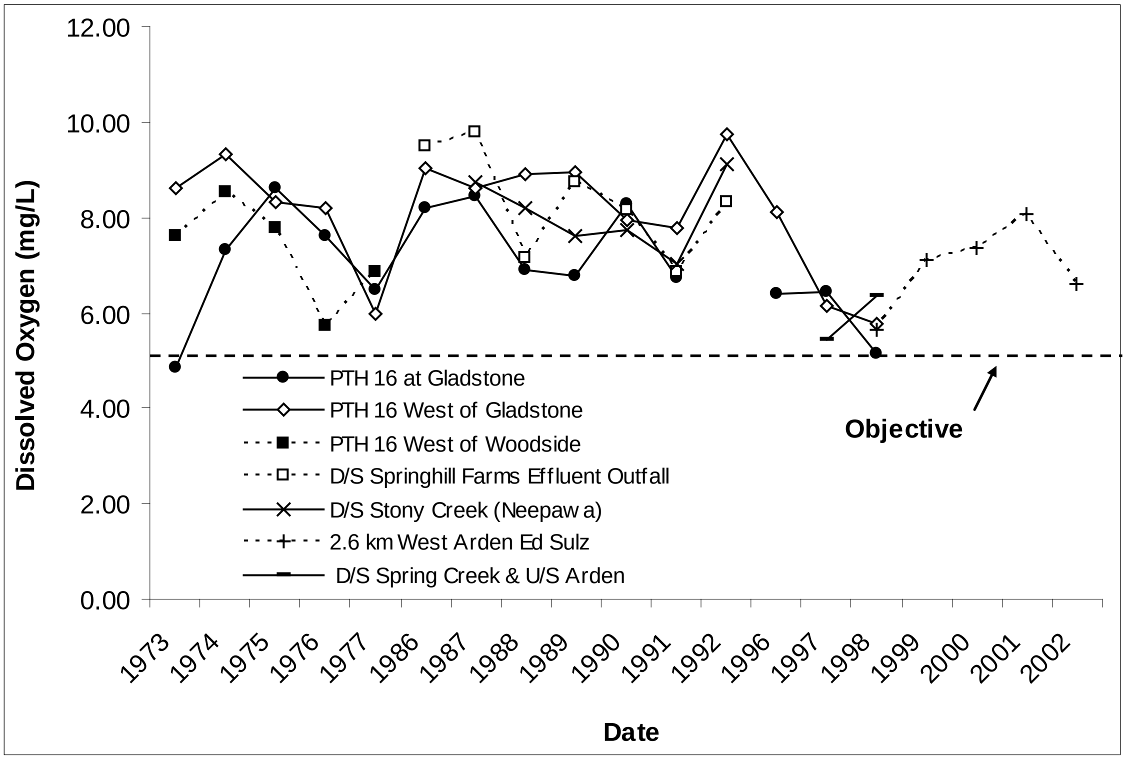

Figure 7: Yearly dissolved oxygen (mg/L) concentrations from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

Maintenance of adequate dissolved oxygen levels is essential to the health of aquatic life inhabiting rivers and streams. The monitoring conducted in the Whitemud River watershed (Figure 6 & 7) demonstrate dissolved oxygen levels have remained relatively constant since 1973, but show a slight decline to present. However, dissolved oxygen levels are generally above the 5.0 mg/ L Manitoba objective (Williamson 2002). This is with the exception of the Whitemud River at PTH 16 at Westbourne in January of 1984 (Figure 6), and the Whitemud River at PTH 16 at Gladstone in July of 1973 (Figure 7). Low oxygen levels under ice conditions are not uncommon in small prairie rivers, as the decomposition of plant material consumes oxygen from the water. As well, low oxygen levels are not uncommon after a summer of intense algal blooms consuming oxygen from the water column. Overall, there is typically adequate dissolved oxygen in this watershed to support healthy aquatic life.

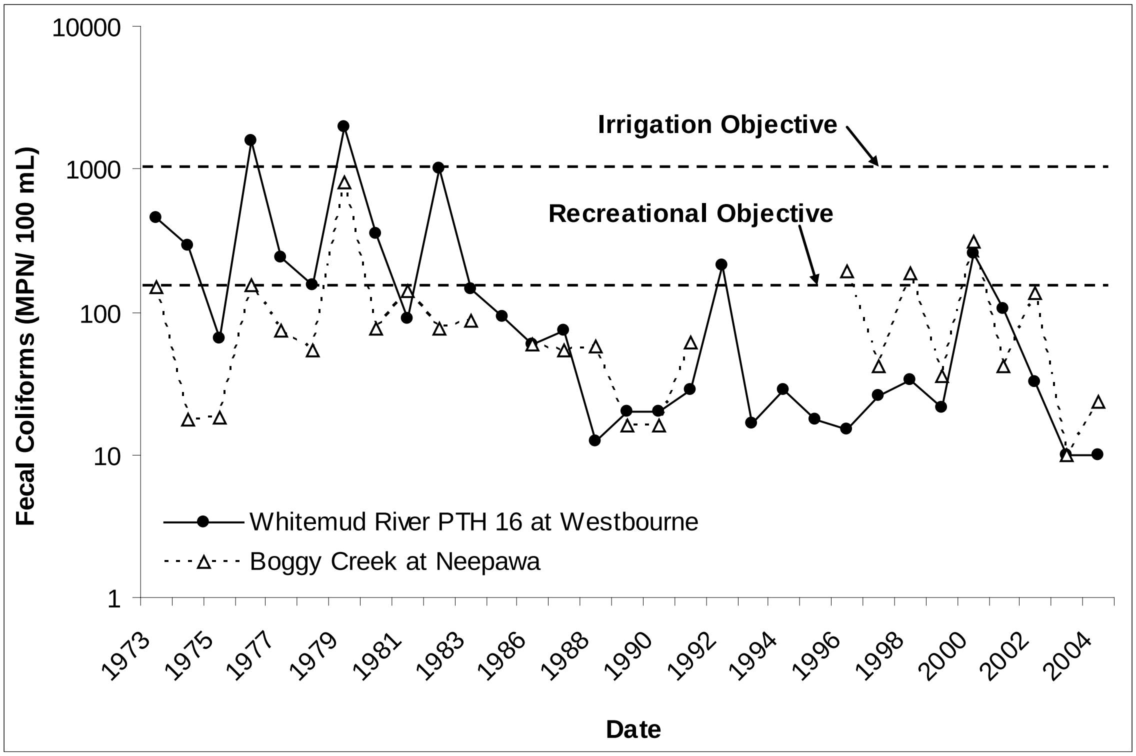

Figure 8: Yearly fecal coliform densities (MPN/ 100 mL) from two long term water quality monitoring stations in the Whitemud River watershed between 1973 and 2009.

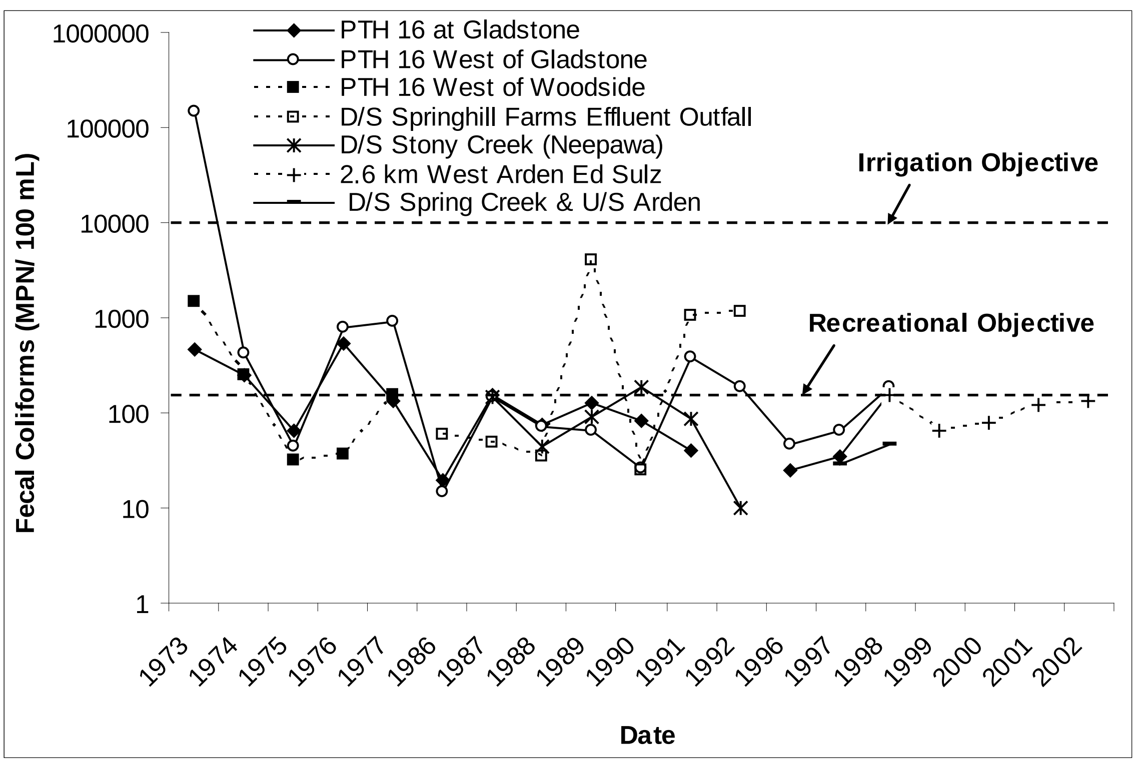

Figure 9: Yearly fecal coliform densities (MPN/ 100 mL) from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

Escherichia coli (E. coli) is one type of fecal coliform, which is a bacteria commonly found all warm-blooded animals including humans, livestock, wildlife, and birds. *E. coli* itself does not generally cause illness, but when present in large numbers the risk of becoming ill from other organisms is elevated. The most common illnesses contracted by bathers are infections of the eyes, ears, nose, and throat as well as stomach upsets. Typical symptoms include mild fever, vomiting, diarrhea and stomach cramps. Extensive studies were undertaken by Manitoba Water Stewardship in 2003 to determine the source of occasionally high *E. coli* counts and the mechanism of transfer to Lake Winnipeg beaches. Studies have shown large numbers of *E. coli* present in the wet sand of beaches. During periods of high winds, when water levels are rising in the south basin, these bacteria can be washed out of the sand and into the swimming area of the lake. Research shows less than 10% of *E. coli* found at Lake Winnipeg beaches is from human sources, with the remaining percentage from birds and animals.

Figure 8 illustrates yearly means of fecal coliform densities from two long term water quality monitoring station on the Whitemud River. Typically, fecal coliform densities were below both the irrigation objective of 1000 MPN/ 100 mL, and the recreational objective of 200 MPN/ 100 mL (Williamson 2002). Historically, the Whitemud River at PTH 16 at Westbourne tended to have greater fecal coliform concentrations than Boggy Creek at Neepawa. Since 1983 both locations have been within the irrigation objective, and have only exceeded the recreational objective on five occasions since 1983. Figure 9 illustrates yearly means of fecal coliform densities from seven historic water quality sites along the Whitemud River. Typically, fecal coliform densities were below the irrigation objective of 1000 MPN/ 100 mL, with the exception of the Whitemud River at PTH 16 West of Gladstone in 1973. There were a number of occasions between 1973 and 2002 where locations on the Whitemud River exceeded the recreational objective of 500 MPN/ 100 mL.

Pesticide concentrations for the two long term water quality monitoring stations were almost always below the level of detection, or very close to that limit, and typically did not exceed water quality objectives. The pesticides Dicamba and MCPA occasionally exceeded the irrigation objectives of 0.006 µg/L and 0.025 µg/L, respectively, at the Whitemud River and Boggy Creek locations. However, the aquatic life objective for Dicamba of 10 µg/L and MCPA of 2.6 µg/L were never exceeded at either location. Pesticide data were not available for the seven historic sites on the Whitemud River.

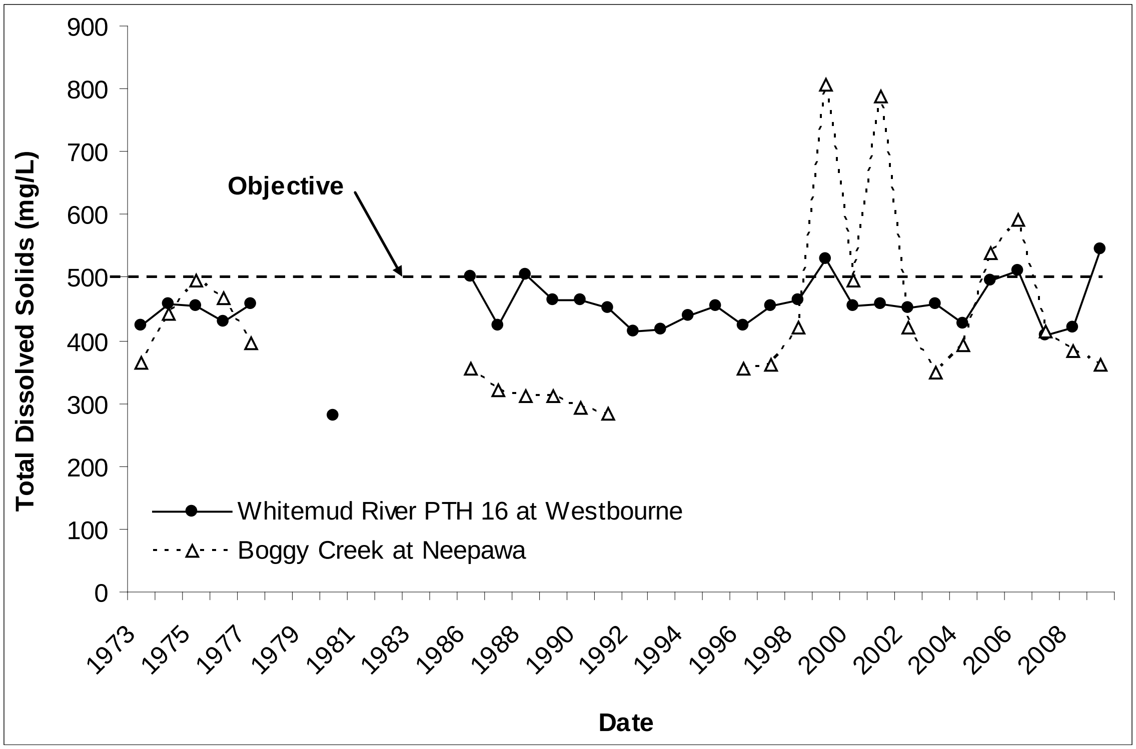

Figure 10: Yearly total dissolved solids (mg/L) from two long term water quality monitoring stations in the Whitemud River watershed between 1973 and 2009.

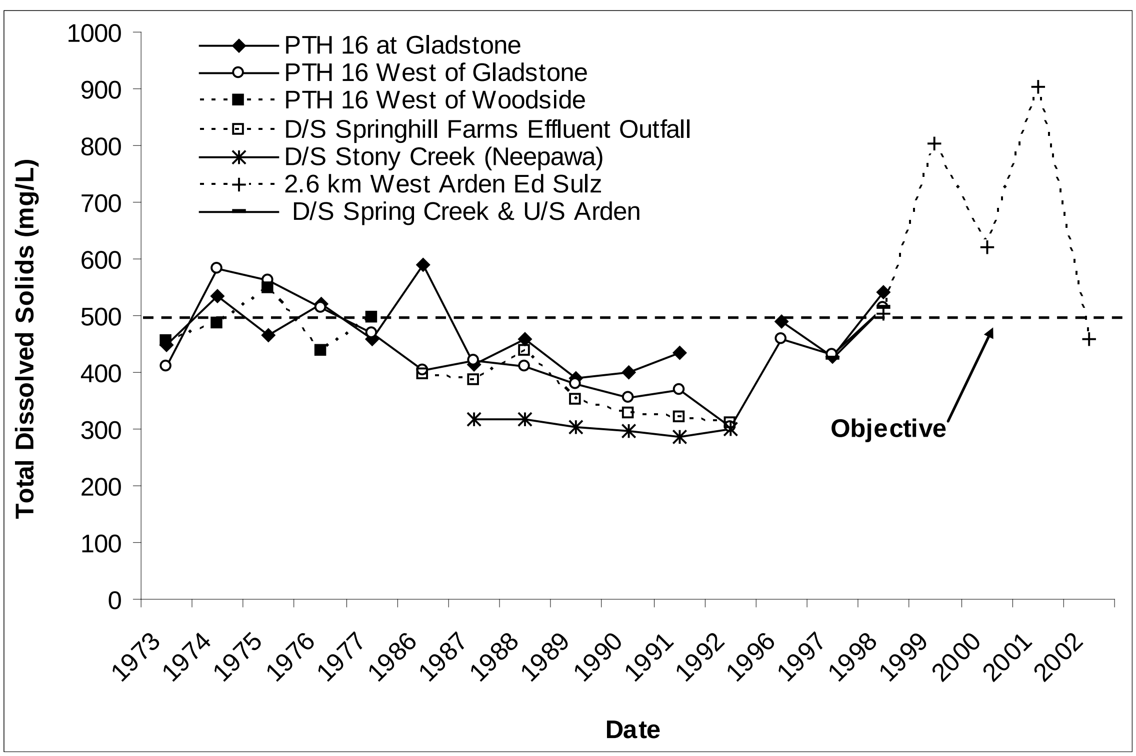

Figure 11: Yearly total dissolved solids (mg/L) from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

Drinking water variables of greatest concern are typically nitrates (objective value = 10 mg/L), arsenic (objective value = 0.025 mg/L), barium (objective value = 1 mg/L), boron (objective value = 5 mg/L), fluoride (objective value = 1.5 mg/L), uranium (objective value = 0.020 mg/L) and total dissolved solids (objective value = <500 mg/L) (Williamson 2002). It should be noted that the above stated drinking water objectives and guidelines only apply to treated, potable water. The data presented in this report however, are ambient natural untreated water quality samples, presented only for comparative purposes. At no time should raw untreated surface water be consumed for drinking water purposes, due to potential health concerns.

Drinking water variables for the two long term stations were always well below the objectives, with the exception of total dissolved solids (Figure 10). Total dissolved solids exceeded the drinking water objective of 500 mg/L at the Whitemud River PTH 16 at Westbourne in 1986, 1988, 1999, 2006, 2009, and at the Boggy Creek at Neepawa during 1999, 2001, 2005, 2006. The seven historic sites on the Whitemud River only had data available for arsenic, nitrates, and total dissolved solids. Arsenic and nitrates were always within drinking water objectives. Total dissolved solids exceeded the drinking water objective of 500 mg/L (Williamson 2002) on a number of occasions between 1973 and 1986, but were within guidelines following that (Figure 11). This was with the exception of the Whitemud River 2.6 km west Arden Ed Sulz which significantly exceeded objectives for all years sampled except 2002.

Total dissolved solids are a secondary drinking water objective, meaning they are primarily an aesthetic concern, rather than an immediate health concern. Total dissolved solids are related to ‘hard’ water which can cause problems and increased costs to drinking water and hot water systems. In addition, high concentrations of total dissolved solids can be an indication of elevated concentrations of potentially harmful ions such as nitrates, arsenic, aluminum, lead, copper, etc. which can be detrimental to health if ingested.

Discussion

Nutrient enrichment or eutrophication is one of the most important water quality issues in Manitoba. Excessive levels of phosphorus and nitrogen fuel the production of algae and aquatic plants. Extensive algal blooms can cause changes to aquatic life habitat, reduce essential levels of oxygen, clog fisher’s commercial nets, interfere with drinking water treatment facilities, and cause taste and odour problems in drinking water. In addition, some forms of blue-green algae can produce highly potent toxins.

Studies have shown that since the early 1970s, phosphorus loading has increased by about 10% to Lake Winnipeg and nitrogen loading has increased by about 13%. A similar phenomenon has also occurred in many other Manitoba streams, rivers, and lakes.

Manitobans, including those in the Whitemud River watershed, contribute about 47% of the phosphorus and 44% of the nitrogen to Lake Winnipeg (Bourne *et al.* 2002, updated in 2006). About 15% of the phosphorus and 6% of the nitrogen entering Lake Winnipeg is contributed by agricultural activities within Manitoba. In contrast, about 9% of the phosphorus and 6% of the nitrogen entering Lake Winnipeg from Manitoba is contributed by wastewater treatment facilities such as lagoons and sewage treatments plants.

As part of Lake Winnipeg Action Plan, the Province of Manitoba is committed to reducing nutrient loading to Lake Winnipeg to those levels that existed prior to the 1970s. The Lake Winnipeg Action Plan recognizes that nutrients are contributed by most activities occurring within the drainage basin and that reductions will need to occur across all sectors. Reductions in nutrient loads across the Lake Winnipeg watershed will benefit not only Lake Winnipeg but also improve water quality in the many rivers and streams that are part of the watershed, including the Whitemud River watershed. The Lake Winnipeg Stewardship Board's 2006 report "Reducing Nutrient Loading to Lake Winnipeg and its watershed: Our Collective Responsibility and Commitment to Action" (LWSB 2006) provides 135 recommendations on actions needed to reduce nutrient loading to the Lake Winnipeg watershed. However, reducing nutrients loading to the Lake Winnipeg watershed, including the Whitemud River watershed, is a challenge that will require the participation and co-operation of all levels of government and all watershed residents. Ensuring good water quality in the Whitemud River watershed and downstream is a collective responsibility among all living in the watershed.

Water Quality Management Zones

In June 2005 *The Water Protection Act* received royal ascension. This Act is intended to enable regulations to be developed for strengthening adherence to water quality standards, for protecting water, aquatic ecosystems or drinking water sources, and to provide a framework for integrated watershed management planning. The first regulation under *The Water Protection Act* — the *Nutrient Management Regulation (see:* www.gov.mb.ca/waterstewardship/wqmz/index.html) — defines five Water Quality Management Zones for Nutrients to protect water from excess nutrients that may arise from the over-application of fertilizer, manure, and municipal waste sludge on land beyond the amounts reasonably required for crops and other plants during the growing season.

As of January 1, 2009, substances containing nitrogen or phosphorus cannot be applied to areas within the Nutrient Buffer Zone or land within Nutrient Management Zone N4 (Canada Land Inventory Soil Capability Classification for Agriculture Class 6 and 7, and unimproved organic soils). The width of the Nutrient Buffer Zone varies depending upon the nature of the body of water and is generally consistent with those contained in the Livestock Manure and Mortalities Management Regulation (42/98).

The *Nutrient Management Regulation* (MR 62/2008) prohibits the construction, modification, or expansion of manure storage facilities, confined livestock areas, sewage treatment facilities, and wastewater lagoons on land in the Nutrient Management Zone N4 or land in the Nutrient Buffer Zone. Further, the construction, installation, or replacement of an on-site wastewater management system (other than a composting toilet system or holding tank) within Nutrient Management Zone N4 or land in the Nutrient Buffer Zone is prohibited (Part 4: Section 14(1): f).

It is recommended that measures are taken to prevent the watering of livestock in any watercourses to prevent bank erosion, siltation, and to protect water quality by preventing nutrients from entering surface water.

No development should occur within the 99 foot Crown Reserve from the edge of any surface water within the rural municipalities. Permanent vegetation should be encouraged on lands within the 99 foot crown reserve to prevent erosion, siltation, and reduce the amount of nutrients entering surface water.

The Nutrient Management Regulation under *The Water Protection Act*, prohibits the application of a fertilizer containing more than 1% phosphorus by weight, expressed as P_2O_5, to turf within Nutrient Management Zone N5 (built-up area such as towns, subdivisions, cottage developments, etc.) except during the year in which the turf is first established and the following year. In residential and commercial applications, a phosphorus containing fertilizer may be used if soil test phosphorus (using the Olsen-P test method) is less than 18 ppm.

The Nutrient Management Regulation (MR 62/2008) under *The Water Protection Act*, requires Nutrient Buffer Zones (set-back distances from the water's edge) be applied to all rivers, streams, creeks, wetlands, ditches, and groundwater features located across Manitoba including within urban and rural residential areas and within agricultural regions (Table A7 in Appendix 7).

Drainage

Although it is recognized that drainage in Manitoba is necessary to support sustainable agriculture, it is also recognized that drainage works can impact water quality and fish habitat. Types of drainage include the placement of new culverts or larger culverts to move more water, the construction of a new drainage channels to drain low lying areas, the draining of potholes or sloughs to increase land availability for cultivation and the installation of tile drainage. Artificial drainage can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide load to receiving drains, creeks and rivers. All types of drainage should be constructed so that there is no net increase in nutrients (nitrogen and phosphorus) to waterways. To ensure that drainage maintenance, construction, and re-construction occurs in an environmentally friendly manner, the following best available technologies, and best management practices aimed at reducing impacts to water quality and fish habitat are recommended.

The following recommendations are being made to all drainage works proposals during the approval process under *The Water Rights Act*:

- There must be no net increase in nutrients (nitrogen and phosphorus) to waterways as a result of drainage activities. Placement of culverts, artificial drainage and construction and operation of tile drains can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide loads to receiving drains, creeks and rivers.
- Synthetic fertilizer, animal manure, and municipal wastewater sludge must not be applied within drains.

<u>Culverts</u>

- Removal of vegetation and soil should be kept to a minimum during the construction and the placement of culverts.
- Erosion control methodologies should be used on both sides of culverts according to the Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat.
- A strip of vegetation 1 to 3 metres wide should be maintained along drainage channels as a buffer. This will reduce erosion of channels and aid in nutrient removal.
- The proponent should revegetate exposed areas along drainage channels.

<u>Surface Drainage</u>

- Surface drainage should be constructed as shallow depressions and removal of vegetation and soil should be minimized during construction.

- Based on Canada Land Inventory Soil Capability Classification for Agriculture (1965), Class 6 and 7 soils should not be drained.
- There should be no net loss of semi-permanent or permanent sloughs, wetlands, potholes or other similar bodies of water in the sub-watershed within which drainage is occurring.
- Erosion control methodologies outlined in Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat should be used where the surface drain intersects with another water body.
- A strip of vegetation 1 to 3 metres wide should be maintained along surface drainage channels as buffers. These will reduce erosion of channels and aid in nutrient removal.
- The proponent should revegetate exposed areas along banks of surface drainage channels.

Tile Drainage

- Discharge from tile drainage should enter a holding pond or wetland prior to discharging into a drain, creek or river.

Manitoba Water Stewardship is working towards the development of an environmentally friendly drainage manual that will provide additional guidance regarding best management practices for drainage in Manitoba.

Conclusions and Recommendations:

1. The Water Quality Index for the Whitemud River is typically of 'Good' quality. The majority of total phosphorus concentrations exceeded objectives, thus impacting the Water Quality Index.

2. Total phosphorus and nitrogen data indicate a steady increase in concentrations from 1973 to 2009. Therefore, management decisions should focus on nutrient reductions to the Whitemud River to ensure the reduction of phosphorus and nitrogen loading to the Whitemud River watershed, and ultimately to Lakes Manitoba and Winnipeg.

3. Although fecal coliform densities are typically below irrigation objectives, the Whitemud River is consistently near or exceeding the body contact objective. Thus, management decisions should focus on reducing fecal contamination to surface waters in the Whitemud River watershed. One suggestion is to ensure cattle are excluded direct access to water bodies. This will significantly reduce bacterial contamination and nutrient loading to surface waters in the Whitemud River watershed.

4. Overall, strategies need to be implemented to protect and enhance the water quality and habitat in the Whitemud River watershed. Best Management Practices should be adopted to reduce nutrient loading to the watershed, and ultimately Lake Manitoba. Consistent with the interim water quality targets set out in the Lake Winnipeg Action Plan, the Whitemud River watershed could consider setting a nutrient reduction goal of 10%.

5. Many steps can be taken to protect the Whitemud River watershed and its downstream environment. These include:

- Maintain a natural, riparian buffer along waterways. Natural vegetation slows erosion and helps reduce the amount of nitrogen and phosphorus entering lakes, rivers and streams.
- Where feasible, “naturalize” drainage systems to reduce streambed and stream bank erosion, and allowing opportunities for nutrients to be assimilated and settled out of the stream.
- Value and maintain wetlands. Similar to riparian buffers along waterways, wetlands slow erosion and help reduce nutrient inputs to lakes, rivers, and streams. Wetlands also provide flood protection by trapping and slowly releasing excess water while providing valuable habitat for animals and plants.
- Reduce or eliminate the use of phosphorus-based fertilizers on lawns, gardens, and at the cottage.
- Choose low phosphorus or phosphorus-free cleaning products.
- Prevent soil from eroding off urban and rural properties and reaching storm drains or municipal ditches.
- Ensure that septic systems are operating properly and are serviced on a regular basis. It’s important that septic systems are pumped out regularly and that disposal fields are checked on a regular basis to ensure that they are not leaking or showing signs of saturation.
- Evaluate options for potential reduction of nutrients from municipal wastewater treatment systems. Consider options such as effluent irrigation, trickle discharge, constructed wetland treatment, or chemical treatment to reduce nutrient load to the watershed.
- Review the recommendations in the Lake Winnipeg Stewardship Board 2006 report “Reducing Nutrient Loading to Lake Winnipeg and its Watershed: Our Collective Responsibility and Commitment to Action” with the intent of implementing those that are relevant to the Whitemud River watershed.

Contact Information

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And visit the Department's web site: http://www.gov.mb.ca/waterstewardship

References:

Bourne, A., N. Armstrong and G. Jones. 2002 (updated in 2006). A preliminary estimate of total nitrogen and total phosphorus loading to streams in Manitoba, Canada. Manitoba Conservation Report No. 2002-04. Winnipeg, MB, Canada. 49 pp.

Canadian Council of Ministers of the Environment (CCME) 2001. Canadian Environmental Quality Guidelines Water Quality Index. http://www.ccme.ca/assets/pdf/wqi_techrprtfctsht_e.pdf

Canadian Council of Ministers of the Environment (CCME). 2001. Canadian water quality guidelines for the protection of aquatic life: CCME Water Quality Index 1.0, Technical Report. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg. http://www.ccme.ca/assets/pdf/wqi_techrprtfctsht_e.pdf

Eastern Interlake Conservation District (EICD). 2008. Gimli Storm Water Quality Assessment 2008 Report. Produced in partnership with the Rural Municipality of Gimli, Manitoba. 16pp. http://www.eicd.net/assets/gimli%20storm%20water%20report%202008.pdf

Hilsenhoff, W.J. 1988. Rapid field assessment of organic pollution with a family-level biotic index. Journal of the North American Benthological Society 7(1):65-68.

Lake Winnipeg Stewardship Board. (LWSB). 2006. Reducing Nutrient Loading to Lake Winnipeg and its watershed: Our Collective Responsibility and Commitment to Action. A Report to the Minister of Water Stewardship., Manitoba. 78pp.
http://www.lakewinnipeg.org/web/downloads/LWSB_December_2006_Report_3.pdf

North/South Consultants Inc. 2007. A summary of the benthic macroinvertebrate fauna (2006 and 2007) from Icelandic River; Washow Bay Creek; Grassmere, Parks, Wavey, Netley, and Willow Creeks; Fish Lake Drain; and Fisher River. 25 pp.

Ralley, W. 2010 Manitoba Water Stewardship. Winnipeg, Manitoba. Personal Communication.

Williamson, D.A., W.E. Ralley, A. Bourne, N. Armstrong, R. Fortin, and C.E. Hughes. 2004. Principal factors affecting *Escherichia coli* densities at Lake Winnipeg beaches. Water Quality Management Section. Manitoba Water Stewardship. Manitoba Water Stewardship Report No. 2004-01. 18pp.
http://www.gov.mb.ca/waterstewardship/water_quality/lkwpg_beach_report_interim-040129.pdf

Williamson, D.A., 2002. Manitoba Water Quality Standards, Objective, and Guidelines. Manitoba Conservation. Report 2002-11
http://www.gov.mb.ca/waterstewardship/water_quality/quality/mwqsog_2002.pdf

Appendix 1:

Table A1: Total phosphorus (mg/L), total nitrogen (mg/L), dissolved oxygen (mg/L), fecal coliforms (MPN/ 100 mL), and total dissolved solids (mg/L) two long term water quality monitoring stations in the Whitemud River watershed between 1973 and 2009.

	Total Phosphorus (mg/L)		**Total Nitrogen (mg/L)**		**Dissolved Oxygen (mg/L)**		**Fecal Coliforms (MPN/ 100 mL)**		**Total Dissolved Solids (mg/L)**	
Date	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa
1973	0.11	0.10	0.95	1.22	8.83	8.47	460.00	150.00	425.00	363.33
1974	0.10	0.13	2.21	2.29	7.88	9.23	295.33	17.67	458.00	443.75
1975	0.07	0.08	1.00	1.04	7.18	9.25	65.33	18.33	453.75	496.50
1976	0.08	0.11	1.18	1.31	6.85	8.50	1567.33	153.33	428.75	468.00
1977	0.09	0.08	1.09	1.10	6.80	9.58	240.75	73.00	459.00	395.25
1978	0.07	0.09	0.86	1.14	9.09	10.13	153.00	54.25	-	-
1979	0.10	0.14	1.22	1.51	8.58	9.29	1941.31	809.67	-	-
1980	0.07	0.12	0.95	1.10	8.73	8.80	349.92	76.13	280.00	-
1981	0.09	0.09	0.97	0.94	9.08	9.49	89.09	141.25	-	-
1982	0.09	0.09	1.13	0.87	8.04	9.44	1009.92	77.14	-	-
1983	0.08	0.10	1.04	1.18	7.92	9.59	143.18	87.57	-	-
1984	0.05	-	1.58	-	2.80	-	93	-	-	-
1986	0.06	0.08	1.10	1.15	9.50	9.35	60.00	60.00	500.00	355.00
1987	0.09	0.10	1.28	1.19	8.63	9.21	73.33	53.33	422.22	321.11
1988	0.08	0.07	0.98	1.11	7.64	8.83	12.22	56.67	504.44	312.22
1989	0.09	0.11	1.02	2.00	7.29	8.29	20.00	16.25	465.00	310.00
1990	0.07	0.11	0.99	1.62	7.19	7.99	20.00	16.25	462.50	293.75
1991	0.08	0.09	0.99	1.46	6.58	6.88	28.33	61.67	451.67	283.33
1992	0.05	0.04	0.91	0.57	7.85	11.50	210.00	-	415.00	-

	Total Phosphorus (mg/L)		Total Nitrogen (mg/L)		Dissolved Oxygen (mg/L)		Fecal Coliforms (MPN/ 100 mL)		Total Dissolved Solids (mg/L)	
Date	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa	Whitemud River PTH 16 at Westbourne	Boggy Creek at Neepawa
1993	0.09	-	1.00	-	9.00	-	16.67	-	417.50	-
1994	0.09	-	1.04	-	6.88	-	28.33	-	438.33	-
1995	0.13	-	1.62	-	8.13	-	17.50	-	455.00	-
1996	0.10	0.14	1.32	1.44	6.88	7.56	15.00	191.43	425.00	354.29
1997	0.09	0.11	1.12	1.18	6.00	6.40	25.71	41.25	455.00	360.00
1998	0.18	0.18	1.64	2.01	6.10	5.03	33.75	185.00	465.00	421.25
1999	0.14	0.19	1.64	2.19	8.86	7.47	21.43	35.71	530.00	805.71
2000	0.19	0.25	1.54	2.02	8.16	7.63	252.50	311.50	454.00	494.00
2001	0.19	0.24	1.58	1.71	6.53	7.50	105.00	41.25	457.25	786.50
2002	0.13	0.19	1.04	1.89	8.35	7.74	32.50	137.50	451.25	419.00
2003	0.19	0.21	1.92	1.90	7.98	8.55	10.00	10.00	458.25	349.00
2004	0.09	0.12	1.30	1.39	6.85	6.90	10.00	23.33	427.00	391.25
2005	0.17	0.19	2.29	2.38	6.13	7.43	-	-	495.75	537.25
2006	0.06	0.14	1.79	2.20	7.35	7.98	-	-	512.25	593.00
2007	0.18	0.24	1.70	1.82	8.13	8.23	-	-	407.20	414.00
2008	0.13	0.09	1.36	1.77	8.32	7.65	-	-	419.00	384.50
2009	0.06	0.10	1.43	1.77	5.85	8.43	-	-	544.50	360.33

Appendix 2:

Table A2: Total phosphorus (mg/L) from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

Date	PTH 16 at Gladstone	PTH 16 West of Gladstone	PTH 16 West of Woodside	D/S Springhill Farms Effluent Outfall	D/S Stony Creek (Neepawa)	2.6 km West Arden Ed Sulz	D/S Spring Creek & U/S Arden
1973	0.09	0.18	0.08	-	-	-	-
1974	0.16	0.16	0.12	-	-	-	-
1975	0.11	0.12	0.06	-	-	-	-
1976	0.13	0.11	0.07	-	-	-	-
1977	0.12	0.12	0.13	-	-	-	-
1986	0.12	0.11	-	0.08	-	-	-
1987	0.11	0.20	-	0.15	0.10	-	-
1988	0.13	0.22	-	0.28	0.07	-	-
1989	0.26	0.34	-	0.42	0.10	-	-
1990	0.14	0.28	-	0.43	0.14	-	-
1991	0.15	0.22	-	0.43	0.08	-	-
1992	-	0.28	-	0.33	0.20	-	-
1996	0.19	0.31	-	-	-	-	-
1997	0.15	0.28	-	-	-	-	0.35
1998	0.27	0.33	-	-	-	0.55	0.43
1999	-	-	-	-	-	0.21	-
2000	-	-	-	-	-	0.29	-
2001	-	-	-	-	-	0.27	-
2002	-	-	-	-	-	0.32	-

Appendix 3:
Table A3: Total nitrogen (mg/L) from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

Date	PTH 16 at Gladstone	PTH 16 West of Gladstone	PTH 16 West of Woodside	D/S Springhill Farms Effluent Outfall	D/S Stony Creek (Neepawa)	2.6 km West Arden Ed Sulz	D/S Spring Creek & U/S Arden
1973	1.13	1.50	1.24	-	-	-	-
1974	2.29	1.89	1.98	-	-	-	-
1975	0.83	1.16	1.17	-	-	-	-
1976	1.42	1.34	1.27	-	-	-	-
1977	1.13	1.09	1.24	-	-	-	-
1986	1.29	1.43	-	1.22	-	-	-
1987	1.11	1.48	-	1.34	1.13	-	-
1988	1.19	1.52	-	1.53	1.18	-	-
1989	2.91	2.40	-	2.82	1.95	-	-
1990	1.34	1.80	-	2.44	1.78	-	-
1991	1.37	1.79	-	2.37	1.51	-	-
1992	-	2.08	-	2.34	1.07	-	-
1996	1.38	1.55	-	-	-	-	-
1997	1.02	1.14	-	-	-	-	1.68
1998	1.61	1.91	-	-	-	2.76	2.54
1999	-	-	-	-	-	2.01	-
2000	-	-	-	-	-	2.05	-
2001	-	-	-	-	-	1.83	-
2002	-	-	-	-	-	1.16	-

Appendix 4:
Table A4: Dissolved oxygen (mg/L) from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

Date	PTH 16 at Gladstone	PTH 16 West of Gladstone	PTH 16 West of Woodside	D/S Springhill Farms Effluent Outfall	D/S Stony Creek (Neepawa)	2.6 km West Arden Ed Sulz	D/S Spring Creek & U/S Arden
1973	4.85	8.60	7.60	-	-	-	-
1974	7.30	9.33	8.52	-	-	-	-
1975	8.63	8.33	7.77	-	-	-	-
1976	7.60	8.18	5.73	-	-	-	-
1977	6.48	5.98	6.85	-	-	-	-
1986	8.20	9.05	-	9.50	-	-	-
1987	8.43	8.60	-	9.80	8.75	-	-
1988	6.91	8.91	-	7.15	8.21	-	-
1989	6.78	8.94	-	8.73	7.63	-	-
1990	8.29	7.93	-	8.15	7.73	-	-
1991	6.73	7.76	-	6.87	7.04	-	-
1992	-	9.75	-	8.30	9.10	-	-
1996	6.40	8.13	-	-	-	-	-
1997	6.43	6.15	-	-	-	-	5.43
1998	5.13	5.78	-	-	-	5.65	6.38
1999	-	-	-	-	-	7.13	-
2000	-	-	-	-	-	7.35	-
2001	-	-	-	-	-	8.05	-
2002	-	-	-	-	-	6.63	-

Appendix 5:
Table A5: Fecal coliform densities (MPN/ 100 mL) from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

Date	PTH 16 at Gladstone	PTH 16 West of Gladstone	PTH 16 West of Woodside	D/S Springhill Farms Effluent Outfall	D/S Stony Creek (Neepawa)	2.6 km West Arden Ed Sulz	D/S Spring Creek & U/S Arden
1973	460.00	150001.00	1500.00	-	-	-	-
1974	247.67	418.00	250.00	-	-	-	-
1975	66.00	44.00	32.33	-	-	-	-
1976	534.33	782.00	37.33	-	-	-	-
1977	133.00	914.75	156.25	-	-	-	-
1986	20.00	15.00	-	60.00	-	-	-
1987	154.44	143.33	-	48.89	146.67	-	-
1988	74.44	71.11	-	35.56	43.33	-	-
1989	128.75	64.17	-	4026.67	90.00	-	-
1990	82.50	26.67	-	25.00	187.50	-	-
1991	40.00	382.00	-	1053.00	88.00	-	-
1992	-	185.00	-	1170.00	10.00	-	-
1996	25.00	47.50	-	-	-	-	-
1997	35.00	65.00	-	-	-	-	28.75
1998	160.00	190.00	-	-	-	155.00	47.50
1999	-	-	-	-	-	65.00	-
2000	-	-	-	-	-	80.00	-
2001	-	-	-	-	-	120.00	-
2002	-	-	-	-	-	135.00	-

Appendix 6:
Table A6: Total dissolved soilds (mg/L) from seven historic water quality monitoring sites on the Whitemud River between 1973 and 2002 (D/S – downstream, U/S – upstream).

Date	PTH 16 at Gladstone	PTH 16 West of Gladstone	PTH 16 West of Woodside	D/S Springhill Farms Effluent Outfall	D/S Stony Creek (Neepawa)	2.6 km West Arden Ed Sulz	D/S Spring Creek & U/S Arden
1973	448	410	457	-	-	-	-
1974	533	584	485	-	-	-	-
1975	467	561	549	-	-	-	-
1976	522	515	438	-	-	-	-
1977	458	469	495	-	-	-	-
1986	590	405	-	395	-	-	-
1987	414	420	-	387	316	-	-
1988	458	411	-	437	318	-	-
1989	389	381	-	353	305	-	-
1990	399	356	-	329	297	-	-
1991	433	368	-	322	287	-	-
1992	-	305	-	310	300	-	-
1996	490	458	-	-	-	-	-
1997	428	433	-	-	-	-	423
1998	540	515	-	-	-	505	513
1999	-	-	-	-	-	805	-
2000	-	-	-	-	-	620	-
2001	-	-	-	-	-	903	-
2002	-	-	-	-	-	460	-

Appendix 7:
Table A7: The Nutrient Buffer Zone widths as outlined in the Nutrient Management Regulation (MR 62/2008) under *The Water Protection Act*.

Water Body	A [(1)]	B [(1)]
o a lake or reservoir designated as vulnerable	30 m	35 m
o a lake or reservoir (not including a constructed stormwater retention pond) not designated as vulnerable o a river, creek or stream designated as vulnerable	15 m	20 m
o a river, creek or stream not designated as vulnerable o an order 3, 4, 5, or 6 drain or higher o a major wetland, bog, swamp or marsh o a constructed stormwater retention pond	3 m	8 m

([1]) Use column A if the applicable area is covered in permanent vegetation. Otherwise, use column B.

A healthy riparian zone is critical to river ecosystem health providing shade, organic inputs, filtering of nutrients and habitat creation (falling trees). Preserving space along rivers gives the river freedom to naturally meander across the landscape and buffers the community from flooding impacts. Reference to the Nutrient Buffer Zone and its significance can be coupled with **Section 3.1.8 – Environmental Policies** which identifies the goals of enhancing surface water and riverbank stability, and the importance of respecting setbacks.