Parsons Creek Aggregate Project  
Conservation and Reclamation Activities and  
Quarry Closure Plan

Prepared for:  
Parsons Creek Aggregates

Graymont Western Canada Inc.  
190, 3025 – 12th Street NE  
Calgary, Alberta T2E 7J2

Inland Aggregates, a Division of Lehigh Hanson Materials Limited  
10515 – 123rd Avenue  
Calgary, Alberta T5V 1J7

Prepared by:  
Millennium EMS Solutions Ltd.  
#217, 811 – 14th Street NW  
Calgary, Alberta T2N 2A4

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1.0  INTRODUCTION

Millennium EMS Solutions Ltd. (MEMS) was retained by Parsons Creek Aggregates (PCA), a joint venture of Graymont Western Canada Inc. and Lehigh Hanson Materials Limited to prepare a detailed quarry mine plan design in support of the environmental impact assessment prepared for the proposed Parsons Creek Aggregates Limestone Quarry Project (the “Project”).

The Project entails quarry activities and operations that will produce limestone aggregate rock products for construction materials applications. In support of the overall quarry mine plan design MEMS has also compiled quarry development details and reclamation information to support the conservation and reclamation activities and closure plan provided in this report.

The Project area, located on Crown land, will be situated on parts of Sections 31, 30, 19, 18, 8, 7, 6 and 5 of Township 90, Range 9, west of the 4th Meridian and a portion of the northeast quarter of Section 36 in Township 90 Range 10, west of the 4th Meridian. The south limits of the Project area are approximately 800 m north of the Fort McMurray Urban Service Area.

The Conservation and Reclamation (C&R) Activities and Quarry Closure Plan for the Parsons Creek Aggregates Limestone Quarry Project have been prepared to:

• provide information about the planning process for the ongoing reclamation and the ultimate closure of the Parsons Creek Aggregates Quarry; and,
• provide the goals and endpoints for the development and reclamation of the Parsons Creek Aggregates Quarry.

The closure plan provides an overview of the development and reclamation plan with the eventual conclusion of quarry activities and operations. Conservation and reclamation activities outline provides a program for the Project life-of-quarry development and reclamation plan covering a 40-year timeframe.

This document forms the basis for the application for approval of the Parsons Creek Resources Project under the Alberta Environmental Protection and Enhancement Act (EPEA). It contains information required as per Section 4.8 in the Final Terms of Reference, which states:

4.8  Conservation and Reclamation

Provide a conceptual Conservation and Reclamation Plan (C&R Plan) for the Project, including:

a) the objectives for reclamation, proposed end land use objectives and other factors necessary for C&R Plan implementation, including:
   i) consideration of pre-development information with respect to land capability, vegetation, forest productivity, wildlife, aesthetics and land use resources;
   ii) project development phasing;
   iii) soil and reclamation material salvage, soil storage areas and soil handling procedures;
   iv) the suitability and availability of soils within the project footprint for reclamation. Outline the criteria to be used in salvaging soils for reclamation and provide a soil balance for the Project;
   v) soil replacement types, depths and volumes;
   vi) re-establishment of a self-sustaining natural appearing topography, drainage and surface watercourses;
vii) closure planning and reclamation activities/sequencing for each phase of development;

viii) post-development reforestation and forest productivity with information required for inclusion into forest management plans for the area;

ix) post-development capability for all uses, including traditional uses (traditional vegetation and wildlife species);

x) the species that will be used for revegetation and discuss the use of native species in the reclamation program;

b) how the land will be returned to pre-disturbed equivalent capability having regard for regulatory requirements and end land use;

c) references to examples of demonstrated success with respect to proposed reclamation techniques, where applicable;

d) operational or mitigative procedures that may be required to ensure that water quality and quantity in the Athabasca River is not impacted as a result of the Project;

e) potential collaborative reclamation procedures considered among Parsons Creek Resources and any other developers should the Project Area be subject to more than one land use, and review any discussions that Parsons Creek Resources has had with these other developer(s); and

f) detailed supporting information demonstrating how the integrity of the reclaimed quarry can be protected during significant open water flooding and ice jam occurrences along the Athabasca River.

1.1 Project Components

The development of the Parsons Creek Aggregates Project will include the following components:

- limestone quarry with opening up, construction and operation in three phases;
- external stockpile area for Non-specification limestone (M3-NLS) placement;
- internal areas (in-quarry pits) for M3-NLS placement;
- external stockpile areas for conserved soil and overburden materials;
- internal areas (in-quarry pits) for placement of salvaged soil and overburden materials;
- construction of three end pit lakes (using partially backfilled in-quarry pits);
- quarry water management systems consisting of ditches, channels and settling ponds;
- crushing and screening activities for producing limestone rock products;
- wash plant and settling pond system for producing washed limestone rock products;
- portable plant working areas and stockpile sites for limestone rock products;
- maintenance, equipment lay down with equipment and vehicle parking areas;
- internal and external haul roads required for quarry activities and operations;
- portable utility systems for electrical distribution, propane and potable water;
- Aboveground storage for diesel fuel supply; and
- Administration, Operations Control, Weigh Scale and Maintenance buildings.

The different development components have been grouped into three main areas as shown on Figure 1.1.1. Estimated areas are provided in Table 1.1.1 of the disturbance associated with the project components through to closure.
The Project will cover about 391 ha of the Graymont MAIM lease area that currently contains 877 ha. The quarry design and mining direction has been recently changed by the boundaries resulting from recent surface reservation dispositions placed by Alberta Transportation for the Highway 63 realignment and Interchange project announced in 2009. References to the original mine plan have been maintained. Quarry activities and operations will commence in Block 3D.

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<tbody>
<tr>
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</tr>
<tr>
<td>Block 3</td>
</tr>
<tr>
<td>Quarry Block 3D</td>
</tr>
<tr>
<td>Quarry Block 3C</td>
</tr>
<tr>
<td>Quarry Block 3B</td>
</tr>
<tr>
<td>Quarry block 3A</td>
</tr>
<tr>
<td>M3-NSL Storage Area</td>
</tr>
<tr>
<td>External TS/OB Stockpiles</td>
</tr>
<tr>
<td>External Haul Road</td>
</tr>
<tr>
<td>Internal Haul Road (in-quarry)</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td>Block 2</td>
</tr>
<tr>
<td>Quarry Block 2B</td>
</tr>
<tr>
<td>Quarry Block 2A</td>
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<tr>
<td>External OB Stockpile Areas</td>
</tr>
<tr>
<td>External Haul Road</td>
</tr>
<tr>
<td>Internal Haul Road (in-quarry)</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td>Block 1</td>
</tr>
<tr>
<td>Quarry Block 1C</td>
</tr>
<tr>
<td>M3-NSL Storage Area</td>
</tr>
<tr>
<td>External OB Stockpile Areas</td>
</tr>
<tr>
<td>External Haul Road</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td>All Blocks (Miscellaneous)</td>
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<td>Portable Plant Site (in-quarry)</td>
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<tr>
<td>Product Stockpiles (in-quarry)</td>
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<tr>
<td>Internal Haul Road (in-quarry)</td>
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<tr>
<td><strong>Subtotal</strong></td>
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<tr>
<td><strong>Total Surface Disturbance</strong></td>
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Project development and reclamation activities will be phased-in eventually over time and will allow for implementation of a progressive reclamation program after year 10 of the quarry project.

1.2 Reclamation Goals and Principles

The primary reclamation goal of the Parsons Creek Aggregates (PCA) Project is to return the lands to a capability that is equivalent to predevelopment conditions. The reclaimed lands will feature regionally acceptable vegetation patterns that are capable of ecological succession. The reclamation program will result in lands that are maintenance-free, with self-sustaining
ecosystems. This goal is a regional priority that is shared with the other developers in the Oil Sands Region (e.g., Shell 2002, CNRL 2002; Suncor 2003).

Maintenance-free reclamation implies that maintenance activities will not be required, thus the ecological system is self-sustaining. This does not mean that an unchanging state will be created, as landforms will experience normal successional processes during the evolution of the reclaimed landscapes. The landscape will evolve through several states of initial revegetation to self-sustaining ecosystems consisting of mature vegetation communities typical of the region. Minimal management of reclaimed lands is expected after establishing the initial ecosystem.

It is not anticipated that closure land uses will be the same as those existing before the opening up and development of quarry operations. Using a focused consultation process, PCA will engage local stakeholders (including aboriginal communities) in an effort to identify acceptable land use options, targets and goals.

Where applicable, the reclaimed landforms will be designed using the Reclamation Working Group (RWG) Landscape Design Checklist (CEMA 2004). The following goals and principles have been incorporated in the reclamation and closure planning:

- progressive reclamation will be undertaken whenever practical;
- landforms will be geo-technically stable and will be integrated into the surrounding natural landforms;
- drainage systems will be designed to minimize erosion rates and sediment loading;
- end pit lakes will be ecologically sustainable;
- forest capability, including commercial forestry potential, will be equivalent to pre-development conditions;
- reclaimed areas will be developed into self-sustaining ecosystems with an acceptable degree of biodiversity;
- reclaimed areas will reduce hazard potential to protect on-site public health and safety;
- reclamation certificates will be applied for and obtained to allow transfer of the lands back to the Crown;
- direct placement of reclamation materials will be undertaken, whenever practical, to maximize potential viability of native seed banks and propagules;
- natural invasion and succession of native vegetation will be encouraged in ecologically receptive areas; and
- local native seed sources will be used wherever practical to maintain genetic integrity of re-established plant communities.

As part of their corporate policies, PCA will ensure that during the on-going reclamation and closure process:

- end land use objectives are developed in consultation with stakeholders, building on the existing consultation process;
- there will be an on-going consultation process with adjacent developers to ensure continuity of landforms and drainage systems across lease boundaries; and
- adaptive management of the C&R and Closure plan will be pursued through the incorporation of results of site specific research, regional research by Canadian Oil
Basic end land use goals for the Project include:

- to reclaim the landscape to an equivalent capability, optimizing the value of watershed, timber, wildlife habitat, fish habitat, recreation or other resources, taking into account stakeholder preferences;
- to return areas of forest productivity to equivalent pre-development levels;
- to promote the aesthetic qualities of the landscape;
- to provide landforms that could support possible future parks and recreation areas to developed by others in accordance with existing RMWB land use policies; and
- to accommodate traditional land uses that are preferred by key stakeholders.

1.3 Issues Related to Closure, Conservation and Reclamation Planning

Information gained during the planning of the Parsons Creek Aggregates Project has been used to identify issues relating to the development and reclamation of the limestone quarry. In addition to the examination of the existing mining operations in the Oil Sands Region, input from the public, examination of the Terms of Reference (AENV 2007) and an issue screening process have been completed.

Examples of identified issues include:

- landform types and integration with adjacent undeveloped areas;
- reclamation landform performance in terms of ecological development and sustainability;
- providing landforms that are consistent with possible future parks and recreation areas to developed by others in accordance with existing RMWB land use policies; and
- acceptable end land uses – balancing the wants and needs of various stakeholders.

A more comprehensive list of issues relating to the development of the Project and PCA’s North Parsons Creek Sand and Gravel Operation is included in PCA 2010, Part E.

1.4 Public Consultation

During the stakeholder consultation process, PCA had discussions with local groups and aboriginal communities about the need to incorporate stakeholder input on traditional use and TEK in preparing the reclaimed landscape design. PCA has considered this consultation information in support of its reclamation program and will work with the interested stakeholders as the Project progresses to establish a mechanism for further information exchange on reclamation. This will also include the RMWB and regulatory agencies such as AENV and ASRD.

1.5 Oil Sands Regional Initiatives

PCA is aware of the Cumulative Environmental Management Association (CEMA) as well as its committees and sub-groups which includes the Reclamation Working Group (RWG). As development of the Project advances, so will PCR’s direct interaction with the appropriate committees and sub-groups. Objectives of CEMA include addressing the issues raised in the
Regional Sustainable Development Strategy (AENV, 1999a) and through the Fort McMurray Sub-regional Integrated Resource Plan (AENV, 1996).

PCA is working with regional stakeholders to ensure that reclamation programs for the Project are progressive and are designed to meet the goals of the program and address the issues that have been raised for the development.

1.6 Reclamation Research

Through interaction with regional committees, PCA will determine its level of participation in regional or specific reclamation research programs. These programs are generally joint efforts by the oil sands operators, regulatory agencies, academia and consulting research partners. PCA understands research is focused on identifying and resolving issues associated with oil sands operations and the reclamation of the mine areas. PCA will consider research programs that build on the successes made in soil replacement, wetlands construction and revegetation techniques.

PCA will explore avenues to participate in research opportunities related to its quarry activities and operations that will assist in the improvement of the reclamation programs that will be implemented by the Project.

1.7 Traditional Land Use

A Traditional Ecological Knowledge and Land Use report was completed in support of the Project EIA application (CR #13, TEK - TLU). Various traditional land uses were identified that PCA will incorporate into the development of the Closure Plan.

Some of the principles that PCA will incorporate into the Reclamation and Closure Plan include:

- direct placement of mineral soil which will introduce biodiversity to the reclaimed landscape and increase the re-establishment of native vegetation;
- reforestation to a variety of species;
- establishment of grassy areas around some water bodies; and
- establishment of wetlands and water bodies.

TEK input from Elders (CR #13, TEK - TLU) indicates that wetland areas should be incorporated in the reclamation plan to accommodate wildlife and hunting activities at the north end of the Project site.
2.0 ENVIRONMENTAL ASSESSMENT

An assessment of pre-development conditions was conducted to inventory baseline conditions, required in the development of a closure, conservation and reclamation plan. The following information was collected and is included in the Project application PCA 2010, Part E:

- Climate
- Noise
- Soils and Terrain
- Vegetation
- Biodiversity
- Aquatic Resources and Surface Water Quality
- Hydrology
- Groundwater
- Fish and Fish Habitat
- Wildlife and Wildlife Habitat
- Traditional Land Use
- Historical Resources
- Resource Use
- Socio-economic

The baseline information contained in the assessment and the identified impacts were used in the preparation of the reclamation plan for the Project.

The PCA Project lease occupies the west (left) floodplain of the Athabasca River (CR #9, Surface Water Impact Assessment). The river valley at this location is about 100 m deep and Highway 63, immediately west of the PCA Project lease, is constructed along the toe of the west valley wall. The active river channel is located to the east (right) side of the valley bottom with outcrops of limestone bedrock along the west (left) bank. PCA is proposing quarry activities and operations for limestone within the Project lease area. Approvals for the excavation and removal of the sand and gravel resources in the northern portion of the lease were obtained under a separate regulatory process.

The Athabasca River may inundate portions of the Project during ice jam and/or open water flood events (CR #9, Surface Water Impact Assessment). The Project anticipates, and is designed to accommodate, occasional flooding. Parsons Creek and other smaller streams originate from offsite watershed areas west of the Project lease and drain across the site into the Athabasca River. The Project will preserve undisturbed riparian corridors for the site’s two fish-bearing streams, which include Parsons Creek and Unnamed Creek 6. The main source of water to these features—the offsite drainage areas—will be entirely unaffected by the Project. However, the proposed Highway 63 re-alignment and interchange project proposed by Alberta Transportation have the potential to either disturb or disrupt these drainages on both a short- and long-term basis.

Other smaller drainages courses on the Project site that are not fish-bearing and have no inherent ecosystem value will be intercepted near the Project’s west boundary, diverted around the work area, and discharged to the Athabasca River. Other lesser drainages within the Project lease area were determined to not have any inherent ecosystem value other than to
provide a conveyance route for offsite watershed areas to drain to the Athabasca River. The Project will provide alternate conveyance paths for the water to reach the river. Any changes to the timing and magnitude of flows in the lesser drainages, including any hydraulic routing effects in the final end pit lake configuration, will be imperceptible in relation to the magnitude and natural variability of Athabasca River flows.

In total, 19 soil series variants were combined with 7 unique landscape forms to create 20 soil map units used to describe the Project (CR #5, Soils Assessment). Soil map units are a combination of soil types and landforms which typically occur together in a landscape (i.e. poorly drained soils associated with level to depressional terrain). The most common terrain types in the Project were floodplains which accounted for approximately 65% of the terrain in the Project area. The landforms are level to nearly level (0-3% slopes), typically having some degree of terracing as a result of the fluvial landscape and are imperfectly to poorly drained.

Within the Project area, two soils types dominated:

- a Rego Gleysol of the Mamawi series (MMW), which accounted for approximately 46% of the LSA; and;
- a Cumulic Regosol of the McMurray series (MMY) which covered an estimated 40% of the Project area.

The occurrence of these soils in the Project area was expected as both series are common in fluvial landscapes.

<table>
<thead>
<tr>
<th>Table 2.0.1 Soil map unit count and area calculations for Project area</th>
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<tbody>
<tr>
<td><strong>Map Unit</strong></td>
</tr>
<tr>
<td>MIL18/I3l</td>
</tr>
<tr>
<td>MMW20/FP3a</td>
</tr>
<tr>
<td>MMW20/I3l</td>
</tr>
<tr>
<td>MMW21/FP3a</td>
</tr>
<tr>
<td>MMW21/L1</td>
</tr>
<tr>
<td>MMW6/FP3a</td>
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<td>MMY2/FP3b</td>
</tr>
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<td>MMY2/I3l</td>
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<td>MMY6/FP3b</td>
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<tr>
<td>ZWA</td>
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<tr>
<td><strong>TOTALS</strong></td>
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Neg. – The percentage value was negligible for the significant figures displayed.
During reclamation of quarry workings, the potential for overburden material to constitute a portion of the rooting zone in the reclaimed soil profiles does exist (CR #5, Soils Assessment). For the purpose of this assessment, overburden is defined as the material located below the soil profile (below 1.20 m in depth) and above, between, and below the limestone seams that are to be mined by the Project (Chernipeski and Knapik 2005). Two overburden zones were targeted:

Within the Project area, two overburden zones were targeted:

- the surficial overburden material, which is composed of glacial fluvial deposits consisting of sand, silt and clay; and;
- the limestone-shale waste rock (M-III zone or Non-specification Limestone Ore or M3-NSL) located between the two limestone ore zones of interest (M-II and M-IV).

Samples were collected throughout the extent of the Project lease. Evaluation of the overburden chemistry included results for SAR, EC, pH, calcium carbonate equivalent, and trace metals. Reclamation suitability of the overburden materials was assessed using the Soil quality criteria relative to disturbance and reclamation guidelines as specified for subsoil materials in the plains region of Alberta (SQCWG 1987).

The surficial overburden materials were rated as Fair to Poor as a reclamation media. The main limitation was coarse texture, as the material was found to be relatively sandy. No chemical parameters were recorded in the analyzed samples that would limit the use of this overburden material for mine reclamation.

The calcareous limestone-shale waste rock (M-III or Non-specification limestone or M3-NSL) was rated as Poor to Unsuitable as reclamation media. Extremely firm to hard consistence of the shale material and areas of high SAR and elevated EC were the dominant limitations. Introduction of this overburden material within the rooting zone of the reclaimed profiles has the potential to impact equivalent forest capability by liming vegetation establishment. Trace metal results were reviewed and all results met applicable screening criteria (CCME guidelines).

The Project is situated in the Central Mixedwood Natural Subregion, on the floodplain of the Athabasca River (CR #7, Vegetation Impact Assessment). The upland areas of the Central Mixedwood Natural Subregion are dominated by a mosaic of aspen dominated deciduous stands, aspen-white spruce forests, white spruce and jackpine stands. Wetlands overlie almost half the area and are dominated by fens and bogs (Natural Regions Committee 2006). The study area, in contrast, is characterized by balsam poplar dominated mixedwood riparian forests, and shrubby and graminoid marshes.

<table>
<thead>
<tr>
<th>Map Unit</th>
<th>Area (ha)</th>
<th>% of Project area</th>
<th>UBZ Area (ha)</th>
<th>% of UBZ Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA01</td>
<td>1.7</td>
<td>0.4</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>CMA01/02</td>
<td>0.9</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>CMA01/10</td>
<td>29.6</td>
<td>7.6</td>
<td>11.0</td>
<td>6.3</td>
</tr>
<tr>
<td>CMA02</td>
<td>0.2</td>
<td>Neg.</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>CMA10</td>
<td>7.9</td>
<td>2.0</td>
<td>29.6</td>
<td>16.8</td>
</tr>
<tr>
<td>CMA15</td>
<td>3.0</td>
<td>0.8</td>
<td>3.1</td>
<td>1.8</td>
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</table>
Table 2.0.2  Pre-disturbance Ecosite Phases

<table>
<thead>
<tr>
<th>Map Unit</th>
<th>Area (ha)</th>
<th>% of Project area</th>
<th>UBZ Area (ha)</th>
<th>% of UBZ Area</th>
</tr>
</thead>
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<tr>
<td>CMA16</td>
<td>1.1</td>
<td>0.3</td>
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<tr>
<td>d1</td>
<td>0.1</td>
<td>Neg.</td>
<td>8.0</td>
<td>4.5</td>
</tr>
<tr>
<td>d2</td>
<td>9.6</td>
<td>2.5</td>
<td>9.7</td>
<td>5.6</td>
</tr>
<tr>
<td>d3</td>
<td>11.1</td>
<td>2.8</td>
<td>2.3</td>
<td>1.3</td>
</tr>
<tr>
<td>e1</td>
<td>104.0</td>
<td>26.6</td>
<td>65.7</td>
<td>37.3</td>
</tr>
<tr>
<td>e2</td>
<td>57.0</td>
<td>14.6</td>
<td>11.7</td>
<td>6.6</td>
</tr>
<tr>
<td>e3</td>
<td>13.5</td>
<td>3.4</td>
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<td>2.0</td>
</tr>
<tr>
<td>f3</td>
<td>7.3</td>
<td>1.9</td>
<td>0.1</td>
<td>Neg.</td>
</tr>
<tr>
<td>h1</td>
<td>4.9</td>
<td>1.2</td>
<td>3.6</td>
<td>2.0</td>
</tr>
<tr>
<td>Industrial</td>
<td>99.3</td>
<td>25.4</td>
<td>14.7</td>
<td>8.4</td>
</tr>
<tr>
<td>Open water</td>
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<td>2.4</td>
<td>7.5</td>
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<td>Regen</td>
<td>31.0</td>
<td>7.9</td>
<td>4.5</td>
<td>2.6</td>
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<tr>
<td>TOTALS</td>
<td>391.3</td>
<td>100</td>
<td>176</td>
<td>100</td>
</tr>
</tbody>
</table>

Neg. – The percentage value was negligible for the significant figures displayed.

2.1  Reclamation Schedule

Reclamation activities will begin during Year 10 while quarry mining operations are completed in Block 3D and Block 3C is being prepared for quarry opening. The progressive reclamation program will result in the formation of a patchwork of reclaimed areas throughout the Project area and quarry operating sites. This process allows for the earliest reclamation possible thereby reducing potential for erosion and sedimentation as well as increasing opportunities for direct placement of soils and storing lesser volumes of soil materials in stockpiles.

Reclamation certification will be requested when a block of land has achieved the required vegetative cover, landform stability and the expected performance criteria. There may be several years between the time that initial reclamation work is completed and the time that tree survival and growth have met the standards set in the evaluation criteria. In most instances, a productive land base will meet the end land use goals and will be integrated into the regional land base well before the return of the land to the Crown through the land certification process.

Additional details of the reclamation schedule are provided in Section 3.0 and 4.0.

2.2  Adaptive Management for Reclamation

PCA will work towards a full adaptive management approach that involves establishing end land use objectives according to pre-development land use capability, site-specific conditions, improved practices based on research and monitoring results, and stakeholder input. As reclamation proceeds, monitoring of reclamation success and revegetation performance will allow land use objectives to be reviewed and, if necessary, modifications can be made to site expectations according to natural revegetation processes.

Adaptive management is intended to respond to changes and advances in technology, such as soil replacement and revegetation, to meet specific objectives. PCA will make every reasonable effort to incorporate adaptive management techniques as routine components in all of its
environmental management activities. These techniques provide the opportunity to develop and fine-tune the reclamation program using data collected on-site and from other regional operators.

Adaptive management may be used at any point throughout the Project life cycle, but will have the greatest benefit in the early planning stages when the location and compositions of landforms are still to be decided. When landforms are designed or constructed, its use will facilitate the decision-making process on surface contouring measures and corrective initiatives that could improve surface drainage, decrease erosion or enhance vegetation performance.

PCA will use the experience gained during the development of the quarry and other successes observed in the oil sands, mining and quarry industries over the next 40 years, to manage and implement a more effective reclamation program.

PCA will examine opportunities to work with other operators of oil sands mines, CEMA and the RWG, as well as Alberta Sustainable Resource Development (ASRD) and local community representatives, to further develop criteria and monitoring programs that clearly demonstrate progress toward environmentally sound sustainable ecosystems.

2.3 Conservation and Reclamation (C&R) and Closure Plan Assumptions

The C&R and Closure Plan was developed using several key assumptions regarding closure planning, detailed reclamation planning, end land uses and final certification and release of successfully reclaimed land back to the Crown, including:

- changes to the quarry mine plan that will require modifications of the reclamation and closure plans;
- the probability of design changes to the quarry mine and closure plans increases over time and are expected;
- the design of the closure landforms will, where appropriate and suitable, employ the Landscape Design Checklist (CEMA 2004);
- there are uncertainties in the closure planning process which include long-term performance of landforms, long-term performance of vegetation communities and capability to return landscape biodiversity;
- uncertainties in landscape performance and technology will be resolved with using the principles of adaptive management, and knowledge gaps are to be resolved through research programs; and
- the closure plan provided is conceptual in nature due to the evolutionary nature of both quarry mine technology development and reclamation planning.

The following assumptions were used for the detailed conservation and reclamation planning process:

- reclamation practices used by other operators in the oil sands region and information gained from the EIA were used as the basis for soil reconstruction and revegetation practices;
- methods outlined in the Land Capability for Forest Ecosystems in the Oil Sands Region (Leskiw 1998), as updated, will be used in assessing reclaimed land capabilities;
- reconstructed soil performance will mimic natural soils over time;
• the Oil Sands Vegetation Reclamation guidelines (OSVRC 1998) will be consulted in support of the revegetation program;
• species identified in Oil Sands Vegetation Reclamation guidelines will be considered for use where appropriate (OSVRC 1998); and
• target vegetation communities identified in the C&R and Closure Plan are conceptual in nature and it is recognized that it is not currently possible to predict total ecosystem succession over time.

The following criteria were assumed for end land uses and final reclamation certification:

• the target ecosystems and vegetation communities identified in the C&R and Closure Plan will allow multiple land uses. As an example, areas reclaimed to commercial forest use could also provide wildlife, recreation and traditional land uses;
• end land use options available will be constrained by the type of landforms to be constructed; and
• final end land use decisions will, in part, depend on government and local stakeholder input.

Several conventions are used throughout this document in terms of terminologies and practices. For the purposes of the C&R and Closure, the following definitions apply:

• “soil” or “soil materials” is defined as any topsoil including the litter layer, any organic soil, upper and lower subsoil, or any material rated as good or fair in the Soil Quality Criteria Relative to Disturbance and Reclamation (Alberta Agriculture 1987); and
• “overburden” is defined as materials below the lower subsoil layer and above the limestone layer.

Any placement or long-term storage of the Moberly M-III non-specification limestone (M3-NSL) as well as any sodic or saline overburden materials will be covered with a minimum of 90 cm of suitable overburden before placement of 30 cm of soil.

The Conservation & Reclamation and Closure Plan utilized numerous reports prepared for the EIA report. The revised Graymont MAIM lease now covers about 566 ha. The Conservation and Reclamation Plan is focused on the sequential phasing of quarry development in three stages. The development sequence indicates soil salvage may occur from at least 391 ha. The remaining areas, about 176 ha, are used for undisturbed buffer zones, development setback areas or unsuitable for quarry development and will have very minimal disturbance where soil salvage is not required. PCA will ensure that proper operational procedures are in place to allow for equivalent reclamation capabilities.

3.0 CONSERVATION AND RECLAMATION PLAN

The Conservation and Reclamation (C&R) Plan for the Project provides details on the annual reclamation activities for the first 10 year period of quarry development and mining activities as well as periodic information through to the closure of the mine. The C&R plan provides the specific reclamation procedures that will be employed during the first 10 years of operation while the closure plan outlines the goals and processes of the reclamation planning.

Inherent in PCA’s quarry reclamation planning are efforts to maintain the development area’s biodiversity and sustainable ecological conditions. However, while providing equivalent land
capability, there will be changes to the current ratio of uplands to wetlands and the inclusion of end-pit lakes in the reclaimed landscape. The Project is proposing to reclaim three areas to incorporate end-pit lakes where uplands or wetlands previously existed. As well, some new upland areas will be created where wetlands or other surficial features once existed. Therefore, alternative end land uses, or different areas available for existing end land uses, will be developed as part of the C&R and Closure Plan.

The reclamation plan was developed for the mine by integrating information assessed in the project EIA. The reclaimed landscape was designed considering the regional land classification system (Strong and Leggat 1992; AENV 1999b) and the Landscape Design Checklist (CEMA, 2004); the eco-sites and wetlands of the area (Beckingham and Archibald 1996; Halsey and Vitt 1996); and the area wildlife (COSEWIC 2004).

Reclamation processes and practices have been adapted from Leskiw (1998), the Oil Sands Vegetation Reclamation Committee (OSVRC 1998) and the Oil Sands Wetlands Working Group (OSWWG 2000). Other documents used in the preparation of this C&R and Closure Plan have been referenced in the applicable sections.

3.1 Reclamation Guidelines

PCA will reference and use the following guidelines and resource plans where appropriate to assist in developing the closure and detailed reclamation plan for the Project:

- Guidelines for Preparation of Applications and Reports for Coal and Oil Sands Operations ALC&R 1991;
- A User Guide to Pit and Quarry Reclamation in Alberta RRTAC 1992;
- Environmental Protection Guidelines for Pipelines (C&R/IL/94-5) AENV 1994;
- Environmental Protection Guidelines for Electric Transmission Lines (C&R/IL/95-2) AENV 1995;
- Regional Sustainable Development Strategy for the Athabasca Oil Sands Area AENV 1999a;
- Fort McMurray-Athabasca Oil Sands Subregional Integrated Resource Plan AENV 1996;
- Guideline for Monitoring and Management of Soil Contamination Under EPEA Approvals AENV 1996;
- Land Capability Classification for Forest Ecosystems in the Oil Sands Region Leskiw 1998;
- Guideline for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region OSVRC 1998;
- Guideline for Wetlands Establishment on Reclaimed Oil Sands Leases OSWWG 2000;
- Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body AENV 2000a;
- Code of Practice for Watercourse Crossings AENV 2000b;
- Environmental Protection Guideline for Roadways AENV 2000c;
- Sites Reclaimed Using Natural Recovery Methods, Guide on Site Assessment AENV 2003;
- Code of Practice for Pits AENV 2004;
- A Guide to the Code of Practice for Pits AENV 2004; and
3.2 Reclamation Planning for Biodiversity

The re-establishment of biodiversity on reclaimed areas will depend on several factors such as terrain design, soil handling procedures, revegetation plans and the establishment of the drainage system. The reclaimed landscape will increasingly resemble pre-development conditions as the landscape matures and evolves. There are several mechanisms that can be used to enhance the biodiversity of the reclaim landscape:

- the direct placement of soil materials;
- landform variability and integration;
- mimic natural soil conditions and create a micro-hummocky surface that enhances moisture by using rough mounded coversoil replacement techniques to unevenly spread coversoil on the recontoured surfaces; and
- enhancing biodiversity through the use of special reclamation procedures during all phases of the reclamation process.

A detailed management system for monitoring biodiversity will be developed and implemented. Input from the regional management plans will be incorporated.

3.3 Quarry Mining Operations and Reclamation Progression

Quarry mining operations and reclamation activities for the first 10 year approval period for the PCA have been summarized in Table 3.3.1 and depicted on Figures 3.3.1, 3.3.2, 3.3.3, 3.3.4, 3.3.5 and 3.3.6.

<table>
<thead>
<tr>
<th>Year</th>
<th>Clearing*</th>
<th>Soil Disturbance**</th>
<th>Reclamation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>36</td>
<td>36</td>
<td>0</td>
</tr>
<tr>
<td>2013</td>
<td>34</td>
<td>34</td>
<td>0</td>
</tr>
<tr>
<td>2014</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>2015</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2016</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2017</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2018</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2019</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2020</td>
<td>0</td>
<td>0</td>
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<tr>
<td>2021</td>
<td>30</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>TOTALS</td>
<td>110</td>
<td>110</td>
<td>25</td>
</tr>
</tbody>
</table>

* Cleared areas include reclamation materials stockpiles (RMS)
** Disturbed areas include areas within mine development plan having soil salvage
3.4 Vegetation Clearing

Quarry development will require the clearing of existing vegetation from the development footprint. The action items listed in the Landscape Design Checklist have been incorporated in the development of the footprint size and location. PCA is committed to minimizing the amount of surface disturbance that is required for Project development. It is estimated that full development of the PCA quarry will disturb approximately 391 ha. The progression of clearing for the first 10 years of quarry development will be about 110 ha.

All merchantable timber that is encountered during the clearing operations will be salvaged and transported to a designated Al-Pac facility. PCA has entered into an agreement with Al-Pac concerning a joint timber harvest plan that would have Al-Pac salvage all the merchantable trees. Slash materials will be left on the surface and will be incorporated in the soil salvage operations.

3.5 Soil Conservation Plan

The goal of the soil conservation program is to provide sufficient volumes of suitable soil materials for reclamation that will support self-sustaining vegetation required to achieve the planned end land uses. Sequential quarry mining development has identified up to 391 ha that will require soil salvage.

Soil salvage operations will be completed by typical earth moving equipment. Depending on surface grade and contour, motor scrapers are first preference for soil salvage and stockpiling or direct placement of conserved soil materials.

For areas with limited scraper access, bulldozers and backhoes will collect the soil into windrows and piles. The collected soils will be loaded into articulated haul trucks and will be either direct placed on re-contoured areas or placed into stockpiles.

Direct placement of soil materials onto re-contoured areas is the preferred operation and will be accomplished at every opportunity. It is estimated that direct placement of soil materials will occur on over 60% of the reclaimed areas in the latter stages of the mine plan.

A total of 3.32 Mm$^3$ of soil is expected to be salvaged and stockpiled or direct placed from the upland areas. In addition, approximately 23.4 Mm$^3$ of overburden material will also be salvaged and stockpiled or direct placed during the life of the mine (Table 3.5.1).

Reclamation Material Stockpiles (RMS) will be constructed to store the reclamation materials for later use. The RMS will be constructed with stable foundations to ensure easy retrieval and will be vegetated to minimize the potential for erosion; no soil will be salvaged from these areas.
Table 3.5.1 10 Year Soil Conservation Plan and Materials Salvage

<table>
<thead>
<tr>
<th>Year</th>
<th>Area* (ha)</th>
<th>Topsoil &amp; Subsoil Materials (Mm³)</th>
<th>OB Materials (Mm³)</th>
<th>M3 NSL Backfill Materials (Mm³)**</th>
<th>Total Materials Available (Mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>36</td>
<td>0.177</td>
<td>1.616</td>
<td>0.0</td>
<td>1.793</td>
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<tr>
<td>2013</td>
<td>34</td>
<td>0.171</td>
<td>1.553</td>
<td>0.0</td>
<td>3.263</td>
</tr>
<tr>
<td>2014</td>
<td>10</td>
<td>0.082</td>
<td>0.0</td>
<td>1.081</td>
<td>1.163</td>
</tr>
<tr>
<td>2015</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2016</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2017</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2018</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2019</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>1.081</td>
<td>1.163</td>
</tr>
<tr>
<td>2020</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2021</td>
<td>33</td>
<td>0.228</td>
<td>1.535</td>
<td>0.0</td>
<td>1.763</td>
</tr>
<tr>
<td>2022 – 2031</td>
<td>144</td>
<td>1.193</td>
<td>11.06</td>
<td>8.042</td>
<td>20.30</td>
</tr>
<tr>
<td>2032 – 2041</td>
<td>95</td>
<td>1.112</td>
<td>5.883</td>
<td>5.898</td>
<td>12.89</td>
</tr>
<tr>
<td>2042 - 2051</td>
<td>43</td>
<td>0.358</td>
<td>1.753</td>
<td>2.112</td>
<td>4.223</td>
</tr>
<tr>
<td>TOTALS</td>
<td>391</td>
<td>3.321</td>
<td>23.40</td>
<td>16.03</td>
<td>45.40</td>
</tr>
</tbody>
</table>

* Cleared areas include reclamation materials stockpiles (RMS)

** Does not include up to 2.42 Mm³ placed in external M3-NSL storage areas

Sufficient soil material will be salvaged to meet the requirements of the reclamation plan with some additional volume for contingency. Excess soil material will not be salvaged and will be disposed of with the overburden materials. In all cases, slash material left from the clearing operations will be incorporated in the soil when it is salvaged.

3.6 Final Grading and Recontouring

The reclamation program in subsequent stages after the first 10 year approval period (Figures 3.6.1, 3.6.2, 3.6.3, 3.6.4, 3.6.5, 3.6.6, 3.6.7 and 3.6.8) will include the following major activities:

- end-pit lake and wetlands area construction;
- final grading and recontouring;
- soil replacement; and
- revegetation.

PCA will undertake progressive final grading and recontouring program (Table 3.6.1) to prepare areas for the next reclamation step, soil replacement.
### Table 3.6.1 Reconstructed Terrain

<table>
<thead>
<tr>
<th>Reclaimed Quarry Component</th>
<th>Slopes (%)</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mine Blocks 3D, 3C, 3B, 3A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West End Pit Lake</td>
<td>0</td>
<td>47.2</td>
</tr>
<tr>
<td>East End Pit Lake</td>
<td>0</td>
<td>31.9</td>
</tr>
<tr>
<td>Shorelines</td>
<td>0</td>
<td>15.8</td>
</tr>
<tr>
<td>Wetland Areas</td>
<td>0</td>
<td>58.9</td>
</tr>
<tr>
<td>Interlake Upland Areas</td>
<td>1-5</td>
<td>55.3</td>
</tr>
<tr>
<td>Capped M-3 NSL Area</td>
<td>5-20</td>
<td>11.6</td>
</tr>
<tr>
<td>West Side Uplands</td>
<td>5-20</td>
<td>30.3</td>
</tr>
<tr>
<td>Area Sub TOTAL</td>
<td></td>
<td>251</td>
</tr>
<tr>
<td><strong>Mine Blocks 2B, 2A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End Pit Lake</td>
<td>0</td>
<td>55.9</td>
</tr>
<tr>
<td>Shorelines</td>
<td>0</td>
<td>11.2</td>
</tr>
<tr>
<td>North Parsons Creek Uplands</td>
<td>1-5</td>
<td>19.7</td>
</tr>
<tr>
<td>West Side Uplands</td>
<td>5-20</td>
<td>13.2</td>
</tr>
<tr>
<td>Area Sub TOTAL</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td><strong>Mine Block 1C</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Parsons Creek Uplands</td>
<td>1-5</td>
<td>29.7</td>
</tr>
<tr>
<td>Capped M-3 NSL Area</td>
<td>5-20</td>
<td>10.3</td>
</tr>
<tr>
<td>Area Sub TOTAL</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>391</td>
</tr>
</tbody>
</table>

### 3.7 Soil Replacement Plan

Soil replacement operations can commence after recontouring and final grading of replaced overburden and M3-NSL materials are done. The loading and movement of soil will be done using conventional mining equipment. Once the material is delivered to the site, it is spread with a dozer which is typical of practices being used by other oil sands operators.

As part of the progressive reclamation program, direct placement of salvaged soil will only be started after the first 10-year period. Stockpiled materials will be used to reclaim areas where the direct placement of soil during the salvage operations is insufficient to meet reclamation plans. The soils in stockpile will be loaded on trucks and transported to the replacement areas. Motor scrapers or bulldozers will be used to spread the cover soil at the prescribed depths.

Generally 30 cm of soil will be spread over 90 cm of fair to good quality overburden replaced over the M3-NSL material at depths between 15 and 25 m. Additional cover will be required on areas with poorer overburden, such as oversize reject from M3-NSL excavations and sodic or saline overburden materials. If problem areas are encountered, additional soil will be available from the reclamation material stockpiles. There is an estimated 0.35 Mm$^3$ of soil available for reclamation during ten year approval period.

There is about 3.32 Mm$^3$ of suitable reclamation material available over the entire quarry footprint. An additional 23.4 Mm$^3$ of overburden material will be salvaged for capping the estimated 17.0 Mm$^3$ of M3-NSL material that will be placed in depleted areas of the quarry as
limestone mining advances. Rock bulking factors, volume expansion between 70 and 80 percent, may be observed for backfill using the fractured and broken M3-NSL material.

### 3.8 Revegetation Plan

The prime revegetation goal is to provide a diverse vegetation community mix on the reclaimed landscape that will integrate with the surrounding communities on undisturbed lands.

The revegetation program will:

- provide an erosion resistant plant cover on upland areas and M3-NSL rock dump slopes;
- provide a diverse range of plant species at the start of reclamation that will increase the potential of the reclaimed sites to achieve a level of bio-diversity equivalent to pre-development conditions; and
- establish self sustaining viable plant communities during reclamation.

In order to achieve these goals the Project will use planting prescriptions that consider variations in micro-climate, drainage, reclamation material, depth and composition to start the process of reaching a target ecosite (OSVRC 1998).

Pre-development vegetation communities will be selected for use as target ecosites for final reclamation. For example, vegetation communities planned for west facing slopes will be similar to the composition of vegetation on west facing slopes on the pre-development landscape. After recontouring and replacement of coversoil, a vegetation cover will be established using the seeding prescriptions as follows:

- natural establishment on areas where soil is direct placed and slopes are <5%; and
- nurse crop approved by ASRD on areas where soil is direct placed and slopes are >5%;

These areas will be integrated with the final reclamation planting prescriptions outlined below and may, over time, develop into forested vegetation communities.

Revegetation will be done in phases, from north to south (HTECH 2009). The final plan will have forested hills of overburden; a mosaic of dry upland forests and swamps; and marshes, small ponds and wetland areas along the shorelines of the end-pit lakes.

After construction, all three end-pit lakes will be connected to the Athabasca River through the floodplain alluvium and lake water levels are expected to fluctuate with the levels in the Athabasca River. On average, the lake water levels will fluctuate 1.0 to 2.5 metres per year, which is unsuitable for marsh vegetation.

The shoreline will be graded to allow periodic flooding in the upland, and will be planted with balsam poplar and shrubs adapted to rich wet soil conditions.

Proposed and suggested vegetation mitigations for final reclamation plantings:

#### Upland sites – south facing hills and crests

- Dry, site type (analogue to Ecosite b)
- Trees: Jack pine, aspen, white spruce, white birch
- Shrub: blueberry, bearberry, green alder, Labrador tea, bog cranberry
Upland Sites – north facing slopes

- Trees: aspen, white spruce, white birch
- Shrubs: blueberry, bearberry, Labrador tea

Upland sites – toes of slopes, seepage areas

- Moist Rich Site Type (analogue to Ecosites d to e)
- Trees: white spruce, aspen, balsam poplar, white birch,
- Shrubs: low-bush cranberry, rose, green alder, rose dogwood, willow species, raspberry, pincherry, chokecherry, saskatoon, high-bush cranberry

North End Pit Lakes - Shorelines with fluctuating water levels (1-2.5 m)

- Wet Rich, coarse substrate, groundwater connected to Athabasca River
- Regrade shoreline to allow flood waters to extend over banks
- Plant with balsam poplar (which has deep root systems that will follow the flood levels. Important – plant in early spring as soon as spring floodwaters recede to allow the roots to follow the water table as it drops.
- Shrubs: willow species, dogwood, green alder

Direct placement of salvaged soils has been demonstrated to enhance native vegetation establishment as the soils contain plant propagules, such as dormant seed and root fragments that are transferred to the reclamation area. Spreading of these materials across the recontoured areas generally results in the establishment of a variety of native plant species such as forbs, grasses and woody stemmed species. Therefore, direct placement of soil materials will be undertaken wherever possible (more than 60% of the reclaimed area).

While there will be the ongoing revegetation during the progressive reclamation program the majority of the revegetation will occur in later years of the Project.

The primary method for the application of seed will be aerial broadcasting. This method has been proven to be the most cost effective delivery system on larger areas of reclaimed land. In small areas a broadcaster mounted on an ATV may be used. In smaller areas with poor access a hydro-seeder may be used.

Part of the revegetation program will be the establishment of woody plants on the reclamation areas. Species selection and proportion in the revegetation plan is based on:

- woody-stemmed species that are common to the target ecosites;
- existing field conditions;
- vegetation type or types desired for development on the site, based on end land use objectives and landscape terrain features; and
- anticipated growth of woody-stemmed species from seeds and root fragments in the reclamation material layer.
3.8.1 Fertilization

There may be a limited fertilization program undertaken in areas where a rapidly established vegetative cover is required for erosion control. The fertilization would be continued until the vegetative cover is well established and the need for additional nutrient is no longer required.

3.8.2 Weed Control

A weed control program will be developed for the Project. The program will consist of conducting spring and summer surveys to identify infestations of noxious weeds. Depending on the weed type found and infestation size, a mechanical or chemical control procedure will be implemented. Weeds will be controlled in accordance with the Weed Control Act.

Mechanical control programs can range from mowing the weeds before seed release to hand-picking and bagging. Chemical programs will be used only if necessary and by a licensed applicator. Approval will be gained from the regulatory agencies before any chemical control programs are initiated.

4.0 CLOSURE PLAN

C&R and Closure planning incorporate the primary mitigation methods that will allow the site to return to pre-development land capability. Where possible, mine planning will attempt to minimize the Project footprint and therefore minimize the area reclaimed. The following section describes features and concepts that will be created as a result of the Project development and how these features will be returned to a productive landscape.

The objectives of this section are to summarize the overall goals of mine closure and environmental management practices that will be implemented throughout the life-of quarry. The mine development plan and design are detailed in (PCA 2010, Section B). This section describes the C&R and Closure principles that PCA will use for its Project development.

Quarry operation developments after the 10 year approval period are included in Table 4.0.1. Sequential quarry development has identified 391 ha of land that will require soil salvage.

<table>
<thead>
<tr>
<th>Table 4.0.1 Development Schedule to Closure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>2012 to 2021</td>
</tr>
<tr>
<td>2022 to 2031</td>
</tr>
<tr>
<td>2032 to 2041</td>
</tr>
<tr>
<td>2042 to 2051</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

* Cleared areas include RMS that were not cleared during mine development
** Disturbed areas include areas within mine development plan having soil salvaged
*** Reclamation includes surface area for constructed end-pit lakes and capped M3-NSL storage area in Mine Block 1

Continuing quarry development after the 10 year approval period is depicted in Figures 4.0.1, 4.0.2, 4.0.3 and 4.0.4. Through a progressive reclamation program, it is estimated that PCA will have reclaimed between 75 and 80% of the quarry disturbance footprint by the end of mining
(ca 2046) for the life-of-quarry. The remaining area will be reclaimed within five years of completion of quarry mining.

### 4.1 Reclaimed Landscapes

Although new landscapes are created during development and reclamation of the Project, these features will be stable and able to support a variety of end land uses. The new landscapes will have an increased diversity of slope classes than the pre-disturbance landscapes (Table 4.1.1).

<table>
<thead>
<tr>
<th>Slopes (%)</th>
<th>Baseline Terrain (ha)</th>
<th>Baseline Terrain (%)</th>
<th>Reclaimed Terrain (ha)</th>
<th>Reclaimed Terrain (%)</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>38.3</td>
<td>10</td>
<td>113</td>
<td>22</td>
<td>74.7</td>
</tr>
<tr>
<td>1-5</td>
<td>307</td>
<td>79</td>
<td>77.6</td>
<td>27</td>
<td>(230)</td>
</tr>
<tr>
<td>5-20</td>
<td>36.6</td>
<td>9</td>
<td>65.4</td>
<td>17</td>
<td>28.8</td>
</tr>
<tr>
<td>Water</td>
<td>9.1</td>
<td>2</td>
<td>135</td>
<td>34</td>
<td>126</td>
</tr>
<tr>
<td>Total</td>
<td>391</td>
<td>100</td>
<td>391</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

### 4.2 Soil Management

Soil is a mixture of surficial materials that are immediately capable of supporting an initial plant cover. The soils will also support the vegetation communities in the adjacent undisturbed lands.

The reconstructed soils will be able to provide:

- adequate moisture retention capability;
- adequate nutrient supply; and
- ability to support an erosion resistant vegetative cover.

The soil management practices of existing oil sands operations and the conditions contained in their operating approvals were reviewed. These practices consist of overstripping organics into mineral soils and placing the material, where possible, on recontoured areas or into stockpile. These operations generally occur during the winter months.

In upland areas a solution is to salvage a thickness of surface soil that is readily accomplished with large equipment and still results in material that is suited for reclamation use. A salvage lift of 30 cm is considered practicable with large bulldozers and where topsoil thickness average is 15 cm, results in a 1:1 mixture of topsoil and upper subsoil. The characteristics of the upland soil and subsoil are similar, so a minor amount of mixing will result in a material with characteristics reflecting the relative proportions of the pre-mixed horizons.

Soil salvage and replacement will follow guidelines provided in the Land Capability Classification for Forest Eco-systems in the Oils Sands Region, Working Manual (Leskiw 1998) and the Landscape Design Checklist (CEMA 2004). Generally, soil replacement depths will be dependant on the type of parent materials being covered. Parent material samples will be analyzed to determine the soil reconstruction prescription that will be used. If unsuitable parent material is found, PCA will ensure that there is at least 80 to 100 cm of suitable parent material.
or will add additional soil to be used as a growing medium at a depth of approximately 50 cm. This practice works well elsewhere in Alberta but will need testing in the oil sands region.

4.3 Revegetation

Established revegetation procedures, as recommended in the “Guidelines for Reclamation or Terrestrial Vegetation in the Alberta Oils Sands Region” (OSVRC 1998) will be used for the revegetation program at the Project. The objectives of the revegetation program are similar to those contained in the “Fort McMurray-Athabasca Oil Sands Subregional Integrated Resource Plan” (AENV 1996). These objectives relate to issues of wildlife, erosion, floodplain, recreation and tourism and ecological resource management.

The goals of the reclamation program include:

- the establishment of an erosion resistant plant cover on reclaimed upland areas and M3-NSL storage area slopes;
- the provision of a diverse range of plant species at the start of reclamation to increase the potential of achieving a bio-diversity level equivalent to pre-development conditions; and
- the establishment of a self sustaining viable plant communities during reclamation.

Information from the guidelines was used to select the target ecosites for the various landform structures and the revegetation program is expected to establish the target ecosite phases. The phases are determined by the following factors

- the type of reclaim landform structure;
- slope and aspect;
- soil type (capability class) and drainage conditions; and
- plant succession.

Vegetation communities are expected to eventually evolve into a biologically diverse boreal forest suitable for traditional land uses, wildlife and recreational uses. Natural processes and succession will augment the vegetation and will provide the framework for the revegetated areas to evolve into ecosystems similar to those naturally present in the region (Figure 4.3.1 and Table 4.3.1).

Table 4.3.1 Comparison of Baseline & Reclaimed Vegetation

<table>
<thead>
<tr>
<th>Vegetation Map Unit</th>
<th>Baseline Terrain</th>
<th>Reclaimed Terrain</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ha)</td>
<td>(%)</td>
<td>(ha)</td>
</tr>
<tr>
<td>Wetlands</td>
<td>44.4</td>
<td>11%</td>
<td>85.6</td>
</tr>
<tr>
<td>d1</td>
<td>0.1</td>
<td>Neg.</td>
<td>0.0</td>
</tr>
<tr>
<td>d2</td>
<td>9.6</td>
<td>2%</td>
<td>0.0</td>
</tr>
<tr>
<td>d3</td>
<td>11.1</td>
<td>3%</td>
<td>0.0</td>
</tr>
<tr>
<td>e1</td>
<td>103.8</td>
<td>27%</td>
<td>30.5</td>
</tr>
<tr>
<td>e2</td>
<td>56.8</td>
<td>15%</td>
<td>31.1</td>
</tr>
<tr>
<td>e3</td>
<td>13.5</td>
<td>4%</td>
<td>17.9</td>
</tr>
<tr>
<td>f3</td>
<td>7.3</td>
<td>2%</td>
<td>0.0</td>
</tr>
<tr>
<td>h1</td>
<td>4.9</td>
<td>1%</td>
<td>2.8</td>
</tr>
</tbody>
</table>
Table 4.3.1 Comparison of Baseline & Reclaimed Vegetation

<table>
<thead>
<tr>
<th>Vegetation Map Unit</th>
<th>Baseline Terrain</th>
<th>Reclaimed Terrain</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ha)</td>
<td>(%)</td>
<td>(ha)</td>
</tr>
<tr>
<td>Mixed / Trans</td>
<td>0.0</td>
<td>0</td>
<td>61.1</td>
</tr>
<tr>
<td>Industrial</td>
<td>99.3</td>
<td>25</td>
<td>0.0</td>
</tr>
<tr>
<td>Regen</td>
<td>31.0</td>
<td>8</td>
<td>0.0</td>
</tr>
<tr>
<td>Shoreline</td>
<td>0.0</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>Water</td>
<td>9.1</td>
<td>2</td>
<td>135</td>
</tr>
<tr>
<td>Total</td>
<td>391</td>
<td>100</td>
<td>391</td>
</tr>
</tbody>
</table>

Neg. – The percentage value was negligible for the significant figures displayed.

Direct placement of soil materials has been demonstrated to enhance the revegetation program by introducing plant propagules consisting of dormant seed and root fragments. The propagules are transported with the soil materials to the replacement area. Over 60% of the reclamation will involve direct coversoil placement.

The use of woody plant species is a fundamental aspect of the revegetation program. Species selection and proportion is dependant on several factors, such as existing field conditions and the species that are common to the target eco-sites.

Undisturbed natural ground within the development footprint has been demonstrated to assist in the colonization of the reclaim areas by wildlife and as a source of native plant seed. Where possible, patches of undisturbed natural vegetation will be retained within the disturbance footprint.

Slash and deadfall material add value as an amendment to the replaced soils. The woody debris provides habitat for micro and mega fauna by supplying cover, nesting or denning sites. The woody debris also facilitates revegetation as the decomposing wood provides a moist and fertile seedbed.

4.4 Water Management

Quarry activities and mining operations will modify the natural hydrological and hydrogeological patterns in the vicinity of the Project. During quarry operations and closure, groundwater and surface water will be managed so that water draining from the Project meets accepted standards. At closure, a sustainable system of drainage channels, wetlands and end-pit lakes will be developed to manage groundwater and surface water. Consequently, while the overall topographical characteristics of the final closure landscape are the result of the material deposition plan for quarry mining, the surface details will be configured to meet the requirements of the sustainable drainage system.

4.4.1 Closure Reclamation Drainage Plan

The configuration of the proposed surface water drainage systems for the reclaimed landscapes includes main and secondary channels, wetlands areas, shoreline features and end-pit lakes. The closure drainage scheme will collect all runoff and drainage from around the development area, similar to the plan when the quarry is in full operation and direct it towards and into the three end pit lakes. Several wetlands will be strategically planned at major collection points between the end-pit lakes to provide the benefit of water treatment. The re-constructed
drainage channels will be developed as riparian areas through undisturbed ground or overburden materials.

4.4.2 End Pit Lakes

During the development of the quarry mine plan it will not be possible to completely backfill the depleted quarry areas to near surface grade. As a result, three end-pit lakes will be developed by PCA during the reclamation program for incorporation into the reclaimed landscape.

4.4.3 Erosion Control

Erosion of the reclaimed land surface is a natural process that will occur on the new landscape for the Project. In order to reduce the negative impact of erosion the landscape will be shaped to provide dips and swales that will reduce slope steepness and slope length thereby reducing surface flow rates and distance. Some erosion of cover soil material is expected to occur on steeper slopes and long slopes. The natural process of erosion, sediment transport and deposition within the reclaimed landscape may modify the thickness and texture of surface layers. The loss and deposition of soil adds to diversity and develops more natural soil landscapes. As vegetation cover becomes established and provides effective protection, the frequency and magnitude of erosion will decrease.

Drainage courses on the reclaimed landscape will shift over time as erosion occurs. The drainage courses will be designed to accommodate these changes through the use of erosion control systems such as the use of armouring with boulders and, in critical cases the establishment of vegetation. The reclaimed landscape will be monitored for erosion and managed as required.

4.4.4 Groundwater

The assessment of potential effects of the Project on groundwater resources considers changes to groundwater levels, flow patterns and quality including groundwater/surface water interactions. A Hydrogeological Impact Assessment was completed for the project (CR #10, Hydrogeological Impact Assessment).

The effects of seepage from the reclaimed landscape to surface water are assessed in the Hydrogeological Impact Assessment (CR #10, Hydrogeological Impact Assessment) and have been considered in the final water quality of the end pit lakes.

4.4.5 Reclamation Water Discharge

Implementation of a protocol by PCA will require that the following measures will be evaluated and implemented:

- forecasting the quality and quantity of reclamation discharges;
- constructing facilities to provide long term controls; and
- monitoring of the impacts of these discharges.

4.4.6 Aquatic Ecosystems

The Project reclaimed landscape will contain both natural and man-made waterbodies and watercourses. The following mitigation strategies have been designed to address issues that may affect the viability and suitability of the closure watercourses and waterbodies:
• all water bodies and watercourses will have a sustainable configuration to provide a stable closure landscape;
• water bodies and watercourses will be designed to provide fishery habitat with a productive capability equivalent to or greater than pre-development conditions;
• end pit lake releases will not occur until water quality objectives are met. Water quality in the end pit lakes was estimated (CR #9, Surface Water Impact Assessment) with consideration given for the three prime influences:
  • unnamed drainage channels;
  • Parsons Creek water; and
  • Athabasca River water;
• since the water quality is an estimate, future monitoring will be required to confirm the predictions; and
• if the end pit lakes are determined to have an effect on fish health, plans to establish a fishery in the lakes will be re-evaluated.

Management and mitigation options for watercourses and waterbodies are described in PCA 2010, Part E.

4.5  Conservation & Reclamation Plans

The Project development and reclamation process will establish several new landforms as depicted in Figure 4.5.1. PCA is committed to ensure that the final C&R and Closure Plan for the Project is integrated and compatible with adjacent leaseholders.

4.5.1  External Storage Areas (M3 NSL storage area)

The external storage areas will be designed and built to establish landforms that meet the overall reclamation goals of the Project. The slopes of the external M3-NSL storage area will be progressively reclaimed as the storage area is developed. Slopes will be contoured at variable angles ranging from 3:1 to a 6:1 gradient. After capping with a minimum cover of 0.9 m lift of overburden, soil will be spread on the recontoured slopes and subsequently revegetated.

4.5.2  End Pit Lakes

There will be three end-pit lakes when quarry mining is concluded. Within Mine Block 3, there will be two end-pit lakes. The West Lake will be along the east side of the Highway 63 right of way with sufficient setback distances from the carriage-way. This lake will have a final surface elevation at 238 m and a surface area of about 47.2 ha. The East Lake will be along the west side of the Athabasca River along the maintained 150 m wide undisturbed buffer zone. This lake feature will have a final surface elevation at 238 m and a surface area of about 31.9 ha.

Within Mine Block 2, there will be a single end-pit lake. This lake will also be along the east side of the realigned Highway 63 right of way with sufficient setback distances from the carriage-way. This lake will have a final surface elevation at 238 m and a surface area of about 55.6 ha. The upland side slopes approaching each of the end pit lakes will be contoured to provide limited access points to the shoreline areas (Table 4.5.2).
Wetland vegetation is expected to be introduced to the lake from the soils used for the shoreline reclamation and through the water flow through the lake. Some of the shoreline may receive direct planting of wetland vegetation species.

<table>
<thead>
<tr>
<th>Conceptual Design Characteristics</th>
<th>Mine Block 3 (West Lake)</th>
<th>Mine Block 3 (East Lake)</th>
<th>Mine Block 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Elevation (mASL)</td>
<td>238</td>
<td>238</td>
<td>238</td>
</tr>
<tr>
<td>Surface Area (ha)</td>
<td>47.2</td>
<td>31.9</td>
<td>55.9</td>
</tr>
<tr>
<td>Maximum Water Depth (m)</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Minimum Water Depth</td>
<td>3.5</td>
<td>2.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Mean Water Depth (m)</td>
<td>4.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Volume (dam$^3$)</td>
<td>1,699</td>
<td>861</td>
<td>2,012</td>
</tr>
<tr>
<td>Total Littoral Area (≤3 m in depth) (ha)</td>
<td>9.4</td>
<td>6.4</td>
<td>11.2</td>
</tr>
</tbody>
</table>

4.5.3 Parsons Creek

Local drainages that originated west of Highway 63 will be conveyed across the Project to the Athabasca River in a manner that avoids active quarry operations. The Project’s fish-bearing streams, Parsons Creek and UC6, will be preserved with the use of buffers that will not be disturbed by mining operations. The Parsons Creek buffer will be 100-metres wide (50 m from each side top of bank). Parsons Creek will require a temporary crossing during later quarry operations for equipment and vehicle movement between Mine Block 2 and Mine Block 1C.

With final reclamation and removal of the quarry infrastructure, the equipment and vehicle crossing will be removed and any disturbances of the slopes and banks resulting from the crossing installation will be reclaimed, ensuring the integrity of Parsons Creek drainage channel.

4.5.4 Linear Corridors

All quarry roads, utilities and powerlines will be reclaimed by PCA to equivalent capability during the closure of the mine. Access roads will have all of the culverts removed and will be recontoured to integrate with the surrounding landscape. With the replacement of reclamation materials it is anticipated that the roads will become part of the productive land base.

Due to the limited amount soil disturbance associated with powerline construction it is anticipated that the right of ways will naturally re-vegetate soon after all of the facilities are removed.

5.0 CONCLUSIONS

The Conservation and Reclamation (C&R) Plan for the Project outlines the vision, goals, approach and detailed plans for reclaiming all areas disturbed through the life of this project.
The primary reclamation goal of the Project is to return the lands to a capability that is equivalent to predevelopment conditions and consistent with end land use objectives.

The key components of the reclamation plan that will ensure these goals are met include:

- the Project has sufficient soil volumes to achieve equivalent land capability;
- salvaging and replacing both upland soil material and organics will add diversity to the reclaimed mine soils.
- the closure plan incorporates a general conversion of the disturbed area to upland, with the inclusion of several wetlands and three end-pit lakes;
- a significant amount of direct soil replacement is a key aspect of maintaining ecological diversity on reclaimed landscape;
- vegetation patterns will be similar to what existed prior to development with early seral stages that are capable of ecological succession;
- progressive reclamation allows for approximately two thirds of entire disturbed area to be reclaimed by the time mining is completed; and
- Incorporating adaptive management strategy into all development activities.
6.0 REFERENCES


Hatfield Consultants. 2009. Parsons Creek Aggregates Project. Surface Aquatic Resources. Prepared for Parsons Creek Aggregates. Vancouver, BC.


3.3.3 Quarry Mining Operations (Years 5-6)

Legend:
- Pit Operating
- Mining M1 and M2
- Overburden/Topsoil Storage
- Project Area
- River and Creek Buffer
- RDS Disposition
- Contour (2m interval)
- Access Road
- Highway
- Pipeline

No additional soil, overburden and vegetation removal required in Mine Block 3D

Reclamation Materials Stockpile Site

Quarry mining of M2 M1 Limestone deposit

M3-NiSL removed and placed in storage pile constructed in Mine Block 3A
No additional soil, overburden and vegetation removal required in Mine Block 3D

M3 NSL removed and placed in storage pile constructed in Mine Block 3A

Legend
- Pit Operating
- Mining M2
- Overburden/Topsoil Storage
- Project Area
- River and Creek Buffer
- RDS Disposition
- Contour (2m interval)
- Access Road
- Highway
- Pipeline

Quarry mining of M2 Limestone deposit

Quarry Access from Hwy 63

Reclamation Materials Stockpile Site

Reclamation Materials Stockpile Site

Parsons Creek Aggregates Project

Quarry Mining Operations (Years 7-8)
No additional soil, overburden and vegetation removal required in Mine Block 3D

Quarry mining of M2-M1 Limestone deposit

M3-NSL removed and placed in storage pile constructed in Mine Block 3A

Legend
- Pit Operating
- Mining M2
- Overburden/Topsoil Storage
- Project Area
- River and Creek Buffer

Parsons Creek Aggregates Project

Quarry Mining Operations (Years 9-10)
No additional soil, overburden, and vegetation removal required in Mine Block 3D

M3-NSL removed and placed in storage pile constructed in Mine Block 3A

45m development setback from property lines

Pond 1

Pond 2

Pond 3

Reclamation Materials
Stockpile Site

Reclamation Materials
Stockpile Site

Quarry mining of M3-M1 Limestone deposit

Legend

- Pit Operating
- Mining M2
- Overburden/Topsoil Storage
- LST M3 Storage Area
- Project Area

- River and Creek Buffer
- Contour (2m interval)
- Access Road
- Highway
- Pipeline

Projects

Parsons Creek Aggregates Project

Quarry Mining Operations (Years 1-5)
Athabasca River

Ft McMurray Urban Service Area

Reclamation Materials Stockpiles

Non-specification Lst ore (M3) stockpile area; up to 7.5 M tonnes / 5.0 M m³

Highway access

45m setback from property lines

45m from pond 1

45m setback from property lines

Portable crushing/screening plant (400t/hr) and stockpile area for 120,000 tonnes Lst rock products (10 ha)

Legend

- Portable Crushing/Screening Plant *
- Project Area
- Active Pit Operations
- LST M3
- Overburden/Topsoil Storage
- Mine Block
- River and Creek Buffer
- RDS Disposition
- Highway
- Powerline
- Pipeline

* Portable crushing/screening plant (400 t/hr) and stockpile area for 120,000 tonnes Lst rock products (10 ha).
Reclamation Materials Stockpiles

Non-specification Lot ore (M3) stockpile area; up to 7.5 M tonnes / 5.0 M m³

Highway access

45m setback from property lines

Portable crushing/screening plant (400 t/hr) and stockpile area for 120,000 tonnes LST rock products (10 ha)

Block 3C, 3B, 3A, est 21.0 M-tonnes for Years 11-20 Quarry operations

45m setback from property lines

Legend

- Portable Crushing/Screening Plant *
- Reclamation
- Highway
- Powerline
- Pipeline
- Mine Block
- River Block
- LST M3 Storage Area
- OB/TS Storage
- Active Pit Operations
- RDS Disposition
- Highway
- Powerline

* Portable crushing/screening plant (400 t/hr) and stockpile area for 120,000 tonnes LST rock products (10 ha).

3A 3B 3C 3D

45m setback from property lines

Annual reclamation

Highway access

45m setback from property lines

Portable crushing/screening plant (400 t/hr) and stockpile area for 120,000 tonnes LST rock products (10 ha)

Block 3C, 3B, 3A, est 21.0 M-tonnes for Years 11-20 Quarry operations

45m setback from property lines

Legend

- Portable Crushing/Screening Plant *
- Reclamation
- Highway
- Powerline
- Pipeline
- Mine Block
- River Block
- LST M3 Storage Area
- OB/TS Storage
- Active Pit Operations
- RDS Disposition
- Highway
- Powerline

* Portable crushing/screening plant (400 t/hr) and stockpile area for 120,000 tonnes LST rock products (10 ha).
Reclamation Materials Stockpiles

Non-specification Lot ore (M³) stockpile area; up to 7.5 M tonnes / 5.0 M m³

Highway access

45m setback from property lines

50m each side of Parsons Ck

45m setback from property lines

Portable crushing/screening plant (400 t/hr) and stockpile area for 120,000 tonnes LST rock products (10 ha)

Block 3A, 3B and 3B up to 25.0 M-tonnes for Years 21-30 of Quarry operations

Portable crushing/screening plant (400 t/hr) and stockpile area for 120,000 tonnes LST rock products (10 ha)

Legend

- Portable Crushing/Screening Plant *
- Mine Block
- River and Creek Buffer
- RDS Disposition
- Highway
- Powerline
- Pipeline

* Portable crushing/screening plant (400 t/hr) and stockpile area for 120,000 tonnes LST rock products (10 ha).

PROJECT:
Parsons Creek Aggregates Project

DATE:
CHECKED:
DRAWN:
FIGURE:

Quarry Mine Plan Years 21 - 30

4.0.3

REF: MEMS, Oct 2009
Reclamation Materials Stockpiles

Non-specification Lot ore (M3) stockpile area; up to 7.5 M tonnes / 5.0 M m³

Highway access

45m setback from property lines

45m from pond 1

45m from property lines

Ammended LOC 070854 proposed for future quarry and quarry work site access

Block 2A and 1C est up to 6.0 M tonnes for Years 26+ of Quarry operations

Block 2A and 1C est up to 6.0 M tonnes for Years 26+ of Quarry operations

Portable crushing/screening plant (400t/hr) and stockpile area for 120,000 tonnes LST rock products (10 ha).

Legend

Portable Crushing/Screening Plant *

Mine Block

River and Creek Buffer

RDS Disposition

Highway

Powerline

Pipeline

* Portable crushing/screening plant (400 t/hr) and stockpile area for 120,000 tonnes LST rock products (10 ha).

Quarry Mine Plan Years 31 - 36

Parsons Creek Aggregates Project