



**Imperial Oil**

**Renewal Application for Water Licence S03L1-001  
Surveillance Network Program  
Inlet & Outlet Summary  
(Section 13 of 20)**

Submitted to the Sahtu Land and Water Board by Imperial Oil Resources N.W.T. Limited

**August 2013**



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## 13.0 Mackenzie River Water Inlet & Outlet

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### 13.1 Introduction

Imperial Oil Resources N.W.T. Limited (IOR) maintains a Surveillance Network Program (SNP) as part of its Norman Wells Operations (NWO). The SNP is operated under the terms and conditions of the Water Licence (S03L1-001 as amended). As part of the SNP, IOR tests the quality of the river water entering and leaving the NWO.

### 13.2 Location of Surveillance Stations

The locations of the Surveillance Stations listed in the current Water Licence are presented in Table A below. A map showing the locations of the active Surveillance Stations is presented as Figure A below and Figure 4.3 in Section 9 of the Renewal Application. A historical figure showing the locations of the Surveillance Stations is included in the SNP annex to the Water Licence; a copy of which is available online through the Sahtu Land and Water Board (SLWB) Registry ([www.slwb.com](http://www.slwb.com)) and is presented in Table A.

**Table A: Location of Surveillance Stations**

Station	Status	Description
S03L1-01	Active	Central Processing Facility Intake water from the Mackenzie River.
S03L1-01A	Physically Removed	Mainland Waterflood Intake from the Mackenzie River.
S03L1-02	Active	Central Processing Facility Outlet return line to the Mackenzie River.
S03L1-1A	Physically Removed	Meter location at the Refinery process water inlet facility.
S03L1-2	Inactive	Immediately downstream of the API Separator outlet weir.
S03L1-3	Inactive	Outlet of the drainage pipe from the diked oil storage area west of Bosworth Creek.

The status of each of these stations has remained unchanged over the period of the current Water Licence.

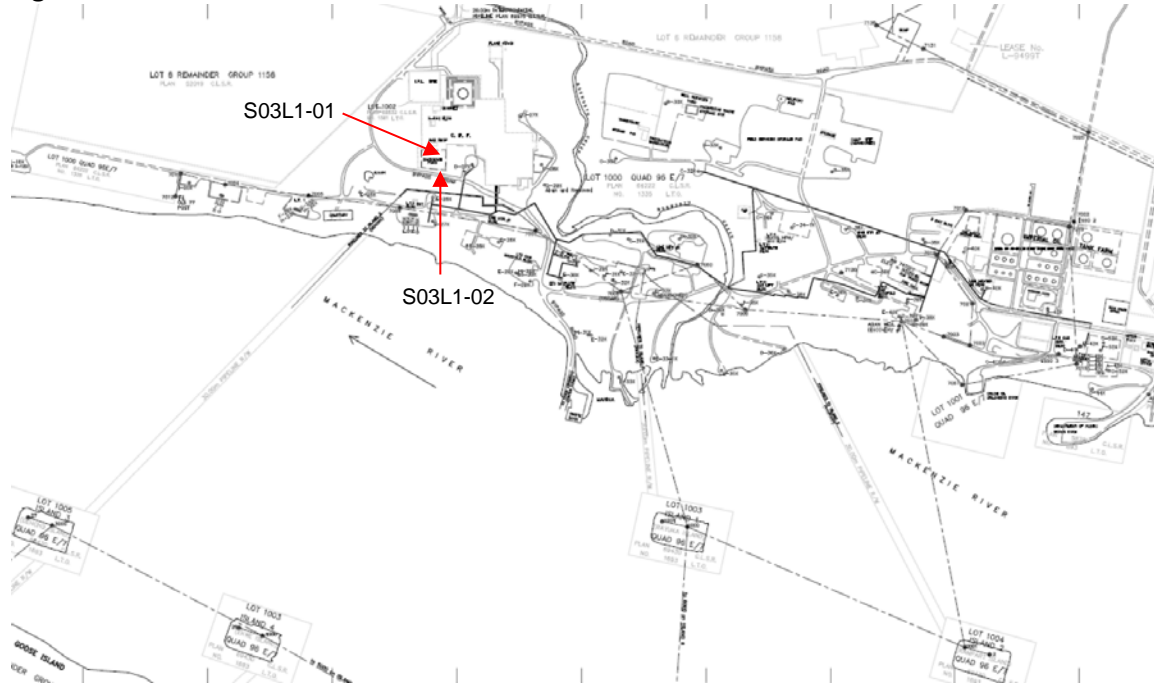
As shown in Table A, the SNP includes the following two active surveillance stations:

- S03L1-01 - the CPF water intake line from the Mackenzie River; and

- S03L1-02 - the CPF outlet return line to the Mackenzie River.

The locations of these monitoring points are shown on Figure A below. Photographs A, B, and C show the buildings which house sampling points S03L1-01 and S03L1-02.

**Figure A: Location of Active Surveillance Stations**



**Photo A: Inlet Water Intake Building and S03L1-01 Sampling Location**



**Photo B: Door to Water Intake Building Displaying Sign for S03L1-01**



**Photo C: Outlet Return Line Building and S03L1-02 Sampling Location**



### **13.3 Regulatory Requirements**

Conditions regulating the SNP are covered in the following items of the Water Licence:

- Part A: Scope and Definitions Item 2. Definitions;
  - sets out the definition of the SNP.
- Part B: General Conditions Item 3. Items a, c, d, f, g, m, and v;
  - sets out data capture and reporting requirements for the SNP.
- Part B: General Conditions Item 4;
  - references the SNP Annex to the licence.
- Part B: General Conditions Item 5;
  - sets out the powers of the SLWB to modify the SNP compliance dates.
- Part B: General Conditions Item 6;
  - sets out measurement requirements for volume of water used.

- Part B: General Conditions Item 7;
  - sets out the signage requirements for the SNP.
- Part C: Conditions Applying to Water Use Item 1, 2, 3;
  - defines the source of fresh water, location of SNP intake, and intake limits.
- Part D: Conditions Applying to Waste Disposal Item 4;
  - requires water to be released in a controlled manner.
- Part D Conditions Applying to Waste Disposal Item 5;
  - sets out water discharge quality requirements.
- Part D Conditions Applying to Waste Disposal Item 7;
  - sets out requirements for using biocides in water that may enter any watercourse.
- Portions of the SNP Annex attached to the Licence provides additional details of the surveillance stations, sampling and analytical requirements, and the QA/QC Manual.

As required, IOR has developed and maintains a Quality Assurance/Quality Control (QA/QC) Manual which details on-site sample collection and testing requirements. This has been provided to the SLWB and Analyst (as designated by the Minister under Section 35(1) of the *Northwest Territories Waters Act*).

## **13.4 Laboratory Analytical Results**

### **13.4.1 Guideline Limits**

There are two sampling methods used at NWO, grab sampling and composite sampling. A grab sample is an instantaneous sample of water. Grab water samples are taken where analytical hold times are short or where an instantaneous sample is needed (i.e. surface water releases). The hold time is the length of time between when a sample is collected and when it is analyzed. For an analytical result to be valid, the sample needs to be analyzed within the laboratory hold times.

A composite sample is a sample that is taken over a period of time, such as seven days or twice a week. Composite samples can be taken manually or by automatic samplers (set to take a specific volume of water over a given period of time). Table B summarizes the Water Licence guideline limits for the SNP.

**Table B: Water Licence Guideline Limits for the SNP**

Parameter	Water Licence Limit
	Note: Analytical limits are for S03L1-02 (outlet return line) only.
Daily Withdrawal Limit	16,000 m <sup>3</sup>
Annual Withdrawal Limit	3,500,000 m <sup>3</sup>
Oil & Grease	5.00 mg/L (4 week average) and 10.00 mg/L (grab and/or composite sample)
Phenols	0.07 mg/L (4 week average) and 0.14 mg/L (grab and/or composite sample)
pH	Between 6.0 and 9.0
Acute Lethality	>50% survival of Rainbow Trout and <i>Daphnia Magna</i>

### 13.4.2 Existing Sampling Frequency Tables

The various sampling, analytical, and reporting requirements required under the SNP for the inlet and outlet are summarized below into four frequency tables. Table C presents daily requirements, Table D presents weekly requirements, Table E presents quarterly requirements, and Table F presents semi-annual requirements.

**Table C: Daily SNP Requirements (Maximum Grab/Composite Sample)**

SNP Sample Point	Measurement	Water Licence Limit	Sample Frequency	Comment
S03L1-01 Water Intake	Temperature and Volume	16,000 m <sup>3</sup>	Continuous	Testing completed as per the licence
S03L1-02 Outlet Return Line	Temperature and Volume	N/A	Continuous	Testing completed as per the licence



**Table D: Weekly SNP Requirements (Maximum Grab/Composite Sample)**

SNP Sample Point	Parameters	Water Licence Limit	Sample Frequency	Comments
S03L1-01 Water Intake	Phenols	N/A	Weekly Composite	---
	Oil & Grease	N/A	Weekly Composite	---
	Total Suspended Solids	N/A	Twice Weekly Composite*	Sampled twice weekly to meet hold times
S03L1-02 Outlet Return Line	Phenols	0.14 mg/L**	Weekly Composite	---
	Oil & Grease	10.00 mg/L	Weekly Composite	---
	Total Residual Chlorine	N/A	Daily Grab*	Sampled daily and analyzed on site to meet hold times
	Total Suspended Solids	N/A	Twice Weekly Composite	Sampled twice weekly to meet hold times
	pH	6 – 9	Twice Weekly Composite	Sampled twice weekly to meet hold times
	Specific Conductivity	N/A	Weekly Composite	---

\*Note: Change in frequency since original licence was issued on August 30, 2004. See letter from IOR to SLWB dated December 17, 2012 for details.

\*\*Note: Guideline value amended June 12, 2006.

**Table E: Quarterly SNP Requirements (Maximum Grab Sample)**

SNP Sample Point	Parameter	Water Licence Limit	Comments
S03L1-01 Water Intake	N/A	N/A	---
S03L1-02 Outlet Return Line	Rainbow Trout	>50% Survival	---
	<i>Daphnia Magna</i>	>50% Survival	---

Notes: N/A = not applicable

**Table F: Semi-annual SNP Requirements (Maximum Grab Sample)**

SNP Sample Point	Parameter	Water Licence Limit	Comments
S03L1-01 Water Intake	pH, Sodium, Potassium, Sulphate, Chloride, Calcium, Magnesium, Phenols, Total Alkalinity, Specific Conductivity, Suspended Solids, Total Dissolved Solids, Oil & Grease, Total Phosphorus, Total Hardness	N/A	---
S03L1-02 Outlet Return Line	N/A	N/A	---

Notes: N/A = not applicable

### 13.4.3 Changes to Sample Frequency Tables Required Due to Laboratory Hold Times

Some analytical hold times required modification during the current licence term. This was done to ensure the samples were collected, shipped, and analyzed within the laboratory hold times. Where these changes were required, it has been reflected in Tables C through F above. The changes made were outlined in a letter to the SLWB on December 17, 2012 and in the 2012 QA/QC plan (IOR 2012).

### 13.5 Summary of Existing Performance

IOR submits water quality and water use data to the SLWB on a monthly and annual basis. Copies of the annual summary reports submitted to the SLWB are available online at the SLWB Registry ([www.slwb.com](http://www.slwb.com)). Section 13.5 below summarizes NWO water use over the period of the current Water Licence. Sections 13.6 and 13.7 summarize water quality from the effective date of the existing Water Licence (August 30, 2004) to December 31, 2012.

### 13.6 Summary of Water Use

From the effective date of the existing Water Licence (August 30, 2004) to December 31, 2012 a total of approximately 22,107,000 m<sup>3</sup> of water has been withdrawn from the Mackenzie River and a total of approximately 12,818,000 m<sup>3</sup> has been discharged. Between August 30, 2004 and December 31, 2012, a total of approximately 9,231,000 m<sup>3</sup> fresh water was injected for maintaining reservoir pressure (Table G).

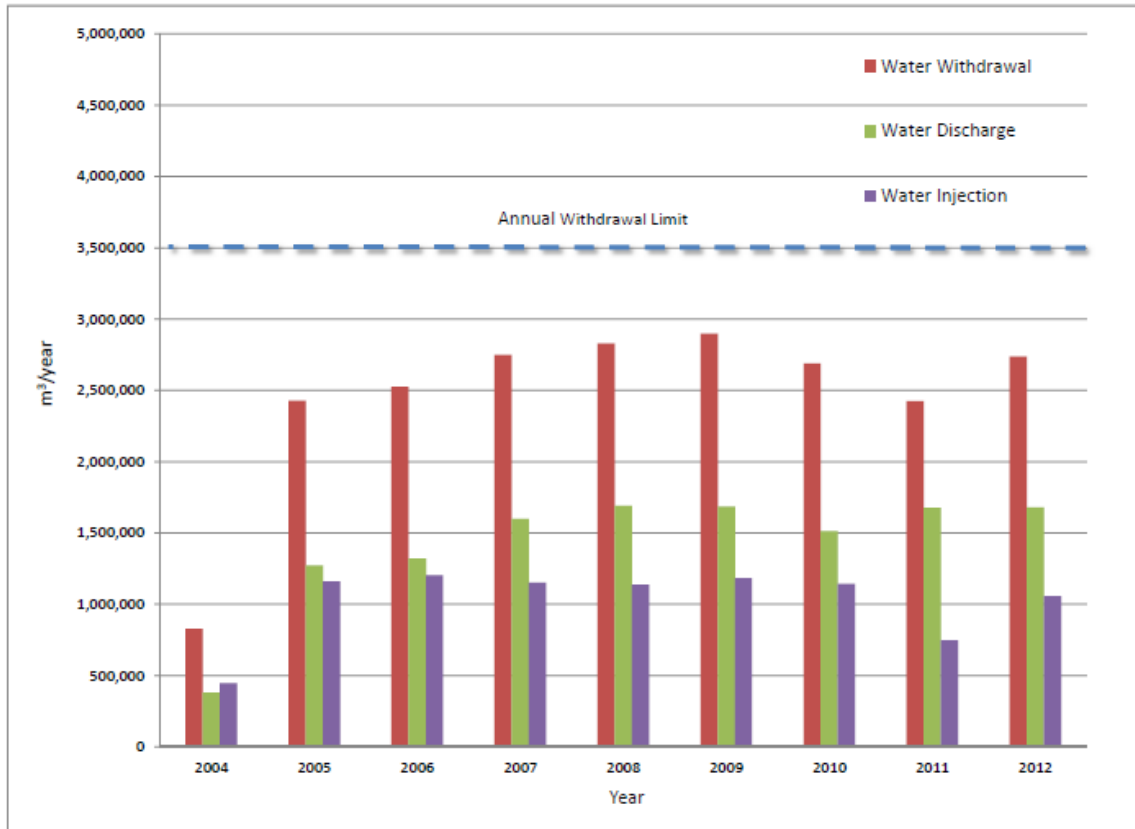
**Table G: Summary of Freshwater Withdrawal, Discharge, and Injection**

Year	Freshwater Withdrawal (m <sup>3</sup> )	Freshwater Discharge (m <sup>3</sup> )	Freshwater Injection (m <sup>3</sup> )
2004*	828,124	381,782	446,339
2005	2,427,367	1,271,166	1,160,665
2006	2,526,217	1,321,907	1,204,154
2007	2,748,866	1,598,032	1,150,834
2008	2,826,900	1,690,039	1,138,151
2009	2,899,169	1,685,698	1,183,288
2010	2,688,673	1,512,610	1,142,538
2011	2,423,826	1,676,004	747,823
2012	2,737,777	1,680,338	1,057,440
<b>Total</b>	<b>22,106,920</b>	<b>12,817,575</b>	<b>9,231,232</b>

\*Note: Volume totals for 2004 are from the effective date of the licence (August 30, 2004).

As noted in Table B, the Water Licence sets water withdrawal limits, which are not to exceed 3,500,000 m<sup>3</sup>/year or 16,000 m<sup>3</sup>/day. Figures B and C display summary charts of this information.

Figure B: Annual Summary of Water Withdrawal, Discharge, and Injection from the Mackenzie River



**Figure C: Daily Summary of Water Withdrawal, Discharge, and Injection from the Mackenzie River**

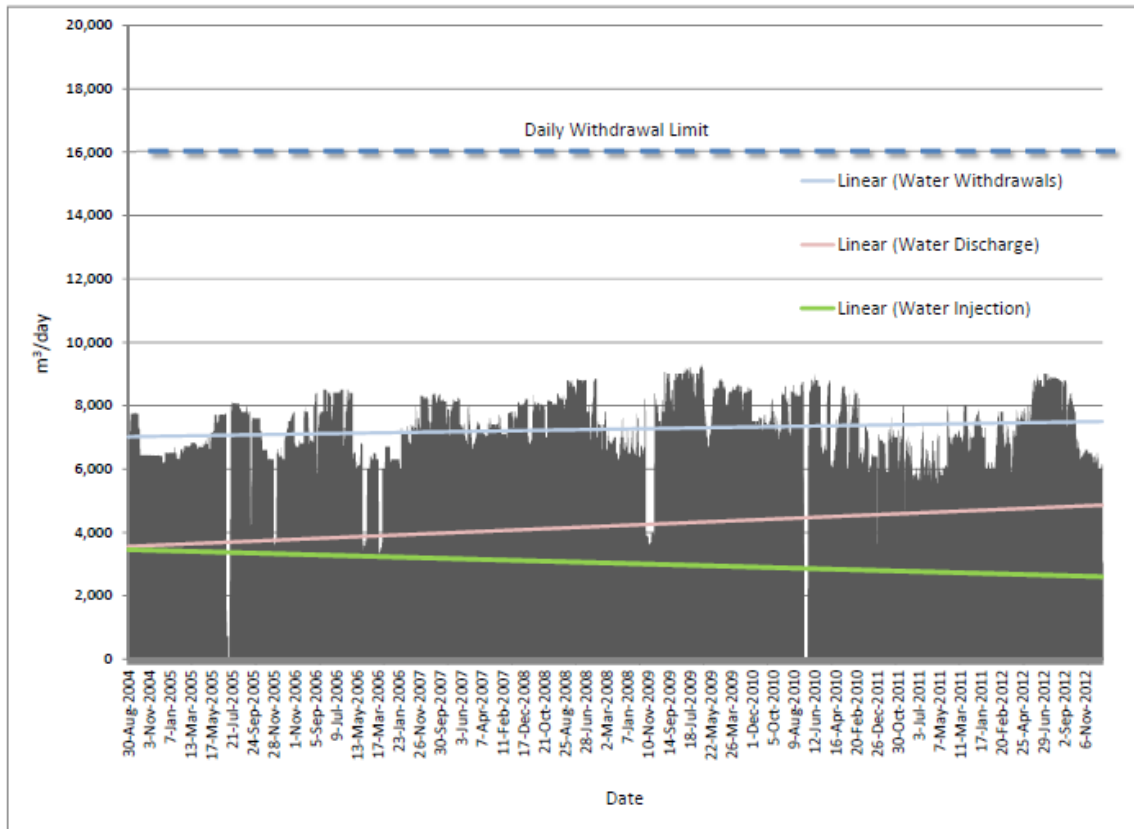
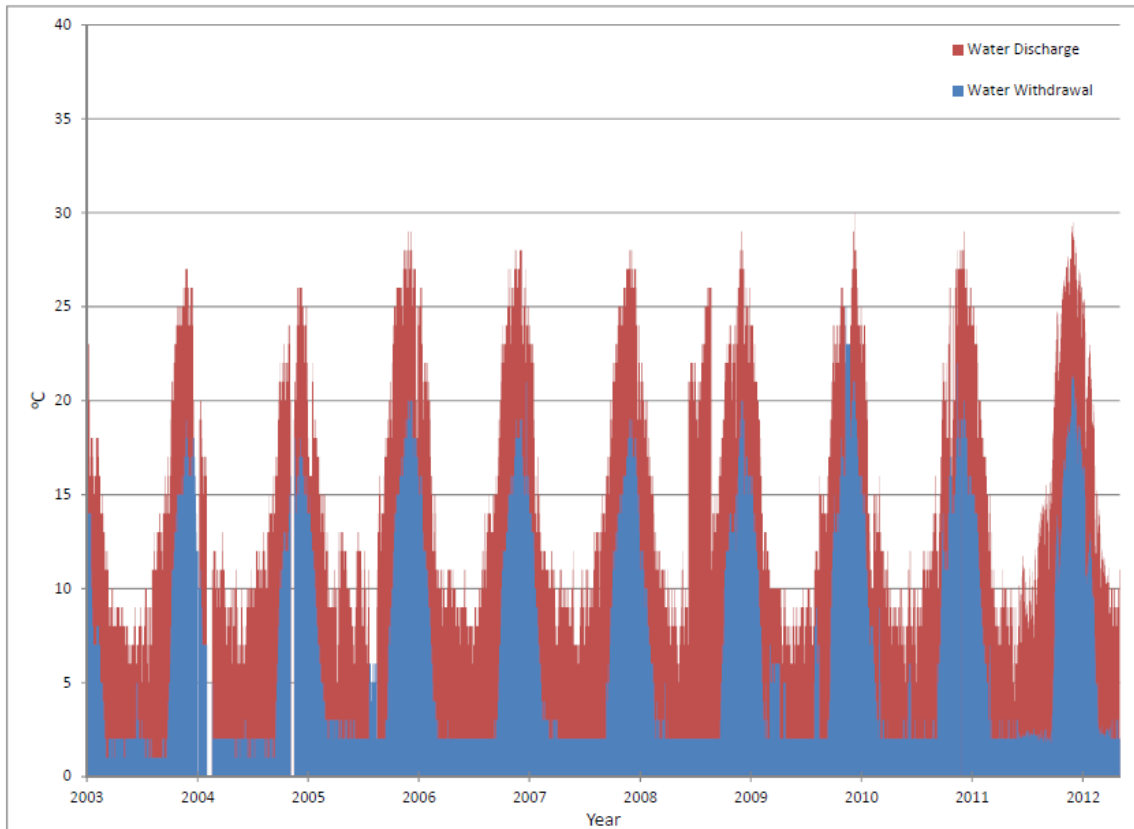


Figure C shows that on average, daily fresh water withdrawals (solid blue line) are half of the daily withdrawal limit (dotted blue line). Fresh water withdrawals from the Mackenzie River have remained relatively constant over time, while the amount of fresh water being diverted to injection (solid green line) has been decreasing (due to increased produced water injection) and the amount of fresh water returned to the river (solid pink line) has been increasing. In 2005 and 2010, there are gaps where the water withdrawal was 0 m<sup>3</sup>/day. This was due to facility turnarounds when the entire NWO was shut in for maintenance activities.

As presented in Table C, the Water Licence also requires that daily water temperature be recorded at both of the SNP monitoring locations. Temperature data from the water intake and outlet return lines are summarized in Figure D.

**Figure D: Daily Temperature Values for Water Intake and Outlet from the Mackenzie River**



On average, the temperature of the water discharged (red coloured data) to the Mackenzie River is 8 degrees warmer than the water withdrawn (blue coloured data). The temperature difference between the water being withdrawn and discharged to the Mackenzie River is highest in the winter months and lowest in the summer. The reason for the gradient in the winter is due to the lower temperature of the intake water in comparison to the temperature of the water after it has gone through the CPF cooling process. In the summer months, the incoming river water is warmer.

## 13.7 Summary of Water Quality

Over the effective period of the Water Licence, there have been a total of six events where an analytical result of the discharge water did not meet the limits in the Water Licence. A summary of these exceedances is presented in Table H and the text below.

**Table H: S03L1-02 Exceedances of Licence Limits**

Sample Date	Parameter	Value	Limit	Cause
Nov 14, 2005	Oil & Grease	13 mg/L	10 mg/L	Dirty sample bottle
Mar 14, 2006	Acute Lethality	0%	>50%	Unknown
Oct 29, 2009	Acute Lethality	29-49%	>50%	Associated with a new water treatment chemical that has since been discontinued.
Mar 1, 2010	pH	2.22	6 – 9	Suspected sampling error
Feb 14, 2011	pH	4.82	6 – 9	Suspected sampling error
Jul 4, 2011	Oil & Grease	22 mg/L	10 mg/L	Suspected sampling error

Note: Exceedances in Table H do not include rolling averages.

Of these six events, three were suspected to have been caused by sampling errors and one by using a dirty sample bottle. Two of the six were failed acute lethality tests. Additional details on these events are provided in Section 17.5.

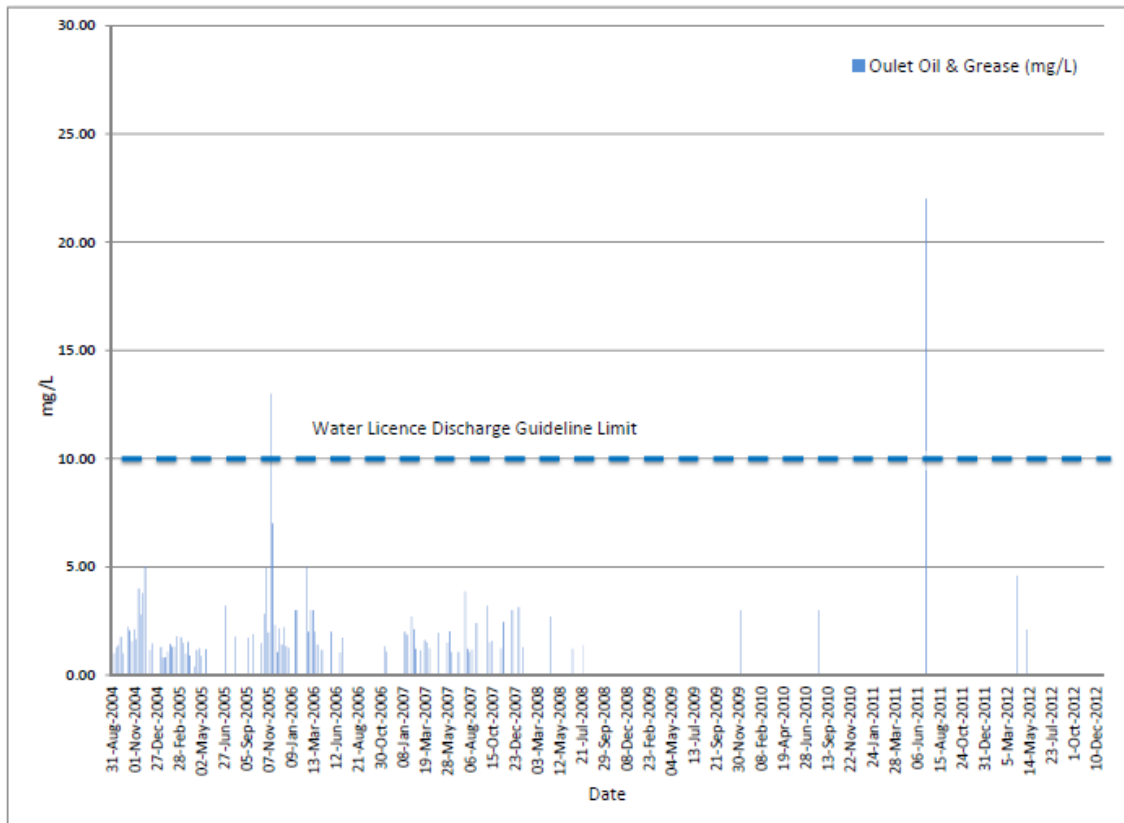
## 13.8 Laboratory Analytical Results

The current Water Licence has set guideline limits for several parameters. As noted in the frequency tables above (C, D, and E), guidelines limits for oil and grease, phenols, pH, and acute lethality have been set for the outlet return line. Figures E through H present a summary of results for each of these parameters: oil and grease (Figure E), phenols (Figure F), pH (Figure G), and acute lethality (Figure H) for rainbow trout and *Daphnia Magna*.

### 13.8.1 Oil and Grease

From the effective period of the Water Licence (August 30, 2004) to December 31, 2012, oil and grease results were below the guideline level 99.5% of the time (Figure E).

**Figure E: Summary of Oil and Grease Results for Water Discharged to Mackenzie River**



Note: Zero values displayed here represent the detection limit of the analytical method used. Additional details regarding individual water tests are provided in the annual reports, available on the SLWB registry ([www.slwb.com/](http://www.slwb.com/)).

Figure E shows that over the last ten years there have been two events where oil and grease results were above the guideline limit. The first event was for the composite sample taken between November 8<sup>th</sup> and 14<sup>th</sup>, 2005. The second event was for a composite sample taken between June 28<sup>th</sup> and July 4<sup>th</sup>, 2011.

In response to the analytical results received for the November 8<sup>th</sup> to 14<sup>th</sup>, 2005, a composite sample, IOR halted water discharge once results were reported back from the laboratory while it completed an investigation into the anomalous result. No source for the reported oil and grease value could be identified and repeated testing of the water being held for release did not produce similar results. An inspection of the sample bottles used to collect these water samples indicated that they may not have been clean prior to sampling (IOR 2005).

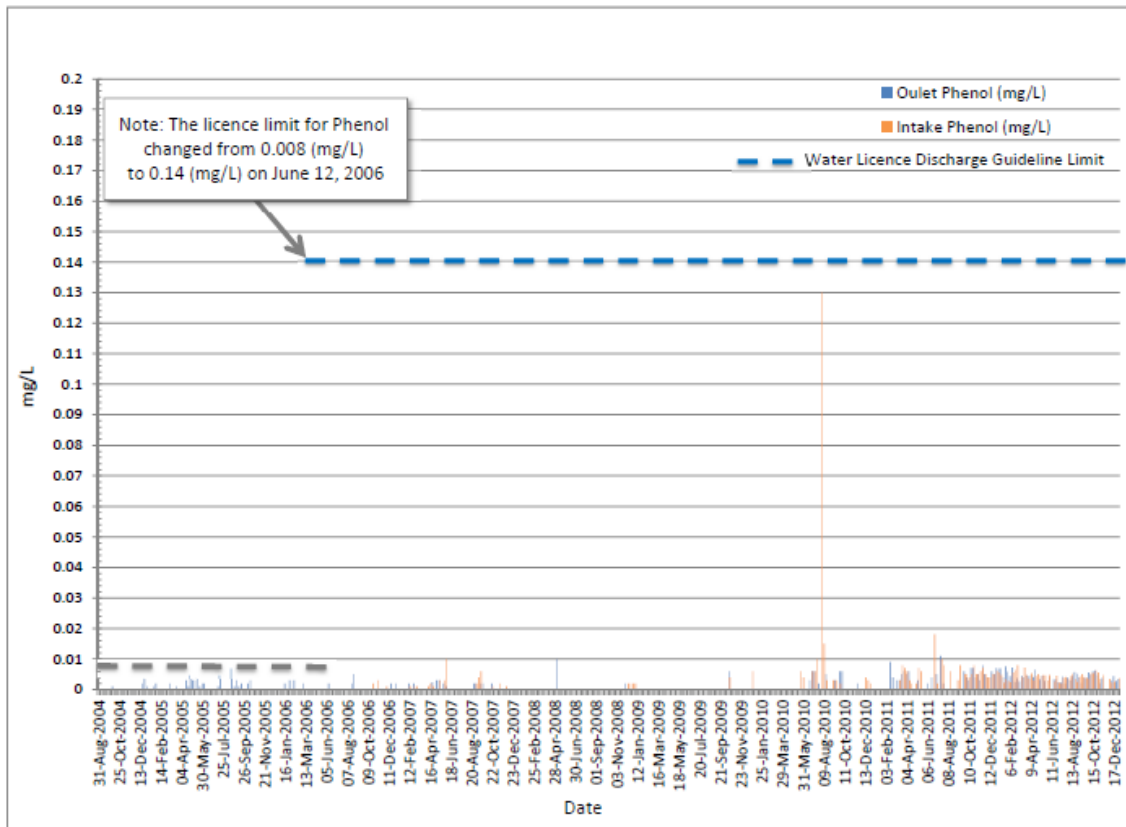


Similar steps were taken when the June 28<sup>th</sup> to July 4<sup>th</sup>, 2011, when composite results were received. Water at this time was already being diverted from the settling pond to the retention area and, therefore, was isolated from the Mackenzie River. An investigation confirmed the integrity of all hydrocarbon components and the leak detection system in the CPF were functioning normally. However, a review of the sampling procedure, noted that manual composite sampling (and not the automatic sampling method normally used) had likely introduced impurities into the sample, which resulted in the elevated reading. Additional testing of the water in the retention pond and water in the CPF cooling process confirmed that oil and grease concentrations were below the analytical detection limit.

### **13.8.2 Phenols**

Figure F shows that from the effective period of the Water Licence (August 30, 2004) to December 31, 2012, there have been no guideline exceedances of phenol. This corresponds to a 100% compliance rate.

**Figure F: Summary of Phenol Results for the SNP Outlet and Inlet**



Note: Zero values displayed here represent the detection limit of the analytical method used. Additional details regarding individual water tests are provided in the annual reports, available on the SLWB registry ([www.slwb.com](http://www.slwb.com)).

### 13.8.3 pH

From the effective period of the Water Licence (August 30, 2004) to December 31, 2012, pH results were within the guideline limits 99.5% of the time (Figure G).

Figure G: Summary of pH results for Water Discharged to the Mackenzie River

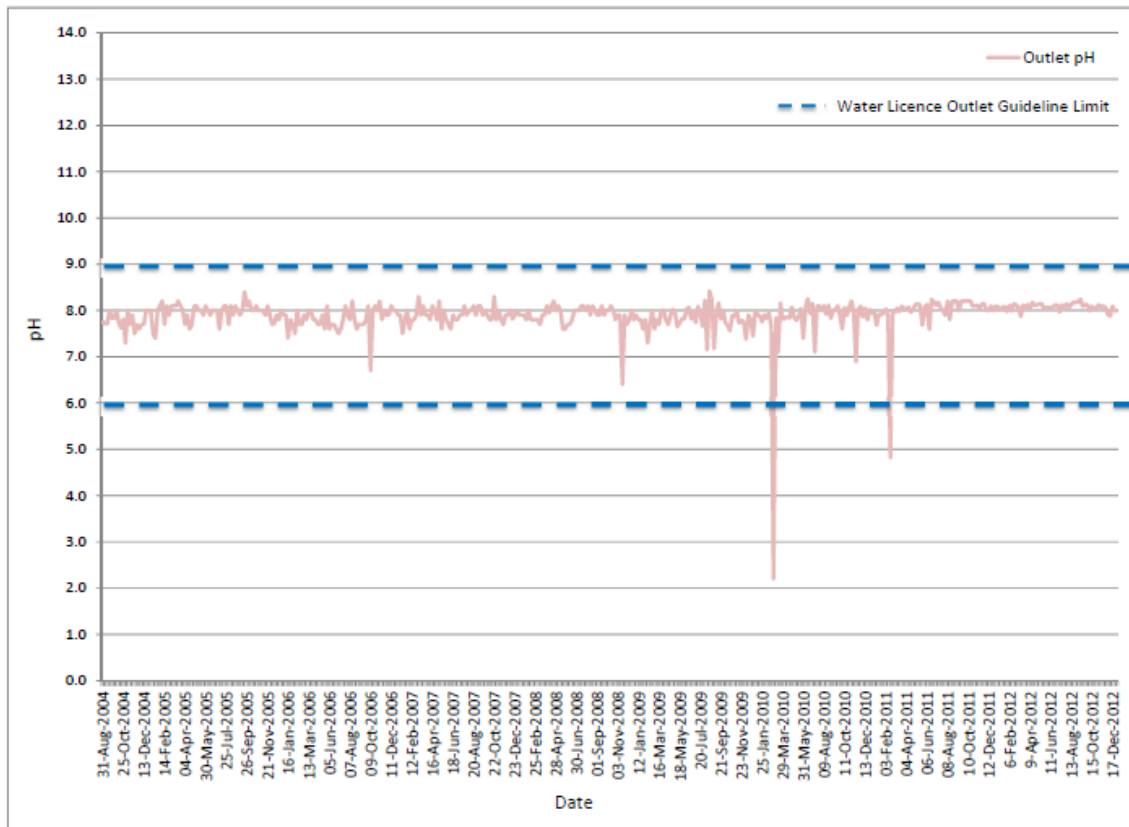


Figure G shows that over the last ten years there have been two events where the measured pH was not within the guideline limits (6.0-9.0). These results correspond to the composite samples taken February 23<sup>rd</sup> to March 1, 2010 (pH 2.2) and February 8<sup>th</sup> to February 14, 2011 (pH 4.82). The low pH values for both the 2010 and 2011 composite samples were suspected to be the result of sampler error whereby an acid preservative was accidentally put into the wrong sample bottle. As such, the lab reported pH values did not reflect the actual pH of the water from the outlet return line to the Mackenzie River.

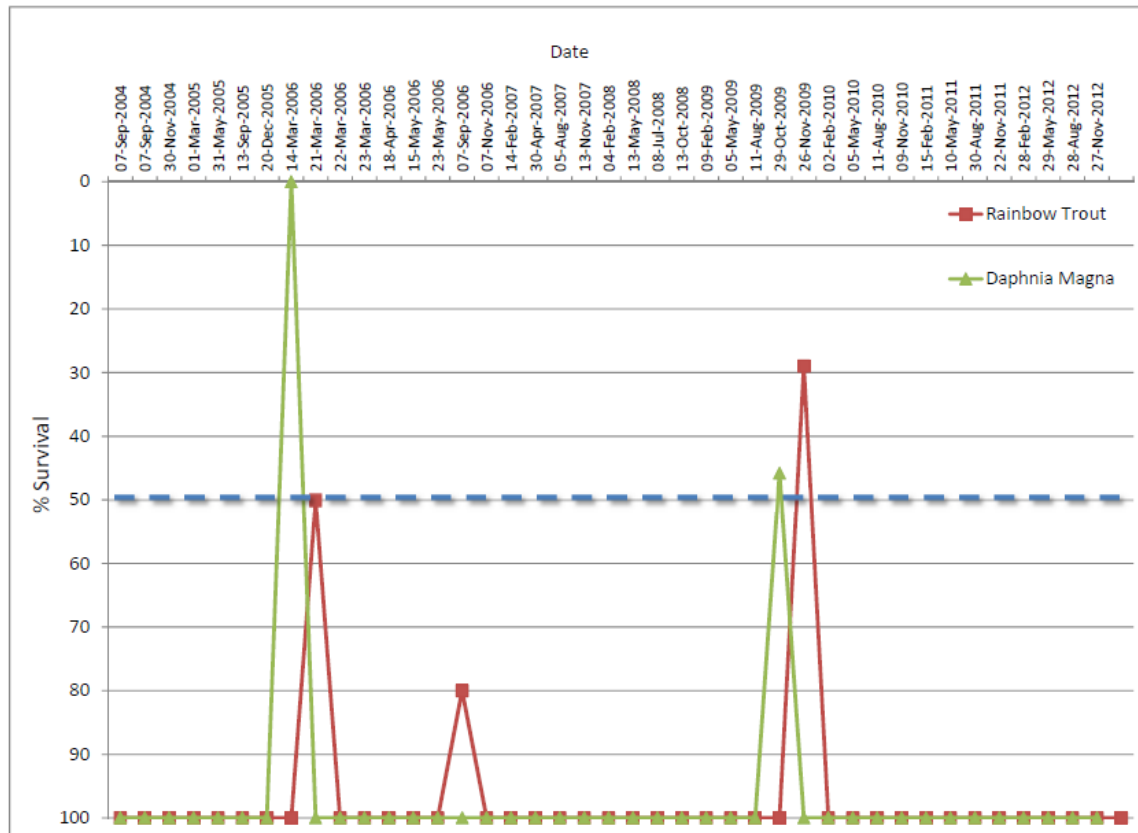
### 13.8.4 Acute Lethality

From the effective period of the Water Licence (August 30, 2004) to December 31, 2012, testing results for acute lethality passed the guideline limit, 95% of the time.

Figure H shows that over the last ten years there have been two testing periods when discharge water did not meet the acute lethality testing guideline of 50%. The dates of these results were:

March 14, 2006 (50% survival for rainbow trout and 0% survival for *Daphnia Magna*), and October 29, 2009 (29% survival for rainbow trout and 46% survival for *Daphnia Magna*).

**Figure H: Summary of Acute Lethality Testing Results for Water Discharged to the Mackenzie River**



In response to the first incident, which was reported on March 14, 2006, IOR immediately halted water discharge operations. Results were reported to the SLWB, an investigation was initiated, and additional water samples were taken and tested for acute lethality. The cause of this incident is unknown and the lab results could not be replicated. IOR worked with the regulators to determine when it was safe to reopen the settling pond.

In response to the second incident, which was reported on November 2, 2009, IOR again halted water discharge operations. Failed results were reported to the SLWB and the NT-NU 24-hour Spill Report Line. A detailed internal investigation was completed where IOR determined the cause of the incident to be a corrosion inhibition chemical (Nalco 7390) which was introduced into the freshwater cooling process. Injection of the chemical ceased immediately. The concentration of chemical in the cooling loop was identified as toxic to juvenile rainbow trout and

*Daphnia Magna* (although none of substances in the chemical are carcinogenic to humans). IOR worked with the regulators to determine when it was safe to reopen the settling pond.

IOR determined that the root cause of the incident was human error during the execution of the management of change process which mistakenly identified that the environmental assessment on the chemical had been completed. Environment Canada completed their own investigation with which IOR cooperated. IOR pled guilty and was charged in the fall of 2011 under *Section 36(3) of the Fisheries Act* (\$5,000 for the offence and \$155,000 to the Environmental Damages Fund) and *Section 40(2)(a) of the NWT Waters Act* (fine of \$25,000).

IOR takes all non-compliance issues seriously. As a result of this incident, IOR made several changes to the way fresh water is handled in the CPF cooling process. Specifically:

- 1) Enhanced the NWO environmental review process of new chemicals to site within the fresh water system.
- 2) Installation of automated isolation valves at the discharge of the settling pond (prior to this incident it was a manual valve).
- 3) Completed additional structured risk assessment on fresh water corrosion inhibitor program. As a result of the risk assessment, IOR has decided to only use chlorine (as a biocide) in the cooling system (which includes the settling pond).
- 4) The change management system was improved from a paper system to a more robust electronic one.

## **13.9 Proposed Changes and Rationale**

*Proposed Amendment:*

Amend the weekly water intake and water outlet monitoring requirements stipulated in the Surveillance Network Program Attachment to the Water Licence as described in Table I:

**Table I: Proposed Changes to Weekly SNP Sampling**

SNP Sample Point	Existing Requirement	Proposed Changes	Field Lab	Guideline Limit
S03L1-01 Water Intake	Phenols	No Change	Lab	N/A
	Oil & Grease	TPH	Lab	N/A
	Total Suspended Solids	Change frequency to 2x per week to meet hold time	Lab	N/A
S03L1-02 Outlet Return Line	Phenols	No Change	Lab	0.14 mg/L
	Oil & Grease	TPH	Lab	10.00 mg/L
	Total Residual Chlorine	Change frequency to Daily Grab to meet hold times	Field	N/A
	Total Suspended Solids	Change to 2x per week frequency to meet hold times	Lab	N/A
	pH	Change to 2x per week frequency to meet hold times	Lab	6.0-9.0
	Specific Conductivity	Change to 2x per week frequency to meet hold times	Lab	N/A
	Temperature	No Change	Field	N/A

*Rationale*

The frequency changes proposed in Table I are designed to achieve more representative data and to accommodate laboratory hold times. Hold time is the length of time between when a

sample is collected and when it is analyzed. For some parameters, a weekly composite sample will exceed hold times due to the length of time it takes to transport samples to the laboratory.

Oil & grease is measured weekly as part of the Water Licence. However, this parameter does not distinguish between petroleum related oil & grease and the oil & grease associated with animal fats and other non-petroleum products. As such, IOR proposes replacing the oil & grease analysis with Total Petroleum Hydrocarbons (TPH). TPH has a lower detection limit than oil & grease, and will provide data that are more useful for detecting potential impacts.

*Proposed Amendment*

Amend the semi-annual water intake and water outlet monitoring requirements stipulated in the Surveillance Network Program Attachment to the Water Licence as described in Table J:

**Table J: Proposed Changes to Semi-Annual SNP Sampling**

SNP Sample Point	Existing Requirement	Proposed Changes
S03L1-01 Water Intake	pH	No Change
	Sodium	No Change
	Potassium	No Change
	Sulphate	No Change
	Chloride	No Change
	Calcium	No Change
	Magnesium	No Change
	Total Alkalinity	No Change
	Specific Conductivity	No Change
	Suspended Solids	No Change
	Total Dissolved Solids	No Change
	Oil & Grease	TPH
	Total Phosphorus	No Change
	Total Hardness	No Change

SNP Sample Point	Existing Requirement	Proposed Changes
S03L1-02 Outlet Return Line	N/A	pH Sodium Potassium Sulphate Chloride Calcium Magnesium Total Alkalinity Specific Conductivity Suspended Solids Total Dissolved Solids TPH Total Phosphorus Total Hardness

*Rationale*

The proposed changes include updating the analytical suite to ensure there is consistency in the parameters assessed at both the intake and outlet locations.



## References

IOR, 2005. Water Licence S03L1-001 Monthly Report for December 2005. Letter to the SLWB dated January 13, 2006.

IOR, 2006. Water Licence S03L1-001 Monthly Report for March 2006. Letter to the SLWB dated April 26, 2006.

IOR, 2009. Water Licence S03L1-001 Monthly Report for November 2009. Letter to the SLWB dated December 29, 2009.

IOR, 2012. Letter RE: S03L1-001 Chlorine, pH, and Total Suspended Solids Sampling and Analysis. Letter to the SLWB dated December 17, 2012.