APPENDIX A

WATERSHED MANAGEMENT PROGRAM-
MANAGEMENT TECHNIQUES AVAILABLE

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WATERSHED MANAGEMENT PROGRAM

Final Environmental Impact Statement
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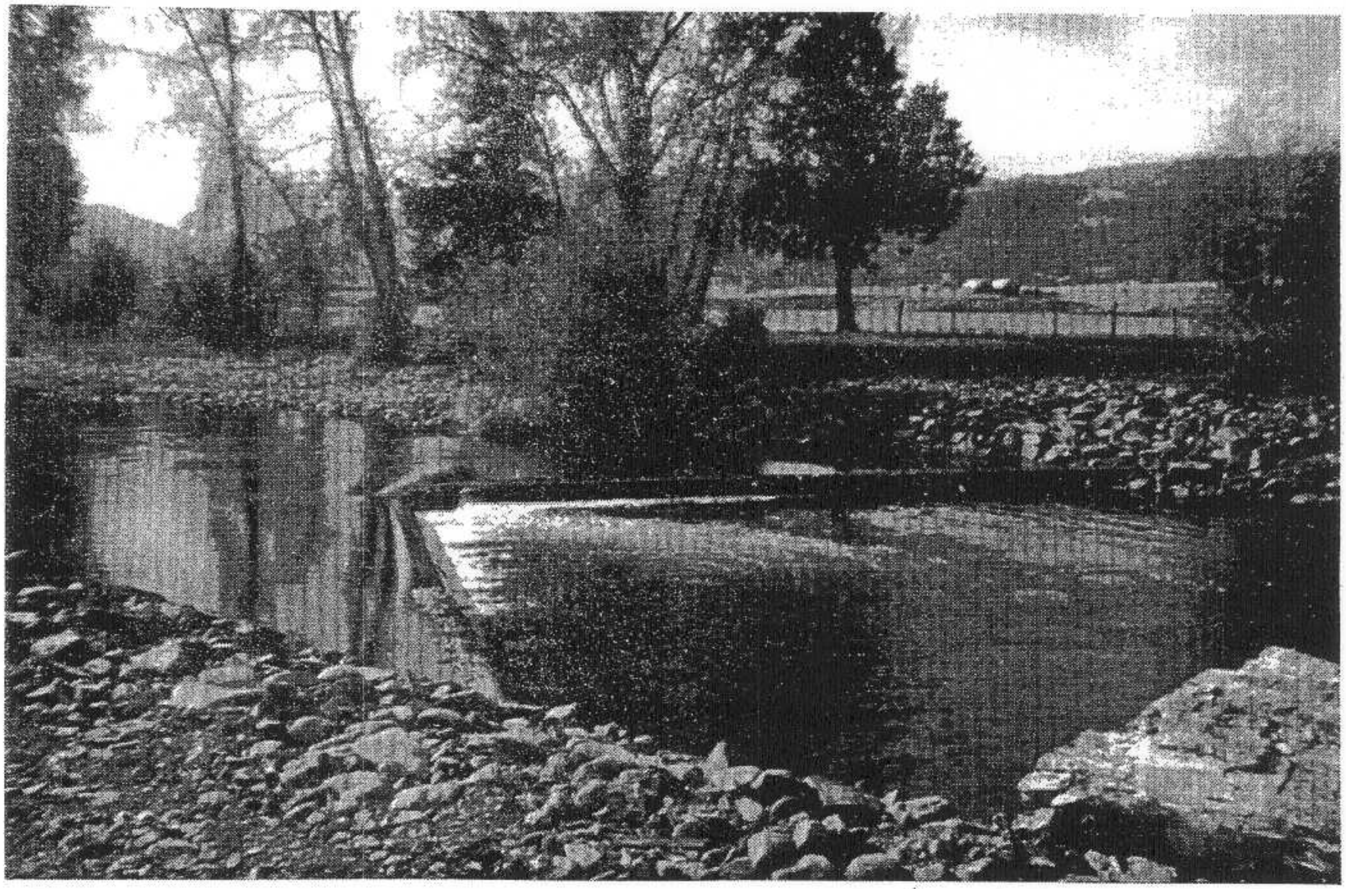

BONNEVILLE POWER ADMINISTRATION

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Appendix A: Available Management Techniques

A wide range of techniques is available to create, protect, enhance, and manage aquatic habitat both directly and through those riparian and upland processes which influence aquatic habitat. This section summarizes some of the primary techniques that may be implemented under the Model Watershed Program and other efforts under the Northwest Power Planning Council to mitigate and restore lost fisheries habitat in the Columbia River Basin. USEPA (1993) is a primary source for many of these techniques. The techniques are not necessarily appropriate for all watersheds or for BPA funding; indeed, misapplication of these techniques could result in worsened habitat conditions. However, all of these techniques can be a viable part of a sound watershed management plan, and properly implemented alone and with other techniques, can result in improvements in the quantity and quality of aquatic habitat.

The techniques are classified in this EIS into 11 major categories:

- In-channel Modifications and Habitat Enhancement Techniques
- Special Vegetation Treatment Techniques, including Techniques for Wetlands and Riparian Areas
- Agricultural Management Techniques--Crops
- Agricultural Management Techniques--Irrigation
- Agricultural Management Techniques--Animal Facilities
- Agricultural Management Techniques--Grazing
- Road Management Techniques
- Forest Management Techniques
- Community Development and Management Techniques
- Recreation Management Techniques
- Mining and Mine Reclamation Techniques

For each major category, a series of specific management techniques is listed and described below. Each technique includes an overview of the technique followed by a brief listing of some general benefits and drawbacks inherent to the technique.

1 IN-CHANNEL MODIFICATIONS AND HABITAT ENHANCEMENT TECHNIQUES

1.1 MODELING THE EFFECTS OF RIVER CHANNELIZATION

1.1.1 Overview of Technique

Use available computer models to evaluate effects of proposed channelization and channel modification projects on physical channel characteristics and flow regimes. Similarly, hydraulic models can be used to aid in the design of natural channel conditions for the restoration of channelized reaches and the removal of control structures. Simulation models can integrate physical transport processes and other parameters over time to aid in decision making during planning level evaluations.

1.1.2 General Benefits

- both physically-based and empirical models force consideration of a variety of factors (input parameters)
- choice of models already developed and in use for many applications
- allows proactive management through predictive capability of modeling

1.1.3 General Drawbacks

- assumptions behind a model may not apply to a site-specific project
- can be difficult and expensive to apply to smaller projects

1.2 PROHIBIT FURTHER CHANNELIZATION

1.2.1 Overview of Technique

Discourage or prohibit any projects that result in increased channelization including channel relocation, dredging, permanent bank armoring with rip-rap or concrete, and disruption of high-flow or side channels.

1.2.2 General Benefits

- maintains naturally operating processes necessary to creation and maintenance of channel structure and fish habitat
- natural channel systems usually result in an optimum configuration unless the river regularly leaves the channel or creates new channels.
- maintains a greater quality and quantity of fish and riparian habitat

1.2.3 General Drawbacks

- some heavily impacted or less resilient systems may require very long periods of time to recover
- dynamic river beds with extreme floods or new channel development are unpredictable

1.3 RESTORATION OF CHANNELIZED RIVER AND STREAM REACHES

1.3.1 Overview of Technique

Channels which have been modified or "trained" using control structures to meet flood control and other land use concerns often experience a reduction in the quantity and/or quality of fish habitat they contain. Where land uses have changed or occur in areas where fish habitat restoration is a priority, restoring channelized reaches may be an appropriate technique.

This technique involves the careful design of natural channel conditions, the removal of control structures (dikes, levees, structural bank protection, other engineered or created structures), and the reclamation of the natural, active floodplain. Good design considers data and results from current and historic aerial photos, maps, hydraulic models, original channelization plans, local knowledge of historic conditions, and recent literature. Heavy equipment excavates the current conditions into a channel and floodplain which mimics natural conditions for gradient, width, sinuosity, and other hydraulic parameters. Bioengineering methods are employed to help stabilize the banks and floodplain as the new channel performs minor self-adjustments during bankfull (and larger) flood events.

1.3.2 General Benefits

- restores naturally operating processes necessary to the sustaining of channel structure and fish habitat
- natural channel systems usually result in an optimum configuration unless the channel frequently convulses (high sinuosity or braided channels)
- maintains a greater quality and quantity of fish and riparian habitat

1.3.3 General Drawbacks

- conflicts with existing land uses
- may require significant land area (channel and floodplain)
- dynamic river beds with extreme floods or new channel development are unpredictable

1.4 PRE-IMPLEMENTATION EVALUATION OF PROPOSED ENHANCEMENTS

1.4.1 Overview of Technique

Proposed enhancements should be based on observed and documented resource conditions and processes. Assess conditions and impacts of enhancements before project design and implementation using any of a number of biological and channel stability check lists and methodologies. Examples include: Habitat Evaluation Procedures (Cooperrider et al., 1986); Rapid Bioassessment Protocols (Plafkin et al. 1989); Rosgen Stream Classification (Rosgen 1994; Rosgen and Fittante 1986); Pfankuch Channel Stability (Pfankuch 1978).

1.4.2 General Benefits

- fosters understanding of habitat-limiting factors
- matches suitability of enhancement methods to habitat needs
- characterizes baseline or reference conditions for post-enhancement habitat evaluation

1.4.3 General Drawbacks

- none

1.5 INSTALL GRADE CONTROL STRUCTURES AND CHECK DAMS

1.5.1 Overview of Technique

Grade control structures are hydraulic barriers placed in a channel to provide stability by controlling headcuts, scour of the stream bed, and upstream degradation. Examples include gabions and concrete weirs, which generally do not impound water, and check dams, which do.

1.5.2 General Benefits

- useful in controlling stream flow velocity and direction
- stabilizes sediments behind structure
- retards gully advancement
- enhances fish habitat by creating deeper pools and holding areas

1.5.3 General Drawbacks

- gradient alterations influence many other channel parameters (width, depth, etc.) and may cause detrimental changes to channel morphology
- can affect sediment transport processes resulting in deposition of fine sediment through a reduction in channel steepness (aggradation)
- could inhibit fish passage if improperly designed

1.6 INSTALL LARGE WOODY DEBRIS STRUCTURES

1.6.1 Overview of Technique

Large woody debris (LWD) in stream channels provides hydraulic roughness which promotes grade control, complex velocity distributions, localized scour, and a variety of naturally maintained stream bed and bank forms. This hydraulic and structural diversity provides an array of habitat features including clean spawning gravel, pools, and protective cover. A reduction in instream LWD through riparian harvest and stream "cleaning" may lead to a simplification and degradation of fish habitat. LWD structures, such as wing deflectors, bank protection logs, and upstream and downstream vee log weirs, can restore lost habitat.

1.6.2 General Benefits

- provides hydraulic and structural diversity
- mimics natural processes
- slow, long-term decay of structures can provide transitional return to natural conditions

1.6.3 General Drawbacks

- LWD insertion requires anchoring either through cabling, or bed/bank disturbance and partial burial, or both
- improperly designed structures can create adverse hydraulic conditions and exacerbate flooding and local bank erosion
- flooding can displace structures to less optimal location

1.7 INSTALL OTHER HABITAT COMPLEXITY STRUCTURES

1.7.1 Overview of Technique

Boulders and concrete structures can be installed in longer reaches with higher stream flow velocities to provide localized scour pools and resting areas. They can also provide additional cover or direct streamflow to preferred channel areas (spawning gravels, side channels, etc.).

1.7.2 General Benefits

- enhances existing habitat
- encourages upstream migration through higher velocity reaches

1.7.3 General Drawbacks

- improperly designed structures can create adverse hydraulic conditions (flooding or scour)
- some bed/bank disturbance may accompany placement or construction of structures

1.8 BANK PROTECTION THROUGH VEGETATION MANAGEMENT

1.8.1 Overview of Technique

Maintenance of existing and/or natural streambank vegetation and replanting of native vegetation are non-structural techniques of protecting streambanks and the habitat features they provide. Trees and shrubs (woody plants) offer the most protection and provide cover to habitat; herbaceous plants retain surface soils on-site; aquatic (under the waterline) vegetation stabilizes banks and absorbs stream energy otherwise directed at soil particles in the bank. This method relies on the rooting strength of streamside plants to stabilize streambank soils.

1.8.2 General Benefits

- promotes natural processes (e.g., repairs itself when damaged, eventually replenishes instream woody debris)
- inexpensive
- visually attractive

1.8.3 General Drawbacks

- vegetation--natural or planted--may be inadequate for natural or man-made reasons
- seasonal limitations and time to effective cover
- high-value property may be lost to rapidly eroding streambanks

1.9 STRUCTURAL BANK PROTECTION USING BIOENGINEERING METHODS

1.9.1 Overview of Technique

Tree boles and root wads installed in the river bed at the banks are effective in stabilizing streambanks by absorbing stream energy otherwise directed to streambank soils. They are especially useful on the outside of curves such as meander bends, where stream energy is greatest. They generally require the use of heavy equipment to either push sharpened boles into the banks, or to excavate, partially bury, and backfill around them.

Other soil bioengineering methods are useful where steep, eroding slopes abut streambanks. Live brush cuttings in bundles (fascines) on narrow contour terraces are effective in reducing sheet and rill erosion and shallow sliding. Branch packing of cuttings and backfill in deeper slumps perpendicular to the slope are effective in reinforcing soil and increasing slope stability..

Bioengineering methods are usually accompanied by planting of trees and shrubs.

1.9.2 General Benefits

- natural materials, often obtainable in riparian stands
- mimics natural processes of LWD recruitment
- gradual decay provides transition to naturally stable banks
- also provides excellent bank cover and localized scour pools for fish

1.9.3 General Drawbacks

- soil disturbance during installation
- heavy equipment near or possibly in stream
- may disrupt natural channel migration

1.10 STRUCTURAL BANK PROTECTION USING ENGINEERED STRUCTURES

1.10.1 Overview of Technique

Direct protection of streambanks may be obtained by lining banks with stone riprap, geotextiles, burlap or jute fabric, and/or bulkhead walls constructed of wood or concrete. Structures provide indirect protection by redirecting stream flow and include dikes, gabions, and fences.

1.10.2 General Benefits

- helpful in highly disturbed areas, or where high quality habitat and high value property require immediate protection
- generally long design life

1.10.3 General Drawbacks

- expensive
- design, labor, and resource intensive
- may require greater maintenance than other measures
- visually unattractive
- disrupts natural channel migration
- inhibits development of vegetative cover
- may simply "transfer" problems downstream
- may result in increased channelization

1.11 REMOVE DEBRIS FUNCTIONING AS BARRIERS TO PASSAGE

1.11.1 Overview of Technique

Some accumulations of debris in channels can be large enough and configured in such a way as to preclude passage by migrating adults or access by rearing juvenile fish to preferred habitats. Examples include large jams of introduced large woody debris at channel constrictions, landslide deposits, and beaver dams.

1.11.2 General Benefits

- access to critical or high quality habitat

1.11.3 General Drawbacks

- hydraulic "side-effects" can create higher flow velocities and downstream scour
- loss of slower-water habitat and cover provided by debris to existing fish population

1.12 HARDENED FORDS

1.12.1 Overview of Technique

Where livestock, farm equipment, and other machinery must cross stream channels only occasionally, and then at low flows, culvert installation or bridge construction may not be warranted. Hardened fords (cobbles, concrete blocks, geotextiles, concrete) at established pathways may adequately protect channel structure (Saskatchewan Environment and Resource Management 1995a).

1.12.2 General Benefits

- resists bank trampling and destruction
- generally easier to install (compared to culverts)
- less resource damage if/when removed

1.12.3 General Drawbacks

- allows direct contact of equipment/livestock with stream
- no sideboards to encourage/require use

1.13 CULVERT REMOVAL/REPLACEMENT TO IMPROVE FISH PASSAGE

1.13.1 Overview of Technique

Improperly installed, designed, or damaged stream crossing structures (culverts, etc.) can cause partial or complete barriers to fish migration. Replacement with properly sized structures, placed at gradients and depths conducive to fish passage, can restore fish migration routes. Generally, preferred structures are, in order: no structure at all (avoid crossing); bridges; bottomless arch culverts; oversized culverts; temporary culverts; and permanent culverts (whether pipes or boxes; whether metal, concrete, or plastic; etc.). Replacement with properly sized structures, placed at gradients and depths conducive to fish passage, can restore fish migration routes (Baker and Votapka, 1990).

1.13.2 General Benefits

- restored fish migration
- improved capacity

1.13.3 General Drawbacks

- temporary impacts due to instream construction

1.14 REDUCE SCOUR AND DEPOSITION AT HYDRAULIC STRUCTURES

1.14.1 Overview of Technique

Improperly installed, designed, or damaged stream crossing structures (culverts, bridges) can result in the scour of the streambed, stream banks, and road fills, and/or the deposition of both fine and coarse sediments. Deleterious effects may include the removal of spawning gravels, sedimentation of spawning gravels, the fill of downstream soils, the perching of culverts precluding fish passage, and the influences of catastrophic road failures after clogging or undermining of the structures. Removal and/or replacement of poorly functioning structures can alleviate such chronic and potentially catastrophic conditions (Saskatchewan Environment and Resource Management 1995a).

1.14.2 General Benefits

- reduces in-channel erosion and sedimentation
- maintains clean spawning gravels
- reduces pool filling
- maintains road and crossing structure investment

1.14.3 General Drawbacks

- temporary sediment increase due to construction

1.15 FISH PASSAGE ENHANCEMENT—FISHWAYS

1.15.1 Overview of Technique

The enhancement of fish passage over or around natural barriers and man-made structures may provide the highest and most immediate benefit to the fisheries resource (Rainey, 1991; Powers and Orsborn, 1985). Barriers may be effective for all or some fish, all or various ages of fish, and at all or some of the time (and stage of flow). Barriers and other deterrents to fish passage associated with fast water include waterfalls, velocity chutes, boulder-strewn reaches, and extremely turbulent areas. Braided reaches and streams with wide, shallow flows can be slow water barriers. Debris-laden reaches may also limit fish passage by creating frequent obstacles. Culverts, dams and diversions, other instream structures, fill areas, and ponds can be human-made obstacles to passage by physically blocking or dewatering streamcourses.

Fish passage enhancement projects include the construction of fish ladders, fish screens, side channels, baffled culverts, fish locks and fish elevators (Rainey, 1991). Simpler approaches may include blasting to remove barriers or create pools. The removal of roughness elements and obstacles such as debris, beaver dams, boulders, and sediment may be appropriate in some cases (see Technique 1.10). Existing culverts may also be replaced to correct passage problems (see Technique 1.12) (Baker and Votapka, 1990).

Design criteria for passage enhancement will include biological, engineering, and hydraulic considerations. Biological considerations should include fish capabilities such as swimming and burst speeds, endurance, and leaping abilities, quality and quantity of upstream habitat, relative frequency of other barriers upstream and downstream, upstream channel stability, and upstream management activities. Engineering considerations should include elements such as structure selection, construction materials, streambed foundation, site access, regulatory and arbitrary design constraints, and the desired life expectancy of the structure. Hydraulic considerations should include design peak flows, hydraulic parameters such as gradient, cross-section, and roughness coefficient, bedload, expected debris load and type, and water storage capacities at the upstream and downstream ends of the structure. Plans should be submitted for peer technical review prior to approval and implementation.

1.15.2 General Benefits

- facilitates increased fish migration
- provides access to unused or under utilized habitat

1.15.3 General Drawbacks

- temporary increase in construction related sediment
- increased maintenance requirements (e.g., cleaning trash racks, etc)
- potential adverse effects by changing channel hydraulics
- potential adverse effects on individuals and fish populations isolated or protected by existing barriers (e.g., introduction of anadromous fish to trophy trout waters)

1.16 SPAWNING HABITAT ENHANCEMENTS

1.16.1 Overview of Technique

Where available spawning area is limiting in areas of otherwise good potential production, enhancement projects may be implemented to increase the quantity or improve the quality of spawning habitat. Approaches to spawning habitat enhancement include placement of log or rock structures to function as gravel traps (see Technique 1.6), augmentation of riffled areas with clean river gravel, and the construction of side spawning channels accessible from natural streams (Seehorn, 1992; Bonnell, 1991). The appropriate method depends on the channel type of the enhancement reach (Rosgen and Fittante, 1986).

1.16.2 General Benefits

- increased or improved available spawning area
- potential to increase spawning success

1.16.3 General Drawbacks

- increased or improved habitat may remain under utilized
- useful design life can be shortened by peak flow events or sedimentation
- some improvements may require maintenance or repeated applications

1.17 REARING HABITAT ENHANCEMENTS

1.17.1 Overview of Technique

Where available rearing area is limiting in areas of otherwise good potential production, enhancement projects may be implemented to increase the quantity or improve the quality of rearing habitat. Approaches to rearing habitat enhancement include using log structures to create pools and glides; enhancing bank cover through riparian planting and the use of log structures; improving access of juvenile fish to tributary channels adjacent to mainstem rivers and spawning areas; reconnecting streams to remnant channels, ponds, oxbow lakes, and perhaps reclaimed borrow pits; and the creation of small side channels to provide accessible rearing habitat (Seehorn, 1992; Cedarholm and Scarlett, 1991). The appropriate method is depends on the channel type of the enhancement reach (Rosgen and Fittante, 1986).

1.17.2 General Benefits

- increased or improved available rearing area
- potential to increase rearing success

1.17.3 General Drawbacks

- increased or improved habitat may remain under-utilized
- useful design life can be shortened by peak flow events or sedimentation
- some improvements may require maintenance or repeated applications

2 SPECIAL VEGETATION TREATMENT TECHNIQUES, INCLUDING TECHNIQUES FOR WETLANDS AND RIPARIAN AREAS

2.1 MAINTAIN HEALTHY RIPARIAN PLANT COMMUNITIES

2.1.1 Overview of Technique

Maintaining a streamside vegetation zone with a complex of woody and herbaceous riparian plants has multiple benefits. Avoid clearing riparian vegetation to support other land uses. Where riparian vegetation has been cleared, seed and/or plant herbaceous and woody vegetation as appropriate to address resource needs. Consider the use of rooted stock and protection of plantings from animal damage to accelerate vegetation establishment and site stabilization. Revegetation efforts should be part of project implementation plans on projects requiring soil disturbance. Project managers should take advantage of heavy equipment used during project implementation while it is still on-site to facilitate the planting of rooted-stock.

2.1.2 General Benefits

- sustains minimum flows in summer
- shades stream to maintain cool water temperatures
- filters sediment, nutrients and other pollutants from upland sources
- retains sediment, nutrients and other pollutants deposited during overbank flow events
- preserves off-channel habitats frequently used by rearing fish (remnant channels, pocket pools)
- provides for recruitment of large woody debris
- provides detritus and primary food production
- protects upland areas where channels tend to migrate

2.1.3 General Drawbacks

- requires commitment of land

2.2 PLANT/PROTECT CONIFERS IN RIPARIAN AREAS FOR THERMAL COVER

2.2.1 Overview of Technique

In addition to the benefits listed under 2.1.2 above, conifers can provide important thermal cover to sensitive stream reaches prone to ice development. Whereas deciduous plants allow greater winter temperature extremes, conifers can moderate riparian temperatures and reduce gravel and pool freezing and the development of ice flows. Large trees can also slow and break up ice flows.

2.2.2 General Benefits

- temperature moderation
- less freezing of fish eggs in spawning gravel
- less freezing of overwintering fry and juvenile fish
- reduced bank and riparian damage from ice floes

2.2.3 General Drawbacks

- some conifers may not adapt to excessively wet sites

2.3 CREATION OF WETLANDS TO PROVIDE NEAR-CHANNEL HABITAT AND STORE WATER FOR LATER USE

2.3.1 Overview of Technique

Constructed wetlands are designed to imitate the water filtering and purification processes of natural wetlands. Upland or riparian sites are converted to wetlands by creating poorly drained soil conditions. Near streams, small shallow channels can be constructed to encourage seasonal filling and access of aquatic species between the channel and adjacent wetland. This water slowly replenishes ground water and helps to sustain low flows later in the summer. Wetland functions such as wildlife habitat may exist in created wetlands, and they may function to moderate stormflows and filter sediment. This water may also be made available for agricultural uses given other resource protections.

2.3.2 General Benefits

- ground water recharge
- improved water quality
- possible rearing habitat enhancement
- possible duel benefit to wildlife and agriculture

2.3.3 General Drawbacks

- difficulty in wetland plant establishment after ground disturbance may result in sediment source and water quality degradation
- requires commitment of land

2.4 PROVIDE FILTER STRIPS TO CATCH SEDIMENT AND OTHER POLLUTANTS

2.4.1 Overview of Technique

Vegetated strips encircle a potential pollution source, or form a barrier between it and a receiving water body. Surface water entering the vegetated filter strip loses (reduces) sediment, nutrients, and bacteria through several processes. These may include filtration, deposition, infiltration, adsorption, absorption, decomposition, and volatilization. Vegetation can consist of an array of close-growing ground cover species. Soil conditions remain in aerobic condition (as compared to the anaerobic conditions of wetlands).

Shrubs and herbaceous cover should be encouraged along the perimeter of roads, including cutslopes, fillslopes, ditches, and adjacent topography. Sediment generated from the road surface, ditches, cutslopes, and fillslopes will, with adequate cover, remain stabilized on or near the road prism. Maintenance may be required where growth is vigorous, especially in ditches, in order to retain the hydraulic capacity to transport water downslope of the road.

2.4.2 General Benefits

- reductions in sediment reaching receiving waters
- nutrients taken up by vegetation
- ancillary benefits for wildlife forage and nesting
- road prism erosion is reduced
- running surface erosion is retained roadside

2.4.3 General Drawbacks

- may require maintenance or removal of sediment
- roadside vegetation can be slow to establish on eroding cutslopes
- may require continued maintenance to meet transportation safety requirements

2.5 PLANT WINDBREAKS

2.5.1 Overview of Technique

Tightly spaced trees planted on field borders can decrease wind shear on the soil surface and reduce the mass of soil removed by the wind. Detached sediment may be stored where it can be secondarily transported by water, or it may deposited directly in surface waters.

2.5.2 General Benefits

- soil stays on site; productivity maintained
- reduced deposit of/transplant of sediment to surface waters

2.5.3 General Drawbacks

- commitment of land
- transpiration of soil water that might otherwise be used by deeper-rooted crops

2.6 NATIVE SEEDS INVENTORIES

2.6.1 Overview of Technique

Local sources of seeds for grasses and legumes ensure plants adapted to local climate and soil chemistry. Hardiness of plants selected for restoration is assured.

Tree and shrub cuttings selected for slope stabilization should also be obtained from local sources-preferably near to the site.

2.6.2 General Benefits

- sources available for immediate needs
- seeds and plants well-suited to local or area ecosystems

2.6.3 General Drawbacks

- some seed types difficult or expensive to obtain and/or germinate

2.7 AVOID EXOTIC SPECIES

2.7.1 Overview of Technique

While nonnative plants can have positive stabilizing influence on a disturbed site, they can also overtake native species. Negative effects include increased maintenance problems, a reduction in plant diversity, increased disease and pest problems, and detrimental secondary effects on coexisting plants and wildlife. Avoidance measures may include using only approved native seed mixes, planting only mature plants, removal of existing non-native plants through hand/mechanical means, and eradication of existing non-native plants through chemical means

2.7.2 General Benefits

- ecosystem interactions not interrupted
- benefits of native plant species maintained

2.7.3 General Drawbacks

- mechanical removal may generate temporary sediment source (see 2.10)
- chemical eradication can have toxic side-effects (see 3.29)

2.8 CONSTRUCT WETLANDS TREATMENT SYSTEMS

2.8.1 Overview of Technique

Constructed wetlands are designed to imitate the water filtering and purification processes of natural wetlands. Upland sites are usually converted to wetlands by creating poorly drained soil conditions. Vegetation is generally not as diverse as in natural wetlands. Though other wetland functions such as wildlife habitat may exist in created wetlands, they are primarily managed in this context to treat agricultural wastewater. Pollutant removal occurs through sediment trapping, assimilation by plants, bacterial decomposition, and adsorption.

2.8.2 General Benefits

- pollutant removal
- sediment retention
- wildlife habitat

2.8.3 General Drawbacks

- if underdesigned, contaminated stormflows may be discharged from the wetland (before pollutants are stabilized)
- land commitment required
- maintenance may require harvest of overgrowth or sediment removal

2.9 MECHANICAL VEGETATION REMOVAL

2.9.1 Overview of Technique

Mechanical removal of vegetation typically involves the use of tractors or other heavy machinery equipped with a blade, mower, or other device to remove vegetation. Cables and chains attached between vehicles may also be used to clear vegetation.

While the degree of disturbance depends on the type of equipment used, mechanical removal breaks the surface of the soil and can remove some or all of the parts of plants, including roots.

Mechanical removal can be carried out over large areas or can be confined to smaller areas (known as scalping). Vegetation is sometimes removed in strips rather than clearing all areas (known as contouring or furrowing).

2.9.2 General Benefits

- generally high efficiency
- no chemicals