

**ALBERTA  
TRANSPORTATION  
POST-DISTURBANCE  
ASSESSMENT GUIDE FOR  
BORROW EXCAVATIONS**

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**Dec 2013 Edition**

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## **ACKNOWLEDGEMENTS**

This guide supersedes the document entitled *Alberta Transportation Post-Disturbance Assessment procedures for Borrow Excavations for Road Construction*. The original document was prepared in May 2002 by EBA Engineering Ltd.

This document was amended with input provided by Alberta Environment and Sustainable Resource Development, and Alberta Transportation.

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## **1.0 INTRODUCTION**

Under Alberta's current Environmental Protection and Enhancement Act (AEPEA), borrow excavations developed for road construction must be reclaimed to a land capability equivalent to its pre-disturbance land capability, in order to receive a Reclamation Certificate for the site. To determine whether a reclaimed borrow site is equivalent to its pre-disturbance capability, the site conditions after reclamation are normally compared to conditions existing on adjacent and comparable lands.

This document presents suggested procedures and criteria to carry out an assessment on reclaimed borrow excavations and their associated haul roads (borrow sites).

### **1.1 Professional sign-off**

Alberta Transportation requires all post-disturbance assessments be signed by a professional that is a member, in good standing, of one of the professional regulatory organizations identified below. All sign-offs must include the professional's signature, and either:

Registration/membership number, or Stamp/seal.

Alberta Transportation recognizes the following professional regulatory organizations whose scopes of practice include land reclamation activities:

- Alberta Institute of Agrologists (AIA);
- Alberta Society of Professional Biologists (ASPB);
- Association of Alberta Forest Management Professionals (AAFMP)
- Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGA); and
- Association of Science and Engineering Technology Professional in Alberta (ASET).

### **1.2 Data Collection**

In summary, a reclamation assessment involves collecting soil, terrain, and vegetation data on a reclaimed borrow site as specified in this document. Data from the borrow site are compared with data from undisturbed controls, to determine if the borrow site has been returned to equivalent capability. These controls are normally undisturbed land adjacent to the disturbance, chosen to have similar characteristics to the borrow site prior to disturbance. Information documented in a pre-disturbance assessment of the site can be used when adjacent controls do not adequately represent pre-disturbance land

capability (see companion document “Alberta Transportation Pre-Disturbance Assessment Guide for Borrow Excavations”).

Comparison criteria are presented that indicate the limits by which the reclaimed borrow site characteristics, as indicated by the data, are allowed to vary from the control characteristics. Topics include:

1. Specific criteria for terrain, soil, and vegetation on a reclaimed site (Section 2.0).
2. An outline of the basic steps involved in carrying out a reclamation assessment on a reclaimed borrow site (Section 3.0).

## 2.0 RECLAMATION CRITERIA

Reclamation criteria have been developed for terrain, vegetation, and soil characteristics that are components of land capability (see Appendix A for definitions of technical terms).

**Terrain characteristics** of a reclaimed borrow excavation are critical. The re-contouring, re-establishment of drainage patterns, and stability of slopes of the reclaimed site affect the land capability of both the site itself and the surrounding land. Debris, stones, or gravel on the soil surface, or within the topsoil, can degrade the land capability of the reclaimed site by hindering plant growth and farming operations.

**Vegetation characteristics**, such as productivity, species composition and plant health, are all indicators of land capability. Individual crops, however, may respond differently to changes in soil, weather, and management conditions. Vegetation characteristics alone, therefore, cannot be used as a complete measure of land capability. Soil and terrain characteristics must also be considered.

**Soil quality characteristics** are important to any assessment of land capability. Soil must supply plants with physical support, nutrients and water. Topsoil quality is critical to plant germination and nutrient supply. Subsoil quality is important to root penetration, water availability, and the health and vigour of mature plants. No single measure can adequately describe soil quality. The reclamation criteria, therefore, use a number of soil characteristics, which together are indicators of land capability.

Reclamation criteria, and the associated assessment processes, vary depending on the area of the province and date of site construction. Different criteria and assessment procedures have been developed for the Green Area (generally Crown Land reserved for forestry use) and the White Area (privately owned land or Crown Land which is arable or potentially arable) in Alberta. In addition, topsoil depth criteria vary depending on the date of construction, in order to accommodate different standards of construction in the past (pre 1999).

## **2.1 Site Controls**

All reclamation criteria are based on a comparison of terrain, vegetation, and soil data collected from a borrow site after reclamation is complete, with similar data collected from undisturbed controls. Data for the controls are obtained from adjacent land that has topography, soil, vegetation and past management similar to the pre-disturbance site. Usually, this is land immediately adjacent to the disturbed area and in the same field. In many cases, data from the reclaimed site cannot be compared directly to data collected in a pre-disturbance assessment for a number of reasons:

1. Pre-disturbance data may be collected by a different assessor, with a different level of expertise and experience than the post reclamation data
2. Vegetation cannot be compared between years because of differences in weather, management practices, and crop type
3. Control locations placed along the perimeter may not adequately represent interior anomalies on large sites, irregular sites, or sites with dugouts. In these instances, fewer points may be acceptable.
4. Most older borrow excavation sites have no pre-disturbance data

## **2.2 Using Pre-Disturbance Assessment Data**

Pre-disturbance assessment information available for a site can explain or defend a conclusion that is different from a conclusion reached by comparing off-site controls to the reclaimed site data. This can occur when adjacent controls do not represent the pre-disturbance land capability very well, or when the pre-disturbance land capability is not apparent from the reclaimed site.

Since it is not uncommon for borrow sites to be developed on land previously disturbed by road construction, and borrow sites frequently have drastically different topography

after reclamation as compared to before, it is in the best interests of operators to carry out pre-disturbance assessments on all sites.

The following examples summarize situations in which pre-disturbance assessment information is critical to a reclamation assessment.

1. The crest of a knoll to be removed for borrow was originally eroded, with little or no topsoil and very sparse crop growth. Over the years, topsoil eroded from the top of the knoll has been deposited on lower slopes adjacent to the area to be disturbed by the borrow excavation. As a result, the crop growth adjacent to the knoll was much better than on the knoll crest. With no pre-disturbance site information, the reclaimed borrow site would be compared to the deeper, better quality adjacent soils for the reclamation assessment. If pre-disturbance conditions are properly documented, this information can be used to explain thinner topsoil and poorer crop growth on the reclaimed site compared to adjacent controls.
2. A proposed borrow area includes part of an area that has been previously disturbed by earlier borrow activity for road construction. The area previously disturbed has 10 cm of poor quality topsoil that was replaced when the site was originally reclaimed. Adjacent undisturbed areas have 25 cm of good quality topsoil and an additional 20 cm of good quality subsoil. In this situation, it is important that the thin, poor quality topsoil on the previously disturbed area be clearly documented, so that it can be used to explain poorer topsoil quality on the reclaimed site compared to adjacent undisturbed controls.
3. On large sites, anomalies in the middle of the borrow area are not present along the perimeter and thus the control sites cannot be reproduced.

### **2.3 Terrain Criteria**

Borrow excavations usually require the alteration of land grades because substantial volumes of material are removed. The altered grades should not adversely impact the future land use or land capability of the site or adjacent land. Drainage patterns, contours, sediment and erosion issues, debris, and stoniness are some of the changes that could affect future land use and land capability on reclaimed borrow excavations and associated haul roads.



Borrow areas typically fall into one of two categories: dugout, or landscape borrow excavations. Backsloped areas outside of the highway right-of-way fall into the landscape borrow excavation category.

### **2.3.1 Dugout Borrow Excavations**

Dugout borrow excavation sites are typically developed in areas of flat topography and may intercept the local water table. In the White Area of the province, a dugout must be of practical use. Dugouts are usually water-filled as appropriate to their intended use. Terrain criteria for dugout borrow excavations are summarized in **Table 1**. Note that disturbed areas around a dugout and haul roads must meet reclamation criteria for landscape borrows (**Table 2**).

### **2.3.2 Landscape Borrow Excavations**

Landscape borrow excavation sites are typically developed in areas of rolling topography and normally do not intercept the water table. They usually involve the removal of a portion of a hill or slope and can result in steep final grades if not properly reclaimed. Terrain criteria for landscape borrow excavations are summarized in **Table 2**.

## **2.4 Vegetation Criteria**

For most projects, vegetation has not yet established at the time of initial assessment. A secondary assessment after the vegetation has established may be requested on occasion in order to obtain a reclamation certificate, or address other issues.

### **2.4.1 White Area**

A number of vegetation characteristics are included in the criteria for White Area sites. The choice of appropriate measures of vegetation productivity depends on the vegetation or crop in question and its maturity. Vegetation on the borrow excavation site is to be compared directly to adjacent undisturbed controls.

Vegetation must be mature when it is assessed. Tame forages are considered mature after one full growing season, including an over-wintering. Cereal crops are considered mature when they begin to head out. Flowering crops (canola, mustard, flax, etc.) are considered mature when they begin to flower.

Since weather, management practices, and crop type at a site vary significantly from year to year, a direct comparison of crop characteristics on the site before and after disturbance is usually not possible. Pre-disturbance vegetation data, however, should be collected wherever possible, to defend a conclusion that is different from the conclusion reached by comparing off-site controls to the reclaimed site data. For example, documentation of an area of poor crop growth before disturbance can be used to explain a similar area of poor crop growth after the site is reclaimed.

Fertilizer application on the borrow site or haul road must be equivalent to off-site application. For example, a landowner normally fertilizes both the site and off-site control as part of normal operations. Alternatively, the site can be fertilized to bring it up to the same nutrient levels as the off-site control soil, based on laboratory soil fertility analyses. In the latter case, copies of the lab results for the site itself and off-site controls, justifying different fertilizer applications, should be included in the reclamation assessment report.

Measures of vegetation productivity for various types of vegetation are listed in **Table 3**. At least two different measures of productivity should be used, such as per cent cover and height for a forage crop or height and head length for a grain crop. Reclamation criteria for vegetation are presented in **Table 4**.

#### **2.4.2 Green Area**

Green Area sites must be vegetated satisfactorily, and vegetation cover must be sufficient to prevent erosion. Commonly, Transportation uses a standard native seed mix, based on regions, and application rates to ensure a uniform vegetative cover is established. However, ESRD increasingly desires natural recovery methods (the seed present within the topsoil is allowed to regenerate the site). At a minimum record:

1. The three dominant herbaceous species including percentage of vegetation cover
2. All woody species by genus
3. Visual indications of vegetation health

## 2.5 Soil Criteria

Soil conditions on a reclaimed site should be compared to the average of the control sites for topsoil depth, texture and tilth. Detailed soil criteria must be gathered for both borrow excavations and haul roads in both the Green and White Area

Where there are distinct zones or units on a reclaimed site, the reclaimed site and the adjacent control area can be divided into different zones. Each zone on the site can then be compared to the control assessment zones and similar pre-disturbance assessment zones. For example, on a site with both a well-drained upland area and a poorly drained wetland area, the reclaimed upland area can be compared to adjacent upland controls, and the reclaimed wetland area can be compared to adjacent wetland controls.

### 2.5.1 Topsoil Depth Criteria

Topsoil depths should be compared to the average off-site control depth. Topsoil depth criteria specify both the acceptable average depth of topsoil replacement, and the minimum acceptable depth of replacement.

Where significantly admixed with subsoil, topsoil can be distinguished by having soil properties that match more closely with off-site topsoil properties than off-site subsoil properties. The percentage of admixed topsoil should be documented in the assessment.

Topsoil depth criteria are presented in **Table 5**.

### 2.5.2 Topsoil Texture Criteria

Topsoil texture is assessed in the field using standard hand texturing techniques. Soil texture categories are based on the texture triangle used by Agriculture Canada and the Canadian System of Soil Classification (CSSC)<sup>1</sup> (see **Figure 1**). The soil texture categories used are very fine, fine, moderately fine, medium, moderately coarse, and coarse.

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<sup>1</sup> Soil Classification Working Group, 1998. The Canadian System of Soil Classification. 3rd Edition. Research Branch, Agriculture and Agri Food Canada, Publication 1646. 187 p.

To assess topsoil texture, determine the texture of the topsoil in the field at each control and borrow site inspection location. Assign a soil texture rating according to **Table 6**. Reclamation criteria are presented in **Table 7**.

### 2.5.3 Topsoil Tilth Criteria

Topsoil tilth is defined as the physical condition of the soil as it relates to plant growth. A rating system is used to assess the quality of topsoil tilth. Soils with the best quality ped (natural aggregation of soil particles) size and strength (consistency) for crop growth are assigned a rating of one. As the topsoil tilth quality decreases, soils are assigned higher values.

Where topsoil depths are greater than 20 cm, assign the tilth rating to the top 20 cm. Topsoil tilth problems below 20 cm are assessed as profile restrictions. When performing an assessment, assign a topsoil tilth rating to soils at each control, and each site inspection location, using Table 8. Ratings for properties that are transitional from one class to another should be interpolated. For example, a soil with ped size <1 cm and a hard-to-very-hard consistency would be assigned a tilth rating of 1.5. Topsoil tilth criteria are presented in **Table 9**.

### 2.5.4 Soil Profile Restriction

Soil profile restrictions occur when soil physical properties restrict normal plant root growth in the soil. Categorize the severity of soil profile restrictions as slight, moderate or severe at all site assessment locations and controls, and assign a rating using Table 10 as a guide. Assign a soil profile restriction rating to both topsoil and subsoil at each assessment point. Soil profile restriction criteria are presented in **Table 11**.

### 2.5.5 Additional Assessment Considerations for Forested Lands in the Green Area

- The presence of large stones on the surface may be acceptable as they may enhance small scale roughness and do not unduly effect normal forested land uses<sup>2</sup>
- The presence of restricting layers within 50 cm of the surface is not permitted

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<sup>2</sup> *Guide to: Reclamation Criteria for Wellsites and Associated Facilities-2007-Forested Lands in the Green Area Update-ESRD pg 9*

- Fine woody debris, such as mulch, may be spread evenly over the site. Depths of 5 cm or more require rationale and indication how any potentially negative effects on soil thermal properties and/or vegetation development have been or will be addressed<sup>3</sup>
- Coarse woody debris and leaning trees have been slashed, limbed and bucked flat to the ground and spread evenly over the site
- Where surplus debris has been burned, 80% has been consumed and the remainder has been spread out across the adjacent area<sup>4</sup>
- The Temporary Field Authority (TFA) approval conditions should be reviewed for requirements that may impact the ability to meet the topsoil average and minimum replacement depth and quality on agricultural lands. For Example, the creation of small scale roughness to enhance use by wildlife and deter ATV usage could impact the ability to uniformly replace topsoil

### **3.0 RECLAMATION ASSESSMENT PROCEDURES**

A reclamation assessment should include the following:

#### **3.1 Gather Background Information**

Collect all available background information. Information required includes dates of disturbance and reclamation, equipment used, seed mixes, inputs, and amendments used. Review the pre-disturbance assessment if there is one, along with any available survey plans and site sketches, approval conditions or special provisions. If the site is an old disturbance with no pre-disturbance assessment, historical airphotos can be useful. Determine whether the site is in the Green or White Area of the province.

#### **3.2 Landowner Contact**

Contact the landowner and occupant, if any, regarding reclamation or other environmental concerns they may have about the site.

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<sup>3</sup> Management of Wood Chips on Public Land, External Directive id 2009-01, Lands Division, ESRD

<sup>4</sup>Debris Management Standards for Timber Harvest operations FO-SOP-Debris disposal, ESRD May13, 2013

### 3.3 Identify Extent of Site

Make sure the extent of the disturbance is clearly marked. The disturbed area should be accurately marked by someone who knows the boundaries of the disturbance, both the excavation itself and any associated haul roads. If there is a survey plan of the disturbance, the site can be re-surveyed. If the boundaries of the disturbance are not known, for example, on an older site, the extent may be more difficult to determine, particularly when there is no accurate survey available. In that case, you may have to rely on evidence of soil or vegetation disturbance, topographic features of the site, comparison with historical airphotos, and interviews with the landowner or occupant, and construction or engineering personnel associated with the project. Note that the extent of the actual disturbance is often different than the area originally covered by the pre-disturbance assessment.

### 3.4 Site Overview

Take a look at the site as a whole. This may entail walking around the perimeter of the site, depending on its size, or viewing the site from one or more high points on or adjacent to the site. Draw a site sketch. A survey plan of the disturbance can be used as a basis for the sketch. If no survey plan is available, a sketch of the site, to scale if possible, should be drawn. Note on your site sketch features like fences, roads, buildings, stands of trees, low areas, water bodies, ditches, drainage channels, adjacent land use, and vegetation. General direction of slopes and topography of the site should be indicated. Photographs of the site should be taken at this time, and their location and direction recorded on the sketch. Record any visible soil, terrain, and vegetation problems. Record any obvious reclamation problems, such as bare areas or sparse vegetation, and areas with ponded water.

### 3.5 Overall Terrain Assessment

Report your observations of the terrain on the reclaimed site. **Tables 1 and 2** indicate terrain characteristics that should be noted. Remember that terrain criteria are different for dugout borrows and landscape borrows (see Section 2.3).

### 3.6 Borrow Site and Haul Road Assessment locations

Normally, the reclaimed borrow excavation and any associated haul roads are assessed as one unit. All control data are averaged, and compared to averages of data from the reclaimed borrow excavation and haul road. If the terrain on the haul road is very different from the terrain on the borrow excavation site, the road and borrow site may be assessed separately. For example, if a haul road was built over an area of organic soils (muskeg) to access borrow from a well-drained knoll, the reclaimed borrow excavation could be compared to well drained borrow excavation controls, and the haul road area could be compared to haul road controls on the organic soils.

1. Determine the minimum number of site inspection and control locations needed to assess the borrow site and haul road (see **Table 12**). Note that the values given in **Table 12** are the minimum number of site inspection locations required. For complex sites, additional site inspection locations must be added to document variability.
2. Choose appropriate off-site control locations. Locations chosen should be as representative of the pre-disturbance borrow site as possible. Control locations must be located at least 10 m from the borrow site or haul road disturbance, and should be carefully chosen to represent the range of conditions that most probably existed on the site prior to the disturbance. Add extra control locations, where necessary, to describe the variability in terrain, vegetation and soil adjacent to the disturbed area. Plot all off-site control locations accurately on the site sketch (**Table 12**).
3. Choose site inspection locations on the disturbed area, so that they are evenly spaced over the site. Each site inspection location is considered to represent the area around it to a distance half way between adjacent site inspection locations. Plot all site inspection locations accurately on the site sketch. Assess vegetation and soil characteristics at each site inspection location, as required to apply the criteria discussed in Section 2.0.
4. If one of the site inspection locations does not meet all of the soil criteria, an additional 'step-out' inspection should be carried out at that location. A 'step-out' inspection consists of three additional inspections, done approximately 5 m from



the initial inspection location in a triangular shape around it. The average of the data for the three 'step-out' inspections is then used to represent that site inspection location.

5. If the borrow site does not meet the criteria, more reclamation work may be required to bring the site up to acceptable standards. Soil and vegetation at the site must be re-assessed once additional reclamation work is completed.

### 3.7 Reclamation Assessment Reporting

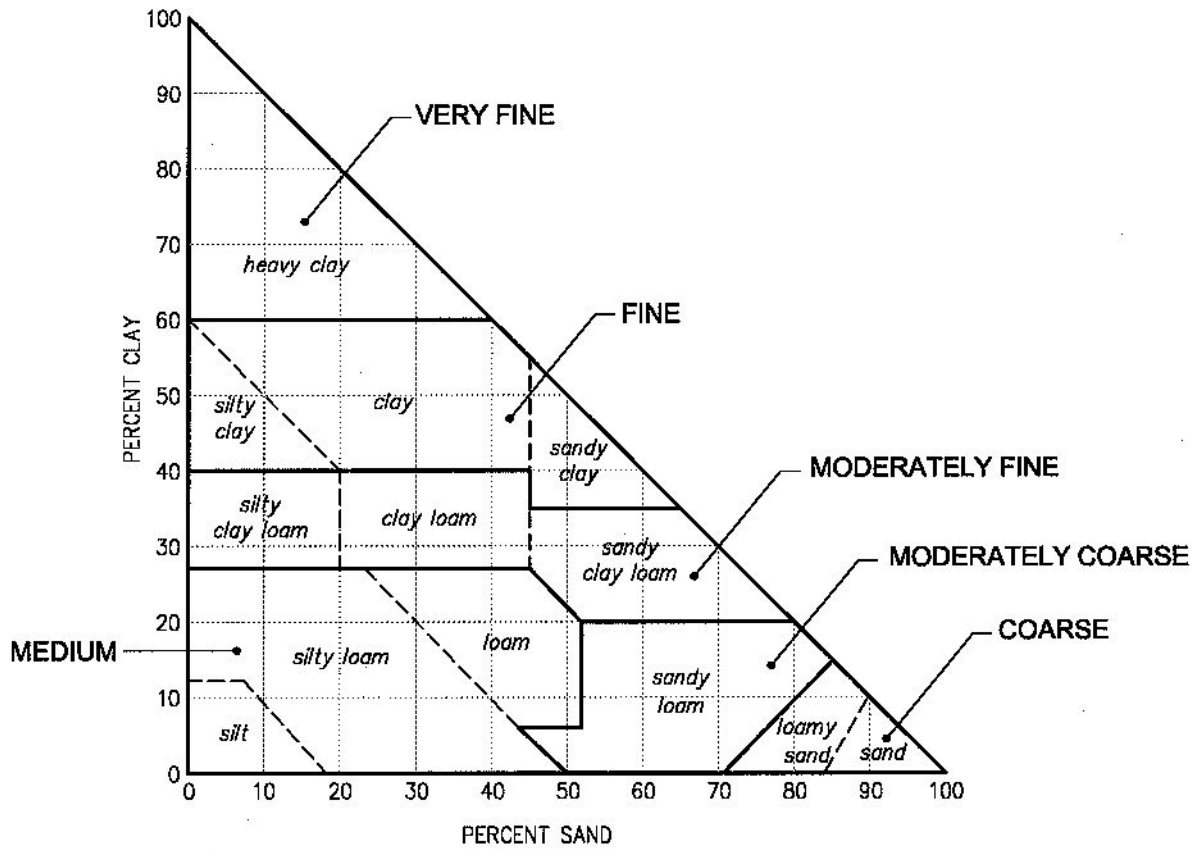
A reclamation assessment report is completed for each borrow excavation. The assessment report should contain the following information:

1. **Recommendation** to accept or reject the reclaimed conditions
2. **Site information**, including client, project name, borrow excavation designation, assessor's name(s), date assessed, size of disturbance, and relevant background information
3. **A history of the site**, including information on how the site was stripped (depths of first and second lifts etc.), equipment used, problems encountered, amount of material extracted, and any other information pertinent to reclamation
4. **A description of the present condition of the site**, if the reclamation criteria have been met, and any necessary explanations, if it has not
5. **A site sketch**, including all site inspection locations, replaced topsoil depths, crop productivity data, and other prominent features of the new landscape, such as low or wet areas, slopes, knolls, etc.
6. **A summary table** of terrain, soil and vegetation data collected during the post-reclamation assessment process and comparison to control and pre-disturbance site data
7. **Site photos**

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## **FIGURE**

Figure 1 - Soil Texture Classes



**Figure 1**  
Soil Texture Classes

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## **TABLES**

- Table 1 - Terrain Criteria for Dugout Borrow Excavations
- Table 2 - Terrain Criteria for Landscape Borrow Excavations
- Table 3 - Vegetation Productivity Characteristics
- Table 4 - Vegetation Criteria
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- Table 6 - Topsoil Texture Rating
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- Table 11 - Soil Profile Criteria
- Table 12 - Recommended Minimum Numbers of Site Inspection Locations

**Table 1**  
**Terrain Criteria for Dugout Borrow Excavations**

<b>Drainage</b>	<ul style="list-style-type: none"> <li>• Dugout must be located and designed to be fully functioning for its intended purpose, and typical of the general area.</li> <li>• Site drainage for disturbed areas around the dugout:             <ol style="list-style-type: none"> <li>1. Must drain towards the dugout</li> <li>2. Must be compatible with the surrounding terrain, land use, and land management practices</li> </ol> </li> </ul>
<b>Contour</b>	<ul style="list-style-type: none"> <li>• Reclaimed slopes of the dugout should be 4:1 or flatter on end slopes, and 2:1 or flatter on the remaining sides. The slopes should be set to minimize the extent of the disturbance, reduce the risk of erosion, and allow access</li> <li>• Contour and roughness of the backslope and disturbed area surrounding the dugout must conform and blend with adjacent contours</li> <li>• Dugout should intersect the groundwater table or be constructed to collect and hold water.</li> </ul>
<b>Stability</b>	<ul style="list-style-type: none"> <li>• Dugout banks and backslopes:             <ul style="list-style-type: none"> <li>- Must be stable, with no slumping or erosion</li> <li>- Banks and slopes, particularly those above the water line, must be stabilized and free of gully erosion</li> </ul> </li> </ul>
<b>Debris</b> (slopes and surrounding areas)	<ul style="list-style-type: none"> <li>• No industrial or domestic debris is allowed</li> <li>• On sloped areas surrounding dugouts, no woody debris (wood, roots, slash, etc.) that could interfere with vegetation growth or with normal use of adjacent land is allowed</li> </ul>

Note that disturbed or damaged areas around the dugout must be assessed with the same criteria and in the same way that a landscape borrow would be assessed.

**Table 2**  
**Terrain Criteria for Landscape Borrow Excavations**

<b>Drainage</b>	<ul style="list-style-type: none"> <li>Site drainage for the disturbance area should be compatible with the surrounding terrain</li> </ul>																												
<b>Erosion</b>	<ul style="list-style-type: none"> <li>No erosion in excess of that noted in pre-disturbance assessment, or equivalent to erosion noted adjacent to the site</li> </ul>																												
<b>Contour</b>	<ul style="list-style-type: none"> <li>The disturbed area should be contoured to match the surrounding land or should be consistent with intended land use</li> </ul>																												
<b>Stability</b>	<ul style="list-style-type: none"> <li>No visible evidence of slope movement, slumping, or subsidence is allowed</li> </ul>																												
<b>Debris</b>	<ul style="list-style-type: none"> <li>No industrial or domestic debris allowed</li> <li>No woody debris (wood, roots, slash, etc.) that could interfere with growth or with normal use of adjacent land</li> </ul>																												
<b>Surface Stoniness</b> Includes both stones and gravel (coarse fragments)	<ul style="list-style-type: none"> <li><b>White Area:</b> Surface stoniness class must be no greater than the stoniness class of the adjacent controls or the pre-disturbance conditions</li> <li><b>Green Area:</b> Meet requirements of the surface disposition on public lands</li> </ul> <p><i>Surface Stoniness Classes:</i></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">non-stony</td> <td style="text-align: center;">- coarse fragments</td> <td style="text-align: center;">&gt;30 m apart</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">slightly stony</td> <td style="text-align: center;">- coarse fragments</td> <td style="text-align: center;">10 - 30 m apart</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">moderately stony</td> <td style="text-align: center;">- coarse fragments</td> <td style="text-align: center;">2 - 10 m apart</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">very stony</td> <td style="text-align: center;">- coarse fragments</td> <td style="text-align: center;">1 - 2 m apart</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">exceedingly stony</td> <td style="text-align: center;">- coarse fragments</td> <td style="text-align: center;">10 cm - 1 m apart</td> </tr> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">gravelly</td> <td style="text-align: center;">- coarse fragments</td> <td style="text-align: center;">5 - 10 cm apart</td> </tr> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">very gravelly</td> <td style="text-align: center;">- coarse fragments</td> <td style="text-align: center;">&lt;5 cm apart</td> </tr> </table>	0	non-stony	- coarse fragments	>30 m apart	1	slightly stony	- coarse fragments	10 - 30 m apart	2	moderately stony	- coarse fragments	2 - 10 m apart	3	very stony	- coarse fragments	1 - 2 m apart	4	exceedingly stony	- coarse fragments	10 cm - 1 m apart	5	gravelly	- coarse fragments	5 - 10 cm apart	6	very gravelly	- coarse fragments	<5 cm apart
0	non-stony	- coarse fragments	>30 m apart																										
1	slightly stony	- coarse fragments	10 - 30 m apart																										
2	moderately stony	- coarse fragments	2 - 10 m apart																										
3	very stony	- coarse fragments	1 - 2 m apart																										
4	exceedingly stony	- coarse fragments	10 cm - 1 m apart																										
5	gravelly	- coarse fragments	5 - 10 cm apart																										
6	very gravelly	- coarse fragments	<5 cm apart																										

**Table 3**  
**Vegetation Productivity Characteristics**

<b>Characteristic</b>	<b>Description</b>
<b>Plant Height</b>	<ul style="list-style-type: none"> <li>• Plant height can be used for all annual and tame forage crops <i>except</i> forages that have been recently grazed or cut, and have little or no regrowth</li> <li>• Where a mixture of diverse species is seeded, (e.g., an alfalfa and timothy mix) the height for each species, or group of similar species, can be recorded</li> </ul>
<b>Percent Cover</b>	<ul style="list-style-type: none"> <li>• A visual assessment of the ground surface visually obscured by the live vegetation and litter looking down directly in front of the assessor is indicative of aboveground biomass</li> <li>• This measurement can be used for most annual and forage crops, with the exception of some row crops such as corn, and crops that are very tall when assessed</li> </ul>
<b>Head Length</b>	<ul style="list-style-type: none"> <li>• Head length is appropriate for any cereal crop that has fully headed out</li> <li>• For canola, the length of the pod producing stem and the average length of pods or the average number of pods can be recorded</li> </ul>
<b>Plant Density</b>	<ul style="list-style-type: none"> <li>• Number of plants, tillers or stems per area (e.g., 25 stems per 10 cm<sup>2</sup>) or per length of seed row</li> </ul>
<b>Stubble Density</b>	<ul style="list-style-type: none"> <li>• If the crop has been harvested, the number of tillers or stems per area or length of seed row (e.g., 10 plants per 10 cm<sup>2</sup>) can be used, if no other vegetation data is available</li> </ul>

**Table 4  
Vegetation Criteria**

	<b>White Area Annual Crops and Tame Forage</b>	<b>White Area Native Forage</b>	<b>Green Area Forested</b>
<b>Species Composition</b>	<ul style="list-style-type: none"> <li>Revegetated species composition must be similar to the original or compatible with adjacent, off-site control vegetation and adjacent land use</li> <li>Percent cover of weeds must be less than or equal to control; types of weeds must be similar to control</li> <li>For native forage sites, seeding of non-aggressive agronomic species should produce a cover sufficient to prevent erosion, but sparse enough to assist natural encroachment of native species</li> </ul>		<ul style="list-style-type: none"> <li>Alberta Transportation's standard native seed mix</li> <li>Consult appropriate authority for area-specific requirements</li> </ul>
<b>Vegetation Productivity*</b>	<ul style="list-style-type: none"> <li>Where off-site control vegetation is similar, vegetation productivity* must be <math>\geq 80\%</math> of control average</li> <li>The required vegetation must be evenly distributed on the site, or be similar to the distribution on the control</li> </ul>	<ul style="list-style-type: none"> <li><math>\geq 60\%</math> cover (plants + litter) with a minimum of 40% plants, with plants evenly distributed</li> <li>Cover must be sufficient to prevent erosion</li> </ul>	<ul style="list-style-type: none"> <li>Cover must be sufficient to prevent erosion</li> <li>Reforestation of sites may be required. Consult the appropriate authority</li> </ul>
<b>Vegetation Health</b>	<ul style="list-style-type: none"> <li>Plants must be of similar or better health and vigour compared to off-site control</li> </ul>		
<p>* Refer to Table 3 to choose appropriate measures of plant productivity. Use two or more different, but appropriate measures of productivity (e.g., plant height and head length for a grain crop, plant height and % cover for a tame forage crop, plant height, and number of tillers for corn).</p>			



**Table 5**  
**Topsoil Depth Criteria**  
**(for sites disturbed in 1999 or later\*)**

<b>Required Replacement Depth (RRD) of Topsoil</b>	<b>Minimum Allowable Depth (MRD) of Topsoil</b>
<ul style="list-style-type: none"> <li>• RRD is 80% of the average control** topsoil depth</li> <li>• (RRD = average control depth x 0.8)</li> </ul>	<ul style="list-style-type: none"> <li>• MRD is 80% of the RRD (MRD = RRD x 0.8)</li> <li>• 10% of assessment points may be lower than the MRD provided none are lower than MRD x 0.8, and they are not adjacent</li> </ul>
<p>Example: A reclaimed site has an average control topsoil depth of 20 cm</p> <ul style="list-style-type: none"> <li>• RRD = 20 cm x 0.8 = 16 cm</li> <li>• MRD = 16 cm x 0.8 = 13 cm</li> <li>• 10% of site assessment points could be as low as 13 cm x 0.8 = 10 cm, provided RRD and MRD are met, and the points are not adjacent</li> </ul>	

\* Consult Alberta Environment and Sustainable Resource Development for topsoil depth requirements for sites disturbed before 1999.

\*\* The average control depth is to be used unless the pre-disturbance assessment identified separate zones, or depth of stripping.

**Table 6**  
**Topsoil Texture Rating**

Rating	Topsoil Texture Categories	Topsoil Texture (see Figure 1)
1	Very coarse	Sand, loamy sand
2	Moderately coarse	Sandy loam
3	Medium	Loam, silty loam, silt
4	Moderately fine	Sandy clay loam, clay loam, silty clay loam
5	Fine	Heavy clay, clay, silty clay, sandy clay
<p>Examples:</p> <ol style="list-style-type: none"> <li>1. Silt loam to silty clay loam has a texture rating of 3.5</li> <li>2. Sandy loam to loamy sand has a texture rating of 1.5</li> </ol>		

**Table 7**  
**Topsoil Texture Criteria**

Criteria	Allowable Variability
The difference between the average site texture rating and the average control texture rating must not be more than 0.2, either higher or lower	Texture ratings at each assessment point must be no more than one texture rating higher or lower than the highest and lowest control point texture ratings

**Table 8  
Topsoil Tilth Rating\***

Consistency			Ped size (cm)			
Wet	Moist	Dry	<1	1 to 2	2 to 5	>5
Slightly sticky	Very friable, friable	Soft, slightly hard	1	1	1	2
Sticky	Firm	Hard	1	2	3	4
Very sticky	Very firm	Very hard, extremely hard	2	3	4	5

Examples:

1. Topsoil with firm consistency and average ped size 2 to 5 cm has a tilth rating of 3
2. Topsoil with friable to firm consistence and 1 to 2 cm ped size has a tilth rating of 1.5

\* Where topsoil is deeper than 20 cm, assess the tilth of the upper 20 cm only.

**Table 9  
Topsoil Tilth Criteria**

Criteria	Allowable Variability
The <u>average</u> site tilth rating must not be more than 0.2 higher than the average control tilth rating (i.e., average site tilth rating minus average control tilth rating $\leq 0.2$ )	Tilth ratings at each assessment point must be no more than one tilth rating higher than the highest control point tilth rating

**Table 10**  
**Soil Profile Restriction Ratings**

<b>Degree</b>	<b>Restriction Rating</b>	<b>Type of Characteristic</b>	<b>Indicator Characteristics</b>
Severe	2	Physical root restriction	<ul style="list-style-type: none"> <li>Root mats, bunches, flattened, and highly branched roots are common, abundant ex-ped, horizontal roots</li> </ul>
		Subsoil structure	<ul style="list-style-type: none"> <li>High density, with massive or thick layered soil structure, very hard or plastic peds</li> </ul>
		Vegetation	<ul style="list-style-type: none"> <li>Obviously reduced vegetation growth over much of the affected area (reduced plant height, density, cover, vigour, health, early or late maturation, increased weeds, or uneven crop height)</li> </ul>
		Water permeability	<ul style="list-style-type: none"> <li>Surface ponding and rutting, abrupt or stratified moisture changes in the soil profile, gleyed soil colours or mottles, chlorotic vegetation</li> </ul>
Moderate	1	Physical root restriction	<ul style="list-style-type: none"> <li>Common root mats, root bunches, flattened, and highly branched roots, ex-ped, and horizontal roots</li> </ul>
		Subsoil structure	<ul style="list-style-type: none"> <li>Larger angular blocky to thick platy structure, hard peds</li> </ul>
		Vegetation	<ul style="list-style-type: none"> <li>Sporadic reduction in vegetation growth (uneven or reduced crop height or cover, early maturation, may be increased weeds)</li> </ul>
Slight	0.5	Physical root restriction	<ul style="list-style-type: none"> <li>Occasional root mats, flattened, and highly branched roots, ex-ped roots and horizontal roots</li> </ul>
		Subsoil structure	<ul style="list-style-type: none"> <li>Firm to slightly hard, angular blocky or thin platy structure</li> </ul>
		Vegetation	<ul style="list-style-type: none"> <li>No visible effect on vegetation</li> </ul>
None	0	All characteristics	<ul style="list-style-type: none"> <li>No obvious profile restrictions</li> </ul>

**Table 11**  
**Soil Profile Criteria**

Criteria	Allowable Variability
Average soil profile restriction rating for the site must be less than or equal to the average rating for the controls	Highest soil profile restriction rating on the site must be no higher than highest control root restriction rating

**Table 12**  
**Recommended Minimum Numbers of Site Inspection Locations**

Site Size*	Number of Site Assessment Points **	Number of Control Points ***
<b>Borrow Sites</b>		
3 ha or less	9/ha	1/3 of number of assessment points
> 3 ha	5/ha (min 27)	1/3 of number of assessment points
<b>Haul Roads</b>		
<100 m length	1	1
>100 m length	1/per 100 m length	1 per 100 m length
<p>*Site size excludes dugout portion</p> <p>** Additional site assessment points may be needed to characterize site adequately, or to delineate deficient areas. Fewer points may be needed for Green Area borrow sites that are reclaimed with rough terrain as per TFA requirements from ESRD</p> <p>*** Control locations placed along the perimeter may not adequately represent interior anomalies on large sites, irregular sites, or sites with dugouts. In these instances, fewer points may be acceptable.</p>		

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**APPENDIX A**

**GLOSSARY OF TERMS**

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## APPENDIX A

### GLOSSARY OF TERMS

<b>A horizon (topsoil)</b>	A mineral horizon formed at the surface in the zone of removal of materials by leaching, or maximum accumulation of organic carbon, or both, as defined by the Canadian System of Soil Classification (CSSC) <sup>1</sup> .
<b>Ae</b>	An A horizon that has had clay, iron, aluminum, or organic matter, or all of these leached from it. Ae horizons are usually grey coloured with a platy structure, as defined by CSSC.
<b>Ah</b>	An A horizon in which organic matter has accumulated as a result of biological activity, as defined by CSSC.
<b>Ahe</b>	An A horizon that has some organic matter accumulation, as well as some leaching of clay, iron, or aluminum, as defined by CSSC.
<b>Ap</b>	An A horizon markedly disturbed by cultivation, as defined by CSSC.
<b>Admixing</b>	The mixing of subsoil into topsoil during soil stripping, handling, storage, or reclamation.
<b>B horizon</b>	A subsoil horizon characterized by enrichment in organic matter, or clay; or by the development of soil structure; or by a change of colour denoting hydrolysis, reduction, or oxidation, as defined by CSSC.
<b>C horizon</b>	A mineral subsoil comparatively unaffected by the pedogenic processes operative in the A and B horizons except for the process of gleying or the accumulation of calcium carbonates or other salts, as defined by CSSC.
<b>Consistency</b>	The resistance of a soil to deformation, the degree of cohesion or adhesion of the soil mass.
<b>Green Area</b>	Public Lands General Land Classification. Forest lands not available for agricultural development other than grazing.
<b>First lift</b>	The top layer of undisturbed soil materials salvaged and separated during excavation to be re-spread as topsoil.

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## APPENDIX A

### GLOSSARY OF TERMS

<b>Horizon (soil)</b>	A layer of mineral or organic soil that differs from adjacent horizons in properties such as colour, structure, texture, and consistence, and in chemical, biological, and mineralogical composition.
<b>Land capability</b>	The nature and degree of limitations imposed by the physical characteristics of a land unit for a certain use.
<b>Organic matter</b>	The decomposition residues of biological materials derived from plant and animal materials deposited on the surface of the soil; and roots and micro-organisms that decay within the soil.
<b>Ped</b>	Fine soil particles held together in a single cluster, such as in a clod or a crumb.
<b>Profile (soil)</b>	A vertical section of the soil through all its horizons and extending into the C horizon.
<b>Root zone</b>	The part of the soil that is occupied by plant roots.
<b>Second lift</b>	The second layer of undisturbed soil material that underlies the first lift, which is salvaged and separated during excavation to be replaced as upper subsoil.
<b>Subsoil</b>	Soil material defined as B and C horizons by CSSC.
<b>Solonetzic</b>	An order of soils with stained brownish or blackish solonetzic B (Bn, Bnt) horizon and a saline C horizon, as defined in CSSC.
<b>Texture</b>	The relative proportions of sand, silt and clay in a soil.
<b>Tilth</b>	The physical condition of the soil in relation to plant growth.
<b>Topsoil</b>	All soil materials defined by CSSC as A horizon.



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## **APPENDIX A**

### **GLOSSARY OF TERMS**

**White Area**            Public Lands General Land Classification; Privately owned lands. Available public lands in this area, which are suitable for the proposed use and are not required for conservation, recreational, wildlife habitat, forestry and other purposes, may be applied for pursuant to the Public Lands Act and associated regulations