Depending on the size of the incident, the size of the team addressing each operations component will vary. The incident management team will set response objectives and priorities and decide the appropriate allocation of resources between these response operations components as the incident situation evolves, based on continuous assessment and analysis of the situation.

8.1.1 Emergency Operations

The emergency operations component involves the true emergency response: securing the plant operations, securing the scene to protect people (responders, refinery workers and the public), preventing fire and explosion, fire containment, preventing escalation of the incident, rescue and evacuation of personnel to safe zones, and provision of medical and other support of a logistics nature. The emergency component always has priority for resources. Despite the urgent need to respond, the safety of responders is a major consideration.

8.1.2 Core-Business Operations

In this case the core-business operations component is the long-term refinery operation. An incident may have resulted in disruption and damage to plant and process components which must be identified and repaired so the refinery can recover and resume its business.

8.1.3 Pollution Response Operations

During an incident, oil or other substance may be released on land at the refinery site or to the marine environment. Whether on land or ocean, the release must be contained to minimize environmental damage. In such cases, the health and safety of the response personnel and other persons will be a priority.

8.1.4 External Affairs Operations

The external affairs operations component of any incident involves communications with government agencies, the community and the media. The objectives are to protect people, the environment, the property and to return to normal operations as soon as possible. To do this requires extensive communication to deal with a wide range of problems and issues. Certain communications must be systematically managed to be effective.

8.1.5 Internal Affairs Operations

The internal affairs operations component involves ensuring that the relevant corporate managers and refinery staff clearly understand the situation and have sufficient resources to fulfill their roles. This component includes providing support for the personal needs of staff and their families. The corporate internal affairs aspects include financial, legal, insurance and business considerations.

8.1.6 Recovery Planning and Operations

The recovery planning and operations component addresses the processes and programs needed to return to a normal stable situation for plant operations, for the environment and for the surrounding community. The assigned team members would address restoration of damages to people, the environment and property within NLRC and the affected community.

8.1.7 Incident Command System (ICS) Structure

The Incident Command System (ICS) provides an organizational structure and systematic approach to managing any incident response. The Incident Management Team who work in the Emergency Operations Centre (EOC) and Field Task Groups who work in the field, are organized by key functions, as illustrated in Figure 8.1.

The number of Field Divisions is expandable by the Incident Manager from one to as many as necessary to respond effectively to each incident. The number of Task Groups within each Division is also expandable to four to six groups, each reporting to the Division Leader. In expanding the number of groups under each Division the span of control limits of the leader must be considered, as they will differ with each person and the intensity and stresses of the tasks. Safety of personnel should be a major consideration in choosing and tasking competent field leaders.

Depending on the incident situation, different Field Divisions are typically assigned tasks around a common theme such as:

1. Planning: Surveillance, investigation, analysis and problem definition tasks
2. Health/Safety Tasks include: assessment of health and safety hazards and risks to people and property; safety plan development, continuous safety monitoring
3. Operations: Plant Operations securing and/or shutdown tasks
4. Operations: Fire prevention, suppression and control tasks
5. Operations: Emergency tasks (rescue, evacuation, first aid, medical support....)
6. Operations: Land based oil spill response tasks
7. Operations: On-water oil spill response tasks
8. Operations: Shoreline oil treatment and removal tasks
9. Logistics: Staging, lifting, handling and transportation tasks for different operational activities
10. Logistics: feeding, housing and hygiene tasks
11. Logistics: Communications infrastructure development tasks

12. Logistics: Personnel and Equipment decontamination tasks
13. Logistics: Recovered oil treatment and disposal tasks
14. Logistics: Waste segregation and management tasks
15. Logistics: Observation and briefing for key personnel (internal and external affairs)
16. Logistics: Security tasks relating to Refinery site and field operations sites
17. Finance: Resource and cost monitoring and tracking, damage claims management
18. Management: External Affairs presentations, briefings, communications and interviews for a variety of audiences (government, community and media) with participation of management when appropriate.

Within each Field Division, each Field Task Group is assigned one work task (field work order or field mission) to be executed including the mobilization and demobilization of the people and equipment resources needed to execute the task and to report progress.

A disciplined approach is taken to assess health and safety conditions, identify hazards and risks, and to manage risks downward.

Each work task is treated as a separate and distinct project so that classical project management principles can be used in assembling resources, purchasing, tracking progress and expenditures, and documentation.

The ICS requires documenting and archiving work tasks, daily-action plans, long-term plans, safety plan, waste management plan and meeting minutes.

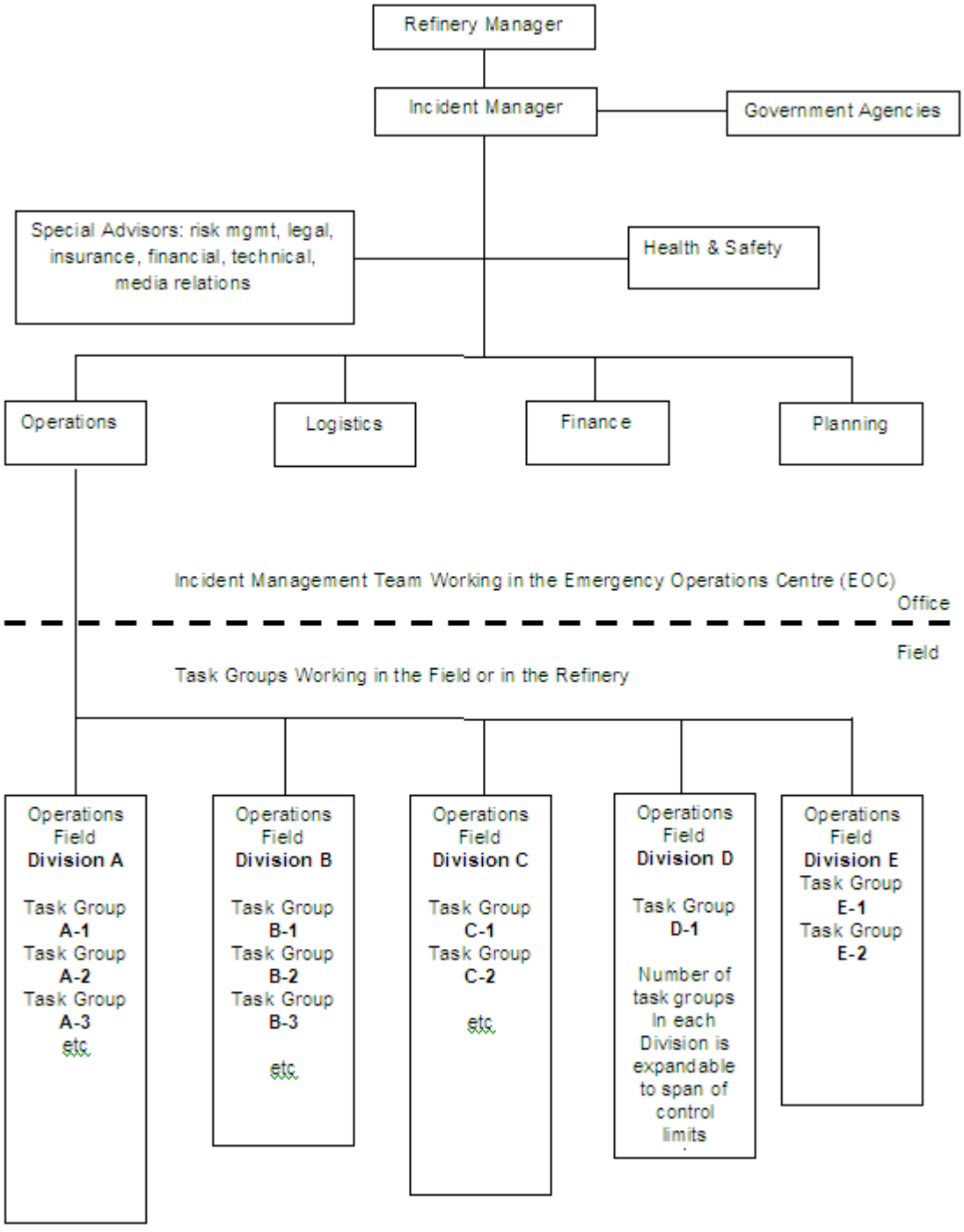

Figure 8.1 Incident Command System (ICS) Organizational Structure (in Functional Groupings)

8.2 Emergency Operations Centre

The Emergency Operations Centre (EOC) will be located in the administration building, very close to the Refinery Control and Communications Centre. This proximity to the control room will ensure efficient communications with critical operations staff during an emergency.

The EOC will be comprised of a larger room surrounded by several smaller break-out rooms for small task groups to address specific aspects of an incident.

8.3 Communications

To ensure that communications between all parties are highly effective, each EOC room will be outfitted with telephones, refinery-wide intercom, data lines, computer intranet, e-mail and Internet infrastructure. Computer capability will be available in the EOC to access digital drawings of refinery systems and other graphical information (maps, charts, aerial photos, satellite imagery, photos) using Geographic Information System (GIS) and Computer Aided Design (CAD) software systems. Radio communications with tankers, marine support vessels and emergency aviation support resources will be available through the Control Room and through other radio base stations in the jetty control rooms and oil spill response warehouse.

8.4 Emergency Response Training

NLRC will train all staff in Emergency Response procedures according to the content and procedures in its emergency response plans. Each staff member will have a role to play in any emergency. In-house training will endeavor to ensure that each staff member clearly understands his or her role.

The Health and Safety Supervisor on staff will be responsible for emergency response planning as well as for delivering emergency response training. Emergency response training will include:

- Notification procedures;
- The organization of a response using the incident command system and the Emergency Operations Centre (EOC);
- Responsibilities of ICS team members and field responders;
- Emergency checklists;
- Properties and hazards of the petroleum hydrocarbons handled by the Refinery;
- Sensitivities and resources at risk (human use and environmental); and
- Site safety plan.

Notification exercises will be conducted once per quarter.

In-house tabletop exercises will be held at least once every six months with a variety of themes to help staff become comfortable with their emergency response roles.

Generic incident command system training will be given to those responsible for:

- Overall incident command;
- The Emergency Operations component of an incident (response to fire, explosion, medical evacuation, injured staff etc.);
- Refinery Operations component of an incident (response to secure the terminal operations and the source of a spill);
- Oil Spill Response component of an incident;
- ICS Operations function Team Leads;
- ICS Logistics function Team Leads;
- ICS Finance function Team Leads;
- ICS Planning function Team Leads; and
- ICS Health and Safety function Team Leads.

This generic ICS training will allow the individuals to address all contingencies in NLRC's Emergency Plan. Generic ICS training will be considered from various training providers.

All staff will receive a comprehensive orientation to the entire Refinery: its Control Room; Emergency Operations Center (EOC); tanker familiarization, tanker loading, jetty operations and support tug operations. This exposure will allow all staff to function with greater understanding during emergencies.

Emergency response training for fire-team individuals will include:

- Refinery accidents and malfunctions;
- Consequences of accidents and malfunctions;
- Potential for fire and explosion;
- Fire suppression and control systems;
- Fire and explosion prevention and containment;
- Prevention of incident escalation;
- Methods to secure a spill source;
- Methods to control the spread of oil during a spill;
- Minimizing environmental effects;
- Fire containment training;
- Fire theory;
- Fire-fighting equipment theory;
- Fire-fighting equipment;
- Protective clothing and equipment;
- Self contained breathing apparatus (SCBA);
- Fire-water pumping systems;

- Foam application systems;
- Fire containment;
- Table top exercises; and
- Emergency response planning.

Refinery fire fighters will be given oil industry standard fire-fighting training and will regularly practice with their equipment. Training may include integration with fire-fighting resources from outside the Refinery.

8.5 Oil Pollution Emergency Plan

The Draft Guidelines for Environmental Impact Statement for the Newfoundland and Labrador Refinery Project (Government of Newfoundland and Labrador, Department of Environment and Conservation, 2007), requires an outline for a contingency plan that details measures to be taken to effectively respond to a marine or terrestrial spill event in a timely manner (reference Section 6.2 Emergency Response/Contingency Plan).

In addition to requirements of the Province of Newfoundland and Labrador, the Canada Shipping Act, Response Organizations and Oil Handling Facilities Regulations (SOR/95-405), requires an Oil Handling Facility (OHF) to submit an Oil Pollution Emergency Plan (OPEP) to the Federal Minister of Transport after the OHF has been designated as such under the Act. It is expected that the NLRC Refinery will be designated as an OHF prior to receiving its first transfer of oil from an incoming tanker.

It is NLRC's intent to prepare one plan for submission to both levels of governments. A draft Oil Pollution Emergency Plan (OPEP) has been prepared by NLRC. For detailed discussion of potential oil spills also see Vol.3, Section 7.0 Accidents and Malfunctions.

8.6 Response Plan for Chemical Spills

For response to a chemical spill, NLRC will develop a companion plan (to the OPEP) to address the chemicals that will be handled on site. For discussion of potential chemical spills and Environmental Emergency (E2) Plans see Vol. 3, Section 7.2.7 Spill Response.

9.0 ENVIRONMENTAL MANAGEMENT

The Newfoundland and Labrador Refining Corporation is committed to stewardship of the environment in which it seeks to operate, and will design and execute the project in a manner that will eliminate or minimize the potential adverse effect on the environment in all phases of the project. NLRC is committed to prevent pollution and to continually improve the integration of environmental protection practices in all its activities. NLRC will ensure that project activities are carried out in full compliance with all applicable environmental, health and safety laws and regulations by applying the best available technologies and highest standards.

Various environmental management plans will be prepared during the design phase of the Project including:

- Environmental Protection Plan (EPP);
- Waste Management Plan;
- Water Management Plan;
- Emergency Response Plan;
- Environmental Monitoring and Follow Up Plan;
- Health and Safety Plan.

9.1 Design Principles

The proponent has already taken a proactive approach to environmental protection at an early stage of project planning, including, for example, the following:

- Project site selection and avoidance of sensitive areas (e.g., marine terminal re-location to avoid fishing grounds, siting and design of the marine intake and outfall and minimize its zone of influence);
- Reduce the size and extent of physical disturbances;
- Reduce environmental effects on sensitive areas (e.g., allow sufficient buffer zones from sensitive areas, avoid and control sediment transport into water bodies, treatment of effluent and reduce the zone of influence, etc.);
- Reduce the number of water intakes /effluent discharge points (only one salt water intake and one outfall/diffuser);
- Effective water management, reduce or eliminate reliance on existing fresh water resources, use desalinization and increase the amount of recycling of process water;
- Reduce harmful alteration, disruption or destruction of habitat (HADD), and adoption of “no net loss” principle in project development;
- Reduce air emission by applying best available technologies economically achievable (as described in preceding sections);
- Develop Marine Transportation and Protection Management Plan;

- Develop an effective Prevention and Emergency Response Plan;
- Development of an effective Environmental Protection Plan, including monitoring and follow up;
- Has initiated air quality and water quality monitoring programs within the project area (e.g., Watson Brook stream flow meter and water quality monitoring); and
- Participation in and financial contribution to the SmartBay program.

9.2 Construction Practices

Well established approved construction methods and practices will be used throughout the construction phase. Before any construction commences, a detailed construction methodology will be developed specific to the activities to be undertaken. This methodology will focus on minimizing the impact of construction procedures.

Appropriate provincial and federal publications will be used in the preparation of general environmental protection procedures. Some of these include the following documents from the Department of Environment and Conservation, Water Resources Division:

- Environmental Guidelines for General Construction Practices;
- Environmental Guidelines for Culverts;
- Environmental Guidelines for Bridges;
- Environmental Guidelines for Fording;
- Environmental Guidelines for Watercourse Crossings.

Fisheries and Oceans Canada also has a number of Fact Sheets that will be considered for the EPP, including some of the following:

- Effects of Silt on Fish and Fish Habitat;
- Blasting – Fish and Fish Habitat Protection;
- Ditching;
- Temporary Fording Sites;
- Forward Trails;
- Filter Fabric;
- Temporary Bridge;
- Resource Road Construction;
- Instream Work in Dry – Cofferdams;
- Streambank Stabilization;
- Instream Work in the Dry – Temporary Diversion;
- Instream Work in the Dry – Elevated Pipes;

- Culvert Stabilazation;
- Highway Construction Low Point Protection;
- Temporary Settling Basins;
- Bridge Construction/Demolition;
- Freshwater Salmonid Habitat Requirements;
- Highway Construction/Upgrading – Infilling, Stabilization and No-Grub Zones;
- Freshwater Intake End of Pipe Fish Screen;
- Stream Clean-up;
- Culvert Installation.

As described in Volume 2, Section 5.2, the following general construction practices will be implemented in the construction phase of the Project:

- Excavated surfaces that are at risk for erosion will be protected by using adequate slopes to minimize slumping.
- Slopes for finished-grade surfaces will be in accordance with the recommendations of geotechnical specialists and will be surface-finished accordingly to provide long-term stability.
- Dewatering of the site will be undertaken in accordance with approved practices and with the objective of preventing drainage-related issues in the area surrounding the site.
- Protective measures such as silt screening will be used to prevent silt from precipitation runoff from progressing to the surrounding area.
- Pumps may be used to assist with dewatering and will be used in such a manner as to prevent the passage of silted water into the surrounding area.
- Surface water will be inhibited from entering the work site by using perimeter ditching to redirect the flow.
- Velocity controls such as check dams will be used to assist in the removal of sediment that may be in that drainage water.
- Surface water from the site will be directed to one or more settling ponds that will be constructed to remove silt and turbidity prior to discharge back into the surrounding environment.
- The water will be evaluated for compliance with the Provincial Environmental Control Water and Sewage Regulations prior to discharge.
- Dust generated during construction will be controlled using one or more conventional measures as applicable to the particular location, including water spraying, wind breaks, spray-on adhesives and vegetative coverings.
- Chemical-based solutions will not be used or applied near water bodies.
- Buildings, tanks and process facilities that have either heavy loading or vibratory foundations will be founded on bedrock, where required.

- Conventional shallow foundations and footings will be designed and constructed for conventional building requirements.
- Concrete will be prohibited from contact with the water until it has adequately cured.
- Water course crossing (by bridge or culvert) will be in accordance with permit requirements.
- Fish-bearing streams will be crossed in accordance with DFO guidelines and standards.
- Blasting operations are required only during the site work phase of the project and will not be required for any operational phase after construction is complete.
- Blasting will be undertaken in such a manner as to make secure any elements and features designated to remain.
- Blasting patterns and procedures will be used to reduce the shock wave and noise. Blasting will not be undertaken in marine areas.
- Water bodies outside the Project footprint will have a minimum 50 m buffer zone as required by the regulatory agencies to preserve the shoreline.
- It is expected that waterbodies within the project area will be in-filled and will not exist in the project area upon completion of construction.
- Those water bodies will be electrofished to remove fish prior to the start of construction.
- Those fish will be relocated to an area of similar habitat that will remain unaltered.
- Culverts will be installed at stream crossing locations on the access roads.
- Bridge structures will be required for more substantial rivers (fish habitat) including Come By Chance River, Watson's Brook, and North Harbour River.
- Alignment of culverts will be such that the original direction of stream flow is not significantly altered.
- Where possible, crossing infrastructure will be installed at right angles to the stream to minimize the crossing length.
- Approaches to all stream crossings will be constructed with erosion resistant materials such as rock or clean gravel.
- Any materials placed in the stream to improve the crossing will be clean, non-erodable, and non-toxic to aquatic life.
- Where streams are deemed to be fish habitat, culvert installations will be designed to allow the passage of fish and to preserve habitat.
- Fording of stream crossings may be required for temporary access only for pole and cable installation for electric power lines; if this is required the immediate area will be stabilized by the use of brush mats, corduroy, or coarse clean gravel fill.

During the construction period, all activities will comply with the Construction Environmental Protection Plan (EPP). All contractors will provide Environment, Health and Safety staff at the site to ensure that project activities are conducted in accordance with the EPP. All required permits from regulatory agencies will be obtained before construction starts. Emergency

response to oil or chemical spill procedures and clean-up will be in accordance with Emergency Response Plan (ERP) approved by DOEC.

9.3 Environmental Protection Plan

The Environmental Protection Plan (EPP), an important element of the Proponent's overall Environmental, Health and Safety Management (EHSM) system, will be prepared in a timely manner. The EPP will provide a practical framework for implementation of the environmental requirements for the project and consolidate all proposed mitigation and monitoring procedures for construction, operation, and decommissioning and abandonment.

NLRC will develop and implement a comprehensive EPP for construction, operations, and decommissioning and abandonment that will meet and exceed all applicable regulatory, permitting and licensing requirements, and to help ensure a high level of environmental protection throughout its work areas and activities associated with the construction and operation of the refinery.

The EPP is a working document for use in the field for project personnel and contractors, as well as at the corporate level, for ensuring commitments made in the proponent's policy statements are implemented and monitored. EPP provides a quick reference for project personnel and regulators to monitor compliance and to make suggestions for improvements.

9.3.1 Purpose

The EPP is the cornerstone for implementing environmental protection measures during the construction and subsequent phases of the Project, providing documentation of environmental protection procedures (general and site-specific), against which performance can readily be assessed and, if appropriate, the need for additional corrective measures can be determined. It is a working document to be used by project personnel and contactors in the field, as well as at the corporate level, to ensure that environmental requirements and commitments made in policy statements are implemented and monitored.

9.3.2 Implementation

An EPP will be implemented for each phase (construction, operations and decommissioning) of the Project to deal with environmental issues specific to each individual phase. Revisions and additions to the EPP will be made to reflect new and site-specific construction sequences, work methods and environmental protection requirements and responsibilities. The EPP will be structured to allow for updates and revisions as required to meet the needs of the reviewers, and as engineering design and work methods are further defined. Each EPP, and revision thereof, will be reviewed and approved by the Proponent.

All Issued for Construction (IFC) drawings will be annotated with environmental considerations and/or EPP notation boxes referencing specific sections of the EPP to be consulted by contractors/field personnel when carrying out activities in the area defined by the IFC drawing. "EPP notation" will be included on the drawings to highlight important environmental protection measures relevant to given construction activity (e.g., buffer zones, stream crossings, etc.).

9.3.3 EPP Content

The style and format of the EPP is intended to enhance its use by project personnel in the field and to provide an important support document between the overall approach to environmental protection planning and the specific requirements contained in various permits, approvals and authorizations issued for project development and activities. The following is a generic contents list of the Project EPP.

Section 1 of the EPP provides an introduction, responsibilities of various project personnel and implementation procedure.

Section 2 of the EPP provides an overview of the environmental concerns and the standard environmental protection measures associated with a variety of specific activities anticipated to occur in relation to each specific phase. Standard environmental protection procedures have been or will be developed for:

- Clearing of vegetation;
- Grubbing and disposal of related debris;
- Storage, handling and transfer of fuel and other hazardous material;
- Sewage disposal;
- Solid waste disposal;
- Quarrying and aggregate removal;
- Buffer zones;
- Erosion prevention;
- Excavations, embankment and grading;
- Stream crossings;
- Dust control;
- Trenching;
- Dewatering – work areas;
- Marine vessels;
- Pumps and generators;
- Noise control;
- Blasting;

- Winter trails;
- Groundwater development and use;
- Drilling – Geotechnical/Water well/marine;
- Concrete production;
- Linear developments;
- Vehicular traffic;
- Works in/around marine environment;
- Construction camp;
- Surveying;
- Equipment operations;
- Drilling – Geotechnical Drilling in the Marine Environment;
- Emissions Reduction;
- Coke and Sulphur Handling and Transportation;
- Miscellaneous – Others.

Section 3 of the EPP references key sources of information for the purposes of HS&E performance including, for example, Department of Fisheries and Oceans (DFO) fact sheets and a list of Proponent's background technical data reports compiled during the environmental assessment.

Section 4 of the EPP provides contingency plans for:

- Accidents and Malfunctions;
- Fuel and Hazardous Materials Spills;
- Wildlife Encounters;
- Discovery of Historic Resources;
- Forest Fires; and
- Vessel Accidents.

Section 5 of the EPP provides the names and numbers of key contacts for the project.

Section 6 of the EPP contains the site-specific EPPs for the principal work areas for construction. These areas include:

- Port Area;
- Coke and Sulphur Handling and Transportation;
- Access and Service Roads;
- Construction Campsite;
- Process Area;

- Tank Farm; and
- Site Utilities (sewage, water supply, firewater, power, etc.).

Site-specific EPPs will be modified or expanded as needed throughout the various phases of the Project as engineering design, work methods and overall schedule progress. The site-specific EPPs contain information on local environmental issues and concerns; potential effects and sensitive areas/periods; general environmental protection measures; relevant drawings and documents; and a listing of applicable permits, approvals and authorizations and associated compliance monitoring requirements.

Construction

The Environmental Protection Plan (EPP) for construction will be developed at an early stage of the Project. The EPP for Construction will provide the general protection procedures for routine construction activities anticipated for the Project. The EPP will also identify applicable permits, authorizations, licences and certificates as well as the site specific conditions of the approval, where appropriate.

The content for the EPP for Construction can be seen in Section 9.3.3.

Operations

The EPP for operations will provide the general protection procedures for routine operation activities associated with the operation of a refinery and marine terminal. The EPP will also identify applicable permits, authorizations, licences and certificates required for the operation phase of the Project. The EPP for operations and construction will be similar; however, the EPP content will focus on the operation of the refinery and marine terminal. Standard environmental protection procedures will be developed for:

- Emissions reduction;
- Coke and sulphur handling and transportation;
- Storage, handling and transfer of fuel and other hazardous material;
- Sewage disposal;
- Solid waste disposal;
- Buffer zones;
- Erosion prevention;
- Dust control;
- Marine vessels;
- Pumps and generators;
- Noise control;
- Vehicular traffic;

- Works in/around marine environment;
- Equipment operations;
- Miscellaneous – Others.

Decommissioning

The EPP for decommissioning will provide the general protection procedures for decommissioning and abandonment of the refinery and marine terminal. The EPP will also identify applicable permits, authorizations, licences and certificates required for this phase of the Project. The EPP content for decommissioning will be very similar that of the EPP content for construction, which can be seen in Section 9.3.3.

9.4 Waste Management

Solid wastes will be generated during all phases of the project. Waste management practices will adhere to applicable regional, provincial and federal waste management acts, regulations, and guidelines. Where possible, best management practices will be adopted in the management of waste streams.

NLRC is committed to managing its wastes as resource materials. NLRC intends to reduce waste generation at all project phases through appropriate system design and operation. Wherever possible, waste materials will be reused to prevent the use of virgin or reprocessed materials. Recycling of refining additives such as catalysts and caustics will be incorporated into the refinery design at all feasible prospects. Recycling of waste materials that require additional processing will be off-site by an approved facility.

Waste materials that cannot be further reduced, and that are not appropriate for reuse, recycling or energy recovery, will be disposed of in a manner approved by regulatory authorities. NLRC will communicate its waste management procedures, policies and objectives to regulatory authorities and employees by creating a detailed Waste Management Plan. Waste management is discussed in further detail in Volume 2, section 11.6.

9.5 Water Management

A water management plan will be implemented to ensure that water brought into the site, used for the refinery and associated processes, treated and eventually discharge are adequately controlled. Conservation and re-use efforts will be in place to minimize the water quantity required to be withdrawn from marine sources. Water quality and quantity, desalination processes, treatment processes and final discharge will be managed in accordance with the mitigation measures outlined in Volume 2, Section 11.7.

9.6 Reclamation Plan

The Environmental Management Program will cover all aspects of reclamation and rehabilitation during construction, operations, decommissioning. A site Decommissioning and Closure Plan will be developed at the design phase of the project and is outlined in Volume 2, Section 7.0. The plan will focus on protecting public health and safety, improving or eliminating environmental damage and liabilities, and allowing the land use to be similar to its original use or an acceptable alternative.

At each stage of the project a reclamation plan will be developed to restore protect the environment and restore disturbances caused by construction and operations. The following will occur prior to reclamation of the site at each stage of the project:

- Inspection of the property pre-closure;
- Preliminary site contamination/facility inventory will be developed;
- Draft conceptual plan will be developed which will identify information needs;
- Site characterization will occur and concerns will be identified; and
- Options will be considered and a preliminary plan developed.

The following rehabilitation measures will be addressed in the Reclamation Plan:

Construction

- Temporary facilities will be removed and the area restored.
- Temporary Equipment will be removed and the area restored.
- Areas disturbed by heavy equipment and vehicles will be restored.
- Temporary settling ponds will be restored.
- Vegetation cover will be re-established where possible.
- Areas will be cleared and cleaned of construction debris.

Operations

- Temporary facilities will be removed and the area restored.
- Temporary Equipment will be removed and the area restored.
- Areas disturbed by heavy equipment and vehicles will be restored.
- Hazardous chemicals, reagents and materials will be removed for proper disposal
- Pipelines and equipment that is decommissioned will be drained and cleaned
- Oil and fuel storage tanks that are decommissioned will have all product and vapours removed from the storage tanks. They will then be dismantled and removed from site by the supplier/contractor.
- Modification or removal of site buildings or other infrastructure will be properly demolished and removed

- An ongoing monitoring program to assess soil contamination in the facility will be developed. If contamination is forund theappropriate remediation measures will be implemented to address contaminated soil
- Fencing will be kept in good repair to provide security to the site.
- Road surfaces be maintained.
- Re-vegetation will occur where practical, including seeding and reforestation through the introduction of vegetation and organic material on site

The Reclamation Plan will address the entire facility. For each project component the reclamation plan will address potential environmental effects, the end-use of the land, and the long-term physical and chemical stability of the reclaimed component.

10.0 ENVIRONMENTAL MONITORING AND FOLLOW-UP PLAN

NLRC is committed to ensuring that any environmental effects that could result from the construction and operation of the proposed refining project are identified, avoided or minimized and managed effectively. NLRC will develop and implement an Environmental Protection Plan, an Emergency Response Plan and an Environmental Monitoring and Follow-up Plan. The development of these plans will be undertaken in consultation with provincial and federal governments, as well as the communities.

The Guidelines for Environmental Impact Statement/Comprehensive Study Report for the Refinery outline the need for monitoring and follow-up programs to verify the accuracy of the environmental assessment predictions and to determine the effectiveness of mitigation measures (as well as for compliance).

The objectives of the monitoring/follow-up programs as outlined in the Guidelines are:

- To ensure compliance with existing regulations, including permit requirements;
- Validation and verification of predictions identified in the Environmental Impacts Statement (EIS);
- To evaluate mitigation and/or avoidance measures taken to protect the environment from the project;
- To satisfy proponent commitments identified as part of the EIS;
- To identify cause-and-effect relationships as a result of the project operations and potential environmental effects on the surrounding environment; and
- To provide an early warning of undesirable environmental changes.

The Guidelines also specify that the proponent take an adaptive approach in order to be able to use monitoring results to accommodate uncertainty in the prediction of effects and/or effectiveness of the mitigation measures. This will permit early intervention through the use of additional mitigation or avoidance measure to control potential environmental damage.

10.1.1 Compliance Monitoring

The objective of compliance monitoring is to ensure all project activities comply with laws, permits, approvals and authorization. The specific details will not be known until permits and authorizations, and their associated conditions, are issued by the appropriate regulatory agencies. The proponent will conduct compliance monitoring as required by all applicable regulations and specified in all permits and approvals. In addition to permits that have environmental implications, NLRC will also acquire and comply with permits associated with Occupational Health and Safety as outlined in Volume 2, Section 10.

As part of compliance monitoring, activities that are conducted to meet regulatory requirements will be reported to appropriate authorities as specified in permits and authorizations. The results will be summarized and made available to the public on a regular basis.

It is anticipated that compliance monitoring will be required for air emissions, waste management, chemical storage and handling, effluent discharges, water quality, and marine and freshwater fish habitat compensation requirements, and for the hundreds of permits during construction.

During all phases of the project, there will be on-site environmental protection management personnel. In addition to ongoing monitoring of implementation of the Environmental Protection Plan, they will provide inforal visual monitoring of site conditions, such as siltation systems in place, effectiveness of measures to prevent injury to wildlife.

The on-site Fisheries Liaison Manager will complement these observations through marine/fisheries monitoring.

There are two key areas for compliance monitoring: air quality and effluent discharge.

Air Quality

Air emissions are regulated by the Province of Newfoundland and Labrador in accordance with the Air Pollution Control Regulations under the Environment Act (2004). Criteria for acceptable air quality are included in Schedule A of the Regulations and apply to ambient air quality resulting from all sources of airborne emissions.

The project is also subject to the Canada Environmental Protection Act (CEPA), and as such must comply with conditions of the National Pollutant Release Inventory (NPRI). Under the authority of the CEPA, all facilities in Canada meeting the NPRI reporting criteria are legally required to submit annual reports to Environment Canada if they manufacture, process or otherwise use one or more of the NPRI-listed substances under prescribed conditions. The project will participate in NPRI reporting throughout its lifecycle. NPRI information is publicly available.

NLRC will comply with all requirements set out in its permits and will incorporate monitoring activities to ensure compliance. The province has indicated that the CALPUFF air dispersion model is approved for use in Newfoundland and Labrador and worked with NLRC to ensure the model inputs, as well as the base case for the assessment, are acceptable.

Emissions modeling will be incorporated into compliance and effects monitoring, equipment selection and process, and plant design. NLRC will update the air dispersion model after equipment has been selected and, when operations have reached steady state and, after that, as is determined necessary according to the operating permit.

The National Framework for Petroleum Refining Emission Reductions primarily addresses the emissions of 'criteria air contaminants' and these will be the focus of the air dispersion modeling: sulphur oxides, nitrogen oxides, volatile organic compounds (VOCs), particulate matter, carbon monoxide and benzene. NLRC intends to initiate air quality monitoring on site following project approval to establish baseline conditions.

Air quality will be monitored at the property limits of the proposed Southern Head Refinery, Goobies and North Harbour. The North Atlantic Refinery Limited monitoring network will also be used to monitor areas such as Sunnyside and Come By Chance. NLRC anticipates that the air quality advisory group that assisted with the air quality modelling study will continue in some form as the project evolves.

Certain components of the surrounding ecosystem may be sensitive to air quality changes. In particular, *Erioderma* (lichen) are a candidate for monitoring because they are sensitive to pollutants such as sulphur oxides, even at relatively low concentrations. *Erioderma* is listed as a Species at Risk and has been found in the project area. Follow-up monitoring programs will be implemented.

Effluent

Effluent sampling will be carried out as required and the effectiveness of treatment will also be addressed through effects monitoring.

Sewage and treated effluent discharge is regulated under provincial and federal regulations and permits. For any undertaking that has the potential to affect water quality through the discharge of treated or untreated effluents, the provincial Department of Environment and Conservation will require that all discharges comply with criteria set out in the Environmental Control Water and Sewage Regulations (2003), under the Water Resources Act.

Also, the proponent is committed to ensuring that all discharges to the marine environment will meet Petroleum Refinery Liquid Effluent Regulations under the Fisheries Act. These Regulations regulate effluent for what it terms "deleterious substances" in liquid effluents from petroleum refining processes. Under the regulations the following are considered deleterious substances: oil and grease; phenols; sulphide; ammonia nitrogen; total suspended matter; and substances capable of altering the pH.

The Project components will include a storm water drainage system, oily water/process water drainage system, sanitary sewerage system, wastewater treatment plant and containment ponds. Decant water from the containment ponds will flow directly into the marine environment near shore while wastewater from the treatment plant will be discharged from a single outfall. All treated water will conform to environmental guidelines before being discharged into marine waters.

NLRC will monitor effluent discharges and decant water on a regular basis to ensure compliance with the Environmental Control Water and Sewage Regulations (2003). Further, any sampling regime specified in the approvals from the provincial Department of Environment and Conservation will be followed.

On-going effluent and effects monitoring will allow detection and response to changes in effluent and water quality and ensure compliance with all environmental regulations.

10.1.2 Environmental Effects Monitoring and Follow-up

Environmental Effects Monitoring (EEM) programs will be used to measure the effectiveness of mitigation and/or avoidance measures taken to protect the environment; to compare the actual effects of a project with those predicted by the EIS; and to identify problem areas and set priorities for stricter environmental controls or enforcement action.

EEM programs will be developed according to regulatory conditions and in consultation with regulators and the Community Liaison Committee (NLRC Project Registration, 2006). Details for all EEM programs will be submitted to regulatory agencies for approval. The results of environmental effects monitoring will be summarized and made available to the public on a regular basis.

NLRC is continuing field programs in order to enhance the data set available for the design of monitoring programs and confirmation of the discharge outfall design and the oil spill probability contours used in the assessment: these include additional current data collection, *Erioderma* surveys, seabird and marine mammal surveys.

Air Quality

In addition to compliance monitoring for air emissions, NLRC will institute three specific programs to monitor potential associated effects: human health, lichen contaminant uptake and health; and the pH of nearby freshwater ponds and streams.

The details of each will be determined in consultation with appropriate regulatory and community agencies or associations but the basis for each is described below.

Human Health: The Health Research Unit report, Review of the Health Status of the Come By Chance Area, Newfoundland and Labrador, established the baseline health profile for the study area. One of the conclusions is that, at present, there is no difference between the incidence of respiratory disease (an end result of SO_2 effects) in the HRU study area compared to elsewhere in the province – even though the ambient air quality shows elevated levels of sulphur dioxide. Because of the potential effects on human health, NLRC will monitor all Criteria Air Contaminants and (as per the recommendation of the HRU report) the health status of the local population, particularly for health problems that may develop or be exacerbated by refinery emissions.

Lichens: NLRC's surveys for the assessment have discovered several specimens of *Erioderma*, the boreal felt lichen, a species listed under Species at Risk. In addition to SAR, *Erioderma* and other species located during the surveys are sensitive to air pollution and will serve as indicators of air quality. NLRC will carry out further field investigations to identify and map the presence of the Eroderma pedicellatum.

Sampling lichen for chemical analysis provides a quantifiable method of assessing the effects of airborne emission on vegetation and subsequent changes in the deposition of these emissions (JWEL 2002). Furthermore, NLRC will carry out monitoring programs to compare concentrations of chemicals in pond water, sediments and soil in areas at varying distances from the refinery to confirm human health and air quality study results.

Fresh water pH levels: There are three salmon rivers in the general area of the Southern Head peninsula, and part of the watershed of one of them, Watson's Brook, is within the refinery property line. NLRC is particularly concerned that the refinery operations do not affect the freshwater habitat through air emissions. NLRC proposes to develop and carry out a freshwater monitoring program in the general area of the refinery in collaboration with ongoing community stewardship initiatives such as the Come By Chance Wetlands and the newly formed Salmon Stewardship group.

Fresh Water

NLRC has documented water quality and freshwater habitat information from Watson's Brook and from the Come By Chance River. Furthermore, NLRC is contributing to the provincial/federal hydrometric station monitoring program in the province. NLRC intends to install a fully automated hydrometric (flow and quality) station on Watson's Brook as soon as practical and, in the interim, is taking measurements manually. NLRC will also have a fresh water fish habitat compensation program.

Terrestrial

The EIS Guidelines require that the proponent develop a monitoring plan for eagles. One of the densest breeding concentrations of bald eagles in eastern North America is in Placentia Bay. Another raptor species, osprey, is less numerous but occurs regularly from late April to September (NLRC Project Registration, 2006). The proponent proposes to conduct raptor monitoring around the perimeter of the project area and along the new transmission line to ascertain if the area or any infrastructure is being used as perches. NLRC, in collaboration with the provincial Wildlife Division, will design and implement a raptor monitoring program.

Marine

The purpose of marine monitoring is to determine and quantify potential changes that might be associated with operations. NLRC will design and implement a marine sampling station network in the project area in consultation with the appropriate regulatory agencies.

Baseline information including nearshore sediment classification, water quality, marine habitat, and ocean currents have been collected. (Data collection continues for some parameters.) Transects were established at various locations around Southern Head, and the main physical and biological features of the benthic region were described in support of marine fish habitat compensation.

The baseline information provides a good characterization of the existing marine environment. The proponent will give annual reports on water quality, sediment quality, and body burden studies at selected sites for the entire period of operation, unless otherwise specified by a regulatory agency. Specific attention will be given to sites around the marine outfall. The marine outfall is located in a water depth of 15m west of Southern Head, approximately 400 m from the shoreline.

The present consideration includes installing a continuous-monitoring mooring for temperature and salinity at the outfall. It may be possible to have data fed to the nearby SmartBay buoy, thereby having near real-time information on water quality conditions and allowing quick detection and response to changes in effluent and water quality.

Marine sediments are important habitat and feeding sources for biological life, a transporting agent for pollutants and an ultimate sink for settling organic and inorganic matter. Its composition constitutes an important criterion for the assessment of long-term water quality and marine environmental quality in general. A sediment sampling program associated with the outfall will be developed.

NLRC will include monitoring of effects on marine organisms meant for human consumption, using blue mussels from aquaculture facilities in Placentia Bay. Mussels would be transported to the monitoring site(s) and placed in cages suspended in the water column at strategic locations. Samples will undergo tainting evaluation and analyzation for oil content and other deleterious substances. The potential for a monitoring program that includes the newly established scallop ‘reef’ in North Harbour will also be considered.

Marine and Freshwater Fish Habitat Compensation

The refinery project will meet with DFO’s “no net loss of habitat” policy and NLRC will have freshwater and marine habitat compensation initiatives.

Appropriate fish habitat compensation plans will be developed and implemented in consultation with DFO and the communities, including the newly formed Salmon Stewardship group. NLRC’s

overall approach to marine and freshwater fish habitat compensation has been reviewed with DFO and is presented in this volume of the assessment. Compensation plans will address, as per the Policy for the Management of Fish Habitat, the "no net loss" policy capacity of fish habitats.

Each area of compensatory habitat will be monitored to ensure that the physical attributes of the habitat are being maintained (e.g., substrate placement, habitat stability) as well as the anticipated net production increases.

The intent is to introduce enhancement features into Watson's Brook that will increase spawning habitat. Monitoring would include:

Increased Spawning Habitat

Areas with increased spawning habitat will be monitored for the presence and persistence of Atlantic salmon and brook trout particularly during the spawning season. Typical sampling would include redd surveys and population estimates.

Reach Rehabilitation

Each reach where habitat structures are added or modified will be surveyed for stability. Each reach will be physically surveyed to ensure that placed substrates are being maintained and that factors such as unanticipated ice or high-flow conditions do not render the habitat unsuitable.

Potential Opportunities for Follow-on Environmental Initiatives

At present the Southern Head peninsula is accessible by boat and, near existing highways and /or transmission line, on foot or by all-terrain vehicles. The development of two access roads will enable access to the interior of the peninsula and could provide an opportunity for new community and/or academic research.

NLRC's surveys for seabirds, waterfowl and songbirds for the refinery assessment have highlighted the number of species found in the area associated with the Come By Chance estuary area and the Arnold's Cove barasway and lagoon. While both areas are already recognised by the communities as special ecological areas, a program of formal seasonal surveys would provide a foundation for community stewardship, potential partnership with professional/academic 'birder' and add to the understating of the overall ecology of this area of Placentia Bay.

River otters were not identified by government agencies as a VEC. However, in Placentia Bay, river otters have a possibly unique coastal lifestyle and NLRC decided to include river otters in the assessment as a VEC. NLRC is considering continuing otter surveys, possibly through winter surveys of otter slides. There could also be a special site awareness and sighting program.

Lichens will be monitored in the project area. In an initial presentation and discussion with Terra Nova National Park staff, there was some interest in a joint lichen-monitoring program. As the project progresses, NLRC will follow up with Park staff regarding this opportunity.

11.0 CONCLUSIONS

The only significant adverse impacts from the construction and operation of the proposed new refinery, based on the assessment presented in the EIS/CSR, will be on the local population of the boreal felt lichen (*Erioderma pedicillatum)* and, only in the event of a marine oil spill, on coastal and pelagic seabirds in Placentia Bay. All other effects are determined to be negligible and not significant.

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13.0 GLOSSARY OF TERMS

Term	Definition
Analytes	The substance which a laboratory test aims to detect.
Baleen	A tough, horny material growing in comb like fringes from the upper jaws of some species of whales.
Benthic Sediment Horizon	Samples taken from the top layer of sediment on the ocean bottom.
Bioaccumulation	The storage of chemicals in an organism in higher concentrations than are normally found in the environment.
Biodiversity	The variety of life forms that inhabit the earth. Biodiversity includes genetic diversity, among members of a population or species as well as the diversity of species and ecosystems.
Biota	The animal and plant life in a given region.
Blubber	A thick layer of fat under the skin of marine animals that maintains body temperature.
Cetacean	Any of various aquatic, chiefly marine mammals of the order *Cetacea*, including the whales, dolphins and porpoises, characterized by a nearly hairless body, anterior limbs modified into broad flippers, vestigial posterior limbs, and a flat notched tail.
Delayed Implantation	After fertilization, time passes before the zygote embeds into the wall of the uterus.
Echolocation	The use of sound waves by some marine animals to locate and identify underwater objects.
Ecoregion	Areas of ecological potential based on combinations of biophysical parameters such as climate and topography.
Ecosystem	The physical and chemical environment of a community and all the interactions among and between organisms and their environment.

Term	Definition
Euphausiid	A planktonic, shrimp-like crustacean.
Eutrophic	Pertaining to a body of fresh water rich in nutrients and, hence, rich in living organisms.
Habitat	The environment in which a population or an individual live.
Intertidal	The zone between high and low tide.
Macrofauna	Animals large enough to be seen with the naked eye.
Macroflora	Plants large enough to be seen with the naked eye.
Mysticete (Baleen Whale)	Any of several usually large whales of the suborder *Mysticeti*, such as the right whale and rorquals; they have symmetrical skulls, two blowholes and whalebone plates instead of teeth.
Odontocete (Toothed Whale)	Any of various whales of the suborder *Odontoceti*; they have numerous conical teeth.
Oligothrophic	Water which is low in nutrients and in prosperity.
Pelagic	Referring to the open water.
Permanent Threshold Shift	A significant, irreversible loss of hearing as shown on an audiogram.
Phocid	True seals of earless seals are one of the three main groups of mammals within the seal suborder *Pinnipedia*.
Pinniped	Marine mammals with flippers; such as seals, walruses and sea lions.
Qualitative	Descriptive of kind, type or direction (as opposed to size, magnitude or degree).
Quantitative	Involving the measurement of quantity or amount.
Temporary Threshold Shift	A loss of hearing associated with the effect of loud noise, which disappears after a period of recovery.
Thermoregulation	The regulation of body temperature.

Term	Definition
Tidal Estuary	An arm of the sea where salty seawater meets fresh water running off the land.
Tidal Flat	An area lying between levels of mean high and mean low tides.
Wetland	A general term for any poorly-drained, uncultivated tract, whatever its vegetational cover and soil.

APPENDIX A

FRESHWATER QUALITY DATA

Table A.1 Watson's Brook - Metals May 2007

Area	Watson's Brook					
Sample ID:	WB-SP-1	WB-SP-2	WB-SP-3	WB-SP-4	WB-SP-5	WB-SP-6
Test Pit Depth (m):	--	--	--	--	--	--
Lab Sample ID:	S33678	S34697	S34680	S34681	S34682	S34683
Sample Date:	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007
Field Duplicate of:	--	--	--	--	--	--
METALS						
Mercury	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01
Aluminum	0.09	0.092	0.089	0.096	0.094	0.088
Antimony	>2	>2	>2	>2	>2	>2
Arsenic	>2	>2	>2	>2	>2	>2
Barium	>5	>5	>5	>5	>5	>5
Beryllium	>2	>2	>2	>2	>2	>2
Bismuth	>2	>2	>2	>2	>2	>2
Boron	>5	>5	>5	>5	>5	>5
Cadmium	>0.3	>0.3	>0.3	>0.3	>0.3	>0.3
Chromium	>2	>2	>2	>2	>2	>2
Cobalt	>1	>1	>1	>1	>1	>1
Copper	>2	>2	>2	>2	>2	>2
Iron	0.4	0.43	0.41	0.46	0.43	0.41
Lead	>0.5	>0.5	>0.5	>0.5	>0.5	>0.5
Manganese	0.039	0.032	0.026	0.041	0.043	0.026
Molybdenum	>2	>2	>2	>2	>2	>2
Nickel	>2	>2	>2	>2	>2	>2
Selenium	>2	>2	>2	>2	>2	>2
Silver	>0.5	>0.5	>0.5	>0.5	>0.5	>0.5
Strontium	0.008	0.008	0.008	0.008	0.008	0.008
Thallium	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Tin	>2	>2	>2	>2	>2	>2
Titanium	>2	>2	>2	>2	>2	>2
Uranium	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Vanadium	>2	>2	>2	>2	>2	>2
Zinc	>5	>5	>5	>5	>5	>5
Calcium	1.9	1.9	1.9	1.8	1.8	1.8
Magnesium	0.7	0.6	0.7	0.7	0.6	0.6
Phosphorus	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Potassium	0.2	0.2	0.2	0.2	0.2	0.2
Sodium	3.9	4	4	3.9	3.9	3.9

Table A.2 Come By Chance River - Metals May 2007

Area	Come By Chance River					
Sample ID:	CBC-SP-1	CBC-SP-2	CBC-SP-3	CBC-SP-4	CBC-SP-5	CBC-SP-6
Test Pit Depth (m):	--	--	--	--	--	--
Lab Sample ID:	S33678	S34697	S34680	S34681	S34682	S34683
Sample Date:	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007
Field Duplicate of:						
METALS						
Mercury	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01
Aluminum	0.075	0.095	0.09	0.094	0.077	0.09
Antimony	>2	>2	>2	>2	>2	>2
Arsenic	>2	>2	>2	>2	>2	>2
Barium	>5	>5	>5	>5	>5	>5
Beryllium	>2	>2	>2	>2	>2	>2
Bismuth	>2	>2	>2	>2	>2	>2
Boron	>5	>5	>5	>5	>5	>5
Cadmium	>0.3	>0.3	>0.3	>0.3	>0.3	>0.3
Chromium	>2	>2	>2	>2	>2	>2
Cobalt	>1	>1	>1	>1	>1	>1
Copper	>2	>2	>2	0.003	>2	>2
Iron	0.22	0.27	0.18	0.21	0.22	0.18
Lead	>0.5	>0.5	>0.5	>0.5	>0.5	>0.5
Manganese	0.033	0.031	0.021	0.016	0.035	0.02
Molybdenum	>2	>2	>2	>2	>2	>2
Nickel	>2	>2	>2	>2	>2	>2
Selenium	>2	>2	>2	>2	>2	>2
Silver	>0.5	>0.5	>0.5	>0.5	>0.5	>0.5
Strontium	0.007	0.008	0.008	0.008	0.007	0.008
Thallium	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Tin	>2	>2	>2	>2	>2	>2
Titanium	>2	>2	>2	>2	>2	>2
Uranium	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Vanadium	>2	>2	>2	>2	>2	>2
Zinc	>5	0.005	0.005	0.009	0.005	0.005
Calcium	2.2	2.4	2.4	2.4	2.3	2.4
Magnesium	0.5	0.5	0.6	0.6	0.5	0.6
Phosphorus	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Potassium	0.2	0.2	0.2	0.2	0.2	0.2
Sodium	9.9	9.5	9.6	8.8	10	9.7

Table A.3 Watson's Brook – TPH May 2007

Area	Watson's Brook					
Sample ID:	WB-SP-1	WB-SP-2	WB-SP-3	WB-SP-4	WB-SP-5	WB-SP-6
Test Pit Depth (m):	--	--	--	--	--	--
Lab Sample ID:	S29774	S29776	S-29777	S29778	S29779	S29780
Sample Date:	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007
Field Duplicate of:						
BTEX/TPH						
Benzene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Toluene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Ethyl Benzene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Xylenes	>0.002	>0.002	>0.002	>0.002	>0.002	>0.002
C6-C10 (Gas Range)	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01
C11-C20 (Fuel Range)	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05
C21-C32 (Lube Range)	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Modified TPH-Tier 1	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1

Table A.4 Come By Chance River – TPH May 2007

Area	Come By Chance River					
Sample ID:	CBC-SP-1	CBC-SP-2	CBC-SP-3	CBC-SP-4	CBC-SP-5	CBC-SP-6
Test Pit Depth (m):	--	--	--	--	--	--
Lab Sample ID:	S29781	S29782	S-29783	S29784	S29785	S29786
Sample Date:	5/12/2007	5/12/2007	5/12/2007	5/12/2007	5/12/2007	5/12/2007
Field Duplicate of:						
BTEX/TPH						
Benzene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Toluene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Ethyl Benzene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Xylenes	>0.002	>0.002	>0.002	>0.002	>0.002	>0.002
C6-C10 (Gas Range)	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01
C11-C20 (Fuel Range)	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05
C21-C32 (Lube Range)	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Modified TPH-Tier 1	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1

Table A.5 Watson's Brook – General Water Chemistry May 2007

Area	Watson's Brook						Units
Sample ID:	WB-SP-1	WB-SP-2	WB-SP-3	WB-SP-4	WB-SP-5	WB-SP-6	
Test Pit Depth (m):	--	--	--	--	--	--	
Lab Sample ID:	S34678	S34697	S34680	S34681	S34682	S34683	
Sample Date:	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007	
Field Duplicate of:					WB-SP-2	WB-SP-4	
General							
Alkalinity (as $CaCO_3$)	>5	>5	>5	>5	>5	>5	mg/L
Bicarbonate (as $CaCO_3$)	>1	>1	>1	>1	>1	>1	mg/L
Carbonate (as $CaCO_3$)	7	7	7	>1	>1	>1	mg/L
Chloride	6	6	6	6	6	6	mg/L
Colour	28	29	27	27	27	28	TCU
Conductivity	33	33	33	34	34	33	uS/cm
Dissolved Oxygey	9.18	9.48	9.48	8.97	--	--	mg/L
Field pH	7.14	6.22	6.72	6.13	--	--	units
Ortho Phosphate (as P)	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01	mg/L
Nitrate + Nitrite (as N)	>0.05	>0.05	>0.05	0.06	>0.05	>0.05	mg/L
Nitrite	0.01	0.02	>0.01	>0.01	>0.01	>0.01	mg/L
pH	6.04	6.29	6.34	6.39	6.37	6.36	units
Reactive Silica (as SiO_2)	>0.5	>0.5	>0.5	>0.05	>0.05	>0.05	mg/L
Temperature	13.31	14.3	15.4	15.85	--	--	ºC
TOC	4.9	4.7	5.1	5.5	5.2	4.9	mg/L
Total Dissolved Solids	13	13	13	14	13	13	mg/L
Turbidity	0.6	0.9	0.7	0.7	0.8	0.8	NTU

Table A.6 Come By Chance River – General Water Chemistry May 2007

Area	Come By Chance River						Units
Sample ID:	CBC-SP-1	CBC-SP-2	CBC-SP-3	CBC-SP-4	CBC-SP-5	CBC-SP-6	
Test Pit Depth (m):	--	--	--	--	--	--	
Lab Sample ID:	S34684	S34685	S34686	S34687	S34589	S34591	
Sample Date:	5/12/2007	5/12/2007	5/12/2007	5/12/2007	5/12/2007	5/12/2007	
Field Duplicate of:	--	--	--	--	CBC-SP-1	CBC-SP-3	
General							
Alkalinity (as $CaCO_3$)	>5	>5	>5	>5	>5	>5	mg/L
Bicarbonate (as $CaCO_3$)	>1	>1	>1	>1	>1	>1	mg/L
Carbonate (as $CaCO_3$)	>1	>1	>1	>1	>1	>1	mg/L
Colour	22	24	20	23	21	20	TCU
Conductivity	62	64	62	58	63	62	uS/cm
Dissolved Oxygey	9.98	10.38	10.27	10.52	--	--	mg/L
Field pH	7.1	6.95	6.75	6.46	--	--	units
Orthophosphate (as P)	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01	mg/L
Nitrate + Nitrite (as N)	>0.05	>0.05	>0.05	0.01	>0.05	>0.05	mg/L
Nitrite	0.02	0.03	0.01	0.01	>0.01	>0.01	mg/L
pH	6.4	6.44	6.47	6.51	6.5	6.48	units
Reactive Silica (as SiO_2)	0.6	1	1.4	1.4	0.6	1.4	mg/L
Temperature	9.96	8.89	8.43	7.9	--	--	ºC
TOC	3.7	3.7	3.7	4.2	3.5	3.4	mg/L
Total Dissolved Solids	30	30	30	28	30	30	mg/L
Turbidity	0.3	0.5	0.4	0.5	0.4	0.4	NTU

Table A.7 Watson's Brook Metals – June 2007

Area	Watson's Brook					
Sample ID:	WB-SP-1	WB-SP-2	WB-SP-3	WB-SP-4	WB-SP-5	WB-SP-6
Test Pit Depth (m):	--	--	--	--	--	--
Lab Sample ID:	S33678	S34697	S34680	S34681	S34682	S34683
Sample Date:	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007
Field Duplicate of:	--	--	--	--	--	--
METALS						
Mercury	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01
Aluminum	0.09	0.092	0.089	0.096	0.094	0.088
Antimony	>2	>2	>2	>2	>2	>2
Arsenic	>2	>2	>2	>2	>2	>2
Barium	>5	>5	>5	>5	>5	>5
Beryllium	>2	>2	>2	>2	>2	>2
Bismuth	>2	>2	>2	>2	>2	>2
Boron	>5	>5	>5	>5	>5	>5
Cadmium	>0.3	>0.3	>0.3	>0.3	>0.3	>0.3
Chromium	>2	>2	>2	>2	>2	>2
Cobalt	>1	>1	>1	>1	>1	>1
Copper	>2	>2	>2	>2	>2	>2
Iron	0.4	0.43	0.41	0.46	0.43	0.41
Lead	>0.5	>0.5	>0.5	>0.5	>0.5	>0.5
Manganese	0.039	0.032	0.026	0.041	0.043	0.026
Molybdenum	>2	>2	>2	>2	>2	>2
Nickel	>2	>2	>2	>2	>2	>2
Selenium	>2	>2	>2	>2	>2	>2
Silver	>0.5	>0.5	>0.5	>0.5	>0.5	>0.5
Strontium	0.008	0.008	0.008	0.008	0.008	0.008
Thallium	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Tin	>2	>2	>2	>2	>2	>2
Titanium	>2	>2	>2	>2	>2	>2
Uranium	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Vanadium	>2	>2	>2	>2	>2	>2
Zinc	>5	>5	>5	>5	>5	>5
Calcium	1.9	1.9	1.9	1.8	1.8	1.8
Magnesium	0.7	0.6	0.7	0.7	0.6	0.6
Phosphorus	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Potassium	0.2	0.2	0.2	0.2	0.2	0.2
Sodium	3.9	4	4	3.9	3.9	3.9

Table A.8 Come By Chance River – Metals June 2007

Area	Come By Chance River					
Sample ID:	CBC-SP-1	CBC-SP-2	CBC-SP-3	CBC-SP-4	CBC-SP-5	CBC-SP-6
Test Pit Depth (m):	--	--	--	--	--	--
Lab Sample ID:	S33678	S34697	S34680	S34681	S34682	S34683
Sample Date:	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007
Field Duplicate of:						
METALS						
Mercury	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01
Aluminum	0.075	0.095	0.09	0.094	0.077	0.09
Antimony	>2	>2	>2	>2	>2	>2
Arsenic	>2	>2	>2	>2	>2	>2
Barium	>5	>5	>5	>5	>5	>5
Beryllium	>2	>2	>2	>2	>2	>2
Bismuth	>2	>2	>2	>2	>2	>2
Boron	>5	>5	>5	>5	>5	>5
Cadmium	>0.3	>0.3	>0.3	>0.3	>0.3	>0.3
Chromium	>2	>2	>2	>2	>2	>2
Cobalt	>1	>1	>1	>1	>1	>1
Copper	>2	>2	>2	0.003	>2	>2
Iron	0.22	0.27	0.18	0.21	0.22	0.18
Lead	>0.5	>0.5	>0.5	>0.5	>0.5	>0.5
Manganese	0.033	0.031	0.021	0.016	0.035	0.02
Molybdenum	>2	>2	>2	>2	>2	>2
Nickel	>2	>2	>2	>2	>2	>2
Selenium	>2	>2	>2	>2	>2	>2
Silver	>0.5	>0.5	>0.5	>0.5	>0.5	>0.5
Strontium	0.007	0.008	0.008	0.008	0.007	0.008
Thallium	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Tin	>2	>2	>2	>2	>2	>2
Titanium	>2	>2	>2	>2	>2	>2
Uranium	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Vanadium	>2	>2	>2	>2	>2	>2
Zinc	>5	0.005	0.005	0.009	0.005	0.005
Calcium	2.2	2.4	2.4	2.4	2.3	2.4
Magnesium	0.5	0.5	0.6	0.6	0.5	0.6
Phosphorus	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Potassium	0.2	0.2	0.2	0.2	0.2	0.2
Sodium	9.9	9.5	9.6	8.8	10	9.7

Table A.9 Watson's Brook – TPH June 2007

Area	Watson's Brook					
Sample ID:	WB-SP-1	WB-SP-2	WB-SP-3	WB-SP-4	WB-SP-5	WB-SP-6
Test Pit Depth (m):	--	--	--	--	--	--
Lab Sample ID:	S29774	S29776	S-29777	S29778	S29779	S29780
Sample Date:	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007	5/11/2007
Field Duplicate of:						
BTEX/TPH						
Benzene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Toluene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Ethyl Benzene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Xylenes	>0.002	>0.002	>0.002	>0.002	>0.002	>0.002
C6-C10 (Gas Range)	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01
C11-C20 (Fuel Range)	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05
C21-C32 (Lube Range)	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Modified TPH-Tier 1	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1

Table A.10 Come By Chance River – TPH June 2007

Area	Come By Chance River					
Sample ID:	CBC-SP-1	CBC-SP-2	CBC-SP-3	CBC-SP-4	CBC-SP-5	CBC-SP-6
Test Pit Depth (m):	--	--	--	--	--	--
Lab Sample ID:	S29781	S29782	S-29783	S29784	S29785	S29786
Sample Date:	5/12/2007	5/12/2007	5/12/2007	5/12/2007	5/12/2007	5/12/2007
Field Duplicate of:						
BTEX/TPH						
Benzene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Toluene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Ethyl Benzene	>0.001	>0.001	>0.001	>0.001	>0.001	>0.001
Xylenes	>0.002	>0.002	>0.002	>0.002	>0.002	>0.002
C6-C10 (Gas Range)	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01
C11-C20 (Fuel Range)	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05
C21-C32 (Lube Range)	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1
Modified TPH-Tier 1	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1

Table A.11 Watson's Brook – General Water Chemistry June 2007

Area	Come By Chance River						Units
Sample ID:	WB-SP-1	WB-SP-2	WB-SP-3	WB-SP-4	WB-SP-5	WB-SP-6	
Test Pit Depth (m):	--	--	--	--	--	--	
Lab Sample ID:	S88971	S88989	S88990	S88991	S88992	S88993	
Sample Date:	6/12/2007	6/12/2007	6/12/2007	6/12/2007	6/12/2007	6/12/2007	
Field Duplicate of:	--	--	--	--	WB-SP-2	WB-SP-4	
General							
Alkalinity (as $CaCO_3$)	7	8	7	7	8	6	mg/L
Bicarbonate (as $CaCO_3$)	7	7	7	7	8	6	mg/L
Carbonate (as $CaCO_3$)	>1	>1	>1	>1	>1	>1	mg/L
Chloride	7	7	7	7	7	7	mg/L
Colour	32	32	33	32	32	32	TCU
Conductivity	42	41	42	43	41	42	uS/cm
Dissolved Oxygey	9.43	9.53	8.82	8.57	--	--	mg/L
Field pH	6.8	7.09	7.2	7.39	--	--	units
Hadrness (as $CaCO_3$)	11	10	11	10	10	11	mg/L
Ortho Phosphate (as P)	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01	mg/L
Nitrate + Nitrite (as N)	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	mg/L
Nitrite	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01	mg/L
pH	6.82	6.7	6.8	6.87	6.78	6.85	units
Reactive Silica (as SiO_2)	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	mg/L
Temperature	14.15	13.82	14.11	14.1	--	--	ºC
TOC	6.5	5.7	6.1	6.3	5.9	6	mg/L
Total Dissolved Solids	21	21	21	20	21	20	mg/L
Turbidity	0.7	0.6	0.6	0.6	0.8	0.5	

Table A.12 Come By Chance River – General Water Chemistry June 2007

Area	Come By Chance River						Units
Sample ID:	CBC-SP-1	CBC-SP-2	CBC-SP-3	CBC-SP-4	CBC-SP-5	CBC-SP-6	
Test Pit Depth (m):	--	--	--	--	--	--	
Lab Sample ID:	S88994	S88995	S88996	S88997	S88998	S88999	
Sample Date:	5/12/2007	5/12/2007	5/12/2007	5/12/2007	5/12/2007	5/12/2007	
Field Duplicate of:	--	--	--	--	CBC-SP-1	CBC-SP-3	
General							
Alkalinity (as $CaCO_3$)	5	6	6	7	>5	7	mg/L
Bicarbonate (as $CaCO_3$)	6	5	6	7	>5	7	mg/L
Carbonate (as $CaCO_3$)	>1	>1	>1	>1	>1	>1	mg/L
Colour	32	20	19	18	19	19	TCU
Conductivity	42	78	83	79	77	83	uS/cm
Dissolved Oxygey	7.67	7.61	7.4	7.95	--	--	mg/L
Field pH	6.99	7.14	7.18	7.81	--	--	units
Orthophosphate (as P)	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01	mg/L
Nitrate + Nitrite (as N)	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	mg/L
Nitrite	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01	mg/L
pH	6.85	6.62	6.79	6.8	6.6	6.76	units
Reactive Silica (as SiO_2)	>0.5	>0.5	0.9	1.1	>0.5	0.9	mg/L
Temperature	22.89	24.25	23.42	22.44	--	--	ºC
TOC	6	4	3.5	4.1	3.3	3	mg/L
Total Dissolved Solids	20	39	42	40	36	43	mg/L
Turbidity	0.5	0.5	0.4	0.2	0.6	0.3	NTU

APPENDIX B

MARINE SEDIMENT DATA

Table B-1 Results of Marine Sediment Analysis

Parameters	Unit	CCME ISQG	T1-1	T1-2	T2-1	T2-1	T2-2	T3-1	T3-1	T3-2
			P	N/A	P	D	P	P	D	P
Naphthalene	µg/g	0.0346	< 0.002	NS	< 0.002		< 0.002	< 0.002		< 0.002
Acenaphthylene	µg/g	0.00587	< 0.001	NS	< 0.001		< 0.001	< 0.001		< 0.001
Acenaphthene	µg/g	0.00671	< 0.002	NS	< 0.002		< 0.002	< 0.002		< 0.002
Fluorene	µg/g	0.0212	< 0.001	NS	< 0.001		< 0.001	< 0.001		< 0.001
Phenanthrene	µg/g	0.0419	0.004	NS	< 0.001		< 0.001	0.003		< 0.001
Anthracene	µg/g	0.0469	< 0.001	NS	< 0.001		< 0.001	< 0.001		< 0.001
Fluoranthene	µg/g	0.111	0.009	NS	< 0.001		< 0.001	0.013		< 0.001
Pyrene	µg/g	0.053	0.007	NS	< 0.003		< 0.003	0.008		< 0.003
Benzo(a)anthracene	µg/g	0.0317	< 0.001	NS	< 0.001		< 0.001	< 0.001		< 0.001
Chrysene	µg/g	0.0571	0.002	NS	< 0.001		< 0.001	0.003		< 0.001
Benzo(b)fluoranthene	µg/g	ng	0.004	NS	< 0.004		< 0.004	0.005		< 0.004
Benzo(k)fluoranthene	µg/g	ng	0.004	NS	< 0.004		< 0.004	< 0.004		< 0.004
Benzo(a)pyrene	µg/g	0.0319	0.009	NS	< 0.003		< 0.003	0.003		< 0.003
Indeno(123 cd.)pyrene	µg/g	ng	0.011	NS	< 0.003		< 0.003	< 0.003		< 0.003
Dibenzo(ah)anthracene	µg/g	ng	< 0.004	NS	< 0.004		< 0.004	< 0.004		< 0.004
Benzo(ghi)perylene	µg/g	ng	0.008	NS	< 0.002		< 0.002	0.007		< 0.002
Benzene	µg/g	ng	< 0.01	NS	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01
Toluene	µg/g	ng	< 0.01	NS	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	µg/g	ng	< 0.01	NS	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01
m+p-Xylene	µg/g	ng	< 0.02	NS	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02
o-Xylene	µg/g	ng	< 0.01	NS	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01
TPH (C6-C10)	µg/g	ng	< 10	NS	< 10		< 10	< 10	< 10	< 10
TPH (C6-C10) less BTEX	µg/g	ng	< 10	NS	< 10		< 10	< 10	< 10	< 10
TPH (>C10-C21)	µg/g	ng	< 10	NS	< 10		< 10	< 10	< 10	< 10
TPH (>C21-< C32)	µg/g	ng	< 50	NS	< 50		< 50	< 50	< 50	< 50
Modified TPH (Tier 1)	µg/g	ng	< 70	NS	< 70		< 70	< 70	< 70	< 70

Parameters	Unit	CCME ISQG	T1-1	T1-2	T2-1	T2-1	T2-2	T3-1	T3-1	T3-2
			P	N/A	P	D	P	P	D	P
Hydrocarbon Identification	µg/g	ng	-	NS	-		-	-	-	-
Total PCB	µg/g	0.0341	< 0.005	N/A	< 0.005		< 0.005	< 0.0005		< 0.0005
Total Organic Carbon	mg/kg	ng	25000	9400	8000	2600	13300	13200		520258
Gravel	%		25	N/S	3		27	17		32
Sand	%		66	N/S	95		72	72		68
Silt	%		6	N/S	2		1	9		< 1
Clay	%		3	N/S				2		< 1

Parameters	Unit	CCME ISQG	T4-1	T4-2	T5-1	T5-2	T6-1	T6-1	T6-2	T7-1
			P	P	P	P	P	D	P	P
Naphthalene	µg/g	0.0346	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Acenaphthylene	µg/g	0.00587	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthene	µg/g	0.00671	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Fluorene	µg/g	0.0212	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Phenanthrene	µg/g	0.0419	0.008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	µg/g	0.0469	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Fluoranthene	µg/g	0.111	0.013	< 0.001	0.003	< 0.001	0.003	0.006	< 0.001	0.001
Pyrene	µg/g	0.053	0.009	< 0.003	< 0.003	< 0.003	< 0.003	0.004	< 0.003	< 0.003
Benzo(a)anthracene	µg/g	0.0317	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Chrysene	µg/g	0.0571	0.004	< 0.001	< 0.001	< 0.001	0.001	0.001	< 0.001	< 0.001
Benzo(b)fluoranthene	µg/g	ng	0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Benzo(k)fluoranthene	µg/g	ng	0.006	< 0.004	< 0.004	0.004	< 0.004	< 0.004	< 0.004	< 0.004
Benzo(a)pyrene	µg/g	0.0319	0.013	< 0.003	< 0.003	0.009	< 0.003	< 0.003	< 0.003	< 0.003
Indeno(123 cd.)pyrene	µg/g	ng	0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Dibenzo(ah)anthracene	µg/g	ng	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Benzo(ghi)perylene	µg/g	ng	0.011	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Benzene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01

Parameters	Unit	CCME ISQG	T4-1	T4-2	T5-1	T5-2	T6-1	T6-1	T6-2	T7-1
			P	P	P	P	P	D	P	P
Toluene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
Ethylbenzene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
m+p-Xylene	µg/g	ng	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02		< 0.02	< 0.02
o-Xylene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
TPH (C6-C10)	µg/g	ng	< 10	< 10	< 10	< 10	< 10		< 10	< 10
TPH (C6-C10) less BTEX	µg/g	ng	< 10	< 10	< 10	< 10	< 10		< 10	< 10
TPH (>C10-C21)	µg/g	ng	< 10	< 10	< 10	< 10	< 10		< 10	< 10
TPH (>C21-< C32)	µg/g	ng	< 50	< 50	< 50	< 50	< 50		< 50	< 50
Modified TPH (Tier 1)	µg/g	ng	< 70	< 70	< 70	< 70	< 70		< 70	< 70
Hydrocarbon Identification	µg/g	ng	-	-	-	-	-		-	-
Total PCB	µg/g	0.0341	< 0.005	< 0.0005	< 0.0005	< 0.005	< 0.005		< 0.0005	< 0.0005
Total Organic Carbon	mg/kg	ng	4200	29000	13000	5600	11100		17800	5200
Gravel	%		6	22	49	7	2		36	7
Sand	%		82	75	44	89	90		57	86
Silt	%		10	3	6	4	5		5	5
Clay	%		2		1		3		2	2

Parameters	Unit	CCME ISQG	T7-2	T8-1	T8-2	T9-4	T9-5	T11-1	T11-1	T11-2
			P	P	P	P	P	P	D	P
Naphthalene	µg/g	0.0346	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Acenaphthylene	µg/g	0.00587	< 0.001	< 0.001	< 0.001	< 0.001	0.001	0.002	0.002	< 0.001
Acenaphthene	µg/g	0.00671	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Fluorene	µg/g	0.0212	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Phenanthrene	µg/g	0.0419	< 0.001	< 0.001	0.001	0.002	0.007	0.005	0.013	< 0.001
Anthracene	µg/g	0.0469	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Fluoranthene	µg/g	0.111	< 0.001	0.009	0.011	0.013	0.018	0.033	0.035	< 0.001
Pyrene	µg/g	0.053	< 0.003	0.006	0.007	0.009	0.013	0.025	0.027	< 0.003
Benzo(a)anthracene	µg/g	0.0317	< 0.001	< 0.001	0.012	< 0.001	0.013	0.018	0.018	< 0.001

Parameters	Unit	CCME ISQG	T7-2	T8-1	T8-2	T9-4	T9-5	T11-1	T11-1	T11-2
			P	P	P	P	P	P	D	P
Chrysene	µg/g	0.0571	< 0.001	0.003	0.004	0.004	0.006	0.011	0.012	< 0.001
Benzo(b)fluoranthene	µg/g	ng	< 0.004	0.004	0.004	0.006	0.008	0.014	0.016	< 0.004
Benzo(k)fluoranthene	µg/g	ng	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.011	0.011	< 0.004
Benzo(a)pyrene	µg/g	0.0319	< 0.003	0.003	0.003	0.004	0.006	0.020	0.021	< 0.003
Indeno(123 cd.)pyrene	µg/g	ng	< 0.003	< 0.003	< 0.003	0.003	0.004	0.021	0.023	< 0.003
Dibenzo(ah)anthracene	µg/g	ng	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.014	0.013	< 0.004
Benzo(ghi)perylene	µg/g	ng	< 0.002	0.002	< 0.002	0.003	0.003	0.016	0.016	< 0.002
Benzene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01
Toluene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01
Ethylbenzene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01
m+p-Xylene	µg/g	ng	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02		< 0.02
o-Xylene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01
TPH (C6-C10)	µg/g	ng	< 10	< 10	< 10	< 10	< 10	< 10		< 10
TPH (C6-C10) less BTEX	µg/g	ng	< 10	< 10	< 10	< 10	< 10	< 10		< 10
TPH (>C10-C21)	µg/g	ng	< 10	< 10	< 10	< 10	< 10	< 10		< 10
TPH (>C21-< C32)	µg/g	ng	< 50	< 50	< 50	< 50	< 50	< 50		< 50
Modified TPH (Tier 1)	µg/g	ng	< 70	< 70	< 70	< 70	< 70	< 70		< 70
Hydrocarbon Identification	µg/g	ng	-	-	-	-	-	-		-
Total PCB	µg/g	0.0341	< 0.0005	< 0.005	< 0.005	< 0.005	< 0.0005	< 0.005		< 0.0005
Total Organic Carbon	mg/kg	ng	520258	520258	520258	11000	12900	9200		35000
Gravel	%		42	27	17	36	24	44		45
Sand	%		56	53	70	43	63	35		53
Silt	%		2	15	11	18	11	16		< 2
Clay	%			5	2	3	2	1		< 2

Parameters	Unit	CCME ISQG	T11-2R	T11-3	T11-3R	T11-3R	T12-1	T12-1	T12-2
			P	P	P	D	P	D	N/A
Naphthalene	µg/g	0.0346	< 0.002	< 0.002	< 0.002		< 0.002	< 0.002	NS
Acenaphthylene	µg/g	0.00587	< 0.001	< 0.001	< 0.001		< 0.001	< 0.001	NS
Acenaphthene	µg/g	0.00671	< 0.002	< 0.002	< 0.002		< 0.002	< 0.002	NS
Fluorene	µg/g	0.0212	< 0.001	< 0.001	< 0.001		< 0.001	< 0.001	NS
Phenanthrene	µg/g	0.0419	< 0.001	< 0.001	< 0.001		< 0.001	< 0.001	NS
Anthracene	µg/g	0.0469	< 0.001	< 0.001	< 0.001		< 0.001	< 0.001	NS
Fluoranthene	µg/g	0.111	< 0.001	< 0.001	< 0.001		0.011	0.008	NS
Pyrene	µg/g	0.053	< 0.003	< 0.003	< 0.003		0.008	0.005	NS
Benzo(a)anthracene	µg/g	0.0317	< 0.001	< 0.001	< 0.001		< 0.001	< 0.001	NS
Chrysene	µg/g	0.0571	< 0.001	< 0.001	< 0.001		< 0.001	< 0.001	NS
Benzo(b)fluoranthene	µg/g	ng	< 0.004	< 0.004	< 0.004		0.004	< 0.004	NS
Benzo(k)fluoranthene	µg/g	ng	< 0.004	< 0.004	< 0.004		< 0.004	< 0.004	NS
Benzo(a)pyrene	µg/g	0.0319	< 0.003	< 0.003	< 0.003		0.003	< 0.003	NS
Indeno(123 cd.)pyrene	µg/g	ng	< 0.003	< 0.003	< 0.003		0.015	0.016	NS
Dibenzo(ah)anthracene	µg/g	ng	< 0.004	< 0.004	< 0.004		< 0.004	< 0.004	NS
Benzo(ghi)perylene	µg/g	ng	< 0.002	< 0.002	< 0.002		0.011	0.010	NS
Benzene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		NS
Toluene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		NS
Ethylbenzene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		NS
m+p-Xylene	µg/g	ng	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02		NS
o-Xylene	µg/g	ng	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		NS
TPH (C6-C10)	µg/g	ng	< 10	< 10	< 10	< 10	< 10		NS
TPH (C6-C10) less BTEX	µg/g	ng	< 10	< 10	< 10	< 10	< 10		NS
TPH (>C10-C21)	µg/g	ng	< 10	< 10	< 10	< 10	< 10		NS
TPH (>C21-< C32)	µg/g	ng	< 50	< 50	< 50	< 50	< 50		NS
Modified TPH (Tier 1)	µg/g	ng	< 70	< 70	< 70	< 70	< 70		NS
Hydrocarbon Identification	µg/g	ng	-	-	-	-	-		NS
Total PCB	µg/g	0.0341	< 0.0005	< 0.005	< 0.0005		< 0.005		N/A
Total Organic Carbon	mg/kg	ng	520258	1500	49000		6		N/S
Gravel	%		52	0	96		6		N/S

Parameters	Unit	CCME ISQG	T11-2R	T11-3	T11-3R	T11-3R	T12-1	T12-1	T12-2
			P	P	P	D	P	D	N/A
Sand	%		46	97	0		83		N/S
Silt	%		2	3	4		6		N/S
Clay	%						5		N/S

Parameters	Unit	CCME	T1-1	T1-2	T2-1	T2-2	T3-1	T3-2	T4-1	T4-2	T5-1
		ISQG	P	N/A	P	P	P	P	P	P	P
Aluminum	µg/g	ng	13900	N/S	19500	19200	13300	13200	15500	18100	14300
Antimony	µg/g	ng	0.6	N/S	0.9	0.8	0.7	0.6	0.7	0.7	0.6
Arsenic	µg/g	7.24 µg/g	5.4	N/S	5.3	2.5	6.4	2.7	4.1	3.0	4.9
Barium	µg/g	ng	17.5	N/S	10.4	13.2	29.4	7.3	28.4	9.8	24.2
Beryllium	µg/g	ng	0.3	N/S	0.3	0.3	0.3	0.2	0.3	0.2	0.3
Bismuth	µg/g	ng	< 0.2	N/S	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Cadmium	µg/g	0.7 µg/g	< 0.5	N/S	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Calcium	µg/g	ng	72800	N/S	34400	20600	9490	88900	32600	21300	6590
Chromium	µg/g	52.3 µg/g	20	N/S	27	30	19	18	21	26	19
Cobalt	µg/g	ng	10	N/S	16	16	10	11	12	15	10
Copper	µg/g	18.7 µg/g	18	N/S	18	**27**	15	16	13	15	16
Iron	µg/g	ng	26900	N/S	36200	34600	25100	23100	28000	31800	26100
Lead	µg/g	30.2 µg/g	7	N/S	5	< 5	10	< 5	6	< 5	10
Magnesium	µg/g	ng	12900	N/S	18700	16200	10600	13400	13100	16300	11700
Manganese	µg/g	ng	519	N/S	879	878	487	583	635	792	524
Mercury	µg/g	0.13 µg/g	0.02	N/S	0.01	< 0.01	0.04	0.01	0.02	0.01	0.03
Molybdenum	µg/g	ng	7	N/S	< 2	< 2	2	< 2	< 2	< 2	5
Nickel	µg/g	ng	20	N/S	27	27	18	19	20	25	19
Phosphorus	µg/g	ng	976	N/S	1080	745	871	708	804	856	859
Potassium	µg/g	ng	1480	N/S	1300	1060	1530	1010	1150	725	1730

Parameters	Unit	CCME	T1-1	T1-2	T2-1	T2-2	T3-1	T3-2	T4-1	T4-2	T5-1
		ISQG	P	N/A	P	P	P	P	P	P	P
Selenium	µg/g	ng	0.3	N/S	< 0.1	< 0.1	0.4	0.1	0.1	< 0.1	0.4
Silver	µg/g	ng	< 0.25	N/S	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sodium	µg/g	ng	9630	N/S	8800	2000	8060	8360	4380	2960	11200
Vanadium	µg/g	ng	52	N/S	52	48	52	35	48	48	50
Zinc	µg/g	124 µg/g	47	N/S	64	57	48	46	50	56	49

Parameters	Unit	CCME	T5-2	T6-1	T6-2	T7-1	T7-2	T8-1	T8-2	T9-4	T9-4
		ISQG	P	P	P	P	P	P	P	P	D
Aluminum	µg/g	ng	17400	16600	17800	15000	15500	12200	12300	12800	12400
Antimony	µg/g	ng	0.5	0.7	0.7	0.5	0.5	< 0.5	< 0.5	0.6	< 0.5
Arsenic	µg/g	7.24 µg/g	4.0	2.8	2.6	2.0	4.0	6.2	3.1	**7.8**	**7.8**
Barium	µg/g	ng	12.2	29.0	11.0	22.7	11.5	29.6	37.8	26.7	26.1
Beryllium	µg/g	ng	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3
Bismuth	µg/g	ng	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Cadmium	µg/g	0.7 µg/g	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Calcium	µg/g	ng	52100	7920	28700	4280	89600	30800	7300	5630	5500
Chromium	µg/g	52.3 µg/g	26	24	27	21	22	16	16	17	17
Cobalt	µg/g	ng	14	15	14	13	12	8	9	9	8
Copper	µg/g	18.7 µg/g	**19**	12	15	10	14	12	9	13	13
Iron	µg/g	ng	31900	29700	30800	25400	25900	22600	21100	24000	23200
Lead	µg/g	30.2 µg/g	< 5	< 5	< 5	< 5	< 5	10	9	11	11
Magnesium	µg/g	ng	16200	14200	16100	12400	15200	9200	8910	9300	8990
Manganese	µg/g	ng	763	695	787	616	681	466	456	451	436
Mercury	µg/g	0.13 µg/g	0.01	0.01	0.01	0.01	0.01	0.05	0.02	0.03	0.03
Molybdenum	µg/g	ng	3	< 2	2	< 2	< 2	2	< 2	3	3
Nickel	µg/g	ng	24	23	25	21	20	15	15	17	16

Parameters	Unit	CCME	T5-2	T6-1	T6-2	T7-1	T7-2	T8-1	T8-2	T9-4	T9-4
		ISQG	P	P	P	P	P	P	P	P	D
Phosphorus	µg/g	ng	940	783	793	668	809	765	704	781	758
Potassium	µg/g	ng	1080	958	926	866	1190	1670	1390	1690	1670
Selenium	µg/g	ng	0.1	< 0.1	0.1	< 0.1	0.2	0.3	0.2	0.3	0.3
Silver	µg/g	ng	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sodium	µg/g	ng	6620	3010	4210	2230	9090	9320	7300	9720	9460
Vanadium	µg/g	ng	48	55	44	47	36	42	42	44	44
Zinc	µg/g	124 µg/g	55	54	54	49	48	41	40	42	42

Parameters	Unit	CCME	T9-5	T9-5	T11-1	T11-2	T11-2R	T11-3	T11-3R	T12-1	T12-2
		ISQG	P	D	P	P	P	P	P	P	N/A
Aluminum	µg/g	ng	11000	11100	14300	12900	13400	17000	16500	11200	N/A
Antimony	µg/g	ng	< 0.5	< 0.5	0.5	< 0.5	0.5	0.9	0.7	0.5	N/A
Arsenic	µg/g	7.24 µg/g	2.5	2.6	6.6	2.3	3.0	1.4	1.2	**12.6**	N/A
Barium	µg/g	ng	40.7	40.9	31.1	16.9	17.3	37.4	19.7	26.4	N/A
Beryllium	µg/g	ng	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.3	N/A
Bismuth	µg/g	ng	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	N/A
Cadmium	µg/g	0.7 µg/g	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.5	N/A
Calcium	µg/g	ng	3830	3690	120000	99500	94700	8020	7330	102000	N/A
Chromium	µg/g	52.3 µg/g	14	14	17	16	18	25	23	17	N/A
Cobalt	µg/g	ng	8	8	9	10	11	16	15	6	N/A
Copper	µg/g	18.7 µg/g	9	9	18	12	13	15	14	**19**	N/A
Iron	µg/g	ng	18100	18100	27100	22300	24300	32300	30900	22800	N/A
Lead	µg/g	30.2 µg/g	8	8	14	< 5	< 5	< 5	< 5	26	N/A
Magnesium	µg/g	ng	7600	7630	15200	12500	13100	14200	13800	11600	N/A
Manganese	µg/g	ng	390	392	493	491	545	625	604	229	N/A
Mercury	µg/g	0.13 µg/g	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.03	N/A

Parameters	Unit	CCME	T9-5	T9-5	T11-1	T11-2	T11-2R	T11-3	T11-3R	T12-1	T12-2
		ISQG	P	D	P	P	P	P	P	P	N/A
Molybdenum	µg/g	ng	< 2	< 2	4	2	2	< 2	< 2	7	N/A
Nickel	µg/g	ng	14	14	16	15	16	21	21	16	N/A
Phosphorus	µg/g	ng	638	636	937	756	821	727	739	1190	N/A
Potassium	µg/g	ng	1230	1250	2010	1010	1140	767	755	2620	N/A
Selenium	µg/g	ng	0.2	0.2	0.3	0.2	0.2	< 0.1	< 0.1	0.7	N/A
Silver	µg/g	ng	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	N/A
Sodium	µg/g	ng	4460	4580	15300	6330	8310	2460	2560	21200	N/A
Vanadium	µg/g	ng	37	37	54	45	50	74	69	51	N/A
Zinc	µg/g	124 µg/g	37	38	42	38	41	50	49	44	N/A
MSS - Marine Sediment Sample					Exceeds Metals (CCME ISQG 2006)						
N/A - Not Applicable				P	Primary						
NS - Not Sampled				D	Duplicate						