RECREATION BMPS

OFF-HIGHWAY VEHICLE (OHV) BMPS

- **EROSION PREVENTION**
- **SURFACE STABILIZATION**
- **TRACKING CONTROL**
- **RUNOFF CONTROL**
- **SEDIMENT CONTROL**
- **ROAD AND TRAIL DRAINAGE**
- **RESTORATION AND REHABILITATION**

WATERCRAFT

- **BILGE SOCK**
- **AQUATIC INVASIVE SPECIES CONTROL**
- **BOAT RAMPS & TURBIDITY CURTAINS**
- **FISH CLEANING STATION**
- **WATERCRAFT PARKING**
- **VEHICLE/BOAT WASHING**

SKI RESORTS

- **TRAIL IMPROVEMENT AND CONSTRUCTION**
- **LIFT CONSTRUCTION**
- **SKI AREA FACILITY CONSTRUCTION**
- **EROSION AND SEDIMENT CONTROL**

OFF-HIGHWAY VEHICLE BMPS:

For comprehensive and necessary guidance in selecting and implementing BMPs at Off-Highway Vehicle (OHV) locations, including the following categories of BMP:

- **EROSION PREVENTION**
- **SURFACE STABILIZATION**
- **TRACKING CONTROL**
- **RUNOFF CONTROL**
- **SEDIMENT CONTROL**
- **ROAD AND TRAIL DRAINAGE**
- **RESTORATION AND REHABILITATION**

Please refer to the ***OHV BMP Manual for Erosion and Sediment Control***, a comprehensive guide prepared for the State of California by Salix Applied Earthcare and Geosyntec Consultants:

https://dirttime.tv/wp-content/uploads/2018/04/OHV_BMP_WYD2.pdf

WATERCRAFT:

BILGE SOCK

DEFINITION

This boating BMP will absorb oils, gas, and diesel fluids while repelling water. Typical bilge oil absorbent socks will not sink even if saturated. The outer poly sleeve is tough, chemical resistant, and will not shed. The bright white color allows you to see how saturated the sock is.

APPLICABILITY

Oils, gasoline, and diesel fuel, when released into the coastal environment, are toxic to marine plants and animals. A poorly maintained engine or an accidental spill may cause these products to collect in the boat's bilge and be discharged into the water when the bilge is pumped.

USAGE

- Place the sock into your bilge. Secure the sock with attached loop (if available) to avoid interference with the bilge pump.
- Check the sock at least monthly and replace when oil or an oily sheen can be seen in the bilge (which indicates that the sock has absorbed to capacity).
- Dispose of used socks properly according to manufacturer instructions.
- Check with your marina operator with questions about bilge sock recycling or disposal options at each facility; also check with your harbormaster about disposal options at public facilities.

AQUATIC INVASIVE SPECIES CONTROL

DEFINITION

Aquatic invasive species (AIS) have detrimental environmental and economic impacts on businesses, communities, and native species populations. Most invasive species do not have predators to keep their populations in balance and once introduced, are difficult if not impossible to eradicate. Many invasive species such as bluegill, black crappie, bullhead catfish, large and small mouth bass, Asian clams, Eurasian watermilfoil, and curly-leaf pondweed have already been introduced into Nevada waterbodies.

AIS is typically addressed through four components:

- Prevent the introduction of new invasive species.
- Educate the public about invasive species.
- Control (remove) existing invasive species.
- Monitor for new invasive species populations.

For recreational purposes, AIS prevention is focused on the inspection of watercraft prior to their entering a Nevada waterbody. Watercraft are the largest vector for spreading aquatic invasive species into new waterways. Mandatory inspections stop aquatic invasive species, such as quagga mussels, before they enter the water. This is done through boat inspections, decontaminations to remove any biological risk, and continuous education for our watercraft users.

Statewide:
The Nevada Division of Wildlife (NDOW) is responsible for AIS prevention statewide. The goal of NDOW's Aquatic Invasive Species Prevention program is to prevent the spread of AIS threatening Nevada's waterways and to prevent new introductions of AIS. The program includes the development and approval of AIS regulations, seasonal inspection and decontamination stations, monitoring, coordination with partners, and AIS prevention education and outreach for the public. The program is funded through collection of an AIS watercraft decal and federal assistance grants.

- **AIS Decal Program:**

  The AIS decal requirement was established to prevent the spread of harmful aquatic species threatening Nevada's waterways. The decal supports AIS monitoring and research, provides AIS prevention through outreach and education, and provides seasonal watercraft inspections and decontamination stations. The AIS decal also supports enforcement of AIS prevention laws. Many aquatic invasive species, including quagga and zebra mussels, have been transferred from one body of water to another through contaminated watercraft transporting standing water. Remember to always clean, drain and dry.

All watercraft using Nevada waters are required to display an Aquatic Invasive Species decal. Costs for the decal are $13 for motorized watercraft and $6 for non-motorized watercraft.

The AIS decal is required to be purchased and displayed on all watercraft capable of retaining water that utilize Nevada waters. Watercrafts required to display a decal include all motorized watercraft and many types of non-motorized watercraft. For example, canoes, kayaks, and non-motorized sailboats are required to purchase and display the decal. Watercraft not required to purchase the decal include float tubes, paddleboards, inner tubes and water toys.

For a complete list of rules and regulations regarding AIS in Nevada, please visit:
https://www.ndow.org/get-outside/boating/aquatic-invasive-species-prevention-program/

Lake Tahoe:
Programs such as the Tahoe Resource Conservation District's mandatory inspections for motorized watercraft have been in place since 2009 for Lake Tahoe, and there are five inspection stations located around the lake.

For more information on Lake Tahoe boat inspections, please visit:
https://tahoeboatinspections.com/

For information regarding non-motorized vessels, please visit:
https://tahoeboatinspections.com/tahoe-keepers/

BOAT RAMPS & TURBIDITY CURTAINS

DEFINITION

In-water work associated with recreational boating facility construction, replacement, or dredging activities can degrade water quality by adding sediment, chemicals, or other pollutants to the waterway. During all in-water work the BMPs listed below should be used to minimize potential water quality impacts. Throughout all in-water work, all construction related debris should be managed so that no debris, garbage, or fuel enters the water. Visual monitoring for excessive turbidity, floating debris, trash, or oil sheen should be performed continuously to ensure water quality is being protected. Site appropriate BMPs should be implemented during each of the in-water construction activities to minimize potential water quality impacts. Typical BMPs are described below.

GENERAL CONSTRUCTION MANAGEMENT PRACTICES

Measures should be implemented to avoid or minimize the adverse effects of construction activities in or near the water. Work should be completed using equipment having the least impact, e.g., use of rubber-tired vehicles versus tracked vehicles. No motorized equipment should be operated (driven) in the water. Construction impacts should be confined to the minimum area necessary to complete the work. Damaged areas should be restored to pre-work conditions, including use of native plant species where appropriate. Care should be taken to prevent any petroleum products, chemicals, or deleterious materials from entering the water during construction. Work should be performed in a manner that does not inhibit fish passage. Only clean material should be used as fill. No fill should be placed in spawning areas or areas with submerged aquatic vegetation. Temporary fills should be entirely removed and the site restored to pre-existing elevation. Excavated materials should be disposed of at an off-site, upland location. All practicable steps should be taken to control erosion during construction and to establish permanent erosion protection upon completion of the work. Sediment fencing and floating silt curtains should be installed and maintained as needed to prevent movement of soil and sediment. No uncured concrete should be allowed to enter the water.

POLLUTION AND EROSION CONTROL BMPS

Measures should be implemented to avoid or minimize the adverse effects of pollution, sedimentation, and erosion by limiting soil disturbance, scheduling work when the fewest number of fish are likely to be present, managing likely pollutants, and limiting the harm that may be caused by accidental discharges of pollutants and sediment. Staging areas, refueling areas, and material and equipment storage areas should be located as far away from the water as possible, preferably in an existing parking. No vegetation removal or soil disturbance should be allowed outside of the project area. Preservation of existing vegetation is typically a key measure for preventing erosion. To the maximum extent practicable, existing vegetation should be protected during construction. Vegetation removal should be confined to the smallest portion of

the project area necessary for completion of the work. Project limits should be clearly marked to avoid unnecessary plant loss or ground disturbance. Only vegetation within 20 feet of the construction limits should be removed. All other vegetation not within the construction area should be left in its current condition, unless the vegetation interferes with site access or if the vegetation is a noxious weed. When practicable, vegetative material including plants and topsoil containing seeds, roots, tubers (i.e., the seed bank) should be salvaged and stockpiled for use in site restoration after the project is completed.

Removal of mature trees providing soil or bank stabilization within the riparian area of any waterway should be coordinated with appropriate regulatory agencies. In the event removal of mature trees is necessary in riparian areas, two seedlings should be replanted for each tree removed. The location of the replanted trees should be chosen to ensure that they do not pose a future threat to public safety or the facility.

Streambank areas should be stabilized to control erosion. Bioengineering solutions should be considered as a means to minimize riprap use in locations above ordinary high water where success is probable and the safety of structural elements are assured. Where vegetative control alone is not feasible, structures such as large wood, riprap, or other measures should be used as designed by a licensed professional engineer. Riprap, if used, should be placed on a layer of geotextile fabric to prevent the underlying sediment from being washed out through the openings of the riprap. Riprap should be keyed into the streambed to ensure its stability and effectiveness in protecting the facility.

Construction and demolition work should be confined to the footprint of the structure where possible. The project area should be enclosed by a floating silt curtain (inwater portion) and sediment fence (out of water portions). Vegetated swales or vegetated buffer strips may also be used when possible to intercept runoff allowing sediment to settle out and be captured by the vegetation.

Structural controls should be installed where appropriate to trap sediment, reduce runoff velocity, and allow for settling of turbid waters. To ensure proper functioning and to avoid catastrophic failure, all structural controls should be regularly inspected, maintained and repaired as needed. Controls should be inspected at least weekly during the rainy season and at two-week intervals during the non-rainy season. Structural controls include the following. Sediment or silt fences should be used in areas of upland disturbance to trap sediment and filter sediment laden runoff during construction. Fences should be used along the perimeter of the project, below the toe or down slope of exposed and erodible slopes, along streams and channels, and around temporary spoil areas and stockpiles. Fences should not be installed in streams, channels, drains, or areas of concentrated flows.

Sediment fences should be installed and maintained to maximize sediment control. Fences should be entrenched and keyed to prevent runoff from escaping beneath the fence. Fences should be installed parallel to the slope with the ends of the silt fence turned uphill so water does

not flow around the fence. Fences should remain in place until the disturbed area is permanently stabilized. Split, torn, slumping, or weathered fabric should be repaired or replaced immediately. Accumulated sediment should be periodically removed in order to maintain the effectiveness of the fence. Sediment should be removed when the accumulation reaches one-third of the barrier height.

Detention basins or settling basins may be used to capture runoff and settle sediments. Check dams may also be used to reduce flow velocity and contain sediment. Structure Inlets and outlets should be regularly monitored for damage or obstruction and repaired as needed. Accumulated sediment should be periodically removed in order to maintain the effectiveness of the structures. Sediment should be removed when the accumulation reaches one-half of the structure's storage volume.

For dredging projects, dredged areas should be confined to the areas used for navigational access to the facility. Dredged areas should be enclosed by a floating silt curtain. If upland spoil disposal areas are used, they should be constructed to contain the spoils and prevent the dredged materials from reentering the waterway after removal. Such disposal areas should be enclosed by a sediment fence.

A supply of erosion control materials (e.g., silt fence and straw bales) should be on hand to respond to sediment emergencies as appropriate. Sterile straw or hay bales should be used when available to prevent introduction of weeds.

For projects where some or all of the work area may be inundated, project operations should be suspended should high flow conditions threaten to inundate any spoil disposal area or areas on the bank where construction equipment is operating.

Tarps, nets, or other measures should be in place to prevent construction debris from dropping into the waterbody. Any material that does enter the water should be removed with a minimum disturbance to the streambed and water quality.

Onsite workers should be trained in identification, storage, and disposal of hazardous and solid waste. All hazardous waste should be collected, removed, and disposed of at authorized disposal areas.

All pollutant leaks and spills should be cleaned up immediately. For significant or hazardous spills that cannot be controlled by properly trained onsite workers, the appropriate emergency responders and regulators should be notified and a spills contractor or a Haz-Mat team should be employed as needed for site cleanup.

WORK AREA ISOLATION MANAGEMENT PRACTICES

Measures should be implemented to minimize the adverse effects of water quality impacts by

installing a barrier to separate the work area from flowing water and fish.

A floating silt curtain should be used during ground-disturbing activities to isolate inwater work areas from the waterway during construction. Use of the floating silt curtain should help contain turbid water and facilitate settling of suspended sediments. Use of the floating silt curtain should also effectively exclude fish from the work area. Upland work areas, including spoil disposal areas, should be enclosed by a sediment fence.

The silt curtain should be made from appropriate materials such as high strength woven geotextiles or monofilament fabrics that are impervious to sediment and fish. Curtain installation should include a chain ballast or other weight along the lower edge of the curtain to extend the curtain to within approximately 1 foot of the streambed, or according to manufacturer's instructions.

The work site should be isolated from the waterbody prior to construction. No dewatering of the site should occur. Isolation materials should not be removed from the site until after construction is complete.

Work should be completed during the period when NDOW guidelines indicate fish are least likely to be affected and fish presence is minimized. No capture of fish is typically necessary. In the event that any ESA listed fish are trapped in the work area, such fish should be captured by NDOW staff or a competent fisheries biologist in accordance with all applicable rules and guidelines, after which all fish should be released at a safe release site.

Safe fish passage around the project area should be maintained. Upstream and downstream fish passage should not be impaired during or after project completion.

REMOVAL OF EXISTING STRUCTURES MANAGEMENT PRACTICES

Measures should be implemented to minimize potential effects on the aquatic environment from removal or demolition operations.

For monolithic concrete structures, such as cast-in-place boat ramps and abutments, concrete should be broken into manageable pieces and removed from the waterway. Individual concrete components such as concrete ramp planks should be removed whole to the extent practicable. Site preparation for the replacement structure may require excavation of any existing riprap abutting the project site. If any excavated riprap is found to be suitable for reuse (durable, angular rock), it should be temporarily stockpiled above the water line. All other demolition spoils should be disposed of in an appropriate upland location.

Existing docks should not be demolished on site, but should be removed from the waterway for disposal. Existing pilings should be extracted and removed from the waterway according to Piling Removal Management Practices, below.

PILING REMOVAL MANAGEMENT PRACTICES

Measures should be implemented to control turbidity and sediments re-entering the water column during pile removal, and to dispose of removed piles and debris.

Existing pilings within the project footprint should be extracted using direct pull and/or vibratory techniques in accordance with the following resource protection measures.

Vibratory extraction is the preferred method of piling removal and should be used where available and feasible depending on piling condition and substrate type. Vibration reduces friction between the pile and substrate to avoid disturbing large amounts of sediment. Typically little or no sediment remains attached to the pile during vibratory withdrawal.

When appropriate for the substrate type and structural integrity of the piling, a crane or excavator may be used to pull the pilings out of the sediment. To the extent practicable, pilings should be removed in their entirety; however, no jetting, excavation, or other significant disturbance of the sediment should occur to facilitate piling removal.

Work should be done during low water/ low tide to the extent possible. Individual piles should be removed slowly to ensure sediment disturbance and resulting turbidity in the water column is minimized. All sediment and contaminants associated with removed piles should be contained during handling and transport to prevent re-introduction to the water. No effort should be made to remove sediment or other material from chemically treated piles, either in or over the water. After removal, the pile should be moved directly from the water to a sediment containment area.

In the event that the pile breaks at or near the existing mudline and cannot be removed, the pile should be cut off at least 1 foot below the mudline. For creosote treated piles, the remaining stump should be covered with clean sediment. Any other holes remaining after piling removal should not be filled.

All floating surface debris should be collected and disposed of along with the piling. All wooden piling treated with preservatives, together with associated sediments, and debris from piling removal should be permanently removed from the water and disposed of at a facility approved for collection of hazardous waste. Extracted piles and debris should be placed in a lined stockpile area or directly loaded into transport container or vehicle. Appropriate controls should be used to prevent runoff from leaving the stockpile and entering surface water or ground water. Steel pipe piling may be recycled or reused if the piling condition is suitable for reuse.

PILING INSTALLATION MANAGEMENT PRACTICES

Measures should be implemented to minimize both the potential injury to fish in the project area from pile driving operations, and the effects on predation in the aquatic environment. To avoid water quality degradation from contaminants, piling materials should be limited to concrete, steel

or other inert materials; no treated wood should be used.

Piling should be driven with a vibratory hammer to the maximum extent possible, with limited impact pile driving as necessary. If impact pile driving is required, a sound attenuation device, such as a bubble curtain, should be employed. All installed pilings should be fitted with devices to prevent perching of birds.

LAUNCH RAMP CONSTRUCTION MANAGEMENT PRACTICES

Measures should be implemented to minimize potential water quality effects due to boat ramp construction. Where appropriate for the site conditions and characteristics, consideration should be given to designs including use of trench drains, trapped catch basins, or other features to manage and treat stormwater runoff after construction is complete.

The boat ramp site should be isolated from the waterway using a floating silt curtain to exclude fish and to contain turbid waters resulting from excavation, grading, and placement of fill materials.

No uncured concrete or runoff from uncured concrete should be allowed to enter the water. The concrete boat ramp should consist of pre-cast concrete planks below the active waterline, and all cast-in-place portions of the ramp should be completed in the dry. Pre-cast concrete planks should be poured and cured at an upland facility located offsite. Use of cast-in-place concrete for ramp construction should be limited to portions of the ramp located two or more feet above the water surface elevation at the time of construction.

LAUNCH RAMP ARMORING MANAGEMENT PRACTICES

Measures should be implemented to minimize potential water quality effects due to riprap placement. Cut or fill slopes below normal high water elevation should be armored with clean (i.e., free of fines) riprap.

Riprap should be placed along both sides and at the toe of all boat ramps to prevent current, waves, boat wake, and prop wash from eroding or undermining the structure.

The armored area should not exceed two feet wide on the ramp edges or four feet wide at the ramp toe. Riprap should be clean and free of fines. Geotextile fabric should be installed to prevent the underlying sediment from being washed out through the openings of the riprap. Riprap should be placed in a controlled manner to minimize sediment disturbance.

DOCK CONSTRUCTION MANAGEMENT PRACTICES

Measures should be implemented to minimize potential water quality effects due to dock construction. Use of wood treated with preservatives for docks construction should be

minimized. All use of treated wood should comply with specific permit conditions for each individual dock project. Dock sections should be constructed at an upland facility located offsite. Synthetic flotation material should be permanently encapsulated to prevent dispersal of foam particles in the water.

Completed dock sections should be launched from the adjacent boat ramp, if available, or lowered into the water using a crane, excavator, or similar equipment operating from the top of bank. Dock sections should be connected together and anchored to piling and/or the boat ramp abutment. No portions of the dock should be allowed to ground out on the bed of the waterway. When installed in reservoir locations, the dock may be designed for ground contact during reservoir drawdown.

DREDGING MANAGEMENT PRACTICES

Measures should be implemented to minimize sediment resuspension, and potential effects on the aquatic environment from dredging operations.

Wherever possible, dredging should be conducted using an environmental clamshell bucket that seals closed in order to minimize the release and redistribution of dredged material to the water column during dredging. In the event that large woody debris or other obstructions must be removed from the dredge prism, or the environmental bucket cannot successfully remove sediment or substrate, a standard clamshell bucket may be used.

Dredging should be accomplished in a manner that minimizes the resuspension of sediment in the water column. Suction dredging may cause less turbidity in the waterbody than clamshell, dragline or other mechanical removal methods; however, removal of excess water from spoils generated from hydraulic dredging creates additional runoff that should be treated to remove sediment and contaminants before returning to the waterway.

For mechanical dredging, full depth cuts should be taken whenever possible to completely fill the dredge bucket with sediment. No stockpiling of material below the water surface should be allowed. The filled bucket should pause at the water surface to release excess water. The bucket should be completely emptied of sediments before returning the bucket to the water. Spoils should be dewatered in an enclosed spoil disposal area to allow regulation and treatment of supernatant as needed to meet water quality requirements for return water. Barges and other floating equipment should be operated in a manner to avoid grounding at all times. The contractor should ensure that no fuel, garbage, or debris enters the water from the dredge or any vessels associated with the project.

FISH CLEANING STATION

DESCRIPTION

Fish waste can create water quality problems at marinas where a lot of fish are landed. This might be the case where long piers or breakwaters provide access to deep water or accommodation for many fishers, where fishing tournaments are held, or at any marina during the local high fishing season. The waste from fish cleaning shouldn't be disposed of into a marina basin because of the chance of overwhelming the natural ability of the waterbody to assimilate and decompose it. The dissolved oxygen consumed by the decomposing fish parts can cause anaerobic, foul-smelling conditions. Unconsumed or floating fish parts are also an unattractive addition to the marina property. Fish waste is better disposed of in offshore waters (if the state allows) where the fish are caught, or treated as waste like any other and deposited in trash containers.

Proper disposal of fish waste by marina patrons helps keep marinas clean and free of waste. Although only a few marinas deal with large amounts of fish waste or fishing within the basin, sport fishers can be found at most marinas, and it is a good idea for marinas to promote proper fish waste disposal. Fish cleaning stations provide convenient places for marina patrons to clean fish and dispose of their waste material, and they help to keep the rest of the marina clean. Marina managers often find that once a good fish cleaning station is available to fishing patrons, the patrons gladly use it because gutting a fish at a fish cleaning station avoids the mess created on a boat or dock. Non-fishing marina patrons are likely to appreciate not having fish waste on docks or floating near their boats.

APPLICABILITY

This management measure is applicable to marinas where fish waste is determined to be a source of water pollution. Many of the BMPs mentioned for this management measure are implementable by marina patrons and are not directly under the control of marina managers.

BEST MANAGEMENT PRACTICES

1. **Clean fish where the fish are caught:** Fish waste can be disposed of in the offshore ecosystems from which the fish are caught. The quantity of fish waste produced from recreational fishing generally should not cause any water quality problems in open waters.
2. **Install fish cleaning stations at the marina and at boat launch sites:** A fish cleaning station is a particular area set aside for cleaning fish that have been caught. It typically has a cutting table large enough to accommodate a few to many people, a freshwater hose or other form of running water, and receptacles for the waste. Boaters and fishers can be informed of the presence of the station and encouraged to use it. To keep the stations attractive and sanitary, they should be cleaned frequently, even as often as

after each use. Making the station convenient to use and clean will encourage people to keep it clean themselves. Fish waste is placed in covered containers, and the collected waste is disposed of with other solid waste or by some other environmentally friendly means. (Refer to the next management practice.) If nutrient enrichment is not a problem in regional waters, fish cleaning stations can use garbage disposal units to grind the waste and then send the ground waste to a municipal sewer line for waste disposal. As always, when state or local regulations could be applicable, check with the environmental authority to determine whether they apply.

Where extensive fishing is done from a boat launch site, fish cleaning stations can be helpful. Fish waste disposal is a problem at boat launch sites because boaters return from fishing and usually want to clean their catch before they leave. Fish cleaning stations provide the ideal facility where fishers can gather to discuss their catch and clean it before heading home. As with a marina fish cleaning station, fish waste can be collected in covered containers and disposed of like regular trash or ground and emptied into a local sewage disposal system (where local regulations permit). An alternative approach would be to install an onsite disposal system with a holding tank, though this is not recommended where waterbodies have nutrient enrichment problems.

3. **Compost fish waste where appropriate:** A local Extension Service can be contacted for information on locally applicable composting procedures and equipment and where supplies can be purchased.
4. **Freeze fish parts and use them as bait or chum on the next fishing trip:** Fishers may consider recycling their own fish waste into bait for their next fishing trip. The fish parts from one fishing trip can be placed in a plastic bag, frozen, and then used on the next excursion as bait or offshore chum to attract game fish.
5. **Encourage catch and release fishing, which does not kill the fish and produces no fish waste:** The increasingly popular practice of “catch and release” by recreational and competitive fishermen is reducing the fish waste problem at many marinas.

WATERCRAFT PARKING

DESCRIPTION

Best Management Practices (BMPs) for Handling Stormwater at Boat Access Sites:

Parking Area:
The parking area is the primary water quality concern associated with boat access site projects. Dripping motor fluids from parked vehicles may present a source of oils, grease, and other pollutants detrimental to water quality. As a result, runoff from parking areas should be minimized if possible and should be treated using BMPs before storm runoff enter lakes and streams.

Boat Launch:
In order to minimize the delivery of oils and greases from parking area runoff to the boat launch and adjacent water body, travel surfaces upslope of the boat launch should be crowned or otherwise pitched to redirect runoff away from the launch ramp.

Perimeter Stabilization:
Areas of land disturbance from equipment access ways or material staging should be stabilized, preferably in vegetation. This can entail seeding with a native grass mix or, in the case of steeper slopes, the use of textile-mesh erosion mats. In areas that are subject to short term water level fluctuations due to wind action or storm surge (seiche) effect or influenced by watercraft wakes, heavy stone or riprap should be considered for stabilization.

Vegetated Filter Strip - Serving Parking Area:
In cases where a boat access site or parking area slopes toward the adjacent water body, a vegetated strip that runs the length of a parking area between it and the water body can be provided to create a low-maintenance solution to protecting water quality. Slope and type of vegetative cover are factors that would influence the effective width of the filter strip.

Sediment/Storm Water Basin/Pond:
Storm water infiltration and sediment detention basins and ponds are effective in allowing for storm water infiltration and sediment reduction prior to runoff.

Above Waterline – Seeding/Erosion Mat Shoreline Stabilization:
In non-channelized areas of milder slope (e.g., <10%), stabilization with seed and mulch can be effective. For steeper slopes, seed and erosion mats may be necessary.

Storm Water Diversion Structures (Diversion of Offsite Runoff):
Minor ditching or earthen diversionary berms may prevent runoff from areas adjacent to pervious surfaces. Note: Care must be taken to prevent erosive conditions at the point of discharge to a waterbody.

VEHICLE/BOAT WASHING

DESCRIPTION

Preventing the entry of chemicals from boat cleaners, cleaning solvents, and antifoulant paint into marina waters is the most direct way to prevent harm to the aquatic environment from these products. The management practices associated with this management measure are easily implemented. They can be practiced by boat owners and marina managers alike, and they do not interfere with the need to keep boats clean.

Marina employees and boat owners use a variety of boat cleaners, such as teak cleaners, fiberglass polishers, and detergents, and boats are usually cleaned while in the water or onshore adjacent to the water. Some of the cleaner used ultimately ends up in the water. Additionally, when boat bottoms are cleaned aggressively while boats are in the water, antifouling paint can be abraded off and deposited into marina waters and sediments. This management measure is aimed at minimizing the release of harmful ingredients in cleaners, bottom paints, and harmful residues on boat hulls to marina basin waters.

Many cleaners contain harsh chlorine, ammonia, phosphates, and other caustic chemicals that harm fish and other aquatic life. If a product's label warns about potential harm to people's skin or eyes, the product is most likely harmful to aquatic life. Some chemicals in these cleaners bioaccumulate in aquatic organisms (that is, they become more concentrated as they are ingested successively by animals higher on the food chain) and could eventually bioaccumulate in fish or shellfish that are be eaten by people, posing a health risk.

Under the Clean Water Act, the NPDES Storm Water Permit Program defines boat wash water as "processed water." Discharge of any processed water by a marina or boatyard is illegal nationwide without a formal permit from EPA or a state government. This permit requirement does not apply to boat owners who are cleaning their own boats, but it does apply to anyone who professionally cleans boats in a marina.

If work is done sensibly, chemicals and debris from washing boat topsides, decks, and wetted hull surfaces while boats are in the water can be kept out of the water. Cleaning boats that are transported from one waterbody to another is important to preventing the spread of exotic species, and it is a highly recommended practice.

Applicability:
This management measure primarily concerns the actions of boat owners, and the BMPs are to be implemented primarily by individual boat owners. The information contained here is provided to educate marina managers about the importance of these measures in maintaining a clean marina, and marina managers are encouraged to incorporate the BMPs mentioned here into education programs and staff activities.

Best Management Practices:

- Wash boat hulls above the waterline by hand. Where feasible, remove boats from the water and clean them where debris can be captured and properly disposed of.
    - Washing the boat hull by hand (that is, not by pressure washing) reduces the amount of abrasion to the hull, which results in less paint chipped off and less debris lost to the marina basin. Where feasible, remove boats from the water and clean them where debris can be captured and properly disposed of.

- Attempt to wash boats frequently enough that the use of cleansers will not be necessary.
    - Frequent washings with water alone can prevent a boat from reaching a point at which abrasive or caustic cleansers are necessary to adequately clean the hull or topsides. This practice will help prevent the possibility of spilling chemicals into the water.

- If using cleansers, buy and use ones that will have minimal impact on the aquatic environment.
    - "Nontoxic" and "phosphate-free" cleaners are available and friendlier to the environment than products with toxic components. Products that carry safety warnings about the harm they can cause to people can harm the environment as well. Although "biodegradable" sounds good, it does not mean that a product is nontoxic. Biodegradable products are those which can be broken down by bacteria, other organisms, or natural processes. The degradation of "biodegradable" products in water uses dissolved oxygen, and therefore these products can lower dissolved oxygen levels. Also, some products might not biodegrade in aquatic environments—freshwater or marine.

- Switch to long-lasting and low-toxicity or nontoxic antifouling paints.
    - Considerable progress has been made in antifouling paint technology in recent years, and more improvements are expected that will reduce and effectively eliminate the toxicity of hull paints and increase their ability to keep hulls free of fouling growth for longer periods. Silicone-based and hard-surfaced, nonablative copper metal-based paints are such recent innovations. In general, harder paints last longer, and some reduce the need to repaint boat bottoms to once every 10 years. More information on antifoulant paints and specifications is available on the Internet (search on "antifoulants") or can be provided by a marine paint supplier.

- Avoid in-the-water hull scraping or any abrasive process done underwater that could remove paint from the boat hull.
    - Any hull cleaning performed in the water will remove the least amount of paint if done with something soft. Mechanical underwater scrubbing machines can scrape and chip off antifouling paint and encourage fouling growth on the hull. Frequent

hand washing of hulls should not cause any paint to abrade or chip off but can adequately remove scum and fouling organisms. In-the-water hull cleaning performed by divers should also be done in a manner that does not remove paint from the hull.

- Ensure that adequate precautions have been taken to minimize the spread of exotic and invasive species when boats are transferred from one waterbody to another.
    - Boat owners should be aware of the importance of thoroughly cleaning boats taken from waters known to be inhabited by exotic or invasive species. Some species can be introduced to new waterbodies this way. Generally, the spread of exotic and invasive species can be controlled by washing a boat in hot water and letting it thoroughly dry for a minimum of 5 days before putting the boat into a different waterbody. The recommendations for specific species vary, and information should be provided to boaters about any exotic or invasive species known to occur in waterbodies connected to a marina's waters, or where patrons from a marina are known to visit.

- Minimize the impacts of wastewater from pressure washing.
    - There are several ways to treat the wastewater from pressure washing to remove the paint chips or particles that might be present:

        - **Settling**: Trap the water in a container and allow it to sit long enough after washing to permit any particles to settle out of the water. This method will remove only the particles large enough to settle out of solution.

        - **Filtration**: Wastewater can be passed through one or more filters that screen out particles. A filter cloth used at the wash site can be effective for straining out visible particles. Additional filtration is achieved by using a series of filters with smaller and smaller mesh sizes.

        - **Treatment**: Chemical or biological cleaning technologies can be used to treat the wastewater and remove contaminants. Treatment can remove oil and grease, metals, or other contaminants. Once wastewater has been treated, it can be discharged into marina waters or a sanitary sewer (check local regulations) or can be reused at the marina for more boat washing or grounds watering.

    - Effluent from pressure washing usually requires a storm water discharge permit, issued by the state or locality. Closed loop or zero discharge pressure wash systems usually do not require a permit. Check with the appropriate environmental authority before discharging any effluent to a sewer system.

SKI RESORTS:

TRAIL IMPROVEMENT AND CONSTRUCTION

DESCRIPTION

The best trails are those that allow skiers to consistently be in the same fall line path that rainfall and snowmelt follow down the mountain. Consequently, when improvement or construction activities disturb vegetation and soil, they create a large source of sediment that can be readily delivered into streams and wetlands. Upon completion of work, ski runs usually present a steep, smooth, highly erodible soil surface, devoid of ground protecting vegetation.

Because ski runs are most vulnerable to erosion during the periods of construction and revegetation, water quality is best protected by BMPs which cover bare soil and slow or divert runoff from the slope. Implementation of these BMPs in a timely fashion immediately after construction and prior to heavy rain or spring snowmelt is essential to their effectiveness in protecting soil and water quality.

CONSIDERATIONS

- When coarse grooming depression areas, fill with subsoil from nearby excavations.
- Do not waste valuable topsoil in deep fill areas, salvage and reapply to slopes to promote better revegetation.
- When working in rocky areas, use a screened trackhoe bucket to help salvage and separate topsoil from rocks.
- Avoid multiple disturbances/entries by scheduling ski run construction and improvement to precede the location of utility pipelines.
- Install sediment fence barriers and cross slope waterbars to minimize soil erosion and water quality degradation during construction.
- Plan for the patrol and maintenance of control measures early and often during the first snowmelt period following construction.

LIFT CONSTRUCTION

DESCRIPTION

Ski lift terminals and towers require concrete for foundations and lifting capability for assembly of large heavy components. Water quality and streams are more likely to be affected by roads needed for equipment access than by the construction work itself. Bottom chairlift terminals, however, are commonly located on flat terraces adjacent to streams or wetlands where sediment from the site could easily affect water quality.

CONSIDERATIONS

- Use helicopter lifting for delivery and assembly of remote tower and terminal components, particularly foundations forms, steel, and concrete.
- Use hand crews to excavate tower foundations not easily accessible by equipment.
- Eliminate the need for permanent top terminal service roads by installing bottom drive systems.
- Locate equipment and vehicle storage along with ski patrol facilities into top terminal chairlift buildings.
- Install strawbale or sediment barriers around disturbed areas, particularly between foundation excavations and stockpiles, and nearby streams and wetlands.

SKI AREA FACILITY CONSTRUCTION

DESCRIPTION

Because of the danger of flooding and foundation settling, most ski areas are located well away from streams and wetland areas. Consequently, buildings will rarely have direct impacts to water quality. Indirectly, the construction process presents many opportunities to use BMPs to reduce the impact of roads, utility corridors, and staging areas that service the construction site.

CONSIDERATIONS

- Locate access roads in previously disturbed areas.
- Use helicopter lifting to transport structural materials and concrete to remote locations.
- Preconstruct utilities (electrical, sewer, and water lines) in the same corridor during the same construction season.
- Locate utility lines under existing roads or previously disturbed areas.
- Reuse foundation excavation as fill for access roads or for coarse ski trail grooming,
- Excavate areas for cement truck washing and fuel storage that are well away from streams and wetlands, and divert surface runoff away from these areas.
- Install straw bale or silt fence barriers between the building site, including the staging area, and nearby streams or wetlands.

PIPELINES AND POWERLINES

DESCRIPTION & CONSIDERATIONS

To service the remote facilities of a ski area, a carefully designed infrastructure is required to move electricity, communications, and water both up and down the mountain. Top-driven ski lifts require high load power and communication lines. Mid-mountain restaurants and snowmaking control buildings will need water and sewer lines as well.

It is usually desirable to bury all these types of utilities at some depth in trenches, and to place power, clean water, and sewer in separate trenches.

Power and communication lines are flexible and can easily be buried within the existing road network on the mountain. Unlike powerlines, water and sewer lines are more rigid and do not locate well along the switchbacks of most mountain roads. These linear utility lines will inevitably have to cross streams and wetlands on their journey from base area to mountain top.

Snowmaking supply lines must follow ski runs, and consequently follow the same fall line path as surface streams, runoff, and groundwater flowing off the mountain. In simple terms, a snowmaking trench is really a very efficient stream channel.

Once surface or ground water gets into this channel, it can run for great distances and create much damage to both the pipeline and the environment. Careful planning and implementation of BMPs can prevent this from happening.

WATER WELLS AND DIVERSIONS

DESCRIPTION

A ski area must be able to make snow for those times when nature does not provide enough. The need can be particularly acute for early season openings before the Christmas/New Year holidays. Also, the trend for ski areas to expand services to four seasons has generated new water demands for residential housing, fire protection, and irrigation of lawns and golf courses. Because streams and lakes are generally drawn down to their lowest flow levels in late summer and early winter, finding a dependable source of water for these uses can be problematic. Removing water to irrigate golf courses and lawns, or to make snow, from a stream already at base flows can imperil fish populations and stream-side vegetation. Beyond these considerations, the drought conditions associated with the need to make snow or irrigate often have reduced stream flows to where there simply is not sufficient water for these uses, even if the streams were totally diverted and dewatered.

Deep aquifer production wells offer several advantages as sources of water for ski areas. Flows are dependable even in times of drought. Groundwater is a constant cool temperature and may work better than surface streams for producing consistent quality artificial snow. The water quality is often high and can be used with little treatment to produce culinary water.

Several aspects of water well development can impact stream and water quality. Waste rock and fluids produced during drilling operations can affect water quality if the site is located near active springs, seeps, and wetlands. Production testing of well output can generate millions of gallons of clouded silty water that must be treated in some fashion prior to discharge into surface waters. Finally, deep aquifer wells may siphon off water from shallow aquifers they pass through, inadvertently dewatering valuable springs and wetlands.

CONSIDERATIONS

- Waste drilling mud and fluid from drilling cannot be discharged into surface waters.
- Detain these fluids in settling basins until they can be recycled back into the operation or disposed of offsite. Discharge well production test water into upland areas for filter treatment by vegetation and soil.
- Hose lay networks connected to temporary storage tanks through distribution manifolds are effective systems for land treatment of production water.
- Seal well shafts with casing or grouting where they pass through shallow, non-target aquifers.
- Divert stormwater run-on around the drilling site

STORAGE TANKS AND RESERVOIRS

DESCRIPTION

To operate waterline fixtures such as faucets and snowmaking guns, water must be supplied under pressure. A convenient, economical way to do this is with storage tanks in mid-mountain locations.

Storage tanks are much preferable to reservoirs, which can pose inherent dangers to life, property, and watershed values associated with potential failure of the man-made impoundment dam. Often, placement of a reservoir in mountainous environment will flood valuable wetlands and streams.

CONSIDERATIONS

- Surplus excavated material can be reused as fill in coarse ski trail grooming.
- Plumb all storage tanks to an emergency firefighting delivery system.
- Bury tanks on hillsides to reduce visual impacts.
- Avoid placing tanks or locating reservoirs in riparian or wetland areas.
- Daylight tank drains and overfill pipes into flat, well-vegetated areas. Provide an energy-dissipating rock pad at the outlet of the drainpipe. Do not discharge tank drains or overflow pipes on steep hillsides or directly into streams.

ROAD DESIGN AND CONSTRUCTION

DESCRIPTION

Every ski area operation needs an infrastructure of permanent access roads. The road system can be the largest single contributor of sediment to area streams and wetlands. Construction projects will also need access roads; the challenge is to identify how much of this roading truly needs to be permanently added to the system, and how much can be used temporarily and then reclaimed.

For permanent additions to the ski area road network, it is critical to plan for location, standards of construction, and maintenance that will avoid short and long term sedimentation problems. Temporary work roads and trails should be located and designed with an eye towards minimizing the scale of reclamation efforts needed to restore to pre-existing conditions. A narrower, steeper trail can often satisfy temporary access needs as well as a higher standard road, but will disturb far less ground and be easier and less costly to reclaim.

CONSIDERATIONS

- Although slower than regular truck tractors, crawler tractors can pull heavier loads, including cement mixers, supply trailer and assembly cranes, up steeper graded temporary trails.

- Temporary road construction can be reduced by using helicopter lifting for movement and materials at remote sites.

- Salvage topsoil and stockpile conveniently for reuse in reclamation.

- Restore temporary road prisms to the original ground slope and geometry by pulling fill slopes back against cut slopes.

- Overly steep slopes are extremely difficult to revegetate, particularly in high elevation environments. To enhance revegetation, avoid constructing road cut/fill slopes at steeper gradients than 2:1.

- Reuse stumps and slash from road clearing as temporary sediment filter windrow barriers at the base of road fill slopes and wherever a road approaches streams or wetlands.

ENCOUNTERS WITH STREAMS AND WETLANDS

DESCRIPTION

Although avoidance of surface water features is stressed throughout ski resort improvements as an important BMP, the reality is that most ski area facilities will eventually meet up with a stream or wetland somewhere on the mountain. Both streams and ski area improvements are curvilinear landscape features that inevitably must intersect at some point on their journey from mountain top to base area. Good planning, location, construction and maintenance can ensure these encounters are both benign and of little long-term consequence.

Construction work that may place fill or sediment, or otherwise alter a stream or wetland will require the proper permitting, which can be a time-consuming process. Inclusion of BMPs that minimize damage and control sediment will speed up permit issuance and help avoid most project delays.

CONSIDERATIONS

- Roads represent the largest source of sediment to streams and wetlands. Runoff from any road surface should always drain through some kind of temporary or permanent sediment filter such as a vegetated buffer strip, slash windrow, silt fence, or detention basin.

- Road crossing culverts should be oversized to allow for passage of flood flows and large bed load rocks that are often associated with steep and incised mountain stream channels.

- Maintain all roads and trails so that runoff water drains readily, rapidly, and frequently off the surface.

- Temporary stream channel and bank disturbances must be restored to the original, preexisting condition, including bed gradient and rock size, channel profile and geometry, and bank vegetation cover.

- Use portable bridges or flatcar spans to minimize channel disturbance and reclamation costs associated with temporary stream crossings.

AVOIDING MULTIPLE ENTRIES

DESCRIPTIONS

The most effective way of protecting water and soil quality is to limit the time bare soils are exposed to runoff from rainfall or snowmelt. The best way to accomplish this is to start and finish projects during one summer construction season, and reclaiming the area permanently before winter snows cover the ground.

Erosion control and reclamation work is time consuming and expensive. Seed, fertilizer, and mulching can cost hundreds of dollars per acre in materials and labor costs. Disturbing a freshly reclaimed area with more construction is not only wasteful, but can severely damage soil productivity and limit long-term prospects for successful revegetation.

While careful project planning and scheduling is essential to completing projects during the short construction seasons common in the mountains, even the best plans can be derailed by unpredictable summer rains and early snowfalls. Rocky soils and steep terrain can cause breakdowns of specialized construction equipment, meaning further delays. Ski areas must have contingency plans for temporary erosion control for any large project where completion could be delayed until the next construction season.

CONSIDERATIONS

- Complete all improvements on one part of the mountain, preferably in one construction season, before moving on to other parts of the ski area.
- Complete ski run construction and terrain modification projects prior to placing utility and snowmaking lines in them.
- Construct co-locatable utilities in the same trench at the same time.
- Place all utility lines in a single corridor wherever possible.
- Locate utility corridors in previously disturbed areas, and preferably along roadways.
- Delay entering previously disturbed areas with new construction until vegetation has completely recovered.

EROSION AND SEDIMENT CONTROL

CROSS SLOPE WATERBARS

DESCRIPTION

Bare soil is extremely vulnerable to runoff and erosion. Erosion can be prevented by either slowing the velocity of overland flow or by diverting it off of bare soil and into more stable vegetated areas. Cross slope waterbars are the simplest, cheapest, and most reliable method for managing runoff from bare soil areas. They should always be the first choice for the control of hill slope runoff and erosion.

Spacing of waterbars is very sensitive to slope gradient and soil type. They must be placed close enough to each other that runoff is captured and diverted before it builds up speed and energy. Spacing usually ranges from 200 feet on flatter mountain roads to less than 50 feet on the steepest ski slopes.

CONSIDERATIONS

- Properly draining waterbars will be self cleaning of sediment.
- Begin waterbars at a 3 to 5 percent gradient and increase to a finished gradient of 5 to 7 percent.
- On steeper slopes, frequent small waterbars work better than a few large ones.
- Waterbars must be inspected and repaired during spring snowmelt, and then cleaned of sediment following large rainstorms.
- Carry the waterbar well off bare soil sloped into adjacent vegetation.
- To prevent low spots, waterbars should be built with a slight curve.

STRAW BALE DIKE AND CHECK DAMS

DESCRIPTION

Straw bales are used in dikes and check dams to create very small basins where surface runoff can be slowed long enough to settle and trap sediments. They are typically used in low gradient ditches or channels. They are also effective when used with sediment fencing to filter and trap sediment generated by high velocity flows from steeper side slopes.

CONSIDERATIONS

- Straw bales will float and can be knocked loose by flowing waters.
- Each bale must be firmly staked in place by driving two stakes or rebar through the bale and 18 inches into the ground.
- Double staking helps to keep straw bales in place. Backing up a check dam with silt fencing provides excellent water quality protection.
- Properly functioning straw bale dikes can quickly fill up with sediment and must be cleaned out after rainstorms.
- Gravel or straw check dams should be used in road ditches as a temporary sediment control until vegetation has been established.
- The ends of each check dam should be higher so that water spills over the center of the dike and not around the ends.
- Prevent leaks in the dike by embedding the bales a minimum of four inches into the ground, and by tightly abutting the ends of adjacent bales.

VEGETATION BUFFERS

DESCRIPTION

In general, most BMPs do a great job of trapping sand and silt sized particles, but are mostly ineffective with finer sediments. The most effective method of treating these fine sediments is by dispersing runoff through a thick screen of live natural vegetation.

In practice, this involves leaving a sufficient buffer of vegetation between live water and construction areas. Effluent from waterbars, silt fences, and detention basins should always be passed through a wide buffer strip of vegetation for final treatment before discharge into surface waters.

CONSIDERATIONS

- Cleared vegetation can be placed in a window within the filter strip to enhance effectiveness.
- Buffer strips are ideal for the treatment of water contaminated with fine mud and clay, such as that discharged during well production testing.
- Water should not be allowed to channelize.
- Vegetation buffer strips should vary in width based upon side-slope gradient. Where only a narrow strip is present, it should be supplemented with other sediment control practices such as silt fences or straw bale dikes.
- Cleared vegetation can also be used a filter by placing and compacting into a windrow.
- Wetlands should be protected from sediment sources with buffer strips of live upland vegetation.
- A stream-side riparian zone may also be used to filter out finer sediments which can pass right through sediment fencing.
- Where space is limited, less effective practices such as berms, silt fences, and slash barriers can be used together to replace a vegetation buffer strip.

DETENTION BASINS

DESCRIPTION

Although all BMPs will capture and filter larger sized sediments from runoff, finer sediments can only be caught in a detention pond of still water. In general, the larger the basin, the finer the sediment is that can be filtered out, and better protection will be provided from the larger rainstorm events. Regardless of size, all basins are usually permanent impoundment features with stabilized inlets, outlets, and emergency spillways.

CONSIDERATIONS

- Detention basins are best located below permanent sediment sources such as parking lots and roads.
- Discharge water from detention basins can be routed through straw bales and silt fence for more complete sediment removal.
- Staging areas and parking lots can generate large amounts of runoff and sediment, and consequently need larger detention ponds.
- Baffles can be placed on the pond bottom to slow inlet velocities and promote still water conditions.
- Basins should be cleaned of sediment following major rainstorms.
- Natural basins in the landscape can be combined with straw bales and silt fence to create temporary detention ponds.
- Detention basins and sediment traps should be located off channel and not within a live stream.
- Sediment pond outlet ditches should be armored with rock to prevent scouring. Step pools in the outlet ditches allow even more sediment to settle out.

LAND RESTORATION

DESCRIPTION

Reclaiming land following construction disturbances will focus on restoring the ability of soil to absorb water from rainstorms and snowmelt without generating undue overland flow or sediment. A good measure of reclamation success is often how quickly vegetation cover can be reestablished to disturbed areas.

Successful revegetation begins with the restoration of a seedbed of thick fertile topsoil. Management of the topsoil resource throughout the construction process is critical. If soil is not salvaged and conserved at the beginning of a project, there will be none left to reapply at the end, and revegetation efforts will be likelier to fail.

Ideally, when a construction project is begun, all topsoil would be stripped from the area and reserved for later reapplication. From a practical standpoint, salvage of topsoil from a construction area can be very difficult, particularly when steep slopes and rocky soils are involved. Most native plants will be able to re-establish in a topsoil layer that ranges from at least six to eight inches in thickness.

Oftentimes topsoil is naturally very thin at mountain summits and on the steep upper elevation slopes of ski areas. It may not be appropriate or desirable to import topsoil from "off the mountain" in order to create seedbed soil layers that are thicker than what is natural. Restoring productivity to these types of land is dependent upon limiting topsoil losses to either two inches, or half the thickness of the original topsoil layer, whichever is less.

CONSIDERATIONS

- In trench excavation, subsoil should be placed above topsoil windrows to protect them from erosion and compaction.

- The final reclaimed surface can be roughened with bulldozer tracks to provide microsites for moisture conservation and seedling establishment.

- On steep slopes, stockpile salvaged topsoil at the top of the cut/fill slopes for ease of reapplication.

- If stored over the winter, topsoil stockpiles should be terraced and seeded to reduce erosion losses and should then be surrounded with sediment control measures such as berms, silt fencing, or straw bale dikes.

- Reapplied topsoil layers are extremely vulnerable to wind and water erosion. Protect with BMPs such as caterpillar track surface roughening, cross slope waterbars, and surface

mulch blankets.

- Trench excavations should stockpile topsoil and subsoil in separate windrows. Avoid traversing topsoil with construction equipment.

REVEGETATION

DESCRIPTION

Construction work often damages vegetation to the point where it cannot grow back without help. To prevent damaging erosion, vegetation must be reestablished as quickly as possible.

Once a proper seedbed of thick fertile topsoil has been prepared, the site is ready to be reseeded. Native grass and forb species are good choices because they are usually adapted to the climate and elevation of the site, and they do not prevent the eventual re-establishment of species that inhabited the site before construction.

Seed should be applied in late autumn to take advantage of snowmelt and rainfall the following spring. If soil tests indicate fertilizer is needed, it can be applied at the same time as the seed.

Seed should be completely covered with soil for successful germination and establishment. Tracking and scarification can help accomplish this, but in practice at least half of broadcast applied seed will never germinate. To be confident of establishing successful vegetation at 40 plants per square foot, seeds should be applied at the rate of at least 100 per square foot. To reduce the risk of having to reseed harsh sites at a later date, initial seeding rates can be safely pushed to 200 per square foot.

CONSIDERATIONS

- Incorporate species native to the area into seed mixes. Harvest seed from the area to reduce costs.

- Seed germination is enhanced dramatically by following seeding with some sort of rolling or tracking in treatment.

- Monitor seedling establishment to fine tune seed mixes and determine if supplemental seeding is needed.

- Enhance seedling establishment and growth with supplemental fertilizer application during the spring following initial seeding.

- Cover freshly seeded areas with a mulch product to create a cool, moist environment for fragile seedling survival.

STRAW MULCH COVERS

DEFINITION

Mulch covers serve a dual purpose in the reclamation process. Primarily, they provide protection of bare soil from raindrops and then slow down surface runoff to prevent erosion. While the mulch is preventing erosion, it is also conserving moisture for germinating seedling and protecting them with shade from summer heat and drought.

In general, flat or gentle slopes with very thick topsoil should revegetate quickly with little concern for erosion. This is particularly true if soil disturbance was light and the root systems are undamaged, and the area is removed from live water sources. Steeper slopes, or those with poor topsoil and heavier damage to vegetation, will require some sort of protective mulch cover.

The type of mulch depends largely on how long it will be expected to perform its job. Loose straw mulch covers function only through the first snowmelt and growing season. They are not durable and are easily damaged by relatively light winds. More durable erosion blankets, if installed correctly, will survive even high winds and can be expected to function for two or more seasons.

CONSIDERATIONS

- Although straw is the cheapest mulch to buy, spreading and fixing against wind damage can be costly and time consuming. Road cut and fill slopes can be quickly covered with mechanical equipment.

- Straw mulch application by hand crews on larger ski slopes is a time-consuming task. Blanket mulches save time and money by installing quicker and lasting longer.

- To prevent wind damage, straw mulch can be crimped or tracked into the ground with bulldozer tracks or snowcat cleats. When properly tracked in, straw will be punched into the soil and appear to stand upright.

- Any mulch type, if installed properly and in good contact with the soil, will enhance vegetation. Straw mulch should be applied at a loose thickness of four to six inches.

- Straw mulches cannot be tracked into rocky or dry soils, and must be secured with either netting or chemical tackifiers.

EROSION CONTROL BLANKETS

CONSIDERATIONS

- Successful revegetation on harsh sites, such as over-steep and erosive slopes, requires a durable mulch blanket cover.

- Although more expensive to purchase than straw, mulch blankets install much faster and are more durable.

- Mulch blankets are commonly made from wood or straw fibers and stitched to an open weave net. Either type of blanket is very light and easy to handle and transport across rough terrain.

- Blankets can be combined with silt fencing to provide added protection next to streams and wetlands.

- To work properly and resist wind damage, blankets must be stapled firmly and in close contact with the underlying soil surface. Blankets must be properly stapled in place to resist lifting and tearing by strong winds.

STREAM RECLAMATION

DEFINITION

It can be difficult to completely avoid stream channels and riparian corridors when constructing fall line projects such as ski runs, lifts, and snowmaking lines. Too often, streams are moved to the edge of ski runs and away from sensitive improvements like buried power, communication, and water lines.

The streams are straightened, channelized, and armored to prevent them from flowing or meandering. Channelizing destroys many important stream functions, including the ability to support riparian bank stabilizing riparian vegetation. Stream flow character can change from perennial to intermittent as the new channel dries out during summer months. The resulting channel often resembles more of a ditch than a living, functioning stream.

Stream reclamation is an expensive, complicated, and time-consuming operation. Streams and their riparian zones are valuable areas for wildlife habitat. They need to be restored to their original location and condition wherever possible. Such reclamation is usually a requirement of the alterations permits secured for construction projects near streams.

CONSIDERATIONS

- Move or permanently relocate a stream only when needed to prevent further disturbance to it, or to protect it from persistent sediment sources. Channelized streams can be relocated to extend channel length, increase, meandering, and create wetlands and floodplains.

- Level sections of streams that dry out in the summer attract temporary staging and construction activities. These areas should be reclaimed by restoring the stream to its original location and condition. Survey stream properties and characteristics prior to construction to facilitate proper restoration to original conditions.

- Facilities that must be located in a low area, such as snowmaking line drain vaults, should be part of stream reclamation through relocation to protect from long-term impacts.

- Reconstruct channels to a width, depth, and course that roughly resembles the original condition. Let the stream itself finish the job of restoring the meanders, pools, and riffles that existed before disturbance.

- Enhance stream recovery by using small rocks and soil in reconstructed banks that can easily be moved and rearranged by stream flood flows. Small trackhoes and bulldozers provide a lighter touch and are better suited to the fine detail work of stream reclamation.

- Only use rock armoring when absolutely necessary to prevent abnormal bank and channel bottom scouring or erosion. Armored channels can be revegetated with burlap bag “soil pillows” and with willow soil-root plugs.