

Technical Note

Vegetation Management Treatments

Introduction:

Vegetation management is critical to establishing desirable plant species and to achieving reclamation objectives. For purposes of simplicity and clarity four Technical Notes on vegetation management have been developed. They are:

1. Principles of Vegetation Management
2. **Vegetation Management Treatments** identifies an array of vegetation management treatment categories and discusses their strengths and weaknesses.
3. Operational Vegetation Management
4. Special Considerations in Herbicide Use

An overview of vegetation management treatments available for reclamation purposes is provided. It gives a generic description of treatments and an overview of strengths and weaknesses of each treatment. Treatments are also ranked relative to each other across an array of criteria including effectiveness, environmental effects, cost, flexibility of deployment, safety concerns, and ability to integrate with other treatments.

Vegetation Management Treatments

Cultivation Treatments

Cultivation treatments rely on disturbing the root of target plants, either severing the top of plants from the roots or/and breaking the connection between roots and soil. Cultivation treatments rank with hand pulling as the oldest vegetation treatments. Cultivation treatments require substantial energy as they must disrupt soil - when the energy is supplied by equipment cultivation treatments result in

significant generation of exhaust emissions; when done by hand, cultivation is expensive. Selectivity of cultivation treatments varies with hand cultivation techniques - hoeing, weed raking being highly selective; while mechanical cultivation treatments - ploughs, disks, and cultivators are largely non-selective. Cultivation treatments are primarily useful as part of an integrated control package for root reproducing species; where cultivation is used to break up roots stimulating emergence and increasing leaf area - this followed with a foliar herbicide treatment to kill the leaves and attached roots. Care should be taken when prescribing and deploying mechanical cultivation treatments as they can increase the potential for soil erosion by disrupting vegetation providing soil stability.

Cultivation treatments on wellsites can range from relatively light treatments using agricultural equipment through substantial using either forestry equipment or decompaction ploughs designed to obviate soil massing effects (see section XXXX.) Figures 1 2 illustrate cultivation treatments. Decompaction treatments frequently act to stimulate root reproducing grasses (e.g. reedgrass and quackgrass) resulting in a significant challenge to desirable vegetation establishment (Figure 4).

Figure 1. Straight shank ripping results in an effect similar to agricultural cultivation.

Figure 2. Riplow decompaction treatment results in substantial disturbance.

Figure 3. Reedgrass emergence 4 months after winter decompaction with a Riplow.

Manual Treatments

Manual treatments rely on hand pulling or breaking to either remove plants from the soil or break the top from woody plants. While very selective and of low environmental impact, manual treatments are extremely expensive and of limited effectiveness. Manual treatments are only used for noxious or

restricted weed control in environmentally sensitive areas; for example, control of purple loosestrife in aquatic or riparian areas. Due to their high cost and marginal effectiveness manual treatments are not typically integrated with other treatments.

Mechanical Cutting Treatments

Mechanical cutting treatments can be manual (brushsaws or chainsaws - Figure 4) or motorized (ranging from grass mowers to hydraulic powered brush cutters - Figure 5). Cutting treatments are a highly effective treatment for reducing biomass - particularly of woody or large herbaceous species (Figure 6). Cutting treatments are marginally effective in controlling root reproducing species. Cutting treatments are highly effective as part of an integrated control program where cutting is used to reduce biomass of woody vegetation (Figure 7). When the treated vegetation responds via root reproduction herbicide treatment is used to reduce the population. In fact, this approach is so successful attachments for brushsaws (SproutLess™) and rotary mowers (Brown Brush Monitor™) designed to apply herbicide to cut surfaces at the time of cutting are very popular in utility vegetation management.

Figure 4. Brushsaw being used to control woody brush.

Figure 5. Rough terrain push mower in use.

Figure 6. Hydraulic powered self-propelled mower mowing large brush.

Figure 7. Root suckers arising from mowing treatment being sprayed with foliar herbicide.

Herbicides

Chemical herbicides are highly effective and very contentious vegetation management tools. Herbicides are especially effective in controlling perennial species that reproduce from root structures. There are a wide range of herbicides available for vegetation control during wellsite reclamation; however, most

desirable plant species are susceptible to the same herbicides suited to controlling undesirable plant species. In reforestation, glyphosate herbicides are most commonly used (97% of herbicide use for forest management in Canada[1]) for vegetation management treatments. Glyphosate is typically a non-selective herbicide BUT differences in onset of seasonal dormancy between coniferous trees species and deciduous tree and native herbaceous species confers crop tolerance on conifers and allows use of glyphosate in a selective manner. Given the need to establish mixed species plant communities on wellsites herbicides are generally not able to provide adequately selective vegetation control. Thus the best method of using herbicides for wellsite reclamation is either as a site preparation treatment prior to establishing desirable plant species or as a selective treatment. When making site preparation treatments care should be taken to ensure herbicides are not persistent in soil and soil active - as if this is the case herbicide carryover in soil can prove injurious or lethal to small desirable plants.

Table 1 outlines the most commonly available herbicides suitable for use in wellsite reclamation - herbicides are listed by active ingredient but marketed by trade name (which is included in the table). More detailed information on effectiveness, environmental behavior, and application methods for the herbicides listed can be found in the Guide to Crop Protection[2] or the Herbicide Handbook (9th Edition)[3].

[1] National Forestry Database http://nfdp.ccfm.org/index_e.php (Accessed December 14, 2011.)
[2] Annual Guide to Crop Protection, Alberta Agriculture Food and Rural Development. ISSN 1201-5059.
[3] Weed Science Society of America. 2007. Herbicide Handbook - 9th Edition. ISBN 1891276565

Table 1. Herbicides suitable for vegetation management in wellsite reclamation.

Active Ingredient	Trade Names	Selective[1] To	Effectively Controls[2]	Marginal or Weak Control[3]	Persistence in Soil[4]	Application Options					
						Cut Surface	Selective Single Stem	Spot Foliar	Patch Foliar	Broadcast Foliar	Soil Applied
Glyphosate	RoundUp, Vision, WeatherMax, Vantage, Glyphos, Weedmaster	Dormancy based selectivity only.	Broadleaf weeds, brush, native grasses	Agronomic grass species, dandelion	Low. No risk of root uptake after treatment.	Yes	No	Yes	Yes	Yes but not aerial application	No.
2,4-D	Esteron, Amine 400, Amine 500	Grasses	Broadleaf weeds, brush, trees	Dandelion, Canada thistle, sow thistle, conifer trees	Amine formulations may be soil active for a growing season after application	Yes - Amines	Yes - Esters	Yes	Yes	Yes	No
Linuron	Linuron, Lorox	Deciduous trees, some grass species	Annual broadleaf weeds	Dandelion, Canada thistle,	Yes. Can affect sensitive species for a full growing season after application.	No.	No.	No.	No.	No.	Yes
MCPA	MCPA	Grasses	Broadleaf weeds	Dandelion, Canada thistle, sow thistle	Amine formulations may soil active for a growing season after application	Not applicable		Yes	Yes	Yes	No
Aminopyralid	Clearview, Milestone	Grasses	Broadleaf weeds, shrubs	Canada thistle, dandelion,	Yes. Can affect sensitive species for up to 1 year after application	Not applicable		Yes	Yes	Yes	No
Imazapyr	Arsenal	Non-selective	Broadleaf weeds, shrubs, grasses, trees		Yes. Can affect sensitive species for up to 1 year after application	Yes	No	Yes	Yes	Yes but not aerial application	No
Clopyralid	Lontrel	Most species except legumes and composites	Canada thistle, scentless chamomile, legumes	Dandelion	Yes. Can affect sensitive species for up to 1 year after application	Not applicable		Yes	Yes	Yes but not aerial application	No
Triclopyr	Garlon	Grasses	Broadleaf weeds, brush, deciduous trees		Low. Little risk of soil uptake.	No	Yes	Yes	Yes	Yes	No

Footnotes:

1. Selectivity means the herbicide will not kill or seriously injure the noted species.
2. Effective control means the herbicide will give at least 2 growing seasons of top growth control.
3. Marginal control means the herbicide will damage and likely stunt the species but not prevent it competing with desired plants.
4. Persistence in soil does not refer to chemical presence but rather to likelihood of root uptake causing an effect in desired plants.

Cultural Controls

Cultural controls are methods that rely on occupying the space weeds or competing species might fill with cover crops, mulches, or mats. Cover crops can range from over-dense seeding of desired species

through use of annual plants that are unlikely to reproduce in the reclamation environment. At present, use of cover crops is constrained by the 2010 Reclamation Criteria for Wellsites and Associated Facilities on Forest Lands[4] favoring use of native species for reclamation purposes while seeds for native species other than trees are practically unavailable. Until native plant seed sources become available agronomic species will be need be used for cover crops. In this situation use of fall rye is recommended as it is unlikely to successfully reproduce in the boreal environment.

Other cultural weed control options include mulches or mats. Mats are generally preferred over mulches as decomposition of organic material in mulches will compete with desired plant species for soil nitrogen, much as competing plants would. At present (late 2011) mats are generally made of plastic that is not stabilized for exposure to ultraviolet light rendering them somewhat environmentally degradable. Available in either rolls or as single plant sheets mats are very useful for weed control when establishing high value woody plantings like orchards or vineyards. They are less useful for reclamation as they are entirely non-selective - all plants under a mat will wither and die from lack of light. Thus mats do not lend themselves to establishing functioning ecosystems - as required by regulation.

An alternative to plastic mats are pulp mats, where available. Pulp mills may have downgraded pulp sheets that are not marketable which can be used in the same manner as pulp mats.

Integration of Treatments

Vegetation management is most effective when more than one means of control or intervention is used. Integration allows focusing treatments on managing specific aspects of the vegetation to be controlled, for example, reducing biomass or reducing the population. Similarly some treatments depend on the target plants being small enough for treatment effectiveness, for example, cultural controls are best used to control emergent seedlings. Similarly manual cutting can only be applied effectively to woody plants less than 3 or 4 meters tall.

Critical Points

1. A wide range of treatment methods are available for vegetation management during well site reclamation.
2. No single method of control is entirely effective in controlling the wide array of weed and competing species encountered during reclamation.
3. Herbicides are highly contentious and highly effective vegetation management tools, the reclamation specialist must carefully examine decisions around herbicide use in light of this dichotomy.
4. Table 2 provides a quick overview of key aspects of vegetation management treatments.

[4] Alberta Environment, 2010. 2010 Reclamation Criteria for Wellsites and Associated Facilities for Forested lands Alberta Environment, Edmonton, Alberta. 99 pp.

Table 2. Comparison of Vegetation Management Treatments.

	Effectiveness				Risk Associated with Use					Integration with Other Treatments				
	Reduce Biomass	*Control Root Reproduction*	*Reduce Population*	*Selectivity*	*Environmental Impact*	*Soil Activity*	*Operational Risk*	*Contentious*	*Cost*	*Cultivation*	*Manual*	*Cutting*	*Herbicides*	*Cultural*
Cultivation	Yes	No	No	No	High	No	Moderate	No	Moderate		Low	Low	Well	Moderate
Manual	No	No	No	Yes	Low	No	Low	No	High			Low	Low	Low
Cutting	Yes	No	No	Yes/No[1.]	Low/Moderate[3.]	No	Low/Moderate[3.]	No	Moderate				High	Moderate
Herbicides	No	Yes	Yes	Yes/No[2.]	Low	Yes	High	High	Low					High
Cultural	No	No	No	No	Low	No	Low	No	High					

Footnotes:

1. Manual cutting is somewhat selective, mechanical cutting is not selective.
2. Depending on herbicide - see Table 1.
3. Manual - Low, Mechanical - Moderate.