2010 Reclamation Criteria for Wellsites and Associated Facilities for Forested Lands

(Updated July 2013)



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Disclaimer: The July 2013 Update replaces previous releases of the 2010 Reclamation Criteria. The references used in the document were current at the time of publication: assessors are advised to check with the appropriatewebsites for possible updates.

1. Preface

The Government of Alberta protects the province's land resources by ensuring land used for industrial activities is reclaimed in an environmentally sound manner. This is directed through the *Environmental Protection and Enhancement Act* (EPEA) and the *Conservation and Reclamation Regulation*. Under EPEA, after an upstream oil and gas facility has been decommissioned, operators must obtain a reclamation certificate. Reclamation certificates are managed through the Alberta Upstream Oil and Gas Reclamation and Remediation Program.

In 2005, the Reclamation Criteria Advisory Group (RCAG) was established to review and provide recommendations for upgrading the 1995 Updated Reclamation Criteria for Wellsites and Associated Facilities (Alberta Environment, 1995). The review of the 1995 Reclamation Criteria was done according to Alberta Environment's Sustainable Resource and Environmental Management (SREM) model, which requires specified outcomes and science-based policy development. The process brought together representative stakeholders to ensure balanced and thorough outcomes.

RCAG included representation from Alberta Agriculture and Rural Development (AARD), Alberta Energy Regulator (AER), Alberta Forest Products Association (AFPA), Canadian Association of Petroleum Producers (CAPP), Environment and Sustainable Resource Development (ESRD), and landowners (independent, Alberta Surface Rights Federation, Wildrose Agricultural Producers). RCAG members attended task groups for cultivated, native grasslands, forested and peat lands in order to address the unique issues for each land type. Reclamation criteria were completed for cultivated lands, native grasslands, and forested lands while, criteria are still under development for peat lands.

A review of reclamation standards for upstream oil and gas facilities is timely because of improvements in reclamation practices, scientific developments and recommendations for improving the former criteria. The Reclamation Criteria Advisory Group (RCAG) began with an assessment of the 1995 Criteria: intending to retain the parts that worked and improving the parts that did not. These Criteria themselves will be continually improved as knowledge of ecosystem processes improves.

Task groups for cultivated, grass, forested and peat lands addressed the unique issues for each land type. Ecological health & function and land operability were objective indicators of equivalent land capability after successful reclamation. Importantly, according to the following litmus tests these criteria are to be:

- Science-based, reproducible and testable as they address ecosystem and management functions on a landscape basis.
- Workable as they offer alternatives or options, where applicable, to promote efficiency and recognize constraints.

- Enforceable as they compel compliance through explicit performance measures and decision, acceptable to all stakeholders with risk transferred to the Government of Alberta.
- Equitable as per cost vs. benefit analysis for all stakeholders after agreed upon changes in land use.
- Transparent as they offer clear rationale for assumptions and decisions (e.g., choice of parameters).

It is recommended that the 2010 Criteria be updated periodically as knowledge of ecosystem processes improves.

2. Table of Contents

1.	PRE	ACE		III
2.	TAB	LE OF C	ONTENTS	V
3.	LIST	OF TAE	BLES	VIII
4.	LIST	OF FIG	URES	IX
5.			DATES	
6.			TION	
	6.1.		OUND	
7.			S IN THE 2010 CRITERIA	
	7.1.		SE CHANGES	_
	7.1. 7.1.1		nged from Peatland	
	7.1.2		nged from Cultivated Land	
8.	THE	ASSESS	SMENT PROCESS ON FORESTED LANDS	6
	8.1.	IMPLEM	ENTATION OF THE 2010 FORESTED LANDS CRITERIA	6
	8.2.		TION OVERRIDE	
	8.3.	ITEMS C	OUT OF SCOPE	10
	8.4.	USE OF	PROFESSIONAL JUDGMENT	10
	8.5.	ASSESSN	MENT TOOL AND RECORD OF OBSERVATION DATASHEETS	11
	8.5.1	. Requ	iired Information, No Alternatives Allowed	11
	8.5.2	· ·	uired Information, Alternative Forms Permitted	
	8.6.		NG AND SAMPLING THE SITE	
	8.6.1		mum Disturbance Sites	
	8.6.2 8.6.3		pling on Variable Sites rmining Sample Intensity on the Lease	
	8.6.4		rmining Sample Intensity on the Access	
	8.7.		MENT COMPARISONS	
	8.7.1	. Ratir	ng Categories	17
	8.7.2	. Phys	ical Measurements	18
9.	LAN	DSCAPE	E ASSESSMENT	19
	9.1.	DRAINA	GE	19
	9.1.1	-	ace Water Flow	
	9.1.2 9.1.3		lingrian Functions	
	9.1.3 9.2.	•	N	
	9.2. 9.2.1		er Erosion	
	9.2.2		d Erosion	
	9.3.	SOIL STA	ABILITY	21
	9.3.1	. Slum	pina/Wastina	21

9.3.2.	Subsidence	21
9.4. E	Bare Areas	22
9.5. (Operability	22
9.5.1.	Contour	22
9.5.2.	Gravel and Rock	22
9.6.	DEBRIS	2 3
9.6.1.	Woody Debris	
9.6.2.	Industrial and domestic refuse	
	GETATION ASSESSMENT	
10.1.	Desired Plants	24
10.1.1	· · · · · · · · · · · · · · · · · · ·	
10.1.2		
10.2.	QUANTITY	
10.2.1.		
10.2.2		
	QUALITY	
10.3.1. 10.3.2.		
	WEEDS / UNDESIRABLE PLANTS	
	LITTER AND LFH	
	IL ASSESSMENT	
	LEVEL 1 SOIL ASSESSMENT: SOIL QUANTITY AND QUALITY	
11.1.1. 11.1.2.	· · · · · · · · · · · · · · · · · · ·	
11.1.3		
11.1.4	•	
11.2. l	LEVEL 2 SOIL ASSESSMENT (OPTIONAL)	33
11.2.1	Sampling	34
11.2.2	g,	
12. OT	HER CONSIDERATIONS	36
12.1. F	PESTS AND WEEDS	36
12.2.	TOPSOIL ADDITIONS	36
12.3. <i>A</i>	Amendments	36
13. AP	PENDIX A	38
13.1.	Nater Act & Riparian Areas (WR)	38
13.1.1		
13.1.2	·	
13.1.1		
13.1.2. 13.1.3	,	
	PENDIX B	
	SUPPLEMENTAL INFORMATION FOR VEGETATION	
15 ΔP	PENDIX C	42

15.1	L. SUPPLEMENTAL MATERIAL FOR SOILS	42
16.	APPENDIX D	43
16.1	L. FORESTED LAND CRITERIA RATING TABLES	43
17.	APPENDIX E	49
17.1	L. EXEMPTION JUSTIFICATION FORM	49
18.	APPENDIX F	50
18.1	L. REFERENCES USED FOR THE 2010 RECLAMATION CRITERIA	50
19.	APPENDIX G	53
19.1	L. GLOSSARY	53
20.	APPENDIX H	64
20.1	L. CONTACT INFORMATION	64
21.	APPENDIX I	65
21.1	L. REGIONAL OFFICES	65

3. List of Tables

Table 1. Implementation dates for the new reclamation criteria based on construction period	8
Table 2. Sampling intensity based on size of disturbance on the site	15
Table 3. Tolerances for rating categories and physical measurements for the vegetation and soil criteria according to sampling intensity	17
Table 4. Landscape methodology parameters none of which require a rating	19
TABLE 5. VEGETATION METHODOLOGY PARAMETERS AND THEIR RESPECTIVE ASSESSMENT TOOL QUESTIONS WHICH MAY OR MAY NOT ALSO REQUIRE EITHER A RATING AND/OR PHYSICAL MEASUREMENT	
Table 6. Soil methodology parameters and their respective Assessment Tool Question which may or mot also require either a rating and/or physical measurement.	
Table 7. Commonly observed indicators or root, permeability and aeration restrictions	33

4. List of Figures

WHICH MAY OR MAY NOT HAVE UNDERGONE A LAND-USE CHANGE. THE PEATLAND CRITERIA REFERS TO THE 1995 UPDATE WHICH WILL REMAIN IN EFFECT UNTIL A NEW CRITERIA OR GUIDE HAS BEEN RELEASED
FIGURE 2. ASSESSMENT DECISION PATH FOR FORESTED SITES
Figure 3. Level 1 assessment locations with an approximate 37 m x 37 m grid. Assessment points are representative sampling area is a circular plot with a 1.78 m radius totaling 10m^2
FIGURE 4. EXAMPLES OF A LEASE SKETCH FOR A FULL DISTURBANCE (LEFT) SITE AND A LEASE SKETCH (RIGHT) FOR MINIMAL DISTURBANCE SITE
FIGURE 5. SITE STRATIFICATION THE FIGURE ON THE LEFT SHOWS NO STRATIFICATIONS (NO ZONES) WHILE THE FIGURE ON THE RIGHT SHOWS TWO ZONES
FIGURE 6. SOIL ASSESSMENT LOCATIONS ALONG ACCESS ROUTES THAT ARE <400 M (A: TOP FIGURE) OR > 400 M (B: BOTTOM FIGURE).
FIGURE 7. FIGURES SHOWING EXAMPLES FOR MACRO- (30-100 M) AND MESO-CONTOUR (10-30 M) (FIGURE LEFT) AND MICRO-CONTOUR (<10 M WIDTH) (FIGURE RIGHT)
FIGURE 8. FIGURES SHOWING EXAMPLES FOR SURFACE STONINESS (FIGURE LEFT) AND COARSE FRAGMENT CONTENT (FIGURE RIGHT)

5. List of Updates

Update Section		Description			
July		Citation changed to:			
Reclama		Environment and Sustainable Resource Development (ESRD). 2013. 2010 Reclamation Criteria for Wellsites and Associated Facilities for Forested Lands (Updated July 2013). Edmonton, Alberta. 99 pp.			
July	1	3 rd Paragraph, 1 st Sentence: The following name changes were made:			
2013		Environment and Sustainable Resource Development (ESRD) replaced Alberta Environment (AENV) and Sustainable Resource Development (ASRD). Alberta Energy Regulator (AER) replaced Energy Resources Conservation Board (ERCB)			
		*Note: Similar name and abbreviation changes have been made through the document where appropriate.			
July 2013	3	List of Tables added			
July 2013	4	List of Figures added			
July 2013	5	List of Updates added			
	6-21	Section titles updated accordingly			
or reviewer is not limite his/her assessment. 6 th Paragraph, 1 st Sent revised: Land Manage Environment and Sust for stewarding public/c Areas this will include Special Areas this will Lands, this includes the 6 th Paragraph, 1 st Sent revised: Regulator: On this refers to Environment.					
		6 th Paragraph, 1 st Sentence, 1 st Bullet for the Land Manager Definition was revised: Land Manager : For Public Lands , this includes staff from <i>Environment and Sustainable Resource Development (ESRD)</i> responsible for stewarding public/crown lands. For Provincial Parks and Protected Areas this will include staff from Tourism, Parks and Recreation. For Special Areas this will include the Special Areas Board. For Private Lands , this includes the landowner, their designate, or occupant.			
		6 th Paragraph, 1 st Sentence, 2 nd Bullet for the Regulator Definition was revised: Regulator : On Public Lands , Private Lands and Special Areas this refers to Environment and Sustainable Resource Development (ESRD).			
July 2013	7	4 th Paragraph, 3 rd Sentence was revised: Grasslands may have a percentage of both native and tame species, hence the name <i>modification</i> and are to be assessed under Grassland Criteria.			
July 2013	7.1	1 st Paragraph, 1 st Sentence was revised to read: If a site changes land use (Figure 1), the Land Manager <u>must</u> be involved in the discussion but any such changes will require their written agreement.			
		Callout box revised, moved up from Section 7.1.2			
		Figure 1 caption revised: Selection process for forested lands for selecting an appropriate land use criteria for sites which may or may not have undergone a land-use change. The Peatland Criteria refers to the 1995			

		Update which will remain in effect until a new criteria or guide has been released.		
July	8.1	2 nd Paragraph, 7 th Sentence revised: These are defined as:		
2013		 Undisturbed Areas: include areas of the lease or access where it is documented that there has been no surface soil disturbance. Generally, this applies where slopes are minimal and lease leveling was not necessary 		
		• Disturbed areas: <u>include areas of the lease</u> or access that have undergone stripping (e.g., stripping, or storage and including points like well-centre and flare pits and longitudinal effects like ruts). In some cases (e.g., soils that were not frozen) even though soil stripping was not conducted, traffic may have caused compaction, pulverized soil, rutting, or clodding.		
July 2013	8.2	1 st Paragraph, 1 st Sentence revised: Where reasonable forest cover (<i>i.e.</i> , amount, species and distribution) is present, and where <u>additional</u> activities <u>are required</u> to meet the conditions described in this criteria <u>pose a risk</u> to existing ecosystem function, a vegetation override may be appropriate.		
July 2013	8.3	1 st Paragraph, 1 st Sentence revised: Contamination: Drilling waste and other oilfield wastes must be properly disposed of according to <u>AER</u> <u>Directives</u> .		
July 2013	8.4	Callout box, 2 nd Paragraph, 1 st Sentence was revised to readconducting the assessment, <i>when possible</i> , to discuss options.		
2013 as a whole. Question		Callout box added: Note: The Assessment Tool questions apply to the site as a whole. Questions should be answered as though they apply to the entire site including associated infrastructure being assessed.		
		Section revised to reflect changes in the naming within the RoO and Assessment Tool.		
July 2013	8.5.2	1 st Paragraph, 1 st Sentence revised: This information is contained within the electronic tool that accompanies the 2010 Reclamation Criteria		
		Section revised to reflect changes in the naming within the RoO and Assessment Tool.		
July	8.6.1	2 nd Paragraph, 2 nd Sentence revised: The entire site must undergo the landscape assessment to allow confirmation and verification of the areas identified as being:		
landscape and vegetation		 Undisturbed Areas: areas of the lease that require a Level 1 landscape and vegetation assessments along with verification (i.e., photos) that soils haven't been disturbed must be provided; and, 		
		■ <u>Disturbed Areas:</u> areas of the lease that require a complete Level 1 assessment (i.e., landscape, vegetation and soil assessments). Vegetation and soil assessments need to be completed at each assessment point on the lease at assessment spacing ≤40 m, with the appropriate number of control assessment points (Figure 4, next page).		
July 2013	8.6.4	1 st Paragraph, last sentence revised to read: Assessing the access shall be as follows:		
		■ <u><400 m:</u> assessment points shall be located at a maximum spacing of 100 m (Figure 6A)		

		 >400 m: assessment points shall be located to reflect different mapping units, (i.e., topographic, vegetation and/or soils variability) with a minimum of one (1) assessment point per map unit or a minimum of one (1) assessment point per 800 m (Figure 6B) 		
July 2013	8.7	1 st Paragraph, 2 nd Sentence revised: The assessment comprises of pass/fail decisions based comparisons between onsite and offsite assessments using ratings and surrogates of ecosystem function.		
resulting in a failure, a provided they meet the (excluding Provincial Criteria for all other procomparison for Contral a single source of we historical weed mana that the weeds or investigations of the contral single source of we historical weeds or investigations.		Callout box added: NOTE: On forested sites where weed issues arise resulting in a failure, applications can be submitted as Routine Applications provided they meet the following conditions:1) The site is on Public Lands (excluding Provincial Parks and Protected Areas); 2) The site has met Criteria for all other parameters being assessed; but, 3) Fails the comparison for Controlled and/or Undesirable/Problem weeds as a result of a single source of weeds from offsite. Application shall include data, photos, historical weed management, and supporting information clearly indicating that the weeds or invasive plants are from an offsite location and were not associated with/introduced from the operators holdings.		
between land and water bodies and include any adjoins or directly influences a water body (e.g.,		1 st Paragraph, 1 st Sentence was revised: Riparian lands are transition zones between land and water bodies and include any geographic area that adjoins or directly influences a water body (<i>e.g.</i> , streams, lakes, ponds, <i>and wetlands which may include floodplains</i>) and land that directly influences alluvial aquifers and may be subject to flooding.		
		The following sentence was deleted: See AER Directive (in progress). This Directive has not been completed.		
July 2013	9.1.3.1	2 nd Paragraph, 1 st Sentence was revised to read: <u>AER Directive 056</u> (<u>Energy Development Applications and Schedules</u>) along with other applicable provincial and federal legislation (<i>i.e.</i> , Environmental Protection and Enhancement Act, Water Act, Public Lands Act and the Navigable Waters Protection Act) requires water bodies be protected during construction and through the operating life of the project		
July 2013	9.2.1	2 nd Paragraph, 2 nd Sentence was revised: Rilling, pedestaling or presence <u>of</u> depositional fans		
July 2013	9.2.2	1 st Paragraph, 2 nd Sentence was revised: Evidence of wind erosion cannot be greater <i>onsite</i> than in the surrounding landscape.		
July 2013	9.3.2	1 st Paragraph, 2 nd Sentence was revised: Rounded smooth edges <u>are</u> <u>observed</u> rather than sharp breaks.		
July 2013	9.5.1	Figure 7 was added		
July 2013	9.5.2	1 st paragraph, 1 st Sentence was revised: Surface Stoniness/ <u>Coarse</u> <u>Fragment Content:</u>		
		Figure 8 was added		
July 2013	10	Table 5 under Litter and LFH, under the Measurement heading No was replaced with Yes. These should be documented in the RoO if present.		
July 2013	10.1.2	Callout box, 2 nd Paragraph, 1 st Sentence was revised: If the site has been planted to seedlings a minimum of 2 growing seasons are required prior <u>to</u> conducting the Vegetation Assessment for the submission of a reclamation certificate application		

July 10.1.2.1 2013		The following sentence was added: Onsite vegetation species must be appropriate for the representative ecosites.		
		Callout box added: Older Sites: Where offsite/control areas consist of trees/shrubs in late seral stages, the data collected is intended to identify the target community, ecosite and community variability. Woody Vegetation (i.e., height, stem count, and leader growth) Measurements for the control are not required. Weeds and herbaceous as well as woody species should still be identified, as well as soils.		
		Younger Sites: Where offsite/control areas consist of trees/shrubs in early successional stages that may be comparable to the Onsite area (i.e., wellsite constructed within a cutblock) the data collected is intended to identify the target community, ecosite and community variability. Measurements for the Offsite Area are required and need to be documented.		
		2nd Paragraph, 3rd Sentence, 4th Bullet was revised: For sites planted with merchantable tree/shrub species the expected planting density is 2000 stems per hectare, or 2 stems per assessment location.		
July 2013	10.4	Callout box added: Note: Use of Nonnative species must be discussed and approved by the Land Manager.		
July 2013	11.1.4.1	2 nd Paragraph, 3 rd Sentence was revised: To determine soil texture, collect a representative handful from the surface horizon, crush it by hand, and determine texture and <u>rating</u> .		
July 11.1.4.2 2013		3 rd paragraph was revised: For all assessment points, topsoil and subsoil consistency and structure need to be assessed and rated separately and results recorded in the Record of Observation (RoO) datasheet.		
July 12.2 2013		2 nd Paragraph, 1 st Sentence was revised: Where topsoil is added to improve soil quantity and/or quality (and controls are not similarly amended), the physical (<u>e.g.</u> , texture, color, etc.) and chemical properties (<u>e.g.</u> , pH, routine salinity package, etc.) of the topsoil require characterization prior to their use.		
July 2013	12.3	Callout box added: Note: The two year waiting period also applies If amendments, including fertilizer, are only applied onsite so that the management practices between on- and offsite are comparable.		
July 2013	Appendix – A: 13.1.3.2	In the heading ERCB, 2008 was replaced by AER, 2008		
July	Appendix - D	Rating table revision:		
2013		FRT 4: Table was revised to remove the instructions regarding conducting soil structure assessments based on soil consistence results.		
July	Appendix – F	Reference changed from:		
2013		Energy Resources Conservation Board (ERCB). 2008. Directive 056: Energy Development Applications and Schedules. Energy Resources Conservation Board, Calgary, AB. July 2008. 320 pp. [Online: http://www.ERCB.ca]		
		То:		
		Alberta Energy Regulator (AER). 2008. Directive 056: Energy Development Applications and Schedules. Alberta Energy Regulator, Calgary, AB. July 2008. 320 pp. [Online: http://www.AER.ca]		

July	Appendix – G	Definitions revised for:
2013		Compatible Species: For the purposes of the 2010 Reclamation Criteria for Forested Lands, these are the seeded species that were part of a seed mix that was appropriate to the time period or as outlined in historical agreements with the Land Manager. For the purposes of the 2010 Reclamation Criteria for Native Grasslands, these are species used for reclamation on sites prior to 2010. These species are comprised of native species but may not be native to the subregion and agronomics that are suitable for grazing purposes. They do not include weeds, Problem Introduced Forages, mosses or lichens.
		Disturbed Areas : areas of the lease or access have undergone stripping (e.g., stripping, or storage and including points like well-centre and flare pits and longitudinal effects like ruts). In some cases (e.g., soils that were not frozen) even though soil stripping was not conducted, traffic may have caused compaction, pulverized soil, rutting or clodding to the extent that the native community (i.e., species and/or layers) has been altered or removed.
		Land Manager: For Public Lands, this includes staff from Environment and Sustainable Resource Development (ESRD) responsible for stewarding public/crown lands. For Provincial Parks and Protected Areas this will include staff from Tourism, Parks and Recreation. For Special Areas this will include the Special Areas Board. For Private Lands, this includes the landowner, their designate, or occupant.
		Native Species: A plant species that is indigenous to the ecosite. For the purposes of the 2010 Native Grassland Reclamation Criteria, native species refer to those species existing offsite found within the control area.
		Native-Infilling Species: For the purpose of the 2010 Reclamation Criteria for Native Grasslands are a combination of native species from the controls or were seeded that are establishing on the disturbed area and are indistinguishable as to their source. They are considered desirable as they are part of the local native plant community and their presence is a measure of native species recruitment and progress along a successional pathway.
		Percent Native-Infill Vegetation: For disturbed wellsites, the percent cover of Native-Infill species on the reclaimed area, relative to the total cover of native species on the control. Need to have greater than 15% of the control for a pass.
		Regulator: For the purposes of the 2010 Reclamation Criteria on Public Lands, Private Lands and Special Areas this refers to Environment and Sustainable Resource Development (ESRD).
		Third-party impacts: pre-oil and gas, Land Manager, Landowner (or designate) activities, such as, recreational or industrial use, trails, wildlife.
		Undisturbed Areas : include areas of the lease or access where there has been no surface soil disturbance and the native plant community has remained relatively intact (<i>i.e.</i> , the on/offsite vegetation community and layers are similar). Generally, this applies where slopes are minimal and lease leveling was not necessary.
July 2013	Appendix – H	Address changed: Energy Resources Conservation Board - Main Office: Suite 1000, 250 – 5 Street, SW; Calgary, AB T2P 0R4; Phone: 403-297-8311; Fax: 403-297-7040; Email: lnfoservices@ercb.ca
		Changed to: Alberta Energy Regulator - Main Office: Suite 1000, 250 – 5

	Street, SW; Calgary, AB T2P 0R4; Phone: 403-297-8311; Fax: 403-297-7040; Email: lnfoservices@AER.ca
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6. Introduction

6.1. Background

The aim of reclamation under Environmental Protection and Enhancement Act is to obtain equivalent land capability. "Equivalent land capability" is defined in the Conservation and Reclamation Regulation as "the ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to an activity being conducted on the land, but that the individual land uses will not necessarily be identical." The 2010 Criteria are to be used to evaluate whether a site has met equivalent land capability. The criteria are based on land function and operability that will support the production of goods and services consistent in quality and quantity with the surrounding landscape.

The intent of the 2010 Criteria is to measure appropriate parameters and evaluate whether land function and operability is comparable to the surrounding area or an appropriate reference. The certification criteria describe the allowable changes in site conditions. They typically require landscape, vegetation and soils assessments as was a component of the 1995 Update. In special cases, the operator may have to find representative land, soil and vegetation a short distance from the site or use available reference plant community or ecosite descriptions.

Note: The reclamation criteria apply to wellsite leases and access roads, and associated facilities such as pits, campsites, and offsite sumps. With written agreement from the Land Manager, they do not apply to facilities or features that are left in place as developed (e.g., roads, pads, dugouts) although these facilities or features will be covered by the reclamation certificate. These facilities or features must be stable, non-erosive, non-hazardous and have no impact to off-lease lands.

For the purposes of these criteria, the term Specified Land, means land that is being or has been used or held for or in connection with the construction, operation or reclamation of a well, battery or pipeline (excerpt from the Conservation and Reclamation Regulation (115/93))

It is necessary to characterize the natural variability associated with various land uses and landscapes and make a reasonable comparison using appropriate sampling methodologies. Given the complexity of the different land use types, soil zones and landscapes, it is acknowledged the 2010 Criteria may not be applicable to all sites under all circumstances. The assessor, operator, inspector, Land Manager or reviewer is not limited to the methods identified in the criteria to draw his/her conclusion on 'equivalent capability'. Where such circumstances occur and the operator is satisfied that the site is ready to certify, an application can be submitted but must be accompanied with a detailed justification as to why the methodologies in the criteria do not support certification yet the site does meet 'equivalent capability'. This application

will be a **Non-Routine Application** and may require consultations with the Regulator prior to submission to avoid a refusal if the justification is found unacceptable.

Based on experience with the 1995 Update (Alberta Environment, 1995), the RCAG made a consensus decision to streamline the assessment of satisfactorily reclaimed sites (*i.e.*, that will qualify for *Reclamation Certification* after a Level 1 assessment) versus sites that have anomalies that might still pass after a more detailed (Level 2) assessment. Sites that fail either the Level 1 assessments or the optional Level 2 assessment must be mitigated.

A fundamental principle carried forward in these criteria is that the success of land reclamation is measured against the representative (adjacent) site conditions with due consideration for construction norms at the time of development. The criteria will be used to judge reclamation success and issue the reclamation certificate. The operator must supply information relative to the criteria on the Wellsite Reclamation Certificate Application. The 2010 Reclamation Criteria is comprised of two components that include:

- Assessment Process and Criteria: This outlines the standards and methodology used for assessing various components of the Landscape, Vegetetation, and Soil Assessments that make up the 2010 Reclamation Criteria.
- Assessment Tool and Record of Observation (RoO) Datasheets: The Assessment Tool for each land type pose Yes/No questions based on what is present onsite compared to offsite and whether it meets the standard set out in the Rationale.

For the purpose of this 2010 Reclamation Criteria the following definitions apply:

- Land Manager: For Public Lands, this includes staff from Environment and Sustainable Resource Development (ESRD) responsible for stewarding public/crown lands. For Provincial Parks and Protected Areas this will include staff from Tourism, Parks and Recreation. For Special Areas this will include the Special Areas Board. For Private Lands, this includes the landowner, their designate, or occupant.
- Regulator: On Public Lands, Private Lands and Special Areas this refers to Environment and Sustainable Resource Development (ESRD).

7. Land Types in the 2010 Criteria

Under the 2010 Criteria, the following land types have been identified: Forested Lands, Cultivated Lands, Native Grasslands and Peatlands. The definitions of the land uses follow:

Forested Lands includes any treed land, whether or not the forest vegetation is utilized for commercial purposes. Treed (bush) lands in the White Area (deedable land) that is to be maintained as 'treed' shall meet the forested criteria. Land in the White Area where a landuse has been changed to cultivation must meet the cultivated criteria. In the Green Area (crown land), native meadows or range improvement areas in grazing dispositions may be assessed using the grasslands or cultivated lands criteria, with approval from the Land Manager.

Cultivated Lands include lands managed under conventional, minimum or zero till practices for agricultural purposes. Land use changed from peatland, forested land or grassland to cultivated land is included here. The cultivated land criteria also apply to trees planted for agroforestry (*i.e.*, tree farms), tame forages, tame pasture, hay lands or areas seeded to perennial agronomic species.

Native Grasslands include lands that are permanently grassed that include a native component. Native grasslands commonly present a mixture of different native grass species, forbs (*i.e.*, flowering/broad-leaved species), shrubs (*i.e.*, woody species) and tree species, whereas tame grasslands (*i.e.*, forage and tame pasture) produce agronomic seeded grass and legume species such as timothy and alfalfa. Grasslands may have a percentage of both native and tame species, hence the name modification and are to be assessed under Grassland Criteria. For grasslands that have been cultivated/seeded to agronomic species and the land use goal is to be managed as tame forage for hay or pasture, they shall be assessed under the Cultivated Land criteria.

Peatlands include areas where the end land use is to be a functioning bog or fen. Where disturbed peatlands are to be reclaimed to an alternative end land use (*i.e.*, cultivated lands or forested lands), agreement with the Land Manager must be reached and the reclamation criteria for that agreed land use is to be used for assessment purposes.

7.1. Land Use Changes

If a site changes land use (Figure 1, next page), the Land Manager must be involved in the discussion but any such changes will require their written agreement. Should a landuse change occur Assessors should refer to Figure 1 for the appropriate Criteria to use for conducting the reclamation assessment.

Note: If the land use (i.e., forested to cultivated) has changed at a site a signed agreement from the private or public land owner/manager, or their designate is required. Figure 1 can be used to determine the appropriate criteria to be used for the assessment. The application is still considered a Routine Application.

7.1.1. Changed from Peatland

On former peatland sites that have been reclaimed to a forested ecosystem, the soils quantity criteria does not apply, however the site must be assessed for soil stability, vertical processes and vegetation. The area must not cause offsite impacts. Vegetation may not be representative of the adjacent offsite (wetland) but must be on the same trajectory as a corresponding offsite upland eco-site based on the eco-site guide for the region.

7.1.2. Changed from Cultivated Land

On former cultivated sites that have been reclaimed back into a forested ecosytem, such as a manged woodlot, the forested criteria would apply. For cultivated sites that have been reclaimed back into agroforestry (e.g. plantations, biomass plantations, etc.) the cultivated criteria would still be applicable. Vegetation may not be representative of the adjacent offsite and would rely on the professional judgement of the assessor with respect to the successional trajectory of the replanted area.

Note: If a site changes land use, written approval from the Land Manager is required.

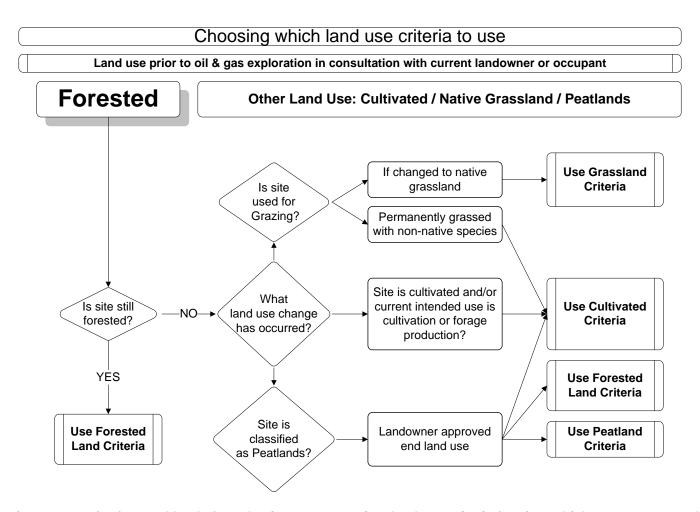


Figure 1. Selection process for forested lands for selecting an appropriate land use criteria for sites which may or may not have undergone a land-use change. The Peatland Criteria refers to the 1995 Update which will remain in effect until a new criteria or guide has been released.

END OF SECTION

8. The Assessment Process on Forested lands

Forested Lands includes any treed land, whether or not the forest vegetation is utilized for commercial ventures. The Forested Land reclamation criteria have been developed with an understanding that where forest presently exists, the post-reclamation land use will also be forested. Successful reclamation of forested landscapes will involve the establishment of woody and herbaceous forest plant communities. These criteria assess the development of the site along the trajectory towards the target forest community.

8.1. Implementation of the 2010 Forested Lands Criteria

- A. **Landscape Criteria:** Sites are required to meet all of the landscape components of this document regardless of the construction period.
- B. **Soils Criteria:** Sites are required to meet elements of the soils criteria according to the construction period (Table 1).
- C. Vegetation Criteria:
 - (a) Sites Reclaimed Prior to June 1, 2007 must meet the following:
 - (i) If a site seeded with grasses: Minimum 80% compatible vegetation cover based on seed mix.
 - (ii) If a Natural Recovery Site: A minimum of 25% canopy cover of herbaceous species; <u>and</u>, a minimum 25% canopy cover of woody species <u>or</u> a minimum stem/plant count of 5.
 - (iii) If a Planted Site: A minimum of 25% canopy cover of herbaceous species; and, a minimum 25% canopy cover of woody species or a minimum stem/plant count of 2.
 - (b) Sites Reclaimed On or After June 1, 2007, sites must meet the following:
 - (i) If a Natural Recovery Site: A minimum of 25% canopy cover of herbaceous species; <u>and</u> a minimum of 25% canopy cover of woody species <u>or</u> a minimum stem/plant count of 5 stems per assessment point area (1.78m radius assessment area; 10 m²).
 - (ii) **If a Planted Site:** A minimum of 25% canopy cover of herbaceous species; <u>and</u> a minimum of 25% canopy cover of woody species <u>or</u> a minimum stem/plant count of 2 stems per assessment point area (1.78m radius assessment area; 10 m²).

Table 1 outlines the various construction periods that shall apply to the implementation of the 2010 Reclamation Criteria for Forested Lands and is intended to outline the pass/fail parameters. The assessment (Figure 2, next page) includes sections on Landscape, Vegetation and Soils. Ecosystem Function is maintained when the onsite ecosystem is functioning when natural processes are noticeable (*i.e.*, proper drainage, moisture retention and cycling, soil and site stability, and nutrient cycling as expressed by litter formation).

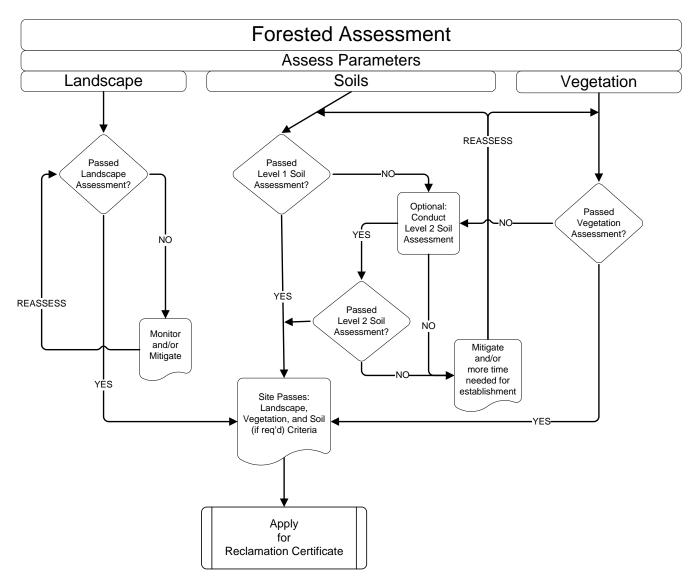


Figure 2. Assessment decision path for Forested sites

Table 1. Implementation dates for the new reclamation criteria based on construction period.

	nstructed April 30, 1994		ucted from 4 to June 1, 2007	Constructed On or After June 1, 2007	
^a Sites abandor Before June 1, 2007	ned and/or reclaimed On or After June 1, 2007	^a Sites abandoned and/or reclaimed Before June 1, 2007 On or After June 1, 2007		^a Sites abandoned and/or reclaimed On or After June 1, 2007	
Landscape Criteria					
Sites are expected to comp	ply with all aspects of the Landscap	e components of the 2010 C	riteria		
Vegetation Criteria					
Sites are encouraged but not required to comply with vegetation expectations.	Sites are expected to comply with all vegetation components of the 2010 Criteria.	Sites are encouraged but not required to comply with the vegetation expectations.	Sites are expected to comply with all aspects of the 2010 Criteria.	Sites are required to comply with all aspects of the 2010 Criteria.	
Topsoil Replacement F	Pass or Fail Conditions by Co	nstruction Period			
Sites are encouraged but not required to comply with soils expectations.	Sites are encouraged but not required to comply with soil expectations.	Sites are expected to comply with the soil components (extenuating soil situations may arise).	Sites are expected to comply with all aspects of the Criteria. Where extenuating conditions exist, topsoil justifications may be accommodated upon written request.	Sites are required to comply with all aspects of the 2010 Criteria.	

WHITE ZONE: Forested white areas going to forested reclamation sites are required to comply with all aspects of the 2010 Criteria and must meet the following:

- a) Sites constructed before April 30, 1994: Topsoil depth replacement must have less than 40% variance between the lease mean and the control mean (i.e., Lease Mean = >60% of Control Mean); or,
- b) Sites constructed after April 30, 1994: Topsoil depth replacement must have less than 20% variance between the lease mean and the control mean (i.e., Lease Mean = ≥80% of Control Mean).

^a 'Reclaimed' in this situation refers to sites that have had site re-contouring, soil replacement and seeding completed. If there is no indication of the reclamation date assessors will need to provide justification based on the timelines outlined above.

All disturbed sites (*i.e.*, stripped, compacted) are to be assessed for all landscape, vegetation and soils parameters. If access is impeded due to large trees or hazardous site conditions, approval for an alternate assessment is needed from the Land Manager. Assurances of soil conditions will not be required provided that documentation is submitted indicating that soils have not been disturbed and all other criteria have been met. If soils have not been disturbed then the site is to be assessed for landscape and vegetation parameters. The process involves a landscape assessment and methodologies for assessing vegetation and soils for areas delineated and identified as being either Undisturbed and Disturbed (see section Assessing and Sampling The Site). These are defined as:

- Undisturbed Areas: include areas of the lease or access where it is documented that
 there has been no surface soil disturbance. Generally, this applies where slopes are
 minimal and lease leveling was not necessary
- **Disturbed Areas**: include areas of the lease or access that have undergone stripping (e.g., stripping, or storage and including points like well-centre and flare pits and longitudinal effects like ruts). In some cases (e.g., soils that were not frozen) even though soil stripping was not conducted, traffic may have caused compaction, pulverized soil, rutting, or clodding.

Under the **Landscape Assessment**, landscape criteria are assessed by looking at the site as a whole, in the context of adjacent land, and if available, the pre-disturbance conditions. Differences between the site and the adjacent land must not interfere with normal land use and not show a negative impact on or offsite.

For the **Vegetation Assessment** there is a greater emphasis on vegetation as an indicator of equivalent land capability, ecosystem function and/or operability. This equates to greater assessment requirements for vegetation.

For the **Soil Assessment**, Level 1 and Level 2 (if necessary) soils assessments are conducted on any area that is delineated and identified as disturbed. All surface soil must be salvaged and replaced on the site as per the 95 Update and 2007 Forested Guideline. Disturbed soils may include locations where soil handling, storage and/or reclamation were conducted, or where the soil was impacted by processes such as by compaction or rutting.

If the Level 2 *is* completed and clearly shows that there are no site limitations (*i.e.*, the site is stable and that time is the only factor for a full recovery) then the site passes the Level 2. If the cause of the grid(s) failure is identified during the Level 2, it must be mitigated and the questionable grid(s) re-assessed prior to applying.

8.2. Vegetation Override

Where reasonable forest cover (*i.e.*, amount, species and distribution) is present, and where additional activities are required to meet the conditions described in this criteria pose a risk to existing ecosystem function, a vegetation override may be appropriate. Equivalent capability for forested landscapes must be demonstrated. The use of a

vegetation override will result in a **Non-Routine Application** and will result in greater scrutiny by the Regulator.

8.3. Items Out of Scope

Contamination: Drilling waste and other oilfield wastes must be properly disposed of according to AER Directives. All contamination must be remediated prior to application for certification. Specific criteria for the assessment and remediation of contaminants (*e.g.*, salts, metals, sterilants, organic chemicals, etc.) are addressed by Alberta Environment Tier 1 (Alberta Environment, 2010a) and 2 (Alberta Environment, 2010b) guidelines.

Previous Contractual Agreements: A fundamental principle carried forward in these criteria is that the success of land reclamation is measured against the representative (adjacent) site conditions with due consideration for construction norms at the time of development. However, if there are previous contractual agreements between interested parties, it is the responsibilities of the parties involved to uphold those agreements.

8.4. Use of Professional Judgment

When assessors are using the 2010 Reclamation Criteria for Forested Lands every attempt should be made to utilize adjacent lands as a representative control and/or reference community for the assessment. However, there may be situations that arise where the use of representative controls is not an option, such as:

- Restricted Access (i.e., assessors aren't granted access offsite, etc.);
- Representative controls are not available

Note: Under these circumstances assessors can use their professional judgment for determining whether a site should pass or fail. The use of a justification to explain why a site should pass indicates a <u>Non-Routine</u> <u>Application</u> which triggers further technical review by the Regulator Appendix E.

When these situations arise, assessors should discuss with the Regulator prior to conducting the assessment, when possible, to discuss options. Assessors <u>must</u> provide supporting rationale for their decision supported by acceptable references, applicable to Alberta (i.e., Soil Surveys, Alberta Sustainable Resource Development, etc.).

This information <u>must</u> be included with the application and will be subject to further review.

8.5. Assessment Tool and Record of Observation Datasheets

The 2010 Reclamation Criteria include additional tools for conducting the landscape, soil and vegetation assessments. A summary of the electronic tools that accompany the 2010 Reclamation Criteria are provided in the following sections, along with a decription of whether the information is required in the form provided, or if an altherative containing equivalent information can be submitted.

8.5.1. Required Information, No Alternatives Allowed

This information is contained within the electronic tool that accompanies the 2010 Reclamation Criteria for Cultivated Lands. This information <u>must</u> be submitted with the application, no substitution or alternative form is permitted.

 Assessment Tool: Contains questions related to the Landscape, Vegetation and Soils Criteria which may or may not require either a Yes/No answer, rating, measurement or some combination thereof.

Note: The Assessment Tool questions apply to the site as a whole. Questions should be answered as though they apply to the entire site, including associated infrastructure, being assessed.

 Record of Observation (RoO) - Soil and Vegetation Datasheets: Datasheets for recording soil and vegetation information, measurements and observations

8.5.2. Required Information, Alternative Forms Permitted

This information is contained within the electronic tool that accompanies the 2010 Reclamation Criteria. This information <u>must</u> be submitted with the application, however, alternatives to these forms are permitted provided they contain the equivalent information

- Title Page and Tab Index (TP-ToC): Title page and Table of Contents for the Assessment Tool Workbook.
- **Site Background**: For documenting the site background, special land management conditions, Land Manager comments.
- **Site and Lease Sketches**: The site sketch should delineate the areas of the lease affected by soils handling or other activities. Careful attention shall be paid to these areas. The site sketch should include changes to drainage patterns, slope, vegetation and any anolomies of offsite versus onsite. Site and lease sketches must be included with the application, the Tool contains examples of the site and lease sketch forms that could be included in the application.

8.6. Assessing and Sampling The Site

For the 2010 Reclamation Criteria for Forested Lands, the assessment locations are not point assessments. To accommodate soil and vegetation variability, assessments shall be completed on a 1.78 m radius totaling 10 m² representative of the entire grid (Figure 3, next page). If a pre-disturbance assessment was conducted at a site, this information can be considered comparable control information.

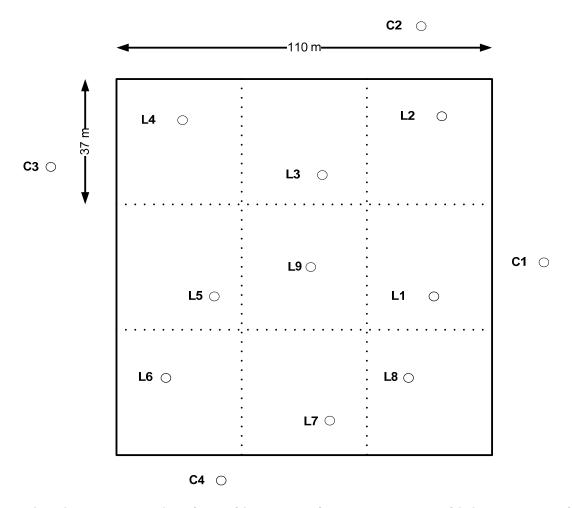


Figure 3. Level 1 assessment locations with an approximate 37 m x 37 m grid. Assessment points are representative sampling area is a circular plot with a 1.78 m radius totaling 10 m^2

8.6.1. Minimum Disturbance Sites

Minimum disturbance sites are sites that have been reclaimed and where construction practices have minimized the level of disturbance on the lease and resulted in two different management zones (i.e., Undisturbed and Disturbed).

For these sites, the Undisturbed and Disturbed areas <u>must</u> be delineated (mapped) clearly on the application (Figure 4). The entire site must undergo the landscape assessment to allow confirmation and verification of the areas identified as being:

- <u>Undisturbed Areas:</u> areas of the lease that require a Level 1 landscape and vegetation assessments along with verification (i.e., photos) that soils haven't been disturbed must be provided; and,
- <u>Disturbed Areas:</u> areas of the lease that require a complete Level 1 assessment (i.e., landscape, vegetation and soil assessments). Vegetation and soil assessments need to be completed at each assessment point on the lease at assessment spacing ≤40 m, with the appropriate number of control assessment points (Figure 4, next page).

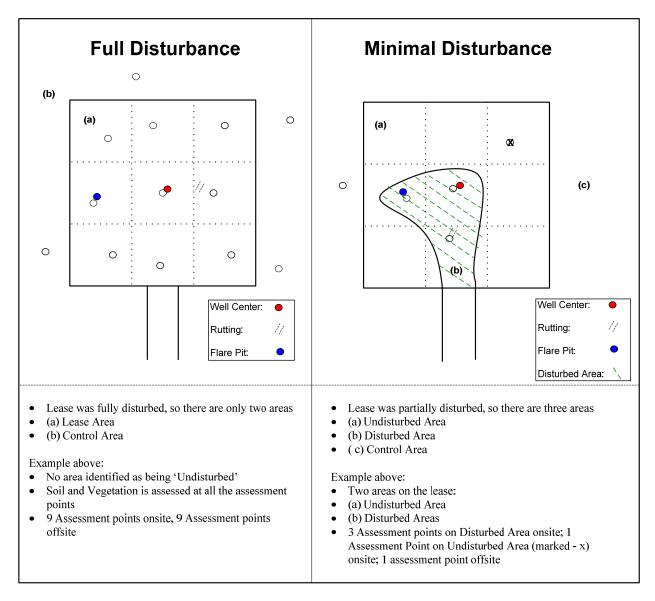


Figure 4. Examples of a lease sketch for a full disturbance (left) site and a lease sketch (right) for minimal disturbance site.

Note: Sites which have undergone Partial and/or Progressive Reclamation are not considered to be minimum disturbance sites. In these situations:

Soils still need to be assessed on the entire reclaimed lease area;

Any assessments within the Undisturbed Area on the lease shall not be used as representative controls for either the soil or vegetation assessments; and,

The site may meet more than one of the implementation dates outlined in Table 1.

8.6.2. Sampling on Variable Sites

On variable sites (such as sites with higher slope percentages or a different land type) more than the standard nine assessment points may be required to accurately estimate topsoil depth. The key is to have representative controls. In order to provide an understanding of topsoil replacement expectations, it is suggested that several controls be assessed, or published soil variability information consulted, prior to assessing the soils onsite. If the landscape has two distinct zones, do assessments points on and offsite in each of the two zones (Figure 5; see Option #2).

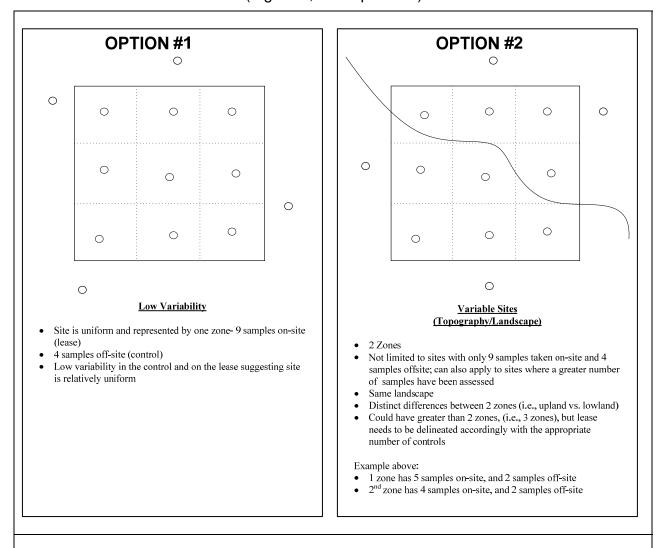


Figure 5. Site stratification the figure on the left shows no stratifications (no zones) while the figure on the right shows two zones

8.6.3. Determining Sample Intensity on the Lease

For reclaimed sites, sampling intensity (i.e., number and spacing) onsite and offsite should address the variability in site conditions. The basic sampling unit is a circular plot with a 1.78 m radius totaling 10 m². The assessment locations should include the

following five locations if known: well centre, sump, flare pit, production areas and entrance to the lease. The well-centre plot shall be as close to the wellbore location as possible to assess the reclamation conditions at this heavily affected location. To ensure that small anomolous conditions are not used to describe the site, the basic soil and vegetation sampling method is a grid system. The assessment points do not have to be at the centre of each grid, but should be located within a grid so that they are representative of the entire grid area. Within this system assessment points shall have spacings <40 m apart. Sampling intensity can be adjusted for different sized and shaped leases (Table 2).

Table 2. Sampling intensity based on size of disturbance on the site.

Maximum disturbance size	Minimum number of onsite	Minimum number of offsite	
(m)	sampling points	sampling points	
Up to 40 m x 40 m (1600 m ²)	1	1	
80 m x 80 m (6400 m ²)	4	2	
120 m x 120 m (14, 400 m ²)	9	4	
>120 m (>14, 000 m ²)	9 (+1 more for each additional 1600	x/2 (round up to nearest whole	
- 1.20 m (- 1 n, 000 m)	m²)	number)	

8.6.4. Determining Sample Intensity on the Access

The assessment points along the access shall be placed to assess conditions at the point where high levels of traffic impacts likely affected the site. Based on landscape variability more control locations may be required. The basic sampling unit is a circular plot with a 1.78 m radius totaling 10 m². For the access, the soil and vegetation assessments will be made using paired comparisons (one offsite representative control and one onsite), with soils being assessed to a depth of 50 cm (Figure 6, next page). Assessing the access shall be as follows:

- <400 m: assessment points shall be located at a maximum spacing of 100 m (Figure 6A)
- >400 m: assessment points shall be located to reflect different mapping units, (*i.e.*, topographic, vegetation and/or soils variability) with a minimum of one (1) assessment point per map unit or a minimum of one (1) assessment point per 800 m (Figure 6B)

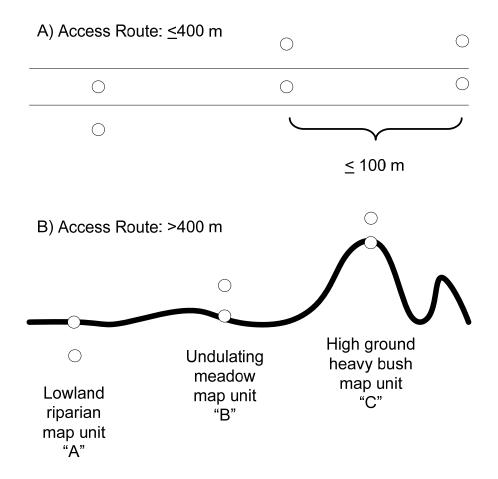


Figure 6. Soil assessment locations along access routes that are <400 m (A: top figure) or >400 m (B: bottom figure).

8.7. Assessment Comparisons

This assessment comparison methodology represents a hybrid of a capability assessment system and criteria. The assessment comprises of pass/fail decisions based comparisons between onsite and offsite assessments using ratings and surrogates of ecosystem function. Sampling differences are observed in undisturbed natural settings, even over relatively short distances. Therefore, tolerances have been incorporated into the rating system to account for this and variability in measuring. For the Landscape, Vegetation, and Soil Assessments various parameters will require the assessor to assign ratings based on the Rating Tables (Appendix D) and where appropriate, record the rating and/or measurement for the appropriate parameter, in the Assessment Tool and/or the RoO. Pass/fail decisions for the landscape, vegetation and soils ssessments questions should consider the Implementation Dates (Table 1) and shall be based on the rating categories and physical measurements outlined in Table 3 (next page).

Table 3. Tolerances for rating categories and physical measurements for the vegetation and soil criteria according to sampling intensity

	For 1 lease and 1 control assessment point:	For 4 lease and 2 control assessment points:	For 9 lease and 4 control Assessment points (or larger leases):			
Pass: Rating Categories	If only one assessment point onsite no rating drops are allowed compared to the control offsite.	The maximum total allowable drop is 2. The maximum allowable drop is one (1) rating for two (2) sampling location or two (2) ratings for one (1) sampling location.	The maximum total allowable drop is 4. The maximum allowable drop is two (2) ratings for two (2) sampling locations or one (1) rating for four sampling locations.			
	Additional requirements:					
	 For grids where rating drops have occurred for the same parameter, these grids cannot be adjacent to one another The difference in the average rating between onsite compared to the offsite control rating must not be greater than 0.50. No Assessment point(s) can drop more than two ratings below the minimum control rating 					
Pass:	Soils:					
Physical	 On private lands the average topsoil depth onsite must be ≥80% of the control average 					
Measurements	Vegetation:					
	 Minimum 25% canopy cover of herbaceous species and; either Minimum 25% canopy cover of woody species; or Minimum stem/plant count of 5 (natural recovery); or, Minimum stem/plant count of 2 (planted) within 1.78 m radius assessment area 					
Fail:	Does not meet above conditions					

NOTE: On forested sites where weed issues arise resulting in a failure, applications can be submitted as Routine Applications provided they meet the following conditions:

- 1) The site is on Public Lands (excluding Provincial Parks and Protected Areas);
- 2) The site has met Criteria for all other parameters being assessed; but,
- 3) Fails the comparison for Controlled and/or Undesirable/Problem weeds as a result of a single source of weeds from offsite

Application shall include data, photos, historical weed management, and supporting information clearly indicating that the weeds or invasive plants are from an offsite location and were not associated with/introduced from the operators holdings.

8.7.1. Rating Categories

The difference in the average rating between onsite compared to the offsite control rating must not be greater than 0.50. No parameter can drop more than two rating categories onsite compared to the lowest rating category offsite. Ratings for noxious

weeds onsite must be comparable to the control rating offsite, while no Prohibited Noxious weeds are allowed onsite (i.e., no rating >1). A pass/fail for the Landscape, Vegetation and Soils assessment questions is based on the tolerances for the ratings (Table 3).

8.7.2. Physical Measurements

For the Vegetation and Soil Assessments, various parameters will require the assessor to conduct physical meaurements such as topsoil depth and stem counts. These measurements are recorded in the RoO and used to compare onsite measurements with the offsite control measurements. A pass/fail for the Vegetation assessment measurements are based on the construction periods and on the tolerances (Table 3).

END OF SECTION

9. Landscape Assessment

Landscape criteria (Table 4) are assessed by looking at the site as a whole, from several vantage points on the site. The landscape criteria will be assessed by comparing the site with the pre-disturbance conditions or adjacent land. To meet the landscape criteria, the reclaimed site must not pose a negative impact to site capability. Differences between the site and the adjacent land must not interfere with normal land use and not show a negative impact on or offsite. Landscape observations are recorded in the Assessment Tool.

Table 4. Landscap	e methodoloav	parameters none	of which re-	guire a rating.
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Parameter	Assessment Tool Question	Pass / Fail Point
Drainage	Surface Water Flow; Sub-Surface Water Flow; Riparian Areas	Yes
Erosion	Erosion	Yes
Stability	Subsidence	Yes
Bare Areas	Bare Areas	Yes
Operability	Macro-contour; Meso-contour; Micro-contour; Surface Stoniness (i.e., Gravel and Rock)	Yes
Debris	Woody Debris;	Yes
	Refuse	

9.1. Drainage

Pre-disturbance aerial photographs, observations of the surrounding landscape and consultation with the Land Manager can help to establish what the normal direction and dispersion patterns should be. Visually assess the direction/dispersion of onsite drainage to determine whether it conforms to the drainage of the surrounding area. If ponding is found, its presence must be documented and an explanation given regarding the site-specific conditions which indicate ponding is consistent with the site's normal state. For example, ponding may be normal depending on the pre-disturbance conditions, the surrounding landscape (e.g., knob and kettle landscape) and/or the timing of assessment relative to moisture events (i.e., snow melt or recent precipitation).

9.1.1. Surface Water Flow

Onsite drainage: Direction and dispersion of water on the lease helps to assess whether surface drainage has been adequately restored. Sites with significant soil compaction; those with sub-surface hard-pans; or those that have been poorly recontoured often exhibit ponding. Another indicator of disrupted water direction and/or drainage is the presence of erosion on the lease. The use of pre-disturbance air-photos can help establish what 'normal' direction and dispersion patterns should be.

Offsite Drainage (cross-site flow; water movement off the lease): Surficial water movement is often more readily apparent than sub-surface flow, however, the impact of

the lease to soil conditions may extend into the immediate sub-surface and disrupt water movement. Cross-site flow disruptions are most likely to occur with long linear features (*i.e.*, roads) or large facilities, but the extent of the impact depends on the local hydrology and geology. The location of a lease may result in drainage patterns being disrupted. Ensuring the surrounding contours are carried into the lease and that landscape features adjacent to it are conserved should prevent a change in the pattern of flow. Where onsite drainage may serve to collect and re-direct water, offsite sediment fans, deposition of organic matter fans, and/or ponding on the up- or downslopes adjacent to the lease are evidence of offsite impacts to surficial drainage.

9.1.2. Ponding

Evidence of offsite (upstream) ponding could indicate that the lease has interrupted subsurface and/or cross surface drainage. The presence of onsite ponding must be documented and should be consistent with offsite conditions. For example, standing water (*i.e.*, ponding) may be normal depending on the surrounding landscape (*i.e.*, knob and kettle topography) and/or the timing of the assessment relative to moisture events (*i.e.*, snow melt or recent precipitation) and therefore not evidence of poor reclamation. Check offsite for indications of ponding, such as the presence of 'bathtub rings', waterloving vegetation types or lack of vegetation in depressions. Assessment is visual and there shall be no evidence of excessive ponding as a result of the reclaimed lease.

9.1.3. Riparian Functions

Riparian lands are transition zones between land and water bodies and include any geographic area that adjoins or directly influences a water body (e.g., streams, lakes, ponds, and wetlands which may include floodplains) and land that directly influences alluvial aquifers and may be subject to flooding. These lands fall under the Water Act, which protects all water resources in the province (Appendix A).

9.1.3.1. BANK OR SHORE STABILITY

There shall be no evidence of shore/bank instability (slumping, channelling within banks) greater than is found on the offsite bank or shore.

AER Directive 056 (Energy Development Applications and Schedules) along with other applicable provincial and federal legislation (*i.e.*, Environmental Protection and Enhancement Act, Water Act, Public Lands Act and the Navigable Waters Protection Act) requires water bodies be protected during construction and through the operating life of the project.

For reclamation, if the lease abuts a water body's bank or shore, there should be no evidence of shore/bank instability (e.g., slumping, channeling within banks, etc.) greater than is found on the offsite bank or shore. The vegetation must be a comparable, self-sustaining native vegetative community or provide evidence that it is on the corresponding successional trajectory to the surrounding area. Short lived non-native species may be appropriate to assist with shore/bed stabilization.

9.2. Erosion

9.2.1. Water Erosion

Gullying: This is evidence of a major flow problem and its presence would normally preclude reclamation certification; however, gullying may be part of the normal processes on certain sites. If so, evidence must be provided to substantiate that the degree, spatial extent, rate and severity of the documented onsite gullying is consistent with the surrounding area or pre-disturbance conditions.

Rilling, pedestaling or presence of depositional fans: These are evidence of excessive surface water flow and often result in a loss of the nutrient-rich topsoil. Movement of soil across the site and especially to offsite areas are significant concerns as these conditions can reduce the productivity of the site. Evidence of small-scale erosion (*i.e.*, movement of materials at the centimetre scale) does not constitute risks to a site's functioning and is not considered a negative characteristic. Small scale is erosion occurring only on site and the material remaining on site rather than loss of soil.

9.2.2. Wind Erosion

Leaf abrasion, plant pedestaling and soil deflation are evidences of wind erosion, which may result in a loss of vegetative health. Evidence of wind erosion cannot be greater onsite than in the surrounding landscape.

9.3. Soil Stability

9.3.1. Slumping/Wasting

Slumping and wasting (*i.e.*, mass movement of soil) is not normally seen on most forested sites; however, locations may exist where naturally unstable slopes move and slumping/wasting are normal. Any slumping and/or wasting on a reclaimed site must be documented and evidence from adjacent areas (*i.e.*, pre-disturbance information) should demonstrate that the scale and amount of slumping/wasting seen onsite is normal for the area.

9.3.2. Subsidence

Where localized and small (*i.e.*, <4 m²) areas of subsidence are stable and unlikely to risk the site's stability, subsidence may be deemed acceptable. Stable is identified by no ongoing slumping subsidence or erosion. Rounded smooth edges are observed rather than sharp breaks. In such cases provide documentation of the size, location and severity of the subsided area(s) and an explanation of why further reclamation efforts are not needed.

9.4. Bare Areas

Bare areas are devoid of vegetation. It does not apply to sparse vegetation on natural recovery sites.

9.5. Operability

On forested lands, operability refers to equipment operation and land management.

9.5.1. **Contour**

Micro-contour (*i.e.*, cm vertical scale; <10 m width scale; Figure 7 right): Minor variations in topography on reclaimed areas often enhances conditions that promote forest vegetation species recruitment, survival and growth. Obstacle planting is a common practice in forestry where tree seedlings are planted adjacent to large woody debris or rocks to enhance protection from excess wind or sun and/or to provide a vegetation free space for plant development. Creation of small elevated sites (*i.e.*, soil ridges) can enhance localized drainage, and increase soil temperature to enhance root development. Reclaiming the site to a 'flat' lease is not recommended.

Meso & Macro-contour: (Meso-contour (*i.e.*, 10-30 m width scale; Figure 7 left) and macro-contours (*i.e.*, 30-100 m width scale; Figure 7 left) should be integrated with adjacent offsite landscape features and retain the character of the adjacent area's relief. It shall not result in excessive erosion, slumping/wasting or altered water flow patterns.

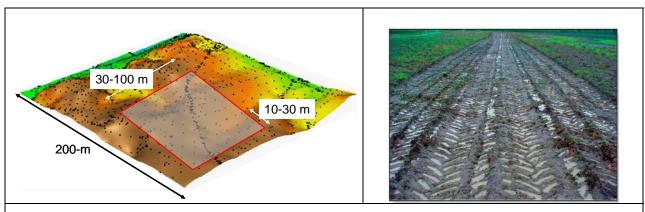


Figure 7. Figures showing examples for macro- (30-100 m) and meso-contour (10-30 m) (figure left) and micro-contour (<10 m width) (figure right)

9.5.2. Gravel and Rock

Surface Stoniness/Coarse Fragment Content: Presence of naturally occurring stones (Figure 8, next page) within reclaimed areas is assumed to present no significant risks to ecosystem functioning, or normal forested land uses and can often aid in creating small-scale roughness to enhance vegetation development. Vegetation and soil quality

criteria should capture any detrimental effects should there be excessive concentrations of stones/rocks present beyond that found in the surrounding area.





Figure 8. Figures showing examples for surface stoniness (figure left) and coarse fragment content (figure right)

9.6. Debris

9.6.1. Woody Debris

Coarse woody debris shall be spread over the site and may not be piled, windrowed or concentrated in one area as this may pose a fire-hazard. As with micro-contours and stones, coarse woody debris can moderate environmental extremes and enhance vegetation development. As it decomposes, woody debris will also contribute to soil litter and organic matter content and provide habitat requirements for smaller species.

Fine chipped woody debris such as mulched sites can be detrimental to both soil thermal conditions, the C:N ratio and plant recruitment. Excess fine chipped woody debris would require management (Alberta Sustainable Resource Development, 2009).

Managing fuel risks for wildfire threats must also be considered where accumulation techniques are practiced, particularly in areas near settlements (Alberta Sustainable Resource Development, 2007a).

9.6.2. Industrial and domestic refuse

Industrial and domestic refuse is not acceptable and must be removed.

END OF SECTION

10. Vegetation Assessment

Vegetation assessment locations are not point assessments. To accommodate vegetation variability, assessments shall be completed on a 1.78-m radius (10 m²) area representative of the 40x40 m sampling grid. Table 5 identifies the Vegetation Assessment parameters and their respective questions that need to be answered and documented in the Assessment Tool and/or RoO datasheets.

Table 5. Vegetation methodology parameters and their respective Assessment Tool Questions which may or may not also require either a rating and/or physical measurement.

Parameter:	Assessment Tool Question	^a RoO Information Required (Yes / No)		Pass / Fail Point
		Measurement	Rating	
Desired Plants - Species	Woody Species and % Cover; Herbaceous Species and % Cover; Planted: Stems and Shrub Count; Unplanted: Stems and Shrub Count;	Yes, document species type	No	Yes
Quality (Limiting Factors)	Browsing; Drought; Health; Other	Yes, document degree of pressure	No	No
Weeds	Prohibited Noxious; Noxious; Problem / Volunteer	Yes	Yes	Yes
Litter and LFH	Litter	Yes	No	No

^a Yes = An answer to an Assessment Tool question is required in addition to a rating and/or physical measurement; No = An answer to an Assessment Tool question is required but a rating and/or physical measurement is not required.

10.1. Desired Plants

The desired species for forested lands are those species which are representative of that natural sub-region, ecosite, and plant community. In some cases to meet revegetation requirements in Table 5, compatible species were used. Compatible species, are species that comprise native and non-native varieties that were part of a seed mix that was appropriate to the time period or as outlined in historical agreements with the Land Manager.

10.1.1. Plant Community/Diversity

The assemblage of woody species should indicate development of an early successional community for the target forest type as described in one of the Guides to Ecosites of Northern Alberta, West-Central Alberta or Southwestern Alberta (Alberta

Sustainable Resource Development, 2007b). These guides provide lists of species typically found on different mature forest site-types in Alberta.

10.1.2. Structure and Layers

A properly reclaimed site should contain the presence of both herbaceous and woody species that are distributed across the site. Complete colonization of a site by herbaceous vegetation (*i.e.*, grass) can preclude the recruitment of shrubs and/or trees due to the lack of appropriate micro-sites. Preventing competitive herbaceous colonizers that could inhibit or preclude the recruitment and/or development of the target forest community is desirable. If provided space to establish, larger stature species (*i.e.*, woody shrubs and tree seedlings) will eventually out-compete the herbaceous vegetation and reduce their extent on the site. Thus, an added assurance that the site is progressing along the target trajectory will be observation of encroachment of desirable species onto the site from the adjacent forest.

Note: A minimum stem count of 5 (5000 stems per hectare) is required for natural recovery sites. If the site has been planted with seedlings the minimum allowable stem count is 2 (2000 stems per hectare). These counts must occur within the assessment location.

If the site has been planted to seedlings a minimum of 2 growing seasons are required prior to conducting the Vegetation Assessment for the submission of a reclamation certificate application.

10.1.2.1. WOODY SPECIES

List Dominant Desirable Woody Species: vegetation assessments at control locations are intended to identify the target community, ecosite and community variability. Ecosite site guides may be used to identify appropriate vegetation targets. Onsite vegetation species must be appropriate for the representative ecosites.

Older Sites: Where offsite/control areas consist of trees/shrubs in late seral stages, the data collected is intended to identify the target community, ecosite and community variability. Woody Vegetation (i.e., height, stem count, and leader growth) Measurements for the control are not required. Weeds and herbaceous as well as woody species should still be identified, as well as soils.

Younger Sites: Where offsite/control areas consist of trees/shrubs in early successional stages that may be comparable to the Onsite area (i.e., wellsite constructed within a cutblock) the data collected is intended to identify the target community, ecosite and community variability. Measurements for the Offsite Area are required and need to be documented.

Undesirable species do not count towards species diversity or percent live cover. Onsite measurements for the dominant desireable species include:

- List three dominant desirable species
- Average Height (m)
- Percent canopy cover (shrub and tree sp.). Data should be recorded in both the Assessment Tool and RoO.

- Woody Stem count (tree sp.) and Plant count (shrubs) Stem and Plant counts are one option for assessing vegetation establishment and success on a reclaimed site. Stem and Plant counts of trees and shrubs are to be conducted within the basic sampling unit, a circular plot with a 1.78 m radius (10 m²) (FRT.1; Appendix D). For sites planted with merchantable <u>tree/shrub</u> species the expected planting density is 2000 stems per hectare, or 2 stems per assessment location.
- Branch leader growth (cm) for previous year: record tree growth indicators of leader increment (length of past year's terminal growth using bud scale scars) and crown expansion.
- Branch leader growth (cm) for current year: record tree growth indicators of leader increment (length of the current year's terminal growth using bud scale scars) and crown expansion.

10.1.2.2. HERBACEOUS SPECIES

List Dominant Desirable Herbaceous (grass and forb) Species: vegetation assessments at control locations are intended to identify the target community, ecosite and community variability. Ecosite site guides may be used to identify appropriate vegetation targets. Onsite vegetation species must be appropriate for the representative ecosites. Depending on the criteria requirements outlined in Table 3 undesirable species (i.e., agronomics, weeds, etc.) do not count towards species diversity or percent live cover. Onsite measurements include:

- List three dominant desirable (or, if applicable, compatible) species (grass and forb) and their % canopy cover
- Total Percent canopy cover of all desireable species (FRT.1; Appendix D).

Note: Compatible species will include those species used in a seed mix that may have been used to meet previous reclamation period requirements outlined in Table 1.

10.2. Quantity

10.2.1. Production

Historically, reclamation of forested lands focused solely on rapid vegetation using grasses or forages in order to retard erosion and prevent weeds. Where structural impediments to erosion (*i.e.*, surface roughness, adequate vertical water flow) are in place, the use of vegetation for erosion control is unnecessary. Instead, there should be a development of a greater variety of species that will facilitate the redevelopment of the target forest plant community. The actual amount of cover will be a function of the timing of the assessment and the type of target forest community. Rather than a single minimum cover value as a measure of equivalent capability for all forest types, evidence of the presence and a reasonable spatial distribution of appropriate vegetation will suffice. Evidence of woody plant growth provides an assurance that there are no significant site limitations. Where growth is inconsistent across the lease and/or poor relative to similar-sized off-lease vegetation for similar time periods, the presence of site limitations to plant productivity are likely.

Heavy wildlife or domestic animal browsing, drought conditions and/or third-party impacts (e.g., recreational use) may account for poor growth not linked to inadequate site conditions. If so, documentation must be included.

10.2.2. Grazing/Browsing Pressure

Document the occurrence and extent of browsing if observed. Data should be recorded in both the Assessment Tool and RoO.

10.3. Quality

10.3.1. Plant Growth, Development

Vegetation health or quality is partially assessed through a visual assessment of health. Onsite vegetation should not appear cholortic (yellow), as this is often an indication of poor plant health or severe limitations caused by poor soil/site conditions (*i.e.*, excessive surface soil moisture, compacted subsoils, lack of adjacent organic matter). Localized chlorosis within one area of a lease may indicate localized site limitations. Widespread chlorosis may be indicative of significant site limitations or plant response to severe weather conditions (*i.e.*, drought).

10.3.2. Limitations Affecting Vegetation

Document visual indications affecting growth including (drought, health or other third party impacts). Data should be recorded in both the Assessment Tool and RoO.

10.4. Weeds / Undesirable Plants

Weeds are generally defined as undesirable or unwanted plants. The distribution of weeds may have been influenced by wellsite activity, particularly in adjacent areas offsite. Therefore, ensure that the control samples are representative of the surrounding area or parcel of the land.

Nonnative species are to be used only where their benefits to site properties are known and the species are part of a plan to improve and/or stabilize a site. These species should not be persistent and cannot be

Note: Use of Nonnative species must be discussed and approved by the Land Manager.

used to contribute to meeting the vegetation criteria. For example, the use of agronomic annuals for early erosion control is an appropriate use of nonnative species. Persistent weeds require active management to control or eradicate, and are a barrier to the vegetation developing into the desired plant community.

Note: For the purposes of rating comparisons for the 2010 Reclamation Criteria, the following applies for:

Prohibited Noxious Weeds: These must be "destroyed" onsite (i.e., the assessment points on the lease cannot have a rating greater than 1, if so, the site fails)

Noxious Weeds: These must be "controlled" onsite (i.e., the average rating onsite cannot be greater than the average rating offsite, and the difference in the average ratings between onsite and offsite must be ≤ 0 . Example, if one assessment point offsite has noxious weeds, i.e., rating of 4, there could be noxious weeds present onsite but these must have ratings <4)

Undesirable/Problem Weeds: These should be "controlled" onsite but not require change in management practice onsite compared to that applied offsite. There cannot be a difference >2 ratings categories between the lowest control rating and the lowest rating at any assessment point on the lease. The difference in average ratings of 0.30 (or, 0.15 depending on sample intensity) still apply.

At the same assessment point where plant measurements are conducted the assessor shall document the type of weeds and undesireable plants present and rate their distribution based the rating table (FRT.2; Appendix D).

Note: Enforcement of the Weed Control Act falls under the jurisdiction of the local authority. There are two main classifications of weeds: Prohibited Noxious and Noxious. Weeds must be assessed and managed as per the Weed Control Act: prohibited noxious weeds destroyed with noxious weeds controlled (Government of Alberta, 2010).

Undesired plants (i.e., incompatible species, etc.) shall be controlled so that they do not impede Land Manager operability and/or management or the functioning of the native plant community. This information shall be recorded in both the Assessment Tool and RoO.

Note: A minimum of one full growing season (including an overwintering period) is required following the use of herbicide before reassessing the weed control program and submitting a reclamation certificate application.

10.5. Litter and LFH

The amount of litter and/or thickness of the surface organic horizons (LFH) are surrogate measures of the redevelopment of a site's nutrient cycling function. LFH depth and/or form can be a useful indicator for assessing the extent of a site's reestablishment of nutrient cycling. Litter development data shall be recorded in both the Assessment Tool and RoO.

END OF SECTION

11. Soil Assessment

Surface soil or topsoil is defined as the uppermost mineral material, valued as a growing medium. All surface soil must be salvaged and replaced. (Both mineral topsoil and organic horizons, *i.e.*, LFH & Of, should also be salvaged.) Topsoil replacement requirements/tolerances acknowledge different eras in construction practices, natural variability and sampling error.

If documentation exists that soils have not been disturbed (stripping, compaction, etc) soils assessment will not be required. Determining physical properties of soil (*i.e.*, compaction and soil structure) may be restricted to the well-centre and access road locations as appropriate. The assessment includes measurements (Table 6) that need to be answered in the Assessment Tool and RoO.

Table 6. Soil methodology parameters and their respective Assessment Tool Question which may or may not also require either a rating and/or physical measurement.

Parameter:	Assessment Tool Question	^a RoO Information Required (Yes / No)		Pass / Fail Point
		Measurement	Rating	
Soil Disturbance	Soil Disturbance	No	No	No
Surface Characteristics	Topsoil Depth and Distribution	Yes	Yes	Yes
Vertical Processes	Texture; Consistence; Structure; Rooting Restrictions	No	Yes	Yes
Level 2 Soil Assessment	Texture; %-Clay; Organic Carbon; pH; Electrical Conductivity (EC); Sodium Adsorption Ratio (SAR)	Yes	Yes	Yes

^a Yes = An answer to an Assessment Tool question is required in addition to a rating and/or physical measurement; No = An answer to an Assessment Tool question is required but a rating and/or physical measurement is not be required.

For the 2010 Reclamation Criteria for Forested Lands, the assessment locations are not point assessments. To accommodate soil, assessments shall be completed on a 1.78 m radius totaling 10 m² representative of the entire grid (max 40 x 40 m grid). The Soil Assessement is broken into two components.

- Level 1 Assessment: This assessment is the standard to be conducted at all sites. The
 Level 1 Assessment does not require samples to be sent to a laboratory for analyses. If
 a problem with the soil is indicated at Level 1, the assessor can apply the following
 options:
- Conduct targeted Level 2 assessment;

- Allow more time for recovery and reassess; or
- Mitigate and reassess.
- Level 2 Assessment: This assessment is optional and can be used at the discretion of the assessor to veryify observations made a the Level 1, consists of samples being sent to the laboratory for analyses of the following: %-clay, organic carbon (OC), pH, electrical conductivity (EC), and sodium adsorption ration (SAR).

11.1. Level 1 Soil Assessment: Soil Quantity and Quality

Relevant soil parameters include the presence, quality and consistence/structure of topsoil. The absence of rooting restrictions is an indication of soil quality.

11.1.1. Evidence of soil disturbance

Areas defined as being disturbed on the lease or access have undergone stripping (e.g., stripping, storage, etc.) and include points like well-centre, flare pits and longitudinal effects such as ruts. In some cases (i.e., soils that were not frozen) even though soil stripping was not conducted traffic may have caused compaction, pulverized soil, rutting or clodding The assessor should document the evidence of soil disturbance in both the Assessment Tool and RoO.

11.1.2. Operability

On forested lands, operability refers to equipment operation and land management.

11.1.2.1. CONTOUR

On forested lands, contour is assessed during the landscape assessment.

11.1.2.2. SURFACE STONINESS/COARSE FRAGMENT CONTENT

On forested lands, surface stoniness and coarse fragment content are assessed during the landscape assessment.

11.1.3. Surface Characteristics

Surface soil compaction or slaking may prevent germination of seeds and/or impede water infiltration. Lack of surface organic matter and vegetation will increase the likelihood of the development of compacted surface soils and excessive surface water flow. The impacts of inappropriate surface characteristics are captured through the vegetation and/or landscape criteria.

Compacted soils and/or the presence of compacted soil layers can severely limit the soil's functioning and vegetation development. Ponding (beyond that in adjacent controls) may result from impeded vertical and surface drainage.

The presence of massive, dense or layered structure (compacted horizon within the soil profile) or abrupt textural or structural changes are indicators of poor vertical moisture flow. The presence of hardpans in offsite control areas (e.g., solonetzic soils) shall be

documented to justify the presence of onsite restricted layers consistent with adjacent land.

At each assessment point the assessor shall identify whether soils have been disturbed and record information in the Assessement Tool and RoO.

11.1.3.1. TOPSOIL DEPTH AND DISTRIBUTION

Topsoil salvage and appropriate re-distribution is required. Topsoil depth shall be assessed at each assessment location to determine quantity, including spatial distribution requirements, and quality. Appropriate site preparation includes the salvage of forest floor (LFH) and all the topsoil (Ah, Ahe and Ae). If the topsoil depth is <15 cm, conservation must include the topsoil plus the B-horizon up to a total depth of 15 cm unless the B-horizon is considered unsuitable (chemical or physical limitations). A principle in salvage and redistribution of topsoil is not to dilute and/or bury the nutrient-rich LFH and A horizons by over- or under-stripping. Where a thick Ae horizon exists (*i.e.*, >15 cm), the intent would be not to mix the nutrient rich layers (LFH, Ah, Ahe) with the less nutrient rich Ae horizon. Generally, however, the Ae horizon has better soil physical qualities than the underlying B-horizon. Two-lift stripping (LFH, Ah, and Ahe) and (Ae) is recommended as it helps to ensure all organic rich and texturally valuable topsoil is available for reclamation.

Topsoil depth may be most effectively assessed and documented immediately after topsoil redistribution rather than at the time of site assessment, however, use of a larger soil assessment area should overcome problems where topsoil has been disturbed due to site rehabilitation techniques (i.e., plowing). The LFH is not included when measuring the control topsoil depth. Data should be recorded in both the Assessment Tool and RoO. For each assessment point, measure topsoil depth and calculate its percentage of the control mean. Rate each assessment point from 1 – 4 (FRT.3; Appendix D), and average the rating numbers, compare the average on and offsite ratings. If the average of the lease rating is greater than 0.50 compared to the average offsite control rating, then the lease fails.

11.1.4. Vertical Processes

In order to represent the soil salvaged from the site, when determining Control soil quality, collect a representative sample from the A horizons (Ahe, Ah, Ae) or, in thin soils, a mix of the top 15 cm of the mineral soils.

11.1.4.1. SOIL TEXTURE

The soil textural class is an indicator of water-holding capacity, nutrient storage and soil tilth and shall be comparable on the reclaimed and undisturbed landscape. Admixing of lower horizons with upper soil horizons may result during stripping, hauling and replacement of the thin upper forest soil horizons. Improvements in texture class, or water holding capacity, on the lease compared to the control are acceptable; however, changes to texture may result in a change in land capability and, in some cases, the need for special management. Soil decompaction practices (i.e., deep ripping) may contribute to admixing but the benefit of decompaction (*i.e.*, relief of rooting restrictions

and the creation of improved soil structure) are considered of greater benefit to vegetation development and ecosystem function than the negative impacts of soil textural change.

To maintain similar quality, soil textures on the lease and the control shall be the same class. These conditions are reflected in the ratings. Improvements in texture class, or water holding capacity, on the lease compared to the control would be acceptable. To determine soil texture, collect a representative handful from the surface horizon, crush it by hand, and determine texture and rating (FRT.4; Appendix D). Data shall be recorded in both the Assessment Tool and RoO.

Imported topsoil must stay within the same control textural classification (i.e., "S" Sandy or "C" Clay) and must remain in the same control texture rating range (sandy "S": 1, S2, S3, and S4) or, clay "C": 1, C2, C3, and C4).

11.1.4.2. SOIL CONSISTENCE AND STRUCTURE

Consistence (the strength of soil described as friable, firm, plastic, *etc.*) and structure (the shape of soil aggregates resulting from the combination and arrangement of sand, silt and clay held together by net charges and organic matter) provides a qualitative measure of the soil's ability to allow root penetration, and air and water movement through the profile. Consistence refers to the combination of soil properties that determines its resistance to having its structure changed either through crushing or being remolded into a different shape. Degradation of structure and progression to firmer consistence are indicators of admixing, compaction or poor reclamation procedures, which make the soil vulnerable to water and/or wind erosion inhibit rooting, which may impair productivity. A large change in soil structure, particularly to a massive structure, would constitute a significant limiting condition that could negatively impact normal soil processes and vegetation development.

Soil consistence (FRT.4; Appendix D) and structure (FRT.5; Appendix D) provide a subjective measure of the suitability or limitation of the soil air and water movement and root penetration. Soil moisture conditions at the time of the assessment shall be noted. Moist conditions are the most suitable for determining consistence. Use the mesostructure (e.g. subangular or angular blocky) rather than the macrostructure (e.g. prismatic) when rating the structure. If the macrostructure is more limiting to roots it takes precedence over the mesostructure. For example, in Solonetzic soils the columnar macrostructure often takes precedence over the angular blocky mesostructure. Similarly, in compacted soils, the compacted macroscale layers take precedence over the angular blocky peds.

For all assessment points, topsoil and subsoil consistency and structure need to be assessed and rated separately and results recorded in the Record of Observation (RoO) datasheet.

11.1.4.3. ROOTING RESTRICTIONS

Research has also indicated that restrictions to water or air movement within the soil profile (*i.e.*, vertically and horizontally) are one of the major inhibitors to the establishment of a native ecosystem; therefore, newly reclaimed sites must not have

any profile restrictions. Evidence of exped rooting or root mats may indicate restrictions in the vertical moisture processes. Indicators identified in Table 7 provide operationally feasible assessment indicators of impaired vertical moisture dynamics. Presence of rooting restrictions at each assessment point is to be assessed to a depth of 50-cm and supporting rationale provided that root depth and distribution are consistent with that found offsite. The assessor should visually assess the absence or presence of any rooting restrictions in the soil profile and rate according to the Rating Table provided in the Assessment Tool (FRT.6; Appendix D). Data should be recorded in both the Assessment Tool and RoO.

Table 7. Commonly observed indicators or root, permeability and aeration restrictions

	Vertical Root Elongation	Water Permeability	Soil Aeration
•	Presence of root mats and bunches; Presence of flattened and	 Presence of surface ponding; Presence of surface vehicle (equipment) ruts; 	 Prensence of dense, massive, or layered soil structure (compaction);
•	highly branched roots; Presence of exped roots;	 Presence of stratified or abrupt moisture changes 	 Presence of reduced pore size and pore space;
•	Presence of soil layers or abrupt texture or structure	within the soil profile; • Presence of dense, massive,	Presence of brownish-red ped surfaces;
•	changes; Absence of roots within or	or layered structure (compaction);	Presence of sour odors
	below reconstructed soil zones;	 Presence of flooded (yellow or stunted) vegetation 	
•	Absence of roots within soil aggregates	conditions;Presence of abrupt texture or structure transitions.	

11.2. Level 2 Soil Assessment (Optional)

A Level 2 assessment is an optional assessment that can be used at the discretion of the assessor that may be triggered by a problem in either the vegetation or soils. The need for a Level 2 Soil Assessment is triggered on sites where anomalies in parameter measurements and/or ratings are encountered at a Level 1 and further investigation is needed to assist in making a Pass/Fail decision.

Level 2 is used to quantify relative differences between onsite and off the site as flagged by the Level 1 assessment (*i.e.*, rooting, consistence/structure, vegetation productivity, soil fertility, pH, salinity, sodicity); the process of which may help to isolate the problem requiring mitigation. The Level 2 is therefore focused and/or systematic. Topsoil samples collected as part of the Level 2 assessment are analzyed for %-clay, organic carbon (OC), pH, EC, and SAR while, subsoil samples collected as part of the Level 2 assessment are analzyed for pH, EC, and SAR.

If a problem with the soil is indicated during the Level 1 assessment, targeted Level 2 soil parameters are checked. After ruling out any problems in Level 2, the site passes. If the site fails any of the Level 2 soils parameters, then the site fails, unless failure is clearly unrelated to the wellsite (*i.e.*, third-party impacts). If a problem persists,

mitigation will be necessary and a re-assessment performed starting at Level 1. Use the ratings provided in (FRT.6; Appendix D) for the Level 2 soil parameters and record data in the Assessment Tool and the RoO.

11.2.1. Sampling

Sample the assessment points that failed the Level 1 Soils Assessment on the lease, access, or both where appropriate. Delineate the area of concern and record it on the site sketch. Use the same process as a step-out to collect a minimum of three soil samples onsite and offsite for the Level 2 Soil Assessment information. There shall be an equal number of control and lease sample points, with a minimum of three on-lease and three control sample points. The control sample points should represent a cross-section of quality (based on ratings assigned for the Level 1 Soils Assessment).

11.2.2. Using Laboratory Measured Values

For assessment points where a Level 1 Soil Assessment showed too great a rating drop and a Level 2 Soil Assessment was conducted to validate infield measurements assessors should examine the laboratory value for the assessment location. For sites where the lab analytical results indicate the site was within the acceptable range identified by the comparison to the control values, the site passes; if not, the site should be mitigated and re-assessed. The following ratings apply to the Level 2 soil assessment portion of the criteria with respect to soil analyses. The ratings are based on the unit differences (*i.e.*, percentage for clay and OC, dS/m for electrical conductivity (salinity)).

11.2.2.1. SOIL TEXTURE

The Level 2 Assessment of soil consists of a particle size analysis (%-Clay; PSA) for texture and the Pass/Fail threshold is based on a change in clay content. If the average of the control samples for %-Clay was 29.1%, and an assessment point in the control had a clay content of 25.6% (a difference of 3.5% from the control), it would be given a #1 Rating. If an assessment point on the lease had a clay content of 35.6%, it would be given a #2 rating (a difference of 6.5% from the control).

11.2.2.2. ORGANIC CARBON

The Level 2 Assessment of topsoil organic carbon (%-OC) and the Pass/Fail threshold is based on a change in the percent organic carbon content. If the average of the control samples for %-OC was 7.2%, and an assessment point in the control had a %-OC content of 6.4% (a difference of 0.8% from the control), it would be given a #1 Rating. If an assessment point on the lease had a %-OC content of 4.2%, it would be given a #2 rating (a difference of 3.0% from the control).

11.2.2.3. SOIL PH

The Level 2 Assessment of soil pH and the Pass/Fail threshold is based on a change in pH. If the average pH on the lease was 7.1, and an assessment point in the control had a pH of 6.4 (a difference of 0.7 from the control average), it would be given a #2 Rating.

If an assessment point on the Lease had a pH of 6.9, it would be given a #1 rating (a difference of 0.2 from the control average).

11.2.2.4. SOIL ELECTRICAL CONDUCTIVITY (EC) AND SODIUM ADSORPTION RATIO (SAR)

The Alberta Tier 1 Soil and Groundwater Remediation Guidelines (AENV, 2010), as amended, are used for EC and SAR to determine pass/fail.

END OF SECTION

12. OTHER CONSIDERATIONS

12.1. Pests and Weeds

Alberta's Agricultural Pests Act and Weeds Control Act name a number of serious disease, insect and weed pests that spend all or most of their life cycle in the soil and/or attack below-ground parts of plants. Preventing their introduction is the first approach followed by restricting their spread. Preventive strategies include, using pest-free seed or transplants, disinfesting equipment used to work the soil, applying chemical and biological control products, and using caution when importing straw, manure and topsoil.

12.2. Topsoil additions

Although not recommended, at times where additional topsoil is desirable (e.g., to avoid re-stripping a site where desirable vegetation is already established), it shall be described (e.g., source, texture, volume, weed count) and shall have similar or as close as possible chemical and physical properties as the control topsoil (e.g., addition of Orthic Black Chernozem to Orthic Black Chernozem). The date and method of application and incorporation, and documentation showing Land Manager acceptance are required.

Where topsoil is added to improve soil quantity and/or quality (and controls are not similarly amended), the physical (e.g., texture, color, etc.) and chemical properties (e.g., pH, routine salinity package, etc.) of the topsoil require characterization prior to their use.

Note: Topsoil additions do not include soil amendments (see section on Amendments)

Where the soil is not being sourced directly from the Land Manager, it must not be imported from areas of known weed and disease infestations. In these cases, it is recommended that testing be conducted for foreign weeds (*i.e.*, weeds not normally found in that area) and problematic diseases for the area (*e.g.*, club root).

12.3. Amendments

Importation of organic amendments is generally not desirable but may be acceptable for site stabilization purposes or soil amelioration.

Amendments (i.e., biosolids, hydro mulch, manure, compost, gypsum, sawdust, clean straw, peat, etc.) can provide physical, biological and nutrient improvements to soils. Amendments (including peat) are **not** topsoil replacements. Any use of amendments **must** be documented (i.e., type, application rate, etc.), comply with the applicable

guidelines, and have agreement from the Land Manager on private lands, while approval from the Regulator is still required for use of amendments on public lands.

Application rates of amendments which cause or result in an imbalance (i.e., salinity issues, nutrient immobilization, fertilizer effects – increased nitrogen, etc.) from the control area should be avoided. Where amendments are added to improve soil quality (and controls are not similarly amended), the physical and chemical properties of the amendments require characterization prior to their use.

Note: Where documentation cannot be provided on the use of amendments assessors should discuss with the Regulator prior to submitting an application.

A minimum waiting period of two years is required following the use of an amendment before doing a vegetation assessment.

Note: The two year waiting period applies when amendments, including fertilizer, are only applied onsite.

END OF SECTION

13. Appendix A

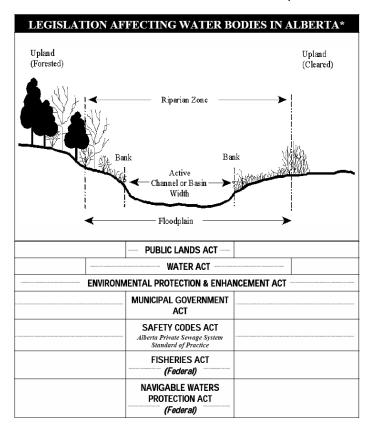
13.1. Water Act & Riparian Areas (WR)

13.1.1. Landscape

The Water Act¹ specifies that a water body is any location where water flows or is present, whether or not the flow or the presence of water is continuous, intermittent or occurs only during a flood, and includes, but is not limited to, wetlands and aquifers

(generally excluding irrigation works)². There are, therefore, direct implications of the Water Act regarding riparian lands.

Riparian lands are transition zones between the land and the water and include any geographic area that adjoins or directly influences a water body (e.g., streams, lakes, ponds, wetlands including floodplains) and land that directly influences alluvial aquifers and may be subject to flooding.³ In west central Alberta, fens, bogs and marshlands represent a large proportion of riparian areas. Healthy, intact riparian lands deliver broad benefits to society including water quality improvement, flood control and water storage, reduced erosion and the maintenance of terrestrial and aquatic biodiversity.



The protection of riparian zones is therefore a key element of integrated land-water management and an important consideration in the development of these new reclamation policy and guidelines⁴. Conserve slough/marsh wetlands in a natural state:

² Except for clause (nn) and section 99), any 'water body' that is part of an irrigation works unless the regulations specify that the location is included in the definition of water body.

¹ http://www.gp.gov.ab.ca/Documents/acts/W03.CFM

³ Fitch, L., B.W. Adams, and G. Hale, Eds. 2001. Riparian health assessment for streams and small rivers – field workbook. Lethbridge, Alberta: Cows and Fish Program. 86 pages. http://rwrp60.rwrp.umt.edu/Lasso/DetailSearch.html

⁴As per Interim Wetland Policy; Administrative guidelines to protect surface water bodies; Alberta Flood damage reduction program; and, Wetland Compensation Guide.

Mitigate degradation or loss of slough/marsh wetlands benefits as near to the site of disturbance as possible; and, Enhance, restore or create wetlands in areas where wetlands have been depleted or degraded.

The *Mitigation Sequence* includes: (1) Avoidance of impacts to wetlands; (2) Minimization of impacts and the provision of applicable compensation; and, (3) Compensation of impacts that cannot be avoided or minimized.

Restored Wetlands should be: (1) Located within the same watershed; (2) As close to site of impact as possible; (3) Similar wetland class as impacted site; and, (4) An area based upon size of the destroyed wetland and distance from site.

Exemptions can include: Refer to the *Water Act*..

13.1.2. Vegetation - Indicators of Riparian Areas

Riparian areas can be classified using hydrologic indicators as indicated by the types of vegetation and soils. Vegetation indicators are hydrophytic plants classified by their frequency of occurrence in wetlands including cattails, bulrushes, most sedges, some mosses, and many willows (SWCD, 2005). Hydrophytic vegetation occurs in distinct zones adjacent to streams and wetlands. Vegetation zones associated with riparian and aquatic areas include low prairie, wet meadow, shallow and deep marsh, and permanent open water (Stewart and Kantrud, 1971). Descriptions and photographs of the vegetation zones are provided in the City of Calgary's Wetland Conservation Plan (City of Calgary, 2004). Descriptions of plant community types in Alberta can be found in various sources (Thompson and Hansen, 2002; Thompson and Hansen, 2003) including helpful photographic and descriptive guide for key riparian plant species in Alberta (Hale et al., 2003).

13.1.1. Soils - Indicators of Riparian Areas

Riparian soils are typically hydric (*i.e.*, usually saturated and subject to flooding or ponding during a portion of the growing season). Detailed wetland soils criteria have been documented by the USDA (NRCS, 2003). Drainage classes found in riparian areas include: moderately well, imperfect, poor, and very poor. Imperfect and moderately-well drained soils can only indicate riparian areas at locations where hydrology and vegetation indicators are also consistent with riparian conditions as imperfect and moderately-well drained soils can also occur in uplands. For example, in central and northern Alberta these soils can also occur in fine-textured parent materials.

13.1.2. Riparian Function: Hydrology

Hydrology is the driving force that creates all wetlands. Hydrologic indicators include standing (lentic) or flowing (lotic) water during at least part of the growing season, water marks or drift lines of debris on trees or shrubs, or thin layers of sediment coating the ground or objects on the ground (SWCD, 2005). Riparian areas usually occur in depressional and toe-slope positions, but groundwater springs can occur in mid- and lower-slope positions.

13.1.3. Wellsites In or Near Riparian Areas

Reclamation criteria: The reclamation criteria for riparian lands are addressed in each Land use group. A framework for the health assessment of Alberta wetlands is provided by the Cows and Fish program's user's manual (Cows and Fish, 2004). Legislation that applies to wellsites in and/or near riparian areas:

13.1.3.1. WATER ACT (GOVERNMENT OF ALBERTA, 2009B):

No person may commence or continue an activity without approval unless it is otherwise authorized under the Act; Section 36(1) Subsection 2.

13.1.3.2. DIRECTIVE 056 (AER, 2008):

Clause 41: States that the well centre must be sited a minimum of 100 m from a water body.

Clause 42: Provides allowable conditions or measures that can allow a well to proceed if it does not meet the 100 m setback requirement including the availability of a vacuum truck or containment structures using impermeable materials.

Clause 42b: States that the applicant must maintain natural drainage if there is intermittent drainage or a spring/ artesian flow across the well site or access road on freehold or Crown land.

14. Appendix B

14.1. Supplemental Information for Vegetation

No supplemental information for the Forested Criteria has been included in this version.

15. Appendix C

15.1. Supplemental Material for Soils

No supplemental information for the Forested Criteria has been included in this version.

16. Appendix D

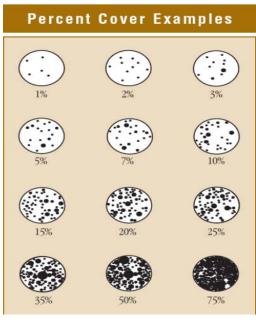
16.1. Forested Land Criteria Rating Tables

FRT.1 Level 1 Vegetation

Woody: % cover and/or stem/plant	- Visual quantitative estimate of percent cover (shrub and trees) and/or wood stem/plant count (trees and shrubs) using a 1.78 meter radius (10 m²).
count	
	- Target is to achieve ≥ 25% tree/shrub cover, or a stem/plant count of 5 if natural recovery, or 2 if planted.
Herbaceous: % cover	- Visual quantitative estimate of percent cover using a using a 1.78 meter circular radius (10 m²)

FRT.2 Undesirable plant/weed ratings for Forested soils

VEGETATION / WEED RATINGS				
Rating	Class	Description		
1	0	None		
2	1	Rare	•	
	2	A few sporadically occurring individual weeds and/or undesirable plants	• •	
3	3	A single patch of weeds and/or undesirable plants	»;	
	4	A single patch plus a few sporadically occurring weeds and/or undesirable plants	* · ·	
4	5	Several sporadically occurring weeds and/or undesirable plants	• • •	
	6	A single patch plus several sporadically occurring weeds and/or undesirable plants		
5	7	A few patches of weeds and/or undesirable plants	* * *	
	8	A few patches plus several sporadically occurring weeds and/or undesirable plants	4 . 4 . 33	
6	9	Several well spaced patches of weeds and/or undesirable plants	* * * *	
	10	Continuous uniform occurrences of well spaced weeds and/or undesirable plants	• • • • •	
7	11	Continuous occurrence of plants with a few gaps in the distribution of weeds and/or undesirable plants		
	12	Continuous dense occurrence of weeds and/or undesirable plants	000, 00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	



FRT.3 Topsoil Rating for Forest Soils distribution

Rating	% of Control Mean
1	≥80.0% of Control mean
2	50.0 - 79.9% of Control Mean
3	30.0 - 49.9% of Control Mean
4	<30.0% of Control Mean

FRT.4 Level 1 Soil Parameters for Forested soils

	Coarse Fragment	Surface Stoniness	TEVT	TIDE	Topso	il (TS)	Subso	il (SS)
Rating	Content	(Stoniness Class)	TEXT	UKE	Consis	stence	Consis	stence
	(% Volume)		Clay (C)	Sandy (S)	Moist	Dry	Moist	Dry
1	<3	SO No stones on the surface	Loam, Silt	Very friable -	Soft - Slightly	Loose, Very	Loose, Soft,	
•	,3	S1 Occasional stones on surface; typically 8-25 m apart.	Loani, siit	Loani, Siit	Fri a ble	Hard	friable, Friable, Firm	Slightly hard, Hard
2	3 to 20	S2 Numerous stones on surface; typically 1-8 m apart.	Sandy Clay Loam, Clay Loam, Silty Clay Loam	Sandy Loam	Loose - Firm	Loose - Hard	Very firm	Very hard
3	20 to 50	S3 Many stones; serious impediment to surface activities (machinery, vehicles); typically 0.5-1 m apart.	Clay, Silty Clay, Sandy Clay	Loamy Sand	Ve ry firm	Very hard	Extremely firm	Extremely hard
4	>50	S4 Very many stones on surface; considerable clearing required before any surface activities possible; typically <0.5 m apart	Heavy Clay, Siltstone	Sand, Gravel, Unconsolidate	Extremely firm	Extremely hard	NA	NA
		S5 Excessively stony on the surface; typically <0.1 m apart.	d Bedrock					

FRT.5 Soil Structure Rating for Forested Soils

Kind	Class	Size (cm)	Topsoil	Subsoil
Single grain ¾ loose, incoherent mass of individual particles as	-	<0.2	2	1
in sands.		0000	000000000	
Amorphous (massive) ¾ a coherent mass showing no evidence of	Breaking to fine fragments	<2	2	1
any distinct arrangement of soil particles.	Breaking to medium fragments	2-5	3	2
	Breaking to coarse fragments	5-10	4	3
	Breaking to very coarse	>10	4	4
Blocky (angular blocky) ¾ faces rectangular and flattened less	Fine blocky	<1	1	1
than 5 sided, vertices sharply angular.	Medium blocky	1-2	2	1
	Coarse blocky	2-5	3	2
	Very coarse blocky	>5	4	3
Subangular blocky ¾ faces subrectangular more than 5 sided,	Fine subangular blocky	<1	1	1
vertices mostly oblique, or subrounded.	Medium subangular blocky	1-2	2	1
	Coarse subangular blocky	2-5	3	2
	Very coarse subangular blocky	>5	4	3
Granular ¾ spheroidal, characterized by rounded vertices.	Fine granular	<0.2	1	1
	Medium granular	0.2-0.5	1	1
	Coarse granular	0.5-1	2	2
Platy ¾ horizontal planes more or less developed.	Fine platy	<0.2	1	1
	Medium platy	0.2-0.5	2	2
	Coarse platy	0.5-1	3	3
Prismatic ¾ vertical faces well defined and edges sharp.	Fine prismatic	<2	2	1
	Medium prismatic	2-5	3	2
	Coarse prismatic	5-10	4	3
	Very coarse prismatic	>10	4	4
Columnar ¾ vertical edges near top of columns not sharp.	Fine columnar	<2	3	2
Columns may be flat-topped, rounded-topped, or irregular.	Medium columnar	2-5	4	3
	Coarse columnar	5-10	4	4
	Very coarse columnar	>10	4	4
Compacted – relatively dense soil layers/lumps, more or less	Fine compacted	<2	3	2
defined. These layers may break with vertices being sharply	Medium compacted	2-5	4	3
angular. Size reflects thickness of layers or diameter of lumps.	Coarse compacted	5-10	4	4
	Very coarse compacted	>10	4	4

FRT.6 Level 2 Soil Parameters for Forested soils. Values are the difference between the average control value and specific assessment point site being evaluated (Lease - Control).

Rating	PSA: % Clay	Organic Carbon	рН
1	0 - 5%	0 - 1%	0 - 0.5
2	5.1 - 10%	1.1 - 2%	0.6 - 1
3	10.1 - 30%	2.1 - 4%	1.1 - 2
4	>30%	>4.1%	>2.1

17. Appendix E

17.1. Exemption Justification Form

NOTE: This is a sample of the form that must be completed when submitting a justification on trying to justify why a wellsite should pass a Landscape, Vegetation, and/or Soils Soils Assessment even though it did not meet the criteria. Justifications initiate a further technical review.

Site:		Category failed:				
Write j	Write justification here and attach any supporting documentation:					
Name	and Title of person	preparing justification:				
		7 ,				
	(Nama)	(Signature)	(Title)	(Date Prepared)		
Nama	(Name)		(Title)	(Date Prepared)		
Name	and Title of Approv	ing Official (GOA).				
	(Name)	(Signature)	(Title)	(Date Approved)		

18. Appendix F

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19. Appendix G

19.1. Glossary

A horizon (topsoil): A mineral horizon formed at the surface in the zone of removal of material by leaching, or maximum accumulation of organic carbon, or both, as defined by the *Canadian System of Soil Classification* (CSSC).

Acceptable Substitutions: For the purposes of the 2010 Reclamation Criteria, these include seeded native (Type 1 and 2) species that *may* not be present on the control but are part of the natural subregion (See the RoO for a species list of native species to the individual subregions). Their presence is considered temporary as plant succession proceeds but in the short-term they are also considered desirable species as they provide ecological benefits such as sheltering canopy, site stabilization and litter accumulation.

Access: In some cases the landowner (or designate) may wish to have roads left in place. The roads must be stable, non-hazardous and non-erosive.

Admixing: The addition of non-topsoil material to topsoil resulting in a mixture. Non-topsoil materials could include subsoil, spoil and/or project wastes.

Ae: An A horizon that has had clay, iron, aluminum, or organic matter, or all of these, leached from it. Ae horizons are usually gray coloured with a platy structure, as defined by CSSC.

Aggregate: A group of soil particles cohering so as to behave mechanically as a unit.

Agroforestry: An ecologically based natural resource management system in which trees are integrated in farmland and rangeland. These typically, are tracts of land, on a farm, ranch or other private property, set aside primarily for the growing, management, and harvest of trees for sale as unprocessed logs and potentially a variety of other ancillary products.

Ah: An A horizon in which organic matter has accumulated as a result of biological activity, as defined by CSSC.

Ahe: An A horizon that has some organic matter accumulation, as well as some leaching of clay, iron, or aluminum, as defined by CSSC.

Anomaly: A result at an assessment location that does not appear representative of the entire grid being evaluated. If an anomaly is encountered, a 'step-out' assessment procedure may be used to see if the location is anomalous or representative of the grid.

Ap: An A horizon markedly disturbed by cultivation, as defined by CSSC.

Arable: Tillage; agricultural production based on cultivation practices; land that is cultivated or capable of being cultivated. Arable is used as a comparison to agriculture based on grazing (noncultivated) systems.

Assessment Grid: An approximately 30 m x 30 m grid, to 40 m x 40 m grid, established on the lease to provide a systematic method for collecting soils (and vegetation) data.

Assessment Point: The point that is positioned at a location within a grid (or access) that is representative of the entire grid (or mapped section of the access) where the soil (and vegetation) is to be assessed.

Audit: Refers to the Wellsite Audit System: The is a process of issuing reclamation certificates for wellsites (following application review), and then conducting a field assessment on a selected number of certified sites to ensure that criteria have been met.

B horizon: A subsoil horizon characterized by enrichment in organic matter, or clay; or by the development of soil structure; or by change of colour denoting hydrolysis, reduction, or oxidation, as defined by CSSC.

Bare Areas: Areas with exposed soil. For cultivated or forage lands, areas between seed rows are not included. Areas devoid of vegetation with exposed soil.

Bare Ground: Areas with sparse or patchy vegetation or areas between seed rows can include exposed mineral soil, in which case would be referred to as bare ground/soil rather than bare areas

Bare Soil: See Bare Ground

Bedrock: The solid rock underlying soils and the regolith or exposed at the surface.

Bog: A peat-covered or peat-filled wetland, generally with a high water table. The water of a bog is generally acid and low in nutrients. Bogs usually support a black spruce forest but may also be treeless. They are usually covered with sphagnum and feathermosses and ericaceous shrubs.

Brunisolic: An order of soils whose horizons are developed sufficiently to exclude them from the Regosolic Order but lack the degrees or kinds of horizon development specified for soils in other orders. They always have Bm or Btj horizons.

C horizon: A mineral subsoil comparatively unaffected by the pedogenic processes operative in the A and B horizons except for the process of gleying (Cg), or the accumulation of calcium carbonates (Cca) or other salts (Csa), as defined by CSSC. A naturally calcareous horizon is designated Ck.

Calcareous soil: Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with cold 0.1N hydrochloric acid.

Canopy Cover: The area of ground within a quadrat (2 dimensional frame) that is occupied by the above-ground parts of plants (live or dead), when viewed from above. Cover is usually estimated as a percent, but multiple layers of vegetation often result in cover values over 100%. Litter (dead vegetation) is included but weeds are not.

Cation Exchange Capacity (C.E.C.): A measure of the total amount of exchangeable cations that can be held by the soil; it is expressed in terms of mols *per* kg of soil (formerly meq/100g); CEC is largely controlled by the amount of clay and organic matter in the soil.

Cemented horizon: Any horizon that has a hard or brittle consistence because the particles are held together by cementing substances such as humus, calcium carbonate, or oxides of silica, ironsite and aluminum. They are commonly represented by horizon designations such as Cc or x.

Chernozemic: An order of soils that have developed under xerophytic or mesophytic grasses and forbs, or under grassland-forest transition vegetation, in cool to cold, subarid to subhumid climates. The soils have a dark-coloured surface (Ah, Ahe or Ap) horizonsite and a B or C horizon, or both, of high base saturation. The order consists of the Brown, Dark Brown, Black and Dark Gray great groups.

Chroma: The relative purity, strength, or saturation of a colour; directly related to the dominance of the determining wavelength of the light and inversely related to grayness; one of the three variables of colour.

Classification, soil: The systematic arrangement of soils into categories and classes on the basis of their characteristics. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed differences in specific properties.

Clay pads: Built-up wellsite.

Clay: As a particle-size term: a size fraction <0.002 mm equivalent diameter.

Clod: A compact, coherent mass of soil produced by digging, plowing or remoulding.

Coarse fragments: Rock or mineral particles greater than 2.0 cm in diameter. Rounded and sub-rounded rock fragments up to 7.5 cm in diameter are referred to as gravelly; 7.5 cm to 25 cm are cobbly; and over 25 cm are stony or bouldery.

Coarse fragment content: The volume (%) of coarse fragments within the soil profile. These coarse fragments represent constraints for the use of the soil and farming practices.

Coarse texture: The texture exhibited by sands, loamy sands, and sandy loams except very fine sandy loam. A soil containing large quantities of these textural classes.

Compaction: the result of bearing equipment and drilling activity onsite that exceeds the soil strength, increasing the density of the topsoil and/or subsoil, limiting root penetration and water infiltration.

Compatible Species: For the purposes of the 2010 Reclamation Criteria for Forested Lands these are the seeded species that were part of a seed mix that was appropriate to the time period or as outlined in historical agreements with the Land Manager. For the purposes of the 2010 Reclamation Criteria for Native Grasslands, these are species used for reclamation on sites prior to 2010. These species are comprised of native species but may not be native to the subregion and agronomics that are suitable for grazing purposes. They do not include weeds, Problem Introduced Forages, mosses or lichens.

Consistence: The resistance of a soil to deformation, or the degree of cohesion or adhesion of the soil mass. Terms used to describe a moist soil are: loose, very friable, friable, firm, very firm, compact, very compact, and extremely compact. Terms used to describe dry soils are: loose, soft, slightly hard, hard, very hard, and extremely hard.

Construction period: Period when site is being prepared for exploration and/or extraction.

Contamination: The condition or state of soil or water, caused by a substance release or escape that results in an impairment of, or damage to, the environment, human health, safety, or property. Introduction of foreign materials as a result of wellsite activity (construction, drilling, production, or reclamation). Types of contaminants include hydrocarbons, gas leaks, salts, sterilants, etc.

Contouring: Topographic features measured in centimeters (micro), meters (meso) and tens of meters (macro). Such can be lost due to cut and fill wellsite construction activities and need to be restored during reclamation.

Control Depth: Calculated as the depth of a single topsoil control (access roads).

Control: Refers to information collected offsite against which collected information from a reclaimed site will be compared. The control information is collected offsite from adjacent or representative land.

Cover: Usually defined as the area of ground covered by all living (includes stems and leaves) and dead (litter) plant material that is produced naturally on a site, expressed as a percentage of the total area. Bare soil is not cover. This definition of cover is also referred to as ground cover, canopy cover or aerial cover. This is the type of cover that is referred to in the vegetation criteria. In a grassland it is important that cover be estimated where possible, by looking directly down on the plants from above.

Cultivated land: Lands within the White Area that are currently or potentially arable, and utilized for production of field crops (cereals, oilseeds, pulses, hay, and pasture in rotation) (Leskiw 1997). See also the intext definition.

Detailed Site Assessment (DSA): The report that must be attached to the Wellsite Reclamation Certificate Application form that provides all the data collected on the site. The report will also contain the justification used to explain why a site should get a certificate if some of the criteria have not be met.

Distribution Tolerance: Level of acceptable variability as found in representative controls.

Disturbed Assessment: A Grasslands land use lease assessment that evaluates landscape, vegetation and soil components in areas of a lease where the soils have been subject to handling, storage, reclamation, compaction or rutting. The purpose is to evaluate reclamation success. A more intensive assessment of vegetation (cover and productivity) and soil (laboratory analyses) may be necessary to address apparent problematic conditions.

Disturbed Areas: areas of the lease or access have undergone stripping (*e.g.*, stripping, or storage and including points like well-centre and flare pits and longitudinal effects like ruts). In some cases (*e.g.*, soils that were not frozen) even though soil stripping was not conducted traffic may have caused compaction.

pulverized soil, rutting or clodding to the extent that the native community (i.e., species and/or layers) has been altered or removed.

Disturbed soils: Soils that have been stripped, compacted, rutted or otherwise altered.

Drainage: Soil drainage refers to the frequency and duration of periods when the soil is not saturated. Terms used are: excessively, well, moderately, imperfectly and poorly drained.

Droughty soil: Sandy or very rapidly drained soil.

Ecological (or ecosystem) **goods and services** and services (EGS) are the benefits humans receive from the environment for free. EGS are categorized as: (1) *Regulating Services* - benefits obtained from an ecosystem's control of natural processes: air quality regulation, climate regulation, natural hazard regulation, water regulation, erosion control and sediment retention, waste treatment, pest regulation, pollination; (2) *Supporting Services* - underlying processes that are necessary for the production of all other ecosystem services: soil formation, primary production, nutrient cycling, photosynthesis, water cycling; (3) *Cultural Services* - nonmaterial benefits people obtain from ecosystem services: ethical values, existence values, recreation and ecotourism; and, (4) *Provisioning Services* - the goods or products obtained from ecosystems: water supply, fiber, food production, genetic resources, biomass fuel, biochemicals, natural medicines, and pharmaceuticals.

Ecological site: A distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation. In a grassland environment, **range site** refers to a broader description of soil landscape (*e.g.*, loamy, clayey, sandy, choppy sand hills) that might be further subdivided into ecological sites due owing to differences in plant community potential.

Ecosystem function: The interactions between organisms and the physical environment, such as nutrient cycling, soil development, water budgeting, and flammability.

Eolian: Material that has been deposited by wind action.

Erosion: The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

Evapotranspiration: The combined loss of water from a given area and during a specific period of time, by evaporation from the soil surface and by transpiration from plants.

Facilities or Features Left in Place: In some cases, the landowner may wish to have roads or pads left in place. In these cases, the vegetation criteria are not necessarily applied. In other cases, roads or pads may be left in place but will be expected to be vegetated (*e.g.*, peat lands in agricultural areas, roads in Green Area). In these cases, some form of root zone must be established and the vegetation portions of the landscape criteria have to be met.

Fen: A peat-covered or peat-filled wetland with a water table which is usually at or above the surface. The waters are mainly nutrient-rich, minerotrophic waters from mineral soils. The vegetation consists mainly of sedges, grasses, reeds and brown mosses with some shrub cover and at times, a scanty tree layer.

Fibre (rubbed): Amount of fibre in an organic soil, greater than 0.15mm, remaining after a specified amount of abrasion (rubbing). A fibric soil has greater than 40% rubbed fibre, a mesic soil has 10% to 40% rubbed fibre and humic soil has less than 10% rubbed fibre.

Fibric: An organic layer containing large amounts of weakly decomposed material whose origins are readily identifiable.

Fine texture: Consisting of, or containing large quantities of the fine fractions, particularly of silt and clay.

First lift: The top layer of undisturbed soil materials salvaged and separated during excavation to be respread as topsoil.

Fluvial: Material that has been transported and deposited by streams and rivers. Also alluvial.

Forage: Perennial agronomic species grown for the purpose of feed.

Friable: A consistency term pertaining to the ease of crumbling of soils.

Full Disturbance: Full disturbance sites are sites that have had soil disturbances across the entire site.

Gleysolic: An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas, or prominent mottling, or both, in some horizons. The great groups Gleysol, Humic Gleysol and Luvic Gleysol are included in the order.

Gravelly: Containing an appreciable or significant amounts of gravel (particles 2 to 75 mm in diameter)

Grazing response - how the various kinds of plants on the range react when they are grazed. This may vary with soil and climate for any one species. Range plants are grouped as follows:

Grazing Response – Type 1 Species (Decreasers): Species that decrease in relative abundance as disturbance increases. They tend to be palatable to grazing animals and are the dominant species in the reference plant community (climax vegetation). Highly productive, palatable plants that grow in the original climax vegetation stand. They are palatable to livestock, and will decrease on a range when exposed to heavy grazing pressures.

Grazing Response – Type 2 Species (Increaser – Type 1): Species that normally increase in relative abundance as the decreasers decline. They are commonly shorter, less productive species and more resistant to grazing and other disturbances. Type 1 increaser species increase at first but may decrease later as grazing or other disturbance pressures continue to increase. The increaser plants are normally shorter, lower producing and less palatable to livestock.

Grazing Response – Type 3 Species (Invaders): Invaders are introduced, non-native species and not normally components of the reference plant community (climax vegetation). They invade a site as the decreasers and increasers are reduced by grazing or other disturbances. Invaders may be annuals, herbaceous perennials, or shrubs and have some (or no) grazing value. They are never considered desirable or acceptable vegetation.

Grazing Response – Type 4 Species (Increaser – Type 2): Species that normally increase in relative abundance as the decreasers decline. They are commonly shorter, less productive species and more resistant to disturbance. Type 2 increaser species continue to increase in abundance with increasing disturbance pressures. When increaser type 2 species occur on a disturbed well site, we limit the amount of this cover that is considered desirable vegetation. The amount considered acceptable would be equal to the cover of the species found in the control or 5 % which ever is greatest.

Green Area: Public Lands General Land Classification. Forest lands not available for agricultural development other than grazing.

Groundwater: That portion of the hydrosphere which at any particular time is either passing through or standing in the soil and the underlying strata and is free to move under the influence of gravity.

Gullying: Erosion of soil or soft rock material by running water that forms distinct, narrow channels that are larger and deeper than rills and that usually carry water only during and immediately after heavy rains or following the melting of ice or snow.

Horizon (soil): A layer in the soil profile approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil forming processes. Soil horizons may be mineral or organic and differ from adjacent horizons in properties such as colour, structure, texture, and consistence, and in chemical, biological, and mineralogical composition.

Hue: One of the three variables of colour. It is caused by light of certain wavelengths and changes with the wavelength.

Humic: An organic layer of highly decomposed material containing little fibre.

Hummocky: Abounding in rounded or conical knolls or mounds, generally of equidimensional shape and not ridge-like.

Hydraulic conductivity: See Permeability.

Immature soil: A soil with indistinct or only slightly developed horizons.

Impeded drainage: A condition which hinders the movement of water through soils under the influence of gravity.

Impervious: Resistant to penetration by fluids or by roots.

Industry Assessment: The time (or times) when the site is assessed by the operator or his consultant. Data for the certificate application are collected at this time.

Infiltration: The downward entry of water into the soil.

Irrigation: The artificial application of water to the soil for the benefit of growing crops.

Justification: Explanation of why a site should get a certificate if some of the criteria have not been met. This information must be included in the Detailed Site Assessment Report (use Appendix E as template). For sites where justification has been used, the assessment is now a Non-Routine Application.

Lacustrine: Material deposited in lake water and later exposed.

Land capability: The nature and degree of limitations imposed by the physical characteristics of a land unit for a certain use.

Land Manager: For Public Lands, this includes staff from Environment and Sustainable Resource Development (ESRD) responsible for stewarding public/crown lands. For Provincial Parks and Protected Areas this will include staff from Tourism, Parks and Recreation. For Special Areas this will include the Special Areas Board. For Private Lands, this includes the landowner, their designate, or occupant.

Landowner: person(s) holding the deed to the property.

Layers: Structural layers (life form layers) in grasslands include: 1) low shrubs, 2) tall graminoids and forbs 3) medium graminoids and forbs and 4) ground cover (graminoids, forbs, moss, lichen). In Forested, the layers would include trees, shrubs, grasses² and herbaceous.

Lease: The wellsite, not the access road, in this document.

Level 1: A wellsite assessment that considers landscape, vegetation and soil components at a low level intensity. It's purpose is to detect any anomalies needing more indepth assessment.

Level 2: An optional assessment used at the discretion of the assessor. This involves a more intensive assessment soil through laboratory analyses to assess the apparent problematic conditions.

Lithic: A feature of a soil subgroup which indicates a bedrock contact within 50 cm of the soil surface.

Litter: Standing and fallen dead plant material that was produced naturally on site.

Loam: See soil texture. A mixture of sand, silt and clay. It is not related to colour.

Loose: A soil consistence term.

Luvisolic: An order of soils that have eluvial (Ae) horizons, illuvial (Bt) horizons in which silicate clay is the main accumulation product. The soils developed under forest or forest-grassland transition in a moderate to cool climate. The Gray Luvisol great Group is the most common in Western Canada.

Management plan: as established through the Site Conservation Plan.

Medium texture: Intermediate between fine-textured and coarse-textured soils. It includes the following textural classes: very fine sandy loam, loam, silt loam, and silt.

Mesic: An organic layer of intermediately decomposed material (between that of fibric and humic).

Minimum Disturbance: Minimum disturbance sites are sites that have been reclaimed where construction practices have minimized the level of disturbance on the lease resulting in two different management zones (i.e., Undisturbed and Disturbed).

Moderately-coarse texture: Consisting predominantly of coarse particles. In soil textural classification it includes all the sandy loams except the very fine sandy loam.

Moderately-fine texture: Consisting predominantly of intermediate-size soil particles. In soil textural classification it includes clay loam, sandy clay, sandy clay loam, and silty clay loam.

Modifed native grasslands: Grasslands where native species integrity has been altered by past disturbance and where > 70% of the community is composed of non-native plant species and where grazing management needs may be different than native communities (more like tame pastures)

Morphology, soil: The makeup of the soil, including texture, structure, consistence, colour, and other mineralogical, physical, and biological properties of the various horizons of the soil profile.

Mulch: Dead plant material (*e.g.*, straw) that is added to a reclaimed site to help promote plant establishment by retaining soil moisture, increasing microbial activity and preventing soil erosion. It is not included in determining cover.

Munsell soil colour system: A colour designation system that specifies the relative degree of the three simple variables of colour: hue, value, and chroma. For example: 10YR 6/4 is a colour (of soil) with a hue of 10YR, value of 6, and chroma of 4. Value (grayness) can be used as a proxy for organic matter content.

Native species: A plant species that is indigenous to the ecosite. For the purposes of the 2010 Native Grassland Reclamation Criteria, native species refer to those species existing offsite found within the control area.

Native-Infilling Species: For the purpose of the 2010 Reclamation Criteria for Native Grasslands are a combination of native species from the controls or were seeded that are establishing on the disturbed area and are indistinguishable as to their source. They are considered desirable as they are part of the local native plant community and their presence is a measure of native species recruitment and progress along a successional pathway.

Natural recovery: Long term re-establishment of diverse native ecosystems (*e.g.*, Prairie, forest) by establishment in the short-term of early successional species. This involves revegetation from soil seedbank and/or natural encroachment and no seeding of nonnative agronomic species.

Non-Arable Lands: Land that has no capability for arable agriculture.

Non-Surface Soil: Nonsurface soil includes subsoil and other materials that do not normally comprise surface soil.

Offsite: See definition for "control". Refers to information collected offsite against which collected information from a reclaimed site will be compared. The control information is collected offsite from adjacent or representative land.

Offsite (remote) sump: A low-lying place, such as a pit, used for temporary storage and/or containment of liquids produced from the site.

Onsite: Refers to information collected on the reclaimed site against which collected information from the control (i.e., offsite) will be compared. The control information is collected offsite from adjacent or representative land. See also definitions for "Lease" and "Access Road".

Operability: The effort required to implement management decisions and practices in order to achieve a desired level of return

Organic matter (OM): 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.

Organic soil: An order of soils that have developed dominantly from organic deposits. The majority of organic soils are saturated for most of the year, unless artificially drained. The great groups include Fibrisol, Mesisol, Humisol and Folisol.

Paralithic: Poorly consolidated bedrock which can be dug with a spade when moist. It is severely constraining but not impenetrable to roots.

Parent material: The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil is developed by pedogenic processes.

Particle size: The effective diameter of a particle measured by sedimentation, sieving, or micrometric methods.

Peat: Unconsolidated soil material consisting largely of organic remains (mainly derived from mosses or sedges).

Ped: Fine soil particles held together in a single cluster, such as in a clod or a crumb. See Aggregate.

Pedology: Those aspects of soil science involving especially the constitution, distribution, genesis and classification of soils.

Percent Acceptable Substitutions: For disturbed wellsites, the percent cover of seeded native species that may not be present on the control but are part of the natural subregion. Their presence is considered temporary as plant succession proceeds but in the short term they provide ecological benefits such as sheltering canopy, site stabilization and litter accumulation.

Percent Native-Infill Vegetation: For disturbed wellsites, the percent cover of Native-Infill species on the reclaimed area, relative to the total cover of native species on the control. Need to have greater than 15% of the control for a pass.

Percolation, **soil water**: The downward movement of water through soil. Especially, the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

Permeability (soil): The ease with which gases and liquids penetrate or pass through a bulk mass of soil.

Pits: For the purposes of these criteria, the term Pits refers to a borrow pit from which earth was removed for constructing the Lease and/or the access.

Plant Density: The number of plants *per* unit area (*e.g.*, *per* area). An individual plant can usually be defined as the sum of the aerial parts that correspond to a single root system. Plants that spread by underground roots may be more difficult to count. In this case it may be more appropriate to use a cover estimate only.

Platy: Consisting of soil aggregates that are developed predominately along the horizontal axes, laminated; flaky.

Productivity: A measure of the physical yield of a particular crop. It must be related to a specified management. Productivity may be used to describe or define suitability but it would be inappropriate as a definition of capability which puts more emphasis on vulnerability or flexibility – on available options – rather than simply yields. Calculated as the average unit productivity of all the assessment locations.

Profile (soil): A vertical section of the soil through all its horizons and extending into the C horizon.

Public Lands: land of the Crown in right of Alberta.

Quality Tolerance: An acceptable change in soil quality factors. The onsite quality tolerance reflects the offsite (representative control) variability.

Rating Drop: For the purposes of the 2010 Reclamation Criteria this refers to a negative variance of a rating category.

Reaction, soil (soil pH): The degree of acidity or alkalinity of soil, usually expressed as a pH value.

Reclamation certification: indicates the site has passed the criteria.

Reclamation: The process of reconverting disturbed land to its former or other productive uses.

Reconstructed soil: A soil profile formed by selected placement of suitable overburden materials on reshaped spoils.

Re-disturbance: Going back on a site after reclamation and re-vegetation to address unresolved issues.

Regulator: For the purposes of the 2010 Reclamation Criteria on **Public Lands**, **Private Lands and Special Areas** this refers to Environment and Sustainable Resource Development (ESRD).

Regosolic: An order of soils having no horizon development or development of the A and B horizons insufficient to meet the requirements of the other orders. Included are Regosol and Humic Regosol great groups.

Remediation: A set of activities that results in the decontamination of a contaminated site.

Residual: Unconsolidated and partly weathered mineral materials accumulated by disintegration of consolidated rock in place.

Rilling: A rill is a narrow, very shallow, intermittent watercourse having steep sides. It presents no obstacle to tilling.

Root zone: The part of the soil that is occupied by plant roots.

Saline soil: A nonalkali soil containing soluble salts in such quantities that they interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 dS/m (formerly mmhos/cm), the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5.

Salinization: The process of accumulation of salts in soils.

Sand: A soil particle between 0.05 and 2.0 mm in diameter.

SAR (Sodium Adsorption Ratio): The proportion of sodium on the soil exchange complex in relation to the proportion of calcium and magnesium.

Saturation percentage: The amount of water required to saturate a unit of soil (often correlated with sodicity).

Second lift: 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.

Seral: Successive changes in flora: the series of different communities of plants that occupy a specific site and create a stable system during the process of ecological succession.

Silt: A soil separate consisting of particles between 0.05 to 0.002 mm in equivalent diameter.

Site: Means the lease, access road and any other associated facility (e.g., campsite, borrow pit, offsite sump, log deck) in this document or The lease and the access road in this document.

Slaking: Initial fragmentation of soil aggregates several millimetres in diameter which may disintegrate further to become microaggregates [*i.e.* < 250 im diameter] due to air trapped in the aggregates being compressed by the water as it is driven into the soil.

Sodicity: A measure of the amount of sodium on the exchange complex (often expressed as sodium adsorption ratio – SAR).

Soil Assessment: An evaluation of the characteristics of the replaced topsoil and the layer of subsoil just beneath it. The purpose of the assessment is to ensure that there are no restrictions to rooting, or to water or air movement. The soil is assessed to a minimum depth of 50 cm.

Soil exchange complex: The complement of ions adsorbed on soil particles.

Soil fertility: The status of a soil with respect to the amount and availability of elements necessary for plant growth.

Soil map: A map showing the distribution of soil types or other soil mapping units in relation to the prominent physical and cultural features of the earth's surface.

Soil moisture: Water contained in the soil.

Soil Profile Assessment: An evaluation of the characteristics of the replaced surface soil and the layer of subsoil just beneath it. The purpose of the assessment is to ensure that there are no restrictions to rooting, or to water or air movement. The soil is assessed to a depth of 50 cm.

Soil structure: The combination or arrangement of primary soil particles into secondary particles, units or peds. These secondary units may be, but usually are not, arranged in the profile in such a manner as to

give a distinctive characteristic pattern. The secondary units are characterized and classified on the basis of size, shape, and degree of distinctiveness into classes, types, and grades, respectively. Common terms for kind of structure are – single grain, amorphous, blocky, subangular blocky, granular, platy, prismatic and columnar.

Soil survey: The systematic examination, description, classification, and mapping of soils in an area. Soil surveys are ranked according to the kind and intensity of field of field examination.

Soil: The unconsolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

Solonetzic: An order of soils developed mainly under grass or grass-forest vegetative cover in semiarid to subhumid climates. The soils have a stained brownish or blackish solonetz B (Bn, Bnt) horizon and a saline C horizon. The order includes the Solonetz, Solodized Solonetz, and Solod great groups.

Solum (plural sola): The upper horizons of a soil in which the parent material has been modified and within which most plants roots are confined. It consists usually of A and B horizons.

Species Composition: The different kinds, amounts, and proportions of plants present on a revegetated disturbed area. These can be grasses, forbs, shrubs, or trees.

Specified land: For the purposes of of the 2010 Reclamation Criteria, the term Specified Land, means land that is being or has been used or held for or in connection with the construction, operation or reclamation of a well, battery or pipeline (excerpt from the Conservation and Reclamation Regulation (115/93))

Staged approach: including Level 1 and Level 2 assessments.

Step-Out Assessment: When an anomaly is encountered at an assessment location, the operator may opt to conduct a 'step-out' assessment to determine if it is representative of the whole grid or not. A step-out consists of assessing a minimum of an additional 3 locations. These additional locations will be <10 m from the original point in a triangular shape around it.

Subsoil: Although a common term it cannot be defined specifically. It may be the B horizon of a soil with a distinct profile. It can also be defined as the zone below the plowed soil in which roots normally grow. For Level 2 it refers to the soil material between 20 cm and 50 cm.

Surface soil (topsoil): The uppermost mineral or organic material, valued as a growing medium and salvaged. More detailed definitions are provided in the text of the criteria for each land use. The uppermost mineral/organic material, valued as a growth medium and salvaged.

Surface Stoniness: Stoniness is the relative proportion of stones on the soil surface. The number, size and spacing of these coarse fragments on the surface represent constraints for the use of the soil and farming practices. Stoniness affects tillage, selection of type of machinery and crop selection.

Texture: The relative proportions of sand, silt and clay in a soil. It is described in terms such as sand (S), loamy sand (LS), sandy loam (SL), loam (L), silt loam (SiL), clay loam (CL), silty clay loam (SiCL), and clay (C).

Third-party impacts: pre-oil and gas, Land Manager, Landowner (or designate) activities, such as, recreational or industrial use, trails, wildlife.

Till: Unstratified glacial drift deposited directly by the ice and consisting of clay, sand, gravel, and boulders intermingled in any proportion.

Tilth: The physical condition of the soil in relation to plant growth Top soil replacement

Topsoil: Topsoil is normally referred to as the plough layer in agricultural soil and contains the majority of the roots. This is the A horizon including Ap, Ah, Ahe, Ae and sometimes AB as defined in The System of Soil Classification For Canada, 1987 (page 23).

Total Acceptable Vegetation: On disturbed wellsites, the combined cover of native infilling species and acceptable substitution species. For reclaimed websites the total acceptable vegetation cover must be

greater than 50% cover relative to the control. For undisturbed wellsites, the total percent cover of native species on the wellsite relative to the corresponding native species in the control. Need more than 70% cover for a pass.

Trajectory: The probable course of plant community development through a series of dynamic changes in ecosystem structure, function and species composition over time (adapted from Dictionary of Natural Resource Management, UBC Press, 1996)

Two-lift stripping : The selective salvage of all surface soil as the first lift and of good quality upper subsoil as the second lift. The lifts are then replaced in the proper order.

Undisturbed Assessment: A Grasslands land use lease assessment that only evaluates landscape and vegetation components. The purpose is to evaluate reclamation success or to identify any anomalies requiring more in-depth assessment (soils and more detailed vegetation parameters).

Undisturbed Areas: include areas of the lease or access where there has been no surface soil disturbance and the native plant community has remained relatively intact (*i.e.*, the on/offsite vegetation community and layers are similar). Generally, this applies where slopes are minimal and lease leveling was not necessary.

Value, colour: The relative lightness or intensity of colour and approximately a function of the square root of the total amount of light. One of the three variables of colour.

Vigour: The relative health of a plant. If a plant is vigourous, it is healthy and is performing as expected, in comparison with the surrounding vegetation or control.

Water table: The upper surface of groundwater or that level below which the soil is saturated with water.

Weed: An undesirable or unwanted plant. Prohibited noxious and noxious weeds must be managed as per the Alberta Weed Control Act and/or the local authority.

Wetland: Land that has the water table at, near, or above the land surface or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydric soils, hydrophytic vegetation and various kinds of biological activity that are adapted to the wet environment.

White Area: The white zone is the settled areas of Alberta, This includes Privately owned lands as well as 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.

Woodlots: A tract of land, on a farm, ranch or other private property, set aside primarily for the growing, management, and harvest of trees for sale as unprocessed logs and potentially a variety of other ancillary products.

20. Appendix H

20.1. Contact Information

Air Photo Distribution

Main Floor, 9920 - 108 Street NW

Edmonton AB T5K 2M4 Phone: (780) 427-3520 Fax: (780) 422-9683

Email: Air.Photo@gov.ab.ca

Web: www.srd.gov.ab.ca/lands/geographicinformation/airphoto

Environmental Law Centre

#800, 10025 - 106 Street NW Edmonton, AB T5J 1G4 Phone: (780) 424-5099 Fax: (780) 424-5133

Toll Free: 1-800-661-4238 Email: elc@elc.ab.ca

Alberta Energy Regulator main office:

Suite 1000, 250 - 5 Street, SW

Calgary, AB T2P 0R4 Phone: 403-297-8311 Fax: 403-297-7040

Email: Infoservices@AER.ca

ESRD Groundwater Information Centre

Fax: (780) 427-1214 Phone: (780) 427-2770 Email: gwinfo@gov.ab.ca

Freedom of Information and Protection of Privacy Office

6 th Floor South Petroleum Plaza, 9915 - 108 Street

Edmonton, AB T5K 2G8 Phone: (780) 427-4429 Fax: (780) 427-9838

Email: foip.environment@gov.ab.ca

21. Appendix I

21.1. Regional Offices

ESRD - SOUTHERN REGION

2nd Floor, Deerfoot Square 2938 - 11 Street NE Calgary, AB T2E 7L7 Telephone: (403) 297-8295

Fax: (403) 297-8232

ESRD - CENTRAL REGION

3rd Floor, Provincial Building 4920 - 51 Street Red Deer, AB T4N 6K8 Telephone: (403) 340-7052

Fax: (403) 340-5022

ESRD - NORTHERN REGION

111 Twin Atria Building 4999 - 98 Avenue Edmonton AB T6B 2J6 Telephone: (780) 427-7617

Fax: (780) 427-7824

ESRD - District Offices

For a complete list of all ESRD offices and contact information, visit http://srd.alberta.ca/Default.aspx

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