MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION PROJECT
FINAL DESIGN – WORK PARCEL 2

2006 CONSTRUCTION SURFACE WATER MONITORING

FINAL REPORT
MARCH 2007

KGS Group Project: 05-1100-01
Reference Number: .9905210 NM4

KGS Group
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March 30, 2007

File No. 05-1100-01.19.06.03

Manitoba Floodway Authority (MFA)
Room 200, 155 Carlton Street
Winnipeg, Manitoba
R3C 3H8

ATTENTION: Mr. Doug Peterson, P. Eng.
Manager of Environmental Services

RE: Red River Floodway Expansion Project
2006 Construction Surface Water Monitoring Report
Final Report – March 2007

Dear Mr. Peterson:

Please find enclosed 20 paper copies and one (1) electronic copy of the Final Report for the 2006 Construction Surface Water Monitoring of the Red River Floodway Expansion. An electronic copy of each individual Final Monthly Monitoring Report from January to December, 2006 is provided separately, as supporting documents for the MFA web page.

This annual construction report describes the analysis results for samples collected from the Red River, Floodway Channel and the drains flowing into the Floodway and along the West Dyke during the 2006 construction time period. The data includes the monthly and event-based monitoring.

We sincerely appreciate the opportunity to provide ongoing services on this project. If you have any questions regarding this report please contact Mr. Shaun Moffatt, or the undersigned.

Yours truly,

Dave MacMillan, P. Eng.
Project Manager

SM/dbm/mlb
Enclosure

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EXECUTIVE SUMMARY

The surface water quality monitoring program for the 2006 construction year was conducted from January to December 2006 in conjunction with the on-going construction activities. This 2006 construction report outlines the analysis results for samples collected from the Red River at the Inlet and Outlet, 11 locations along the Floodway Channel including the upstream and downstream ends of the construction and revegetation zones, 11 of the outfall drains flowing into the Floodway and at 2 drains along the West Dyke. The 2006 construction data is summarized and compared to the data presented in the baseline surface water monitoring report.

There were twelve (12) monthly monitoring events, with one conducted each month following precipitation events or at the flood peak during Red River flood conditions. There were thirteen (13) Level I event-based monitoring events conducted between May and September 2006 in response to precipitation events of 5 mm or greater. Additionally polycyclic aromatic hydrocarbon (PAH) sampling was conducted in the vicinity of the Canadian National Railway (CNR) Sprague and Redditt bridge crossings on August 6 to address potential PAH concerns associated with creosote treated piles at the two CNR bridge crossings.

Construction activities at the start of January 2006 consisted of Channel contracts; C-1 (Stn. 12+500 – 14+300) and C-2 (Stn 4+400 – 12+098), and bridge contracts for PTH 59 South (T4, Stn. 12+250), Trans-Canada Highway (T5, Stn 19+600) and CNR Sprague (T8/T9, Stn. 19+300). Construction activities at the Aqueduct (A1, Stn. 20+300 – 22+073) began in July. Additional Channel contracts in 2006 included C3a (Stn. 12+430 – 19+200 west side) and C4 (Stn 22+250 – 25+650) that started up in September and C3b (Stn. 12+430 – 19+200 east side), C5 (Stn 25+970 – 30+140) and C6a (Stn 30+280 – 33+750) that started up in October. As part of the Channel contracts seeding and fertilizer applications occurred from July to October. Construction activities for the West Dyke started with earthworks (W1, W2 and W3) in August. Rip-rap placement along these contracts (W4) began in late November after the earthwork activities were completed. Details of the construction contracts and activities that occurred during each month are summarized in each of the individual monthly monitoring reports, NM4.1 – January to NM4.12 – December, 2006.

The Manness and Domain Drains downstream of the West Dyke were only sampled during the April monthly monitoring, coincident with the spring flooding, because they were dry or frozen during all the other monthly monitoring dates. As there were no construction activities in the vicinity of these drains along the West Dyke during the 2006 construction monitoring period, the April monthly monitoring is representative of baseline conditions. Therefore analytical results from the April monitoring will not be discussed in this construction monitoring report.

Construction monitoring data for the key water quality parameters of interest, identified and discussed in the baseline surface water monitoring report, were compared to the baseline data under spring flooding, non-flood/unfrozen and non-flood/frozen conditions. These parameters included total suspended solids, nutrients (total phosphorus, ammonia, nitrate plus nitrite and potassium), specific conductance, major ions (sodium and chloride), and *E.Coli* for bacterial concerns.

When samples upstream of the construction area, representing background conditions could be collected, concentrations of petroleum hydrocarbons and pesticides from these samples were

compared to concentrations downstream of construction. Likewise concentrations of PAHs from an upstream sample location were compared to concentrations downstream of the area of potential creosote concerns.

Results of the level I event-based monitoring indicated negligible potential increases in total suspended solids (TSS) concentration in the Red River downstream of the Outlet during the 2006 construction year. The only measurable TSS concentration increases occurred following rain events close to a 2 and 5 year rain event with approximate TSS increases of 2.4% and 4.4%, respectively. These potential increases in sediment concentration in the Red River downstream of the Channel discharge at the Outlet were well below the Provincial Guidelines of an allowable 10% increase. Therefore, no level II event-based monitoring was required during the 2006 construction year. Additionally, no spill event-based monitoring was required as all of the spills that occurred within the contract areas during 2006, were contained and cleaned up with no run off to the Low Flow Channel.

During the spring flood condition, represented by the April monthly monitoring event, slight concentration increases of TSS, total phosphorus, ammonia and nitrate + nitrite-N were measured in the Floodway Channel downstream of construction, compared to the background conditions upstream of construction. These slight increases were not considered a concern as all of the observed concentrations, except for nitrate + nitrite-N were below the spring flood baseline conditions measured during 2005, indicating no effect from construction. The elevated nitrate + nitrite-N was not attributed to construction because no construction activities, such as fertilizer application, had occurred prior to the monitoring event. Additionally, there were no increases observed in the Red River downstream of the Outlet compared to the background surface water concentrations upstream of the Outlet.

Several of the key water quality parameter concentrations, in particular electrical conductivity, ammonia, potassium, sodium, chloride and *E.Coli* varied spatially throughout the Floodway Channel for a given monthly monitoring during both the unfrozen and frozen non-flood conditions. Additionally they could vary temporally (with time) between the monthly monitoring events, at any given sample location.

Within the non-flood unfrozen condition, concentrations of several parameters, in particular electrical conductivity, potassium, sodium and chloride measured in the Floodway Channel, exceeded the summer baseline concentrations during each monthly monitoring event. These exceedances were not attributed to construction activities. Often the concentration downstream of construction was within the range of baseline concentrations, indicating no effect of construction. Additionally, the concentrations of most of the parameters elevated above baseline in the Floodway were lower than the concentration in the Red River and would have resulted in dilution if anything. The elevated levels of conductivity, sodium and chloride above summer baseline concentrations were a result of the dry conditions having very little surface water contribution to the Low Flow Channel relative to natural groundwater infiltration and the temporary construction groundwater dewatering that began in August. The elevated potassium concentrations in the Floodway were not a project concern, as there is no applicable Canadian Council of Ministers of the Environment (CCME) criterion for the protection of freshwater aquatic life and not related to construction activities, as the fertilizer applied does not contain potassium.

During the non-flood unfrozen condition monthly monitoring events concentrations of several parameters, in particular TSS, phosphorus, ammonia, nitrate + nitrite-N and *E.Coli,* measured in the Red River downstream of the Outlet were higher compared to the background surface water concentrations upstream of the Outlet. These concentration increases downstream of the Outlet were not attributed to construction, as the parameter concentrations in the Floodway Channel at the Outlet were typically lower compared to the Red River and would have resulted in dilution if anything. Additionally the parameter concentrations were not a concern as they were generally within the summer baseline range of concentrations measured in the Red River.

Concentrations of most parameters measured in the Floodway Channel, excluding ammonia and potassium, were within the winter baseline concentrations during the monthly monitoring events within the non-flood frozen condition or they were within summer baseline concentrations if there was no winter baseline. These ammonia exceedances were not attributed to construction, as there were no activities from January to March, such as fertilizer application, that would contribute to the elevated concentration of ammonia. Additionally these elevated concentrations did not result in an exceedance of the CCME un-ionized ammonia criteria. The elevated potassium concentrations in the Floodway were not a project concern, as there is no applicable CCME criterion for the protection of freshwater aquatic life and not related to construction activities, as the fertilizer applied over the summer does not contain potassium.

Most parameter concentrations measured in the Red River downstream of the Outlet during the non-flood frozen condition, primarily the November and December monthly monitoring events, were higher compared to the background surface water concentrations upstream of the Outlet, excluding TSS and phosphorus. These concentration increases downstream of the Outlet were not attributed to construction, as the parameter concentrations in the Floodway Channel were typically within baseline concentrations and some were lower compared to the Red River, such that they would have resulted in dilution if anything.

Based on the results of the 2006 Construction monitoring events recommendations and refinements for the ongoing monitoring include the following;

- Continued monitoring at all of the current sample locations (including the drain locations upstream of the perimeter ditching when a drain is within an area of construction activities), following the established Monthly monitoring schedule, with Event-based monitoring conducted as required for the 2007 surface water monitoring program.

- The Event-based monitoring in 2007 should follow the protocol that was revised in September 2006, based on the results of a review of precipitation levels and measured TSS increases as outlined in the October, 2 2006 Surface Water Program – Precipitation Review Memorandum (File No: 05-1100-01.19.06.03). Level I Event-based monitoring was changed to a rainfall criteria of 10 mm instead of 5 mm, with no sampling conducted for precipitation levels <10 mm. Additionally, Level II Event-based monitoring was modified to only be conducted if the results of the Level I Event-based monitoring indicated that TSS increases were approaching the CCME criteria. The protocol should be reviewed again during the 2007 monitoring program and revised if required as more construction contracts begin.

- All future hydrocarbon monitoring should be analyzed for hydrocarbon fractions F1 to F4 to ensure that data is comparable to future criteria being developed, instead of analyzing samples for Total Purgeable Hydrocarbons (TPH) and Total Extractable Hydrocarbons (TEH). CCME has developed Canadian Wide Standards for hydrocarbon fractions F1 to F4 in soils and in the future will be developing standards for groundwater and surface water, whereas there are no CCME criteria for the protection of aquatic life for TPH and TEH.

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1.0 INTRODUCTION

1.1 INTRODUCTION

The Environmental Impact Statement (EIS) prepared by TetrES Consultants Inc./Intergroup Consultants Ltd.[(1)] presented the assessment of potential effects on surface water quality resulting from the Floodway Expansion Project (Project). The EIS identified potential effects related to sedimentation associated with Project construction and the use of fertilizers (containing phosphorus, nitrogen and potassium), herbicides (glyphosate and 2,4-D amine) or spills of chemicals during Project construction or maintenance.

The EIS stated that potential effects on surface water quality would be mitigated through the use of appropriate construction management practices that would be specified in the Construction Phase Environmental Protection Plans (CPEPP) developed for each construction site. Additionally as a component of the monitoring plans for the CPEPP potential changes in surface water quality would be monitored during construction. Further, in the Red River Floodway Expansion Project Screening Report prepared for Infrastructure Canada [(2)] the responsible authorities concluded that the effects of the project on surface water quality are not likely to be significant provided that the mitigation measures proposed are followed and that a monitoring and follow-up plan for surface water quality is submitted by the Manitoba Floodway Authority (MFA).

A baseline surface water quality monitoring program [(3)] was undertaken in the spring – summer of 2005, prior to the start of construction of the Floodway Expansion Project. It consisted of sampling during early spring (April), the peak spring flow period (April), summer emergency operation (June) and during typical summer monthly (May to August) flow conditions. Additionally a winter baseflow program [(4)] was conducted in 2005 prior to construction, to monitor the groundwater discharge into the Floodway Channel when there was no surface water contribution. During the baseflow program, samples were collected on March 2, 2005 and these water quality results are considered representative of winter baseline data.

The data obtained during the baseline monitoring program will form the basis for comparison to this 2006 construction monitoring report and all future construction monitoring reports that will be compiled at the end of each construction year from 2007 - 2009. Comparison of the 2006 monthly construction monitoring (January to December), collected during typical monthly flow conditions, to baseline data will allow the effects of construction to be compared to the applicable compliance criteria and to predictions made in modelling effects. As well, the effectiveness of proposed mitigation measures will be assessed.

1.2 SCOPE OF WORK

The scope of work for the 2006 construction Surface Water Monitoring program conducted by KGS Group included the following:

- Collect **monthly** surface water quality data for the Red River, Floodway Channel, Drains that flow into the Floodway Channel and Drains that cross the West Dyke, preferably following a precipitation event or at the flood peak during Red River flood conditions;

- Collect **event-based** surface water quality data for compliance monitoring of applicable parameters (TSS, nutrients, herbicides or hydrocarbons) from the Floodway Channel upstream and downstream of the overall construction area, the Red River downstream of the Outlet and any additional required locations following precipitation events greater than 5 mm (changed to 10 mm in September) or a spill; and

- Provide an assessment of surface water quality comparing results of construction monthly and event-based compliance monitoring to baseline water quality and summarized in an 2006 construction monitoring report in order to;

    - compare predictions made in modelling effects
    - to assess the effectiveness of proposed mitigation measures and adapt if necessary
    - adapt the construction monitoring program in response to data and changes in mitigation measures

2.0 METHODOLOGY

2.1 OVERVIEW

The Field investigation program for the 2006 construction year was conducted from January to December 2006 in conjunction with the on-going construction activities. There were twelve monthly construction sampling events conducted with one each month. There were thirteen (13) level I event-based monitoring events conducted between May and September, 2006 in response to precipitation levels. Additionally polycyclic aromatic hydrocarbon (PAH) sampling was conducted in the vicinity of the CNR Sprague and Redditt bridge crossings on August 3 to address potential PAH concerns associated with creosote treated piles at the two CNR bridge crossings. No level II event-based monitoring was required during the 2006 construction year as the results of the level I event-based monitoring indicated that the potential increase in sediment concentration in the Red River was within the Provincial Guidelines. Likewise, no spill event-based monitoring was required during the 2006 construction year as all of the spills that occurred within the contract areas were reportedly contained and cleaned up with no run off to the Low Flow Channel.

The methodology used for the field program conducted by KGS Group followed the general methodology outlined in the Surface Water Monitoring – 2006 Sampling Program (Appendix A) along with the modifications made following the 2005 baseline and 2005 construction monitoring programs. The Event-based monitoring protocol was revised in September 2006, based on the results of a review of precipitation levels and measured TSS increases as outlined in the October, 2 2006 Surface Water Program – Precipitation Review Memorandum (File No: 05-1100-01.19.06.03). Level I Event-based monitoring was changed to a rainfall criteria of 10 mm instead of 5 mm, with no sampling conducted for precipitation levels <10 mm. The decision to sample was based on precipitation amounts recorded at the official Winnipeg Airport weather station and several unofficial weather stations located around the east and south edges of Winnipeg. Level II Event-based monitoring was also modified to only be conducted if the results of the Level I Event-based monitoring indicated that TSS increases were approaching the CCME criteria. Deviations and changes from the general methodology used during the 2006 construction monitoring are described below.

2.2 SAMPLING LOCATIONS

The sample locations for the 2006 construction monitoring program are outlined on Figure NM4–1 and Figure NM4–2, listed in table NM4-1 and described as follows;

Red River at Inlet – Upstream of the Floodway Channel along the west shore of the river, the 3 replicate samples (S-01, S-02 and S-03) were only sampled during the April monthly monitoring that coincided with the spring flooding because there was no river water entering into the Floodway Channel at the Inlet during all of the other monthly monitoring events.

Red River at Outlet – Upstream of the Floodway Outlet along the east shore (S-34) and downstream of the Outlet at 4 locations along the east shore at 0.5, 1, 2 and 3 kilometers (S-30, S-31, S-32 and S-33, respectively) were sampled during each of the twelve (12) monthly monitoring events. Additionally, S-31 was sampled during each of the thirteen (13) level I event-based monitoring events. These 5 river locations were sampled from the shore for safety reasons, except during the January to March and December monthly monitoring at which time the river was covered by at least 6" of ice that had to be augured through to collect the samples.

Floodway Channel – The Floodway Channel downstream of the Inlet (S-04) was only sampled during the April monthly monitoring that coincided with the spring flooding because there was no river water entering into the Floodway Channel at the Inlet during all of the other monthly monitoring events. There are a total of 6 other locations in the Floodway Channel that included; downstream of the Grande Pointe Diversion drop structure (S-13), downstream of the North Bibeau Drain drop structure (S-14) and at the four weir locations; Keewatin Weir (S-21), Springfield Weir (S-23), Dunning Weir (S-25) and PTH# 44 Weir (S-28). Each of these locations were sampled during all twelve (12) of the monthly monitoring events, except for S-13 that was not sampled during the February and March monthly monitoring because the water was frozen to the bottom of the channel.

Outfall Sources – Of the 11 outfalls that drain into the Floodway channel the Seine River Syphon Overflow (S-05), Grande Point Diversion Drop Structure (S-06), Deacon Reservoir Drain (S-08) and Cooks Creek Diversion Drop Structure (S-09) were only sampled during the April monthly monitoring that coincided with the spring flooding. These were all dry or frozen during all other monthly monitoring events with no water flowing into the Floodway Channel. The Centreline Drain Drop Structure (S-07), North Bibeau Drain Drop Structure (S-10) and Ashfield Drain Drop Structure (S-27) were also sampled during the April monthly monitoring in addition to each being sampled during the January, September and May monitoring, respectively, during all other monthly monitoring events they were dry or frozen. The Country Villa Estates Drain (S-11) was not sampled during any of the monthly monitoring events as it was always dry. The Kildare Trunk-Transcona Storm Sewer Outlet (S-12) was also not sampled during any of the monthly monitoring events because no water was flowing out of the sample location at the flap gate structure except during the April monthly monitoring (spring flood) at which time it was inundated by flood waters. Springfield Road Drain Drop Structure (S-22) was sampled during each of the monthly monitoring events except during the November and December monthly monitoring when the drain could not be sampled, as it was being re-constructed. Skholny Drain Drop Structure (S-26) was sampled during most of the monthly monitoring events except during the January, February, March and December monitoring events as the drain was frozen.

West Dyke – Two drains, the Manness (S-35) and Domain (S-36) Drains downstream of the West Dyke were only sampled during the April monthly event because they were dry or frozen during each of the other monthly monitoring events. As there were no construction activities in the vicinity of these drains along the West Dyke during the 2006 construction monitoring period, the April monthly monitoring is representative of baseline conditions and will be included in the baseline data. Therefore analytical results from the April monthly monitoring will not be discussed in this construction monitoring report.

Construction Areas – In addition to the sample locations shown in figures NM4.1 and NM4.2, samples were also collected from the Floodway Channel upstream and downstream of construction activities (CON U/S and CON D/S, respectively) and upstream and downstream of re-vegetation activities (VEG U/S and VEG D/S, respectively). These sample locations were based on the construction contracts, the extent of the contracts along the Floodway Channel and the construction activities that occurred for each month as summarized in each of the monthly monitoring reports, NM4.1 – January to NM4.12 – December, included in Appendix B.

Beginning in January 2006 the location upstream of construction was designated at Station 4+400 the upstream end of contract C-2 (Station 4+400 – 12+098). From the May monthly monitoring and to the end of the 2006 program the upstream end of construction was designated at Station 7+650 because the construction activities in the Channel upstream of Station 7+650, primarily re-grading and armouring the Low Flow Channel as a portion of C-2 were complete. Samples were only collected upstream of construction from these various locations during the April monthly monitoring (Spring Flood) and 3 of the thirteen (13) level I event-based monitoring events because there was no flow during the other monthly and event-based monitoring.

Beginning in January 2006 the location downstream of construction was designated at Station 19+900, downstream of contract T-5 (Station 19+600). After construction began on the Aqueduct (A1, Station 20+300 – 22+073) in July the location downstream of the construction zone was designated at Station 22+200. In September construction began on contract C-4 (Station 22+250 – 25+650) and the location downstream of the construction zone was designated at Station 25+750. Finally in November construction began on C-6a (Station 30+280 – 33+750) and the location downstream of the construction zone was designated at Station 33+800. Samples were collected downstream of construction from these various locations during each of the twelve (12) monthly and thirteen (13) level I event-based monitoring events.

During the 2006 construction year re-vegetation activities did not begin until July, at which time revegetation occurred at contract C-1 (Station 12+653 – 14+353) and portions of C-2. A location in the Floodway Channel upstream of revegetation was designated at Station 7+650, however, no samples were collected upstream of revegetation areas during any of the monthly monitoring events because there was no flow. A location in the Floodway Channel downstream of the revegetation zone at Station 14+400 was sampled during the July, August and September monthly monitoring. Seeding began at the Trans-Canada Highway bridge contract (T5 Station 19+600) late in September after the September monthly monitoring had already been conducted and therefore for October and November the location downstream of the revegetation zone was designated at Station 20+500. No sample was collected in the Floodway Channel downstream of the revegetation zone in during the December monthly monitoring because no revegetation occurred with the frozen ground conditions, additionally previous revegetation activities were snow covered with no potential for nutrient run-off to the Floodway.

In addition to the above sample locations, on August 3, 2006 surface water samples were also collected from the Floodway Channel upstream and downstream of the CNR Sprague bridge crossing and downstream of the CNR Redditt bridge crossing. These three samples were collected to address potential polycyclic aromatic hydrocarbon (PAH) concerns associated with creosote treated piles at the two CNR bridge crossings.

2.3 SAMPLING PROTOCOL

Sample Frequency – The monthly monitoring events were conducted once per month from January to December, following a precipitation event. Thirteen (13) level I event-based monitoring events were conducted between May and September in response to precipitation events of 5 mm as outlined in Appendix A. Additionally, three samples were collected on August 3, 2006 to address the potential PAH concerns.

Sampling Protocol – The protocol followed the U.S. Environmental Protection Agency (EPA), Office of Water Quality (November, 1997, EPA 841-B-97-003) Monitoring Water Quality, Chapter 5 Water Quality Conditions [(5)] as outlined in Appendix A.

Field Measurements – pH, temperature, conductivity, turbidity and water depth were obtained during each of the twelve monthly monitoring and thirteen level I event-based monitoring events, as outlined in Appendix A.

Laboratory Analysis – The analysis package at all of the locations sampled during each of the twelve monthly monitoring events included the following;

- Routine extractable (iron, manganese, fluoride, pH, total dissolved solids, sulphate, nitrate-nitrite, calcium, potassium magnesium, sodium, hardness, conductivity, chloride, total alkalinity, bicarbonate, carbonate and hydroxide)
- Total suspended solids (TSS) and turbidity
- Ammonia
- Ortho phosphorus, total phosphorus, total dissolved phosphorus
- Dissolved organic carbon (DOC), total organic carbon (TOC)
- Total Kjeldahl nitrogen (TKN)
- Total coliform and *E.Coli* by m-Coli Blue Membrane Filtration method

In addition to the above, at the upstream and downstream of construction locations during each monthly monitoring, benzene, toluene, ethylbenzene and xylenes (BTEX), total extractable hydrocarbons (TEH) and total purgeable hydrocarbons (TPH) were also analyzed. During the April monthly monitoring (spring flood) laboratory analysis also included phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA and picloram), AMPA and glyphosate, at the upstream and downstream of construction locations.

As part of the level I event-based monitoring, laboratory analysis of TSS and nutrients (pH, nitrate – nitrite+N, ammonia, total Kjeldahl nitrogen, ortho phosphorus and total dissolved phosphorus) was conducted for the samples collected in the Floodway Channel upstream and downstream of construction and on the Red River downstream of the Outlet (S-31). No laboratory analysis of herbicides (phenoxy acid herbicide screen, AMPA and glyphosate) or hydrocarbons were required during the event-based monitoring as there were no herbicides applied during the 2006 construction year or potential for spills to reach the Low Flow Channel.

To address the potential concerns associated with the creosote treated piles at the CNR Sprague and Redditt bridge crossings laboratory analysis of PAH's was also conducted as noted for the three samples collected on August 3, 2006.

Quality Assurance/Quality Control Program - Quality Assurance and Quality Control (QA/QC) methods have been adopted to ensure that all samples are representative of the site. In the field, quality was assured by using experienced field staff trained to follow the U.S. EPA sampling protocol and ensuring that all sampling equipment was sterilized and/or rinsed with the sampling media a minimum of three times to eliminate cross contamination of samples. Disposable latex gloves were used for every sample retrieved. Samples were placed into EPA approved sample containers provided by the laboratory and stored in cooler chests at 4°C for transport to ALS Laboratory Group (formerly Enviro-Test Laboratories), a Canadian Accredited Environmental Analytical Laboratory (CAEAL) for detailed analyses.

Implementation of one field duplicate sample per monthly monitoring event and laboratory quality control including; calibration verification standards, continuing calibration verification, certified reference material, matrix spikes, laboratory control samples, duplicates and method blanks, were also used to assure that the laboratory analyses of samples collected in the field were representative of conditions encountered in the investigation. The QA/QC program for the 2006 construction sampling included the following:

- Record keeping for all aspects of sample handling and analysis, including the description of methods/standards used to analyse samples, proper records of sampling and sample handling (chain of custody), analytical result records, and QC sample records.
- Field QC duplicated samples and laboratory QC including calibration verification standards, continuing calibration verification, certified reference material, matrix spikes, laboratory control samples, duplicates and method blanks.

2.4 FLOW CALCULATIONS

Estimates of the flow in the Red River, Floodway Channel, and agricultural drains that flow into the Channel are helpful for interpreting and comparing construction test results. Additionally, flow estimates are necessary to calculate approximate mass balances for the chemical analysis results to interpret the results in particular during event-based compliance monitoring.

The estimate of flow in the Red River was based on information provided in Manitoba Water Stewardship's weekly flow reports for the Red River near Selkirk (Appendix B) [(6)]. Estimates of the flow in the Floodway Channel and in each of the agricultural drains that flow into the channel were based on the recorded water levels at each location. As noted in Section 2.3, water levels were recorded using staff gauges installed at each of the sampling locations. The flow was then estimated using a relationship between flow and water level (rating curve), which was developed by KGS Group at each location. The rating curves developed for the agricultural drain drop structures were based on the physical characteristics of the drop structure and approach channel. Rating curves developed for the in-channel locations were based on the physical characteristics of the Floodway channel.

3.0 RESULTS

3.1 HYDROLOGICAL CONDITIONS

Monthly Monitoring

The monthly monitoring events were generally conducted following a substantial precipitation event during the month or near the end of the month if a substantial precipitation event had not yet occurred. The April monthly monitoring, however, was conducted based on the Red River spring flood peak (Appendix B). Full details of the hydrological conditions for each monthly monitoring are provided in each of the monthly monitoring reports, NM4.1 – January to NM4.12 – December. Details of precipitation recorded by Environment Canada at the Winnipeg International Airport, Manitoba (7) are provided in the Daily Data Report for January to December, 2006 in Appendix C. The precipitation levels during each of the monthly monitoring events and the percentage of the monthly precipitation total are summarized in the following table;

Summary of Precipitation Levels During the 2006 Monthly Monitoring

Sample Date	Amount of Precipitation (mm) for the Monitoring Event	Percent of Monthly Total	Monthly Total Precipitation (mm) *	Historical Average Monthly Total Precipitation (mm) (8)
January 17 & 18	5.5	22%	25.5	*19.7*
February 27 & 28	0	0%	5.0	14.9
March 8 & 9	7.0	19%	36.5	*21.5*
April 20	-	-	16.5	31.9
May 27	6.5	15%	44.5	58.8
June 29	0	0%	29.0	89.5
July 26	5.5	52%	10.5	70.6
August 6	4.0	8%	51.0	75.1
September 18	32.5	76%	43.0	52.3
October 17	8.5	33%	26.0	36.0
November 24	1.0	6%	17.5	25.0
December 14	1.0	3%	37.0	*18.5*
Annual Total			342.0	513.7

* - Mr. Dale Marciski, Environment Canada Outreach Officer provided some corrections on precipitation records and the monthly totals compared to those reported.

As evident by the table above, 2006 was an extremely dry year with an annual total precipitation of 342.0 mm, approximately 67% of the historical average of 513.7. All months except January, March and December had total precipitation amounts lower than the historical average monthly precipitation and these three months are winter months with relatively low precipitation compared to typical amounts during the summer months. July 2006 was the driest July in Winnipeg since records of precipitation began in 1872. The total July precipitation of 10.5 mm recorded at the airport was only 15% of the historical average of 70.6 mm.

Event-Based Monitoring

The level I event-based monitoring events were conducted between May and September, 2006 following precipitation events of 5 mm or greater. The amount and duration of each precipitation event and the year storm categorization (based on the Atmospheric Environment Service, Rainfall Intensity – Duration Frequency (Rainfall IDF) Values for the Winnipeg International Airport [(9)]) which triggered each of the level I event-based monitoring events are summarized in the following table;

Summary of Precipitation Levels During the 2006 Event-Based Monitoring

Sample Date	Amount of Precipitation (mm) for the Monitoring Event [1]	Approximate Duration (hours)	Year Storm [(9)]
May 9	6 - 14	1.75	<2
May 27	5.2 - 13	3.00	<2
May 28	14.5 - 20.1	1.75	<2
June 5	4.8 - 6.3	1.00	<2
June 25	4.8 - 8.6	3.50	<2
July 26	7.1 - 10.7	1.00	<2
August 3	6.1 - 8.8	1.50	<2
August 4	6.3 - 9.1	3.00	<2
August 5	4.1 - 7.9	4.00	<2
August 10	(0)[2] 20 - 24	2.50	<2
August 12	15.5 - 20.8 / 21.3 - 39.9	2.50 / 2.50	<2 / 2 - 5
August 25	4.1 - 5.1	3.50	<2
September 17	22.4 - 30.0	5.50	<2

1 - Amount of precipitation measured varied between the different weather stations.
2 – One of the unofficial weather stations reported no precipitation but this appeared to be an error.

3.2 WATER QUALITY

The field chemistry and turbidity measured in the surface water at each location during the monthly and event-based monitoring events are listed in Table NM4–1. The general water quality results for all of the analyzed parameters collected at each location during the monthly and event-based monitoring events are summarized in Table NM4–2. The petroleum hydrocarbons and bacteria results for samples collected during the monthly monitoring and the herbicide results for samples collected during the April monthly (spring flood) monitoring are summarized in Table NM4–3, Table NM4–4 and Table NM4–5, respectively. The PAH results for the samples collected to address potential creosote concerns are summarized in Table NM4–6. Existing CCME Surface Water Quality Guideline values are given for any parameters that have established objectives.

Construction monitoring data for the key water quality parameters of interest, identified and discussed in the baseline surface water monitoring report, were compared to the baseline data under spring flooding, non-flood/unfrozen and non-flood/frozen conditions. These parameters included total suspended solids, nutrients (total phosphorus, ammonia, nitrate plus nitrite and potassium), specific conductance, major ions (sodium and chloride), and *E.Coli* for bacterial concerns (Figures NM4-3 to NM4-34).

The April 2006 monthly monitoring was conducted during the 2006 spring flood peak and therefore represents the spring flooding condition. As a result the baseline conditions for comparison shown on the figures for the Red River, Floodway Channel and drains that flow into the Floodway Channel are represented by the concentrations from the samples collected on April 12, 2005 during the Baseline Monitoring peak spring flood.

During the May to October 2006 construction monitoring there was no Red River water entering the Floodway Channel therefore these monthly monitoring events represent the non-flood/unfrozen condition. As a result the range of baseline conditions for comparison shown on the figures for the Channel are represented by the minimum and maximum concentrations observed during the summer baseline monitoring when there was no Red River water diverted. This included data from the May 10, June 13 and August 19, 2005 baseline monthly events. For the upstream end of the Floodway Channel where there was insufficient baseline data to provide a range of baseline conditions, the range was extrapolated using the data immediately downstream and following the observed trends. The Floodway Channel summer baseline conditions are representative of surface water run-off from precipitation events and therefore are comparable to the non-flood/unfrozen condition. The baseline conditions used for comparison for the drains flowing into the Floodway Channel and for the Red River at the Outlet are from the corresponding sample events as above. In addition, for the Red River at the Outlet the baseline conditions from the emergency summer operation and the July monthly event are used for comparison because these dates represent the range of Red River flow conditions that could occur in any given year during construction.

During the January to March, November and December 2006 construction monitoring there was no Red River water entering the Floodway Channel therefore these monthly monitoring events represent the non-flood/frozen condition. The Floodway Channel summer baseline conditions as discussed above are representative of surface water run-off from precipitation events and therefore for some parameters are not comparable to the frozen conditions. Under frozen conditions the surface water is primarily from groundwater discharge into the Channel, referred to as baseflow. As a result in addition to the summer baseline conditions, for applicable parameters, the monthly monitoring values during the non-flood/frozen condition are also compared to the winter baseline results from the baseflow monitoring conducted at the Floodway Channel weir locations in March 2005 [(4)].

3.2.1 Total Suspended Solids

Monthly Monitoring

The comparison of TSS concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flooding, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM4–3 to NM4–5.

The TSS concentration measured in the Floodway Channel downstream of construction (120 mg/L) was higher compared to upstream of construction (91 mg/L) during the spring flood condition (Figure NM4–3). This increase, however, was not a concern as the TSS concentration along the entire length of the Floodway was below the observed baseline concentrations.

Additionally, the TSS concentrations in the Red River downstream of the Outlet (160 to 180 mg/L) where lower compared to the background concentration in the Red River upstream of the Outlet (200 mg/L).

The TSS concentrations measured in the Floodway Channel were within the lower range or lower than the baseline concentrations during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM4–4). A few exceptions include the samples collected in the Floodway Channel downstream of the North Bibeau Drain (210 mg/L), downstream of construction (96 mg/L) and at the Dunning Weir location (64 mg/L) during the June, August and October monthly monitoring, respectively. These elevated concentrations above the baseline concentrations were not a concern however, as all of the concentrations returned to being near the lower range of the baseline values at the Floodway Channel Outlet. The elevated concentration measured downstream of the North Bibeau Drain also appeared to be an anomaly compared to the other Floodway Channel samples and was likely the result of sample error from disturbing the bottom surface during sampling. It was not attributed to construction activities as the TSS concentration measured in the Floodway Channel downstream of construction (24 mg/L) during the June monitoring was below the summer baseline values. The TSS concentrations measured in the Red River downstream of the Outlet were similar to slightly elevated at some locations during the June to September monthly monitoring events compared to the background concentrations upstream of the Outlet. These concentration increases downstream of the Outlet were not attributed to construction, as the TSS concentrations in the Floodway Channel at the Outlet were lower compared to the Red River and would have resulted in dilution if anything. Additionally, the concentrations in the Red River were not a concern as they were within the CCME criteria (allowable increase of 25 mg/L) when compared to the background concentrations upstream of the Outlet, they were below the baseline conditions measured for the Red River and the elevated concentrations were representative of the natural variation typically observed.

The TSS concentrations measured in the Floodway Channel were lower than the baseline concentrations during the monthly monitoring representing the non-flood/frozen condition (Figure NM4–5). Likewise, concentrations in the Red River downstream of the Outlet were either similar to or lower than upstream indicating that TSS was not a concern in 2006 during frozen conditions.

The TSS concentrations measured in the Red River at the Floodway Outlet during 2006 were compared to the 10^{th} to 90^{th} percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The TSS concentrations measured each month during 2006, except January were within the 10^{th} to 90^{th} percentile ranges (Figure NM4-6). During January the TSS concentration in the Red River upstream of the Outlet (26 mg/L) and downstream of the Outlet (18 to 27 mg/L) were at or higher than the historical January 90^{th} percentile (19 mg/L). These elevated TSS concentrations were not a result of construction however, because the concentrations downstream of the Outlet were similar to or lower than the background concentrations upstream of the Outlet. In addition to the 2006 TSS concentrations generally being within the historical 10^{th} to 90^{th} percentile ranges, the monthly concentrations were generally lower compared to the respective monthly concentrations measured during the baseline and 2005 construction monitoring period (Figure NM4-6).

Event-Based Monitoring

Results of the 13 event-based monitoring events conducted between May and September have indicated negligible increases in TSS concentration in the Red River during the 2006 construction year. The level I event-based worksheet and the follow-up lab results fax for each rain event are provided with the monthly monitoring reports, NM4.1 – January to NM4.12 – December. A summary of the estimated and actual change in Red River Sediment Concentration measured during the level I event-based monitoring to the end of August was described in the enclosed October, 2 2006 Surface Water Program – Precipitation Review Memorandum (File No: 05-1100-01.19.06.03; Appendix D).

The only measurable increases in TSS concentration in the Red River were following the August 10 (2.3% increase) and August 12 (4.4% increase) rain events with nearly all the other events resulting in a negligible (<0.5%) decrease. The August 10 rainfall (20 to 24 mm in 2.5 hours) was close to a 2-year storm based on the Atmospheric Environment Service, Rainfall Intensity – Duration Frequency (Rainfall IDF) Values for the Winnipeg International Airport [(9)]. The August 12 rainfall (41 to 55 mm in 5 hours) occurred with two events separated by approximately 5 hours. The first rainfall was less than a 2-year storm and the second rainfall was between a two and 5-year storm. Based on these results the protocol for conducting level II event-based monitoring was modified to only be conducted if the results of the level I event-based monitoring indicated that TSS increases were approaching the CCME criteria. In addition the protocol for conducting level I event-based monitoring was changed in September with the rainfall criteria at 10 mm instead of 5 mm, with no sampling conducted for precipitation levels less than10 mm.

3.2.2 Specific Conductance

The comparison of specific conductance values between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flooding, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM4–7 to NM4–9.

Specific conductance measured in the Floodway Channel was very similar to the baseline values during the monthly monitoring representing the flood condition (Figure NM4–7). Likewise, specific conductance measured in the Red River downstream of the Outlet was slightly lower than upstream and similar to the baseline values, indicating no construction effects.

The specific conductance measured in the Floodway Channel downstream of construction and at most of the other Floodway locations was generally above the range of summer baseline values during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM4–8). The elevated values in the Floodway Channel at the Outlet above the baseline values did not result in any noticeable increases in the Red River downstream of the Outlet compared to upstream of the Outlet. Therefore, the elevated specific conductance in the Floodway was not a concern. The elevated conductance measured in May, June and July was not attributed to construction, as there were no construction activities during this time that would contribute to the elevated specific conductance. The drought conditions during summer 2006 resulted in relatively little surface water contribution to the low flow channel this summer compared to normal conditions. Therefore, the relatively greater contribution of groundwater infiltration resulted in the elevated specific conductance that was similar to winter baseline (1150 to 1730 μS/cm) conditions. Temporary construction groundwater dewatering at the aqueduct during the August to October monthly monitoring was also contributing to the relatively greater amount of groundwater and elevated conductance values in the Floodway Channel.

The specific conductance measured in the Floodway Channel downstream of construction and at most of the other Floodway locations was generally within or below the range of winter baseline values (1150 to 1730 μS/cm) during the monthly monitoring representing the non-flood/frozen condition (Figure NM4–9). One exception was the high value measured in the Floodway Channel downstream of the Grande Pointe Drain (2630 μS/cm) during the January monitoring. Groundwater infiltration during the frozen months typically results in specific conductance values in the Floodway Channel elevated compared to non-frozen conditions when there is a greater proportion of surface water contribution from the drains and precipitation. Temporary construction groundwater dewatering at the aqueduct during the November and December monthly monitoring contributed a greater volume of groundwater to the Floodway Channel. The specific conductance values in the Floodway Channel at the Outlet were higher compared to those in the Red River at the Outlet and resulted in slight specific conductance increases (0 to 7.7%) in the Red River downstream of the Outlet compared to upstream of the Outlet. These slight increases in specific conductance in the Red River are likely typical during frozen conditions as noted above the values in the Floodway Channel were within normal winter baseline values. The slight increases in the Red River downstream of the Outlet were not specifically a result of construction activities as slight increases also occurred from January to March (0.3 to 6.3%) when there was no construction dewatering occurring. Additionally the slight increases were not a concern as there is no CCME criterion for the protection of freshwater aquatic life for specific conductance.

3.2.3 Total Phosphorus

Monthly Monitoring

The comparison of total phosphorus concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flooding, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM4–10 to NM4–12.

The total phosphorus concentration measured in the Floodway Channel downstream of construction (0.36 mg/L) was slightly higher compared to upstream of construction (0.33 mg/L) during the spring flood condition (Figure NM4–10). This increase, however, was not a concern as the total phosphorus concentration along the entire length of the Floodway was below the observed baseline concentrations. Additionally, the total phosphorus concentrations in the Red River downstream of the Outlet (0.37 to 0.42 mg/L) where lower to similar compared to the background concentration in the Red River upstream of the Outlet (0.42 mg/L).

The total phosphorus concentrations measured in the Floodway Channel were typically lower than the baseline concentrations with a few sample locations within the lower range, during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM4–11). A few exceptions include the total phosphorus concentrations measured in the Floodway Channel at the Outlet during the May (0.21 mg/L), June (0.15 mg/L) and July (0.27 mg/L) monthly monitoring that were near the middle to upper end of the summer baseline range. The increase in total phosphorus at the Floodway Outlet during May and June was not attributed to construction as no fertilizers were applied in the construction area and the concentration downstream of construction was below baseline concentrations. Instead the increase was likely in response to the high total phosphorus concentrations flowing into the Floodway from the Skholny Drain during the May (1.82 mg/L), June (0.29 mg/L) and July (5.96 mg/L) monthly monitoring. During the non-flood/unfrozen condition the range of total phosphorus concentrations measured in the Red River downstream of the Outlet were typically similar to slightly higher compared to upstream of the Outlet during each of the months, except for September when they were similar to lower. These slightly elevated concentrations were not a concern however, as they were at the low end of the summer baseline range of concentrations measured in the Red River. Additionally, the total phosphorus concentrations in the Floodway Channel at the outlet were lower than the concentrations in the Red River and would have resulted in dilution if anything, with the exception of the July monitoring as discussed above.

The total phosphorus concentrations measured in the Floodway Channel were lower than the baseline concentrations during the monthly monitoring representing the non-flood/frozen condition (Figure NM4–12). Likewise, concentrations in the Red River downstream of the Outlet were either similar to or lower than upstream indicating that total phosphorus was not a concern in 2006 during frozen conditions.

The total phosphorus concentrations measured in the Red River at the Floodway Outlet during 2006 were compared to the 10^{th} to 90^{th} percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The total phosphorus concentrations measured each month during 2006, except November, were within the 10^{th} to 90^{th} percentile ranges (Figure NM4-13). During November the total phosphorus concentration in the Red River upstream of the Outlet (0.41 mg/L) and downstream of the Outlet (0.35 to 0.39 mg/L) were similar to slightly higher than the historical November 90^{th} percentile (0.37 mg/L). These elevated total phosphorus concentrations above historical concentrations were not a result of construction however, because the concentrations downstream of the Outlet were lower compared to the background concentrations upstream of the Outlet.

Event-Based Monitoring

Total phosphorus was only analyzed during 9 of the 13 event-based monitoring events conducted, beginning in July following the first application of fertilizer. The total phosphorus concentrations measured in the Floodway Channel downstream of active construction activities were lower than those in the Red River generally by an order of magnitude, except during the August 10 (0.21 mg/L) and 12 (0.23 mg/L) event-based monitoring, which were still lower than the concentrations in the Red River (0.24 mg/L and 0.28 mg/L, respectively; Table NM4-2). These results indicate that during 2006 total phosphorus was not a concern, as the concentrations in the Floodway Channel would have resulted in dilution in the Red River if anything. Additionally the total phosphorus concentrations measured in the Floodway Channel and the Red River during the event based monitoring were lower than or within the historical 10^{th} to 90^{th} percentile ranges during the respective months.

3.2.4 Ammonia (NH_3)

The water quality guidelines for ammonia vary depending on the temperature and pH concentrations of the water. For the 2006 construction monitoring program, the pH ranged from 7.3 to 9.0 and the temperature ranged from 0°C to 26°C. The soluble ammonia (NH_3) values reported by the laboratory were converted by KGS Group into un-ionized ammonia values based on a pH temperature relationship (Table NM4-2). The un-ionized ammonia represents all the forms of ammonia in the water, with the exception of the ammonium ion (NH_4). The corresponding un-ionized ammonia CCME criteria for the protection of freshwater aquatic life is 0.019 mg/L.

Monthly Monitoring

The comparison of ammonia concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flooding, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM4–14 to NM4–16. The ammonia concentration measured in the Floodway Channel downstream of construction (0.19 mg/L) was slightly higher compared to upstream of construction (0.15 mg/L) during the spring flood condition (Figure NM4–14). This increase, however, was not a concern as the ammonia concentration along the entire length of the Floodway was below the observed baseline concentrations. Additionally, the ammonia concentrations in the Red River downstream of the Outlet (0.16 to 0.17 mg/L) where lower compared to the background concentration in the Red River upstream of the Outlet (0.20 mg/L). The concentrations in the Red River were also below baseline concentrations and resulted in un-ionized ammonia concentrations within the acceptable CCME criteria.

The ammonia concentrations measured in the Floodway Channel were typically within or lower than the baseline concentrations, during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM4–15). A couple of exceptions include the ammonia concentrations measured in the Floodway Channel downstream of the Grande Pointe Drain during September (0.18 mg/L) and downstream of the North Bibeau Drain during the June (0.17 mg/L) monthly monitoring, which were higher than the summer baseline range. This elevated ammonia concentration measured in June resulted in an un-ionized ammonia concentration of 0.031 mg/L, which exceeded the CCME criteria of 0.019 mg/L. This exceedance was not a result of construction as there were no construction activities, such as fertilizer application, in June that would account for the elevated ammonia. During the non-flood/unfrozen condition the range of ammonia concentrations measured in the Red River at the Outlet varied. The ammonia concentrations measured in the Red River from July to October resulted in exceedances of the CCME un-ionized ammonia criteria both upstream and downstream of the Outlet, whereas in May only the concentration upstream of the Outlet resulted in an exceedance. The ammonia concentrations in the Red River downstream compared to upstream of Outlet were lower in May and August, whereas they ranged from lower to slightly higher during June, July, September and October. The slight increases in ammonia concentrations in the Red River downstream of the Outlet and the exceedance of the CCME un-ionized ammonia criteria were not attributed to construction activities because the ammonia concentrations in the Floodway Channel at the

Outlet were lower than the concentrations in the Red River and would have resulted in dilution if anything.

The ammonia concentrations measured in the Floodway Channel varied from below the summer baseline to higher than the winter baseline concentrations at a few locations during the monthly monitoring representing the non-flood/frozen condition (Figure NM4–16). The ammonia concentrations measured in the Floodway Channel downstream of the Grande Pointe Drain (0.75 mg/L) and downstream of construction (0.27 mg/L) during January, downstream of construction (0.29 mg/L) during February, and at the Springhill (0.41 mg/L) and Dunning (0.28 mg/L) weir locations during the March monitoring exceeded the range of winter baseline concentrations (0.06 to 0.26 mg/L). These elevated concentrations were not attributed to construction, as there were no activities from January to March, such as fertilizer application, that would contribute to the elevated concentration of ammonia. Additionally these concentrations above the baseline conditions did not result in an exceedance of the CCME un-ionized ammonia criteria. The ammonia concentrations in the Red River downstream of the Outlet where lower compared to the background concentration in the Red River upstream of the Outlet, except during November when there were slight increases. The slight increase observed in November was not a result of construction, as noted above there were no construction activities that would contribute to ammonia concentrations. Additionally, the concentration in the Floodway at the Outlet was an order of magnitude lower than in the Red River and would have resulted in dilution if anything. The ammonia concentrations measured in the Red River at the Outlet during November and December resulted in exceedances of the CCME un-ionized ammonia criteria both upstream and downstream.

The ammonia concentrations measured in the Red River at the Floodway Outlet during 2006 were compared to the 10^{th} to 90^{th} percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The ammonia concentrations measured each month during 2006 were within or lower than the 10^{th} to 90^{th} percentile ranges (Figure NM4-17). Even though the ammonia concentrations were within the historical conditions in the Red River, as noted above the ammonia concentrations measured from July to December resulted in un-ionized ammonia concentrations that exceeded the CCME criteria. This suggests that exceedance of the CCME unionized ammonia criteria is a regular occurrence in the Red River and not a result of construction activities.

Event-Based Monitoring

Ammonia was only analyzed during 9 of the 13 event-based monitoring events conducted, beginning in July following the first application of fertilizer. The ammonia concentrations measured in the Floodway Channel downstream of active construction activities were lower than those in the Red River generally by an order of magnitude, except during the July 25 (0.03 mg/L) and August 12 (0.57 mg/L) event-based monitoring, which were still lower than the concentrations in the Red River (0.09 mg/L and 1.47 mg/L, respectively; Table NM4-2). Whereas the ammonia concentrations measured in the Red River resulted in an exceedance of the CCME un-ionized ammonia criteria during each of the 9 event-based monitoring conducted, only the ammonia concentrations measured in the Floodway on August 12 resulted in a similar exceedance. These results indicate that during 2006 potential construction effects associated with ammonia were not a concern, as the concentrations in the Floodway Channel would have resulted in dilution in the Red River if anything.

3.2.5 Nitrate + Nitrite-N

Monthly Monitoring

The comparison of nitrate + nitrite-N concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flooding, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM4–18 to NM4–20.

The nitrate + nitrite-N concentration measured in the Floodway Channel downstream of construction (2.26 mg/L) was slightly higher compared to upstream of construction (2.08 mg/L) and the concentrations along the entire Floodway Channel were higher than the observed baseline concentrations during the spring flood condition (Figure NM4–18). This increase and elevated concentrations in the Floodway Channel were not attributed to construction as no fertilizers were applied in the construction area at this time. Additionally, they were not a concern as the nitrate + nitrite-N concentrations in the Red River downstream of the Outlet

(2.31 to 2.34 mg/L) where lower compared to the background concentration in the Red River upstream of the Outlet (2.45 mg/L).

The nitrate + nitrite-N concentrations measured in the Floodway Channel were typically within the lower range of the baseline concentrations during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM4–19). The nitrate + nitrite-N concentrations measured in the Red River generally increased further downstream of the Outlet and were slightly higher compared to upstream of the Outlet during each of the months representing the non-flood/unfrozen condition. An exception was the nitrate + nitrite-N measured in the Red River 1,000 m downstream of the Outlet (1.21 mg/L) during May, which was nearly three times above the concentration upstream of the Outlet (0.47 mg/L). These slightly elevated concentrations were not a concern however, as they were within the baseline range of concentrations measured in the Red River. Additionally, the nitrate + nitrite-N concentrations in the Floodway Channel at the outlet were lower than the concentrations in the Red River and would have resulted in dilution if anything. These results indicate that during 2006 potential construction effects associated with nitrate + nitrite-N were not a concern.

The nitrate + nitrite-N concentrations measured in the Floodway Channel were typically within the lower range of the baseline concentrations during the monthly monitoring representing the non-flood/frozen condition (Figure NM4–20). An exception was the nitrate + nitrite-N concentrations measured during the January monitoring in the Floodway Channel downstream of construction (1.76 mg/L) and at the Keewatin (0.79 mg/L) and PTH #44 (0.63 mg/L) weir locations, which were higher compared to the baseline concentrations. The nitrate + nitrite-N concentrations in the Red River downstream of the Outlet where generally similar to slightly higher compared to the background concentration in the Red River upstream of the Outlet, with a few of exceptions. The nitrate + nitrite-N concentrations in the Red River 2,000 m downstream of the Outlet in February and March and measured 500 m and 3,000 m downstream of the Outlet in February were close to two times or more higher compared to upstream of the Outlet. The high concentrations that were measured in February were not attributed to construction as there were no construction activities during February that would have contributed to nitrate + nitrite-N. Additionally these high concentrations appear to be anomalous because very low concentrations were also measured in the Floodway Channel and the Red River during February.

The nitrate + nitrite-N concentrations measured in the Red River at the Floodway Outlet during 2006 were compared to the 10^{th} to 90^{th} percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The nitrate + nitrite-N concentrations measured each month during 2006, except for February and an anomalous concentration in May, were generally within the 10^{th} to 90^{th} percentile ranges (Figure NM4-21). During February the nitrate + nitrite-N concentration in the Red River upstream of the Outlet (0.87 mg/L) and 500 m downstream of the Outlet (0.88 mg/L) were slightly higher than the historical February 90^{th} percentile (0.83 mg/L), whereas the other concentrations in the Red River downstream of the Outlet (1.35 to 3.07 mg/L) were much higher. The elevated nitrate + nitrite-N concentrations above historical concentrations are not a result of construction however, as noted above, there were no construction activities during February and May that would have contributed to nitrate + nitrite-N. Additionally, the nitrate + nitrite-N concentrations in the Floodway Channel at the outlet were lower than the concentrations in the Red River and would have resulted in dilution if anything.

Event-Based Monitoring

Nitrate + nitrite-N was only analyzed during 9 of the 13 event-based monitoring events conducted, beginning in July following the first application of fertilizer. The nitrate + nitrite-N concentrations measured in the Floodway Channel downstream of active construction activities were lower than those in the Red River generally by an order of magnitude, except during the August 12 event-based monitoring (0.23 mg/L), which was still lower than the concentration in the Red River (0.47 mg/L; Table NM4-2). These results indicate that during 2006 nitrate + nitrite-N was not a concern as the concentrations in the Floodway Channel would have resulted in dilution in the Red River if anything. Additionally the nitrate + nitrite-N concentrations measured in the Floodway Channel and the Red River during the event-based monitoring were lower than or within the historical 10^{th} to 90^{th} percentile ranges during the respective months.

3.2.6 Potassium

The comparison of potassium concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flooding, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM4–22 to NM4–24.

There was almost no variation in the potassium concentrations measured in the Floodway Channel (7.03 to 7.29 mg/L) during the spring flood condition and they were below the baseline concentrations (Figure NM4–22). Likewise, the potassium concentrations in the Red River downstream of the Outlet (7.25 to 7.37 mg/L) where slightly lower compared to the background concentration upstream of the Outlet (7.87 mg/L) and lower than the baseline concentrations, indicating no construction effects.

The potassium concentrations measured in the Floodway Channel between the Inlet and downstream of the North Bibeau drain were typically higher than the baseline concentrations, during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM4–23). Whereas, potassium concentrations were typically similar to the baseline concentrations further downstream in the Floodway Channel to the Outlet, except for the concentration measured at the Outlet during the July monitoring (7.80 mg/L), which was higher than the summer baseline range. This elevated potassium concentration measured in July was not a result of construction because the fertilizer applied in July, as part of the construction activities did not contain potassium as a component. Instead the increase was likely in response to the high potassium concentration flowing into the Floodway from the Skholny Drain during the July (13.1 mg/L) monthly monitoring. The potassium concentrations in the Red River downstream of Outlet compared to upstream ranged from similar to lower in May, August and September, whereas they ranged from slightly lower to slightly higher during June, July, and October. The slight increases in potassium concentrations observed in the Red River downstream of the Outlet were not attributed to construction activities, as noted above potassium was not a component of the fertilizer used. Additionally the potassium concentrations in the Floodway Channel at the Outlet were lower than the concentrations in the Red River and would have resulted in dilution if anything.

The potassium concentrations measured in the Floodway Channel generally ranged from slightly lower to slightly higher than the summer baseline concentrations during the monthly monitoring representing the non-flood/frozen condition (Figure NM4–24). A few exceptions included the potassium concentrations measured in the Floodway Channel downstream of the Grande Pointe drain (15.9 mg/L) during January and at the Dunning weir (9.8 mg/L) location and Outlet (8.5 mg/L) during the March monitoring, which were higher than the baseline concentrations. These elevated concentrations were not attributed to construction, as there were no activities in January and March, such as fertilizer application, that would contribute to the elevated concentration of potassium and as already noted potassium is not a component of the fertilizer that was used during 2006. The potassium concentrations in the Red River downstream of the Outlet where generally similar to the background concentrations in the Red River upstream of the Outlet, except during November and December when there were slight increases. The slight increase observed in November and December were not a result of construction, as noted above, and the concentration in the Floodway at the Outlet was lower than in the Red River, which would have resulted in dilution if anything.

The potassium concentrations measured in the Red River at the Floodway Outlet during 2006 were compared to the 10th to 90th percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The potassium concentrations measured during July and from October to December were slightly higher than the 90th percentile, whereas all other months during 2006 were within or slightly lower than the 10th to 90th percentile ranges (Figure NM4-25). The elevated potassium concentrations above than the 90th percentile were not a concern even though there were slight increases in the Red River downstream of the Outlet compared to the background condition upstream as already discussed potassium was not a component of the fertilizer used and therefore not related to construction activities in 2006. Additionally the potassium concentrations in the Floodway Channel at the Outlet were generally lower than the concentrations in the Red River and would have resulted in dilution if anything.

3.2.7 Sodium

The comparison of sodium concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flooding, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM4–26 to NM4–28.

The sodium concentrations measured along the length of the Floodway Channel (12.9 to 13.6 mg/L) and in the Red River downstream of the Outlet (13.1 to 13.6 mg/L) were very similar to both the baseline concentrations and their respective background conditions during the spring flood condition (Figure NM4–26). These results indicate no sodium construction effects during the spring flood in 2006.

The sodium concentrations measured in the Floodway Channel downstream of construction and at most of the other Floodway locations were generally above the range of summer baseline values during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM4–27). The elevated sodium concentrations measured in the Floodway Channel during May, June and July were not attributed to construction, as there were no construction activities during this time that would have contributed to sodium concentrations. The drought conditions during summer 2006 resulted in relatively little surface water contribution to the low flow channel this summer compared to normal conditions. Therefore, the relatively greater contribution of groundwater infiltration resulted in the elevated sodium concentrations that were generally similar to winter baseline (70.5 to 165 mg/L) conditions. Temporary construction groundwater dewatering at the aqueduct during the August to October monthly monitoring also contributed to the relatively greater amount of groundwater and elevated sodium concentrations in the Floodway Channel. The elevated concentrations in the Floodway Channel at the Outlet above the baseline values generally did not result in noticeable increases in the Red River downstream of the Outlet compared to upstream of the Outlet, except for slight increases measured during June and October. The elevated sodium concentrations measured were not a concern because they were generally similar to winter baseline conditions that occur within the Floodway and because there is no sodium CCME criterion for the protection of freshwater aquatic life.

The sodium concentrations measured in the Floodway Channel downstream of construction and at the other Floodway locations were within or below the range of winter baseline values (70.5 to 165 mg/L) during the monthly monitoring representing the non-flood/frozen condition (Figure NM4–28). Groundwater infiltration during the frozen months typically results in sodium concentrations values in the Floodway Channel elevated compared to non-frozen conditions when there is a greater proportion of surface water contribution from the drains and precipitation. Temporary construction groundwater dewatering at the aqueduct during the November and December monthly monitoring contributed a greater volume of groundwater to the Floodway Channel. The sodium concentrations in the Floodway Channel at the Outlet were typically higher compared to those in the Red River at the Outlet, except during December, and resulted in slight sodium concentration increases of up to 7.4% in the Red River downstream of the Outlet compared to upstream of the Outlet. These slight increases are likely typical during frozen conditions as noted above the values in the Floodway Channel were within normal winter baseline values. The slight increases were not a concern as there is no CCME sodium criterion for the protection of freshwater aquatic life. During March the sodium concentrations measured in the Floodway Channel were higher compared to the other months even though there was no construction groundwater dewatering. These higher concentrations are potentially from road salts running into the Floodway Channel off of the numerous bridge crossings, as there were temperatures at and above the freezing point during the four days prior to the sampling event. The Department of Transportation applies either calcium chloride or magnesium chloride as road salt, however, sodium chloride is also a common road salt used.

3.2.8 Chloride

The comparison of chloride concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flooding, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM4–29 to NM4–31.

The chloride concentrations measured along the length of the Floodway Channel (14 to 16 mg/L) and in the Red River downstream of the Outlet (15 to 17 mg/L) were very similar to their respective background conditions and slightly lower than the baseline concentrations during the spring flood condition (Figure NM4–29). These results indicate no chloride construction effects during the spring flood in 2006.

The chloride concentrations measured in the Floodway Channel downstream of construction and at most of the other Floodway locations were generally above the summer baseline concentrations during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM4–30). The chloride concentrations generally ranged from 40 to 100 mg/L, with a couple of anomalous concentrations measured at the Keewatin (259 mg/L) and Spring Hill (242 mg/L) weir locations in June, whereas the baseline concentrations ranged from 16 to 73 mg/L. The elevated chloride concentrations measured in the Floodway Channel during May, June and July were not attributed to construction, as there were no construction activities during this time that would have contributed to chloride concentrations. The drought conditions during summer 2006 resulted in relatively little surface water contribution to the low flow channel this summer compared to normal conditions. Therefore, the relatively greater contribution of groundwater infiltration resulted in the elevated chloride concentrations that were generally similar to winter baseline (60 to 205 mg/L) conditions. Temporary construction groundwater dewatering at the aqueduct during the August to October monthly monitoring also contributed to the relatively greater amount of groundwater and elevated chloride concentrations in the Floodway Channel. Slight increases in chloride concentrations up to 6.4% were measured in the Red River downstream of the Outlet compared to upstream of the Outlet, except during May and July when no changes were noticeable. The slight chloride concentration increases in the Red River were not a concern because the conditions observed in the Floodway Channel were generally similar to baseline conditions that occur in winter and because there is no chloride CCME criterion for the protection of freshwater aquatic life.

The chloride concentrations measured in the Floodway Channel downstream of construction and at the other Floodway locations were generally within or below the range of winter baseline concentrations (60 to 205 mg/L) during the monthly monitoring representing the non-flood/frozen condition (Figure NM4–31). A couple of exceptions included the elevated chloride concentrations measured in the Floodway Channel at the Dunning Weir location (230 mg/L) and the Outlet (221 mg/L) during the March monitoring. Groundwater infiltration during the frozen months typically results in chloride concentrations values in the Floodway Channel elevated compared to non-frozen conditions when there is a greater proportion of surface water contribution from the drains and precipitation. Temporary construction groundwater dewatering at the aqueduct during the November and December monthly monitoring contributed a greater volume of groundwater to the Floodway Channel. The chloride concentrations in the Floodway Channel at the Outlet were typically higher compared to those in the Red River at the Outlet, except during December, and resulted in slight chloride concentration increases of up to 9.4% in the Red River downstream of the Outlet compared to upstream of the Outlet. These slight increases are likely typical during frozen conditions as noted above the values in the Floodway Channel were generally within normal winter baseline values. The slight increases were not a concern as there is no CCME chloride criterion for the protection of freshwater aquatic life. As noted above the chloride concentrations measured in the Floodway Channel during March were higher compared to the other months even though there was no construction groundwater dewatering. Similar to what was discussed for sodium the higher chloride concentrations are potentially from road salts running into the Floodway Channel off of the numerous bridge crossings, as there were temperatures at and above the freezing point during the four days prior to the sampling event.

3.2.9 Iron

During the 2006 construction monitoring there were fewer occurrences of iron concentrations above the CCME criteria for the protection of freshwater aquatic life (Table NM4–2), compared to what was observed during the baseline and 2005 construction monitoring. As discussed in the baseline monitoring report the iron concentrations are likely influenced, in part, by the presence of high levels of suspended sediment in the samples, which contributes to the iron when the samples are acidified for analysis.

The iron concentrations measured at all of the Floodway Channel (0.58 to 0.81 mg/L) and Red River (0.62 to 0.93 mg/L) sample locations, as well as in the Seine River (0.59 mg/L), Centreline Drain (0.42 mg/L) and Cooks Creek Diversion (0.32 mg/L) exceeded the CCME iron criteria (0.3 mg/L) during the spring flood condition (Table NM4–2). These elevated iron concentrations are both not attributed to construction and not a concern because elevated iron concentrations (0.32 to 3.34 mg/L) were measured during the spring flood baseline.

The iron concentrations measured in the Floodway Channel were generally below the CCME criteria during the monthly monitoring representing the non-flood/unfrozen condition (Table NM4–2). Elevated iron concentrations above the CCME criteria were primarily measured in the Floodway Channel at the upstream end to the Keewatin weir location in September (0.35 to 0.85 mg/L) as well as downstream of the North Bibeau drain in June, July and August. The iron concentrations measured in the Red River at all of the locations at the Outlet (0.35 to 0.63 mg/L) exceeded the CCME criteria during May, September and October, and at a couple of locations in June during the non-flood/unfrozen condition. Again, these elevated iron concentrations are not a concern because elevated iron concentrations (0.29 to 1.56 mg/L) were measured in the Red River during the baseline monitoring.

The iron concentrations measured in the Floodway Channel were all below the CCME criteria, indicating no effects from construction, during the monthly monitoring representing the non-flood/frozen condition (Table NM4–2). Elevated iron concentrations above the CCME criteria were measured in the Red River at the Outlet (0.40 to 0.50 mg/L), however these were only measured during November.

3.2.10 Petroleum Hydrocarbons

The concentration of petroleum hydrocarbons analyzed (Benzene, Toluene, Ethyl-benzene, Xylenes (-o,-m,-p), Total Purgeable Hydrocarbons (C_5-C_{10}) and Total Extractable Hydrocarbons (C_{11}-C_{30})) were below detection limits in the Floodway Channel downstream of the construction area during each of the monthly monitoring events (Table NM4–3). Except for during the spring flood (April), there was no water upstream of the construction area to sample as a background condition, however, as the concentration of petroleum hydrocarbons analyzed downstream of construction were below detection limits, petroleum hydrocarbons were not a concern during 2006 construction.

There is no CCME criteria for the protection of aquatic life for TPH and TEH and the CCME criteria for Recreation and Aesthetics only indicates that oil or petrochemicals should not be present in concentrations that can be detected by visible film, sheen or discoloration or detectable odour. CCME has developed Canadian Wide Standards for hydrocarbon fractions F1 to F4 in soils and in the future will be developing standards for groundwater and surface water. To ensure that data is comparable to future criteria being developed, all future monitoring should be analyzed for hydrocarbon fractions F1 to F4 instead of analyzing samples for TPH and TEH.

3.2.11 Bacterial

The comparison of *E.Coli* concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flooding, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM4–32 to NM4–34. The laboratory analysis method used for Total Coliform and *E.Coli* testing was the Mcoli Blue membrane filtration analysis method, which has an upper detection limit of 1500 to 2000 CFU/100 ml. Samples in which the bacteria exceed the upper limit of 2000 CFU/100 ml are identified as overgrown.

E.Coli concentrations measured in the Floodway Channel were very similar to the baseline values during the monthly monitoring representing the flood condition (Figure NM4–32). Likewise, *E.Coli* concentrations measured in the Red River were similar to lower compared to the baseline values (0 to 200 CFU/100 ml), indicating no construction effects. Although there was a greater range of concentrations downstream of the Outlet (10 to 50 CFU/100 ml) compared to the background condition upstream of the Outlet (30 CFU/100 ml).

The *E.Coli* concentrations measured in the Floodway Channel varied along the length of the Channel and from month to month, during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM4–33). Whereas, *E.Coli* concentrations were typically similar to the baseline concentrations in the Floodway Channel during May and August, the concentrations ranged from below to well above baseline concentrations along the length of the Channel during the other months. *E.Coli* concentrations were particularly elevated during September with measurements of overgrown (>2000 CFU/100mL) in the Floodway Channel downstream of the Grande Pointe drain and at the Keewatin weir location. The elevated *E.Coli* concentrations, however, were not attributed to construction, as there were no construction activities that would release bacteria into the construction area. The *E.Coli* concentrations in the Red River downstream of Outlet compared to upstream ranged from lower in May and June, to similar with slight increases in July, September and October and much higher in August. The concentrations measured in the Red River, were generally within the range of baseline concentrations measured for the Red River, except the overgrown concentration in the Red River upstream of the Outlet in May. Because the elevated concentration was measured in the background source upstream of the Outlet it was not attributed to construction and therefore *E.Coli* was not a concern.

The *E.Coli* concentrations measured in the Floodway Channel were generally below the detection limit of 10 CFU/100mL and therefore below the summer baseline concentrations during the monthly monitoring representing the non-flood/frozen condition (Figure NM4–34). A few exceptions included the *E.Coli* concentrations measured in the Floodway Channel at the Keewatin weir (280 and 390 CFU/100mL) and Spring Hill weir (100 CFU/100mL and overgrown) locations during February and March, respectively. Excluding the overgrown value, these detectable *E.Coli* concentrations were within the baseline concentrations and therefore not a concern. The overgrown concentration was not attributed to construction, as there were no activities in March that would release bacteria into the Floodway Channel. The *E.Coli* concentrations in the Red River downstream of Outlet compared to upstream ranged from lower in February and November, to similar with slight increases in January and December and much higher in March. The concentrations measured in the Red River, were generally within the range of baseline concentrations measured for the Red River, except the elevated concentrations in the Red River during March. The elevated and increases in concentration were not attributed to construction, as noted above, there were no construction activities that would release bacteria to the Floodway Channel. Additionally, the concentrations in the Floodway at the Outlet were lower than in the Red River, which would have resulted in dilution if anything.

3.2.12 Herbicides

The concentration of herbicides analyzed (2,4-D, AMPA, Bromoxynil, Dicamba, Glyphosate, MCPA and Picloram) were below the laboratory analysis detection limits for the samples collected in the Floodway Channel upstream and downstream of the construction area during the flood condition (Table NM4–5). There were no herbicides applied during the 2006 construction year and therefore no other herbicide monitoring was conducted beyond the flood condition. Based on these results herbicides were not a concern during the 2006 construction year.

3.2.13 Polycyclic Aromatic Hydrocarbons (PAH's)

In response to potential concerns regarding PAH impacts, associated with the existing creosote treated piles at the CNR Sprague and Redditt bridge crossings, surface water samples were collected on August 6, 2006 from the Low Flow Channel upstream and downstream of these areas. Results of laboratory analysis of PAH's show that the concentrations of most parameters analyzed (15 of 22) were below detection limits (Table NM4–6). Parameters that had measurable concentrations included; Acenaphthylene, Carbazole, Dibenzofuran, Fluorene, Methyl naphthalenes, Napthalene and Phenanthrene. These measurable concentrations, however, were all well below applicable CCME criteria for the protection of freshwater aquatic life. Additionally, most of the measurable parameters that were present downstream of the bridge crossings were also present in the surface water sample collected upstream of the CNR Sprague bridge that represents background conditions. These results indicated that there were no concerns regarding PAH impacts to surface water from the creosote treated piles.

4.0 SUMMARY AND CONCLUSIONS

1. The 2006 construction surface water quality monitoring program was conducted from January to December 2006 in conjunction with the on-going construction activities that occurred from Station 4+400 to 33+750 and consisted of; Channel contracts (C-1, C-2, C3a, C3b, C4, C5 and C6a); bridge contracts for PTH 59 South (T4), Trans-Canada Highway (T5) and CNR Sprague (T8/T9); the Aqueduct (A1) and the West Dyke (W1, W2, W3 and W4).

2. Samples were collected from the Red River at the Inlet and Outlet, at 11 locations along the Floodway Channel including the upstream and downstream ends of the construction and revegetation zones, at 11 of the outfall drains flowing into the Floodway and at 2 drains along the West Dyke, when there was a sufficient amount of water to collect a sample.

3. At each sampling location, field data was obtained (conductivity, pH, temperature, EC and turbidity) and water samples were submitted to an accredited laboratory for testing (including inorganic parameters, turbidity, TSS and bacteria). These results were compared to the floodway baseline surface water data, based on sampling in April to August, 2005.

4. There were twelve (12) monthly monitoring events, with one conducted each month following precipitation events or at the flood peak during Red River flood conditions. There were thirteen (13) level I event-based monitoring events conducted between May and September, 2006 in response to precipitation events of 5 mm or greater. Additionally polycyclic aromatic hydrocarbon (PAH) sampling was conducted once in August to address potential PAH concerns associated with creosote treated piles at the two CNR bridge crossings.

5. Results of the level I event-based monitoring indicated negligible potential increases in TSS concentration in the Red River downstream of the Channel Outlet during the 2006 construction year. The only measurable TSS concentration increases occurred following rain events close to a 2 and 5 year rain event, with approximate TSS increases of 2.4% and 4.4%, respectively. These potential increases in sediment concentration in the Red River downstream of the Channel Outlet were well below the Provincial Guidelines of an allowable 10% increase. Therefore, no level II event-based monitoring was required during the 2006 construction year. Additionally, no spill event-based monitoring was required, as all of the spills that occurred within the contract areas during 2006 were contained and cleaned up with no run off to the Low Flow Channel.

6. During the 2006 spring flood condition slight concentration increases of total suspended solids (TSS), total phosphorus, ammonia and nitrate + nitrite-N were measured in the Floodway Channel downstream of construction, compared to the background conditions upstream of construction. These slight increases were not considered a concern as all of the observed concentrations, except for nitrate + nitrite-N, were below the spring flood baseline conditions indicating no effect from construction. The elevated nitrate + nitrite-N was not attributed to construction because no construction activities, such as fertilizer application, had occurred prior to the monitoring event. Additionally, there were no

parameter increases observed in the Red River downstream of the Outlet compared to the background surface water concentrations upstream of the Outlet.

7. During the 2006 non-flood unfrozen condition concentrations of several parameters, in particular electrical conductivity, potassium, sodium and chloride measured in the Floodway Channel, exceeded the summer baseline concentrations. These exceedances were not attributed to construction activities. Often the concentration downstream of construction was within the range of baseline concentrations, indicating no effect of construction. The elevated levels of conductivity, sodium and chloride above summer baseline concentrations were a result of the dry conditions having very little surface water contribution to the Low Flow Channel relative to natural groundwater infiltration and the temporary construction groundwater dewatering that began in August. The elevated potassium concentrations in the Floodway were not related to construction activities, as the fertilizer applied did not contain potassium.

8. During the 2006 non-flood unfrozen condition concentrations of several parameters, in particular TSS, phosphorus, ammonia and nitrate + nitrite-N, measured in the Red River downstream of the Outlet were higher compared to the background surface water concentrations upstream of the Outlet. These concentration increases downstream of the Outlet were not attributed to construction, as the parameter concentrations in the Floodway Channel at the Outlet were typically lower compared to the Red River and would have resulted in dilution if anything. Additionally the parameter concentrations were not a concern as they were generally within the summer baseline range of concentrations measured in the Red River.

9. *E.Coli* concentrations measured during the 2006 non-flood unfrozen condition varied from month to month. Some months the concentrations were higher in the Red River downstream of the Outlet compared to the background surface water concentrations upstream of the Outlet. These concentration increases downstream of the Outlet were not attributed to construction, as the *E.Coli* concentrations in the Floodway Channel at the Outlet were typically lower compared to the Red River and the concentrations were generally within the summer baseline range measured in the Red River.

10. During the 2006 non-flood frozen condition concentrations of most parameters measured in the Floodway Channel, excluding ammonia and potassium, were within the winter baseline concentrations or the summer baseline concentrations if there was no winter baseline. The ammonia exceedances were not attributed to construction as there were no activities from January to March, such as fertilizer application, that would have contributed to the elevated concentration of ammonia. Additionally these elevated concentrations did not result in an exceedance of the CCME un-ionized ammonia criteria. The elevated potassium concentrations in the Floodway were not related to construction activities, as the fertilizer applied over the summer did not contain potassium.

11. During the 2006 non-flood frozen condition, primarily the November and December monthly monitoring events, concentrations of most parameters measured in the Red River downstream of the Outlet were higher compared to the background surface water concentrations upstream of the Outlet, excluding TSS and phosphorus. These concentration increases downstream of the Outlet were not attributed to construction, as the parameter concentrations in the Floodway Channel were typically within baseline

concentrations and some were lower compared to the Red River such that they would have resulted in dilution if anything.

5.0 RECOMMENDATIONS

Based on the results of the 2006 Construction monitoring events, recommendations and refinements for the ongoing monitoring should include the following;

- Continued monitoring at all of the current sample locations (including the drain locations upstream of the perimeter ditching when a drain is within an area of construction activities), following the established Monthly monitoring schedule, with Event-based monitoring conducted as required for the 2007 surface water monitoring program.

- The Event-based monitoring in 2007 should follow the protocol that was revised in September 2006, based on the results of a review of precipitation levels and measured TSS increases as outlined in the October, 2 2006 Surface Water Program – Precipitation Review Memorandum (File No: 05-1100-01.19.06.03; Appendix D). Level I Event-based monitoring was changed to a rainfall criteria of 10 mm instead of 5 mm, with no sampling conducted for precipitation levels <10 mm. Additionally, Level II Event-based monitoring was modified to only be conducted if the results of the Level I Event-based monitoring indicated that TSS increases were approaching the CCME criteria. The protocol should be reviewed again during the 2007 monitoring program and revised if required as more construction contracts begin.

- All future hydrocarbon monitoring should be analyzed for hydrocarbon fractions F1 to F4 to ensure that data is comparable to future criteria being developed, instead of analyzing samples for TPH and TEH. CCME has developed Canadian Wide Standards for hydrocarbon fractions F1 to F4 in soils and in the future will be developing standards for groundwater and surface water, whereas there is no CCME criteria for the protection of aquatic life for TPH and TEH.

6.0 REFERENCES

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TABLES

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
Monthly							
CON D/S	Floodway Channel - Station 19+900	17-Jan-06	6.90	1628	1.7	3.97	
		27-Feb-06	7.70	1673	0.9	4.27	
		8-Mar-06	7.66	1502	3.1	1.4	
		20-Apr-06	8.05	435	14.7	120	
		27-May-06	8.27	849	18.6	16.29	
		29-Jun-06	7.87	1239	23.5	24.26	
	- Station 22+200	25-Jul-06	8.22	1278	24.7	22.18	
		6-Aug-06	8.26	1201	19.8	12.12	
	- Station 25+750	18-Sep-06	8.30	1164	11.1	14.3	
		17-Oct-06	8.40	1483	4.2	17.03	
	- Station 33+800	24-Nov-06	8.28	1491	1.7	8.74	
		14-Dec-06	7.79	1567	0.6	4.85	
CON U/S	Floodway Channel - Station 4+400	17-Jan-06	-	-	-	-	CNM - No flow
		27-Feb-06	-	-	-	-	CNM - No flow
		8-Mar-06	-	-	-	-	CNM - No flow
		20-Apr-06	8.02	426	14.1	100.8	
	- Station 7+650	27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow
		14-Dec-06	-	-	-	-	CNM - No flow
VEG D/S	Floodway Channel - Station 14+400	25-Jul-06	8.39	778	25.6	32.26	
		6-Aug-06	8.33	866	18.6	30.66	
		18-Sep-06	8.40	849	13.5	27.53	
	- Station 20+500	17-Oct-06	8.50	1340	4.5	33.42	
		24-Nov-06	5.73	1575	2.2	1.53	
		14-Dec-06	-	-	-	-	CNM - No Active Re-vegetation
VEG U/S	Floodway Channel - Station 7+650	25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow
		14-Dec-06	-	-	-	-	CNM - No flow
S-01	Red River - Upstream of Inlet	17-Jan-06	-	-	-	-	CNM - No river water diverted
		27-Feb-06	-	-	-	-	CNM - No river water diverted
		8-Mar-06	-	-	-	-	CNM - No river water diverted
		20-Apr-06	8.00	441	13.2	120	
		27-May-06	-	-	-	-	CNM - No river water diverted
		29-Jun-06	-	-	-	-	CNM - No river water diverted

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-01	Red River - Upstream of Inlet	25-Jul-06	-	-	-	-	CNM - No river water diverted
		6-Aug-06	-	-	-	-	CNM - No river water diverted
		18-Sep-06	-	-	-	-	CNM - No river water diverted
		17-Oct-06	-	-	-	-	CNM - No river water diverted
		24-Nov-06	-	-	-	-	CNM - No river water diverted
		14-Dec-06	-	-	-	-	CNM - No river water diverted
S-02	Red River - Upstream of Inlet (replicate of 1)	17-Jan-06	-	-	-	-	CNM - No river water diverted
		27-Feb-06	-	-	-	-	CNM - No river water diverted
		8-Mar-06	-	-	-	-	CNM - No river water diverted
		20-Apr-06	7.94	433	13.8	118.7	
		27-May-06	-	-	-	-	CNM - No river water diverted
		29-Jun-06	-	-	-	-	CNM - No river water diverted
		25-Jul-06	-	-	-	-	CNM - No river water diverted
		6-Aug-06	-	-	-	-	CNM - No river water diverted
		18-Sep-06	-	-	-	-	CNM - No river water diverted
		17-Oct-06	-	-	-	-	CNM - No river water diverted
		24-Nov-06	-	-	-	-	CNM - No river water diverted
		14-Dec-06	-	-	-	-	CNM - No river water diverted
S-03	Red River - Upstream of Inlet (replicate of 1)	17-Jan-06	-	-	-	-	CNM - No river water diverted
		27-Feb-06	-	-	-	-	CNM - No river water diverted
		8-Mar-06	-	-	-	-	CNM - No river water diverted
		20-Apr-06	7.93	439	13.7	119.1	
		27-May-06	-	-	-	-	CNM - No river water diverted
		29-Jun-06	-	-	-	-	CNM - No river water diverted
		25-Jul-06	-	-	-	-	CNM - No river water diverted
		6-Aug-06	-	-	-	-	CNM - No river water diverted
		18-Sep-06	-	-	-	-	CNM - No river water diverted
		17-Oct-06	-	-	-	-	CNM - No river water diverted
		24-Nov-06	-	-	-	-	CNM - No river water diverted
		14-Dec-06	-	-	-	-	CNM - No river water diverted
S-04	Floodway Channel - Downstream of Inlet	17-Jan-06	-	-	-	-	CNM - No river water diverted
		27-Feb-06	-	-	-	-	CNM - No river water diverted
		8-Mar-06	-	-	-	-	CNM - No river water diverted
		20-Apr-06	8.02	436	14.0	119.3	
		27-May-06	-	-	-	-	CNM - No river water diverted
		29-Jun-06	-	-	-	-	CNM - No river water diverted
		25-Jul-06	-	-	-	-	CNM - No river water diverted
		6-Aug-06	-	-	-	-	CNM - No river water diverted
		18-Sep-06	-	-	-	-	CNM - No river water diverted
		17-Oct-06	-	-	-	-	CNM - No river water diverted
		24-Nov-06	-	-	-	-	CNM - No river water diverted
		14-Dec-06	-	-	-	-	CNM - No river water diverted

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-05	Seine River Syphon Overflow	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	8.03	436	14.2	119.5	
U/S	- Upstream of Perimeter Ditches	20-Apr-06	8.01	424	15.2	89.55	
		27-May-06	-	-	-	-	CNM - No flow
U/S		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
U/S		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
U/S		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
U/S		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
U/S		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
U/S		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow, frozen
U/S		24-Nov-06	-	-	-	-	CNM - No flow, frozen
		14-Dec-06	-	-	-	-	CNM - No flow, frozen
U/S		14-Dec-06	-	-	-	-	CNM - No flow, frozen
S-06	Grande Pointe Diversion Drop Structure	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	8.28	470	15.3	40.53	
U/S	- Upstream of Perimeter Ditches	20-Apr-06	8.10	468	14.5	44.21	
		27-May-06	-	-	-	-	CNM - No flow
U/S		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
U/S		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
U/S		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
U/S		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
U/S		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
U/S		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow
U/S		24-Nov-06	-	-	-	-	CNM - No flow
		14-Dec-06	-	-	-	-	CNM - No flow
U/S		14-Dec-06	-	-	-	-	CNM - No flow

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-07	Centreline Drop Structure	17-Jan-06	7.10	*	0.2	6.69	
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	8.35	1155	15.9	65.74	
U/S	- Upstream of Perimeter Ditches	20-Apr-06	9.07	689	15.3	4.9	
		27-May-06	-	-	-	-	CNM - No flow
U/S		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
U/S		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
U/S		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
U/S		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
U/S		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
U/S		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow, frozen
U/S		24-Nov-06	-	-	-	-	CNM - No flow, frozen
		14-Dec-06	-	-	-	-	CNM - No flow, frozen
U/S		14-Dec-06	-	-	-	-	CNM - No flow, frozen
S-08	Deacon Reservoir Drain	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	7.66	1685	8.3	0.79	Aqueduct Dewatering pumping at sample time
		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow
		14-Dec-06	-	-	-	-	CNM - No flow
S-09	Cooks Creek Diversion Drop Structure	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	8.40	182.9	12.7	52.42	
		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow, frozen
U/S	- Upstream of Perimeter Ditches	24-Nov-06	-	-	-	-	CNM - No flow, frozen
		14-Dec-06	-	-	-	-	CNM - No flow, frozen
U/S		14-Dec-06	-	-	-	-	CNM - No flow, frozen

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-10	North Bibeau Drain Drop Structure	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	8.20	1244	16.7	2.51	
		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	8.00	599	11.2	1.52	
U/S	- Upstream of Perimeter Ditches	18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
U/S		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow, frozen
U/S		24-Nov-06	-	-	-	-	CNM - No flow, frozen
		14-Dec-06	-	-	-	-	CNM - No flow, frozen
U/S		14-Dec-06	-	-	-	-	CNM - No flow, frozen
S-11	Country Villa Estates Drain	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	-	-	-	-	CNM
		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow
		14-Dec-06	-	-	-	-	CNM - No flow
S-12	Kildare Trunk-Transcona Storm Sewer Outlet	17-Jan-06	-	-	-	-	CNM - No flow
		27-Feb-06	-	-	-	-	CNM - No flow
		8-Mar-06	-	-	-	-	CNM - No flow
		20-Apr-06	-	-	-	-	CNM - Water level above downstream end of culvert
		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow
		14-Dec-06	-	-	-	-	CNM - No flow
S-13	Floodway Channel - D/S of Grande Pointe Drain	17-Jan-06	7.10	*	0.7	7.96	
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	8.06	435	16.4	115.9	
		27-May-06	8.35	526	17.6	25.81	
		29-Jun-06	7.94	864	23.8	45.42	

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-13	Floodway Channel - D/S of Grande Pointe Drain	25-Jul-06	8.38	905	24.3	31.92	
		6-Aug-06	8.02	849	17.8	44.93	
		18-Sep-06	8.40	800	12.4	42.59	
		17-Oct-06	8.50	643	4.6	21.41	
		24-Nov-06	6.83	796	2.0	4.9	
		14-Dec-06	6.80	903	0.6	7.73	
S-14	Floodway Channel - D/S of North Bibeau Drain	17-Jan-06	7.10	1016	0.6	2.54	
		27-Feb-06	7.85	1405	0.7	4.72	
		8-Mar-06	7.61	1252	0.7	3.54	
		20-Apr-06	8.03	440	14.3	119.5	
		27-May-06	8.23	1023	19.2	30.21	
		29-Jun-06	8.13	495	24.6	197.5	
		25-Jul-06	8.28	1208	26.3	39.02	
		6-Aug-06	8.33	1211	20.4	15.54	
		18-Sep-06	8.40	1254	12.0	52.34	
		17-Oct-06	8.50	1400	4.7	29.77	
		24-Nov-06	6.03	1352	2.8	4.47	
		14-Dec-06	7.57	1530	1.2	3.67	
S-21	Floodway Channel - Keewatin Weir	17-Jan-06	7.30	1645	0.8	10.29	
		27-Feb-06	7.75	1530	1.4	10.86	
		8-Mar-06	7.56	1793	1.7	7.3	
		20-Apr-06	8.00	295	14.4	118.1	
		27-May-06	8.13	1342	19.6	13.31	
		29-Jun-06	7.95	1935	24.8	12.58	
		25-Jul-06	8.12	1293	22.0	16.22	
		6-Aug-06	7.74	840	17.9	9.43	
		18-Sep-06	8.20	542	11.0	60.88	
		17-Oct-06	8.50	1354	4.1	18.36	
		24-Nov-06	6.23	1404	2.0	5.34	
		14-Dec-06	7.76	1609	1.1	3.99	
S-22	Springfield Road Drain Drop Structure	17-Jan-06	7.10	1576	1.7	2.41	
		27-Feb-06	7.30	1698	0.3	35.86	
		8-Mar-06	7.30	1748	2.7	34.56	
		20-Apr-06	8.10	618	11.8	2.37	
		27-May-06	8.24	909	18.0	2.84	
		29-Jun-06	7.74	581	20.8	1.71	
		25-Jul-06	7.33	574	22.0	1.52	
		6-Aug-06	7.38	601	22.3	3.06	
		18-Sep-06	7.23	593	12.4	9.58	
		17-Oct-06	7.57	616	3.9	6	
		24-Nov-06	-	-	-	-	CNM - Destroyed, ditch diked off - No flow
U/S	- Upstream of Perimeter Ditches	24-Nov-06	-	-	-	-	CNM - No flow, frozen
		14-Dec-06	-	-	-	-	CNM - Destroyed, ditch diked off - No flow
U/S		14-Dec-06	-	-	-	-	CNM - No flow, frozen

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-23	Floodway Channel - Spring Hill Weir	17-Jan-06	7.40	1598	1.2	7.74	
		27-Feb-06	7.75	1587	0.3	10.62	
		8-Mar-06	7.66	1695	3.4	8.32	
		20-Apr-06	7.90	166.3	15.1	127.2	
		27-May-06	8.34	1211	18.0	14.28	
		29-Jun-06	8.26	1410	21.8	4.1	
		25-Jul-06	8.57	1209	23.6	11.18	
		6-Aug-06	7.74	1074	22.4	10.70	
		18-Sep-06	7.89	1073	11.4	26.54	
		17-Oct-06	8.36	1348	3.3	13.18	
		24-Nov-06	7.76	1354	1.5	10.45	
		14-Dec-06	7.65	1410	0.7	7.97	
S-25	Floodway Channel - Dunning Weir	17-Jan-06	7.40	1455	1.6	14.49	
		27-Feb-06	7.86	1488	-0.3	12.31	
		8-Mar-06	7.50	1947	0.1	13.51	
		20-Apr-06	8.00	168	15.2	135.9	
		27-May-06	8.33	1012	18.7	17.69	
		29-Jun-06	8.36	1039	22.4	11.13	
		25-Jul-06	8.89	1123	25.3	10.91	
		6-Aug-06	8.00	960	22.8	10.84	
		18-Sep-06	8.35	1226	12.1	31.61	
		17-Oct-06	8.58	1212	3.2	15.96	
		24-Nov-06	8.27	1417	2.0	12.32	
		14-Dec-06	7.83	1512	1.0	7.50	
S-26	Skholny Drain Drop Structure	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	8.20	296	16.0	4.39	
		27-May-06	8.51	809	18.4	8.89	
		29-Jun-06	7.82	478	20.5	5.63	
		25-Jul-06	7.57	1016	22.0	21.98	
		6-Aug-06	7.72	691	24.4	157.5	
		18-Sep-06	7.08	751	11.7	21.06	
		17-Oct-06	8.18	432	3.1	2.26	
		24-Nov-06	8.15	546	1.0	1.78	
		14-Dec-06	-	-	-	-	CNM - No flow, frozen
S-27	Ashfield Drain Drop Structure	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	8.30	585	16.6	0.66	
		27-May-06	7.64	913	18.5	3.42	
		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow, frozen
		14-Dec-06	-	-	-	-	CNM - No flow, frozen

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-28	Floodway Channel - PTH #44 Weir	17-Jan-06	7.30	1257	2.0	6.33	
		27-Feb-06	7.75	1373	0.2	8.18	
		8-Mar-06	7.58	1884	0.5	6.9	
		20-Apr-06	7.90	313.5	15.3	135	
		27-May-06	8.53	949	20.0	10.83	
		29-Jun-06	8.02	988	22.0	6.44	
		25-Jul-06	7.86	1157	24.5	8.09	
		6-Aug-06	7.63	1153	21.3	9.72	
		18-Sep-06	8.35	1087	10.5	9.61	
		17-Oct-06	8.25	1163	3.3	7.08	
		24-Nov-06	8.00	1389	1.0	6.29	
		14-Dec-06	7.79	1514	0.2	6.24	
S-30	Red River - Downstream of Outlet (500 m)	17-Jan-06	7.40	1059	0.8	20.26	
		27-Feb-06	7.88	1041	2.4	12.1	
		8-Mar-06	7.60	1141	2.8	10.14	
		20-Apr-06	7.80	329.1	14.8	138.4	
		27-May-06	8.06	865	18.9	89.8	
		29-Jun-06	8.54	909	24.8	48.13	
		25-Jul-06	7.92	877	26.2	24.66	
		6-Aug-06	8.42	891	23.7	41.37	
		18-Sep-06	8.29	897	15.8	57.93	
		17-Oct-06	8.43	1012	5.4	14.58	
		24-Nov-06	8.43	1088	1.4	33.08	
		14-Dec-06	8.05	1392	0.2	15.52	
S-31	Red River - Downstream of Outlet (1000 m)	17-Jan-06	7.30	1053	0.5	15.1	
		27-Feb-06	7.80	1032	2.0	14.3	
		8-Mar-06	7.74	1117	3.6	11.31	
		20-Apr-06	7.80	335.4	15.3	141.4	
		27-May-06	8.04	857	19.4	110.2	
		29-Jun-06	8.50	909	24.8	34.84	
		25-Jul-06	7.84	881	26.2	25.32	
		6-Aug-06	8.46	885	24.2	39.46	
		18-Sep-06	8.26	900	15.0	54.93	
		17-Oct-06	8.44	1003	5.3	31.74	
		24-Nov-06	8.20	1123	1.0	33.21	
		14-Dec-06	7.92	1340	0.8	14.76	
S-32	Red River - Downstream of Outlet (2000 m)	17-Jan-06	7.40	1050	0.5	15.85	
		27-Feb-06	7.84	1020	1.2	12.4	
		8-Mar-06	7.71	1101	5.2	11.34	
		20-Apr-06	7.80	173.3	14.7	136.1	
		27-May-06	7.96	859	19.7	97.57	
		29-Jun-06	8.47	912	24.5	38.31	
		25-Jul-06	*	880	25.7	27.86	
		6-Aug-06	8.51	856	24.2	48.8	
		18-Sep-06	8.22	897	14.8	*	
		17-Oct-06	8.45	1014	5.3	19.29	
		24-Nov-06	8.33	1095	1.4	27.96	
		14-Dec-06	8.08	1368	0.8	13.44	

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-33	Red River - Downstream of Outlet (3000 m)	17-Jan-06	7.50	1088	0.4	16.03	
		27-Feb-06	7.70	1020	1.6	12.58	
		8-Mar-06	7.76	1105	5.6	11.76	
		20-Apr-06	7.80	336	14.6	140.7	
		27-May-06	7.97	857	19.2	95.2	
		29-Jun-06	8.45	910	24.2	42.56	
		25-Jul-06	8.00	878	25.5	27.24	
		6-Aug-06	8.44	881	25.6	40.72	
		18-Sep-06	8.31	898	15.0	50.58	
		17-Oct-06	8.48	1007	5.3	17.61	
		24-Nov-06	8.27	1108	1.2	31.72	
		14-Dec-06	8.14	1343	0.6	14.64	
S-34	Red River - Upstream of Outlet	17-Jan-06	7.50	1064	0.4	24.2	
		27-Feb-06	7.73	1028	1.4	12.54	
		8-Mar-06	7.72	1099	2.6	10.54	
		20-Apr-06	7.90	359.8	15.1	152.9	
		27-May-06	8.02	841	18.7	103.7	
		29-Jun-06	8.52	910	24.6	38.23	
		25-Jul-06	8.50	878	26.3	25.69	
		6-Aug-06	8.54	883	25.9	39.82	
		18-Sep-06	8.29	891	15.6	57.33	
		17-Oct-06	8.46	1001	5.3	18.28	
		24-Nov-06	8.20	1073	1.0	34.77	
		14-Dec-06	8.06	1311	0.6	15.84	
S-35	West Dyke - Downstream of Manness Drain	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	7.82	515	9.7	64.2	
		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow, frozen
		14-Dec-06	-	-	-	-	CNM - No flow, frozen
S-36	West Dyke - Downstream of Domain Drain	17-Jan-06	-	-	-	-	CNM - No flow, frozen
		27-Feb-06	-	-	-	-	CNM - No flow, frozen
		8-Mar-06	-	-	-	-	CNM - No flow, frozen
		20-Apr-06	7.92	546	7.6	5.83	
		27-May-06	-	-	-	-	CNM - No flow
		29-Jun-06	-	-	-	-	CNM - No flow
		25-Jul-06	-	-	-	-	CNM - No flow
		6-Aug-06	-	-	-	-	CNM - No flow
		18-Sep-06	-	-	-	-	CNM - No flow
		17-Oct-06	-	-	-	-	CNM - No flow
		24-Nov-06	-	-	-	-	CNM - No flow, frozen
		14-Dec-06	-	-	-	-	CNM - No flow, frozen

TABLE NM4-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
Level I							
CON D/S	Floodway Channel - Station 19+900	9-May-06	8.15	699	16.4	63.13	
		27-May-06	8.27	849	18.6	16.29	
		28-May-06	8.26	834	19.8	45.57	
		5-Jun-06	8.46	707	23.5	21.26	
	- Station 22+200	25-Jul-06	8.22	1278	24.7	22.18	
		26-Jul-06	8.15	1275	24.8	22.66	
		3-Aug-06	8.14	1274	22.3	13.93	
		4-Aug-06	8.15	1241	20.9	14.27	
		5-Aug-06	8.15	1187	20.3	16.44	
		10-Aug-06	8.22	791	21.2	292.6	
		12-Aug-06	7.85	511	20.7	170.9	
		25-Aug-06	8.13	934	19.1	15.69	
	- Station 25+750	17-Sep-06	7.44	1149	16.1	11.01	
CON U/S	Floodway Channel - Station 4+400	9-May-06	7.95	877	20.1	56.13	
	- Station 7+650	27-May-06	-	-	-	-	CNM - No flow
		28-May-06	7.73	755	18.7	56.44	
		5-Jun-06	7.86	600	22.9	36.8	
		25-Jul-06	-	-	-	-	CNM - No flow
		26-Jul-06	-	-	-	-	CNM - No flow
		3-Aug-06	-	-	-	-	CNM - No flow
		4-Aug-06	-	-	-	-	CNM - No flow
		5-Aug-06	-	-	-	-	CNM - No flow
		10-Aug-06	-	-	-	-	CNM - No flow
		12-Aug-06	-	-	-	-	CNM - No flow
		25-Aug-06	-	-	-	-	CNM - No flow
		17-Sep-06	-	-	-	-	CNM - No flow
S-31	Red River - Downstream of Outlet (1000 m)	9-May-06	8.23	747	15.2	101	
		27-May-06	8.04	857	19.4	110.2	
		28-May-06	8.11	793	18.2	86.82	
		5-Jun-06	8.22	842	22.1	66.48	
		25-Jul-06	7.84	881	26.2	25.32	
		26-Jul-06	8.39	913	26.0	29.51	
		3-Aug-06	8.43	903	24.4	35.52	
		4-Aug-06	8.40	911	24.3	38.68	
		5-Aug-06	8.08	886	23.7	41.21	
		10-Aug-06	8.46	718	22.7	34.65	
		12-Aug-06	8.48	731	23.2	44.13	
		25-Aug-06	8.37	823	21.2	51.52	
		17-Sep-06	7.97	856	17.9	38.31	

Notes:
"-" = No Data
 * = Equipment failure
E.C. = Electrical Conductivity
CNM = Could Not Monitor

TABLE NM4-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia (3)	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
		Parameter (1)																												
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003*	*-*	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001*	*0.001*	*5*	*5*	*0.2*	*1*	*-*
CCME (2)																														
Freshwater Aquatic Life		(4)	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	(5)	-	-	-
Monthly																														
CON D/S	17-Jan-06	1.7	7.78	1520	308	376	<0.6	<0.4	613	74	0.3	459	0.006	0.273	0.002	0.027	103	86.5	7.11	108	0.22	0.0380	9	0.013	0.010	1020	<5	0.38	7	96.2
	27-Feb-06	4.0	7.59	1580	318	388	<0.6	<0.4	639	82	0.3	488	0.007	0.290	0.001	1.76	103	92.6	7.88	118	0.03	0.0531	6	0.011	0.009	1090	6	0.5	4	95.5
	8-Mar-06	1.7	8.15	1350	267	326	<0.6	<0.4	549	77	0.5	367	0.003	0.246	0.004	0.040	91.1	78.0	6.94	107	<0.01	0.0383	3	0.008	0.007	887	<5	0.4	3	104
	20-Apr-06	110	8.23	411	121	148	<0.6	<0.4	178	14	0.2	68	0.254	0.185	0.009	2.26	43.3	17.1	7.26	13.6	**0.58**	0.144	9	0.363	0.253	246	120	1.3	10	98.6
	27-May-06	13	8.57	855	240	270	11.1	<0.4	387	33	0.2	196	0.030	0.063	0.008	0.025	76.9	47.4	8.23	38.2	0.12	0.0505	12	0.063	0.042	543	14	1.0	13	97.9
	29-Jun-06	24	8.48	1140	240	276	8.0	<0.4	443	64	0.3	276	0.014	0.040	0.006	0.069	72.6	63.6	7.63	77.7	0.20	0.0420	7	0.058	0.016	705	24	0.7	7	101
	25-Jul-06	22	8.45	1250	232	270	6.3	<0.4	461	69	0.4	379	0.005	0.030	0.004	0.012	72.3	68.2	6.95	90.9	0.26	0.0158	6	0.036	0.012	825	20	0.5	6	92.1
	6-Aug-06	75	8.52	1190	220	252	7.9	<0.4	489	70	0.4	357	0.020	0.023	0.003	0.021	72.8	74.6	6.92	102	0.07	0.0104	5	0.023	0.010	815	96	0.3	5	104
	18-Sep-06	15	8.33	1100	198	237	2.2	<0.4	494	59	0.4	319	0.012	0.042	0.002	<0.005	68.6	62.7	8.3	83.5	**0.35**	0.0261	5	0.023	0.011	741	11	0.4	5	101
	17-Oct-06	14	8.29	1530	258	315	<0.6	<0.4	610	96	0.2	469	<0.001	0.054	0.001	0.013	89.0	94.2	7.20	115	0.26	0.0146	8	0.019	0.006	1020	12	0.3	6	98.5
	24-Nov-06	6.8	8.26	1360	274	325	4.5	<0.4	509	88	0.4	378	0.005	0.020	0.000	0.018	77.7	76.5	6.74	100	0.13	0.0158	5	0.017	0.006	892	<5	0.3	5	92.7
	14-Dec-06	2.8	8.02	1370	288	351	<0.6	<0.4	526	77	0.3	346	0.001	0.069	0.001	0.033	83.8	76.9	6.11	99.7	0.15	0.0214	4	0.012	0.005	862	<5	0.3	5	99.1
CON U/S	20-Apr-06	85	8.19	401	120	146	<0.6	<0.4	171	15	0.3	68	0.268	0.145	0.006	2.08	41.2	16.6	7.15	12.9	**0.58**	0.109	10	0.331	0.239	242	91	2.4	10	94.8
VEG D/S	25-Jul-06	32	8.65	760	218	243	11.3	<0.4	328	37	0.3	133	0.008	0.033	0.007	0.015	58.1	44.4	8.67	36.8	0.30	0.0209	12	0.048	0.018	449	30	0.9	13	102
	6-Aug-06	32	8.59	811	188	211	8.9	<0.4	338	49	0.4	181	0.031	0.032	0.004	0.010	54.0	49.5	9.30	48.0	0.26	0.0273	13	0.043	0.014	504	24	1.3	14	102
	18-Sep-06	23	8.44	830	193	226	5	<0.4	346	42	0.4	200	0.018	0.035	0.002	<0.005	62.3	46.3	9.5	43.3	**0.36**	0.0189	12	0.042	0.013	519	16	1	13	97.9
	17-Oct-06	26	8.35	1350	237	283	3.4	<0.4	518	87	0.4	389	<0.001	0.075	0.002	0.021	80.9	76.6	7.04	105	**0.31**	0.0183	8	0.026	0.006	888	23	0.4	6	98.4
	24-Nov-06	4.7	8.26	1530	255	311	<0.6	<0.4	563	98	0.4	485	0.002	<0.003	0.000	<0.005	84.9	85.2	8.05	116	0.07	0.0120	6	0.015	0.010	1030	<5	0.5	8	91.8
S-01	20-Apr-06	110	8.20	409	120	147	<0.6	<0.4	177	15	0.2	72	0.264	0.196	0.008	2.32	42.6	17.1	7.22	13.5	**0.62**	0.149	10	0.358	0.249	250	120	1.3	10	95.5
S-02	20-Apr-06	110	8.20	410	120	147	<0.6	<0.4	178	15	0.3	72	0.261	0.198	0.008	2.27	42.8	17.2	7.28	13.6	**0.66**	0.143	10	0.359	0.243	249	130	1.4	9	96.0
S-03	20-Apr-06	110	8.19	410	121	147	<0.6	<0.4	179	14	0.2	71	0.280	0.194	0.008	2.31	43.3	17.3	7.27	13.7	**0.62**	0.150	10	0.362	0.244	249	130	1.3	10	98.0
S-04	20-Apr-06	110	8.19	411	121	147	<0.6	<0.4	178	15	0.2	71	0.284	0.193	0.008	2.29	43.0	17.1	7.22	13.4	**0.66**	0.147	9	0.360	0.248	249	120	1.4	10	96.3
S-05	20-Apr-06	110	8.18	408	120	147	<0.6	<0.4	176	15	0.2	74	0.255	0.186	0.007	2.29	42.6	16.9	7.26	13.4	**0.59**	0.134	9	0.345	0.244	252	120	1.3	10	94.2
U/S	20-Apr-06	75	8.20	402	119	145	<0.6	<0.4	170	16	0.2	76	0.268	0.149	0.007	2.25	41.2	16.3	7.15	13.0	**0.48**	0.0780	10	0.326	0.244	250	70	1.2	10	90.5
S-06	20-Apr-06	32	8.43	449	168	196	4.1	<0.4	205	17	0.3	47	0.147	0.038	0.003	1.18	47.1	21.3	6.12	12.5	0.26	0.0258	11	0.200	0.150	257	22	1.5	11	97.9
U/S	20-Apr-06	35	8.40	442	165	195	3.2	<0.4	201	17	0.3	47	0.156	0.046	0.003	1.23	46.6	20.6	6.01	12.2	0.27	0.0275	11	0.185	0.150	254	24	1.6	11	96.7
S-07	17-Jan-06	7.1	7.51	2770	673	821	<0.6	<0.4	1550	31	0.3	1120	0.034	0.314	0.001	0.121	196	257	8.05	139	**0.51**	2.11	<1	0.060	0.027	2150	5	1.42	<1	98.7
	20-Apr-06	55	8.53	1160	330	380	10.9	<0.4	496	78	0.3	211	0.016	0.096	0.009	0.013	64.1	81.5	8.35	61.0	**0.42**	0.486	14	0.133	0.036	702	71	1.6	14	96.8
U/S	20-Apr-06	3.9	9.00	669	225	220	26.9	<0.4	316	19	0.3	126	0.014	0.008	0.002	<0.005	48.5	47.4	7.27	25.6	0.11	0.0239	14	0.059	0.043	409	5	1.4	15	99.3
S-08	20-Apr-06	2.0	8.05	1650	326	398	<0.6	<0.4	686	76	0.4	567	<0.001	0.316	0.006	<0.005	104	104	7.26	117	0.08	0.0390	2	0.009	0.008	1170	<5	0.4	2	92.8
S-09	20-Apr-06	40	8.38	437	221	262	3.5	<0.4	236	<9	0.2	15	0.025	0.038	0.002	0.014	57.2	22.6	3.23	5.81	**0.32**	0.0306	14	0.061	0.018	236	41	0.8	12	107
S-10	20-Apr-06	2.1	8.52	1240	282	324	9.8	<0.4	581	41	0.4	416	0.016	0.006	0.001	0.007	78.3	93.7	10.5	54.1	0.08	0.0442	15	0.055	0.045	863	<5	1.1	13	92.0
	18-Sep-06	1.8	7.93	566	179	219	<0.6	<0.4	251	25	0.3	94	0.035	0.008	0.000	<0.005	45.3	33.4	7.09	16.7	0.14	0.0459	11	0.055	0.052	329	<5	0.7	10	94.4
S-13	17-Jan-06	10	7.49	2630	807	984	<0.6	<0.4	1530	159	0.3	649	0.010	0.748	0.002	0.039	248	222	15.9	148	0.22	4.15	<1	0.086	0.042	1930	12	1.7	<1	110
	20-Apr-06	100	8.24	413	124	151	<0.6	<0.4	177	15	0.3	71	0.267	0.171	0.009	2.15	42.6	17.2	7.03	13.2	**0.60**	0.130	10	0.352	0.242	250	120	1.4	10	94.5
	27-May-06	21	8.61	528	267	299	13.1	<0.4	276	14	<0.1	16	0.056	0.071	0.009	0.013	65.1	27.7	3.33	11.2	0.15	0.0347	13	0.108	0.059	297	19	0.9	15	101
	29-Jun-06	37	8.57	786	220	247	10.2	<0.4	329	43	0.3	149	0.041	0.031	0.005	<0.005	64.2	41.0	7.96	40.6	0.18	0.0263	12	0.068	0.024	478	26	1.0	12	98.0
	25-Jul-06	30	8.64	883	173	192	9.2	<0.4	333	62	0.3	193	0.006	0.053	0.011	0.026	51.6	49.5	10.6	54.1	**0.33**	0.0236	16	0.050	0.015	524	28	1.1	14	100
	6-Aug-06	45	8.62	826	167	185	9.2	<0.4	336	62	0.4	190	0.058	0.056	0.007	0.011	50.0	51.2	10.4	57.0	0.29	0.0288	15	0.060	0.013	521	35	1.3	15	104
	18-Sep-06	40	8.28	767	199	243	<0.6	<0.4	329	28	0.4	188	0.027	0.181	0.008	0.009	62.8	41.7	10.2	32.5	**0.45**	0.034	13	0.074	0.017	483	37	1.4	13	94.6
	17-Oct-06	12	8.40	649	215	254	4.3	<0.4	272	26	0.4	111	0.001	0.051	0.002	0.238	52.7	34.2	6.99	26.8	0.24	0.0119	12	0.027	0.011	388	11	0.8	12	91.9
	24-Nov-06	5.6	8.21	706	327	399	<0.6	<0.4	308	25	0.3	36	0.011	0.020	0.000	0.023	65.0	35.4	6.29	22.8	0.15	0.0115	13	0.029	0.020	387	<5	0.8	12	91.2
	14-Dec-06	6.8	7.95	779	378	461	<0.6	<0.4	381	21	0.2	26	0.009	0.058	0.000	0.190	86.3	40.1	6.08	22.2	0.19	0.0298	11	0.033	0.023	429	5	0.6	14	100
S-14	17-Jan-06	2.9	7.77	929	212	258	<0.6	<0.4	418	39	0.2	231	0.002	0.121	0.001	0.055	73.0	57.3	4.98	60.1	0.13	0.0562	10	0.012	0.009	593	<5	0.5	9	109
	27-Feb-06	3.3	7.74	1330	280	342	<0.6	<0.4	530	58	0.2	403	0.015	0.221	0.001	0.049	84.1	77.8	6.22	87.8	0.10	0.0452	7	0.011	0.009	886	<5	0.5	6	93.2
	8-Mar-06	2.2	8.14	1170	243	297	<0.6	<0.4	456	53	0.5	317	0.002	0.199	0.003	0.060	75.7	64.8	5.40	77.5	<0.01	0.0447	4	0.012	0.008	740	<5	0.4	5	97.3
	20-Apr-06	110	8.26	412	121	148	<0.6	<0.4	176	15	0.3	70	0.266	0.167	0.008	2.26	42.1	17.1	7.11	13.3	**0.68**	0.142	9	0.362	0.249	247	120	1.5	9	95.2
	27-May-06	22	8.64	1030	253	279	14.5	<0.4	448	41	0.2	260	0.025	0.044	0.007	0.015	79.3	60.7	7.10	60.2	0.13	0.0181	8	0.051	0.022	660	23	0.8	10	101
	29-Jun-06	220	8.58	911	197	221	9.9	<0.4	404	49	0.3	235	0.153	0.167	**0.031**	0.414	69.0	56.4	7.26	60.4	**0.95**	0.0712	9	0.200	0.014	597	210	1.1	9	106
	25-Jul-06	38	8.57	1190	223	253	9.4	<0.4	469	67	0.4	348	0.008	0.070	0.014	0.023	76.9	67.3	8.45	86.5	**0.35**	0.0229	8	0.053	0.014	788	28	0.7	8	98.1
	6-Aug-06	28	8.59	1190	206	230	10.3	<0.4	509	72	0.4	361	0.043	0.041	0.006	0.012	76.5	77.3	8.34	99.0	**0.33**	0.0404	8	0.061	0.011	818	29	0.6	7	107
	18-Sep-06	53	8.52	1210	220	252	8.3	<0.4	535	71	0.4	380	0.055	0.049	0.004	0.007	86.1	77.7	8.23	91.6	**0.69**	0.0272	3	0.059	0.008	846	48	0.4	4	104
	17-Oct-06	24	8.44	1430	245	285	6.6	<0.4	541	91	0.3	441	<0.001	0.042	0.001	0.014	79.3	83.3	6.62	105	0.27	0.0101	5	0.021	<0.001	953	18	0.3	5	93.4
	24-Nov-06	4.9	8.08	1310	263	321	<0.6	<0.4	483	70	0.4	350	0.003	0.158	0.002	0.016	78.7	69.7	6.14	103	0.10	0.0202	5	0.010	0.005	835	<5	0.4	5	98.3
	14-Dec-06	2.9	8.00	1370	272	332	<0.6	<0.4	515	72	0.3	364	0.002	0.205	0.002	0.055	84.2	74.0	6.41	107	0.14	0.0214	7	0.014	0.008	871	<5	0.4	6	100

TABLE NM4-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia (3)	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
		Parameter (1)																												
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003*	*-*	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001*	*0.001*	*5*	*5*	*0.2*	*1*	*-*
CCME (2)																														
Freshwater Aquatic Life		(4)	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	(5)	-	-	-
S-21	17-Jan-06	9.0	7.86	1530	291	355	<0.6	<0.4	646	132	0.3	368	0.007	0.136	0.001	0.056	105	93.4	8.72	131	0.25	0.0764	7	0.024	0.015	1010	11	0.3	7	110
Field Dup.	17-Jan-06	8.8	7.89	1530	290	354	<0.6	<0.4	573	132	0.3	363	0.006	0.136	0.001	0.057	89.4	84.9	7.19	120	0.27	0.0772	8	0.024	0.026	971	12	0.7	8	98.6
	27-Feb-06	8.0	7.53	1460	307	375	<0.6	<0.4	590	81	0.3	420	0.021	0.176	0.001	0.794	90.1	88.8	6.71	97.6	0.22	0.0279	9	0.025	0.018	972	10	0.4	7	94.1
	8-Mar-06	5.9	8.16	1680	278	339	<0.6	<0.4	534	205	0.6	339	0.008	0.255	0.004	0.120	85.6	77.9	8.50	160	0.02	0.0672	5	0.032	0.017	1040	7	0.5	7	97.0
	20-Apr-06	110	7.98	404	121	148	<0.6	<0.4	180	15	0.2	73	0.244	0.166	0.004	2.28	43.2	17.6	7.25	13.5	**0.70**	0.145	13	0.352	0.234	252	120	1.3	12	96.4
	27-May-06	10	8.57	1380	288	325	13.2	<0.4	579	79	0.3	404	0.008	0.004	0.001	<0.005	91.3	85.2	7.46	93.1	0.05	0.0434	8	0.044	0.015	934	14	1.9	6	96.3
	29-Jun-06	15	8.44	1860	288	336	7.4	<0.4	612	259	0.5	398	0.013	0.023	0.003	0.007	76.7	102	7.17	186	0.09	0.0272	12	0.065	0.030	1200	14	1.0	12	95.9
	25-Jul-06	17	8.34	1360	273	327	2.8	<0.4	553	85	0.4	361	0.011	0.050	0.005	0.021	77.7	87.3	7.23	92.6	0.22	0.0492	6	0.062	0.026	875	26	0.5	5	99.3
	6-Aug-06	5.7	8.11	781	167	204	<0.6	<0.4	321	52	0.3	173	0.013	0.018	0.001	0.090	50.6	47.3	5.52	53.9	0.14	0.0479	7	0.057	0.022	482	9	0.4	8	106
	18-Sep-06	54	8.12	509	86	104	<0.6	<0.4	144	73	0.2	69	0.073	0.012	0.000	0.187	28.7	17.6	5.08	43.4	**0.85**	0.0396	4	0.122	0.048	289	45	0.5	5	93.8
	17-Oct-06	7.9	8.34	1400	264	316	2.9	<0.4	555	87	0.3	389	0.004	0.054	0.001	0.026	81.9	85.3	6.38	98.9	0.22	0.0199	7	0.041	0.012	907	20	0.4	6	98.3
	24-Nov-06	6.1	8.21	1340	273	333	<0.6	<0.4	496	81	0.4	371	0.004	0.029	0.000	0.015	76.2	74.3	6.04	96.6	0.18	0.0197	5	0.015	0.007	868	6	0.3	5	92.2
	14-Dec-06	3.3	8.03	1420	287	350	<0.6	<0.4	550	89	0.3	363	<0.001	0.091	0.001	0.053	87.1	80.7	6.47	108	0.16	0.0235	5	0.013	0.005	906	<5	0.3	5	100
S-22	17-Jan-06	2.5	7.59	1500	609	743	<0.6	<0.4	845	50	0.2	276	0.107	0.697	0.003	0.031	146	117	6.99	39.0	0.03	2.57	<1	0.222	0.210	1000	7	1.6	<1	97.2
	27-Feb-06	40	7.32	1610	752	917	<0.6	<0.4	849	45	0.2	220	3.29	0.632	0.001	0.006	144	119	6.96	41.3	**4.37**	11.2	6	2.52	0.775	1030	29	2.3	6	90.8
	8-Mar-06	58	7.70	1660	775	946	<0.6	<0.4	898	47	0.2	250	1.75	0.856	0.005	0.008	158	123	6.79	44.2	**5.87**	15.1	23	3.35	1.11	1090	35	2.5	20	91.2
	20-Apr-06	2.2	8.24	813	339	414	<0.6	<0.4	422	29	0.2	91	0.059	0.004	0.000	0.008	75.0	57.0	5.32	20.1	0.05	0.0187	22	0.080	0.075	481	<5	1.0	21	99.3
	27-May-06	3.0	8.59	879	371	421	15.6	<0.4	450	35	0.2	110	0.106	<0.003	0.000	0.006	67.7	68.2	3.35	27.1	0.07	0.0184	20	0.140	0.127	535	<5	1.3	19	95.8
	29-Jun-06	2.1	8.13	528	207	252	<0.6	<0.4	259	22	0.2	50	0.057	0.007	0.000	0.125	47.4	34.1	3.90	7.92	<0.01	0.0319	3	0.085	0.068	289	12	0.3	3	96.6
	25-Jul-06	2.1	7.86	555	206	252	<0.6	<0.4	260	26	0.3	54	0.054	0.157	0.005	0.153	50.2	32.7	4.85	7.97	0.13	0.0994	3	0.112	0.086	301	5	0.7	2	94.2
	6-Aug-06	2.1	7.75	573	202	247	<0.6	<0.4	285	33	0.3	54	0.081	0.091	0.003	0.214	54.8	35.9	4.95	8.32	0.04	0.0447	4	0.099	0.089	314	<5	0.4	3	101
	18-Sep-06	7.5	7.64	546	226	276	<0.6	<0.4	281	20	0.3	52	0.056	0.095	0.001	0.011	53.3	35.8	4.57	6.72	0.26	0.46	5	0.153	0.056	308	8	0.7	4	97.2
	17-Oct-06	9.9	8.38	595	255	303	3.9	<0.4	296	21	0.2	56	0.014	0.014	0.000	<0.005	58.9	36.1	4.48	7.44	0.27	0.0898	7	0.248	0.030	336	26	1.8	8	92.5
Field Dup.	17-Oct-06	9.8	8.40	593	255	302	4.5	<0.4	296	21	0.3	56	0.015	0.013	0.000	<0.005	58.9	36.1	4.47	7.36	0.21	0.0451	7	0.186	0.029	336	21	1.6	12	92.3
S-23	17-Jan-06	6.8	7.83	1490	286	349	<0.6	<0.4	599	132	0.3	345	0.007	0.143	0.001	0.057	97.6	86.3	8.09	125	0.23	0.0875	8	0.026	0.020	965	10	0.2	7	106
	27-Feb-06	7.0	7.57	1440	317	386	<0.6	<0.4	587	78	0.3	403	0.026	0.173	0.001	0.059	90.9	87.5	6.63	96.0	0.14	0.0702	7	0.027	0.020	953	7	0.4	7	95.0
	8-Mar-06	7.1	8.06	1620	283	346	<0.6	<0.4	511	188	0.6	318	0.018	0.414	0.006	0.094	82.4	74.1	7.65	141	0.02	0.0890	5	0.050	0.033	981	8	1.0	5	94.0
	20-Apr-06	120	8.02	404	121	147	<0.6	<0.4	180	15	0.2	76	0.248	0.167	0.005	2.29	43.3	17.6	7.29	13.5	**0.67**	0.142	13	0.356	0.233	256	140	11.6	12	95.5
	27-May-06	12	8.62	1210	276	306	15.1	<0.4	527	61	0.2	296	0.007	<0.003	0.000	0.007	84.0	77.0	7.33	75.2	0.04	0.0317	7	0.051	0.019	767	17	0.7	13	104
Field Dup.	27-May-06	11	8.63	1200	276	305	15.4	<0.4	518	61	0.2	296	0.008	<0.003	0.000	0.006	83.1	75.5	7.28	74.1	0.05	0.0384	7	0.044	0.018	763	14	0.7	7	103
	29-Jun-06	5.4	8.47	1790	269	311	8.4	<0.4	625	242	0.4	364	0.006	0.009	0.001	0.051	81.9	102	8.04	181	0.13	0.0190	12	0.048	0.017	1140	21	0.9	12	104
	25-Jul-06	12	8.58	1260	255	289	10.8	<0.4	508	82	0.4	333	0.008	0.013	0.002	0.013	69.1	81.6	7.36	85.3	0.25	0.0263	6	0.055	0.016	811	17	0.6	5	97.9
Field Dup.	25-Jul-06	9.9	8.58	1260	255	289	10.9	<0.4	505	81	0.4	297	0.007	0.017	0.003	0.014	68.4	81.3	7.36	84.4	0.23	0.0259	6	0.054	0.017	773	21	0.6	6	103
	6-Aug-06	13	8.30	1120	223	272	<0.6	<0.4	470	76	0.4	276	0.013	0.012	0.001	<0.005	65.9	74.1	6.68	79.7	0.14	0.0341	7	0.057	0.020	713	17	0.6	8	105
	18-Sep-06	16	8.18	1010	204	249	<0.6	<0.4	418	67	0.4	240	0.036	0.016	0.001	0.11	65.2	61.9	7.07	70.4	0.26	0.0316	9	0.095	0.035	635	22	0.7	9	105
	17-Oct-06	18	8.43	1330	264	310	6.2	<0.4	520	94	0.4	338	0.005	0.036	0.001	0.039	79.0	78.4	6.60	92.6	0.24	0.0143	6	0.032	0.015	847	19	0.4	6	97.3
	24-Nov-06	8.2	8.19	1130	294	354	2.2	<0.4	496	76	0.4	287	0.003	0.028	0.000	0.017	73.6	75.8	6.79	93.5	0.15	0.0178	2	0.016	0.008	789	<5	0.3	3	101
Field Dup.	24-Nov-06	6.7	8.24	1270	280	334	3.6	<0.4	506	65	0.4	259	0.006	0.037	0.001	0.031	80.4	74.2	6.55	89.0	0.18	0.0179	5	0.015	0.008	742	<5	0.3	4	110
	14-Dec-06	6.7	8.05	1190	293	358	<0.6	<0.4	495	52	0.3	242	0.006	0.071	0.001	0.056	81.0	71.1	5.74	83.0	0.15	0.0223	5	0.018	0.009	712	<5	0.3	4	110
Field Dup.	14-Dec-06	5.4	8.10	1090	295	360	<0.6	<0.4	458	44	0.3	214	0.005	0.071	0.001	0.049	78.4	63.7	5.15	63.8	0.26	0.0221	2	0.015	0.009	647	<5	0.3	3	104
S-25	17-Jan-06	12	7.98	1370	275	335	<0.6	<0.4	517	126	0.3	299	0.005	0.094	0.001	0.088	87.6	72.4	7.39	104	0.14	0.0435	6	0.024	0.013	862	14	0.3	7	98.5
	27-Feb-06	9.7	7.86	1300	309	377	<0.6	<0.4	531	66	0.3	354	0.013	0.115	0.001	0.092	89.1	75.1	5.72	77.7	0.17	0.0591	2	0.022	0.011	853	12	0.3	2	91.8
	8-Mar-06	11	7.93	1730	286	349	<0.6	<0.4	509	230	0.3	288	0.008	0.284	0.002	0.111	84.6	72.3	9.80	164	0.10	0.0684	5	0.034	0.019	1020	13	0.4	5	96.4
Field Dup.	8-Mar-06	10	7.95	1730	286	349	<0.6	<0.4	502	237	0.4	291	0.009	0.284	0.002	0.105	83.6	71.3	9.60	160	0.11	0.0675	4	0.035	0.018	1020	12	0.4	4	93.4
	20-Apr-06	120	8.03	404	121	147	<0.6	<0.4	178	15	0.2	75	0.256	0.183	0.006	2.29	43.1	17.0	7.25	13.3	**0.80**	0.153	9	0.362	0.234	254	150	1.8	9	94.4
	27-May-06	24	8.61	986	255	284	13.3	<0.4	433	51	<0.1	215	0.015	0.008	0.001	0.007	75.3	59.5	6.81	53.9	0.15	0.0787	6	0.065	0.017	615	32	0.8	6	101
	29-Jun-06	9.9	8.50	993	229	262	8.2	<0.4	431	61	0.3	207	0.015	0.036	0.005	0.007	68.5	63.1	6.86	62.8	0.16	0.0394	7	0.049	0.015	606	20	0.7	7	109
	25-Jul-06	9.8	8.62	1150	233	261	11.5	<0.4	431	92	0.4	237	0.007	0.021	0.004	0.019	56.9	70.1	6.91	81.6	0.26	0.0176	6	0.032	0.012	685	14	0.5	5	101
	6-Aug-06	6.4	8.48	950	223	258	6.5	<0.4	403	59	0.4	207	0.014	0.055	0.007	<0.005	59.1	62.1	6.25	58.9	0.16	0.0167	7	0.049	0.025	585	8	0.6	6	103
	18-Sep-06	25	8.47	1140	241	279	7.4	<0.4	473	68	0.4	286	0.014	0.008	0.001	0.015	71.5	71.5	6.56	74.3	0.28	0.0268	5	0.05	0.011	722	27	0.5	6	101
	17-Oct-06	75	8.49	1180	251	289	8.5	<0.4	483	67	0.4	310	<0.001	0.013	0.000	0.015	74.6	72.1	5.83	73.8	0.25	0.0109	6	0.025	0.009	754	64	0.4	5	97.2
	24-Nov-06	8.7	8.28	1300	271	322	4.6	<0.4	512	79	0.4	354	0.005	0.010	0.000	0.036	77.7	77.2	7.69	93.4	0.14	0.0125	6	0.021	0.007	852	5	0.4	5	96.3
	14-Dec-06	5.9	8.05	1350	297	363	<0.6	<0.4	517	70	0.3	331	<0.001	0.044	0.000	0.029	83.1	75.1	6.02	90.7	0.13	0.0173	5	0.012	0.014	835	<5	0.2	4	97.3
S-26	20-Apr-06	3.8	8.33	721	312	375	2.4	<0.4	373	23	0.2	76	0.006	0.004	0.000	0.012	77.6	43.5	3.06	13.9	0.09	0.0189	24	0.027	0.018	424	7	0.8	22	96.1
	27-May-06	8.3	8.79	766	327	350	24.0	<0.4	328	41	0.1	53	1.52	0.580	**0.110**	0.894	60.9	42.7	8.65	45.5	0.05	0.0384	16	1.82	1.53	452	23	4.1	20	98.7
	29-Jun-06	4.8	8.18	424	217	265	<0.6	<0.4	232	12	0.1	12	0.258	0.037	0.002	0.014	40.7	31.6	1.91	9.40	0.21	0.0891	11	0.285	0.247	238	15	1.0	10	103
	25-Jul-06	15	7.94	1020	416	507	<0.6	<0.4	392	69	0.3	55	1.49	0.115	0.005	0.034	74.3	50.1	13.1	72.8	**0.70**	0.730	16	5.96	5.00	584	25	2.4	16	99.2
	6-Aug-06	8.3	8.15	662	247	301	<0.6	<0.4	355	11	0.4	116	0.173	0.006	0.000	0.015	69.9	43.9	4.41	12.4	0.14	0.0569	16	0.314	0.215	406	18	1.8	20	101
	18-Sep-06	16	7.66	690	265	323	<0.6	<0.4	357	25	0.3	90	0.276	0.077	0.001	0.027	62.4	48.9	6.33	15.5	**0.6**	0.483	13	0.452	0.31	407	21	1.2	12	101
	17-Oct-06	3.0	8.31	414	176	213	1.2	<0.4	194	17	0.2	27	0.025	0.008	0.000	<0.005	34.9	28.7	5.64	8.10	0.07	0.0185	8	0.081	0.029	204	8	<0.2	8	100
	24-Nov-06	1.5	8.10	489	235	287	<0.6	<0.4	254	15	0.3	19	0.028	0.003	0.000	0.035	45.4	34.2	3.70	8.56	0.10	0.0058	8	0.054	0.038	267	<5	0.6	8	100

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TABLE NM4-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Parameter [1]																												
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003*	*-*	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001*	*0.001*	*5*	*5*	*0.2*	*1*	*-*
CCME [2]																														
Freshwater Aquatic Life		[4]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	[5]	-	-	-
S-27	20-Apr-06	0.55	8.43	682	330	389	6.5	<0.4	380	12	0.3	59	0.003	<0.003	0.000	0.011	74.9	46.8	2.45	9.17	<0.01	0.0055	28	0.022	0.021	402	<5	0.9	27	98.5
	27-May-06	3.2	8.49	872	400	465	11.3	<0.4	473	14	0.2	127	0.010	0.008	0.001	0.014	73.9	70.2	2.15	17.3	0.08	0.104	26	0.040	0.031	546	<5	1.4	26	93.0
S-28	17-Jan-06	5.0	7.89	1170	291	355	<0.6	<0.4	507	79	0.3	251	0.008	0.104	0.001	0.251	86.4	70.8	6.06	76.0	0.13	0.0286	8	0.025	0.016	744	7	0.3	7	102
	27-Feb-06	7.2	7.78	1240	323	394	<0.6	<0.4	516	57	0.2	288	0.014	0.109	0.001	0.629	87.2	72.5	5.45	68.2	0.08	0.0395	4	0.027	0.017	775	7	0.4	3	95.2
Field Dup.	27-Feb-06	7.8	7.79	1240	324	396	<0.6	<0.4	514	59	0.3	292	0.014	0.109	0.001	0.399	86.4	72.5	5.44	67.9	0.11	0.0397	3	0.025	0.018	779	7	0.5	3	93.8
	8-Mar-06	5.2	7.85	1670	301	367	<0.6	<0.4	501	221	0.3	265	0.013	0.250	0.002	0.255	83.8	70.8	8.46	150	0.07	0.0383	4	0.039	0.026	981	7	0.6	4	94.2
	20-Apr-06	140	8.04	405	120	147	<0.6	<0.4	178	16	0.2	78	0.275	0.151	0.005	2.30	43.2	17.1	7.27	13.3	**0.81**	0.153	13	0.367	0.235	258	170	1.4	14	92.9
Field Dup.	20-Apr-06	140	8.03	405	120	147	<0.6	<0.4	178	16	0.2	78	0.285	0.148	0.005	2.29	43.1	17.1	7.17	13.1	**0.77**	0.155	11	0.371	0.234	256	160	1.4	13	92.5
	27-May-06	9.4	8.75	926	271	289	20.5	<0.4	400	47	0.1	181	0.119	0.019	0.004	0.009	68.5	55.7	6.80	48.8	0.04	0.0506	7	0.205	0.130	570	18	1.3	9	97.9
	29-Jun-06	7.0	8.28	933	248	303	<0.6	<0.4	408	57	0.4	167	0.113	0.018	0.002	0.081	63.6	60.6	6.56	56.6	0.11	0.0406	6	0.154	0.121	560	17	0.5	6	107
Field Dup.	29-Jun-06	7.3	8.28	933	246	300	<0.6	<0.4	399	58	0.2	167	0.112	0.016	0.001	0.082	62.5	59.1	6.39	55.3	0.11	0.0396	6	0.152	0.120	556	13	0.6	6	105
	25-Jul-06	8.6	8.38	1200	294	350	4.1	<0.4	451	100	0.4	203	0.197	0.040	0.005	0.161	59.4	73.6	7.80	87.8	0.21	0.0463	6	0.274	0.216	710	11	0.8	7	101
	6-Aug-06	5.8	8.33	1150	256	307	2.4	<0.4	481	71	0.4	271	0.029	0.027	0.002	0.091	61.1	79.8	6.57	73.6	0.11	0.0291	5	0.063	0.038	716	8	0.5	10	102
Field Dup.	6-Aug-06	6.3	8.37	1150	256	304	3.7	<0.4	447	70	0.4	285	0.029	0.027	0.003	0.092	58.7	73.1	6.14	67.1	0.09	0.0328	<1	0.063	0.039	714	10	0.4	6	92.2
	18-Sep-06	7.2	8.42	1010	238	279	5.4	<0.4	447	52	0.4	232	0.015	<0.003	0.000	0.089	65.9	68.6	6.36	60.8	0.11	0.0175	6	0.051	0.021	629	6	0.4	6	106
Field Dup.	18-Sep-06	6.8	8.42	1020	239	280	5.6	<0.4	428	52	0.4	233	0.015	<0.003	0.000	0.059	63.2	65.8	5.98	58.1	0.1	0.0174	5	0.051	0.019	621	6	0.5	6	101
	17-Oct-06	6.9	8.39	1130	267	316	4.7	<0.4	477	60	0.3	274	0.003	0.007	0.000	0.111	73.5	71.2	5.72	65.7	0.19	0.0169	7	0.032	0.007	711	5	0.4	7	98.2
	24-Nov-06	4.9	8.18	1250	280	335	3.5	<0.4	511	72	0.4	272	0.005	<0.003	0.000	0.092	77.3	77.2	6.33	84.7	0.10	0.0078	6	0.017	0.007	758	<5	2.4	5	105
	14-Dec-06	5.0	8.02	1330	305	373	<0.6	<0.4	527	69	0.3	321	<0.001	0.021	0.000	0.096	84.5	76.8	6.05	90.0	0.12	0.0123	5	0.013	0.006	831	<5	0.3	5	98.9
S-30	17-Jan-06	17	7.96	958	282	344	<0.6	<0.4	426	42	0.2	186	0.146	1.05	0.009	0.702	86.9	50.7	7.87	54.2	0.30	0.0770	13	0.226	0.181	600	27	1.5	13	103
	27-Feb-06	13	7.79	986	301	367	<0.6	<0.4	390	40	0.2	180	0.163	0.515	0.003	1.35	79.8	46.3	6.66	53.6	0.15	0.0384	10	0.200	0.173	593	13	1.6	10	93.7
	8-Mar-06	9.0	7.99	1030	296	361	<0.6	<0.4	388	57	0.3	183	0.197	0.785	0.009	0.848	80.6	45.3	7.49	61.3	0.11	0.0388	10	0.226	0.203	616	12	1.5	12	93.1
	20-Apr-06	130	8.09	405	120	147	<0.6	<0.4	180	15	0.2	75	0.250	0.161	0.006	2.31	43.7	17.3	7.25	13.1	**0.75**	0.158	11	0.371	0.234	254	160	1.4	11	95.4
	27-May-06	90	8.55	821	240	272	10.3	<0.4	366	30	<0.1	197	0.180	0.110	0.013	0.419	78.3	41.5	8.33	40.9	**0.59**	0.219	14	0.242	0.116	542	160	1.4	12	95.3
	29-Jun-06	44	8.64	857	243	266	14.7	<0.4	382	33	0.3	183	0.180	0.048	0.010	0.473	75.7	47.0	9.70	53.1	**0.37**	0.0989	10	0.271	0.183	549	66	1.3	10	106
	25-Jul-06	22	8.67	881	246	273	13.4	<0.4	349	35	0.3	177	0.092	0.149	**0.035**	0.538	73.6	40.2	10.8	55.1	0.27	0.0816	10	0.254	0.174	542	33	1.2	13	100
	6-Aug-06	35	8.67	857	244	270	13.9	<0.4	337	39	0.3	186	0.210	0.241	**0.050**	0.274	70.0	39.3	10.4	56.3	0.23	0.107	11	0.257	0.180	549	41	1.3	12	95.4
	18-Sep-06	51	8.43	838	230	269	5.6	<0.4	307	51	0.4	155	0.239	0.758	**0.059**	0.295	62	37	10.2	56.7	**0.61**	0.183	11	0.298	0.226	511	57	2.1	11	95.3
	17-Oct-06	18	8.46	1000	237	276	6.3	<0.4	334	75	0.2	190	0.223	1.09	**0.042**	0.459	67.9	39.8	9.94	75.3	**0.35**	0.0780	12	0.296	0.250	602	11	2.1	12	94.0
	24-Nov-06	23	8.41	976	259	290	12.6	<0.4	363	59	0.4	171	0.234	1.07	**0.027**	0.337	71.0	45.2	9.97	72.2	**0.48**	0.0650	10	0.352	0.248	585	28	2.4	12	102
	14-Dec-06	12	8.23	1260	297	362	<0.6	<0.4	419	93	0.3	225	0.180	1.78	**0.027**	0.490	78.4	54.4	13.1	101	0.24	0.0504	12	0.389	0.308	745	12	3.1	13	98.7
S-31	17-Jan-06	14	8.01	935	273	333	<0.6	<0.4	415	42	0.2	183	0.176	1.12	0.011	0.696	87.3	47.8	8.07	54.7	0.21	0.0481	13	0.233	0.220	589	18	1.6	13	104
	27-Feb-06	13	7.90	949	298	363	<0.6	<0.4	380	38	0.2	169	0.201	0.737	0.006	0.883	80.2	43.6	7.02	54.9	0.20	0.0404	11	0.238	0.211	575	14	1.6	10	95.8
	8-Mar-06	9.5	7.99	1020	297	362	<0.6	<0.4	399	56	0.3	180	0.162	0.748	0.009	0.758	83.6	46.3	7.72	62.6	0.12	0.0407	11	0.226	0.201	617	13	1.4	10	96.4
	20-Apr-06	130	8.09	406	120	147	<0.6	<0.4	185	17	0.2	88	0.291	0.161	0.006	2.32	44.9	17.6	7.37	13.4	**0.64**	0.166	12	0.378	0.235	272	160	1.4	12	91.1
	27-May-06	100	8.55	822	241	273	9.9	<0.4	376	30	<0.1	193	0.179	0.115	0.015	1.21	81.2	42.1	8.46	41.4	**0.47**	0.255	13	0.261	0.116	547	180	1.5	15	97.7
	29-Jun-06	16	8.61	858	242	268	13.4	<0.4	374	32	0.3	184	0.252	0.060	0.012	0.515	75.0	45.3	9.72	52.3	0.27	0.0649	10	0.251	0.187	545	44	1.2	10	104
	25-Jul-06	9.3	8.65	892	247	276	12.9	<0.4	352	36	0.3	179	0.111	0.094	**0.021**	0.553	72.9	41.4	10.8	55.3	0.29	0.0869	10	0.242	0.166	547	37	1.3	11	99.8
	6-Aug-06	38	8.68	853	243	268	13.9	<0.4	329	39	0.3	176	0.228	0.224	**0.048**	0.346	67.7	38.8	10.4	52.7	0.26	0.104	10	0.272	0.185	531	49	1.4	11	94.5
	18-Sep-06	35	8.43	837	230	269	5.8	<0.4	312	51	0.3	156	0.24	0.703	**0.052**	0.297	63.5	37.3	10.3	57.9	**0.56**	0.176	12	0.3	0.225	515	50	2.1	13	96.7
	17-Oct-06	35	8.46	998	236	275	6.4	<0.4	350	76	0.4	188	0.216	1.15	**0.044**	0.467	72.4	41.1	10.5	78.5	**0.59**	0.112	12	0.342	0.258	610	18	2.3	13	98.6
	24-Nov-06	22	8.43	995	260	289	13.8	<0.4	350	61	0.3	178	0.237	1.09	**0.028**	0.387	68.5	43.6	9.63	69.7	**0.40**	0.0622	14	0.376	0.260	588	32	2.5	12	96.4
	14-Dec-06	12	8.22	1190	289	353	<0.6	<0.4	407	83	0.3	206	0.137	1.85	**0.029**	0.464	79.3	50.6	12.3	94.4	**0.31**	0.0499	11	0.392	0.312	701	12	3.1	12	101
S-32	17-Jan-06	14	8.01	929	272	332	<0.6	<0.4	395	40	0.2	180	0.181	1.09	0.010	0.719	84.2	44.9	7.99	52.4	0.27	0.0477	12	0.251	0.228	576	20	1.6	13	100
	27-Feb-06	14	7.97	936	296	361	<0.6	<0.4	379	38	0.2	167	0.199	0.709	0.006	1.40	81.6	42.6	7.06	54.5	0.20	0.0401	12	0.231	0.206	575	15	1.6	10	95.9
	8-Mar-06	9.5	7.98	1020	295	360	<0.6	<0.4	409	55	0.3	180	0.199	0.705	0.009	1.24	86.3	46.9	8.09	64.9	0.16	0.0417	10	0.226	0.205	624	11	1.4	11	99.2
	20-Apr-06	150	8.10	408	121	148	<0.6	<0.4	194	16	0.2	77	0.280	0.167	0.006	2.31	47.0	18.5	7.28	13.5	**0.90**	0.190	10	0.419	0.238	262	180	1.6	9	99.7
	27-May-06	100	8.52	821	240	275	9.2	<0.4	367	30	<0.1	191	0.176	0.107	0.013	0.460	78.6	41.4	8.29	40.8	**0.55**	0.231	14	0.243	0.116	536	160	1.4	13	96.4
	29-Jun-06	35	8.62	858	243	269	13.8	<0.4	377	32	0.3	183	0.186	0.060	0.012	0.542	76.0	45.4	9.76	52.1	0.28	0.0661	10	0.240	0.190	547	51	1.1	11	104
	25-Jul-06	27	8.64	892	250	280	12.4	<0.4	356	35	0.3	176	0.096	0.084	0.018	0.603	73.8	41.8	10.8	55.0	0.28	0.0842	10	0.236	0.162	546	36	1.1	12	101
	6-Aug-06	45	8.65	856	245	273	13.1	<0.4	337	40	0.3	175	0.212	0.269	**0.055**	0.359	69.5	39.7	10.5	52.6	0.23	0.0998	10	0.248	0.185	536	56	1.5	15	95.6
	18-Sep-06	49	8.43	834	229	268	5.7	<0.4	319	51	0.4	153	0.252	0.893	**0.065**	0.3	65.3	38	10.8	60.2	**0.58**	0.181	12	0.307	0.225	517	53	2	12	100
	17-Oct-06	21	8.38	992	236	280	3.9	<0.4	336	77	0.4	187	0.274	1.20	**0.039**	0.487	68.8	39.8	10.3	76.5	**0.36**	0.0864	12	0.319	0.268	603	21	2.2	13	95.0
	24-Nov-06	20	8.41	979	262	294	12.6	<0.4	368	59	0.4	170	0.248	1.11	**0.028**	0.412	73.4	44.9	10.5	73.7	**0.49**	0.0665	12	0.378	0.268	591	27	2.5	14	103
	14-Dec-06	10	8.21	1180	287	350	<0.6	<0.4	403	81	0.3	204	0.141	1.77	**0.027**	0.530	77.8	50.8	12.1	93.9	0.23	0.0497	11	0.387	0.306	694	11	3.0	12	101

TABLE NM4-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Parameter (1) Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia (3)	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003*	*-*	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001*	*0.001*	*5*	*5*	*0.2*	*1*	*-*
CCME (2)																														
Freshwater Aquatic Life		(4)	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	(5)	-	-	-
S-33	17-Jan-06	14	8.06	942	275	336	<0.6	<0.4	413	42	0.3	182	0.178	1.10	0.012	0.780	88.5	46.6	8.42	54.1	0.23	0.0480	13	0.246	0.231	590	20	1.7	14	103
	27-Feb-06	13	7.99	934	296	361	<0.6	<0.4	362	38	0.2	162	0.188	0.515	0.005	3.07	76.5	41.5	7.01	51.9	0.15	0.0366	11	0.216	0.188	573	14	1.4	10	91.4
	8-Mar-06	8.8	7.96	1020	297	363	<0.6	<0.4	409	55	0.2	181	0.174	0.688	0.009	0.857	85.4	47.5	8.18	64.9	0.13	0.0413	11	0.233	0.203	625	13	1.4	12	98.9
	20-Apr-06	140	8.11	412	122	149	<0.6	<0.4	181	16	0.2	79	0.283	0.161	0.006	2.34	43.9	17.3	7.27	13.6	**0.82**	0.170	11	0.394	0.244	260	170	1.4	12	93.1
	27-May-06	100	8.45	824	236	275	6.5	<0.4	377	30	<0.1	193	0.168	0.096	0.010	0.450	81.3	42.3	8.51	41.5	**0.57**	0.260	13	0.244	0.115	541	180	1.4	14	99.4
	29-Jun-06	60	8.62	858	242	268	13.5	<0.4	365	32	0.2	186	0.186	0.055	0.011	0.545	73.9	43.8	9.35	49.8	**0.46**	0.102	10	0.283	0.191	542	78	1.2	10	100
	25-Jul-06	28	8.65	882	247	275	12.8	<0.4	355	35	0.3	177	0.093	0.077	0.017	0.658	74.7	41.0	11.0	55.3	0.29	0.0920	11	0.244	0.164	544	39	1.2	10	101
	6-Aug-06	36	8.65	853	244	271	13.0	<0.4	332	38	0.4	173	0.203	0.265	**0.059**	0.337	69.3	38.6	10.5	53.6	0.30	0.106	10	0.258	0.186	531	51	1.4	10	96.3
	18-Sep-06	42	8.44	828	226	264	5.8	<0.4	323	51	0.4	152	0.237	0.881	**0.066**	0.303	65.2	38.8	10.9	61.1	**0.53**	0.1760	12	0.296	0.24	515	42	2.1	13	102
	17-Oct-06	20	8.40	990	234	277	4.4	<0.4	344	78	0.4	183	0.171	1.23	**0.041**	0.485	71.4	40.3	10.6	79.4	**0.37**	0.0907	12	0.319	0.277	606	18	2.1	12	98.6
	24-Nov-06	19	8.45	980	261	291	13.4	<0.4	373	61	0.4	171	0.253	1.14	**0.031**	0.364	74.7	45.4	10.9	75.3	**0.50**	0.0684	13	0.387	0.259	597	24	2.5	12	105
	14-Dec-06	10	8.25	1170	288	351	<0.6	<0.4	391	82	0.3	201	0.179	1.67	**0.027**	0.556	75.8	49.1	12.0	91.9	0.24	0.0466	11	0.374	0.296	687	11	2.9	13	98.6
S-34	17-Jan-06	17	8.09	926	272	331	<0.6	<0.4	395	40	0.2	194	0.188	1.12	0.013	0.713	84.8	44.5	8.12	53.4	0.26	0.0563	14	0.260	0.233	591	26	1.7	14	97.9
	27-Feb-06	14	7.97	928	294	359	<0.6	<0.4	357	37	0.2	165	0.211	0.782	0.007	0.870	77.5	39.8	6.81	51.1	0.16	0.0390	10	0.250	0.223	558	16	1.7	10	91.5
	8-Mar-06	10	8.01	1010	293	358	<0.6	<0.4	392	55	0.3	176	0.219	0.925	0.010	0.752	84.4	44.0	7.99	62.0	0.12	0.0437	10	0.253	0.223	609	11	1.7	10	96.4
	20-Apr-06	150	8.12	433	126	154	<0.6	<0.4	193	16	0.2	82	0.265	0.197	0.007	2.45	46.0	18.9	7.87	15.5	**0.93**	0.206	12	0.419	0.242	273	200	1.6	13	97.1
	27-May-06	95	8.53	824	239	272	9.5	<0.4	372	31	0.1	193	0.162	0.188	**0.022**	0.465	80.4	41.6	8.50	41.7	**0.63**	0.246	11	0.218	0.130	541	180	1.6	13	97.5
	29-Jun-06	42	8.67	854	244	264	16.5	<0.4	363	31	0.2	186	0.179	0.047	0.010	0.445	74.0	43.3	9.51	50.8	0.27	0.0767	10	0.244	0.185	543	53	1.1	10	100
	25-Jul-06	21	8.73	888	246	267	16.4	<0.4	352	38	0.3	179	0.108	0.081	**0.021**	0.505	71.5	42.1	10.7	56.2	0.29	0.0912	9	0.231	0.164	547	30	1.2	8	99.8
	6-Aug-06	37	8.67	851	243	268	13.8	<0.4	337	38	0.3	181	0.217	0.347	**0.081**	0.268	80.0	39.3	10.4	54.8	0.24	0.109	10	0.257	0.189	540	43	1.3	12	102
	18-Sep-06	47	8.42	835	230	270	5.2	<0.4	322	50	0.3	154	0.247	0.883	**0.066**	0.284	65.7	38.3	10.8	61.2	**0.59**	0.1840	12	0.307	0.238	520	48	2.1	13	101
	17-Oct-06	25	8.48	991	235	272	7.2	<0.4	339	75	0.4	188	0.155	1.16	**0.047**	0.462	70.6	39.5	10.4	76.5	**0.45**	0.102	11	0.326	0.255	603	32	2.2	11	96.2
	24-Nov-06	26	8.43	965	258	284	14.9	<0.4	354	58	0.4	167	0.244	1.11	**0.028**	0.383	71.8	42.5	10.3	70.5	**0.46**	0.0757	11	0.413	0.269	577	49	2.7	14	101
	14-Dec-06	12	8.20	1170	286	349	<0.6	<0.4	397	85	0.2	200	0.172	1.93	**0.028**	0.475	77.7	49.2	12.6	96.3	0.23	0.0560	11	0.407	0.328	694	13	3.2	13	101
S-35	20-Apr-06	55	8.14	481	126	154	<0.6	<0.4	192	40	0.3	48	0.260	0.091	0.002	1.84	44.1	19.9	10.1	15.0	**0.32**	0.0358	12	0.329	0.263	262	35	1.3	13	99.0
S-36	20-Apr-06	4.2	8.23	498	154	188	<0.6	<0.4	203	38	0.2	38	0.131	0.016	0.000	0.021	43.7	22.7	13.0	13.3	0.15	0.0195	17	0.176	0.160	261	<5	1.3	17	100
Level I																														
CON D/S	9-May-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49	-	-	-
	27-May-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-
	28-May-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43	-	-	-
	5-Jun-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-
	25-Jul-06	-	8.45	-	-	-	-	-	-	-	-	-	0.005	0.030	0.004	0.012	-	-	-	-	-	-	-	0.036	0.012	-	20	0.5	-	-
	26-Jul-06	-	8.43	-	-	-	-	-	-	-	-	-	0.026	0.047	0.007	0.018	-	-	-	-	-	-	-	0.044	0.012	-	18	0.5	-	-
	3-Aug-06	-	8.47	-	-	-	-	-	-	-	-	-	0.010	0.036	0.005	0.014	-	-	-	-	-	-	-	0.030	0.010	-	7	0.4	-	-
	4-Aug-06	-	8.56	-	-	-	-	-	-	-	-	-	0.016	0.036	0.005	0.020	-	-	-	-	-	-	-	0.029	0.011	-	12	0.3	-	-
	5-Aug-06	-	8.39	-	-	-	-	-	-	-	-	-	0.015	0.040	0.004	0.023	-	-	-	-	-	-	-	0.039	0.009	-	25	0.3	-	-
	10-Aug-06	-	8.48	-	-	-	-	-	-	-	-	-	0.024	0.041	0.005	0.070	-	-	-	-	-	-	-	0.209	0.016	-	120	0.4	-	-
	12-Aug-06	-	8.08	-	-	-	-	-	-	-	-	-	0.087	0.574	**0.029**	0.233	-	-	-	-	-	-	-	0.232	0.098	-	170	0.7	-	-
	25-Aug-06	-	8.37	-	-	-	-	-	-	-	-	-	0.015	0.074	0.006	0.008	-	-	-	-	-	-	-	0.048	0.014	-	11	0.4	-	-
	17-Sep-06	-	8.07	-	-	-	-	-	-	-	-	-	0.013	0.044	0.002	0.019	-	-	-	-	-	-	-	0.032	0.016	-	8	0.4	-	-
CON U/S	9-May-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140	-	-	-
	28-May-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	-	-	-
	5-Jun-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-
S-31	9-May-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	130	-	-	-
	27-May-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180	-	-	-
	28-May-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	170	-	-	-
	5-Jun-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	94	-	-	-
	25-Jul-06	-	8.65	-	-	-	-	-	-	-	-	-	0.111	0.094	**0.021**	0.553	-	-	-	-	-	-	-	0.242	0.166	-	37	1.3	-	-
	26-Jul-06	-	8.66	-	-	-	-	-	-	-	-	-	0.109	0.178	**0.041**	0.472	-	-	-	-	-	-	-	0.246	0.173	-	35	1.4	-	-
	3-Aug-06	-	8.70	-	-	-	-	-	-	-	-	-	0.209	0.361	**0.082**	0.544	-	-	-	-	-	-	-	0.305	0.204	-	40	1.3	-	-
	4-Aug-06	-	8.74	-	-	-	-	-	-	-	-	-	0.238	0.325	**0.078**	0.529	-	-	-	-	-	-	-	0.306	0.210	-	45	1.6	-	-
	5-Aug-06	-	8.47	-	-	-	-	-	-	-	-	-	0.279	0.635	**0.089**	0.515	-	-	-	-	-	-	-	0.388	0.267	-	40	1.8	-	-
	10-Aug-06	-	8.69	-	-	-	-	-	-	-	-	-	0.155	0.240	**0.048**	0.385	-	-	-	-	-	-	-	0.243	0.185	-	34	1.2	-	-
	12-Aug-06	-	8.65	-	-	-	-	-	-	-	-	-	0.146	1.470	**0.284**	0.471	-	-	-	-	-	-	-	0.280	0.192	-	39	1.7	-	-
	25-Aug-06	-	8.59	-	-	-	-	-	-	-	-	-	0.147	0.500	**0.077**	0.244	-	-	-	-	-	-	-	0.298	0.168	-	60	1.8	-	-
	17-Sep-06	-	8.30	-	-	-	-	-	-	-	-	-	0.231	0.802	**0.054**	0.328	-	-	-	-	-	-	-	0.289	0.013	-	38	2.1	-	-

TABLE NM4-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Parameter [1]																												
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003*	-	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001*	*0.001*	*5*	*5*	*0.2*	*1*	-
CCME [2]																														
Freshwater Aquatic Life		[4]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	[5]	-	-	-

Notes:

"-" = No Data

E.C. = Electrical Conductivity
D.O.C. = Dissolved Organic Carbon
T.O.C. = Total Organic Carbon
T.K.N. = Total Kjeldahl Nitrogen
T.D.S. = Total Dissolved Solids
T.S.S. = Total Suspended Solids

1. All values are expressed in milligrams per litre (mg/L) unless indicated otherwise.
2. CCME 2003 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines
   Guidelines for Canadian Drinking Water Quality.
   Chapter 4 - Aquatic Life (1999, Updated 2003.) - Fact Sheets
3. Unionized Ammonia = (f) x (Ammonia), f = 1/(10(pKa - pH) + 1), pKa = 0.09018+2729.92/T, where T = Temperature in Kelvins
4. Turbidity Guidelines Narrative (see fact sheet for complete details):
   Clear Flow:
      Maximum increase of 8 NTUs from background levels for a short-term exposure (e.g. 24 hr period).
      Maximum average increase of 2 NTUs from background levels for a longer exposure (e.g. 30 d period).
   High Flow or Turbid Waters:
      Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs.
      Should not increase more than 10% of background levels when background is >80 NTUs.
5. Suspended Sediments Guidelines Narrative (see fact sheet for complete details):
   Clear Flow:
      Maximum increase of 25 mg/L from background levels for any short-term exposure (eg. 24 hr period).
      Maximum average increase of 5 mg/L from background levels for longer term exposures (eg. Inputs lasting between 24 hrs and 30 days).
      Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L.
   High Flow:
      Should not increase more than 10% of background levels when background is >250 mg/L.

BOLD - Exceedance of Criteria

TABLE NM4-3
PETROLEUM HYDROCARBONS IN SURFACE WATER
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Parameter [1]					
		Benzene	Toluene	Ethyl-benzene	Xylenes (-o,-m,-p)	T.P.H. (C_5-C_{10})	T.E.H. (C_{11}-C_{30})
CON D/S (Stn 19+900)	17-Jan-06	<0.5	<0.5	<0.5	<0.5	<100	<100
	28-Feb-06	<0.5	<0.5	<0.5	<0.5	<100	<100
	9-Mar-06	<0.5	<0.5	<0.5	<0.5	<100	<100
	20-Apr-06	<0.5	<0.5	<0.5	<0.5	<100	<100
	27-May-06	<0.5	<0.5	<0.5	<0.5	<100	<100
	29-Jun-06	<0.5	<0.5	<0.5	<0.5	<100	<100
(Stn 22+200)	25-Jul-06	<0.5	<0.5	<0.5	<0.5	<100	<100
	6-Aug-06	<0.5	<0.5	<0.5	<0.5	<100	<100
(Stn 25+750)	18-Sep-06	<0.5	<0.5	<0.5	<0.5	<100	<100
	17-Oct-06	<0.5	<0.5	<0.5	<0.5	<100	<100
(Stn 33+800)	24-Nov-06	<0.5	<0.5	<0.5	<0.5	<100	<100
	14-Dec-06	<0.5	<0.5	<0.5	<0.5	<100	<100
CON U/S (Stn 4+400)	20-Apr-06	<0.5	<0.5	<0.5	<0.5	<100	<100
Detection Limit		*0.5*	*0.5*	*0.5*	*0.5*	*100*	*100*
CCME [2]							
Recreation and Aesthetics		-	-	-	-	[3]	[3]
Freshwater Aquatic Life		370 (MAC)	2 (MAC)	90 (MAC)	-	-	-

Notes:
"-" = No Data
T.P.H. = Total Purgeable Hydrocarbons
T.E.H. = Total Extractable Hydrocarbons

1. All concentrations in micrograms per litre (µg/L).
2. CCME - Canadian Council of Ministers of the Environment. Canadian Water Quality Guidelines.
   Chapter 3 - Recreation and Aesthetics (1999, Updated 2003.)
   Chapter 4 - Aquatic Life (1999, Updated 2003.)
3. Oil or petrochemicals should not be present in concentrations that:
   - Can be detected as a visible film, sheen, or discoloration on the surface;
   - Can be detected by odour; or
   - Can form deposits on shorelines and bottom deposits that are detectable by sight and odour.

BOLD	- Exceedance of Health Related Criteria (MAC)
Underlined	- Exceedance of Non-Health Related Criteria (AO)

TABLE NM4-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME [1]			
Freshwater Aquatic Life		-	-
CON D/S (Stn 19+900)	17-Jan-06	<10	<10
	27-Feb-06	50	<10
	8-Mar-06	<10	<10
	20-Apr-06	OVERGROWN	<10
	27-May-06	1350	80
	29-Jun-06	- [2]	50
(Stn 22+200)	25-Jul-06	OVERGROWN	70
	6-Aug-06	OVERGROWN	27
(Stn 25+750)	18-Sep-06	1380	140
	17-Oct-06	450	80
(Stn 33+800)	24-Nov-06	20	<10
	14-Dec-06	OVERGROWN	<10
CON U/S (Stn 4+400)	20-Apr-06	1790	30
VEG D/S (Stn 14+400)	25-Jul-06	OVERGROWN	440
	6-Aug-06	OVERGROWN	66
	18-Sep-06	OVERGROWN	580
(Stn 20+500)	17-Oct-06	1200	370
	24-Nov-06	<10	<10
S-01	20-Apr-06	1520	<10
S-02	20-Apr-06	OVERGROWN	30
S-03	20-Apr-06	OVERGROWN	30
S-04	20-Apr-06	OVERGROWN	10
S-05	20-Apr-06	1630	<10
U/S	20-Apr-06	1200	<10
S-06	20-Apr-06	940	20
U/S	20-Apr-06	1330	<10
S-07	17-Jan-06	210	10
	20-Apr-06	OVERGROWN	10
U/S	20-Apr-06	800	<10
S-08	20-Apr-06	<10	<10
S-09	20-Apr-06	1420	<10
S10	20-Apr-06	590	<10
S-13	17-Jan-06	460	<10
	20-Apr-06	OVERGROWN	10
	27-May-06	OVERGROWN	130
	29-Jun-06	- [2]	50
	25-Jul-06	OVERGROWN	240
	6-Aug-06	OVERGROWN	109
	18-Sep-06	OVERGROWN	OVERGROWN
	17-Oct-06	870	40
	24-Nov-06	20	<10
	14-Dec-06	10	<10
S-14	17-Jan-06	80	<10
	27-Feb-06	120	<10
	8-Mar-06	230	<10
	20-Apr-06	OVERGROWN	20
	27-May-06	940	50
	29-Jun-06	- [2]	170
	25-Jul-06	OVERGROWN	40
	6-Aug-06	OVERGROWN	9
	18-Sep-06	OVERGROWN	20
	17-Oct-06	330	30
	24-Nov-06	20	<10
	14-Dec-06	<10	<10

TABLE NM4-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME [1]			
Freshwater Aquatic Life		-	-
S-21	17-Jan-06	350	<10
Field Dup.	17-Jan-06	270	10
	27-Feb-06	380	280
	8-Mar-06	OVERGROWN	390
	20-Apr-06	OVERGROWN	20
	27-May-06	OVERGROWN	500
	29-Jun-06	- [2]	60
	25-Jul-06	OVERGROWN	540
	6-Aug-06	OVERGROWN	100
	18-Sep-06	OVERGROWN	OVERGROWN
	17-Oct-06	890	70
	24-Nov-06	690	<10
	14-Dec-06	OVERGROWN	10
S-22	17-Jan-06	60	<10
	27-Feb-06	360	<10
	8-Mar-06	460	<10
	20-Apr-06	410	<10
	27-May-06	1380	90
	29-Jun-06	- [2]	50
	25-Jul-06	1340	180
	6-Aug-06	OVERGROWN	960
	18-Sep-06	1250	150
	17-Oct-06	520	<10
Field Dup.	17-Oct-06	400	20
S-23	17-Jan-06	950	10
	27-Feb-06	580	100
	8-Mar-06	OVERGROWN	OVERGROWN
	20-Apr-06	OVERGROWN	10
	27-May-06	1300	620
Field Dup.	27-May-06	1330	80
	29-Jun-06	- [2]	10
	25-Jul-06	640	150
Field Dup.	25-Jul-06	590	110
	6-Aug-06	1610	80
	18-Sep-06	OVERGROWN	910
	17-Oct-06	670	10
	24-Nov-06	10	<10
Field Dup.	24-Nov-06	20	<10
	14-Dec-06	OVERGROWN	<10
Field Dup.	14-Dec-06	OVERGROWN	<10
S-25	17-Jan-06	520	10
	27-Feb-06	380	<10
	8-Mar-06	1080	10
Field Dup.	8-Mar-06	960	<10
	20-Apr-06	OVERGROWN	20
	27-May-06	1260	250
	29-Jun-06	- [2]	80
	25-Jul-06	1360	180
	6-Aug-06	1580	20
	18-Sep-06	OVERGROWN	680
	17-Oct-06	1100	260
	24-Nov-06	10	<10
	14-Dec-06	<10	<10

TABLE NM4-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME [(1)]			
Freshwater Aquatic Life		-	-
S-26	20-Apr-06	380	<10
	27-May-06	OVERGROWN	30
	29-Jun-06	- [2]	620
	25-Jul-06	OVERGROWN	550
	6-Aug-06	OVERGROWN	OVERGROWN
	18-Sep-06	OVERGROWN	690
	17-Oct-06	1930	310
	24-Nov-06	130	<10
S-27	20-Apr-06	420	<10
	27-May-06	OVERGROWN	40
S-28	17-Jan-06	60	<10
	27-Feb-06	320	<10
Field Dup.	27-Feb-06	310	<10
	8-Mar-06	670	30
	20-Apr-06	OVERGROWN	10
Field Dup.	20-Apr-06	OVERGROWN	20
	27-May-06	1420	210
	29-Jun-06	- [2]	70
Field Dup.	29-Jun-06	- [2]	90
	25-Jul-06	1490	670
	6-Aug-06	590	90
Field Dup.	6-Aug-06	840	100
	18-Sep-06	OVERGROWN	1360
Field Dup.	18-Sep-06	OVERGROWN	1520
	17-Oct-06	760	140
	24-Nov-06	10	<10
	14-Dec-06	10	<10
S-30	17-Jan-06	1760	310
	27-Feb-06	OVERGROWN	480
	8-Mar-06	OVERGROWN	1050
	20-Apr-06	OVERGROWN	50
	27-May-06	1920	150
	29-Jun-06	- [2]	110
	25-Jul-06	OVERGROWN	40
	6-Aug-06	OVERGROWN	660
	18-Sep-06	OVERGROWN	210
	17-Oct-06	1100	90
	24-Nov-06	570	50
	14-Dec-06	990	270
S-31	17-Jan-06	1880	270
	27-Feb-06	OVERGROWN	690
	8-Mar-06	OVERGROWN	1080
	20-Apr-06	OVERGROWN	50
	27-May-06	1080	140
	29-Jun-06	- [2]	140
	25-Jul-06	OVERGROWN	60
	6-Aug-06	OVERGROWN	860
	18-Sep-06	OVERGROWN	110
	17-Oct-06	590	110
	24-Nov-06	670	80
	14-Dec-06	960	240

TABLE NM4-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Sample No.	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME [(1)]			
Freshwater Aquatic Life		-	-
S-32	17-Jan-06	OVERGROWN	260
	27-Feb-06	OVERGROWN	470
	8-Mar-06	OVERGROWN	1510
	20-Apr-06	OVERGROWN	20
	27-May-06	1680	130
	29-Jun-06	- [2]	100
	25-Jul-06	OVERGROWN	60
	6-Aug-06	OVERGROWN	120
	18-Sep-06	OVERGROWN	100
	17-Oct-06	1850	90
	24-Nov-06	600	110
	14-Dec-06	1070	310
S-33	17-Jan-06	OVERGROWN	300
	27-Feb-06	OVERGROWN	430
	8-Mar-06	OVERGROWN	1600
	20-Apr-06	OVERGROWN	10
	27-May-06	1290	130
	29-Jun-06	- [2]	130
	25-Jul-06	<10	<10
	6-Aug-06	OVERGROWN	130
	18-Sep-06	OVERGROWN	120
	17-Oct-06	1630	70
	24-Nov-06	660	60
	14-Dec-06	910	180
S-34	17-Jan-06	OVERGROWN	300
	27-Feb-06	OVERGROWN	860
	8-Mar-06	OVERGROWN	1030
	20-Apr-06	OVERGROWN	30
	27-May-06	OVERGROWN	OVERGROWN
	29-Jun-06	- [2]	140
	25-Jul-06	OVERGROWN	40
	6-Aug-06	OVERGROWN	230
	18-Sep-06	OVERGROWN	30
	17-Oct-06	OVERGROWN	60
	24-Nov-06	630	140
	14-Dec-06	1080	190
S-35	20-Apr-06	OVERGROWN	10
S-36	20-Apr-06	1010	<10

Notes:

"-" = No Data

1. CCME 2003 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines Guidelines for Canadian Drinking Water Quality.
   Chapter 4 - Aquatic Life (1999, Updated 2003.)
2. Laboratory Error, the laboratory did not run the Total Coliform analysis as requested

BOLD - Exceedance of Criteria

TABLE NM4-5
HERBICIDES IN SURFACE WATER
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Location	Date	Parameter (1)						
		2,4-D	AMPA	Bromoxynil	Dicamba	Glyphosate	MCPA	Picloram
EQL		*0.05*	*1*	*0.02*	*0.02*	*1*	*0.05*	*0.2*
CCME (2)								
Freshwater Aquatic Life		4	-	5	10	65	2.6	29
CON D/S (Stn 19+900)	20-Apr-06	< 0.05	< 1	< 0.02	< 0.02	< 1	< 0.05	< 0.02
CON U/S (Stn 4+400)	20-Apr-06	< 0.05	< 1	< 0.02	< 0.02	< 1	< 0.05	< 0.02

Notes:
"-" = No Data
EQL = Estimated Quantitation Limit = The lowest level of the parameter that can be quantified with confidence
1. All values are expressed in micrograms per lite (µg/L).
2. CCME 2003 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines
   Guidelines for Canadian Drinking Water Quality.
   Chapter 4 - Aquatic Life (1999, Updated 2003.)

BOLD	- Parameter Detected
BOLD & Shaded	- Exceedance of Criteria

TABLE NM4-6
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN SURFACE WATER
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

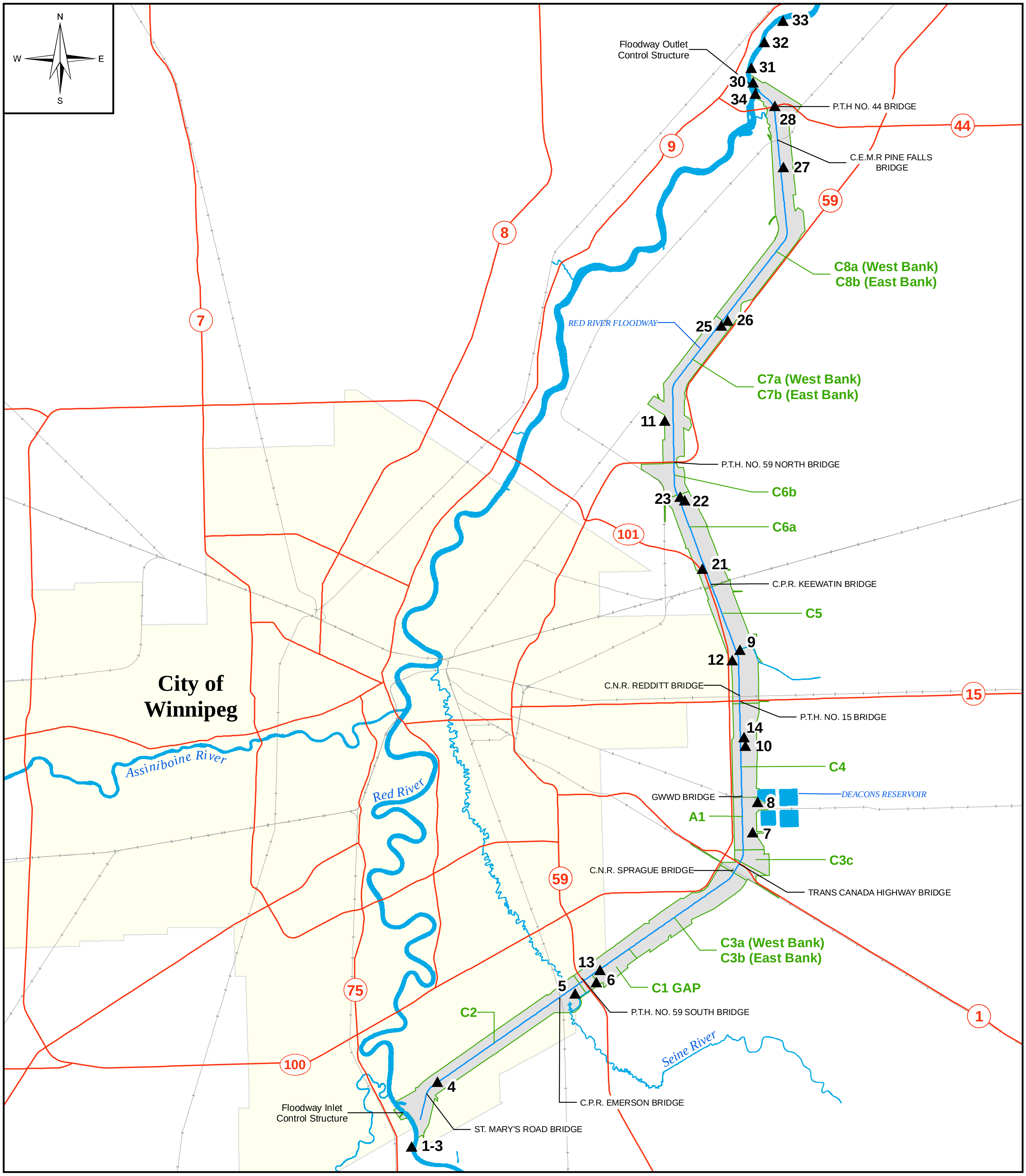
Sample ID	Date	Parameter (1)																	
		3-Methylcholanthrene	Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (k) fluoranthene	Benzo (g,h,i) perylene	Carbazole	Chrysene	Dibenzo (a,h) anthracene	Dibenzofuran	Dimethyl naphthalenes	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	Methyl anthracenes
Detection Limit		*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
CCME (2)																			
Freshwater Aquatic Life		-	5.800	-	0.012	0.018	0.015	-	-	-	-	-	-	-	-	0.040	3.000	-	-
SPRAGUE U/S	6-Aug-06	<0.01	<0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.02**	<0.01	<0.01
SPRAGUE D/S	6-Aug-06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
REDDITT D/S	6-Aug-06	<0.01	<0.01	**0.15**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.01**	<0.01	<0.01	**0.05**	<0.01	**0.02**	**0.09**	<0.01	<0.01

Sample ID	Date	Parameter (1)								
		Methyl naphthalenes	Napthalene	Pentachlorophenol	Phenanthrene	Pyrene	Nitrobenzene d5 (%)	2-Fluorobiphenyl (%)	p-Terphenyl d14 (%)	2,4,6-Tribromophenol (%)
Detection Limit		*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-	-	-
CCME (2)										
Freshwater Aquatic Life		-	1.100	-	0.400	0.025	-	-	-	-
SPRAGUE U/S	6-Aug-06	**0.02**	**0.02**	<0.01	**0.01**	<0.01	89	89	107	97
SPRAGUE D/S	6-Aug-06	<0.01	<0.01	<0.01	**0.01**	<0.01	87	90	108	98
REDDITT D/S	6-Aug-06	<0.01	**0.03**	<0.01	**0.05**	<0.01	84	85	104	94

Notes:
"-" = No Data
1. All values are expressed in micrograms per litre (µg/L) unless indicated otherwise.
2. CCME - Chapter 4: Canadian Water Quality Guidelines For the Protection of Aquatic Life, Update October 2005.

BOLD	- Parameter Detected
BOLD & Shaded	- Exceedance of Criteria

FIGURES



▲ 10 Surface Water Sampling Locations

C2 Contract Reference Locations

1:200,000

0 1 2 4 6 8 10

Kilometres

MEMO REFERENCE 05-1100-01.9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

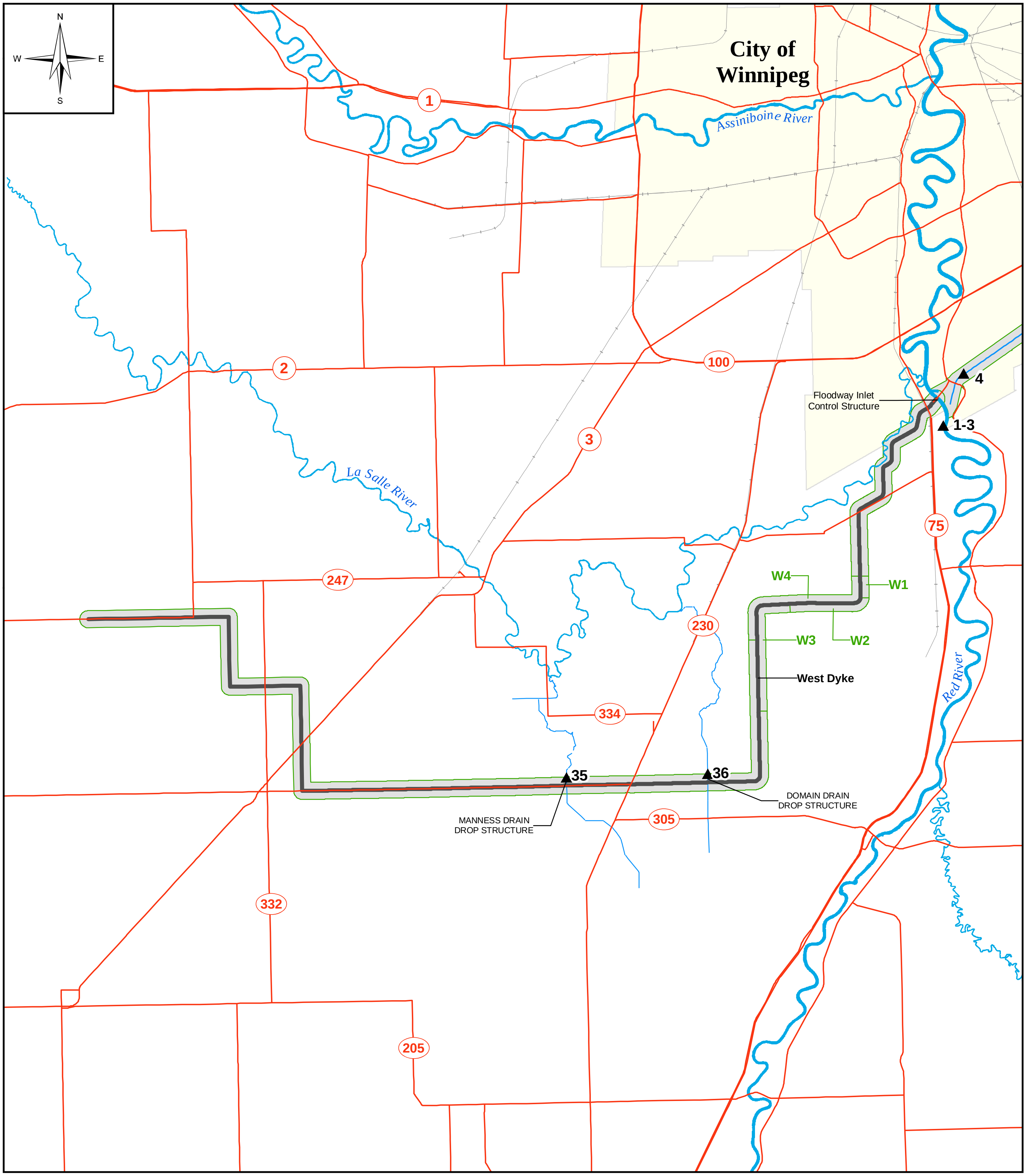
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

FLOODWAY CHANNEL SAMPLE LOCATIONS

APRIL 2006	FIGURE NM4-1	REV A

X:\projects\2003\03-1100-01\GIS\Archive\Contract_General\9905210\PDFs\NM4-1.pdf



▲ 35 Surface Water Sampling Locations

W2 Contract Reference Locations

MEMO REFERENCE 05-1100-01.9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

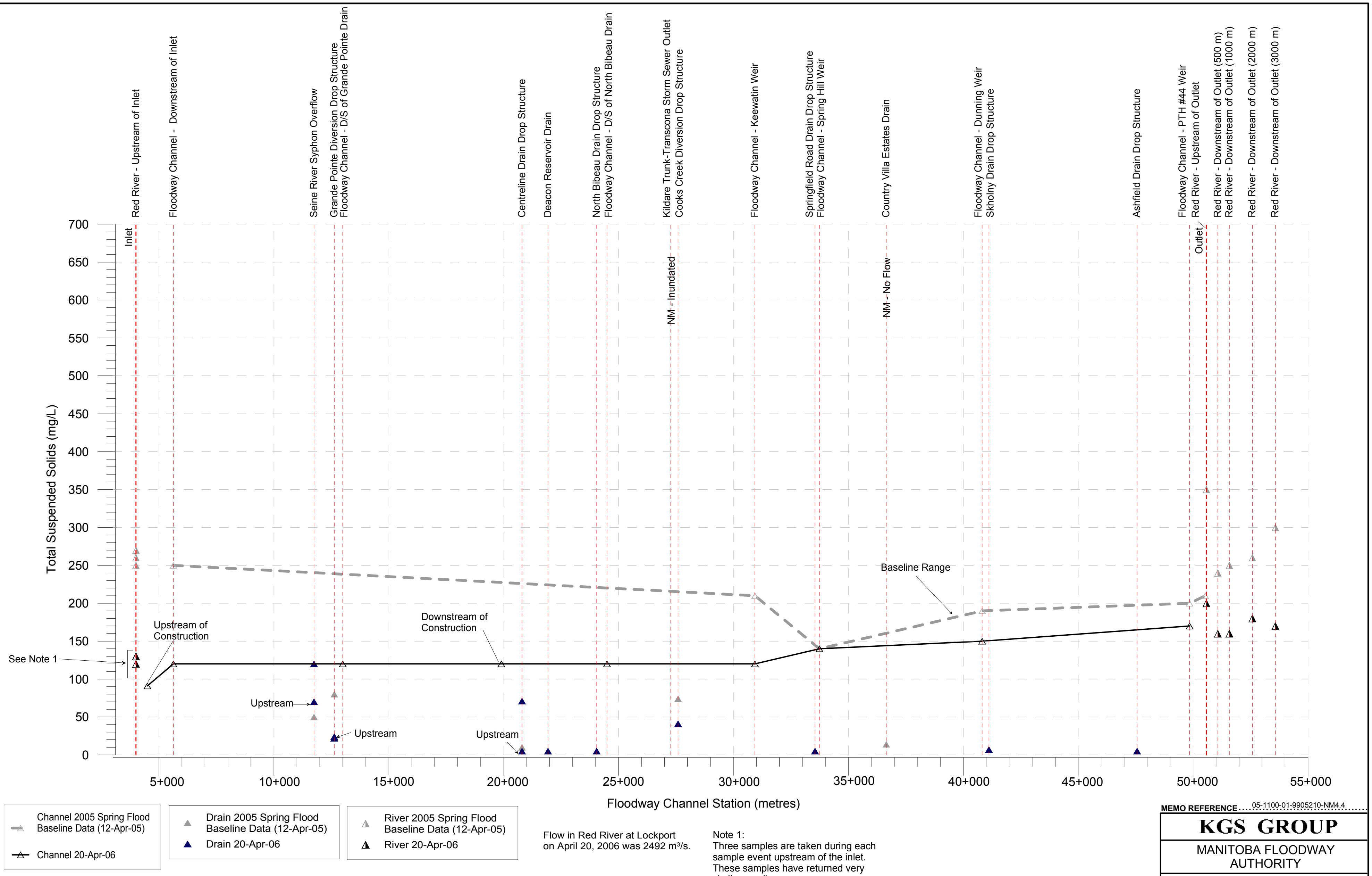
RED RIVER FLOODWAY EXPANSION

2006 CONSRTUCTION SURFACE WATER MONITORING

WEST DYKE SAMPLE LOCATIONS

APRIL 2006	FIGURE NM4-2	REV A

X:\projects\2003\03-1100-01\GIS\Archive\Contract_General\9905210\PDFs\NM4-2.pdf



Flow in Red River at Lockport on April 20, 2006 was 2492 m³/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905210-NM4.4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

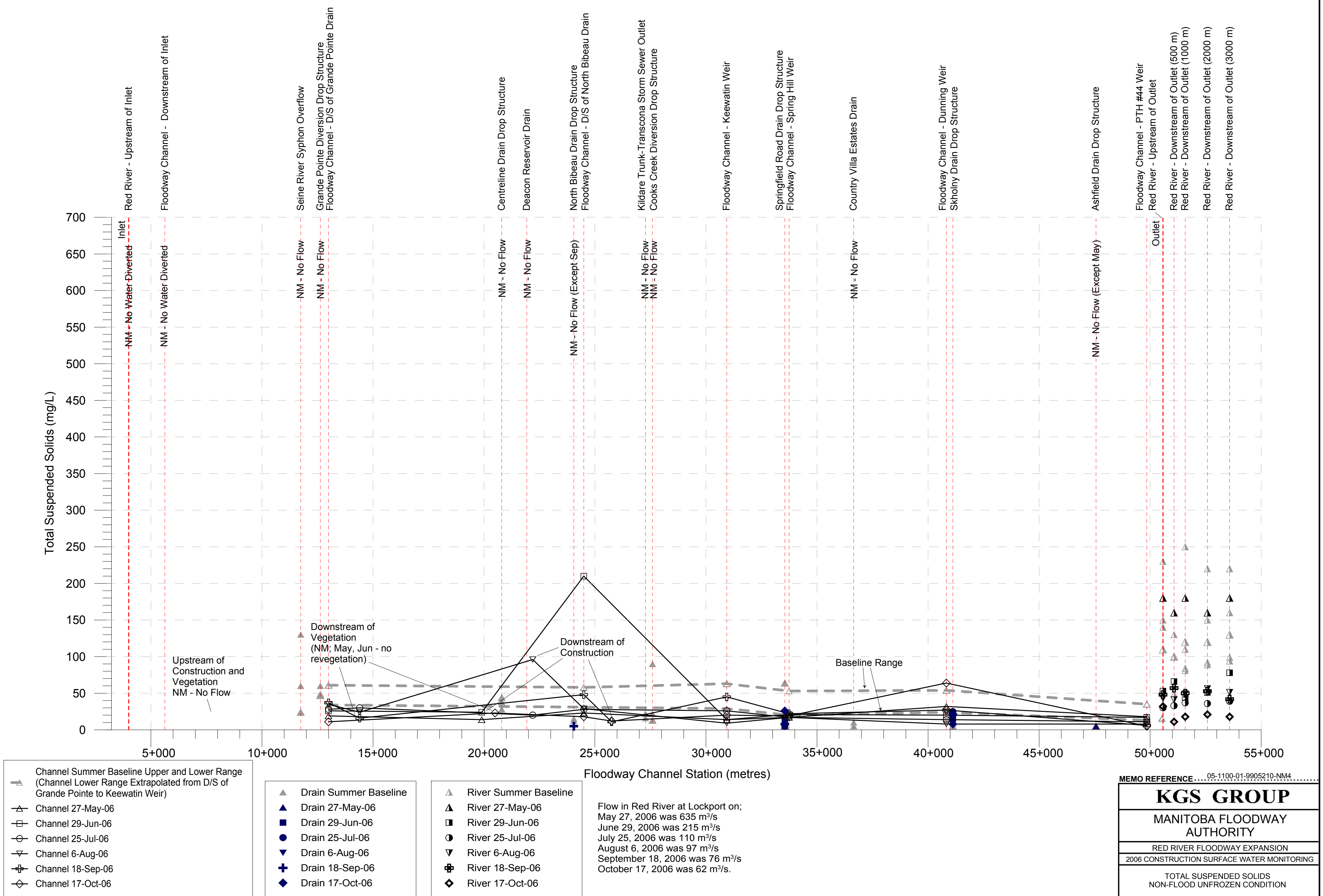
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

TOTAL SUSPENDED SOLIDS
SPRING FLOOD CONDITION

FEBRUARY 2007	FIGURE NM4-3	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-3_TSSconstruction_Spring Flood.grf



Flow in Red River at Lockport on;
May 27, 2006 was 635 m³/s
June 29, 2006 was 215 m³/s
July 25, 2006 was 110 m³/s
August 6, 2006 was 97 m³/s
September 18, 2006 was 76 m³/s
October 17, 2006 was 62 m³/s.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

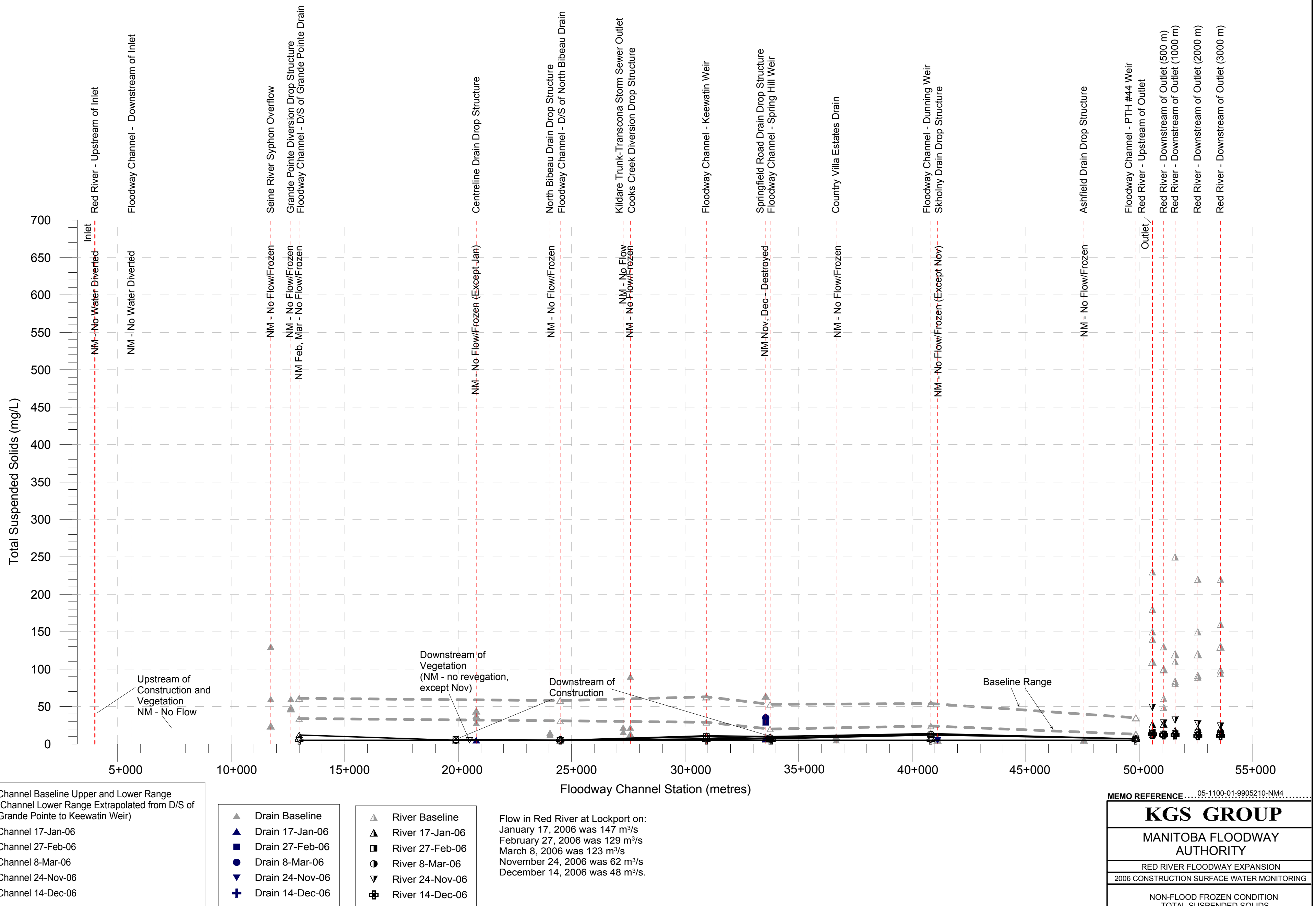
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

TOTAL SUSPENDED SOLIDS
NON-FLOOD UNFROZEN CONDITION

FEBRUARY 2007	FIGURE NM4-4	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-4_TSSconstruction_Non-Flood Unfrozen.grf



Flow in Red River at Lockport on:
January 17, 2006 was 147 m^3/s
February 27, 2006 was 129 m^3/s
March 8, 2006 was 123 m^3/s
November 24, 2006 was 62 m^3/s
December 14, 2006 was 48 m^3/s.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

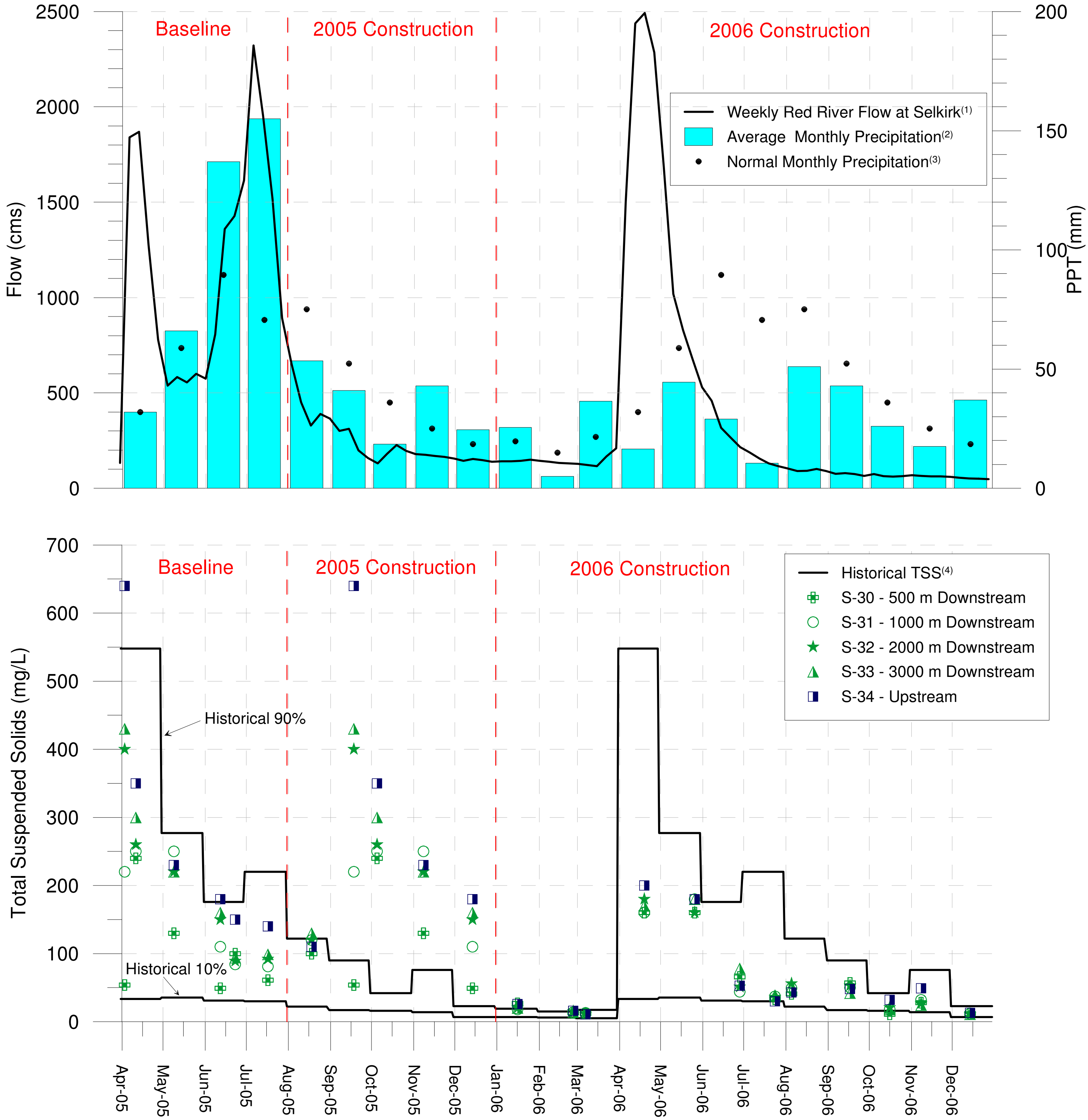
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD FROZEN CONDITION
TOTAL SUSPENDED SOLIDS

FEBRUARY 2007 | FIGURE NM4-5 | REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-5_TSSconstruction_Non-Flood Frozen.grf



Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
4 - Historical Data obtained from the Proposed Floodway Expansion Project Environmental Assessment Report
Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10th and 90th percentile.
Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 at Selkirk (downstream of the Floodway Outlet).

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\Graphs

MEMO REFERENCE 05-1100-01-9905210-NM4

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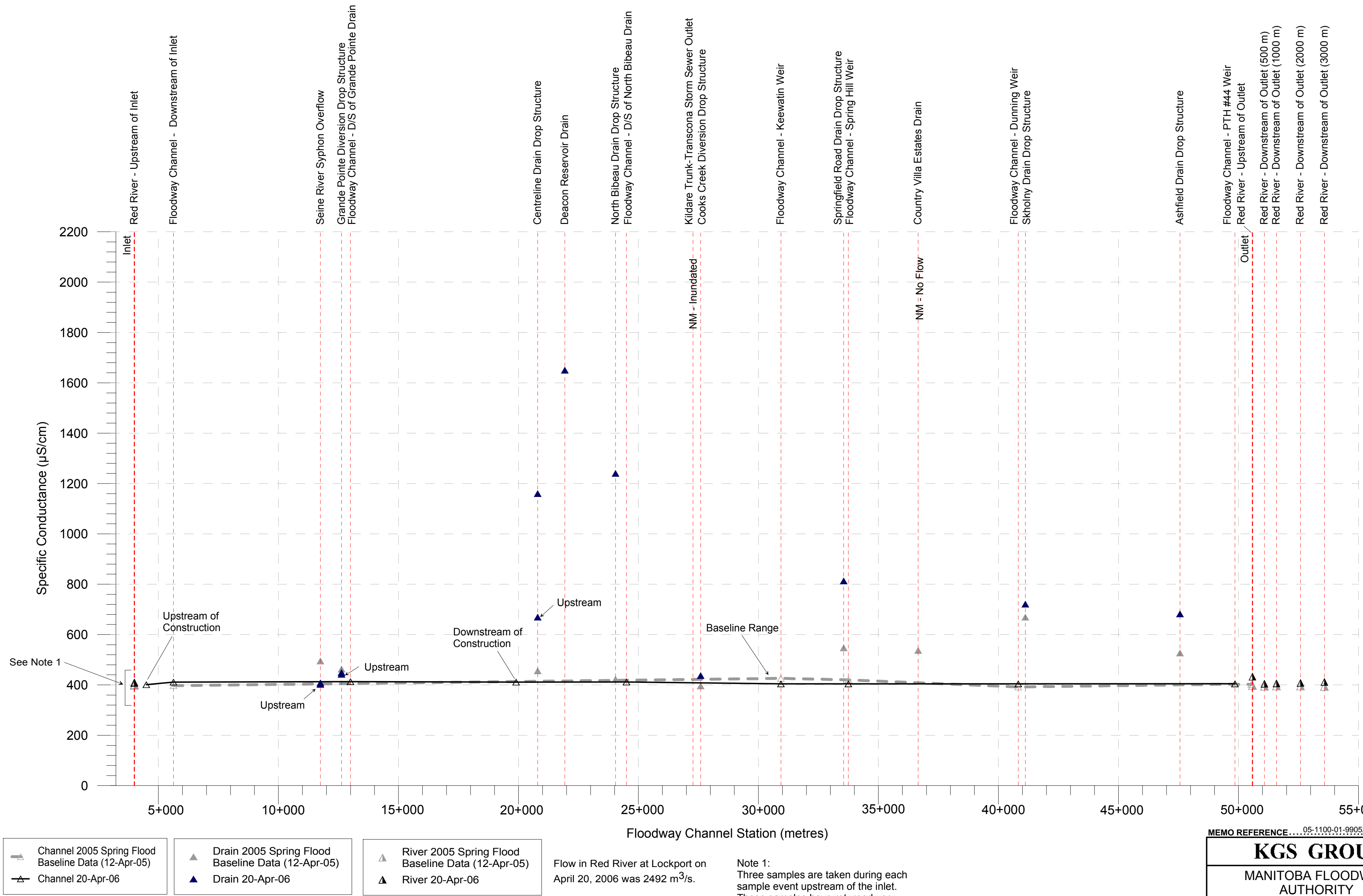
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING

HISTORICAL WATER QUALITY COMPARISON
RED RIVER AT FLOODWAY OUTLET
TOTAL SUSPENDED SOLIDS

FEBRUARY 2007	FIGURE NM4-6	REV 0



Flow in Red River at Lockport on April 20, 2006 was 2492 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

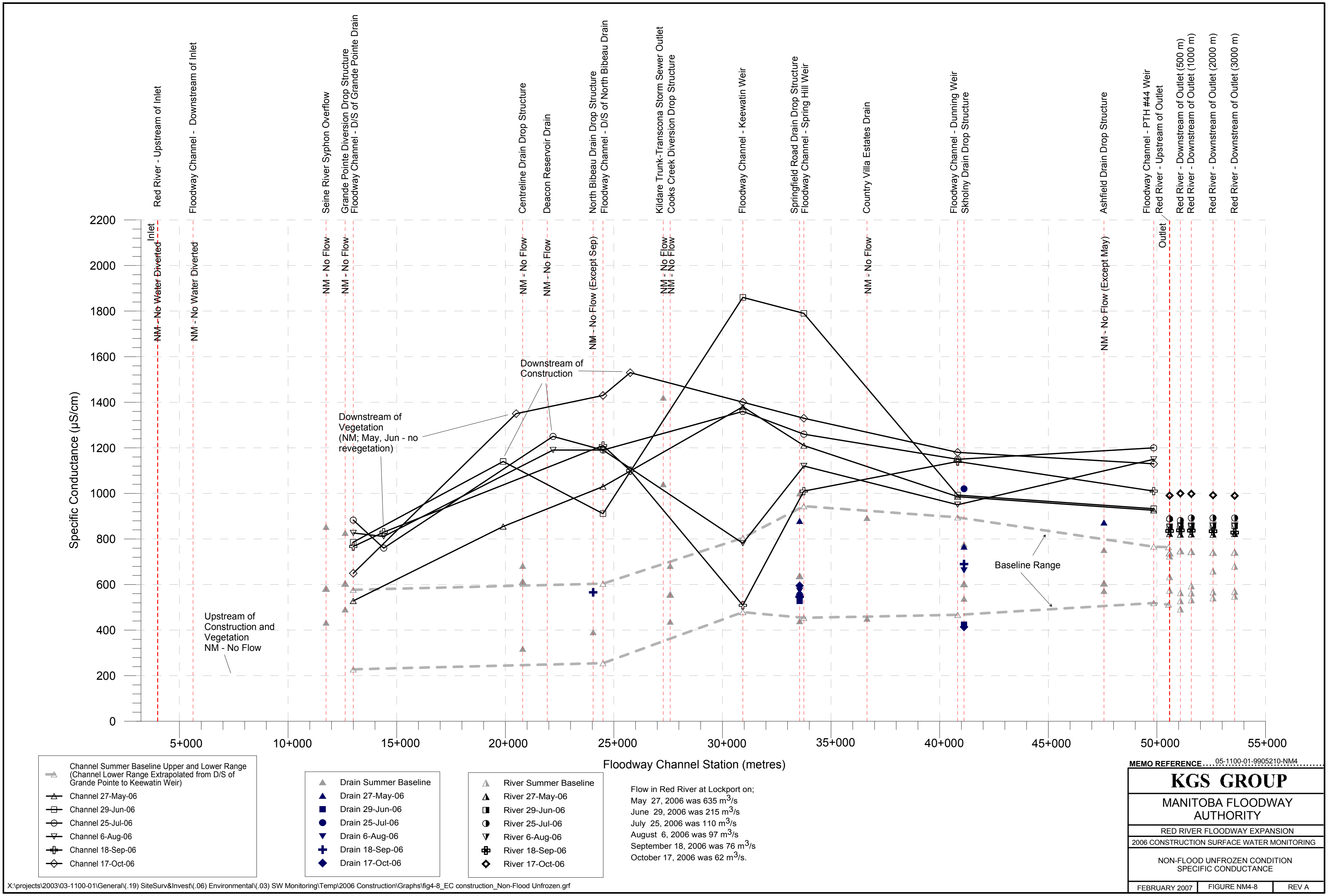
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

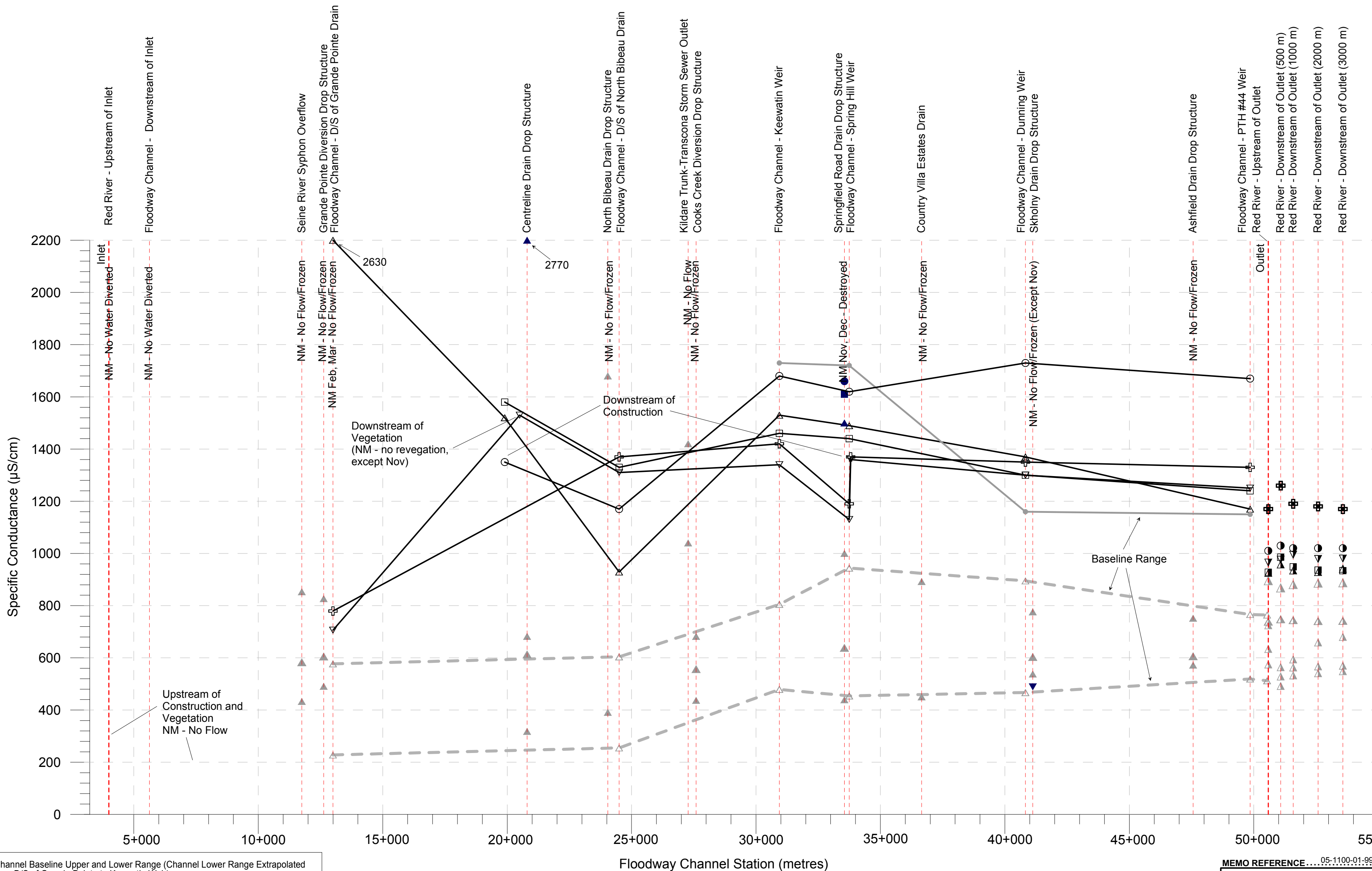
SPECIFIC CONDUCTANCE
SPRING FLOOD CONDITION

FEBRUARY 2007	FIGURE NM4-7	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\figNM4-7_EC construction_Spring Flood.grf



Red River - Upstream of Inlet
Floodway Channel - Downstream of Inlet
Seine River Syphon Overflow
Grande Pointe Diversion Drop Structure
Floodway Channel - D/S of Grande Pointe Drain
Centreline Drain Drop Structure
Deacon Reservoir Drain
North Bibeau Drain Drop Structure
Floodway Channel - D/S of North Bibeau Drain
Kildare Trunk-Transcona Storm Sewer Outlet
Cooks Creek Diversion Drop Structure
Floodway Channel - Keewatin Weir
Springfield Road Drain Drop Structure
Floodway Channel - Spring Hill Weir
Country Villa Estates Drain
Floodway Channel - Dunning Weir
Skholny Drain Drop Structure
Ashfield Drain Drop Structure
Floodway Channel - PTH #44 Weir
Red River - Upstream of Outlet
Red River - Downstream of Outlet (500 m)
Red River - Downstream of Outlet (1000 m)
Red River - Downstream of Outlet (2000 m)
Red River - Downstream of Outlet (3000 m)
Inlet
Outlet
NM - No Water Diverted
NM - No Water Diverted
NM - No Flow
NM - No Flow
NM - No Flow
NM - No Flow
NM - No Flow (Except Sep)
NM - No Flow
NM - No Flow
NM - No Flow
NM - No Flow (Except May)
Downstream of Construction
Downstream of Vegetation (NM; May, Jun - no revegetation)
Upstream of Construction and Vegetation NM - No Flow
Baseline Range
Specific Conductance (µS/cm)
Floodway Channel Station (metres)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
5+000
10+000
15+000
20+000
25+000
30+000
35+000
40+000
45+000
50+000
55+000
Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 27-May-06
Channel 29-Jun-06
Channel 25-Jul-06
Channel 6-Aug-06
Channel 18-Sep-06
Channel 17-Oct-06
Drain Summer Baseline
Drain 27-May-06
Drain 29-Jun-06
Drain 25-Jul-06
Drain 6-Aug-06
Drain 18-Sep-06
Drain 17-Oct-06
River Summer Baseline
River 27-May-06
River 29-Jun-06
River 25-Jul-06
River 6-Aug-06
River 18-Sep-06
River 17-Oct-06
Flow in Red River at Lockport on;
May 27, 2006 was 635 m3/s
June 29, 2006 was 215 m3/s
July 25, 2006 was 110 m3/s
August 6, 2006 was 97 m3/s
September 18, 2006 was 76 m3/s
October 17, 2006 was 62 m3/s.
MEMO REFERENCE 05-1100-01-9905210-NM4
KGS GROUP
MANITOBA FLOODWAY AUTHORITY
RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING
NON-FLOOD UNFROZEN CONDITION SPECIFIC CONDUCTANCE
FEBRUARY 2007
FIGURE NM4-8
REV A
X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\fig4-8_EC construction_Non-Flood Unfrozen.grf



- Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
- Channel Winter Baseline (Baseflow, Groundwater Discharge Conditions Sampled March 2005)
- Channel 17-Jan-06
- Channel 27-Feb-06
- Channel 8-Mar-06
- Channel 24-Nov-06
- Channel 14-Dec-06

- Drain Baseline
- Drain 17-Jan-06
- Drain 27-Feb-06
- Drain 8-Mar-06
- Drain 24-Nov-06
- Drain 14-Dec-06

- River Baseline
- River 17-Jan-06
- River 27-Feb-06
- River 8-Mar-06
- River 24-Nov-06
- River 14-Dec-06

Flow in Red River at Lockport on:
January 17, 2006 was 147 m^3/s
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MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

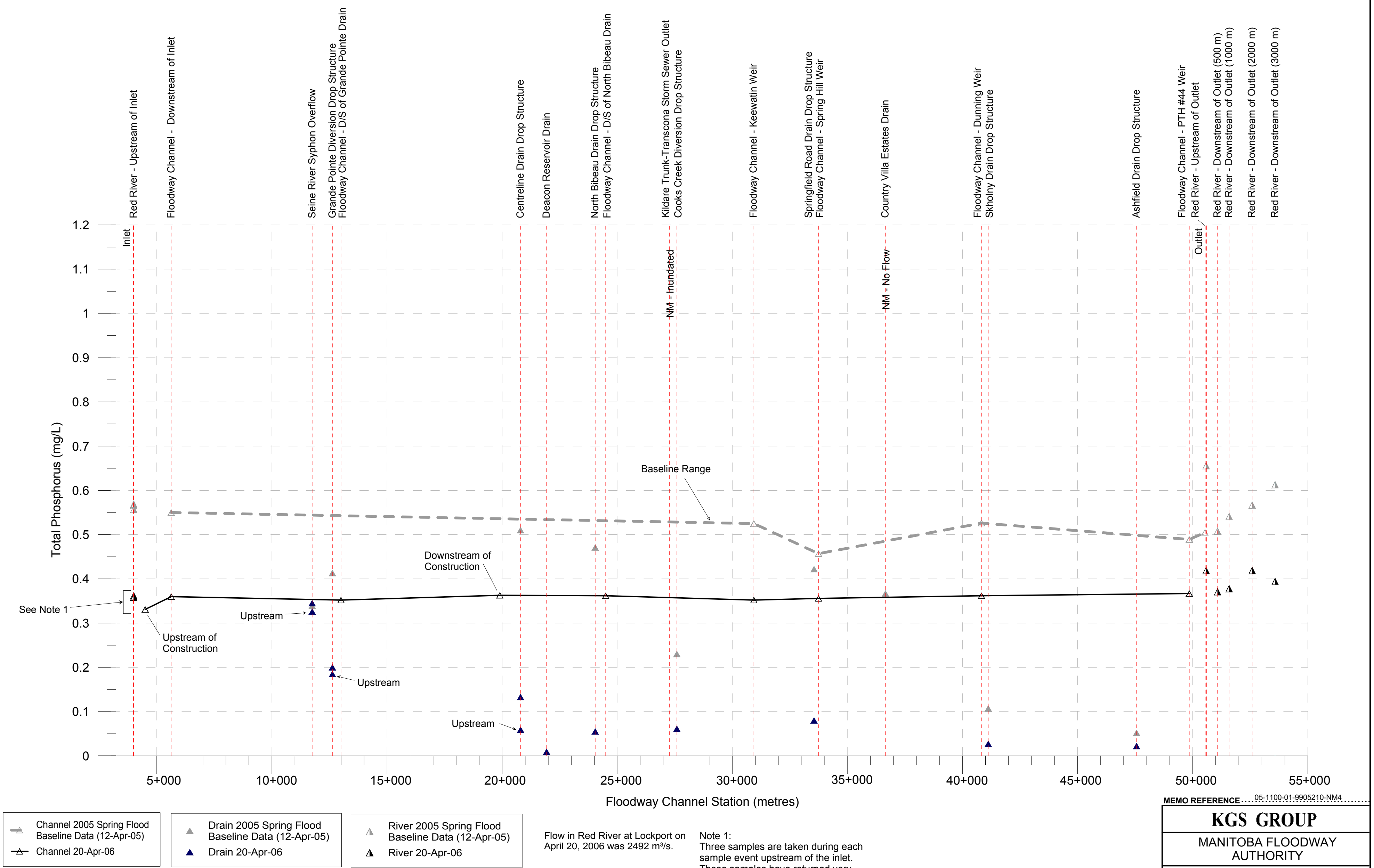
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD FROZEN CONDITION
SPECIFIC CONDUCTANCE

FEBRUARY 2007	FIGURE NM4-9	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\figNM4-9_EC construction_Non-Flood Frozen.grf



Flow in Red River at Lockport on April 20, 2006 was 2492 m³/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

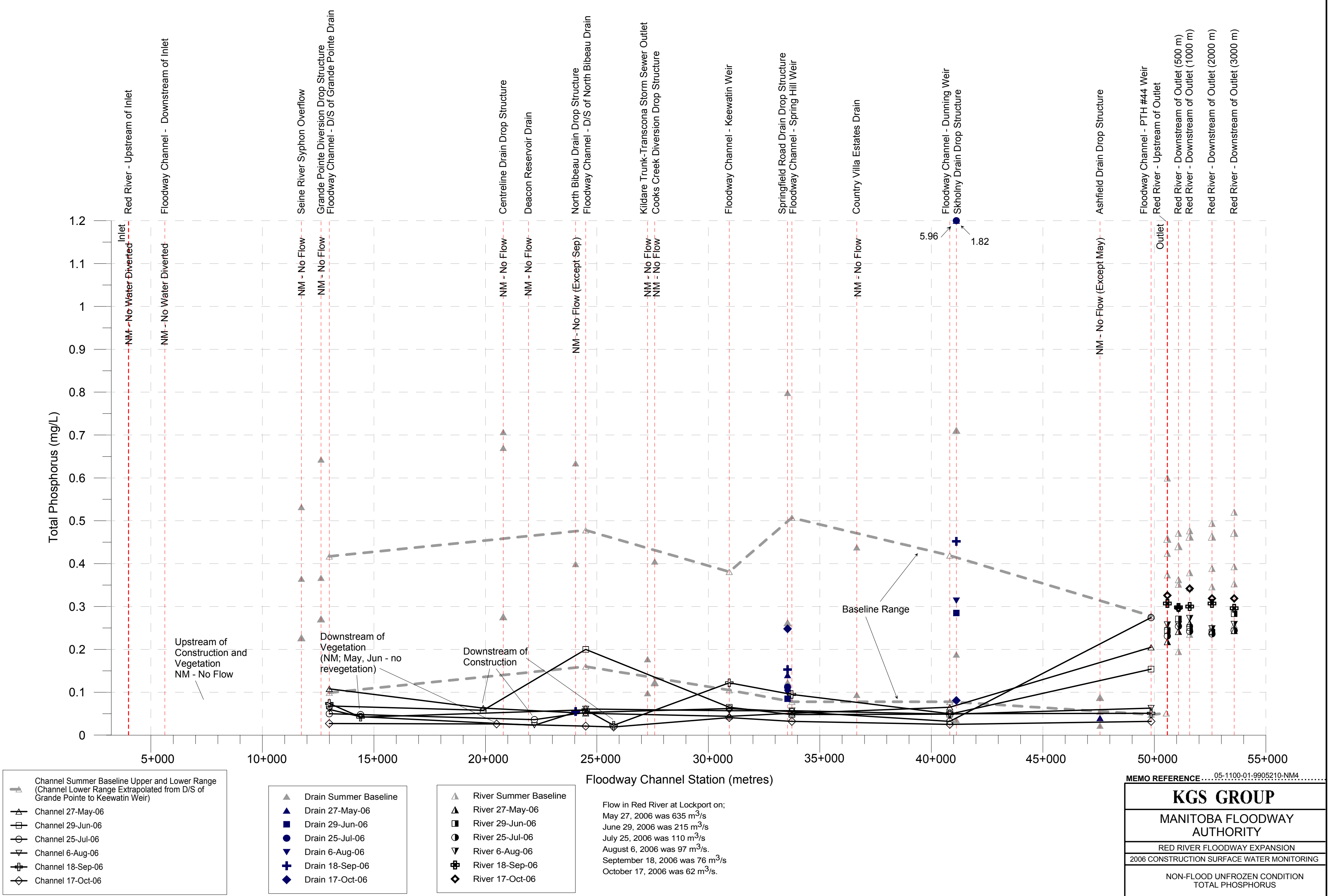
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

TOTAL PHOSPHORUS
SPRING FLOOD CONDITION

FEBRUARY 2007	FIGURE NM4-10	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-10_Phosphorus construction_Spring Flood.grf



Flow in Red River at Lockport on;
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MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

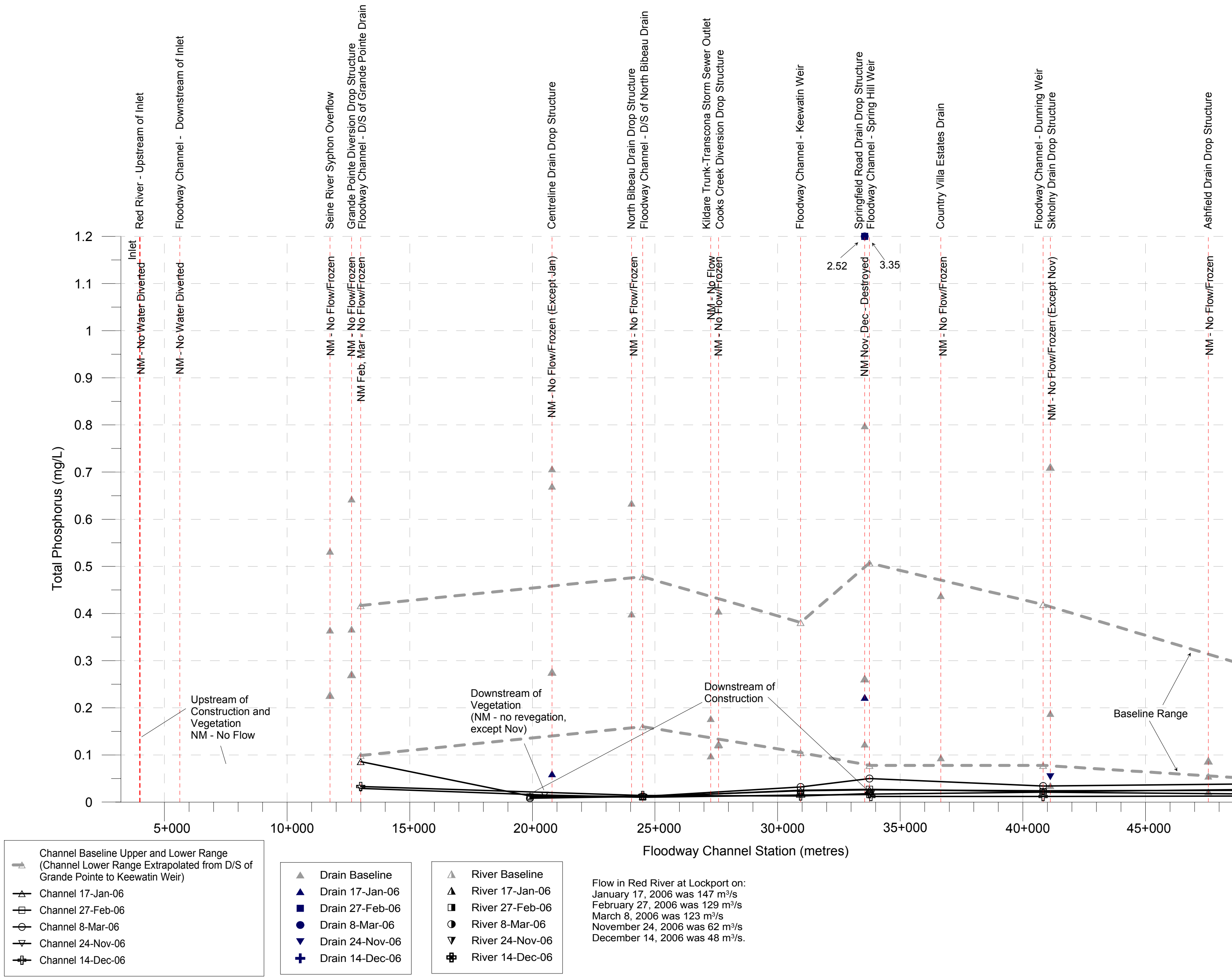
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD UNFROZEN CONDITION
TOTAL PHOSPHORUS

FEBRUARY 2007	FIGURE NM4-11	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\Fig4-11_Phosphorus construction_Non-Flood Unfrozen.grf



MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

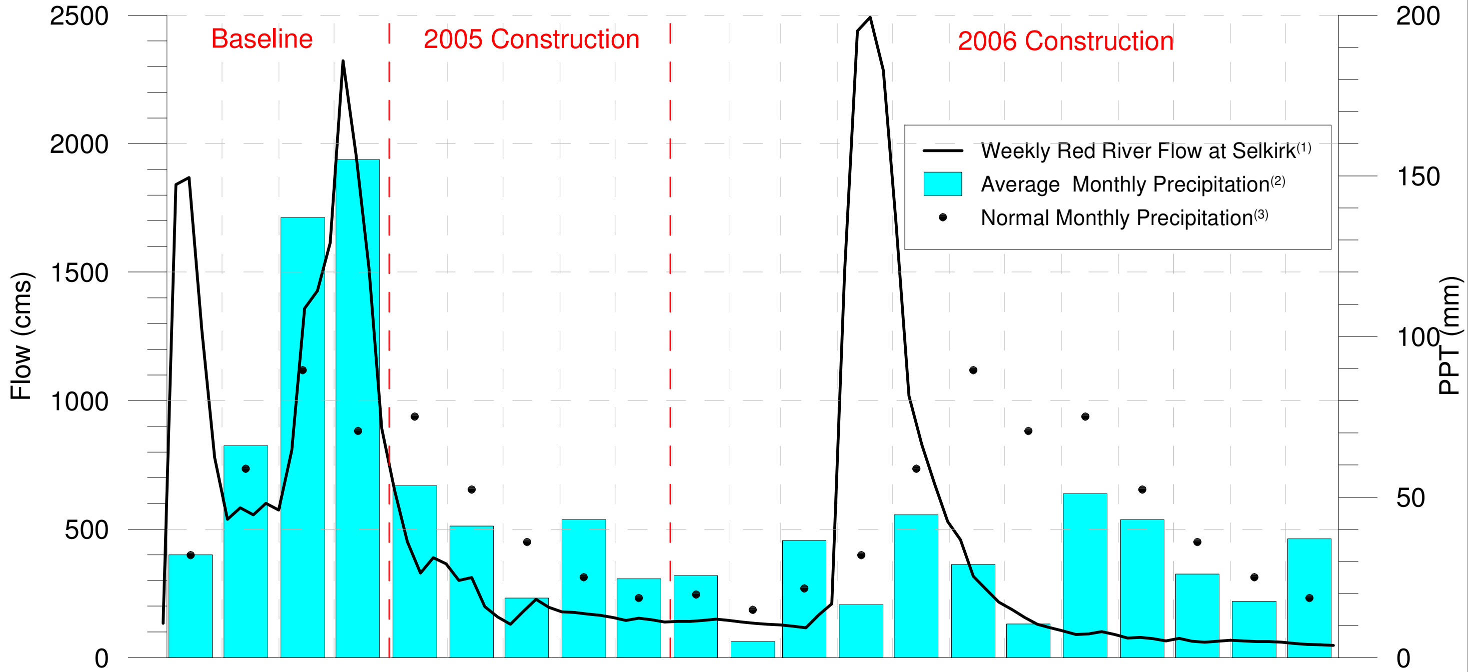
RED RIVER FLOODWAY EXPANSION

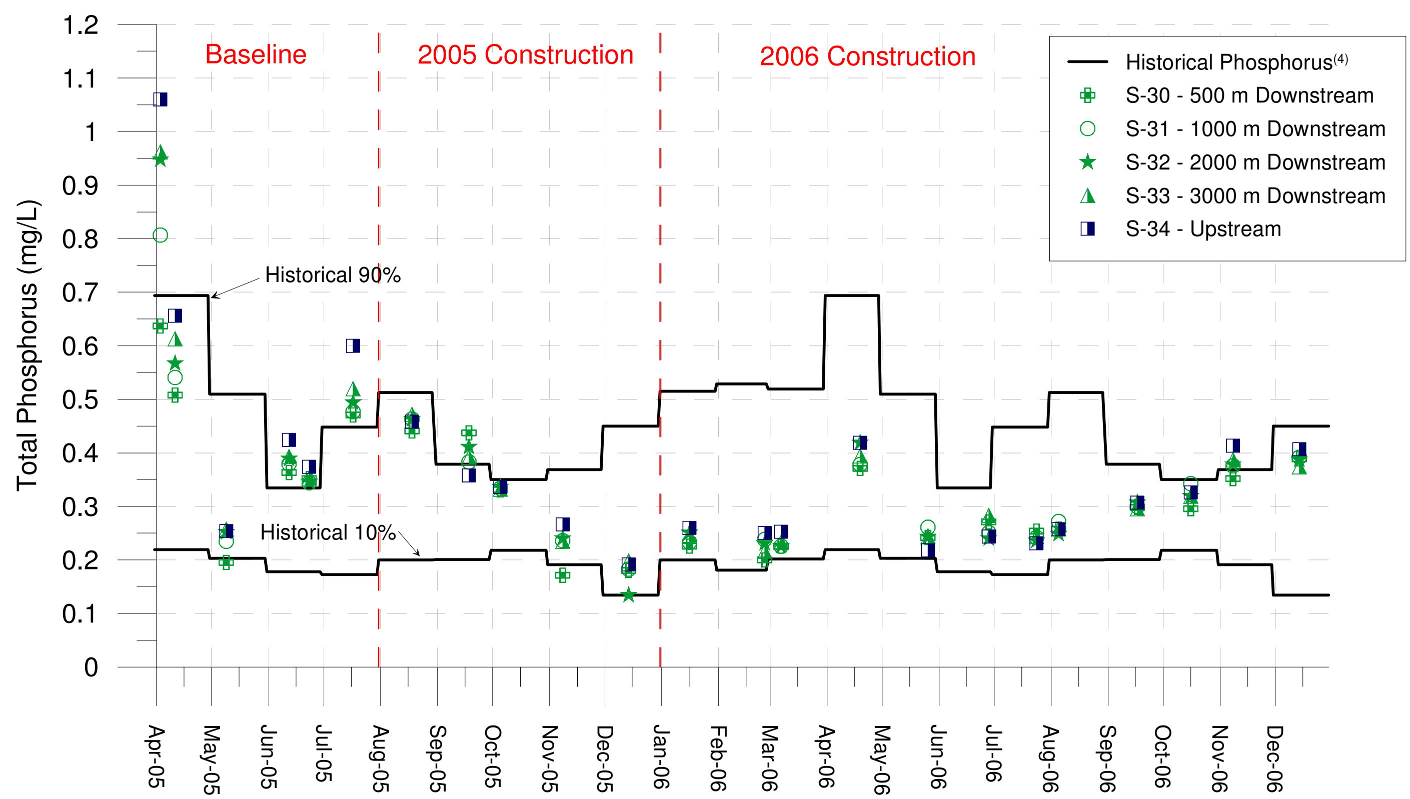
2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD FROZEN CONDITION
TOTAL PHOSPHORUS

FEBRUARY 2007	FIGURE NM4-12	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-12_Phosphorus construction_Non-Flood Frozen.grf





Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
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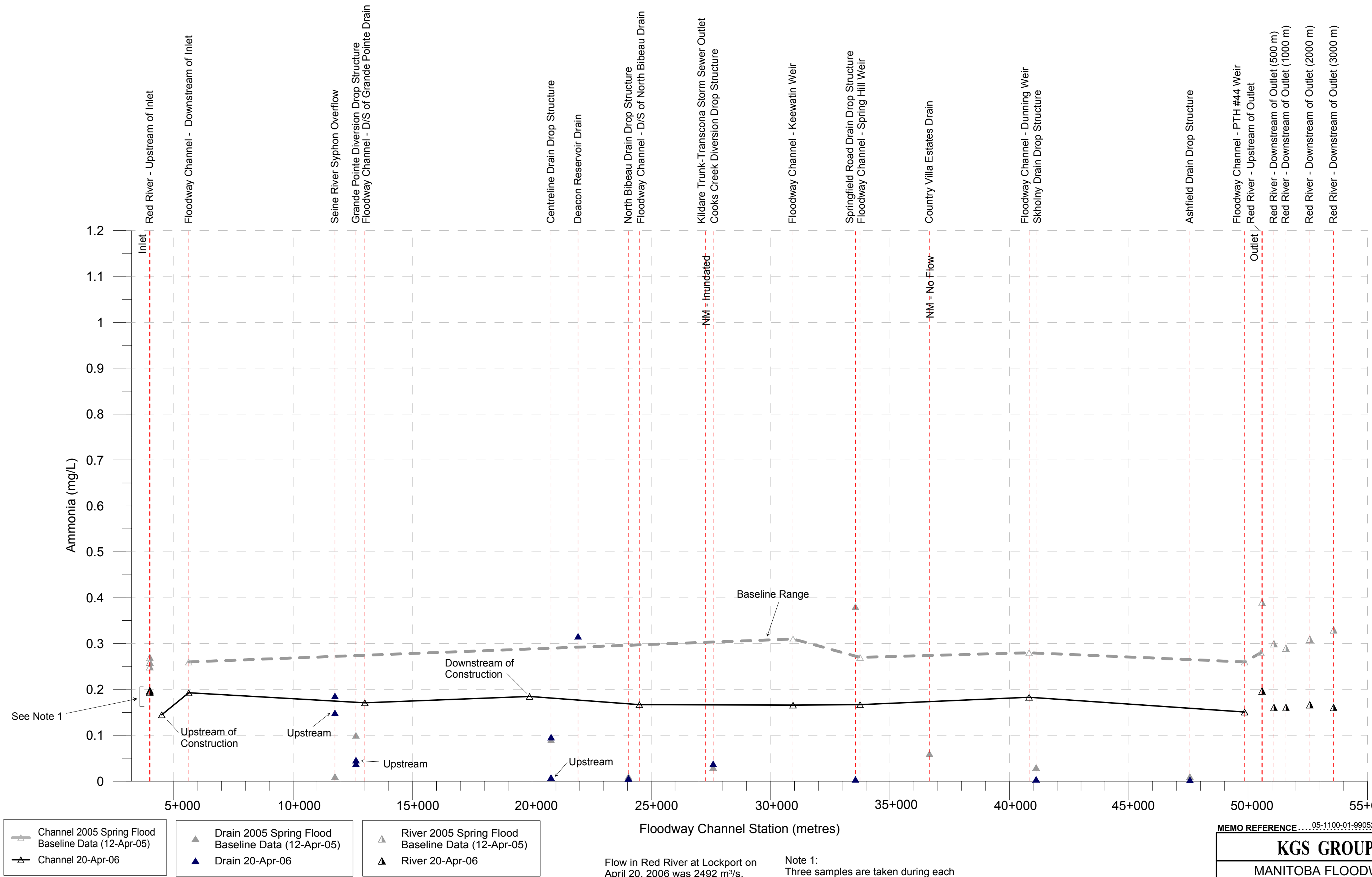
Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10^{th} and 90^{th} percentile. Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 at Selkirk (downstream of the Floodway Outlet).

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP		
MANITOBA FLOODWAY AUTHORITY		
RED RIVER FLOODWAY EXPANSION		
2006 CONSTRUCTION SURFACE WATER MONITORING		
HISTORICAL WATER QUALITY COMPARISON RED RIVER AT FLOODWAY OUTLET TOTAL PHOSPHORUS		
FEBRUARY 2007	FIGURE NM4-13	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\Graphs



Flow in Red River at Lockport on April 20, 2006 was 2492 m³/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

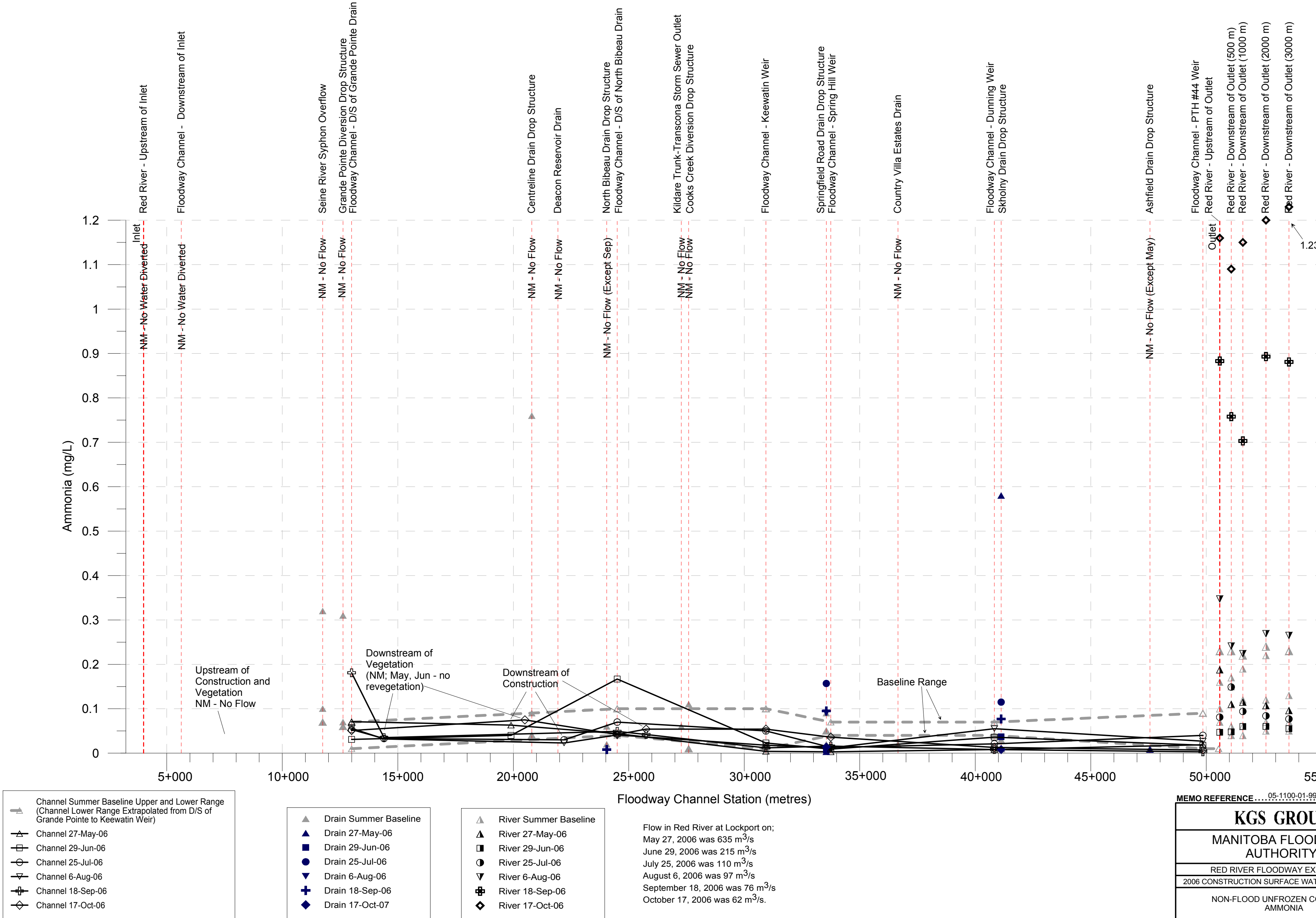
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

AMMONIA
SPRING FLOOD CONDITION

FEBRUARY 2007 | FIGURE NM4-14 | REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\Graphs\FigNM4-14_Ammonia construction_Spring Flood.grf



Flow in Red River at Lockport on;
May 27, 2006 was 635 m^3/s
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MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

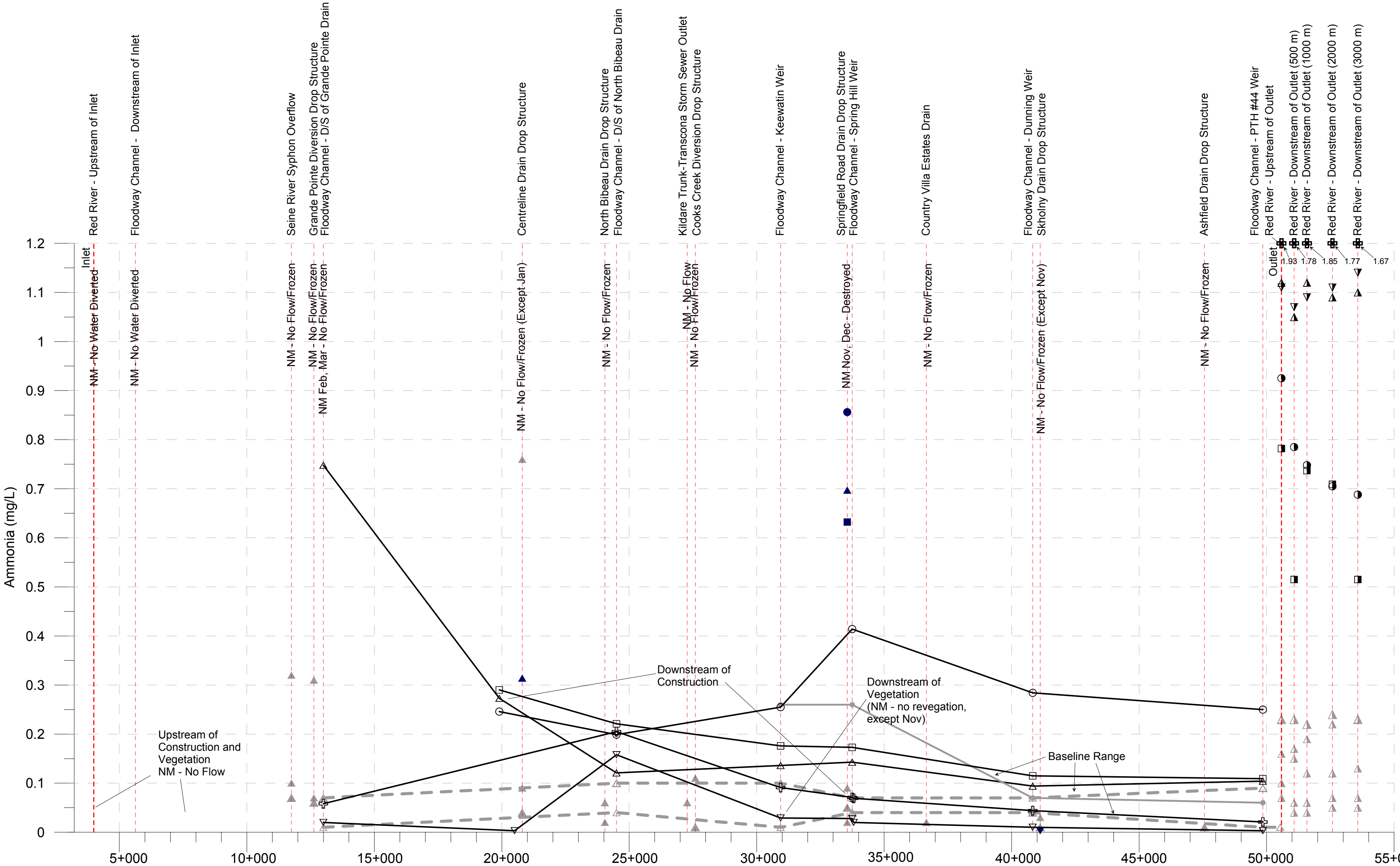
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD UNFROZEN CONDITION AMMONIA

FEBRUARY 2007	FIGURE NM4-15	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\Graphs\Fig4-15_Ammonia construction_Non-Flood Unfrozen.grf



Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel Winter Baseline (Baseflow, Groundwater Discharge Conditions Sampled March 2005)
Channel 17-Jan-06
Channel 27-Feb-06
Channel 8-Mar-06
Channel 24-Nov-06
Channel 14-Dec-06

Drain Baseline
Drain 17-Jan-06
Drain 27-Feb-06
Drain 8-Mar-06
Drain 24-Nov-06
Drain 14-Dec-06

River Baseline
River 17-Jan-06
River 27-Feb-06
River 8-Mar-06
River 24-Nov-06
River 14-Dec-06

Flow in Red River at Lockport on:
January 17, 2006 was 147 m^3/s
February 27, 2006 was 129 m^3/s
March 8, 2006 was 123 m^3/s
November 24, 2006 was 62 m^3/s
December 14, 2006 was 48 m^3/s.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

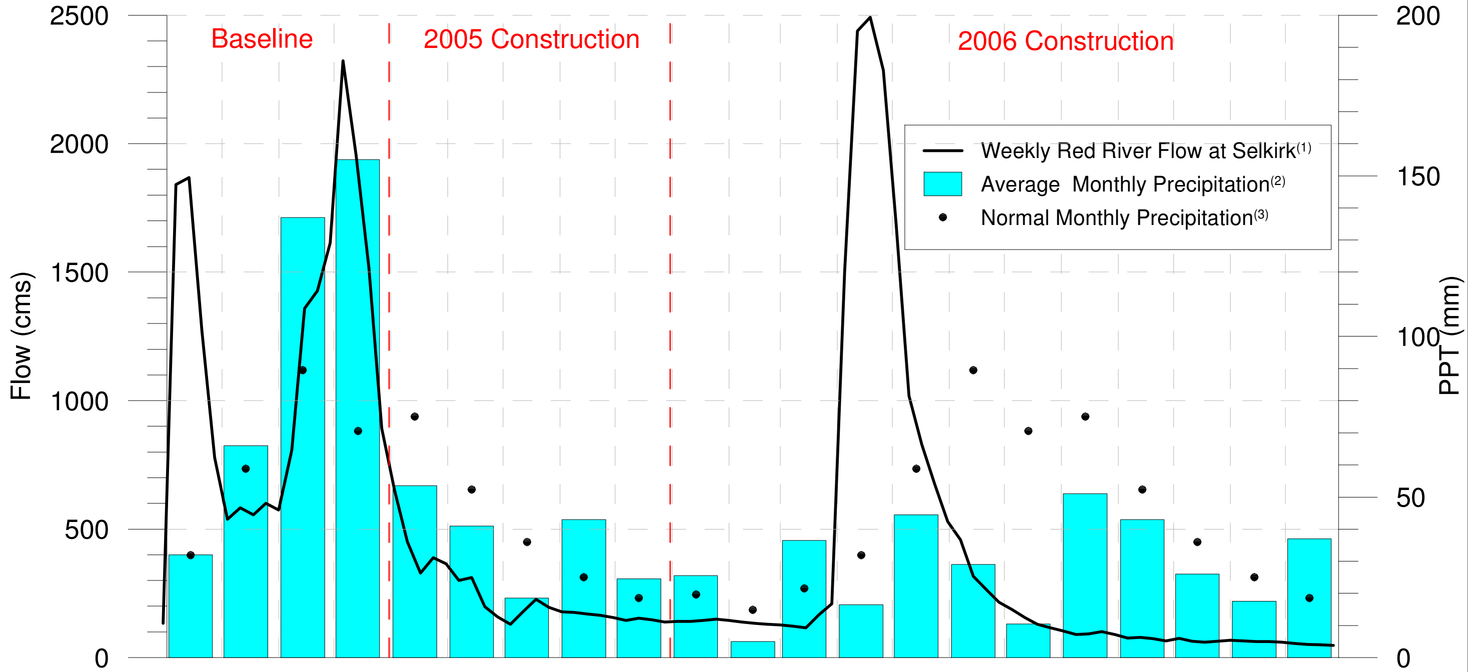
MANITOBA FLOODWAY AUTHORITY

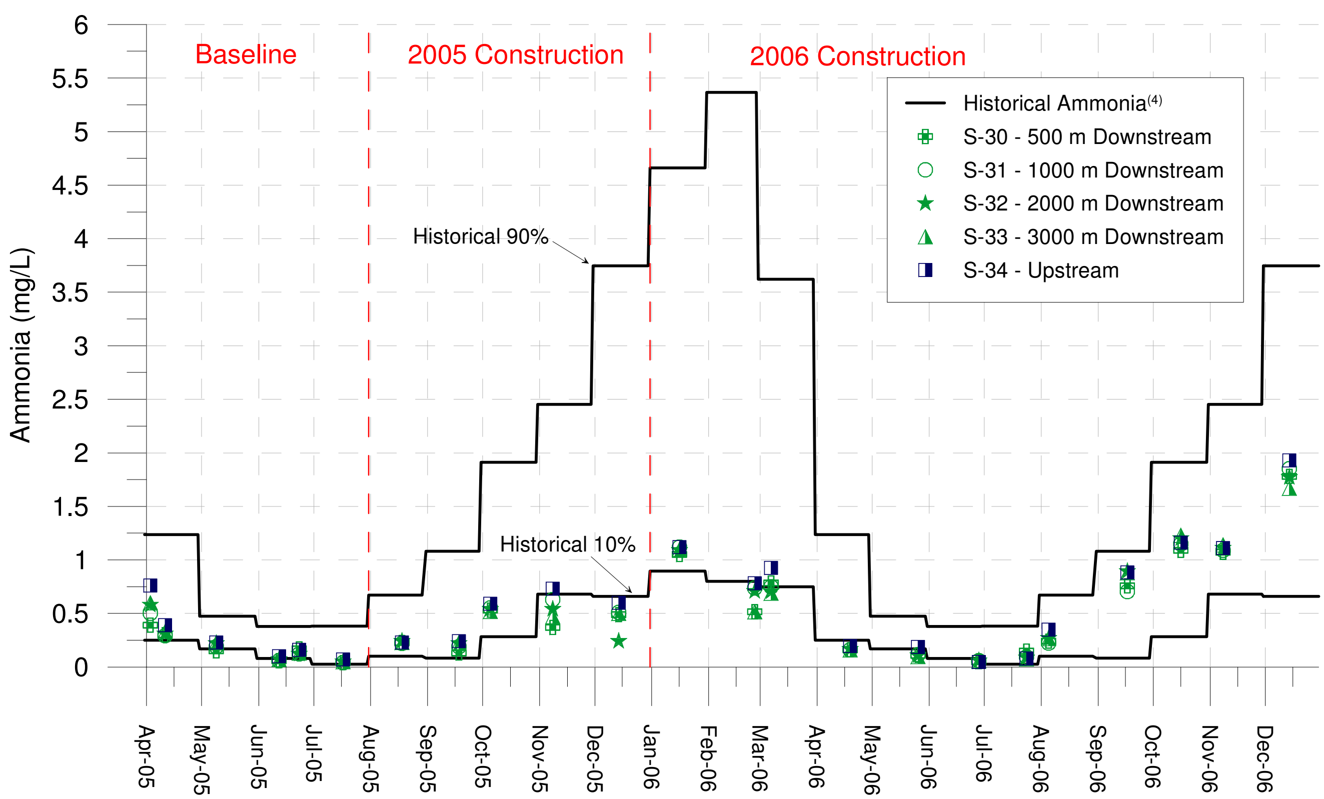
RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD FROZEN CONDITION
AMMONIA

FEBRUARY 2007	FIGURE NM4-16	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\Graphs\FigNM4-16_Ammonia construction_Non-Flood Frozen.grf





Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
4 - Historical Data obtained from the Proposed Floodway Expansion Project Environmental Assessment Report Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10th and 90th percentile. Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 at Selkirk (downstream of the Floodway Outlet).

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\Graphs

MEMO REFERENCE 05-1100-01-9905210-NM4

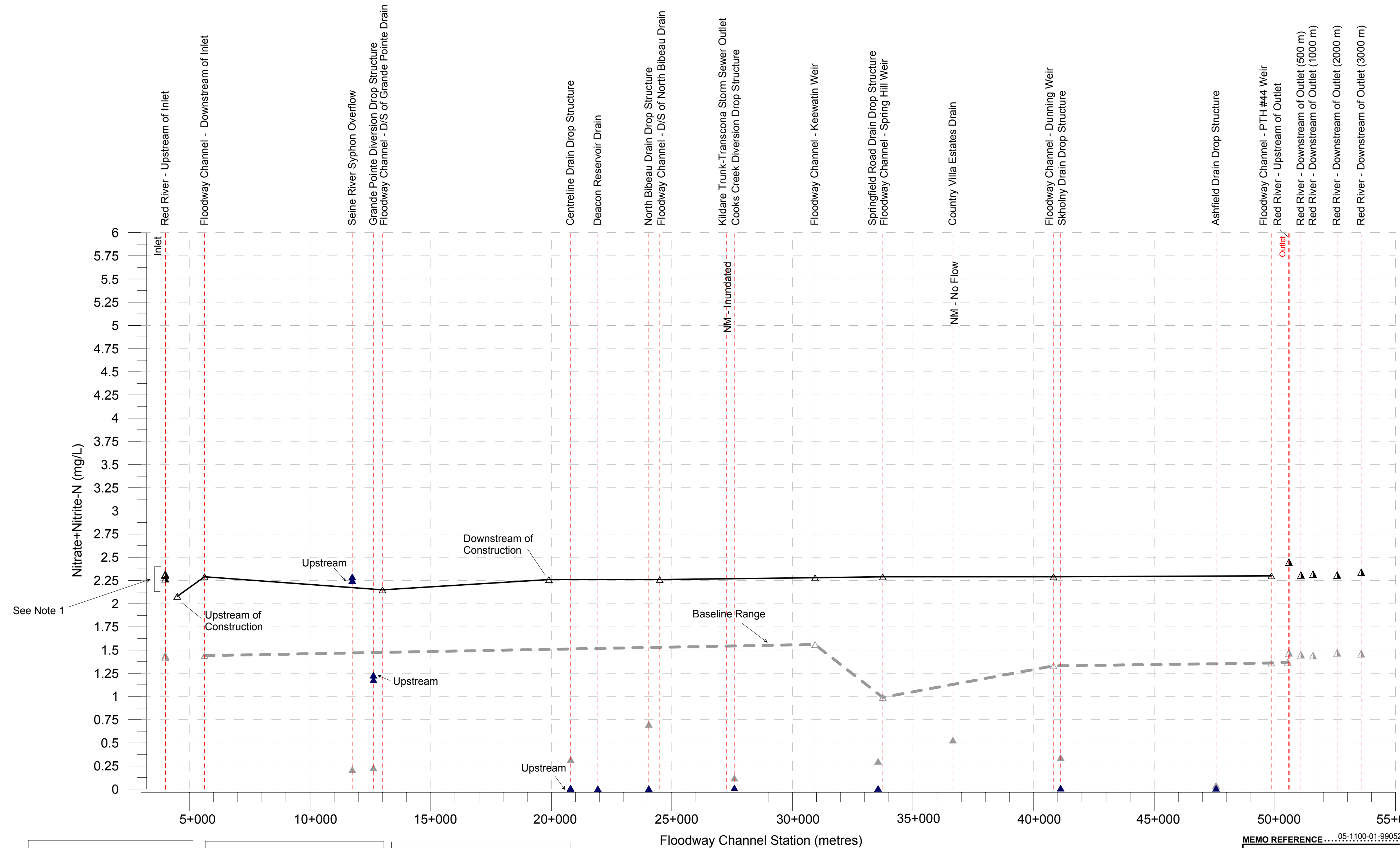
KGS GROUP

MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING

HISTORICAL WATER QUALITY COMPARISON
RED RIVER AT FLOODWAY OUTLET
AMMONIA

FEBRUARY 2007	FIGURE NM4-17	REV 0



Channel 2005 Spring Flood Baseline Data (12-Apr-05)	Channel 20-Apr-06
Drain 2005 Spring Flood Baseline Data (12-Apr-05)	Drain 20-Apr-06
River 2005 Spring Flood Baseline Data (12-Apr-05)	River 20-Apr-06

Flow in Red River at Lockport on April 20, 2006 was 2492 m³/s

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

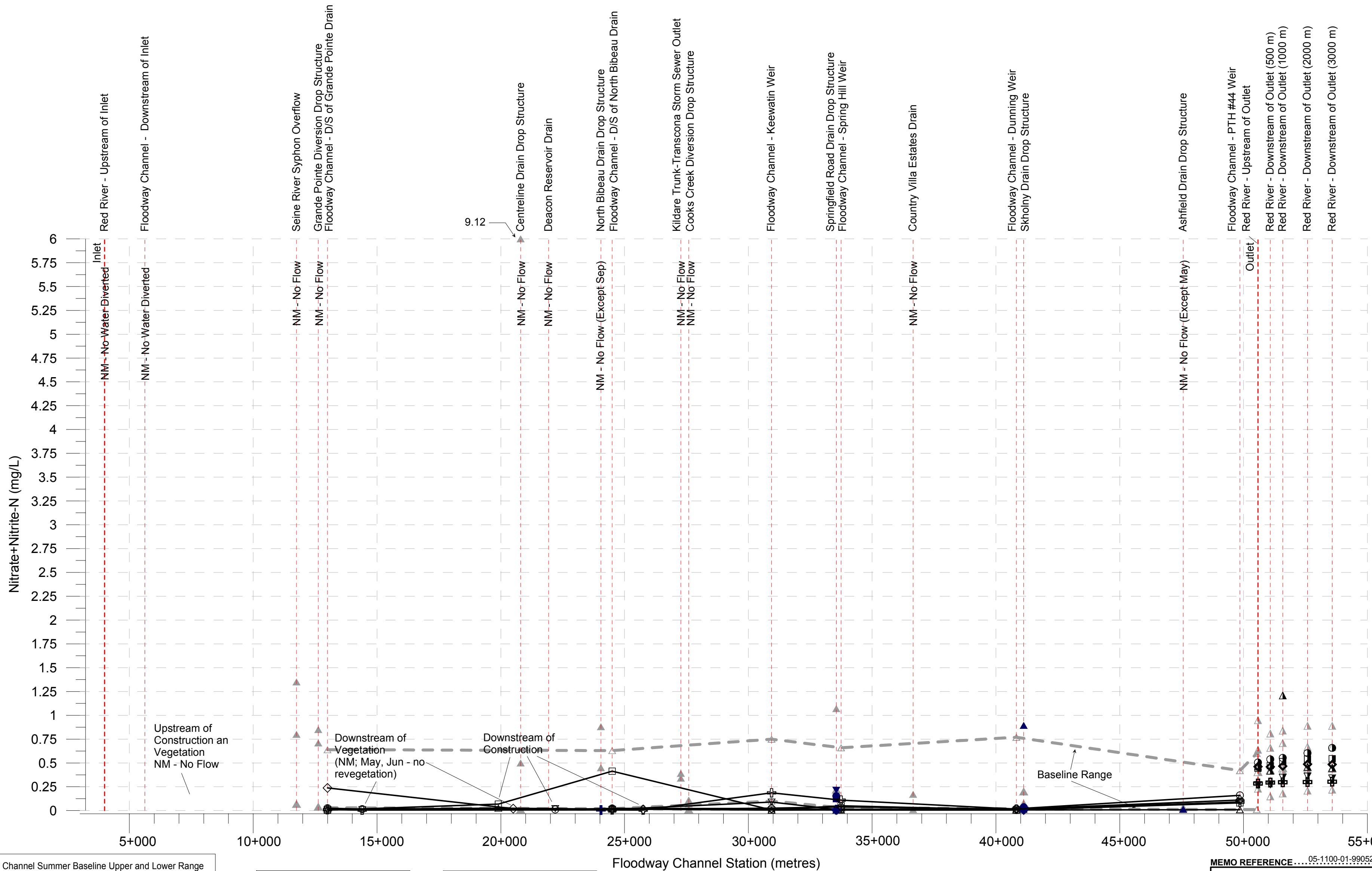
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

NITRATE+NITRITE-N
SPRING FLOOD CONDITION

FEBRUARY 2007 | FIGURE NM4-18 | REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-18_Nitrate+Nitrite construction_Spring Flood.grf



Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 27-May-06
Channel 29-Jun-06
Channel 25-Jul-06
Channel 6-Aug-06
Channel 18-Sep-06
Channel 17-Oct-06

Drain Summer Baseline
Drain 27-May-06
Drain 29-Jun-06
Drain 25-Jul-06
Drain 6-Aug-06
Drain 18-Sep-06
Drain 17-Oct-06

River Summer Baseline
River 27-May-06
River 29-Jun-06
River 25-Jul-06
River 6-Aug-06
River 18-Sep-06
River 17-Oct-06

Flow in Red River at Lockport on;
May 27, 2006 was 635 m^3/s
June 29, 2006 was 215 m^3/s
July 25, 2006 was 110 m^3/s
August 6, 2006 was 97 m^3/s
September 18, 2006 was 76 m^3/s
October 17, 2006 was 62 m^3/s.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

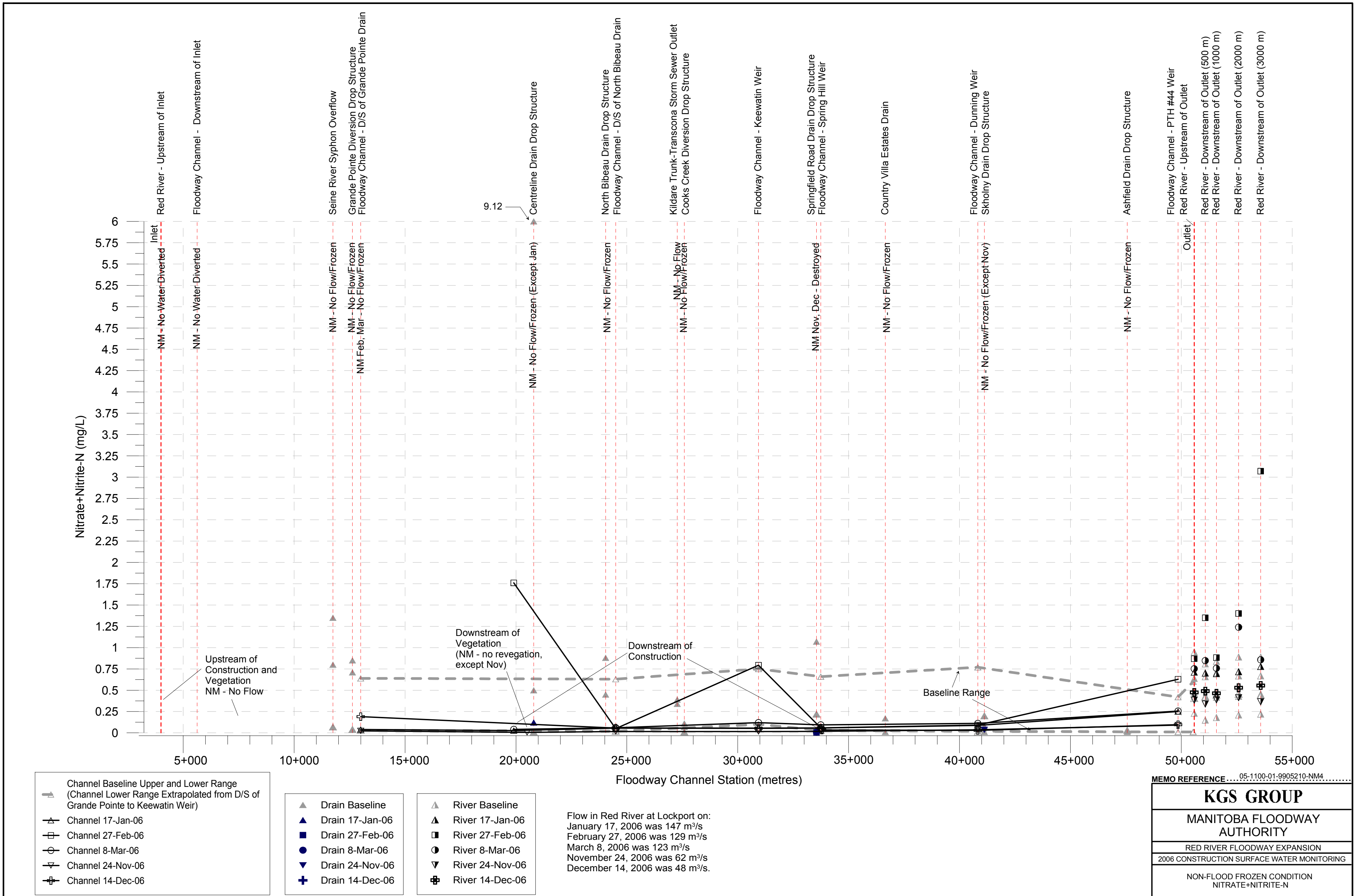
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD UNFROZEN CONDITION
NITRATE+NITRITE-N

FEBRUARY 2007	FIGURE NM4-19	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\Fig4-19_Nitrate+Nitrite construction_Non-Flood Unfrozen.grf



Flow in Red River at Lockport on:
January 17, 2006 was 147 m³/s
February 27, 2006 was 129 m³/s
March 8, 2006 was 123 m³/s
November 24, 2006 was 62 m³/s
December 14, 2006 was 48 m³/s.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

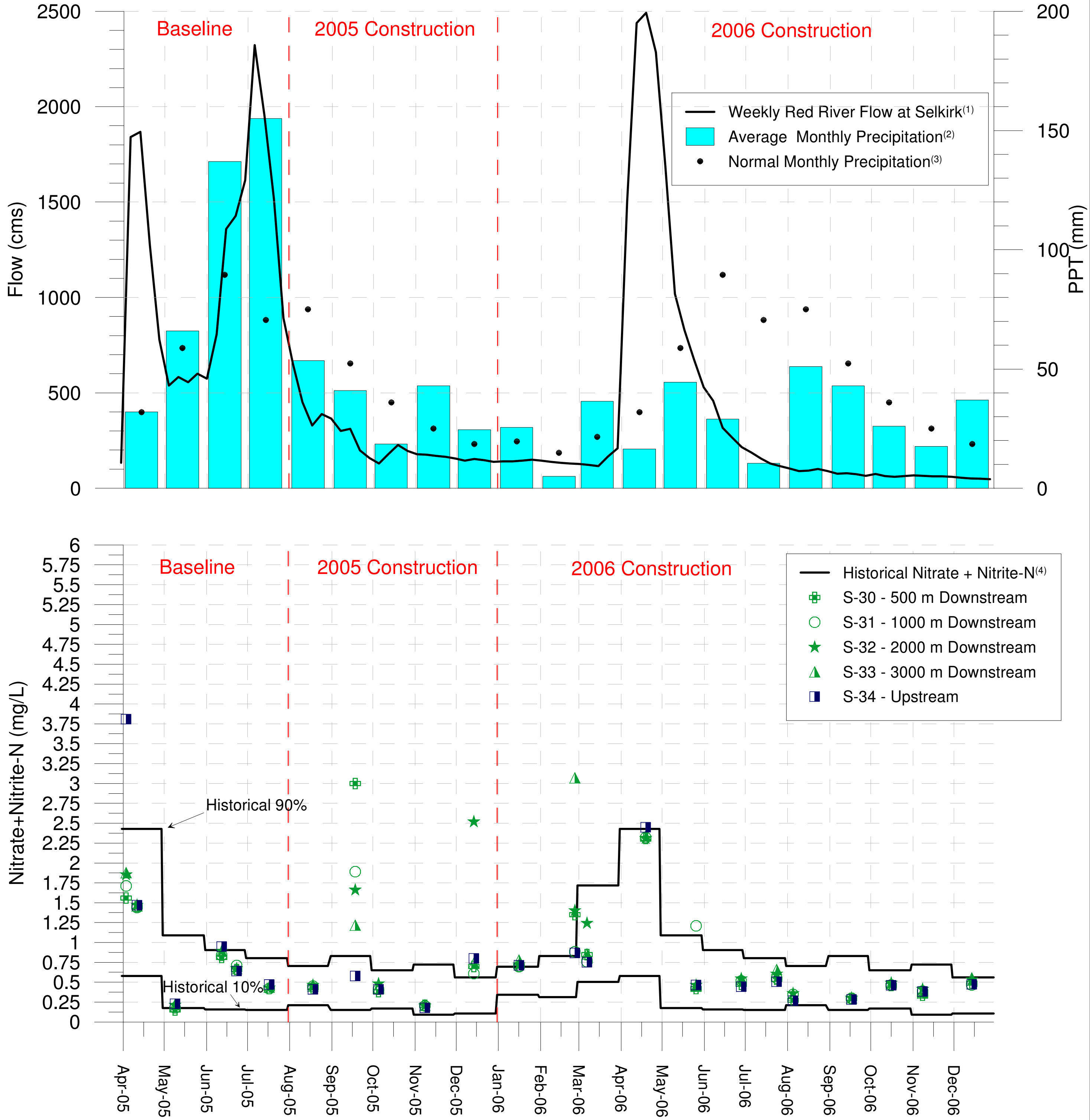
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD FROZEN CONDITION
NITRATE+NITRITE-N

FEBRUARY 2007	FIGURE NM4-20	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-20_Nitrate+Nitrite construction_Non-Flood Frozen.grf



Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
4 - Historical Data obtained from the Proposed Floodway Expansion Project Environmental Assessment Report Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10^{th} and 90^{th} percentile. Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 at Selkirk (downstream of the Floodway Outlet).

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

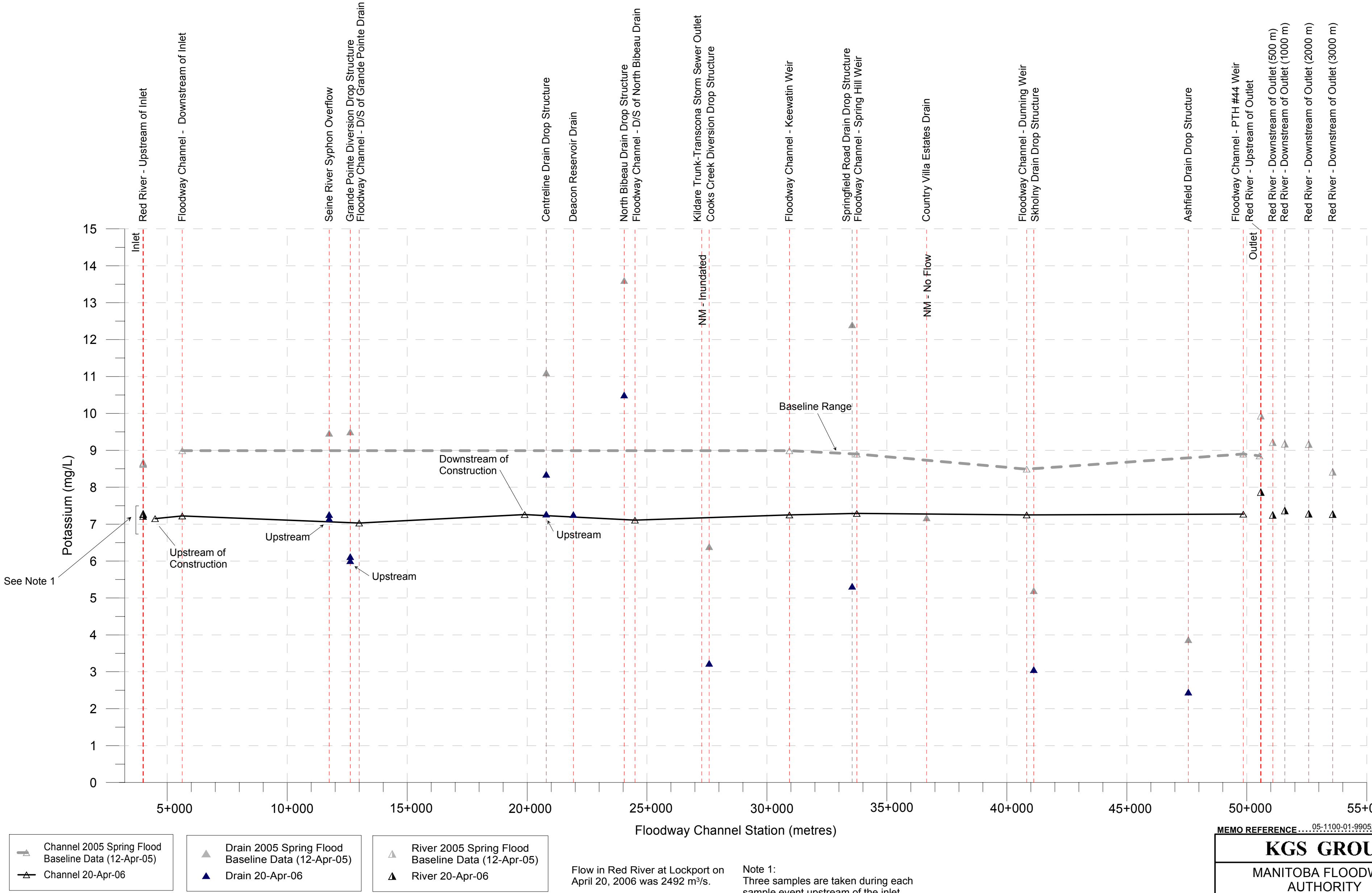
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

HISTORICAL WATER QUALITY COMPARISON
RED RIVER AT FLOODWAY OUTLET
NITRATE + NITRITE-N

FEBRUARY 2007	FIGURE NM4-21	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\Graphs



Flow in Red River at Lockport on April 20, 2006 was 2492 m³/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

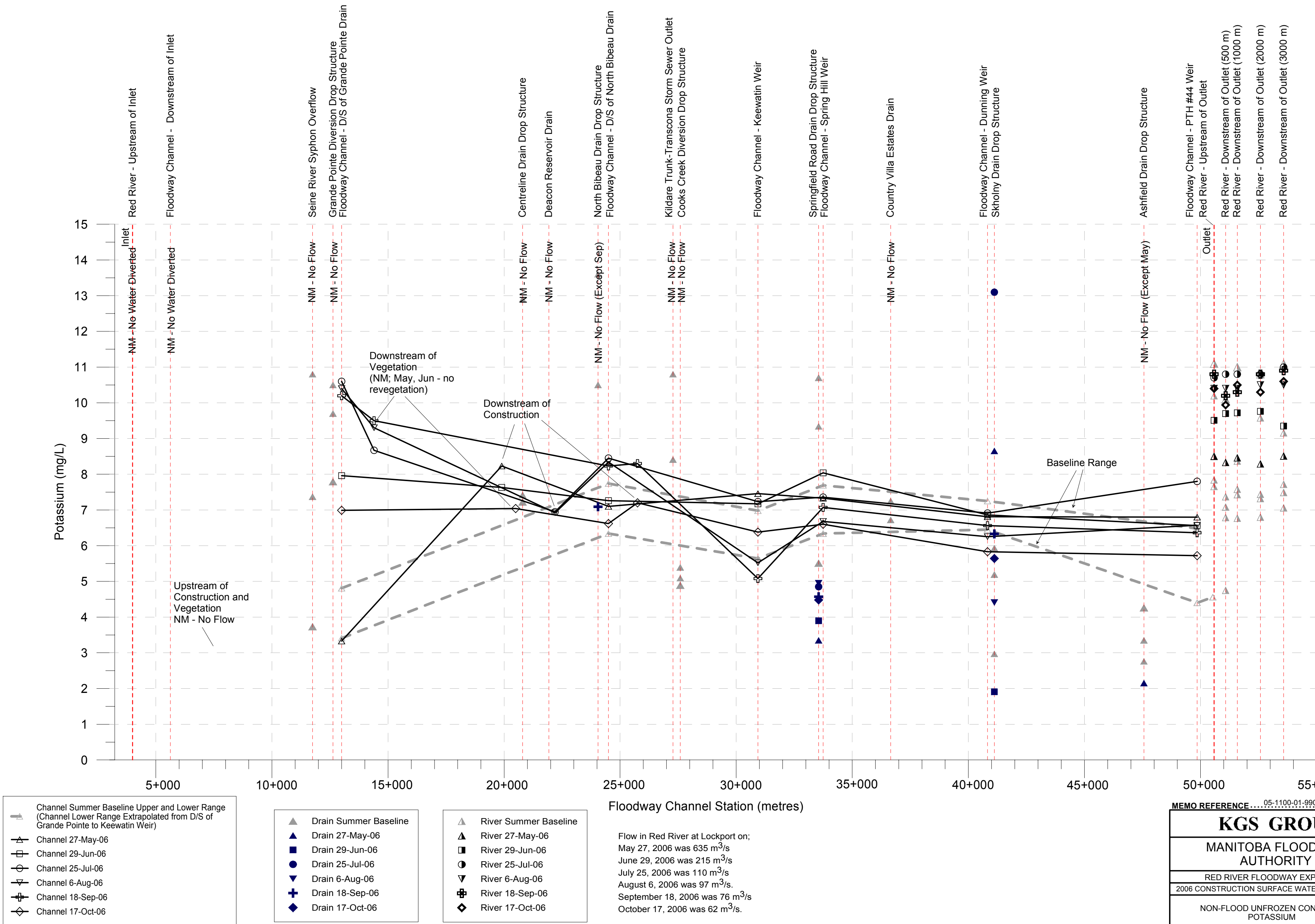
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

POTASSIUM
SPRING FLOOD CONDITION

FEBRUARY 2007	FIGURE NM4-22	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-22_Potassium construction_Spring Flood.grf



Flow in Red River at Lockport on;
May 27, 2006 was 635 m^3/s
June 29, 2006 was 215 m^3/s
July 25, 2006 was 110 m^3/s
August 6, 2006 was 97 m^3/s.
September 18, 2006 was 76 m^3/s
October 17, 2006 was 62 m^3/s.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

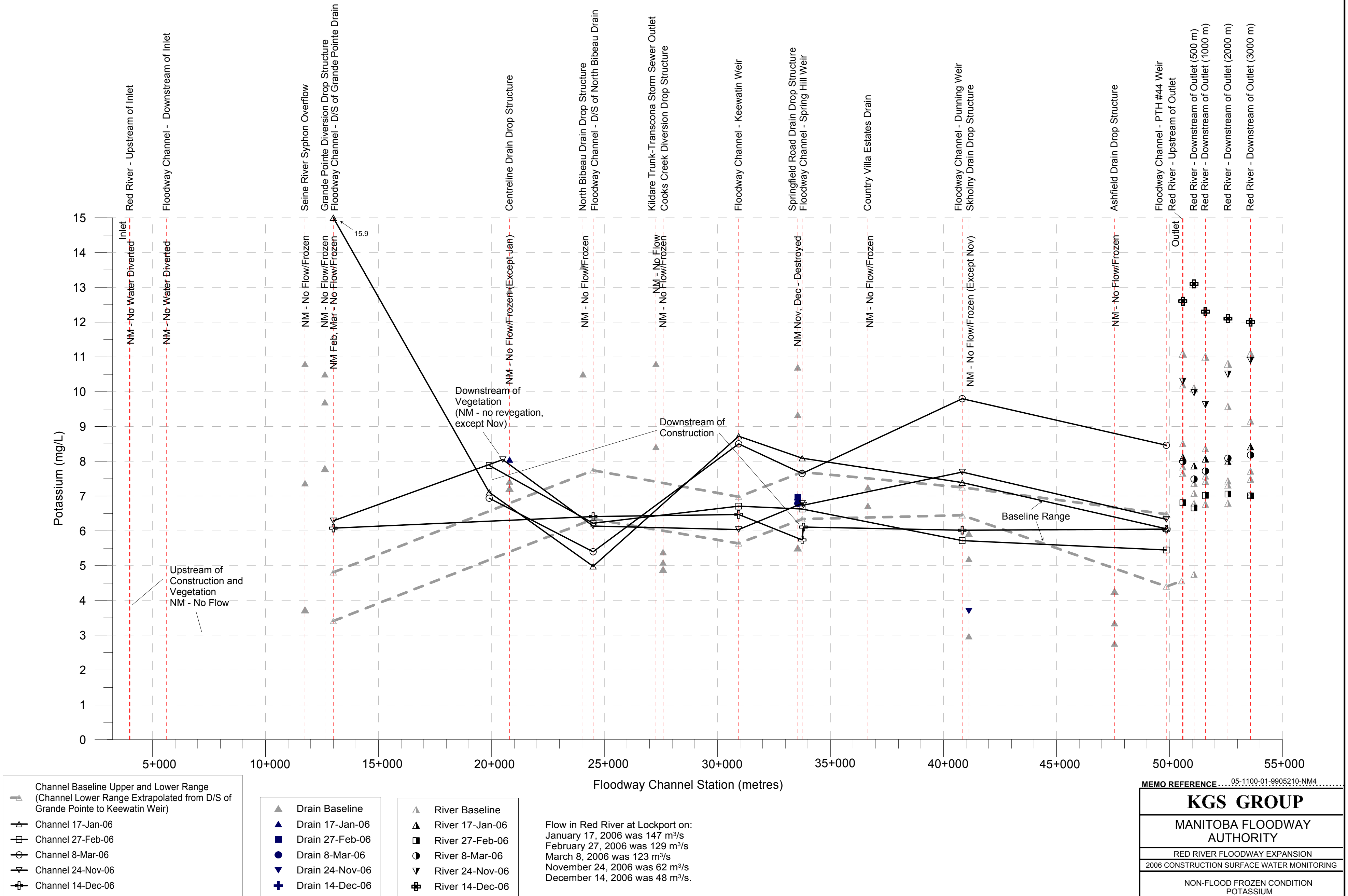
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD UNFROZEN CONDITION
POTASSIUM

FEBRUARY 2007	FIGURE NM4-23	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\Fig4-23_Potassium construction_Non-Floood Unfrozen.grf



Flow in Red River at Lockport on:
January 17, 2006 was 147 m³/s
February 27, 2006 was 129 m³/s
March 8, 2006 was 123 m³/s
November 24, 2006 was 62 m³/s
December 14, 2006 was 48 m³/s.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

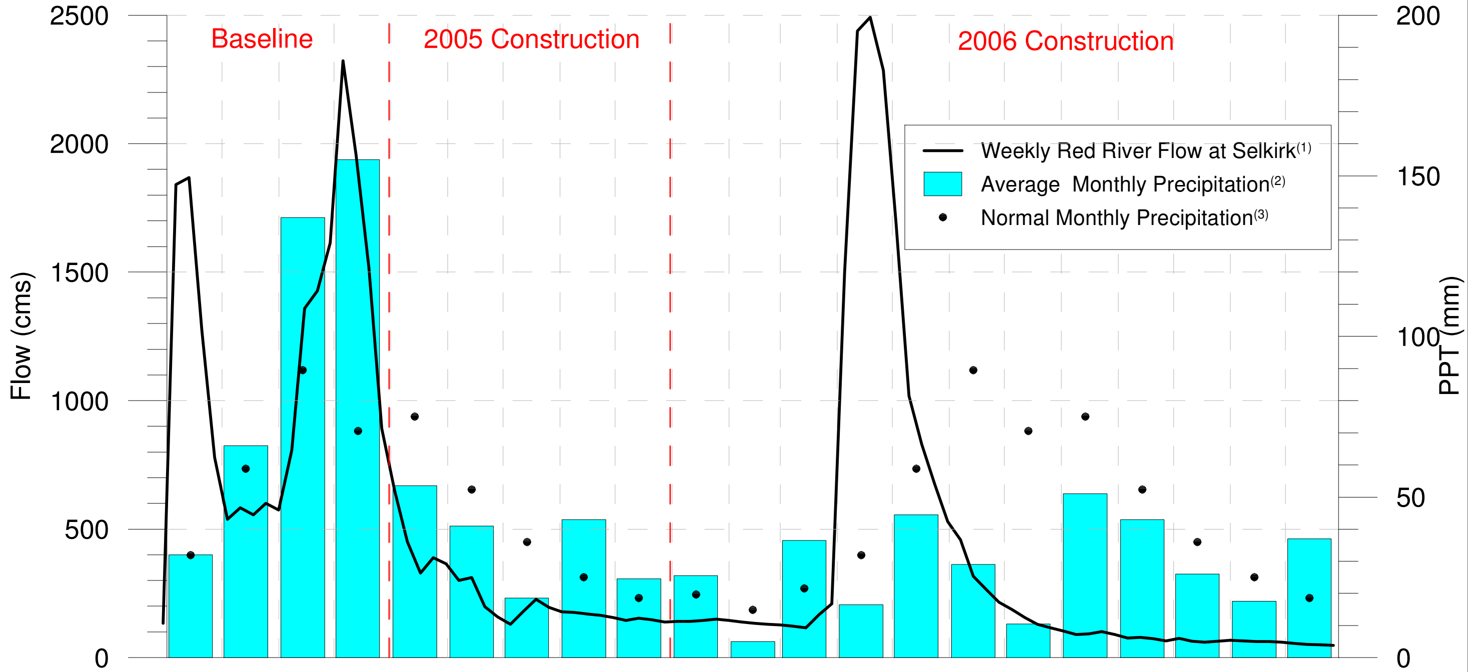
MANITOBA FLOODWAY AUTHORITY

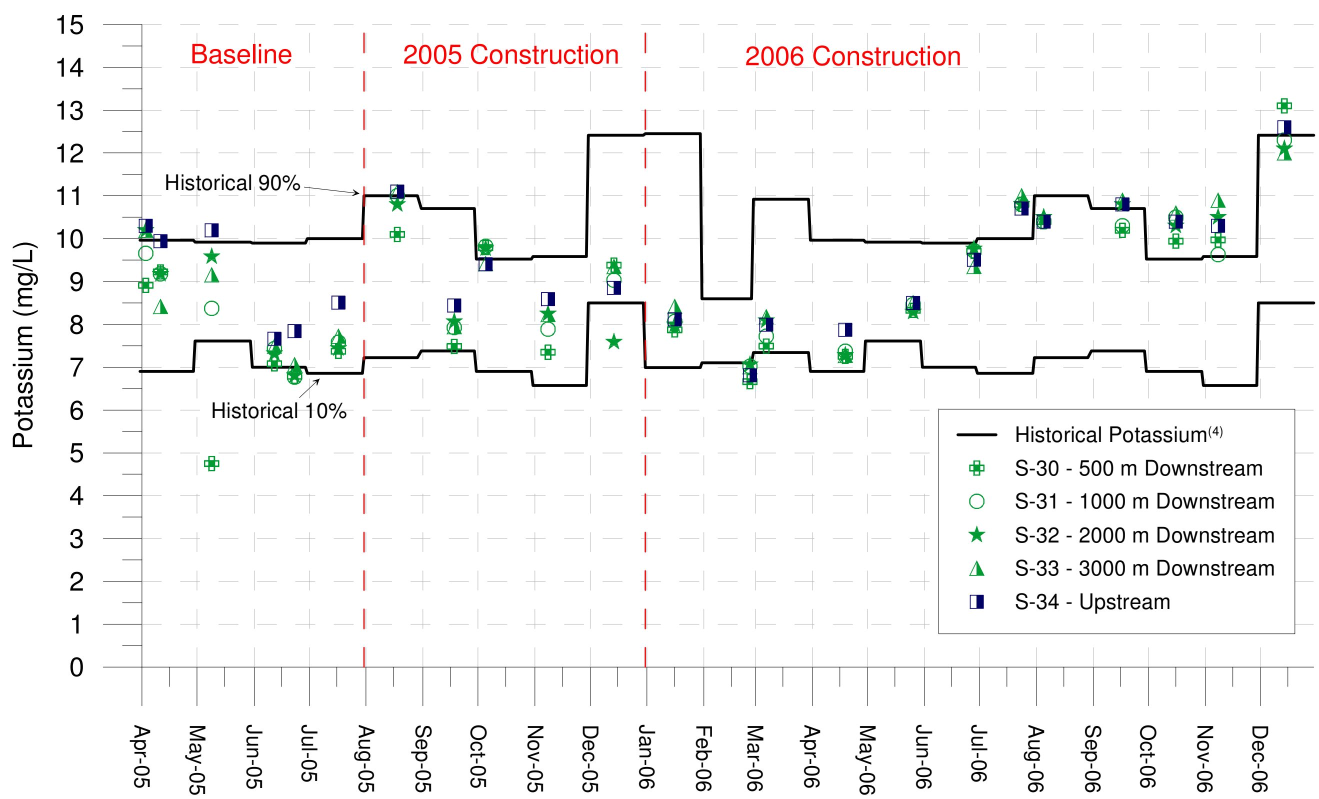
RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD FROZEN CONDITION
POTASSIUM

FEBRUARY 2007 | FIGURE NM4-24 | REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-24_Potassium construction_Non-Flood Frozen.grf





Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
4 - Historical Data obtained from the Proposed Floodway Expansion Project Environmental Assessment Report
Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10^{th} and 90^{th} percentile. Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 at Selkirk (downstream of the Floodway Outlet).

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\Graphs

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

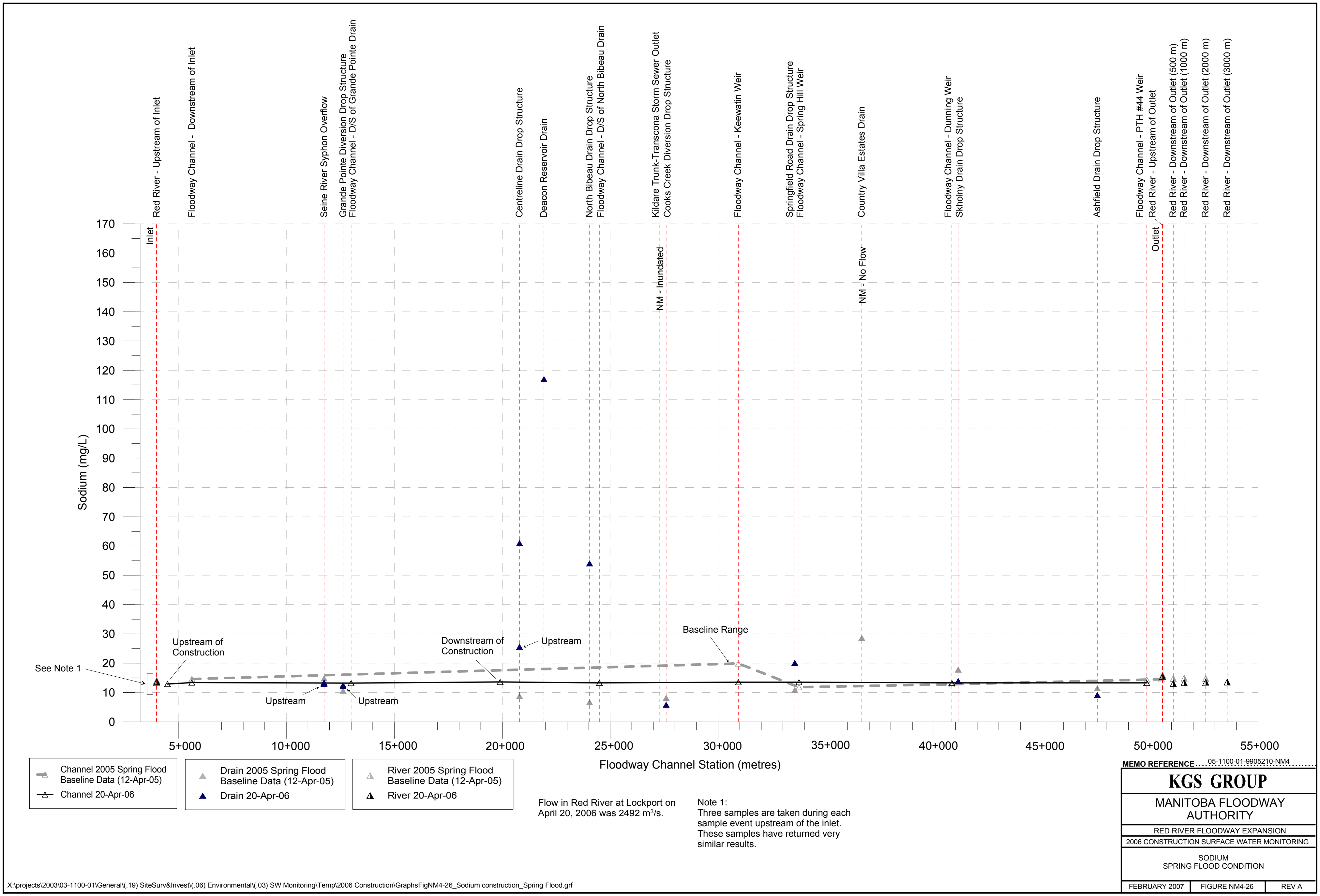
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

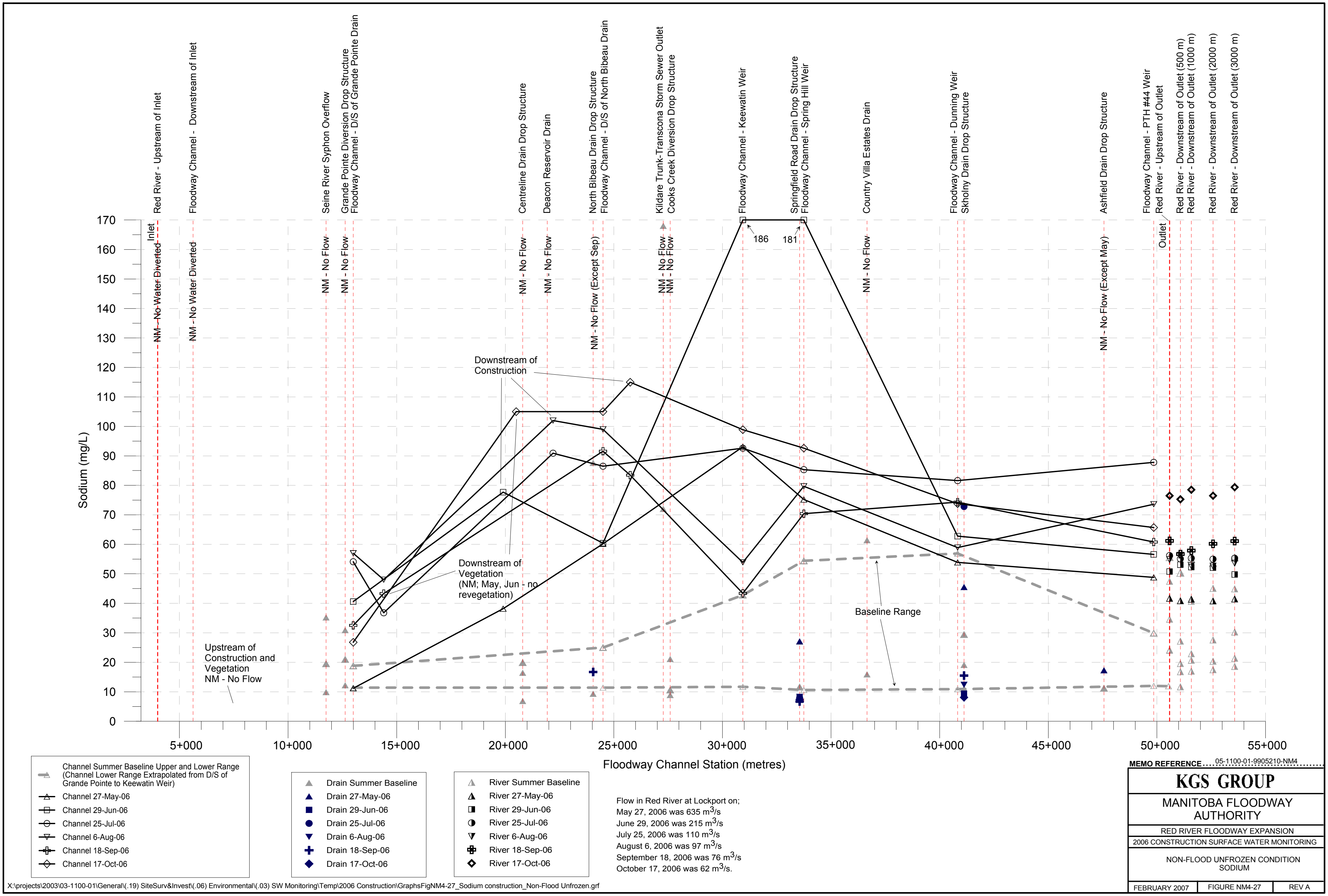
2006 CONSTRUCTION SURFACE WATER MONITORING

HISTORICAL WATER QUALITY COMPARISON
RED RIVER AT FLOODWAY OUTLET
POTASSIUM

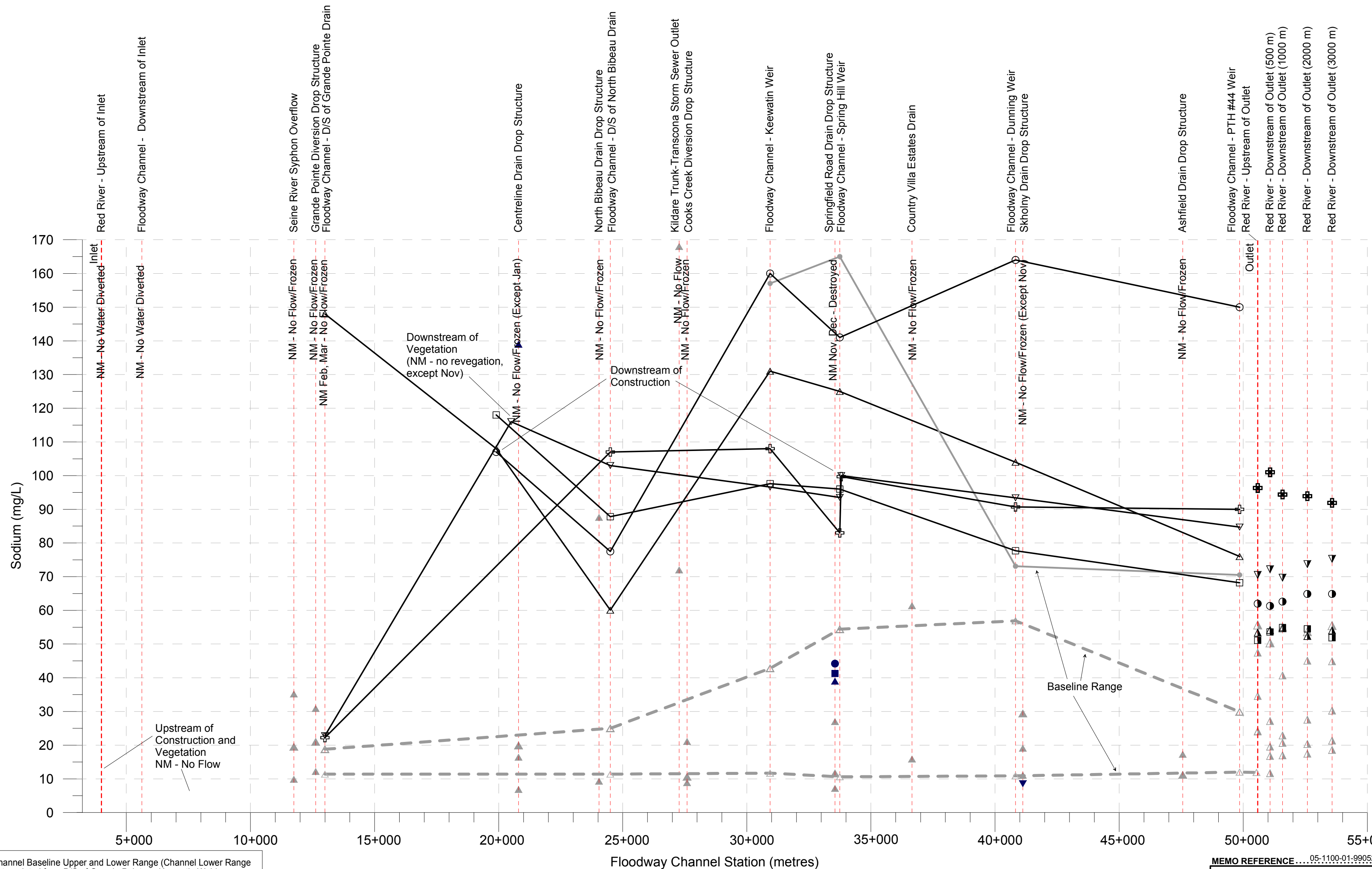
FEBRUARY 2007	FIGURE NM4-25	REV 0



Red River - Upstream of Inlet
Floodway Channel - Downstream of Inlet
Seine River Syphon Overflow
Grande Pointe Diversion Drop Structure
Floodway Channel - D/S of Grande Pointe Drain
Centreline Drain Drop Structure
Deacon Reservoir Drain
North Bibeau Drain Drop Structure
Floodway Channel - D/S of North Bibeau Drain
Kildare Trunk-Transcona Storm Sewer Outlet
Cooks Creek Diversion Drop Structure
Floodway Channel - Keewatin Weir
Springfield Road Drain Drop Structure
Floodway Channel - Spring Hill Weir
Country Villa Estates Drain
Floodway Channel - Dunning Weir
Skholny Drain Drop Structure
Ashfield Drain Drop Structure
Floodway Channel - PTH #44 Weir
Red River - Upstream of Outlet
Red River - Downstream of Outlet (500 m)
Red River - Downstream of Outlet (1000 m)
Red River - Downstream of Outlet (2000 m)
Red River - Downstream of Outlet (3000 m)
Inlet
Outlet
NM - Inundated
NM - No Flow
Sodium (mg/L)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
See Note 1
Upstream of Construction
Upstream
Upstream
Downstream of Construction
Upstream
Baseline Range
5+000
10+000
15+000
20+000
25+000
30+000
35+000
40+000
45+000
50+000
55+000
Floodway Channel Station (metres)
Channel 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 20-Apr-06
Drain 2005 Spring Flood Baseline Data (12-Apr-05)
Drain 20-Apr-06
River 2005 Spring Flood Baseline Data (12-Apr-05)
River 20-Apr-06
Flow in Red River at Lockport on April 20, 2006 was 2492 m³/s.
Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.
MEMO REFERENCE 05-1100-01-9905210-NM4
KGS GROUP
MANITOBA FLOODWAY AUTHORITY
RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING
SODIUM
SPRING FLOOD CONDITION
FEBRUARY 2007
FIGURE NM4-26
REV A
X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\GraphsFigNM4-26_Sodium construction_Spring Flood.grf



Red River - Upstream of Inlet
Floodway Channel - Downstream of Inlet
Seine River Syphon Overflow
Grande Pointe Diversion Drop Structure
Floodway Channel - D/S of Grande Pointe Drain
Centreline Drain Drop Structure
Deacon Reservoir Drain
North Bibeau Drain Drop Structure
Floodway Channel - D/S of North Bibeau Drain
Kildare Trunk-Transcona Storm Sewer Outlet
Cooks Creek Diversion Drop Structure
Floodway Channel - Keewatin Weir
Springfield Road Drain Drop Structure
Floodway Channel - Spring Hill Weir
Country Villa Estates Drain
Floodway Channel - Dunning Weir
Skolny Drain Drop Structure
Ashfield Drain Drop Structure
Floodway Channel - PTH #44 Weir
Red River - Upstream of Outlet
Red River - Downstream of Outlet (500 m)
Red River - Downstream of Outlet (1000 m)
Red River - Downstream of Outlet (2000 m)
Red River - Downstream of Outlet (3000 m)
Inlet
Outlet
NM - No Water Diverted
NM - No Flow
NM - No Flow (Except Sep)
NM - No Flow (Except May)
186
181
Downstream of Construction
Downstream of Vegetation (NM; May, Jun - no revegetation)
Upstream of Construction and Vegetation NM - No Flow
Baseline Range
Sodium (mg/L)
Floodway Channel Station (metres)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
5+000 10+000 15+000 20+000 25+000 30+000 35+000 40+000 45+000 50+000 55+000
Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 27-May-06
Channel 29-Jun-06
Channel 25-Jul-06
Channel 6-Aug-06
Channel 18-Sep-06
Channel 17-Oct-06
Drain Summer Baseline
Drain 27-May-06
Drain 29-Jun-06
Drain 25-Jul-06
Drain 6-Aug-06
Drain 18-Sep-06
Drain 17-Oct-06
River Summer Baseline
River 27-May-06
River 29-Jun-06
River 25-Jul-06
River 6-Aug-06
River 18-Sep-06
River 17-Oct-06
Flow in Red River at Lockport on;
May 27, 2006 was 635 m3/s
June 29, 2006 was 215 m3/s
July 25, 2006 was 110 m3/s
August 6, 2006 was 97 m3/s
September 18, 2006 was 76 m3/s
October 17, 2006 was 62 m3/s.
MEMO REFERENCE 05-1100-01-9905210-NM4
KGS GROUP
MANITOBA FLOODWAY AUTHORITY
RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING
NON-FLOOD UNFROZEN CONDITION
SODIUM
FEBRUARY 2007
FIGURE NM4-27
REV A
X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\GraphsFigNM4-27_Sodium construction_Non-Flood Unfrozen.grf



Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel Winter Baseline (Baseflow, Groundwater Discharge Conditions Sampled March 2005)
Channel 17-Jan-06
Channel 27-Feb-06
Channel 8-Mar-06
Channel 24-Nov-06
Channel 14-Dec-06

Drain Baseline
Drain 17-Jan-06
Drain 27-Feb-06
Drain 8-Mar-06
Drain 24-Nov-06
Drain 14-Dec-06

River Baseline
River 17-Jan-06
River 27-Feb-06
River 8-Mar-06
River 24-Nov-06
River 14-Dec-06

Flow in Red River at Lockport on:
January 17, 2006 was 147 m^3/s
February 27, 2006 was 129 m^3/s
March 8, 2006 was 123 m^3/s
November 24, 2006 was 62 m^3/s
December 14, 2006 was 48 m^3/s.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

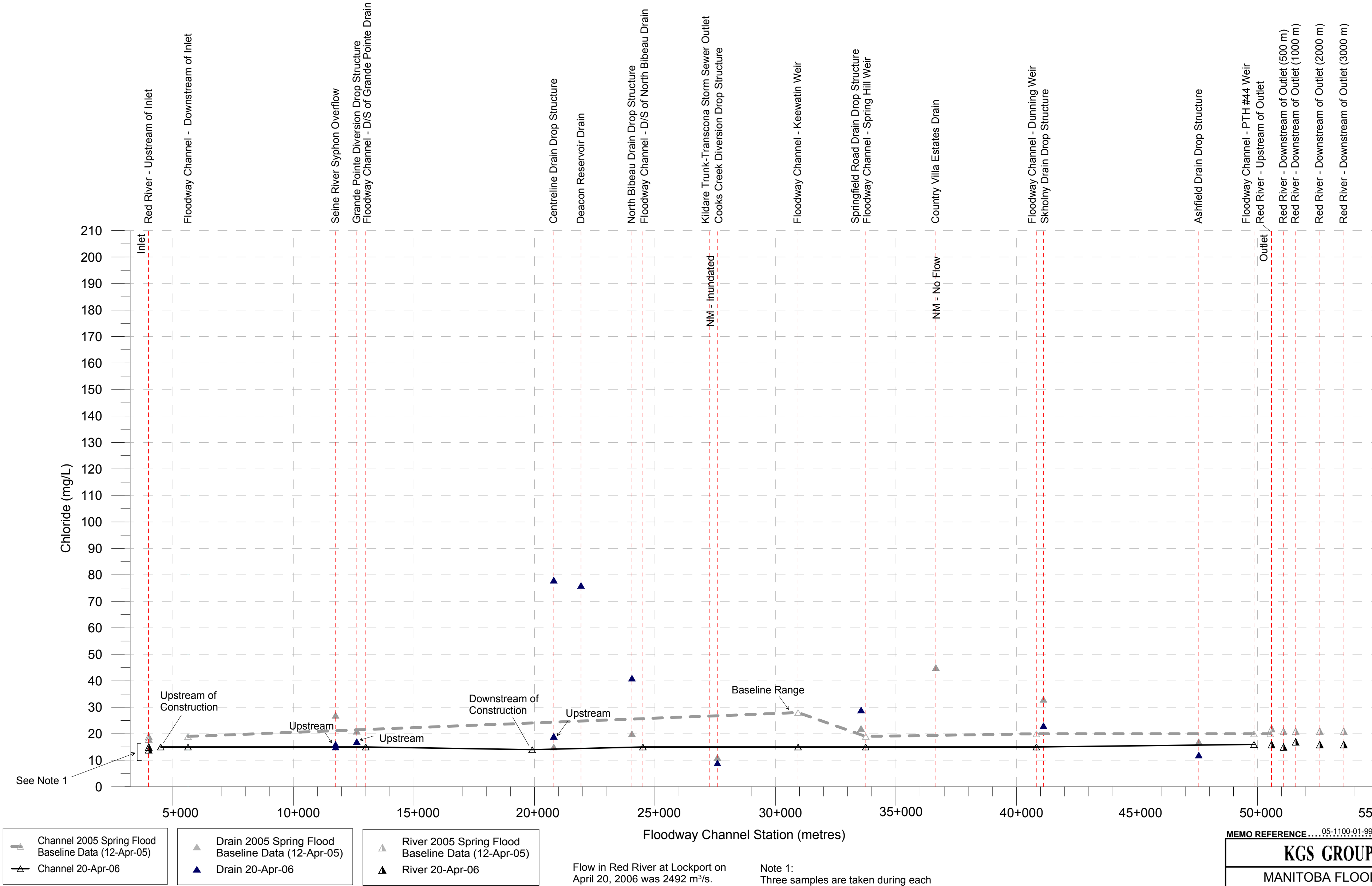
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD FROZEN CONDITION
SODIUM

FEBRUARY 2007 | FIGURE NM4-28 | REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\GraphsFigNM4-28_Sodium construction_Non-Flood Frozen.grf



Flow in Red River at Lockport on April 20, 2006 was 2492 m³/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

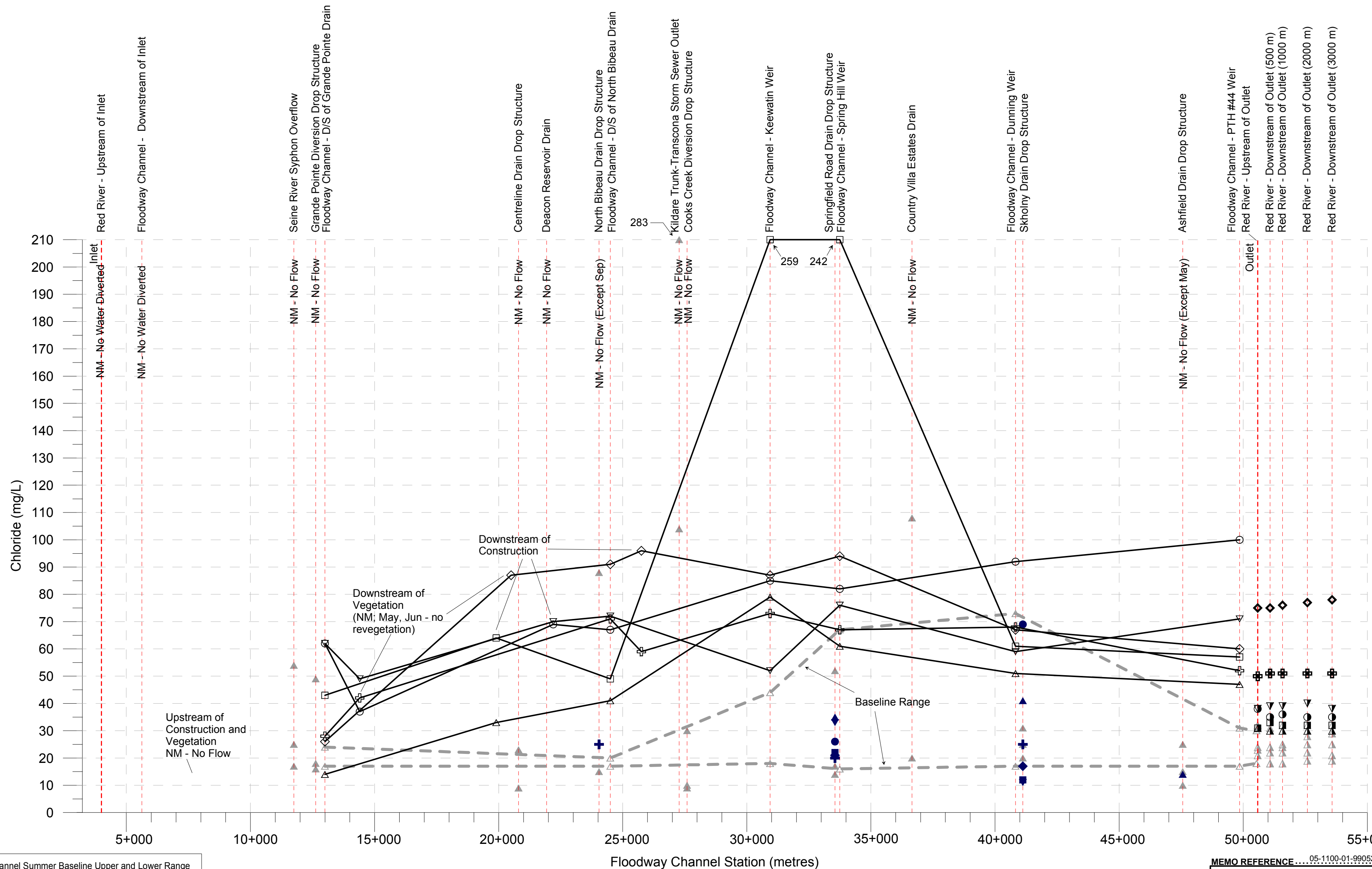
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

CHLORIDE
SPRING FLOOD CONDITION

FEBRUARY 2007	FIGURE NM4-29	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-29_Chloride construction_Spring Flood.grf



Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 27-May-06
Channel 29-Jun-06
Channel 25-Jul-06
Channel 6-Aug-06
Channel 18-Sep-06
Channel 17-Oct-06

Drain Summer Baseline
Drain 27-May-06
Drain 29-Jun-06
Drain 25-Jul-06
Drain 6-Aug-06
Drain 18-Sep-06
Drain 17-Oct-06

River Summer Baseline
River 27-May-06
River 29-Jun-06
River 25-Jul-06
River 6-Aug-06
River 18-Sep-06
River 17-Oct-06

Flow in Red River at Lockport on;
May 27, 2006 was 635 m^3/s
June 29, 2006 was 215 m^3/s
July 25, 2006 was 110 m^3/s
August 6, 2006 was 97 m^3/s
September 18, 2006 was 76 m^3/s
October 17, 2006 was 62 m^3/s.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

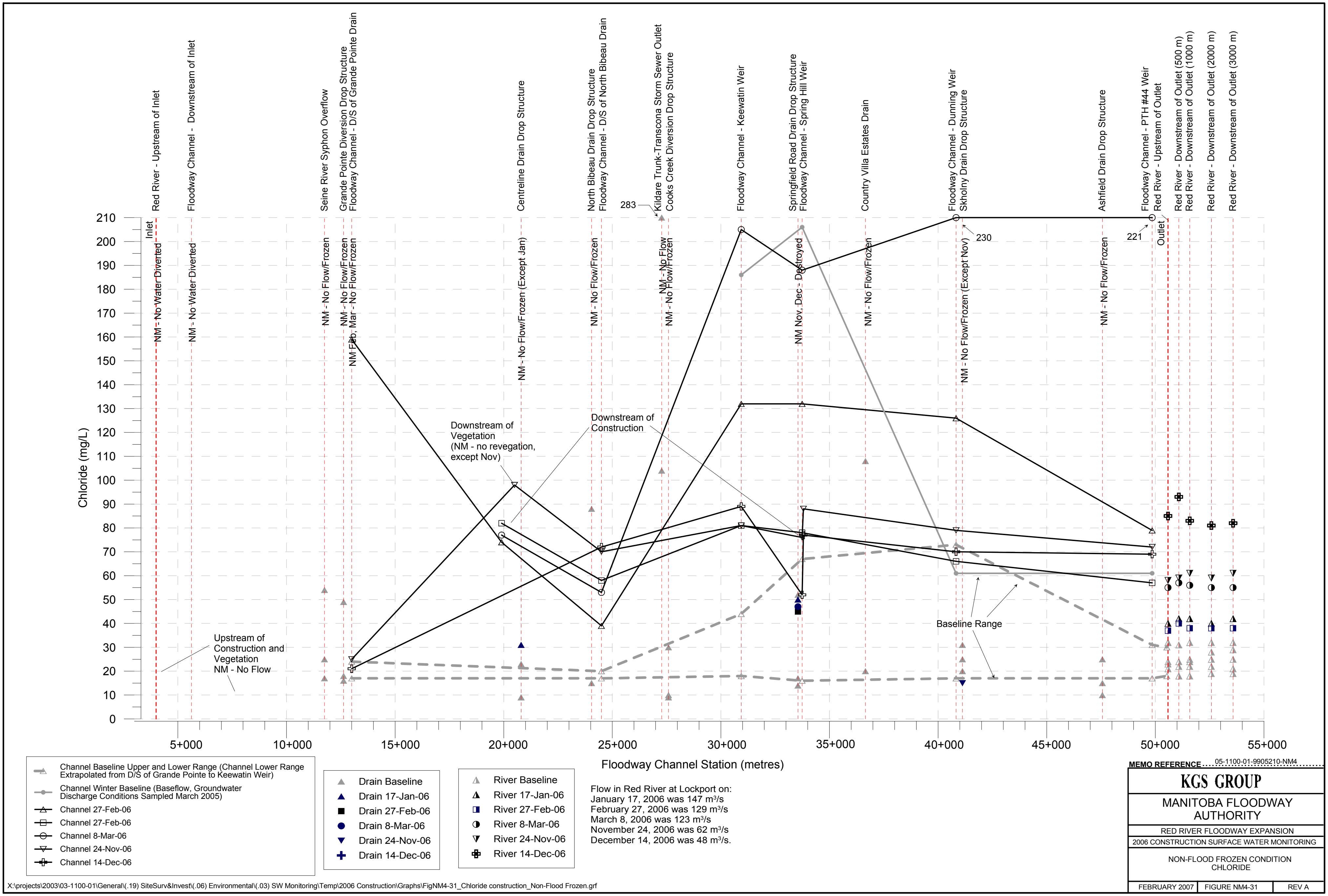
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

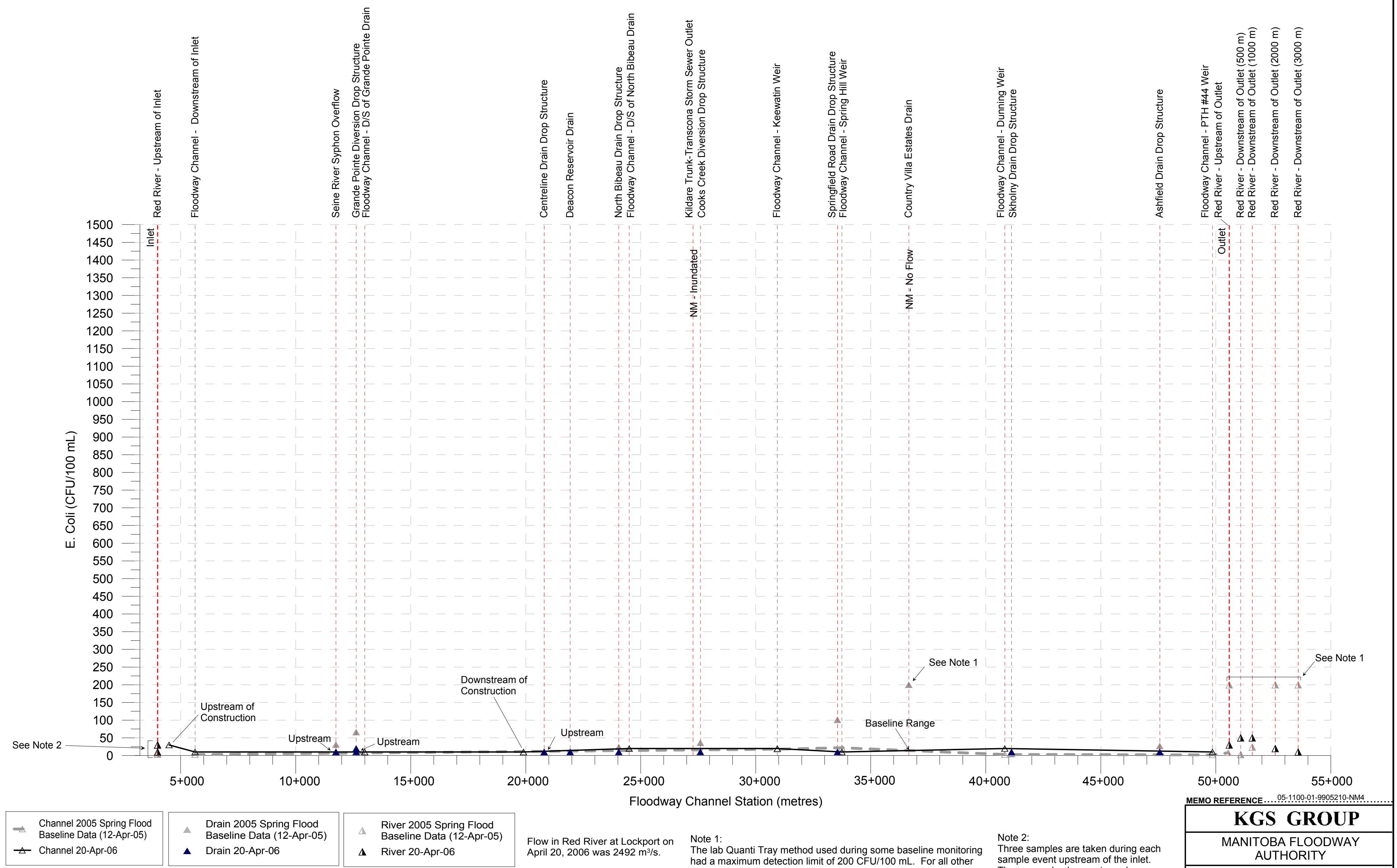
NON-FLOOD UNFROZEN CONDITION
CHLORIDE

FEBRUARY 2007	FIGURE NM4-30	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-30_Chloride construction_Non-Flood Unfrozen.grf



Red River - Upstream of Inlet
Floodway Channel - Downstream of Inlet
Seine River Syphon Overflow
Grande Pointe Diversion Drop Structure
Floodway Channel - D/S of Grande Pointe Drain
Centreline Drain Drop Structure
North Bibeau Drain Drop Structure
Floodway Channel - D/S of North Bibeau Drain
Kildare Trunk-Transcona Storm Sewer Outlet
Cooks Creek Diversion Drop Structure
Floodway Channel - Keewatin Weir
Springfield Road Drain Drop Structure
Floodway Channel - Spring Hill Weir
Country Villa Estates Drain
Floodway Channel - Dunning Weir
Skholny Drain Drop Structure
Ashfield Drain Drop Structure
Floodway Channel - PTH #44 Weir
Red River - Upstream of Outlet
Red River - Downstream of Outlet (500 m)
Red River - Downstream of Outlet (1000 m)
Red River - Downstream of Outlet (2000 m)
Red River - Downstream of Outlet (3000 m)
Inlet
NM - No Water Diverted
NM - No Water Diverted
NM - No Flow/Frozen
NM - No Flow/Frozen
NM Feb, Mar - No Flow/Frozen
NM - No Flow/Frozen (Except Jan)
NM - No Flow/Frozen
NM - No Flow
NM - No Flow/Frozen
NM Nov, Dec - Destroyed
NM - No Flow/Frozen
NM - No Flow/Frozen (Except Nov)
NM - No Flow/Frozen
Outlet
283
230
221
Downstream of Vegetation (NM - no revegation, except Nov)
Downstream of Construction
Upstream of Construction and Vegetation NM - No Flow
Baseline Range
Chloride (mg/L)
Floodway Channel Station (metres)
Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel Winter Baseline (Baseflow, Groundwater Discharge Conditions Sampled March 2005)
Channel 27-Feb-06
Channel 27-Feb-06
Channel 8-Mar-06
Channel 24-Nov-06
Channel 14-Dec-06
Drain Baseline
Drain 17-Jan-06
Drain 27-Feb-06
Drain 8-Mar-06
Drain 24-Nov-06
Drain 14-Dec-06
River Baseline
River 17-Jan-06
River 27-Feb-06
River 8-Mar-06
River 24-Nov-06
River 14-Dec-06
Flow in Red River at Lockport on:
January 17, 2006 was 147 m³/s
February 27, 2006 was 129 m³/s
March 8, 2006 was 123 m³/s
November 24, 2006 was 62 m³/s
December 14, 2006 was 48 m³/s.
MEMO REFERENCE 05-1100-01-9905210-NM4
KGS GROUP
MANITOBA FLOODWAY AUTHORITY
RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING
NON-FLOOD FROZEN CONDITION CHLORIDE
FEBRUARY 2007
FIGURE NM4-31
REV A
X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-31_Chloride construction_Non-Flood Frozen.grf



Flow in Red River at Lockport on April 20, 2006 was 2492 m³/s.

Note 1:
The lab Quanti Tray method used during some baseline monitoring had a maximum detection limit of 200 CFU/100 mL. For all other samples, the EColi by MColi Blue MF method was used.

Note 2:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

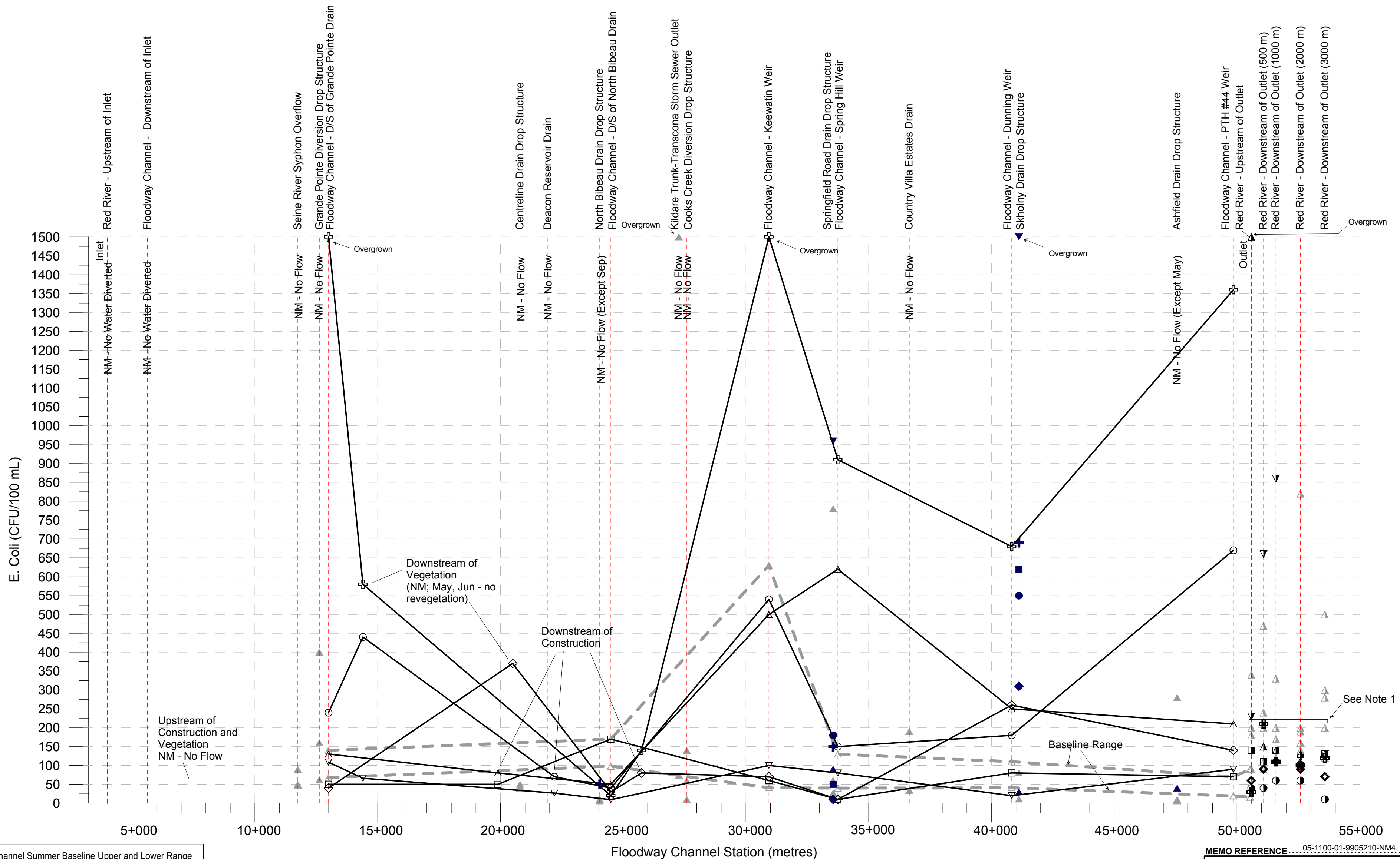
RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

E.COLI
SPRING FLOOD CONDITION

FEBRUARY 2007	FIGURE NM4-32	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-32_EColi construction_Spring Flood.grf



Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 27-May-06
Channel 29-Jun-06
Channel 25-Jul-06
Channel 6-Aug-06
Channel 18-Sep-06
Channel 17-Oct-06

Drain Summer Baseline
Drain 27-May-06
Drain 29-Jun-06
Drain 25-Jul-06
Drain 6-Aug-06
Drain 18-Sep-06
Drain 17-Oct-06

River Summer Baseline
River 27-May-06
River 29-Jun-06
River 25-Jul-06
River 6-Aug-06
River 18-Sep-06
River 17-Oct-06

Flow in Red River at Lockport on;
May 27, 2006 was 635 m^3/s
June 29, 2006 was 215 m^3/s
July 25, 2006 was 110 m^3/s
August 6, 2006 was 97 m^3/s
September 18, 2006 was 76 m^3/s
October 17, 2006 was 62 m^3/s.

Note 1:
The lab Quanti Tray method used during some baseline monitoring had a maximum detection limit of 200 CFU/100 mL. For all other samples, the EColi by MColi Blue MF method was used.

Overgrown:
Exceeded maximum detection limit of approximately 2000 CFU/100ml using MColi Blue MF Method.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

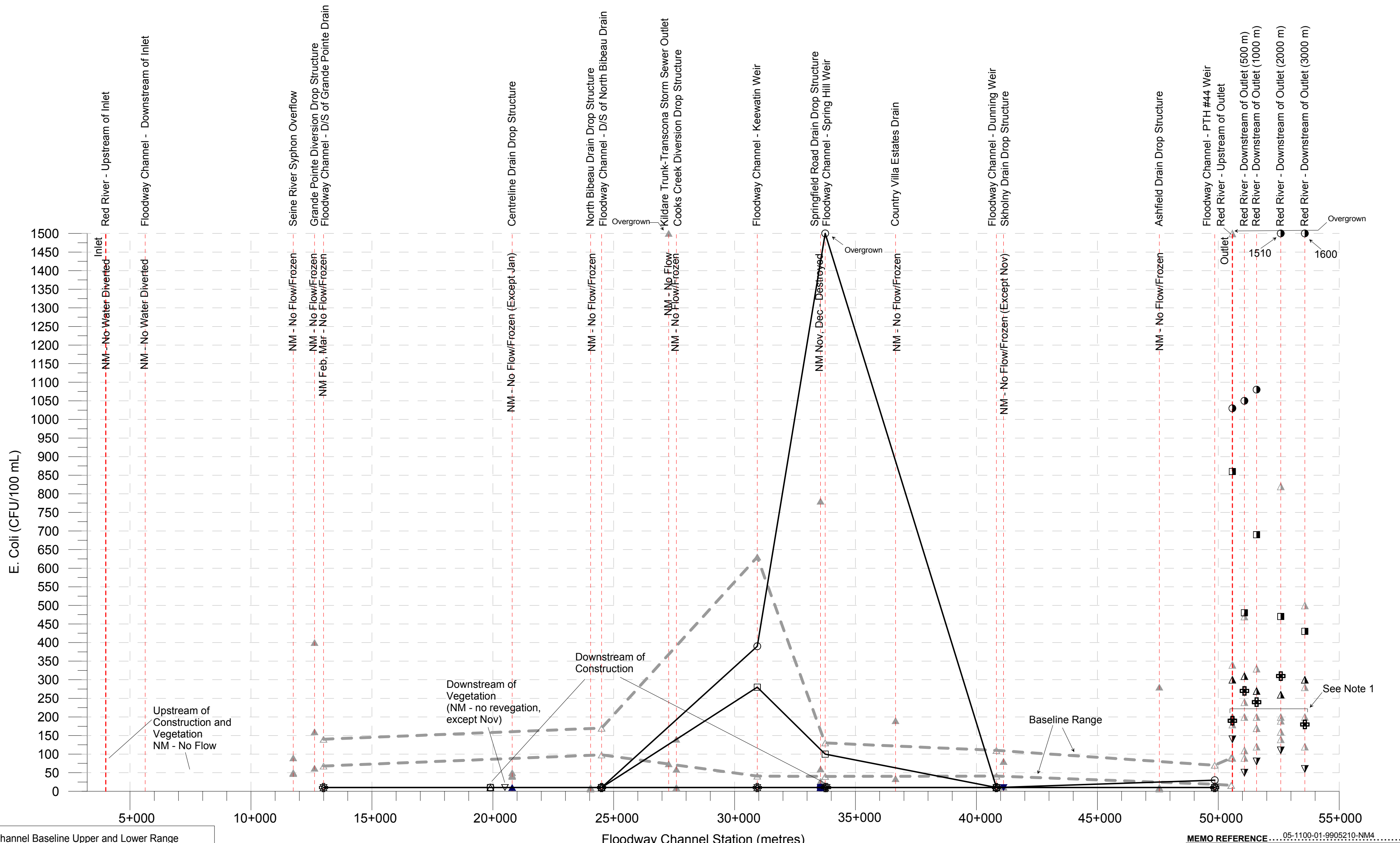
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION
2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD UNFROZEN CONDITION
E.COLI

FEBRUARY 2007	FIGURE NM4-33	REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-33_EColi construction_Non-Flood Unfrozen.grf



Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 17-Jan-06
Channel 27-Feb-06
Channel 8-Mar-06
Channel 24-Nov-06
Channel 14-Dec-06

Drain Baseline
Drain 17-Jan-06
Drain 27-Feb-06
Drain 8-Mar-06
Drain 24-Nov-06
Drain 14-Dec-06

River Baseline
River 17-Jan-06
River 27-Feb-06
River 8-Mar-06
River 24-Nov-06
River 14-Dec-06

Flow in Red River at Lockport on:
January 17, 2006 was 147 m^3/s
February 27, 2006 was 129 m^3/s
March 8, 2006 was 123 m^3/s
November 24, 2006 was 62 m^3/s
December 14, 2006 was 48 m^3/s.

Note 1:
The lab Quanti Tray method used during some baseline monitoring had a maximum detection limit of 200 CFU/100 mL. For all other samples, the EColi by MColi Blue MF method was used.

Overgrown:
Exceeded maximum detection limit of approximately 2000 CFU/100ml using MColi Blue MF Method.

MEMO REFERENCE 05-1100-01-9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

NON-FLOOD FROZEN CONDITION
E.COLI

FEBRUARY 2007 | FIGURE NM4-34 | REV A

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\Graphs\FigNM4-34_EColi construction_Non-Flood Frozen.grf

APPENDICES

APPENDIX A

SURFACE WATER MONITORING
2006 SAMPLING PROGRAM

1.0 INTRODUCTION

This provides details and a description of the sampling events, sampling protocol, data reduction, reporting and summary tables for the 2006 Surface Water Sampling Program prepared by KGS Group.

The surface water quality monitoring program consists of Monthly monitoring during the 2006 construction year from January to December 2006 in conjunction with the on-going construction activities. It also consists of Event-based monitoring during 2006 in response to potential erosion causing precipitation and spill events.

The scope of work for the 2006 construction Surface Water Monitoring program conducted by KGS Group includes the following:

- Collect **monthly** surface water quality data for the Red River, Floodway Channel, Drains that flow into the Floodway Channel and Drains that cross the West Dyke, preferably following a precipitation event or at the flood peak during Red River flood conditions;
- Collect **event-based** surface water quality data for compliance monitoring of applicable parameters (TSS, nutrients, herbicides or hydrocarbons) from the Floodway Channel upstream and downstream of the overall construction area, the Red River downstream of the Outlet and any additional required locations following precipitation events greater than 5 mm or a spill; and
- Provide an assessment of surface water quality comparing results of construction monthly and event-based compliance monitoring to baseline water quality and summarized in an 2006 construction monitoring report in order to;
    - compare predictions made in modelling effects
    - assess the effectiveness of proposed mitigation measures and adapt if necessary
    - adapt the construction monitoring program in response to data and changes in mitigation measures.

2.0 SAMPLING LOCATIONS

The sample locations are outlined on Figure NM4-1 and Figure NM4-2 and described as follows;

Red River at Inlet

- Upstream of the Floodway channel along the west shore of the river, 3 replicate samples collected consecutively at the same location (S-01) to capture the natural variation within the Red River. During a sample event when there is no river water entering into the Floodway channel at the inlet, then these samples will not be collected during that event.

Red River at Outlet

- Upstream of the Floodway Outlet along the east shore (S-34) and downstream of the Outlet along the east shore at 500, 1000, 2000 and 3000 m (S-30, S-31, S-32 and S-33, respectively).

Floodway Channel

- Floodway Channel downstream of the Inlet (S-04), downstream of the Grande Pointe Diversion drop structure (S-13), downstream of the North Bibeau Drain drop structure (S-14) and at the four weir locations within the low flow channel used to calculate the channel base flow during the winter; Keewatin Weir (S-21), Springfield Weir (S-23), Dunning Weir (S-25) and PTH# 44 Weir (S-28). For quality control one replicate sample is collected during each sample event from one of the channel locations. Note during a sampling event if no Red River water is entering into the Floodway Channel, sample location S-04 in the channel downstream of the inlet will not be collected during that event. Likewise, during a sample event if there is less than 0.1 m water depth in the low flow channel at a sample location then that location will not be collected during that event.

Outfall Sources

- At the 11 outfalls immediately upstream of where they drain into the Floodway channel. These include; Seine River Syphon Overflow (S-05), Grande Point Diversion Drop Structure (S-06), Centreline Drain Drop Structure (S-07), Deacon Reservoir Drain (S-08), Cooks Creek Diversion Drop Structure (S-09), North Bibeau Drain Drop Structure (S-10), Country Villa Estates Drain (S-11), Kildare Trunk-Transcona Storm Sewer Outlet (S-12), Springfield

Road Drain Drop Structure (S-22), Skholny Drain Drop Structure (S-26) and Ashfield Drain Drop Structure (S-27). During a sample event if there is low flow or the water is frozen such that no water is entering into the Floodway from any of the above drains or there is insufficient amounts of water in the drain to collect a sample (< 0.10 m flow depth) then, that drain will not be sampled during that event. Additionally, during a sample event if a drain is within an area of on-going construction activities, to eliminate a potential confounding effect and in order to assess the effects from the perimeter ditches an additional sample will be collected from the drain upstream of the perimeter ditching.

West Dyke

- Downstream of the West Dyke in the Manness (S-35) and Domain (S-36) Drains to provide additional baseline data prior to start of construction. During construction additional sample locations will be added upstream of the dyke in the Manness and Domain Drains and at previously identified critical fish habitat, upstream and downstream of the construction area. During a sample event if there is insufficient amounts of water in either of the drains to collect a sample (< 0.10 m flow depth) or the water is frozen then, that drain will not be sampled during that event.

Construction Areas

- Sample locations will be located in the Floodway Channel, upstream and downstream of the overall construction (Con U/S and Con D/S) and upstream and downstream of the overall revegetation areas (Veg U/S and Veg D/S). Note these sample locations will change as work proceeds. During a sample event if there is less than 0.1 m water depth in the low flow channel at a sample location then that location will not be collected during that event.

The potential maximum number of sample locations, likely only for monthly sampling events in late fall, is 43, whereas on average there will likely be 30 sample locations. The sample locations used for any given sampling event will depend on the time of year, flow conditions and construction progress to date. For example, until construction activities begin in the vicinity of the West Dyke drains, the sample locations upstream of the West Dyke at the Manness and Domain Drains and upstream and downstream of identified fish habitat are not required. During the winter construction period no river water will be flowing into the Floodway Channel and most or all of the drains will likely be frozen and therefore samples will likely only be collected from the Floodway Channel and the Red River at the Outlet. Likewise, during the spring to fall construction period when drier conditions occur, if any of the source flows of water into the Floodway Channel (i.e. Red River and the 11 outfalls) are not flowing into the channel or have an insufficient amount of water to sample, then they will not be sampled.

3.0 SAMPLING PROTOCOL

As in the 2005 program, the protocol follows the U.S. Environmental Protection Agency (EPA), Office of Water Quality, Monitoring Water Quality, Chapter 5 Water Quality Conditions (November, 1997, EPA 841-B-97-003). Samples are collected by wading into the water source and/or using a 3 metre sample extension rod to sample as close to the centre of the flow as possible. For safety considerations, the Red River samples are collected from the shoreline using the sample extension rod. Samples are collected by dipping a sample collector into the water to a depth of approximately 30 cm, or half the depth if there is less than 60 cm of water, and scooping the sample collector upstream into the water flow. If there is an insufficient depth of water, 10 cm or less, then sampling is not conducted as the bottom would likely be disturbed during sampling and spoil the sample. Before each sample, the collection jar is rinsed a minimum of three times with the sample water to ensure representative readings of the existing surface water conditions.

During winter when the surface water has an ice cover, an auger or other tools will be used to provide access to sample the water. The sampling health and safety plan includes: two person sampling; flotation suits during cold weather and/or high flows; Personal Floatation Devices (PFD’s) during other times; use of a harness and rope to anchor personnel to a fixed object and specifications for working on ice.

4.0 PARAMETERS

While sampling during monthly monitoring, field measurements of pH, temperature, conductivity and turbidity will be obtained. Water depth is also recorded from staff gauges installed at Floodway Channel locations and in the outfalls. Staff gauges are not installed at Kildare Trunk-

Transcona Storm Sewer Outlet, Country Villa Estates Drain and Deacon Reservoir Drain as it is not feasible to record the depth of water at these drains. No depth of water is recorded for any of the samples collected from the Red River or the West Dyke drains. The water depth is recorded to estimate the water discharge at each site using rating curves developed for each of the drains and the Floodway Channel at the sample locations. Estimates of the water discharge are necessary to calculate approximate mass balances for the chemical analysis results to interpret the results in particular during event-based compliance monitoring. Discharge estimates for the Red River are based on upstream and downstream measurements from Water Survey of Canada Metering Stations.

The analysis package for the monthly sampling events includes various combinations of the following;

- Routine extractable (iron, manganese, fluoride, pH, total dissolved solids, sulphate, nitrate-nitrite, calcium, potassium magnesium, sodium, hardness, conductivity, chloride, total alkalinity, bicarbonate, carbonate and hydroxide)
- Total suspended solids (TSS) and turbidity
- Ammonia
- Ortho phosphorus, total phosphorus, total dissolved phosphorus
- Dissolved organic carbon (DOC), total organic carbon (TOC)
- Total Kjeldahl nitrogen (TKN)
- Phenoxy acid herbicide screen (2,4-D, Bromoxynil, Dicamba, MCPA, Picloram), AMPA and Glyphosate
- Benzene, toluene, ethylbenzene and xylenes (BTEX)
- Total extractable hydrocarbons (TEH) and total purgeable hydrocarbons (TPH)
- Total coliform and *E.Coli* by m-Coli Blue Membrane Filtration method

The specific parameters assessed during monthly monitoring at each sampling location are similar to the 2005 program and are detailed in Table 1. Additional other parameters can be added, if required and approved by MFA.

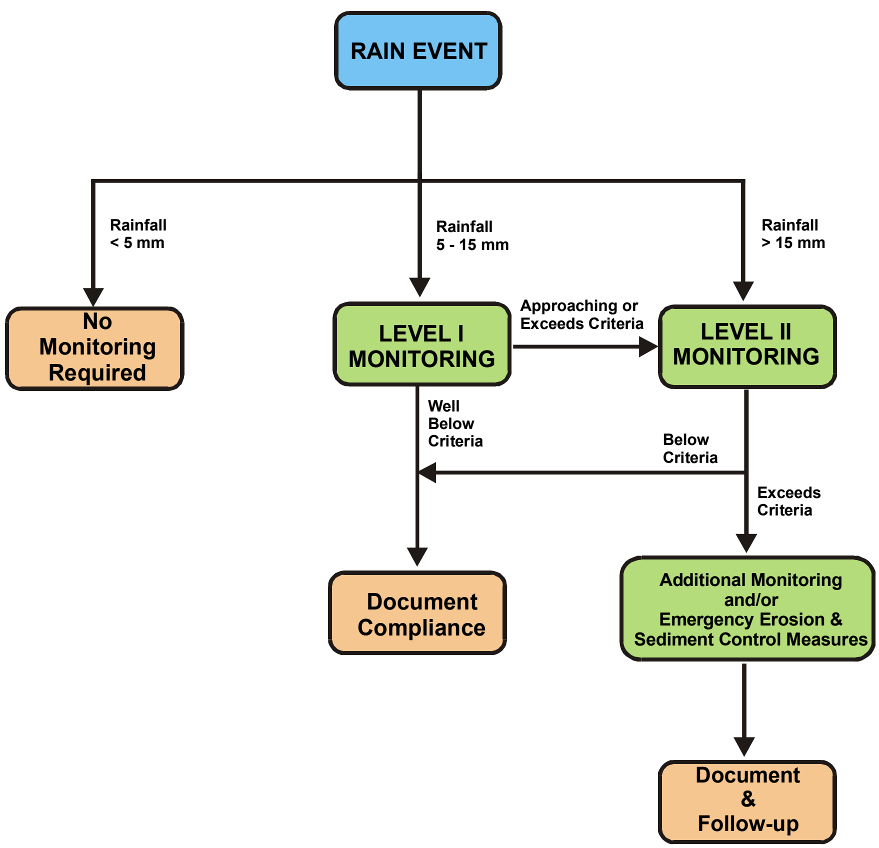
5.0 EVENT-BASED COMPLIANCE MONITORING

Event-based compliance monitoring will be conducted in response to rain events and spill events with samples analyzed for the following parameters of interest:

- Total Suspended Solids (as detailed in the KGS Group Memorandum 03-1100-01.37.10 Erosion and Sediment Control Plan, Event-Based Compliance Monitoring Program)
- Nutrients - field temperature, pH, nitrate-nitrite+N, ammonia, total Kjeldahl nitrogen, ortho phosphorus, total phosphorus and total dissolved phosphorus
- Herbicides - Phenoxy acid herbicide screen, AMPA and Glyphosate
- Hydrocarbons - BTEX, TEH and TPH

Rain Event

As outlined in the flow chart below, the event-based monitoring program will be structured so that the level of effort associated with the monitoring is consistent with the level of potential concern. When a rainfall is less than 5 mm no monitoring is required. When rainfall is between 5 mm and 15 mm, a relatively simple monitoring approach (“Level I”) will be carried out to indicate whether the downstream conditions are approaching the CCME and Provincial limits or whether the concentration inflow to the Red River is within accepted limits. When rainfall exceeds 15 mm or if the “Level I” downstream conditions approach the CCME and Provincial limits, more rigorous monitoring (“Level II”) will be carried out to determine whether additional mitigation control measures are required.



Monitoring Program Flow Chart

Real-time precipitation data will be used to trigger the initiation of either the Level I or Level II monitoring programs. This real-time data will be monitored regularly whenever there are precipitation events to allow for the monitoring team to mobilize in order to carry out the surface water sampling without delay following or during rain events.

There are a number of rainfall gauges within the City of Winnipeg that could be used as a source of real-time rainfall data. This data will not be accessible directly by the monitoring team and will be provided by the owners of the rainfall gauge network on a minimum a 6 hour basis, but most likely a daily basis.

The rainfall/monitoring criteria have been formulated on a judgmental basis, assuming an adaptive management approach will be followed throughout the Project to ensure that the level of monitoring is consistent with the potential concern. That is, if it is regularly determined that parameter concentrations are well below the CCME and Provincial criterion for an 10 mm rain event, the criterion for “Level I” monitoring will be revised accordingly.

Level I – The “Level I” monitoring program will consist of sampling in the Floodway Channel upstream and downstream of the construction area and in the Red River downstream of the Outlet. Field turbidity, using a hand-held turbidity meter, and the water level will be measured and used to estimate the TSS and the flow.

TSS will be estimated using the site-specific relationships between TSS and field turbidity. These were defined as part of the Baseline Surface Water Monitoring Program and updated following each monthly sampling event during the 2005 Construction Surface Water Monitoring. Two relationships were developed, one for Red River water and a second for non-Red River water. The Red River water relationship is based on data collected from the Red River as well as data collected from the Floodway during operation of the Floodway. The non-Red River water relationship is based on data collected from the Floodway when it was not in operation and from the inflowing drains. The TSS and field turbidity relationships will continue to be updated on a monthly basis, allowing the quality of the relationships to improve as more samples are collected.

The estimated TSS and flows will be used in conjunction with a simple mass balance (see attached "Level I Compliance Monitoring Worksheet") to provide an indication as to whether an increase in sediment concentration in the Floodway will have an impact on the Red River downstream of the Floodway Outlet. Additionally, as phosphorus fertilizer and glyphosate-based herbicides readily bind to soil particles the estimated TSS will give an indication of potential nutrient and herbicide concentration increases.

In addition to measuring field turbidity, samples will be collected at the three locations for laboratory confirmation analysis of TSS. If fertilizer has been applied or if herbicides have been used within two weeks prior to the rain event, then samples will also be collected and submitted for laboratory analysis of nutrients and herbicides, respectively.

Level II – The "Level II" monitoring program considers more sample locations that allow for both the assessment of the dilution effect of the Floodway channel downstream of the construction zone and of where the potential contaminant source(s) originate. It will consist of collecting samples at all of the sample locations that would be monitored during a monthly monitoring event, however only the applicable parameters will be analyzed. These include TSS, and if used within two weeks prior to the rain event, nutrients and herbicides.

Spill Event

The event-based monitoring program in response to spills will consist of sampling in the Floodway Channel and in the Red River with samples analyzed for nutrients, herbicides or hydrocarbons as dictated by the material spilled. Samples will be collected in the Floodway Channel upstream and downstream of the spill point source, at two more locations further downstream in the Floodway Channel and in the Red River upstream and 1000 m downstream of the Outlet immediately following notification of the spill. In order to track the status of the contaminant plume as it moves downstream, these six sample locations will also be sampled at regular time intervals (based on the flow magnitude during the spill event) for a total of up to three days of monitoring following the spill event.

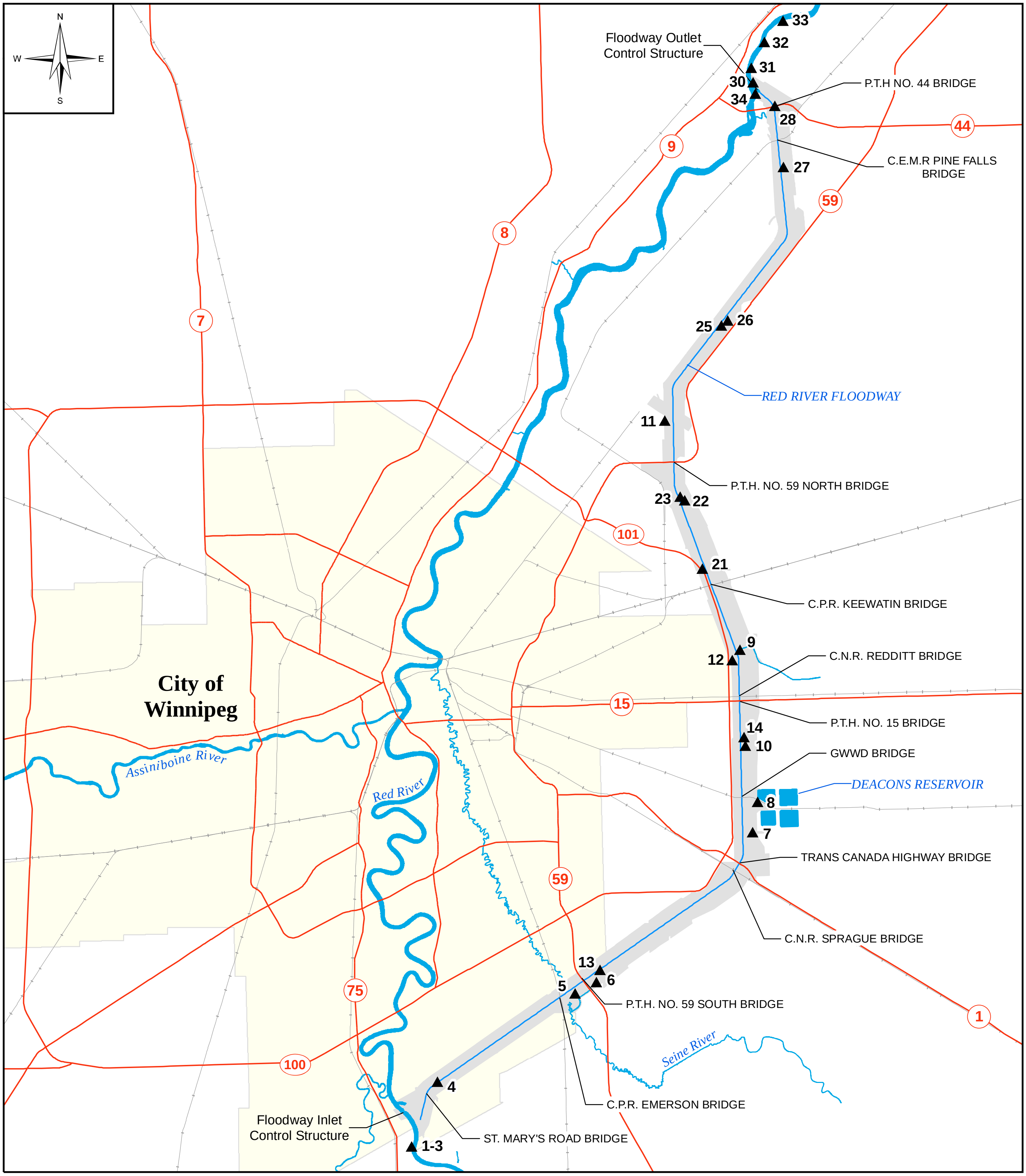
6.0 REPORTING

The data collected during the monthly monitoring and event-based compliance monitoring will be summarized in table format outlining the surface water quality. This information will be compared to the 2005 baseline data on a monthly and event basis to assess the accuracy of predictions made and the effectiveness of mitigation measures. It will also be summarized in a separate 2006 Annual Construction Monitoring Report. In addition to the annual report, documentation will be provided to MFA after each Level I, Level II, and spill monitoring events.

TABLE 1: SAMPLE PARAMETERS FOR EACH SAMPLE LOCATION DURING THE 2006 CONSTRUCTION MONTHLY MONITORING (JANUARY 2006 - DECEMBER 2006)

Sample Location	Sample Number	Parameters												
		Routine Extractable	TSS	Ammonia	Ortho - P	Total P	Total Dissolved P	DOC	TOC	TKN	Phenoxy Acid Herbicide Screen	Glyphosate	BTEX, TEH, TVH	Total Coliform / E. Coli
Red River														
Upstream of Inlet (3 replicates) [1]	1 - 3	X	X	X	X	X	X	X	X	X				X
Upstream of Outlet	34	X	X	X	X	X	X	X	X	X				X
Downstream of Outlet (500, 1000, 2000 and 3000 m)	30 - 33	X	X	X	X	X	X	X	X	X				X
Floodway Channel														
Downstream of Inlet [1]	4	X	X	X	X	X	X	X	X	X				X
Downstream of Grande Pointe DS	13	X	X	X	X	X	X	X	X	X				X
Downstream of North Bibeau DS	14	X	X	X	X	X	X	X	X	X				X
Keewatin Weir	21	X	X	X	X	X	X	X	X	X				X
Spring Hill Weir	23	X	X	X	X	X	X	X	X	X				X
Dunning Weir	25	X	X	X	X	X	X	X	X	X				X
Hwy #44 Weir	28	X	X	X	X	X	X	X	X	X				X
Field Duplicate of one Channel location	99	X	X	X	X	X	X	X	X	X				X
Upstream of Construction Area	CON-U/S	X	X	X	X	X	X	X	X	X			X	X
Downstream of Construction Area	CON-D/S	X	X	X	X	X	X	X	X	X			X	X
Upstream of Revegetation Area	VEG-U/S	X	X	X	X	X	X	X	X	X	X	X		X
Downstream of Revegetation Area	VEG-D/S	X	X	X	X	X	X	X	X	X	X	X		X
Drains [1]														
Seine River Syphon Overflow	5	X	X	X	X	X	X	X	X	X				X
Grande Pointe Diversion Drop Structure	6	X	X	X	X	X	X	X	X	X				X
Centreline Drain Drop Structure	7	X	X	X	X	X	X	X	X	X				X
Deacon Reservoir Drain	8	X	X	X	X	X	X	X	X	X				X
Cooks Creek Diversion Drop Structure	9	X	X	X	X	X	X	X	X	X				X
North Bibeau Drain Drop Structure	10	X	X	X	X	X	X	X	X	X				X
Country Villa Estates Drain	11	X	X	X	X	X	X	X	X	X				X
Kildare Trunk–Transcona Storm Sewer Outlet	12	X	X	X	X	X	X	X	X	X				X
Spring Field Road Drain Drop Structure	22	X	X	X	X	X	X	X	X	X				X
Skholny Drain Drop Structure	26	X	X	X	X	X	X	X	X	X				X
Ashfield Drain Drop Structure	27	X	X	X	X	X	X	X	X	X				X
Upstream of perimeter ditch in active constructin areas		X	X	X	X	X	X	X	X	X				X
West Dyke [2]														
Upstream of Manness Drain														
Upstream of Domain Drain														
Upstream of Identified Fish Habitat														
Downstream of Manness Drain	35	X	X	X	X	X	X	X	X	X				X
Downstream of Domain Drain	36	X	X	X	X	X	X	X	X	X				X
Downstream of Identified Fish Habitat														
Estimated Average Number of Samples/Month [3]		30	30	30	30	30	30	30	30	30	2	2	2	30

Notes:
1 - During the sampling events if there is no water flowing into the floodway channel from the Red River or a drain due to frozen or low flow conditions then sampling that location is not required.
2 - It is assumed that in 2006 there will be no construction in the vicinity of the Manness and Domain drains along the West Dyke, if any occurrs then the upstream samples will be obtained.
3 - Average based on experience obtained during 2005 that realizes that not every sample location visited each month will have a sample collected.



▲ 10 Surface Water Sampling Locations

MEMO REFERENCE ....05-1100-01.9905210-NM4...............

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RED RIVER FLOODWAY EXPANSION

2006 CONSTRUCTION SURFACE WATER MONITORING

FLOODWAY CHANNEL SAMPLE LOCATIONS

APRIL 2006	FIGURE NM4-1	REV A

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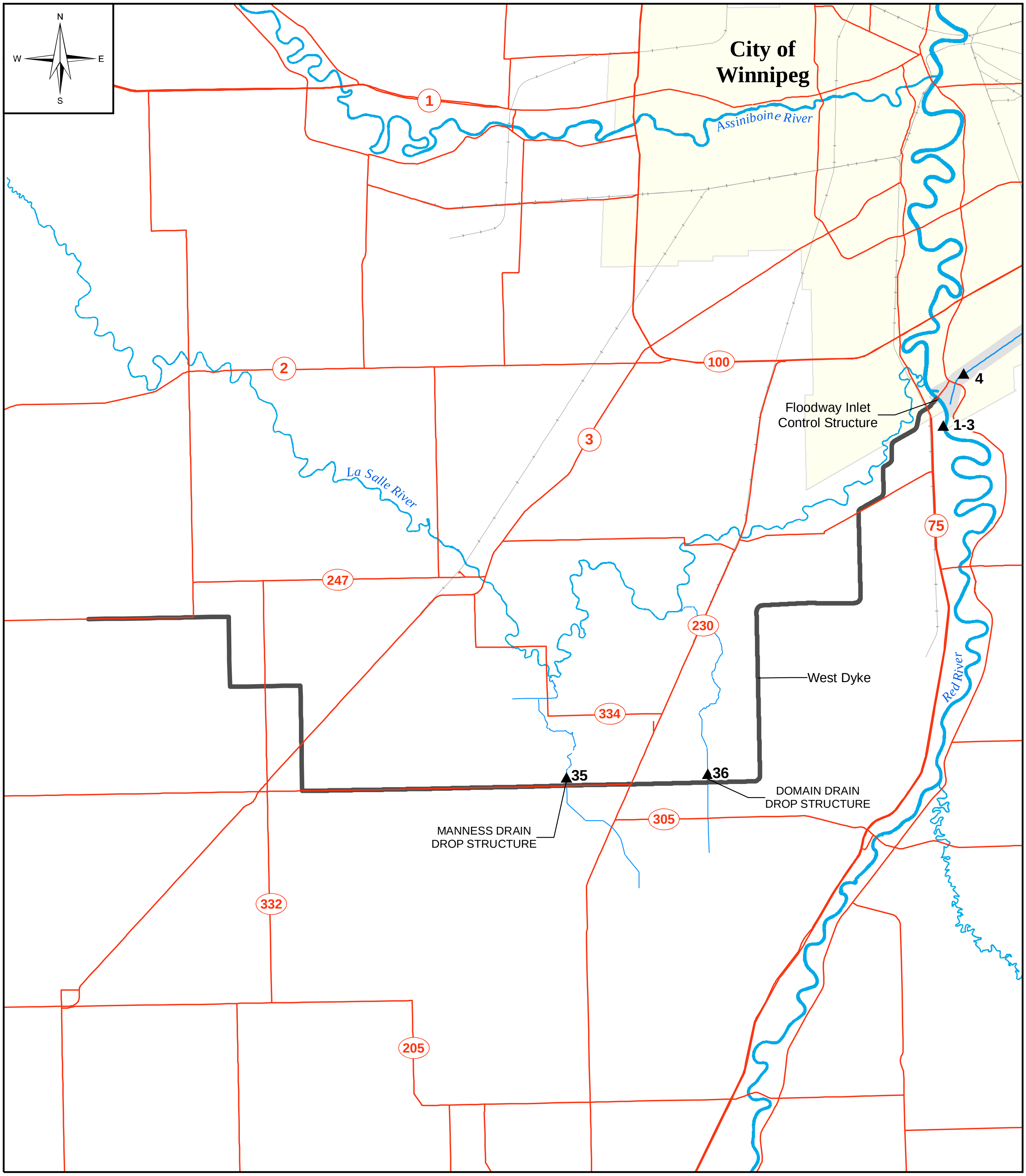

▲ 35 Surface Water Sampling Locations

1:250,000

0 1 2 4 6 8 10

Kilometres

MEMO REFERENCE 05-1100-01.9905210-NM4

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2006 CONSRTUCTION SURFACE WATER MONITORING

WEST DYKE SAMPLE LOCATIONS

APRIL 2006	FIGURE NM4-2	REV A

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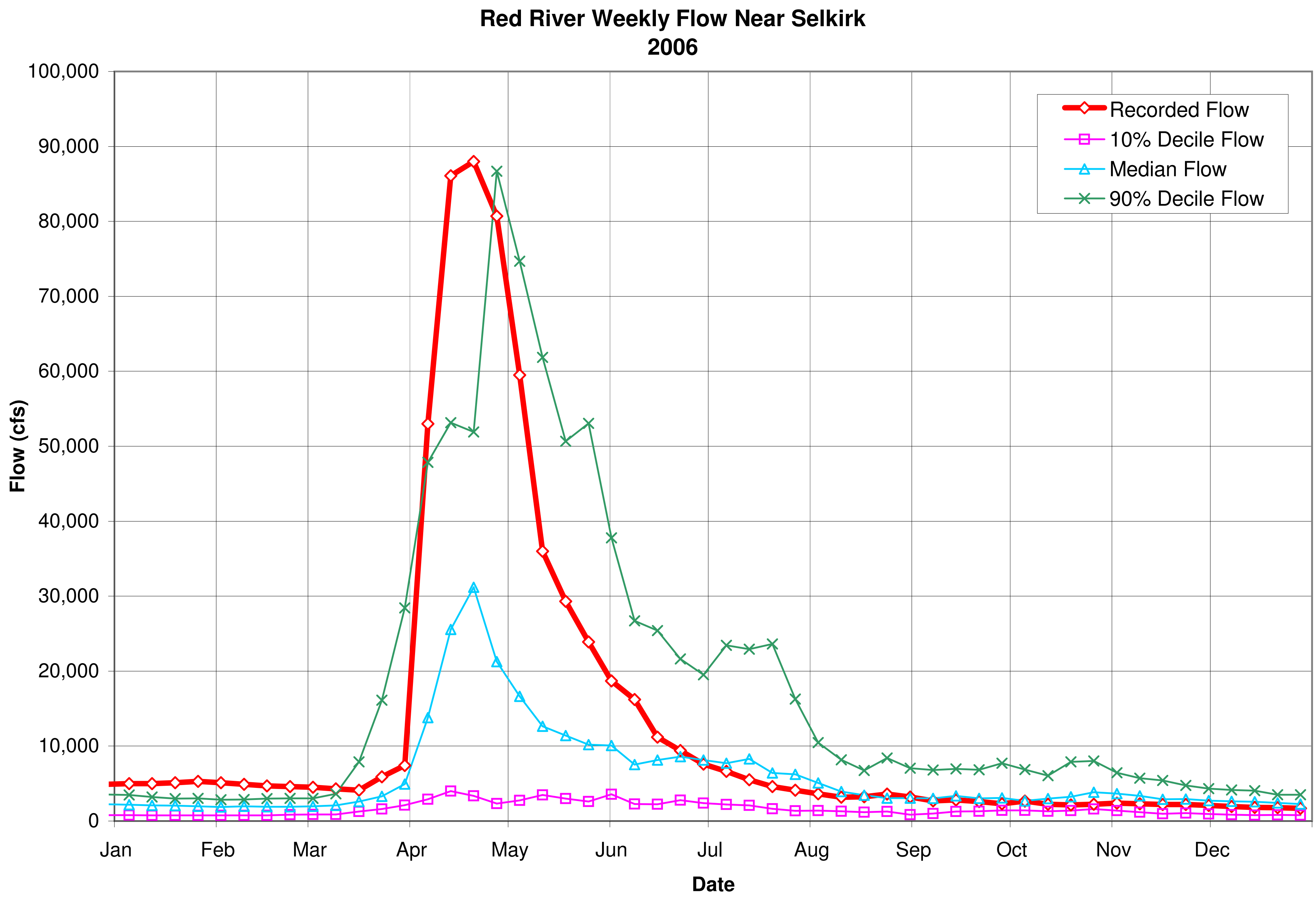
APPENDIX B

MANITOBA WATER STEWARDSHIP
WEEKLY RIVER FLOW REPORT
RED RIVER NEAR SELKIRK



Red River Weekly Flow Near Selkirk
2006
Recorded Flow
10% Decile Flow
Median Flow
90% Decile Flow
Flow (cfs)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Date

APPENDIX C

ENVIRONMENT CANADA
WINNIPEG INT'L A, MANITOBA – DAILY DATA REPORTS
JANUARY - DECEMBER 2006

Environment Canada Environnement Canada

Daily Data Report for January 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m

Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for January 2006

Day	Max Ter °C	Min Ter °C	Mean Te °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01	-3.4	-5.8	-4.6	22.6	0.0	0.0	0.0	0.0			
02	-2.7	-7.4	-5.1	23.1	0.0	0.0	0.0	0.0			
03	-1.3	-2.8	-2.1	20.1	0.0	T	0.0	T			
04	-1.3	-2.9	-2.1	20.1	0.0	T	0.5	0.5			
05	-2.8	-5.8	-4.3	22.3	0.0	T	T	T			
06	1.2	-6.6	-2.7	20.7	0.0	0.0	T	T			
07	-2.8	-4.4	-3.6	21.6	0.0	0.0	T	T			
08	-3.8	-9.9	-6.9	24.9	0.0	T	0.5	0.5			
09	-4.3	-17.2	-10.8	28.8	0.0	0.0	T	T			
10	1.5	-5.1	-1.8	19.8	0.0	0.0	0.5	0.5			
11	0.4	-2.0	-0.8	18.8	0.0	T	3.0	3.0			
12	-0.7	-17.4	-9.1	27.1	0.0	T	5.0	5.0			
13	-2.4	-13.2	-7.8	25.8	0.0	0.0	0.5	0.5			
14	-2.2	-11.8	-7.0	25.0	0.0	0.0	0.0	0.0			
15	-0.4	-4.8	-2.6	20.6	0.0	T	0.5	0.5			
16	-1.4	-11.9	-6.7	24.7	0.0	0.0	5.0	5.0			
17	-9.2	-14.6	-11.9	29.9	0.0	0.0	T	T			
18	-12.3	-21.6	-17.0	35.0	0.0	0.0	T	T			
19	-5.9	-19.1	-12.5	30.5	0.0	T	1.0	1.0			
20	-10.6	-18.8	-14.7	32.7	0.0	0.0	0.5	0.5			
21	-12.2	-19.9	-16.1	34.1	0.0	0.0	1.0	1.0			
22	-14.8	-32.9	-23.9	41.9	0.0	0.0	T	T			
23	2.8	-15.0	-6.1	24.1	0.0	0.0	5.0	5.0			
24	-0.9	-10.0	-5.5	23.5	0.0	0.0	0.5	0.5			
25	-0.5	-14.6	-7.6	25.6	0.0	0.0	0.0	0.0			
26	2.7	-5.7	-1.5	19.5	0.0	0.0	0.0	0.0			
27	-0.1	-5.4	-2.8	20.8	0.0	0.0	0.0	0.0			
28	-4.9	-14.2	-9.6	27.6	0.0	0.0	0.5	0.5			
29	-4.9	-7.2	-6.1	24.1	0.0	0.0	1.5	1.5			
30	-5.3	-20.4	-12.9	30.9	0.0	0.0	0.0	0.0			
31	0.6	-5.3	-2.4	20.4	0.0	T	0.0	T			
Sum				**786.6**	**0.0**	**T**	**25.5**	**25.5**			
Avg	**-3.3**	**-11.4**	**-7.4**								
Xtrm	**2.8**	**-32.9**									

Legend

[empty] = No data available
M = Missing
E = Estimated

Navigation Options

Canada Map
Manitoba Map
Customized Search

Environment Canada Environnement Canada

Daily Data Report for February 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m

Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for February 2006

Day	Max Ter °C	Min Ter °C	Mean Ter °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01	-2.1	-9.0	-5.6	23.6	0.0	0.0	0.0	0.0			
02	-7.0	-22.5	-14.8	32.8	0.0	0.0	2.0	2.0			
03	-14.2	-23.9	-19.1	37.1	0.0	0.0	0.0	0.0			
04	-11.7	-27.1	-19.4	37.4	0.0	0.0	0.0	0.0			
05	-10.4	-25.9	-18.2	36.2	0.0	0.0	0.0	0.0			
06	-6.8	-17.8	-12.3	30.3	0.0	0.0	0.0	0.0			
07	-7.9	-19.3	-13.6	31.6	0.0	0.0	0.0	0.0			
08	-10.6	-22.6	-16.6	34.6	0.0	0.0	0.0	0.0			
09	-1.9	-14.4	-8.2	26.2	0.0	0.0	2.0	2.0			
10	-5.1	-11.3	-8.2	26.2	0.0	0.0	0.0	0.0			
11	-8.1	-13.7	-10.9	28.9	0.0	0.0	0.0	0.0			
12	-7.3	-15.8	-11.6	29.6	0.0	0.0	0.0	0.0			
13	-9.4	-17.7	-13.6	31.6	0.0	0.0	0.0	0.0			
14	-8.7	-27.6	-18.2	36.2	0.0	0.0	0.0	0.0			
15	-17.4	-30.4	-23.9	41.9	0.0	0.0	0.0	0.0			
16	-23.0	-32.4	-27.7	45.7	0.0	0.0	0.0	0.0			
17	-24.6	-33.7	-29.2	47.2	0.0	0.0	0.0	0.0			
18	-14.3	-26.5	-20.4	38.4	0.0	0.0	0.0	0.0			
19	-9.3	-17.8	-13.6	31.6	0.0	0.0	0.0	0.0			
20	-7.9	-22.4	-15.2	33.2	0.0	0.0	1.0	1.0			
21	-8.4	-21.9	-15.2	33.2	0.0	0.0	0.0	0.0			
22	-8.5	-19.9	-14.2	32.2	0.0	0.0	0.0	0.0			
23	-9.2	-24.6	-16.9	34.9	0.0	0.0	0.0	0.0			
24	-10.4	-26.5	-18.5	36.5	0.0	0.0	0.0	0.0			
25	-15.6	-29.4	-22.5	40.5	0.0	0.0	0.0	0.0			
26	-14.2	-24.1	-19.2	37.2	0.0	0.0	0.0	0.0			
27	-9.1	-21.6	-15.4	33.4	0.0	0.0	0.0	0.0			
28	-2.3	-11.4	-6.9	24.9	0.0	0.0	0.0	0.0			
Sum				**953.1**	**0.0**	**0.0**	**5.0**	**5.0**			
Avg	**-10.2**	**-21.8**	**-16.0**								
Xtrm	**-1.9**	**-33.7**									

Legend

[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred

Navigation Options

Canada Map
Manitoba Map
Customized Search
Nearby Stations with Data
1971-2000 Climate Normals
Customizable Chart

Environment Canada Environnement Canada

Daily Data Report for March 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m
Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for March 2006

Day	Max Ter °C	Min Ter °C	Mean Tei °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01	-5.4	-8.4	-6.9	24.9	0.0	0.0	10.0	10.0			
02	-6.5	-9.8	-8.2	26.2	0.0	0.0	0.5	0.5			
03	-6.4	-16.5	-11.5	29.5	0.0	0.0	0.0	0.0			
04	-1.0	-19.9	-10.5	28.5	0.0	0.0	1.0	1.0			
05	-0.8	-2.6	-1.7	19.7	0.0	0.0	3.5	3.5			
06	-0.6	-4.2	-2.4	20.4	0.0	0.0	2.5	2.5			
07	1.6	-2.0	-0.2	18.2	0.0	0.0	0.0	0.0			
08	0.7	-4.6	-2.0	20.0	0.0	0.0	0.0	0.0			
09	1.3	-6.0	-2.4	20.4	0.0	0.0	0.0	0.0			
10	2.5	-4.2	-0.9	18.9	0.0	0.0	0.0	0.0			
11	-0.3	-4.9	-2.6	20.6	0.0	0.0	2.5	2.5			
12	-3.5	-18.5	-11.0	29.0	0.0	0.0	0.0	0.0			
13	-9.8	-19.4	-14.6	32.6	0.0	0.0	0.0	0.0			
14	-10.0	-20.6	-15.3	33.3	0.0	0.0	0.0	0.0			
15	-8.9	-25.1	-17.0	35.0	0.0	0.0	0.0	0.0			
16	-7.6	-18.4	-13.0	31.0	0.0	0.0	0.0	0.0			
17	-5.4	-21.4	-13.4	31.4	0.0	0.0	0.0	0.0			
18	-3.9	-14.6	-9.3	27.3	0.0	0.0	0.5	0.5			
19	-4.9	-20.3	-12.6	30.6	0.0	0.0	0.0	0.0			
20	-3.7	-18.9	-11.3	29.3	0.0	0.0	0.0	0.0			
21	-3.3	-14.8	-9.1	27.1	0.0	0.0	0.0	0.0			
22	0.1	-18.9	-9.4	27.4	0.0	0.0	0.0	0.0			
23	1.3	-15.1	-6.9	24.9	0.0	0.0	0.0	0.0			
24	1.6	-4.8	-1.6	19.6	0.0	0.0	0.0	0.0			
25	2.7	-8.5	-2.9	20.9	0.0	0.0	0.0	0.0			
26	3.6	-1.2	1.2	16.8	0.0	0.0	0.0	0.0			
27	3.4	-2.0	0.7	17.3	0.0	0.0	0.0	0.0			
28	3.5	-4.9	-0.7	18.7	0.0	0.0	0.0	0.0			
29	5.0	1.0	3.0	15.0	0.0	0.0	0.5	0.5			
30	2.7	1.1	1.9	16.1	0.0	0.0	9.5	9.5			
31	4.2	-3.2	0.5	17.5	0.0	0.0	6.0	6.0			
Sum				**748.1**	**0.0**	**0.0**	**36.5**	**36.5**			
Avg	**-1.5**	**-10.7**	**-6.1**								
Xtrm	**5.0**	**-25.1**									

Legend

[empty] = No data available
M = Missing
E = Estimated

Navigation Options

Canada Map
Manitoba Map
Customized Search

Environment Canada Environnement Canada

Daily Data Report for April 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m

Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for April 2006

Day	Max Ter °C	Min Ter °C	Mean Ter °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01	5.5	-4.1	0.7	17.3	0.0	0.0	0.0	0.0			
02	5.8	-1.4	2.2	15.8	0.0	0.5	0.0	0.5			
03	3.0	-3.1	-0.1	18.1	0.0	0.0	0.0	0.0			
04	8.6	-5.6	1.5	16.5	0.0	0.0	0.0	0.0			
05	13.4	0.4	6.9	11.1	0.0	0.0	0.0	0.0			
06	8.7	-1.7	3.5	14.5	0.0	0.5	0.0	0.5			
07	4.8	-4.3	0.3	17.7	0.0	0.0	0.0	0.0			
08	10.4	-4.8	2.8	15.2	0.0	0.0	0.0	0.0			
09	16.3	1.5	8.9	9.1	0.0	0.0	0.0	0.0			
10	19.4	4.5	12.0	6.0	0.0	2.0	0.0	2.0			
11	15.4	6.3	10.9	7.1	0.0	9.0	0.0	9.0			
12	12.6	0.9	6.8	11.2	0.0	0.0	0.0	0.0			
13	18.9	1.1	10.0	8.0	0.0	1.5	0.0	1.5			
14	17.7	3.5	10.6	7.4	0.0	0.0	0.0	0.0			
15	24.1	10.4	17.3	0.7	0.0	0.5	0.0	0.5			
16	24.9	12.3	18.6	0.0	0.6	0.0	0.0	0.0			
17	22.0	10.2	16.1	1.9	0.0	0.5	0.0	0.5			
18	19.5	10.4	15.0	3.0	0.0	0.0	0.0	0.0			
19	13.0	3.8	8.4	9.6	0.0	0.5	0.0	0.5			
20	19.8	3.0	11.4	6.6	0.0	0.0	0.0	0.0			
21	21.7	2.9	12.3	5.7	0.0	0.0	0.0	0.0			
22	22.3	4.2	13.3	4.7	0.0	0.0	0.0	0.0			
23	23.5	1.8	12.7	5.3	0.0	0.0	0.0	0.0			
24	10.4	-1.3	4.6	13.4	0.0	0.0	0.0	0.0			
25	18.6	-0.9	8.9	9.1	0.0	0.0	0.0	0.0			
26	21.2	4.3	12.8	5.2	0.0	0.0	0.0	0.0			
27	22.1	5.4	13.8	4.2	0.0	0.0	0.0	0.0			
28	20.3	9.9	15.1	2.9	0.0	0.0	0.0	0.0			
29	16.7	10.1	13.4	4.6	0.0	0.0	0.0	0.0			
30	14.4	7.8	11.1	6.9	0.0	1.5	0.0	1.5			
Sum				258.8	0.6	16.5	0.0	16.5			
Avg	15.8	2.9	9.4								
Xtrm	24.9	-5.6									

Legend

[empty] = No data available
M = Missing
E = Estimated
A = Accumulated

Navigation Options

Canada Map
Manitoba Map
Customized Search
Nearby Stations with Data

Environment Canada Environnement Canada

Daily Data Report for May 2006

Notes on Data Quality.

WINNIPEG INT'L A MANITOBA

Latitude: 49° 55' N Longitude: 97° 13' W Elevation: 238.70 m
Climate ID: 5023222 WMO ID: 71852 TC ID: YWG

Daily Data Report for May 2006

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days C	Cool Deg Days C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01	14.5	10.3	12.4	5.6	0.0	3.0	0.0	3.0	0		
02	18.0	6.9	12.5	5.5	0.0	8.0	0.0	8.0	0		
03	12.6	2.7	7.7	10.3	0.0	3.0	0.0	3.0	0		
04	4.4	-2.8	0.8	17.2	0.0	0.0	0.0	0.0	0		
05	13.9	-4.8	4.6	13.4	0.0	1.0	0.0	1.0	0		
06	19.3	-2.1	8.6	9.4	0.0	0.0	0.0	0.0	0		
07	27.7	9.9	18.8	0.0	0.8	0.5	0.0	0.5	0		
08	22.3	9.5	15.9	2.1	0.0	0.5	0.0	0.5	0		
09	20.4	7.8	14.1	3.9	0.0	8.5	0.0	8.5	0		
10	12.4	2.5	7.5	10.5	0.0	1.5	0.0	1.5	0		
11	10.5	-1.9	4.3	13.7	0.0	0.0	0.0	0.0	0		
12	15.4	-0.9	7.3	10.7	0.0	0.0	0.0	0.0	0		
13	13.5	6.1	9.8	8.2	0.0	1.5	0.0	1.5	0		
14	14.2	5.3	9.8	8.2	0.0	0.0	0.0	0.0	0		
15	14.9	1.9	8.4	9.6	0.0	0.0	0.0	0.0	0		
16	22.9	-1.2	10.9	7.1	0.0	0.0	0.0	0.0	0		
17	19.1	2.2	10.7	7.3	0.0	0.0	0.0	0.0	0		
18	15.2	0.9	8.1	9.9	0.0	1.0	0.0	1.0	0		
19	20.3	7.9	14.1	3.9	0.0	1.5	0.0	1.5	0		
20	13.1	2.2	7.7	10.3	0.0	2.0	0.0	2.0	0		
21	14.0	-3.2	5.4	12.6	0.0	0.0	0.0	0.0	0		
22	24.1	5.1	14.6	3.4	0.0	0.5	0.0	0.5	0		
23	29.4	13.8	21.6	0.0	3.6	1.0	0.0	1.0	0		
24	27.5	17.0	22.3	0.0	4.3	0.0	0.0	0.0	0		
25	18.2	6.2	12.2	5.8	0.0	0.0	0.0	0.0	0		
26	19.6	4.6	12.1	5.9	0.0	0.0	0.0	0.0	0		
27	23.6	14.6	19.1	0.0	1.1	6.5	0.0	6.5	0		
28	23.6	13.7	18.7	0.0	0.7	1.5	0.0	1.5	0		
29	22.5	12.5	17.5	0.5	0.0	0.0	0.0	0.0	0		
30	22.6	11.5	17.1	0.9	0.0	0.0	0.0	0.0	0		
31	24.9	10.2	17.6	0.4	0.0	3.0	0.0	3.0	0		
Sum				196.3	10.5	44.5	0.0	44.5			
Avg	18.5	5.4	12.0								
Xtrm	29.4	-4.8									

Legend

[empty] = No data available
M = Missing
E = Estimated

Navigation Options

Canada Map
Manitoba Map
Customized Search

Environment Canada Environnement Canada

Daily Data Report for June 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m
Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for June 2006

Day	Max Ter °C	Min Ter °C	Mean Ter °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01	24.7	7.6	16.2	1.8	0.0	0.0	0.0	0.0	0		
02	27.9	7.0	17.5	0.5	0.0	0.0	0.0	0.0	0		
03	29.8	16.4	23.1	0.0	5.1	0.0	0.0	0.0	0		
04	24.8	15.9	20.4	0.0	2.4	0.5	0.0	0.5	0		
05	25.7	13.2	19.5	0.0	1.5	7.5	0.0	7.5	0		
06	25.6	13.1	19.4	0.0	1.4	1.5	0.0	1.5	0		
07	21.9	10.3	16.1	1.9	0.0	0.0	0.0	0.0	0		
08	14.9	6.0	10.5	7.5	0.0	0.0	0.0	0.0	0		
09	18.7	11.8	15.3	2.7	0.0	0.0	0.0	0.0	0		
10	21.4	11.8	16.6	1.4	0.0	0.0	0.0	0.0	0		
11	23.6	9.9	16.8	1.2	0.0	0.0	0.0	0.0	0		
12	24.9	11.4	18.2	0.0	0.2	0.5	0.0	0.5	0		
13	23.9	7.7	15.8	2.2	0.0	0.0	0.0	0.0	0		
14	27.2	9.3	18.3	0.0	0.3	0.0	0.0	0.0	0		
15	27.5	16.8	22.2	0.0	4.2	0.0	0.0	0.0	0		
16	29.3	20.0	24.7	0.0	6.7	1.0	0.0	1.0	0		
17	28.7	16.3	22.5	0.0	4.5	2.0	0.0	2.0	0		
18	21.6	8.8	15.2	2.8	0.0	2.5	0.0	2.5	0		
19	27.6	5.8	16.7	1.3	0.0	0.0	0.0	0.0	0		
20	26.8	15.1	21.0	0.0	3.0	0.5	0.0	0.5	0		
21	23.2	6.7	15.0	3.0	0.0	0.5	0.0	0.5	0		
22	23.6	4.5	14.1	3.9	0.0	0.0	0.0	0.0	0		
23	25.5	10.0	17.8	0.2	0.0	0.0	0.0	0.0	0		
24	24.4	8.2	16.3	1.7	0.0	12.0	0.0	12.0	0		
25	27.5	8.4	18.0	0.0	0.0	0.0	0.0	0.0	0		
26	24.6	9.8	17.2	0.8	0.0	0.5	0.0	0.5	0		
27	24.8	6.7	15.8	2.2	0.0	0.0	0.0	0.0	0		
28	27.2	10.7	19.0	0.0	1.0	0.0	0.0	0.0	0		
29	30.2	14.8	22.5	0.0	4.5	0.0	0.0	0.0	0		
30	29.5	18.1	23.8	0.0	5.8	0.0	0.0	0.0	0		
Sum				**35.1**	**40.6**	**29.0**	**0.0**	**29.0**			
Avg	**25.2**	**11.1**	**18.2**								
Xtrm	**30.2**	**4.5**									

Legend

[empty] = No data available
M = Missing
E = Estimated
A = Accumulated

Navigation Options

Canada Map
Manitoba Map
Customized Search
Nearby Stations with Data

Environment Canada Environnement Canada

Daily Data Report for July 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m

Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for July 2006

Day	Max Ter °C	Min Ter °C	Mean Ter °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01	29.3	16.0	22.7	0.0	4.7	0.0	0.0	0.0	0		
02	28.7	12.5	20.6	0.0	2.6	0.0	0.0	0.0	0		
03	23.1	8.9	16.0	2.0	0.0	0.0	0.0	0.0	0		
04	26.2	6.4	16.3	1.7	0.0	0.0	0.0	0.0	0		
05	28.3	9.7	19.0	0.0	1.0	0.0	0.0	0.0	0		
06	33.0	16.6	24.8	0.0	6.8	0.0	0.0	0.0	0		
07	32.1	19.6	25.9	0.0	7.9	0.0	0.0	0.0	0		
08	29.2	13.2	21.2	0.0	3.2	0.0	0.0	0.0	0		
09	19.1	7.8	13.5	4.5	0.0	0.0	0.0	0.0	0		
10	26.6	6.6	16.6	1.4	0.0	0.0	0.0	0.0	0		
11	32.6	16.6	24.6	0.0	6.6	0.0	0.0	0.0	0		
12	35.9	13.6	24.8	0.0	6.8	0.0	0.0	0.0	0		
13	29.8	19.9	24.9	0.0	6.9	4.5	0.0	4.5	0		
14	32.5	17.0	24.8	0.0	6.8	0.0	0.0	0.0	0		
15	32.1	14.9	23.5	0.0	5.5	0.0	0.0	0.0	0		
16	34.6	13.4	24.0	0.0	6.0	0.0	0.0	0.0	0		
17	27.5	11.8	19.7	0.0	1.7	0.0	0.0	0.0	0		
18	30.0	12.9	21.5	0.0	3.5	0.0	0.0	0.0	0		
19	29.8	12.9	21.4	0.0	3.4	0.0	0.0	0.0	0		
20	27.9	11.3	19.6	0.0	1.6	0.0	0.0	0.0	0		
21	31.2	12.7	22.0	0.0	4.0	0.0	0.0	0.0	0		
22	31.8	12.9	22.4	0.0	4.4	0.0	0.0	0.0	0		
23	35.3	17.2	26.3	0.0	8.3	0.0	0.0	0.0	0		
24	31.0	13.4	22.2	0.0	4.2	0.0	0.0	0.0	0		
25	27.0	15.4	21.2	0.0	3.2	5.5	0.0	5.5	0		
26	30.4	12.2	21.3	0.0	3.3	0.0	0.0	0.0	0		
27	33.1	14.8	24.0	0.0	6.0	0.0	0.0	0.0	0		
28	21.7	12.2	17.0	1.0	0.0	0.5	0.0	0.5	0		
29	24.8	8.2	16.5	1.5	0.0	0.0	0.0	0.0	0		
30	34.5	12.6	23.6	0.0	5.6	0.0	0.0	0.0	0		
31	33.3	14.7	24.0	0.0	6.0	0.0	0.0	0.0	0		
Sum				**12.1**	**120.0**	**10.5**	**0.0**	**10.5**			
Avg	**29.8**	**13.2**	**21.5**								
Xtrm	**35.9**	**6.4**									

Legend

[empty] = No data available
M = Missing
E = Estimated

Navigation Options

Canada Map
Manitoba Map
Customized Search

Environment Canada Environnement Canada

Daily Data Report for August 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m
Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for August 2006

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days C	Cool Deg Days C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	28.2	12.4	20.3	0.0	2.3	M	M	0.0		33	41
02†	30.8	13.9	22.4	0.0	4.4	M	M	2.0		27	56
03†	27.4	10.9	19.2	0.0	1.2	M	M	0.0		34	44
04†	25.7	13.9	19.8	0.0	1.8	M	M	5.5		1	39
05†	29.7	16.1	22.9	0.0	4.9	M	M	4.0		30	65
06†	24.9	11.3	18.1	0.0	0.1	M	M	0.0		32	56
07†	27.7	7.6	17.7	0.3	0.0	M	M	0.0		17	33
08†	32.5	16.6	24.6	0.0	6.6	M	M	0.0		21	61
09†	31.1	19.9	25.5	0.0	7.5	M	M	0.0		4	37
10†	26.2	18.4	22.3	0.0	4.3	M	M	20.0		11	46
11†	28.1	17.6	22.9	0.0	4.9	M	M	0.0		20	44
12†	24.3	17.4	20.9	0.0	2.9	M	M	10.5		29	57
13†	23.5	12.6	18.1	0.0	0.1	M	M	0.0		29	48
14†	24.4	11.4	17.9	0.1	0.0	M	M	0.0		32	52
15†	27.9	9.3	18.6	0.0	0.6	M	M	0.0			<31
16†	23.8	16.5	20.2	0.0	2.2	M	M	0.0			<31
17†	27.0	13.5	20.3	0.0	2.3	M	M	0.0		33	39
18†	24.9	9.9	17.4	0.6	0.0	M	M	0.0		7	33
19†	28.7	7.0	17.9	0.1	0.0	M	M	0.0		30	33
20†	31.4	13.0	22.2	0.0	4.2	M	M	0.0		21	69
21†	23.6	8.9	16.3	1.7	0.0	M	M	0.0		35	37
22†	27.3	5.8	16.6	1.4	0.0	M	M	0.0		16	33
23†	27.9	15.6	21.8	0.0	3.8	M	M	0.0		11	44
24†	26.8	16.4	21.6	0.0	3.6	M	M	0.0		15	50
25†	26.0	12.9	19.5	0.0	1.5	M	M	4.0		32	37
26†	27.2	10.6	18.9	0.0	0.9	M	M	5.0		29	35
27†	30.7	8.1	19.4	0.0	1.4	M	M	0.0		1	44
28†	22.7	8.0	15.4	2.6	0.0	M	M	0.0		3	41
29†	24.5	6.8	15.7	2.3	0.0	M	M	0.0		14	33
30†	27.1	13.1	20.1	0.0	2.1	M	M	0.0		17	54
31†	25.8	13.2	19.5	0.0	1.5	M	M	0.0		18	76
Sum				**9.1**	**65.1**	**M**	**M**	**51.0**			
Avg	**27**	**12.5**	**19.8**								
Xtrm	**32.5**	**5.8**								**18**	**76**

Legend

[empty] = No data available
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Navigation Options

Canada Map
Manitoba Map
Customized Search

Environment Canada Environnement Canada

Daily Data Report for September 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m
Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for September 2006

Day	Max Ter °C	Min Ten °C	Mean Tei °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01†	22.3	8.1	15.2	2.8	0.0	M	M	0.0			<31
02†	24.4	4.8	14.6	3.4	0.0	M	M	0.0			<31
03†	27.1	7.6	17.4	0.6	0.0	M	M	0.0			<31
04†	29.2	7.2	18.2	0.0	0.2	M	M	0.0			<31
05†	30.7	12.8	21.8	0.0	3.8	M	M	0.0			<31
06†	27.5	9.7	18.6	0.0	0.6	M	M	0.0			<31
07†	23.6	7.0	15.3	2.7	0.0	M	M	0.0		2	50
08†	16.4	-1.3	7.6	10.4	0.0	M	M	0.0		6	32
09†	19.6	1.1	10.4	7.6	0.0	M	M	0.0		11	33
10†	22.3	4.4	13.4	4.6	0.0	M	M	0.0		17	48
11†	21.7	6.7	14.2	3.8	0.0	M	M	0.0		18	46
12†	27.4	8.5	18.0	0.0	0.0	M	M	0.0		17	41
13†	29.5	9.9	19.7	0.0	1.7	M	M	0.0		17	54
14†	29.8	17.1	23.5	0.0	5.5	M	M	0.0		18	57
15†	31.6	13.9	22.8	0.0	4.8	M	M	0.5		2	63
16†	19.9	13.5	16.7	1.3	0.0	M	M	3.5		16	52
17†	13.6	9.0	11.3	6.7	0.0	M	M	28.0		24	39
18†	9.0	4.6	6.8	11.2	0.0	M	M	4.5		1	57
19†	10.8	1.0	5.9	12.1	0.0	M	M	0.0		34	32
20†	M	2.0E	M	M	M	M	M	0.0			<31
21†	17.2	3.4	10.3	7.7	0.0	M	M	0.0			<31
22†	16.8	5.9	11.4	6.6	0.0	M	M	0.5		5	44
23†	16.5	5.1	10.8	7.2	0.0	M	M	0.0		36	41
24†	21.2	7.2	14.2	3.8	0.0	M	M	1.0		36	56
25†	18.7	5.2	12.0	6.0	0.0	M	M	0.5		33	50
26†	15.7	5.8	10.8	7.2	0.0	M	M	1.0		1	52
27†	12.9	0.6	6.8	11.2	0.0	M	M	0.0		33	52
28†	10.9	-1.4	4.8	13.2	0.0	M	M	2.5		2	50
29†	16.1	4.8	10.5	7.5	0.0	M	M	1.0		32	50
30†	17.7	4.8	11.3	6.7	0.0	M	M	0.0			<31
Sum				**144.3***	**16.6***	**M**	**M**	**43.0**			
Avg	**20.7**	**6.3E**	**13.5E**								
Xtrm	**31.6**	**-1.4E**								**2**	**63**

Legend	Navigation Options
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Environment Canada Environnement Canada

Daily Data Report for October 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m

Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for October 2006

Day	Max Ter °C	Min Ter °C	Mean Ter °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01†	26.1	6.7	16.4	1.6	0.0	M	M	0.0		18	65
02†	20.0	4.9	12.5	5.5	0.0	M	M	0.0		31	32
03†	13.5	-0.6	6.5	11.5	0.0	M	M	0.0		1	33
04†	15.0	-2.6	6.2	11.8	0.0	M	M	0.0			<31
05†	18.8	2.7	10.8	7.2	0.0	M	M	0.0		19	50
06†	18.6	9.3	14.0	4.0	0.0	M	M	0.0		19	54
07†	23.6	11.6	17.6	0.4	0.0	M	M	0.0		3	72
08†	14.3	-3.8	5.3	12.7	0.0	M	M	0.0		28	82
09†	11.4	-0.8	5.3	12.7	0.0	M	M	0.0		30	33
10†	8.3	-4.1	2.1	15.9	0.0	M	M	2.0		22	50
11†	1.3	-5.7	-2.2	20.2	0.0	M	M	0.0		32	54
12†	4.3	-3.1	0.6	17.4	0.0	M	M	0.0		33	85
13†	4.9	-1.6	1.7	16.3	0.0	M	M	M		33	85
14†	7.5	-4.8	1.4	16.6	0.0	M	M	M		32	46
15†	10.2	-4.8	2.7	15.3	0.0	M	M	M			<31
16†	6.8	3.3	5.1	12.9	0.0	M	M	8.5		12	44
17†	3.4	0.7	2.1	15.9	0.0	M	M	0.0		36	54
18†	2.4	-4.1	-0.9	18.9	0.0	M	M	0.0		32	41
19†	4.5	-5.2	-0.4	18.4	0.0	M	M	0.0		17	37
20†	3.3	-7.1	-1.9	19.9	0.0	M	M	0.0		32	39
21†	2.3	-8.0	-2.9	20.9	0.0	M	M	0.0		32	39
22†	1.5	-1.7	-0.1	18.1	0.0	M	M	0.0		32	37
23†	2.8	-2.0	0.4	17.6	0.0	M	M	0.0		32	32
24†	6.7	-1.6	2.6	15.4	0.0	M	M	0.0		18	32
25†	9.7	-4.0	2.9	15.1	0.0	M	M	0.0		16	33
26†	13.9	0.7	7.3	10.7	0.0	M	M	0.0		2	37
27†	11.2	-2.3	4.5	13.5	0.0	M	M	0.0		33	63
28†	7.6	-8.1	-0.3	18.3	0.0	M	M	0.0		33	46
29†	0.7	-7.5	-3.4	21.4	0.0	M	M	0.0			<31
30†	-0.6	-4.4	-2.5	20.5	0.0	M	M	1.0		34	48
31†	-2.8	-5.3	-4.1	22.1	0.0	M	M	0.0		32	44
Sum				**448.7**	**0.0**	**M**	**M**	**11.5***			
Avg	**8.7**	**-1.7**	**3.5**								
Xtrm	**26.1**	**-8.1**								**33**	**85**

Legend

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Daily Data Report for November 2006

Notes on Data Quality.

WINNIPEG INT'L A
MANITOBA

Latitude: 49° 55' N **Longitude:** 97° 13' W **Elevation:** 238.70 m

Climate ID: 5023222 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for November 2006

Day	Max Ter °C	Min Ter °C	Mean Ter °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01†	-2.8	-6.2	-4.5	22.5	0.0	M	M	M		29	37
02†	-2.6	-6.3	-4.5	22.5	0.0	M	M	0.0		28	37
03†	-3.5	-15.4	-9.5	27.5	0.0	M	M	0.0			<31
04†	0.3	-4.9	-2.3	20.3	0.0	M	M	0.0		13	33
05†	5.5	-6.6	-0.6	18.6	0.0	M	M	0.0		16	37
06†	4.7	-0.9	1.9	16.1	0.0	M	M	0.5			<31
07†	4.1	-0.2	2.0	16.0	0.0	M	M	1.5			<31
08†	3.6	-3.5	0.1	17.9	0.0	M	M	1.5		32	57
09†	-1.9	-5.5	-3.7	21.7	0.0	M	M	0.0		33	48
10†	-5.5	-13.5	-9.5	27.5	0.0	M	M	0.0			<31
11†	0.6	-13.5	-6.5	24.5	0.0	M	M	0.5		16	54
12†	2.6	-2.8	-0.1	18.1	0.0	M	M	0.0		18	48
13†	4.5	-4.0	0.3	17.7	0.0	M	M	0.0		15	48
14†	8.6	-4.0	2.3	15.7	0.0	M	M	0.0		17	59
15†	-2.9	-7.6	-5.3	23.3	0.0	M	M	0.0		28	35
16†	-0.2	-4.9	-2.6	20.6	0.0	M	M	1.5		14	46
17†	0.7	-8.4	-3.9	21.9	0.0	M	M	0.0		33	41
18†	4.1	-11.3	-3.6	21.6	0.0	M	M	0.0			<31
19†	1.5	-9.2	-3.9	21.9	0.0	M	M	0.0		20	48
20†	5.8	-6.9	-0.6	18.6	0.0	M	M	0.0		18	69
21†	8.2	-6.8	0.7	17.3	0.0	M	M	0.0		18	37
22†	12.4	-8.1	2.2	15.8	0.0	M	M	0.0		29	67
23†	2.7	-12.7	-5.0	23.0	0.0	M	M	0.0		12	41
24†	4.8	-8.5	-1.9	19.9	0.0	M	M	1.0		3	41
25†	-8.5	-14.6	-11.6	29.6	0.0	M	M	0.0		29	39
26†	-9.0	-16.7	-12.9	30.9	0.0	M	M	0.5			<31
27†	-5.4	-18.1	-11.8	29.8	0.0	M	M	0.0		10	57
28†	-5.4	-11.9	-8.7	26.7	0.0	M	M	10.5		9	44
29†	-11.8	-19.4	-15.6	33.6	0.0	M	M	0.0		24E	41E
30†	-12.2	-23.4	-17.8	35.8	0.0	M	M	0.0		2	46
Sum				**676.9**	**0.0**	**M**	**M**	**17.5***			
Avg	**0.1**	**-9.2**	**-4.5**								
Xtrm	**12.4**	**-23.4**								**18**	**69**

Legend

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MANITOBA

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Day	Max Ter °C	Min Ter °C	Mean Te °C	Heat Deg D C	Cool Deg D C	Total Ra mm	Total Sn cm	Total Pre mm	Snow on G cm	Dir of Max (10's Deg	Spd of Max (km/h
01†	-8.1	-12.3	-10.2	28.2	0.0	M	M	1.5		17	48
02†	-10.0	-23.6	-16.8	34.8	0.0	M	M	1.0		1	46
03†	-13.9	-29.3	-21.6	39.6	0.0	M	M	1.5		17	48
04†	-13.9	-22.6	-18.3	36.3	0.0	M	M	0.0		33	39
05†	-8.2	-16.0	-12.1	30.1	0.0	M	M	0.0		18	37
06†	-10.0	-26.5	-18.3	36.3	0.0	M	M	0.0		32	39
07†	-8.1	-26.7	-17.4	35.4	0.0	M	M	0.0		19	59
08†	-4.3	-10.4	-7.4	25.4	0.0	M	M	0.0		21	39
09†	0.4	-12.4	-6.0	24.0	0.0	M	M	0.0			<31
10†	-3.2	-14.5	-8.9	26.9	0.0	M	M	0.0			<31
11†	-0.8	-3.6	-2.2	20.2	0.0	M	M	0.0			<31
12†	-0.9	-4.1	-2.5	20.5	0.0	M	M	0.0		20	39
13†	1.2	-5.7	-2.3	20.3	0.0	M	M	0.0		19	37
14†	-2.4	-5.7	-4.1	22.1	0.0	M	M	0.0		32	37
15†	-1.5	-5.0	-3.3	21.3	0.0	M	M	0.0		14	56
16†	1.3	-4.6	-1.7	19.7	0.0	M	M	0.0		18	56
17†	-4.2	-16.9	-10.6	28.6	0.0	M	M	0.0		28	56
18†	-8.4	-20.9	-14.7	32.7	0.0	M	M	0.0		2	35
19†	0.1	-8.4	-4.2	22.2	0.0	M	M	0.0		21	48
20†	-1.6	-15.3	-8.5	26.5	0.0	M	M	0.0		27	35
21†	-2.8	-13.7	-8.3	26.3	0.0	M	M	0.0		18	33
22†	-1.9	-10.5	-6.2	24.2	0.0	M	M	0.0		17	41
23†	-4.7	-13.6	-9.2	27.2	0.0	M	M	0.0			<31
24†	-3.4	-11.8	-7.6	25.6	0.0	M	M	0.0		32	37
25†	-4.0	-19.8	-11.9	29.9	0.0	M	M	0.0		16	46
26†	-1.5	-13.5	-7.5	25.5	0.0	M	M	0.0		18	48
27†	-10.2	-18.9	-14.6	32.6	0.0	M	M	0.0			<31
28†	-4.4	-11.6	-8.0	26.0	0.0	M	M	0.0			<31
29†	-5.7	-18.6	-12.2	30.2	0.0	M	M	0.0			<31
30†	-5.3	-20.6	-13.0	31.0	0.0	M	M	11.5			<31
31†	-5.2	-16.2	-10.7	28.7	0.0	M	M	11.5		34	33
Sum				**858.3**	**0.0**	**M**	**M**	**27.0**			
Avg	**-4.7**	**-14.6**	**-9.7**								
Xtrm	**1.3**	**-29.3**								**19**	**59**

Legend

[empty] = No data available
M = Missing
E = Estimated

Navigation Options

Canada Map
Manitoba Map
Customized Search

N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Important Notices

Created : 2002-06-21
Modified : 2005-04-08
Reviewed : 2005-04-08
Url of this page : http://www.climate.weatheroffice.ec.gc.ca/climateData/dailydata_e.html

APPENDIX D

SURFACE WATER PROGRAM
PRECIPITATION REVIEW MEMORANDUM
OCTOBER 2, 2006 (FILE NO: 05-1100-01.19.06.03)

KGS GROUP

MEMORANDUM

TO: Dave MacMillan
Bert Smith
Dave Brown

FROM: Shaun Moffatt

DATE: October 3, 2006

FILE NO: 05-1100-01.19.06.03

RE: Red River Floodway Expansion Project
2006 Surface Water Sampling Program – Precipitation Review

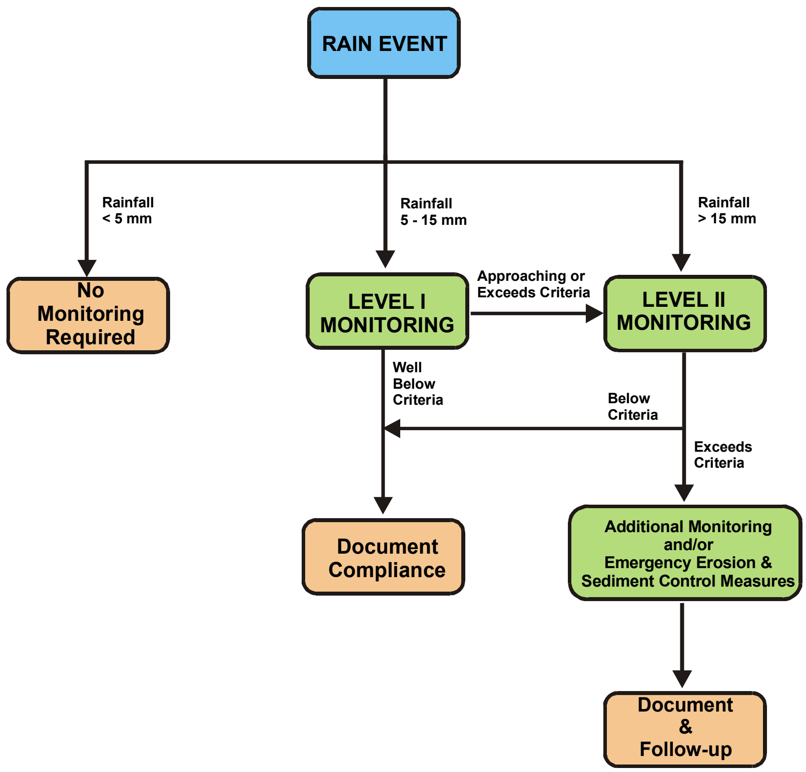
The 2006 Sampling Program outlined the event-based monitoring protocol in response to rain events as shown in the original flow chart (attached). This established three rain levels of < 5mm (no sampling), between 5 and 15 mm (Level I) and > 15 mm (Level II). It was noted that the rainfall/monitoring criteria were formulated on a judgmental basis and that an adaptive management approach would be followed allowing the level of monitoring to be modified so that the level of effort is consistent with the potential concern.

A summary of the estimated and actual change in Red River Sediment Concentration measured during the level I Event-based monitoring to the end of August is provided in Table 1. The monitoring has indicated negligible increases in TSS even following rain events greater than 15 mm. The only measurable increases were following the August 10 (2.3% increase) and August 12 (4.4% increase) rain events. The August 10 rainfall (20 to 24 mm in 2.5 hours) was close to a 2-year storm based on the Atmospheric Environment Service, Rainfall Intensity – Duration Frequency (Rainfall IDF) Values for the Winnipeg International Airport (Figure 1). The August 12 rainfall (41 to 55 mm in 5 hours) occurred with two events separated by approximately 5 hours. The first rainfall was less than a 2-year storm and the second rainfall was between a two and 5-year storm.

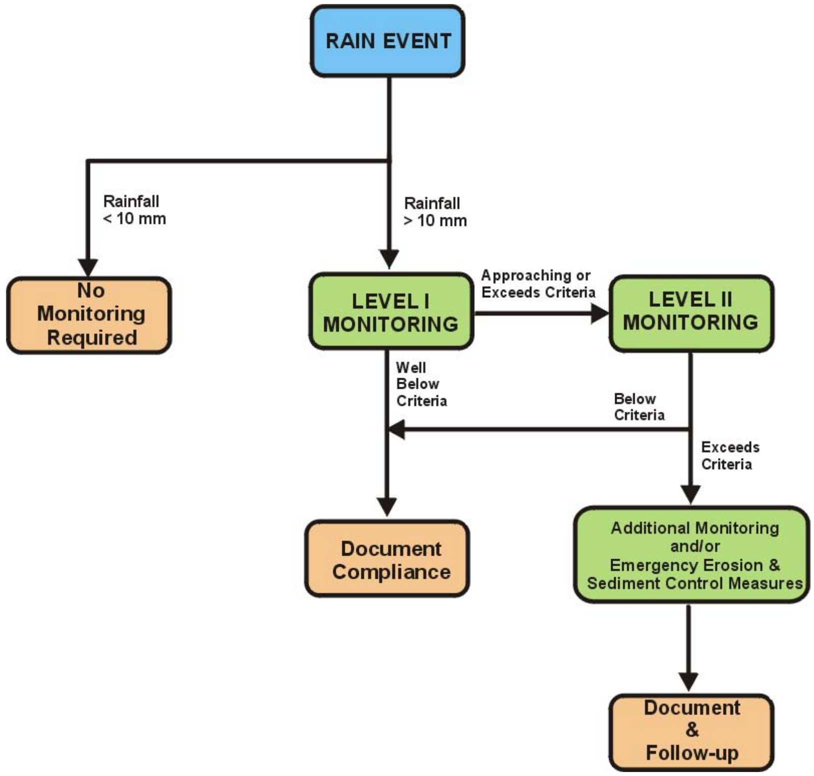
In response to these results, we have modified the protocol for conducting Level II Event-based monitoring as outlined in the August 14 email. In addition to that change we are proposing to modify the protocol for conducting Level I Event-based monitoring so the rainfall criteria is 10 mm instead of 5 mm, with no sampling conducted for precipitation levels <10 mm.

Although Table 1 shows that increases in sediment concentration in the Red River only occurred during the 20 – 24 mm and 41 – 55 mm rain events, it is proposed that 10 mm be used as a conservative rainfall criteria as there was only a limited amount of open excavation during this summer. During mid July 2006 there was at most approximately 3.5 km lineal length of open channel excavation without straw mulch or vegetation, however, next summer there could potentially be as much as 10 km lineal length open at a given time. Additionally, because this year was under drought conditions most rain that fell was absorbed into the ground rather than running off and potentially increasing erosion and sedimentation. The revised Event-Based monitoring flow chart that will be used for the remainder of this year is attached.

We will revisit this protocol again for the start of the 2007 monitoring program as more construction contracts begin and review the results with MFA.



Original Monitoring Flow Chart



Revised Monitoring Flow Chart

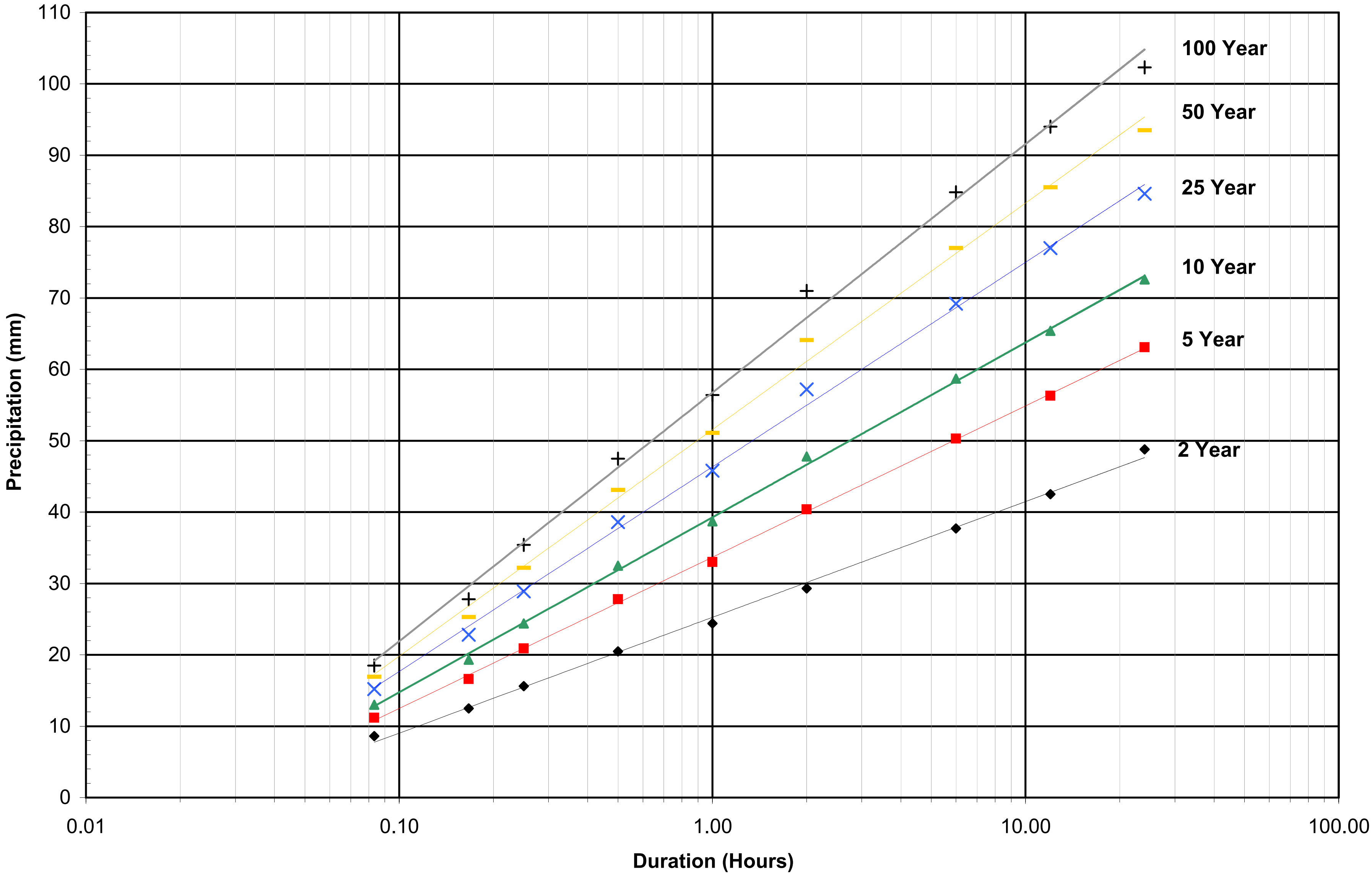
TABLE 1
REVIEW OF ESTIMATED AND ACTUAL CHANGE IN SEDIMENT CONCENTRATION
RED RIVER FLOODWAY - 2006 SURFACE WATER MONITORING

Date	Precipitation (mm)	Approx. Duration (hrs)	Year Storm (1)	Estimated							Actual						
				Floodway - Downstream of Construction			Red River - Downstream of Outlet			Change in Red River Sediment Concentration (%)	Floodway - Downstream of Construction			Red River - Downstream of Outlet			Change in Red River Sediment Concentration (%)
				Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)	Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)		Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)	Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)	
9-May-06	6 - 14	1.75	<2	3.90	58.1	19.6	1100	108.5	10,312	-0.16%	3.90	49	16.5	1178	130	13,231	-0.21%
27-May-06	5.2 - 13	3.00	<2	0.38	4.0	0.1	630	122.2	6,652	-0.06%	0.38	14	0.5	635	180	9,876	-0.06%
28-May-06	14.5 - 20.1	1.75	<2	0.48	40.9	1.7	610	92.8	4,891	-0.04%	0.48	43	1.8	614	170	9,018	-0.06%
5-Jun-06	4.8 - 6.3	1.00	<2	0.33	17.1	0.5	450	72.0	2,799	-0.06%	0.33	15	0.4	489	94	3,971	-0.06%
25-Jul-06	4.8 - 8.6	3.50	<2	0.56	27.4	1.3	110	26.5	252	0.02%	0.56	20	1.0	120	37	384	-0.22%
26-Jul-06	7.1 - 10.7	1.00	<2	0.50	18.6	0.8	106	31.6	289	-0.19%	0.50	18	0.8	118	35	357	-0.21%
3-Aug-06	6.1 - 8.8	1.50	<2	0.48	13.9	0.6	113	38.8	379	-0.27%	0.48	7	0.3	103	40	356	-0.38%
4-Aug-06	6.3 - 9.1	3.00	<2	0.56	14.1	0.7	113	42.6	416	-0.33%	0.56	12	0.6	101	45	393	-0.41%
5-Aug-06	4.1 - 7.9	4.00	<2	0.19	15.2	0.2	113	45.7	446	-0.11%	0.19	25	0.4	99	40	342	-0.07%
10-Aug-06	(0) 20 - 24	2.50	<2	0.83	163.5	11.8	113	37.8	369	2.44%	0.83	120	8.6	90	34	264	2.32%
12-Aug-06	15.5 - 20.8 / 21.3 - 39.9	2.50 / 2.50	<2 / 2 - 5	1.18	98.2	10.0	113	49.2	480	1.03%	1.18	170	17.3	90	39	303	4.35%
25-Aug-06	4.1 - 5.1	3.50	<2	0.19	14.8	0.2	102	58.1	512	-0.14%	0.19	11	0.2	100	60	518	-0.16%

Notes:

1 - Year Storm is an approximate calculation based on the Atmospheric Environment Service, Rainfall Intensity - Duration Frequency Values for the Winnipeg Int'l Airport and recorded precipitation at the unofficial rain gauge sites

Figure 1. Return Period Rainfall Intensity - Duration



Data from: Atmospheric Environment Service, Rainfall Intensity - Duration Frequency Values for the Winnipeg Int'l Airport.