APPENDIX 2-V

MONITORING PROGRAMS

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1 INTRODUCTION

MEG Energy Corp. (MEG) has committed to undertaking numerous monitoring programs in relation to the Christina Lake Regional Project – Phase 3 (the Project). Monitoring programs will be implemented for aspects of the Project which have been predicted to have an effect on the environmental and social resources in the Project area, including air quality, aquatic resources, terrestrial resources and social resources.

In general, these programs build on the monitoring programs currently proposed for the approved Christina Lake Regional Project (CLRP) (Golder Associates Ltd. [Golder] 2007a; Matrix Solutions Inc. [Matrix] 2007) and MEG's participation in various regional initiatives. This appendix discusses these programs and MEG's commitment to developing them further to address the needs of the Project.

2 AIR QUALITY

As part of the current CLRP *Environmental Protection and Enhancement Act* (EPEA) approval (216466-00-01) issued on July 20, 2007, MEG is required to conduct ambient air quality monitoring for their existing and approved operations. This monitoring will consist of one continuous station to monitor sulphur dioxide (SO_2), nitrogen dioxide (NO_2), hydrogen sulphide (H_2S) and Total Hydrocarbon (THC), and four passive stations to monitor SO_2 and H_2S. Ambient air quality monitoring for the Project will be integrated into the proposed monitoring program for the CLRP. MEG is also involved in regional air monitoring initiatives as detailed in Section 6.2 of this appendix.

3 AQUATIC RESOURCES

3.1 HYDROGEOLOGY

The potential hydrogeologic effects were described with respect to the following project activities:

- surface facility operations;
- groundwater withdrawal;
- wastewater injection; and
- steam injection.

This section describes existing and proposed groundwater monitoring plans for each of the operation components.

3.1.1 Surface Facilities

A network of groundwater monitoring wells will be installed at Plant 3A, Plant 3B and selected wellpads to establish baseline data for groundwater levels, flow conditions and groundwater quality. The Project groundwater monitoring programs will be incorporated into other ongoing programs. Data from the groundwater monitoring program will provide information on:

- geologic and hydrogeologic properties of the shallow Quaternary sediments;
- pre-development groundwater levels and groundwater chemistry; and
- potential changes to groundwater quality related to the Project.

Groundwater monitoring well networks for Plant 3A, Plant 3B and (a) select wellpad(s), will primarily focus on the shallowest groundwater-bearing zones and therefore target the most vulnerable hydrostratigraphic unit with respect to potential effects associated with surface facility operations. Monitoring wells will be installed on-site and adjacent to areas exposed to potential sources of accidental releases. A number of monitoring well locations will consist of nested pair with one well completed at the water table (0 to 5 m) a second monitoring well completed at a depth of approximately 5 to 10 m below ground surface, and a third at (50 to 70 m). The deeper wells will provide a measure of the direction and magnitude of the vertical hydraulic gradient and monitor groundwater quality below the water table aquifer. Some monitoring wells will be located

hydraulically upgradient of the site to serve as a background (control) well. At least one monitoring well will be installed at the base of the quaternary aquifer in order to measure any potential effects of well bore heating on groundwater quality.

Groundwater samples will be collected regularly from each monitoring well and analyzed for field parameters, including temperature, pH, Electrical Conductivity (EC), Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP). Laboratory analyses may include the indicator parameters, which are based on potential effect to groundwater quality associated with heavy oil facilities listed in Table 1.

Table 1 Analytical Parameters That May be Used in the Groundwater Monitoring Program

Source of Effect	Routine[(a)]	Dissolved Metals[(b)]	Dissolved Organic Carbon	BTEX, F1 and F2[(c)]	NO_2-NO_3 and NH_4	Phenols
Bitumen	-	-	X	X	-	X
Diluent	-	-	X	X	-	-
Produced Water	X	X	X	X	-	-
Sewage Lagoons	-	-	-	-	X	-
Process Chemicals	X	-	X	-	-	-

(a) Routine water includes EC, pH, total dissolved solids, sodium, potassium, calcium, magnesium, manganese, iron, hydroxide, chloride, carbonate, bicarbonate, sulphate, hardness and alkalinity.

(b) Dissolved metals include aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, molybdenum, nickel, phosphorus, selenium, silicon, strontium, sulphur, thallium, tin, titanium, uranium, vanadium, zinc and zirconium.

(c) BTEX includes benzene, toluene, ethylbenzene and xylenes, F1 includes hydrocarbon fractions C_5-C_{10} and F2 includes hydrocarbon fractions C_{10}-C_{16}.

- Analytical parameter not recommended to be included in groundwater monitoring program in vicinity of identified potential source.

X Analytical parameter recommended to be included in groundwater monitoring program in vicinity of identified potential source.

Additionally, deep monitoring wells will be installed at the base of the quaternary formation. The purpose of the well is to detect potential changes in deep potable aquifers from heating of the Steam Assisted Gravity Drainage (SAGD) reservoirs.

3.1.2 Steam Injection

A groundwater monitoring program was initiated at a representative wellpad for the CLRP to monitor possible effects to groundwater quality as a result of thermal plumes. At least one additional Project wellpad will be incorporated into

this monitoring program for the Project. Monitoring will be conducted to document pre-development conditions and monitor changes in temperature with distance.

The monitoring program will include water levels, temperature, and analysis of major ions and dissolved metals, including arsenic. Should significant changes in groundwater quality be detected, a groundwater response plan will be implemented as detailed in Section 3.1.5.

3.1.3 Groundwater Withdrawal

MEG will manage groundwater usage by operating all wells as per the terms and conditions of associated groundwater diversion (*Water Act*) licenses. In addition, MEG will responsibly manage the Project make-up water usage by:

- Monitoring actual water as well as the usage from the Ethel Lake, Empress Terrace, Empress Channel Aquifers and Upper Clearwater Water Sands.
- Monitoring water level changes in select aquifers near the groundwater source wells.
- Conducting annual reviews and interpretations of water level and water usage data including a comparison of actual changes in water level compared to the predictions. If necessary, the annual review will include recommendations to further mitigate effects and/or improve monitoring.

3.1.4 Wastewater Injection

Disposal wells will be drilled, completed and tested following all requirements outlined in Energy and Resources Conservation Board (ERCB) Directive 051: Injection and Disposal Wells (EUB 1994). Each disposal well will be equipped with a surface-installed turbine meter, flow choke and pressure recorder. The wellhead injection pressure and injection rate for each well will be monitored on a daily basis.

3.1.5 Groundwater Response Plan

If major changes in groundwater quality are detected as a result of Project operations, an incident-specific response plan will be developed and implemented. Aspects of the plan include:

- conducting confirmatory sampling;
- notifying Alberta Environment (AENV) on confirmation of effect; and
- identifying the source of the effect.

Once the source of the effect has been identified, a site specific risk management strategy based on the nature and concentration of contaminants and potential receptors in the area will be developed. The risk management strategy will be submitted to AENV for approval and may include a site specific remediation plan. The risk management strategy will then be implemented.

3.2 HYDROLOGY

3.2.1 Surface Disturbances

An integral part of Project operations will include a surface water monitoring program with remedial maintenance where and when required. MEG's hydrology monitoring efforts have been integrated with the wetlands monitoring as appropriate. These programs will be implemented for CLRP and will be expanded to include The Project until decommissioning and will include the components listed below.

- Monitoring stations will be installed in waterbodies and watercourses above and below the Project Area in the Local Study Area (LSA). Stream levels, lake levels and stream flows at monitoring stations will be observed and recorded four times per year.
- Culvert installations at road crossings and wetlands areas will be monitored on a regular basis, particularly during or following high runoff periods. This monitoring will consist of regular inspections and manual water level measurements once per year. Excessive sedimentation, debris, or ice accumulation will be removed to maintain the flow capacity of the culvert. Screens may be added to culvert inlets to prevent blockage in areas of potential beaver activity. In the wetlands areas, water levels will be monitored to ensure that they remain equal on both sides of access roads.
- Re-graded areas will be inspected for evidence of erosion or instability, and repaired or stabilized as required. Revegetation efforts will be monitored and maintained to ensure growth and survival. Replanting will occur if survival of vegetation is inadequate.
- Drainage courses disturbed during construction will be inspected to ensure that riparian vegetation and stable drainage conditions have been re-established.

- Regular monitoring of the stormwater ponds will ensure adequate storage capacity is available and prevent any uncontrolled releases from the plant and wellpad drainage systems. The downstream drainage path from the slow release lines will also be inspected on an annual basis to ensure that the terrain is absorbing the water with no apparent vegetation stress and that no downstream channel development or erosion is occurring. If required, remedial measures such as re-directing the drainage, extending or perforating release lines, incorporating bio-technical erosion control measures or revegetation efforts will be employed to correct potential areas of concern before they could become a problem.
- Consistent with the proposed flow and water level monitoring programs for the CLRP, streamflow and lake level monitoring will be conducted at selected watercourses and waterbodies potentially affected by the Project. Consistent with previous practice, a detailed monitoring plan will be presented to AENV as part of permitting requirements under the *Water Act* and EPEA. Changes to surface water flows and lake levels associated with Project activities will be evaluated using the monitored data to identify potential areas of concern and develop mitigation strategies.

3.2.2 Watercourse Crossings

A monitoring program will be implemented to ensure that sediment generation caused by construction and operation of all watercourse crossings for the Project is kept to a minimum. The monitoring program will include the following:

- inspection of culverts to ensure proper operation particularly during or following high runoff periods;
- water levels at stream crossings will be monitored on a bi-annual basis;
- inspection of all watercourse crossings to ensure that properly installed sediment control measures are in place during and following construction; and
- post-construction inspection to ensure that affected streambed profiles and bank disturbances have been restored to pre-construction conditions.

3.3 WATER QUALITY

An integral component of Project operations will include a water quality monitoring program, completed in concert with the Hydrology (Section 3.2) and

Wetlands (Section 4.1) monitoring programs. These programs will be implemented for the CLRP; and will be expanded to include the Project.

There are two programs which monitor water quality near the Project: Lakeland Industry and Community Association (LICA) and the Regional Aquatics Monitoring Program (RAMP). Both of these programs are multi-stakeholder initiatives whose members include industry, regulators, Aboriginal groups, environmental non-governmental organizations and other stakeholders (e.g., local communities). MEG is a participant in RAMP and the water quality parameters selected for MEG's monitoring program are consistent with RAMP programs.

Water quality samples will be collected at the waterbody and watercourse monitoring stations upstream and downstream of the Project three times per year. Table 2 presents the water quality parameters to be monitored for the water quality part of the Wetlands Monitoring Program submitted to AENV (Matrix 2007).

Table 2 Surface Water Quality Parameters

Group	Parameters[(a)]	
field parameters	temperature pH turbidity	Dissolved Oxygen (DO) Electrical Conductivity (EC)
conventional variables	colour Dissolved Organic Carbon (DOC) Total Organic Carbon (TOC) pH Electrical Conductivity (EC)	total alkalinity Total Dissolved Solids (TDS) total hardness Total Suspended Solids (TSS)
major ions	bicarbonate calcium carbonate chloride magnesium	potassium sodium sulphate sulphide
nutrients	nitrate+nitrite ammonia nitrogen total Kjeldahl nitrogen	total phosphorus dissolved phosphorus chlorophyll a
total and dissolved metals	aluminum (Al) antimony (Sb) arsenic (As) barium (Ba) beryllium (Be) bismuth (Bi) boron (B) cadmium (Cd) calcium (Ca) chromium (Cr) cobalt (Co) copper (Cu) iron (Fe) lead (Pb)	lithium (Li) manganese (Mn) mercury (Hg) molybdenum (Mo) nickel (Ni) selenium (Se) silver (Ag) strontium (Sr) thallium (Th) tin (Sn) titanium (Ti) uranium (U) vanadium (V) zinc (Zn)

(a) The RAMP monitoring program parameters are subject to change on a yearly basis; therefore, this list may not be complete.

Stormwater ponds will be tested before any release to the surrounding environment to verify acceptability of release waters for water quality parameters as defined by EPEA Approval No. 21-6406-06-01. Water to be released will be collected from the stormwater ponds early in the open-water season (e.g., April or May) and once more later in the season (e.g., August or September). In addition, during start-up of commercial activities, MEG has committed to periodic analysis of runoff waters for a wider range of chemicals, including conventional parameters, major ions, nutrients, metals (total and dissolved) and indicator organic parameters (e.g., mineral oil and grease, naphthenic acids). The quality of the water in the stormwater pond will be evaluated by comparison against water quality guidelines for the protection of aquatic life and typical water chemistry in the region. If the data collected during the first year of monitoring indicate no concern regarding water quality, the monitoring program will be reduced or discontinued.

Effluent from domestic wastewaters will be sampled and tested a minimum of three times per week to ensure that the effluent quality meets or exceeds the standards for treated wastewater discharge of 25 mg/L Carbonaceous Biochemical Oxygen Demand (CBOD) and 25 mg/L TSS as required under MEG's current EPEA Approval.

4 TERRESTRIAL VEGETATION AND WETLANDS

Terrestrial vegetation and wetlands monitoring programs for the Project will build on the programs proposed for the CLRP (Golder 2007; Matrix 2007). MEG intends to establish the proposed programs, review findings, implement any modifications and if necessary develop additional programs for the Project. Any new monitoring programs will benefit from the knowledge acquired from the existing CLRP monitoring programs and MEG's adaptive management approach. The specific details and methods for any new monitoring programs will be developed in consultation with AENV before implementation

The following sections provide a summary of the methods and protocols of the proposed monitoring programs. With exception of the Reclamation Monitoring Program, all programs have been submitted to AENV.

4.1 WETLANDS

A wetlands monitoring program proposal was initially designed by Matrix Solutions (2007) and has been summarized here. Wetlands development, characterization and sustainability depend on climate, hydrology and biogeochemical relationships in the environment (NWWG 1997). Any changes to the hydrology and biogeochemical relations in the LSA have the potential to cause changes in wetlands area and/or wetlands types. The proposed wetlands monitoring program provides:

- a summary of the background hydrogeology, hydrology and wetlands vegetation conditions at the Project and the potential impacts to the hydrogeology, hydrology and wetlands vegetation conditions from the Project;
- a method for determining impacts to surface water quality and quantity, water levels and wetlands types;
- mitigation measures for unforeseen or underestimated impacts, if they occur, including MEG's adaptive management approaches; and
- consideration of other monitoring programs for the Project, such as the wildlife and biodiversity monitoring requirements (Sections 4.2 and 4.4, respectively).

Final wetlands vegetation monitoring site locations and surface water monitoring locations will be determined in consultation with AENV staff.

4.1.1 Hydrology and Water Quality

Monitoring potential changes in surface water quantity (hydrology) and quality will involve the installation of monitoring stations above and below the Project area in waterbodies (lakes) and watercourses (creeks) in the LSA. Selecting locations above and below the Project will provide baseline information and information on the impacts of the Project on the surface water quality and quantity and therefore on the wetlands in the vicinity of the Project. The details of these programs have been presented in Sections 3.2 and 3.3 of this appendix.

4.1.2 Wetlands Vegetation

Wetlands vegetation can be used to measure Project effects to wetlands ecosystems because wetlands contain a diverse assembly of plant species. Also, the plants in wetlands ecosystems have rapid growth rates and respond directly to abiotic and biotic changes in the environment. Plant communities in wetlands have been found to change in response to impacts such as hydrologic changes, nutrient enrichment, sediment loading, metal deposition and other pollutants.

Wetlands vegetation monitoring sites will be selected to provide baseline information and potential effects on wetlands structure and function from the Project. Baseline sites will be located in areas not affected by the Project, while others will be located in areas with the potential to be effected by the Project. Site selection will be based on the following factors:

- wetlands types most responsive to changes in groundwater quantity and quality;
- wetlands that can be linked to groundwater and surface water monitoring sites;
- proximity to plant facilities and major infrastructure, such as roadways; and
- potential sites for ponding or impoundment.

Fen, swamp and marsh wetlands types are more sensitive to changes to groundwater and surface water because they are connected to both surface and groundwater. Bog wetlands types are isolated from groundwater changes and only receive water via precipitation. Therefore more monitoring sites will be placed in fen, swamp and marsh wetlands types.

To ascertain if the Project is effecting the structure and function of wetlands types, the following parameters will be measured at each monitoring site:

- plant species composition (including trees and shrubs), height and percent cover;
- water table depth;
- water chemistry (EC, pH and TDS);
- soil profile and classification; and
- appearance (as documented in photos).

Once sites have been selected they will be monitored every year for the first two years of the Project and then every two years after that, for the life of the Project.

4.2 WILDLIFE

The wildlife monitoring program will include surveys to assess wildlife changes from the Project and the effectiveness of mitigation strategies, with a focus on sensitive species occurring within the LSA (e.g., woodland caribou and Canadian toad). MEG will contribute information collected as part of its wildlife monitoring program to regional wildlife databases, such as Alberta Sustainable Resource Development's (ASRD's) Fish and Wildlife Management Information System (FWMIS) database.

4.2.1 Woodland Caribou

Local Caribou

As part of the proposed wildlife monitoring and mitigation program, MEG will monitor local use of the Project area by woodland caribou. Methods for monitoring will include incidental wildlife sightings documented by on-site staff through a wildlife sighting card program, ungulate aerial surveys, winter tracking surveys and remote camera monitoring. Roads will be monitored during winter to ensure that snow berms are not too high and that gaps are left to facilitate wildlife movement at regular intervals. Caribou monitoring is consistent with previously proposed caribou monitoring programs for neighbouring operators. Caribou observations and responses to habitat enhancement measures will also be monitored.

Remote cameras will be deployed for an eight week period during both the spring and fall movement periods. The remote camera monitoring will be repeated the following year to obtain two years of continuous data. The remote camera program will be re-evaluated based on results obtained, and on the relevance of data at measuring long-term responses of caribou movement from the Project.

All woodland caribou data obtained during the local monitoring program will be summarized within annual conservation and reclamation plans as well as within annual Caribou Protection Plans (CPPs), and a 5-year comprehensive summary report. Raw data will also be provided to the Alberta Caribou Committee (ACC) and to ASRD for incorporation within the provincial FWMIS database.

Regional Caribou

To stay informed of future caribou landscape planning objectives, population monitoring results and caribou research, MEG will continue to participate with the ACC. In addition, MEG is committed to a collaborative regional caribou monitoring program with neighbouring operators (i.e., EnCana, Devon Energy), which will include maintaining consistency on timing of the local monitoring programs (such as the intensive remote camera monitoring and aerial surveys) and survey methods to obtain information on woodland caribou movement at a more regional level. MEG will continue to advocate the collection of regional distribution, abundance and movement data for caribou in the Christina Lake region through the ACC Research Subcommittee.

4.2.2 Above-Ground Pipeline Monitoring

Monitoring to assess the effects of barriers to wildlife movement will include surveys of wildlife tracks and wildlife presence in relation to above-ground pipelines and crossing opportunities (i.e., areas of elevated pipe or over-the-pipe crossing structures). This assessment will evaluate if movements are being affected and determine the effectiveness of the mitigation measures employed. Monitoring objectives for the above-ground pipeline crossing structures will include: relative use of the crossing structures for different wildlife species, seasonal differences in use and changes in movement patterns over the life of the Project. Common methods for monitoring include winter snow tracking and remote cameras to document the use of crossing structures during all seasons.

Snow track surveys will follow the Alberta Biodiversity Monitoring Institute (ABMI) protocols with some modifications, and previously established protocols for the CLRP that have successfully recorded moose, lynx, weasel species, fisher and other wildlife (e.g., Golder 2004b).

Remote cameras will measure use of above-ground pipeline crossing structures and elevated sections of pipe by mammals at different times of the year. Target species include moose, woodland caribou and black bear. Use of remote cameras will complement winter track surveys and extend pipeline monitoring through the spring, summer and fall seasons. Cameras will be placed at crossing structures

and at elevated sections of pipe to detect successful crossing by wildlife species and to detect those individuals that did not cross but walked along the pipeline Rights-of-Way (ROW).

Data obtained during the local monitoring program will be summarized within annual conservation and reclamation plans, annual CPPs, and a 5-year comprehensive summary report as applicable. Raw data will also be provided to ASRD for incorporation within the provincial FWMIS database and when applicable, to the ACC.

4.2.3 Canadian Toad

The objectives of the Canadian toad monitoring program are to monitor the distribution, abundance and population status in the LSA over the life of the Project. To monitor changes in distribution and abundance over time, additional baseline surveys must be conducted to better understand the Canadian toad's current distribution and abundance in the LSA. To separate Project effects from other effects, such as weather, a control area must be selected.

The most efficient method to detect Canadian toads is an auditory survey conducted during the period when male toads congregate at breeding wetlands and emit loud mating calls. The calls of the male Canadian toad can be heard at great distances and therefore point count sites will be spaced throughout the LSA along access corridors to adequately sample the LSA. To survey during peak breeding activity, three spring surveys will be conducted.

Although auditory surveys provide an efficient method of detecting calling toads, not all male toads call during a single night and the proportion of calling males can depend on environmental conditions. To supplement the data obtained from the auditory survey, tadpole surveys and metamorph surveys are also proposed. Once breeding wetlands are identified from the auditory survey, systematic surveys of tadpoles and metamorphs can be conducted during summer. These wetlands will be included in the wetlands monitoring to determine any changes in hydrology or water quality.

To determine changes in relative abundance from factors other than the Project (i.e., environmental conditions), a control area will be identified. The baseline auditory survey will be conducted within the control area to determine the current distribution and relative abundance. The tadpole and metamorph surveys will also be conducted in the control area. The location of the control area has not been determined but would consider data from the FWMIS database.

MEG is proposing a number of habitat enhancement measures that include the reclamation of borrow pits to wetlands. Monitoring of these wetlands for tadpoles and metamorphs will be conducted in conjunction with the treatment and control sites. Since the distribution of Canadian toads may not occur near borrow pits, all amphibian species will be monitored at these sites.

The baseline surveys will be conducted for a total of five years and all amphibian species will be recorded, as well as incidental information on other wildlife observations. Measurements taken at each breeding wetlands location will include wetlands classification (Halsey et al. 2003) and standard water chemistry measurements using a field meter (pH and conductivity). Annual reports will be completed and included with the annual Conservation and Reclamation Plans. Data obtained from the surveys will be submitted to FWMIS on a yearly basis.

4.3 RECLAMATION

The objectives of the reclamation monitoring program are to evaluate the achievement of reclamation procedures over time and to adjust or modify these measures where necessary to ensure the following:

- the land is reclaimed to the proposed land capability classes to meet equivalent land capability requirements;
- the replacement of all salvaged topsoil and subsoil material on all re-contoured areas are such that replacement depths meet approval conditions;
- sustainable, diverse vegetation growth is present on all disturbed areas,
- invasive and non-native invasive species are under control as per the *Alberta Weed Control Act*;
- pre-disturbance wildlife carrying capacities can be obtained; and
- reclamation certification can be attained.

The objectives will be met through regular site inspections, additional reclamation procedures over time (if necessary), evaluation of the monitoring program results on reclaimed areas and other naturally regenerating disturbances such as seismic lines and rights-of-ways and extrapolation of data from other oil sands and heavy oil projects where applicable. Vegetation, soil, wildlife and biodiversity monitoring will be coordinated on reclaimed sites and naturally regenerating disturbances to provide an indication of the potential (soil conditions) and the realized reclamation (vegetation conditions) of reclaimed/regenerating areas and the ability of the monitoring sites to provide the habitat necessary to support desired wildlife species (e.g., Canadian toad).

Monitoring will examine the soil capability to support vegetation growth by comparing the pre-disturbance average soil depths to the replacement average depth. As well, other soil physical and chemical parameters, such as pH, texture, and organic matter will be recorded, to allow calculation of post reclamation Land Capability for forestry (Leskiw 1998). Vegetation monitoring will utilize permanent vegetation plots to assess plant species composition, height, percent cover and vigour on the following types of sites:

- wellpads;
- borrow pits;
- seismic lines; and
- pipeline ROW.

Photo-monitoring of the permanent plots will also be implemented to provide a comparable visual record of growth conditions during each monitoring period. Details of the reclamation monitoring program will be provided in a letter to AENV for approval prior to the initiation of the program.

MEG will produce an annual C&R Report summarizing the previous years' activities in terms of development activities, assessments completed on facility areas to be constructed in the following year, reclamation activities, reclamation monitoring and planned activities for the following year. This report will be submitted to AENV annually.

4.4 BIODIVERSITY

MEG recognizes the importance of long-term, large-scale monitoring of a wide range of taxa to measure changes in biodiversity that may result from anthropogenic disturbances. As such, MEG will support the regional ABMI programs as they emerge. In addition, MEG will implement a local Biodiversity Monitoring Program to monitor the cumulative effects of the Project on biodiversity using established ABMI protocols, where feasible, and modifying the protocols when necessary to address project-specific disturbances. An additional owl survey (Takats et al. 2001) not included by the ABMI is proposed based on the relatively high number of owls recorded during baseline surveys, including two owl species (i.e., barred owl and great gray owl) that are listed as 'Sensitive' (ASRD 2006).

Biodiversity monitoring will include standard monitoring of regional species of conservation concern, but will also consider the surrogate concept and a suite of umbrella species, defined as those species whose conservation is expected to

confer protection to a large number of co-occurring species (Roberge and Angelstam 2004; Sergio et al. 2006). The surrogate species program offers simple, ecologically-based solutions for monitoring long-term cumulative effects of the Project on biodiversity. This approach will be conducted in accordance with ABMI protocols where feasible, for mammals, breeding birds and wetlands vertebrates and will ensure comparable indices of biodiversity for future monitoring. If possible, umbrella species for this monitoring program will also be a 'flagship' to ensure public and financial support into the future. The list of umbrella species will include top predators and animals with large home ranges that have been successfully used as surrogate species in the conservation literature. Focal animals and taxonomic groups for this monitoring program include felids, terrestrial mustelids, owls (Sergio et al. 2006) and moose (Snaith and Beazley 2002), all of which have been recorded in the Project area and can be used to quantify changes in biodiversity. Data collected for the Wetlands Monitoring Program (Section 4.1) and the Wildlife Monitoring Program (Section 4.2) will also contribute to the Biodiversity Monitoring Program. The goal is to identify possible Project conflicts with focal species by monitoring their abundance and distribution in space and time such that appropriate mitigation can be quickly implemented to maintain biodiversity.

4.4.1 Index of Biological Integrity Program

Upon completion of the second year of the habitat-based biodiversity program, the development of a multi-metric Index of Biological Integrity (IBI) (Stevens et al. 2006; Coppedge et al. 2006) will be considered for monitoring and measuring the ecological condition of the Project. The wildlife-based IBI is an inexpensive bio-monitoring tool that can be used to monitor regional changes in ecological condition into the future. The IBI program provides a tool for calculating scores (0 to 100) for locations of interest and for calculating targets for restoration and mitigation. High scores (e.g., more than 80) reflect healthy landscapes and low scores (e.g., less than 40) reflect degraded landscapes.

4.4.2 Analysis and Reporting

Biological data will be summarized per site (i.e., transect, station or wetlands site) for each year of the program, and adjusted for effort and to standard units employed by the ABMI. This will allow for comparisons with regional trends in the abundance of large mammals and breeding birds, and the general composition of wildlife communities. As part of an adaptive management plan for evaluating threats to biodiversity, Analysis of Variance (ANOVA) and regression methods will examine for effects of proximity to plant facilities on track densities and occurrences of focal species using at least two years of species data plus environmental information as covariates. This approach will ensure that

potential threats to biodiversity can be accurately identified and quickly addressed with appropriate mitigation. Temporal trends in populations will be quantified upon compilation of data from the second year of the monitoring program and will complement spatial tests and models in quantifying influences of the Project on biodiversity. Statistical analyses will focus on species or families that occur at relatively high densities in the study area.

All biodiversity data obtained during the local monitoring program will be summarized within annual conservation and reclamation plans. A 5-year comprehensive summary report of the Biodiversity Monitoring Program will also be compiled and submitted within the annual conservation and reclamation plan for that year. Applicable raw data will be provided to the ABMI, and ASRD for incorporation within the provincial FWMIS database.

5 SOCIO-ECONONIC MONITORING

Socio-economic monitoring is necessary to establish trends in community wellness so that problems that may be related to the Project, or those the Project can effectively address, can be identified. The primary objectives of socio-economic monitoring are:

- Record the uptake of employment, business, education and training opportunities over time and to analyze the trends in this uptake in relation to expectations.
- Monitor the implementation of education, training, traffic and other mitigation and benefit enhancement initiatives.
- Monitoring will generate the information MEG, government and the affected people will need to adjust implementation as socio-economic mitigation and enhancement proceeds. Regular monitoring allows problems and successes to be identified, and this information can then be used to improve implementation of agreed initiatives.

MEG's community relations and other management staff will informally monitor the day-to-day implementation of socio-economic mitigation and benefit enhancement measures in the course of management and administration of their relationship with the Project workforce, the affected people and their leadership, and partner organizations. By giving the workforce and the affected people access to MEG's management, concerns can be identified as they evolve. In addition, more formal monitoring systems (including consultation events), and documenting of results, are also required.

MEG's operations will provide monitoring data on the initiatives described in this document. Such operational records will include human resource activities and patterns of Project expenditures. In this regard, MEG undertakes to:

- maintain human resource records in a manner that will permit an annual roll-up of selection, employment, promotion, training and exit statistics on the workforce by residence, ethnicity, gender, level, and field as a percentage of the total workforce;
- maintain procurement records in a manner that will permit an annual roll-up of the number, value and general content of contracts for goods and services by supplier location and ownership as a percentage of total procurement;
- request all contractors and subcontractors to provide annual reports documenting the same employment and business information;

- maintain health and safety, accident, workforce behaviour, and other relevant records pertaining to events that occur in direct relation to Project operations;
- conduct a periodic review of the results of the above to determine the success and trends over time of initiatives to enhance participation of nearby people and businesses, accommodate concerns of the local population, and to identify any specific obstacles or problem areas;
- maintain records on all formal consultations, meetings, and grievance and dispute events with the public, leadership, partner organizations, the Project workforce, contractors and advisory bodies to the Project, noting attendance, issues raised and resolutions;
- conduct a periodic annual review of the results of the above to identify any systematic successes or failures; and
- maintain records on all funding and other inputs provided to community and/or partner organizations.

With regard to consultation, throughout the life of the Project this serves multiple purposes, but is also in large part a monitoring mechanism. Consultation provides qualitative information necessary to understand effects that may be, at the Project outset, difficult to identify with any certainty. MEG has planned consultation and information disclosure to provide people with the information needed to participate in project related discussions from an informed position. Intended mechanisms include:

- public meetings with the community stakeholders twice annually, and at additional times as requested;
- meetings with population subgroups as appropriate, for example with elders or women to address issues that may be of particular interest;
- participation in local and regional initiatives and organizations with mandates to manage potential effects of oil sands developments in the region;
- distribution of information on Project progress and events of interest, as well as dissemination of other Project information through various media;
- provision of training to all management and supervisory staff on communication with local stakeholders, such that they are able to constructively engage people they meet on a day to day basis; and
- fostering of a workplace environment that facilitates employee input without fear of misunderstanding or retribution, including having comment boxes and/or worker feedback meetings for example.

MEG will communicate the results of this monitoring internally to management and to the workforce as appropriate, such that the information can be used to adjust policies, procedures, mitigation and enhancement measures, and behaviours where deemed necessary. Results will also be discussed with nearby populations, as part of ongoing consultation and information exchange on the project.

6 REGIONAL MONITORING INITIATIVES

MEG is currently an active member of the Regional Issues Working Group (RIWG) and has applied for membership with Wood Buffalo Environmental Association (WBEA), (the Cumulative Environmental Management Association (CEMA), and RAMP). Below is a summary of the mandate of each organization.

6.1 WOOD BUFFALO ENVIRONMENTAL ASSOCIATION

The WBEA is a dynamic collaboration of communities, industry and government within the Regional Municipality of Wood Buffalo (RMWB). The WBEA consists of four key activities that are described as follows:

- Regional Air Monitoring Network: The Regional Air Monitoring Network currently comprises 13 monitoring stations equipped with several continuous air monitoring instruments. The purpose of this program is to monitor the ambient environment and produce monitoring results within the RMWB.
- Terrestrial Environmental Effects Monitoring (TEEM) Program: The TEEM Program is designed to detect possible changes in soil chemistry and tree growth resulting from acid deposition, as well as to monitor certain other indicators of environmental stress. This program includes collection and review of data from a series of cyclical monitoring activities that are undertaken at annual or five-year intervals.
- Human Exposure Monitoring Committee (HEMC): The WBEA formed HEMC in late 2002 with a mandate to develop and implement a strategy and program for ongoing human exposure monitoring in the Oil Sands Region. The decision to form a committee within WBEA followed from the results of the Alberta Oil Sands Community Exposure and Health Effects Assessment Program (AOSCEHEAP), completed in 1997, through which continued monitoring was recommended. The activities of AOSCEHEAP were documented in a series of reports issued by Alberta Health and Wellness (2000a,b,c). In 2005, the HEMC completed exposure monitoring in Fort McMurray and Fort Chipewyan (WBEA 2007). Plans are also being assembled by the committee to branch out monitoring studies to other communities. HEMC is being implemented as a partnership of regional, provincial and national health authorities and the WBEA.
- Communications Committee: The mandate of the Communications Committee is to develop a plan to create awareness of the WBEA in the community. The focus of the work is to connect with students and youth, as well as to promote an advertising campaign aimed at enhancing recognition of the WBEA in the community at large.

6.2 CUMULATIVE ENVIRONMENTAL MANAGEMENT ASSOCIATION

The Cumulative Environmental Management Association (CEMA) is a multi-stakeholder forum established to design management systems to address cumulative effects of regional development in the RMWB in northeastern Alberta. The RSDS, an AENV initiative closely aligned to CEMA, provides a regulatory 'backstop' by which stakeholders can make recommendations to regulators on the management of cumulative effects. Currently, CEMA has several working groups. These include:

The NO_X/SO_2 Management Working Group (NSMWG), whose mandate is to develop a management plan (system) for NO_X and SO_2 emissions as they relate to acidification and eutrophication, as well as ground-level ozone. In 2004, an acidification management plan (CEMA 2004) was endorsed by the Alberta Government based on recommendations from CEMA members. In 2006, the NSMWG also developed the Ozone Management Framework for the Regional Municipality of Wood Buffalo Area (CEMA 2006) that is based on the federal and provincial ozone frameworks.

The Trace Metals and Air Contaminants Working Group (TMAC), whose mandate is to assess the risks posed by trace metals and air contaminants to human health and ecosystems under existing environmental management systems. The TMAC issued recommendations for trace metals management in 2002 (TMAC 2002).

Previously separate from CEMA, as part of the Reclamation Advisory Committee (RAC), the Reclamation Working Group (RWG) joined CEMA in May 2001. The RWG is tasked with providing recommendations related to reclamation of surface disturbance areas in the region. The group's mandate is to provide recommendations to regulators on a reclamation process that meets the needs and values of stakeholders in the region while maintaining sustainable environmental integrity.

The main objective for the RWG is to define the process and standards by which developed land will return to sustainable ecosystems with desired end land use values. The RWG has six subgroups that aid in completing the necessary research for the group. The six subgroups and their respective objectives are reviewed below.

The RWG issued a landscape design checklist in 2004 (RWG 2004) that was subsequently approved by CEMA for recommendation to the responsible

departments of government. The checklist is a concise and comprehensive checklist of design objectives for creation (design, construction, reclamation and maintenance) of landforms and landscapes in the Athabasca Oil Sands Region. It is the intention that this checklist provides the overall framework for design and assessment of all reclaimed landscapes and landforms in the region.

The Sustainable Ecosystem Working Group (SEWG) was formed to address three interrelated themes of the RSDS, namely Sustainable Ecosystems, Biodiversity and Wildlife. The overall purpose of SEWG is to recommend a management system to address cumulative effects on ecosystems and landscapes in the RMWB.

In 2004, the SEWG updated its Terms of Reference and associated Work Plan. Input is being sought from the Alberta government and other stakeholders in 2005 to confirm that the plans of SEWG are consistent with regional needs and meet the mandate of CEMA.

Work to date by SEWG has resulted in the adoption by CEMA of three management tools designed to address cumulative land disturbance and ecosystem fragmentation as a result of existing and planned development activities:

6.3 REGIONAL ISSUES WORKING GROUP

The Regional Issues Working Group (RIWG) was formerly known as the Regional Infrastructure Working Group. The vision for RIWG is to provide a proactive process that promotes the responsible, sustainable development of resources within the Regional Municipality of Wood Buffalo for the benefit of all stakeholders. The RIWG mission is to:

- facilitate planning for growth in the Oil Sands Region;
- facilitate effective and efficient resolution of issues;
- involve all of the resource developers and affected stakeholders in planning; and
- develop plans for sharing benefits with Aboriginal stakeholders.

Several sub-committees have been created under RIWG, including Childcare, Communications, Co-Generation, Housing, Transportation, Southern Athabasca Oilsands Producers (SAOP), Athabasca Tribal Council/Athabasca Resource Developers (ATC/ARD) and Education and Employment. The activities that RIWG is involved in include:

- a number of annual surveys, which it uses as support for industry updates and, generally for planning purposes;
- the completion of an annual survey of capital expenditure and production forecasts of oil sands firms in cooperation with Canadian Association of Petroleum Producers;
- communication and collaboration on operational, development and community issues of mutual interest;
- the completion of an annual survey of new hires by oil sands companies in the Fort McMurray area; and
- the completion of an annual survey of co-generation capacity.

The RIWG produces an annual forecast of:

- revenues to government (royalties and taxes); and
- population of the urban area of Wood Buffalo.

The RIWG produces ad hoc products on an as needed basis, including, for example:

- traffic assessments of Highways 63 and 881;
- presentations to regional stakeholders, such as the Fort McMurray Construction Association; and
- presentations to the Alberta Government, including the Standing Policy Committee on Energy and Sustainable Resources.

6.4 REGIONAL AQUATICS MONITORING PROGRAM

The Regional Aquatics Monitoring Program was initiated in 1997. It is a joint environmental monitoring program that assesses the health of rivers, lakes and wetlands in the Oil Sands Region of northeastern Alberta.

The program's design identifies and addresses potential impacts of oil sands development. It is frequently adjusted to reflect monitoring results, technological advances and community concerns.

The Regional Aquatics Monitoring Program is a multi-stakeholder initiative, with industry funding members and non-funding members including regulators, Aboriginal groups, Environmental Non-Governmental Organizations (ENGOs)

and other stakeholders (e.g., local communities). Benefits to non-funding members include the following:

- receiving information relevant to their concerns or issues related to aquatic environments;
- increasing confidence in the information that was collected;
- communication of the state of the aquatic environment; and
- ensuring that sharing of information and addressing of issues continue beyond oil sands developments until closure.

As the Oil Sands Region experienced rapid growth from 1997 to 2001, changes to RAMP were made annually. These changes not only affected RAMP's objectives and organizational structure, but the study area and study design as well. Potential sampling methods, sentinel species and reference lakes and streams were also evaluated during this period.

A Peer Review was funded by RAMP of its entire program in 2004. The review was conducted to ensure that the program is designed with a scientific basis and to ensure that predictions were measurable and had statistical validity. Based on the recommendations made by the Peer Review Team, RAMP is beginning implementations by starting with a review of all Industry members EIA predictions. Upon completion of the EIA review, RAMP Technical members can ensure that the program designs are the endpoint measurements suggested in the original EIA predictions.

The RAMP objectives evolved since its initiation with the revision of the program objectives in 2001 focused on "scientifically defensible" data collection that incorporate flexibility and technological advances into monitoring activities. In addition, the program was designed to work with other relevant, current and historical research and monitoring programs. This evolution of RAMP resulted in the following program objectives:

- to monitor aquatic environments in the oil sands area to detect and assess cumulative effects and regional trends;
- to collect scientifically defensible baseline and historical data to characterize variability in the oil sands area;
- to collect data against which predictions contained in EIAs can be verified;
- to collect data that may be used to satisfy the monitoring required by regulatory approvals of developments in the oil sands area;

- to recognize and incorporate traditional knowledge (including Traditional Ecological Knowledge and Traditional Land Use studies) into the monitoring and assessment activities;
- to communicate monitoring and assessment activities, results and recommendations to communities in the RMWB, regulatory agencies, environmental committees/organizations and other interested parties;
- to design and conduct various RAMP activities such that they have the flexibility to be adjusted, on review, to reflect monitoring results, technological advances and community concerns; and
- to seek cooperation with other relevant research and monitoring programs where practical, and generate interpretable results which can build on their findings and on those of historical programs.

RAMP was designed as a long-term monitoring program that incorporated both traditional and scientific knowledge. Specific programs in RAMP were established each year by committees and subcommittees after consultation with industrial, Aboriginal, environmental and regulatory stakeholders and expert independent consultants. Through the years, the program included the following environmental monitoring in the Oil Sands Region:

- water quality and sediment in rivers;
- fish in rivers;
- benthic invertebrates in rivers and two lakes;
- water quality in wetlands and acid sensitive lakes;
- aquatic vegetation; and
- hydrology and climate (monitoring began in 1995, but became a component of RAMP in 2000).

The RAMP study areas have evolved since its inception, with changes made to address new interest areas or development locations. The program now has a RSA and a Focus Study Area. The RSA covers a large portion of northeastern Alberta and is consistent with the CEMA Water Working Group study area (i.e., the Regional Municipality of Wood Buffalo). The focus study area is located within the RSA boundary and includes watersheds where oil sands development was occurring or planned as well as areas downstream of those developments. The key watercourses or waterbodies within the RAMP study area include:

- the Athabasca River and Peace Athabasca delta;

- tributaries to the Athabasca River including the Steepbank, Muskeg, MacKay, Ells, Tar, Calumet, Firebag and Christina rivers as well as Poplar, Donald, McLean and Fort creeks;
- Shipyard, Isadore's, Kearl and McClelland lakes; and
- acid sensitive lakes in northeastern Alberta.

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