Best Management Practices
to
Insure That Water Quality is Maintained

Along with standard engineering designs and special construction methods for the types of substrate encountered along the proposed alignment or alternatives, additional design, construction, and maintenance commitments would be made to protect stream, soil, and aquatic resources. These commitments take the form of environmental protection measures and/or Best Management Practices (BMPs) that would be implemented where applicable. They are based upon sound, tested techniques from established sources, including, but not limited to, Utah Department of Transportation Road Drainage Manual (UDOT,); various U.S. Forest Service Road-Water Interaction publications (Furniss, 1997; Copstead, 1998; Flanagan, 1998; Moll, 1999); BLM (undated); Wasatch-Cache National Forest BMPs (USFS, 2001); State of Utah (1995); and local USFS personnel.

DESIGN BMPS

Drainage Crossings

- Proper engineering design would insure that the existing channel configurations immediately up- and downstream of culverts are maintained to the maximum extent possible. This would include maintenance of cross sectional dimensions, profile, velocity, and flow patterns. Removal of existing riparian vegetation would be restricted to the minimum necessary for the maneuvering of equipment and the actual disturbed footprint.

- Channel crossing culverts would be designed to pass the peak flow, sediment, and debris associated with the 100-year event without headwater allowances greater than the culvert diameter. For example, where a crossing culvert is 36 inches, headwater depth would be less than or equal to 36 inches.

- Culvert crossings in streams where fisheries have been identified would be designed to pass appropriate species and life-stages during appropriate times of the years during both high and low flow conditions. The relevant design criteria and final designs would be determined through consultation with DWR and USFS fisheries biologists. Flow depth, flow velocity, and grade would be among the items the final design would take into consideration.

- In the interest of passing sediment and debris, and facilitating maintenance, minimum culvert diameter would be 24 inches. This would apply to channel crossings, ditch relief culverts, irrigation canal crossings, and all other culverts used in the project.

- Culvert inverts would be placed a couple of inches under the bed surface, along grade, whenever possible. This would allow a natural substrate to bed the culvert to provide aquatic benefits as well as reduce the potential for up- and downstream channel changes.

- Road fills at culvert inlets would be protected through the use of wing walls or similar structures such as vegetation, boulders, shotcrete, gunnite, or molded steel plate culvert ends, for flow depths up to those associated with the 100-year peak flow.

- Energy dissipating rock aprons would be used at culvert outlets to return flows to an acceptable velocity and depth as they exit the culvert. The distance downstream that the aprons would extend would be based upon site conditions as modeled by standard UDOT engineering design techniques to calculated outflow distances.

- Unless specific conditions are prohibitive, culverted crossings would be placed perpendicular to the roadway, in other words with the road approaching the natural channel alignment at a 90 degree angle. However, where the road alignment cannot accommodate this, the channel would not be realigned, and thus the angle would not be perpendicular.

- The width of the road fill at the crossing would be limited to the minimum necessary for the crossing. For example, pull out lanes, wide shoulders, etc. would not occur in these areas unless required for safety.

- All terms and requirements of the relevant Corps of Engineers Nationwide Permit for Road Crossings (NWP 14) would be followed at crossings for which it applies. These are not repeated here, but are incorporated by reference.

- Culverts would be installed and maintained to avoid inlet scouring and to prevent erosion of downstream banks. This includes such items as use of rock aprons, protected fills, installation along grade but slightly below bed elevation and other items discussed in this section.

- Crossings would be designed such that, if failure occurs due to blockage or capacity exceedance, flow would be returned to the natural channel and would not continue along the roadway toward another channel or an overland areas (least consequence flow path during overtopping). In many cases, this would be done simply by installing a slight depression in the crossing vicinity that does not interfere with traffic speeds.

<u>Road Drainage Network</u>

- Ditch relief culverts would be installed at spacings adequate to manage runoff, generally no more than 500 feet apart. The spacing of ditch relief culverts would not exceed 250 feet in locations where the road is within 500 feet of perennial streams. As with all culverts used in the project, the minimum ditch relief culvert diameter would be 24 inches in order to prevent plugging by passing sediment and debris, and to facilitate maintenance.

- Rerouting or transferring of up-gradient runoff water via roadside ditches to adjacent basins, even on a small sub-basin scale, which would result in a cross-basin diversions that could alter natural flow and sediment regimes, would be avoided. This would be done by properly locating and spacing ditch relief culverts.

- Runoff from road surfaces would be discharged in a manner so as to avoid directly converging with stream channels wherever possible, minimizing or eliminating hydrologic connectivity between the road drainage network and the stream channels. This would be done by: (1) properly locating ditch lines and ditch relief culverts; (2) by grading slopes away from channel networks; and/or (3) by allowing sufficient distance for flows leaving a ditch relief culvert to re-infiltrate and deposit sediments. Where it is not possible to prevent a ditch or cross drain from draining more or less directly to a channel, the ditchline would be armored until reaching the next upstream ditch relief.

- Where possible, cross drains and ditch turn outs would be sites on gently sloping, stable terrain such as where rock or stable vegetation is found. Discharge areas would be located to release water on convex slopes where possible, so that water would be dispersed rather than channeled; concave slopes would be avoided wherever possible.

- As needed, ditch relief culvert outflow areas would be armored with loose riprap, grouted riprap, shotcrete, gunnite, turf reinforcement mate, gabions, or similar types of materials and configured to reduce velocity by providing dispersal and velocity reduction for at least 50 feet downstream. This armoring would occur wherever needed due to grade and/or substrate characteristics. Further, wherever ditch lines and ditch relief culverts are located within 500 feet of perennial stream, the ditchline and the ouflow area would be similarly armored.

Channel Realignment or Roadfill/channel interactions

- Any in-channel work, whether related to stream bank realignment, crossing, or other purpose would result in reestablishment of original channel gradient, bank width, bank slope, and bankfull depth. As necessary, this would involve accurate surveying of existing, predisturbance conditions and follow up surveys after the work has occurred.

- Where channel realignment cannot be avoided, such as at East Spring Canyon, the rock art site, and the upper narrow Convulsion Canyon reach, the natural channel’s pattern and geometry would be mimicked where possible, including radius of curvature of meanders, bed profile, bank slope, substrate diameter, habitat feature. A hydrologist would assist in the design and implementation of channel realignment and design projects.

- Realigned or reconstructed streams would be designed to carry bank full flows in-channel, with flood flows dispersed on floodplains or in a widening channel appropriate for the given valley type present.

- At the upstream and downstream ends of realigned reaches, appropriate transitions to the undisturbed channel reaches would be designed.

- Where appropriate, low-stage grade control structures would be incorporated into the designs to prevent vertical migration of entrenched channels. Typically, these structures would be keyed into the bed and banks, with the top elevations at the same elevation as the channel bottom or no higher than 1.5 feet above the bed. Specific designs for each structure would insure that erosion around the ends of the structures would not occur during higher flows, and that gradient stability would be maintained by properly spacing the structures.

- Where appropriate, rather than using riprap, new channel banks would be treated with burlap bag soil pillows, willow soil-root plugs, cuttings or similar bioengineering treatments from on-site to encourage and enhance both herbaceous and woody vegetation growth. This would occur where banks have non-rocky substrate that would allow such treatments to be effective and develop natural functioning deformable banks.

- As required, conditions of the State General Permit 40 for Stream Alterations would be followed. Conditions are not listed in entirety here, but are incorporated by reference.

Fill Slopes and Cut Slopes

- Where cut or fill slopes are steep (2.5:1 or steeper) and sufficient soil substrate (i.e. not too rocky, bouldery, or in bedrock) allows for eventual revegetation, synthetic turf reinforcement mats (TRMs), rolled coir logs, or similar products would be used to provide erosion protection and hold soil/seed in place. Any such products would be installed following the specific manufacturer's specifications.

- Where cut or fill slopes are 2.5:1 or steeper and are longer than 100 feet, benched slopes would be used when feasible from an engineering standpoint in order to reduce runoff velocities, prevent erosion, maximize infiltration, and facilitate revegetation.

- Where long, steep fill slopes (greater than 200 feet long and steeper than 2:1) would be needed within 50 feet of perennial streams, vertical retaining walls would used to eliminate the chronic erosion/sedimentation potential for these areas.

- Where construction activities result in exposure of large boulders (2 feet or more in diameter), these would be placed or left on cut or fill slopes in a secure manner to mimic natural micro-topography, thus somewhat controlling runoff/erosion and providing niches for vegetative growth.

- Revegetated road fills and slopes would be permanently protected from livestock through fencing with cow-proof barbed wire, or management controls such as herding restrictions.

- Where fill slopes toe out within or close to the floodplain, the toes would be adequately protected with rock rip-rap sized to withstand expected velocities without movement, and will be sub-excavated to prevent undercutting.

CONSTRUCTION BMPS

- Construction would be timed to occur so as to minimize the time of exposure of bare soils before reseeding or other reclamations techniques are implemented. Specific revegetation treatments are discussed in Chapter 2.

- Construction near or in drainages would be restricted to normal low flow seasons (late June through October) and would be temporarily halted during flash flood or other runoff events, which are most common in late summer. During construction the channel would be lined or water would be pumped to prevent increases in turbidity from channel excavations.

- Length of construction time in/near the stream channel would be minimized by segregating that work task to occur as rapidly as possible in a sequential manner; area of disturbance would also be minimized, by restricting equipment to a narrow construction corridor.

- As construction within 50 feet of a stream channel is completed, loose material would be removed from outside the flow path of flood events.

- Where a fill slopes toes out within 50 feet of Quitchupah Creek, a wetland area, or other perennial water, silt fences or similar sediment collection treatments, such as sediment traps, straw bales, coir wattles would be used during construction.

- Riparian vegetation would remain undisturbed wherever possible, and would be limited to that necessary in the actual footprint as well as the minimum necessary for equipment work in the established construction corridor.

- Silt fences or similar sediment collection treatments such as hay bales, coir wattles, small retention basins, pre-made vendor marketed sediment collection traps would be used when the construction activity occurs within 300 feet of Quitchupah Creek, a wetland area, or other perennial water.

- A Storm Water Pollution Prevention Plan would be prepared and followed, according to all the terms and requirements of the Utah Pollutant Discharge Elimination System (UPDES) Permit for Storm Water Discharges from Construction Activities. These are not reproduced here, but are incorporated by reference.

- Contractors responsible for constructing the road would be responsible for maintaining spill kits on site and would train their personnel on how to respond to an emergency spill.

- Equipment and construction materials would not be stored, stockpiled, or maintained within 200 feet of perennials streams.

RECLAMATION BMPS

Road Corridor and Cut/Fill Slopes

- All areas of the constructions corridor, and surfaces not associated with drainage, safety or travelways would be reclaimed as described in Chapter 2. Road cuts and fill would be included within the reclaimed corridor.

- Once reclamation treatments have occurred, they would be monitored and maintained as discussed in the monitoring/maintenance plan until they are deemed successful. A higher level of vegetative success would be applied for road cuts and fills within 500 feet of channels.

- Larger stumps and slash that are by necessity removed during road clearing would be used as temporary sediment filter windrow barriers at the base of road fill slopes or below ditch relief culverts or other locations to provide sediment trapping and runoff velocity control.

Existing Jeep Trail

- Under Alternatives B and C, the existing jeep trail, where it remains exposed but is no longer needed due to the new road, would be fully reclaimed. This would include substrate preparation and surface roughening including deep ripping, furrowing and introduction of organic matter; reseeding with an appropriate seed mix as specified in Chapter 2 and as approved by the appropriated land managing entity; fertilizing or adding inocculants to encourage growth; mulching with rock or other suitable material such as straw or matting; traffic barriers such as boulders, fencing, or steep berms; and follow up monitoring/maintenance, as specified in the monitoring and maintenance plans. The reclaimed road area would be protected from livestock grazing until the plants are sufficiently established such that soil protection would be assured even if grazed.

- Where the existing jeep trail includes cut and fill slopes, obliteration would be accomplished by decompacting the inner ½ of the prism to a minimum of 14 inches. The fill material would then be replaced against the cutslope to restore the natural outslope as much as possible.

- Where the existing jeep trail crosses watercourses, channel width, gradient, and side slope would be reinstated to match conditions above and below the crossing. If follow-up monitoring notes that an equilibrium gradient cannot be maintained, low stage grade control would be installed.

Staging, Borrow, and Miscellaneous Areas

- All staging and on-site borrow areas would be graded gently to minimize offsite erosion, and where needed, sediment control via silt fences, berms, straw wattles, sediment basins, etc. would be placed. When completed, these areas would also be reclaimed to the same standards as other reclamation areas described in Chapter 2, including follow up maintenance and monitoring. These sites would be protected from livestock grazing until the plants are sufficiently established such that soil protection would be assured even if grazed.

- The Broad Hollow holding facility would be graveled and graded so as to minimize erosion.

OPERATIONAL BMPS

Winter Deicing BMPs

- Sand with added salt or salt substitutes would be used when necessary to provide safe winter driving conditions, using criteria that are acceptable and standard for the State of Utah. The source and quality of the sand would be chosen such as to minimize contributions of salt into the watershed.

- Salt storage facilities would be sited on flat areas, at least 500 feet away from streams and other water sources, would be roofed, and drainage would be directed away from the area via grading, ditching, berming or other means.

- Springs, wetlands and other sensitive areas would be marked with visible fluorescent flagging and extra care taken during application to insure that salt is not added to those areas either directly or via runoff.

- Operators would be trained when hired and training would be repeated annually in proper application rates, techniques, etc. to insure both safe conditions and minimal environmental harm.

Miscellaneous

- Truck drivers would be trained to properly respond to and report spills of fuel, coal, or other materials. Trucks would be equipped to enable them to properly do so.

- Air or water baths would be used after loading coal trucks to prevent coal from falling off the trucks during transport.

- Large animal carcasses would be disposed of where they cannot be delivered or dragged to dry or wet channels.

- Monitoring of all site reclamation would continue for as long as it takes to assure that the reclamation measures have been effective. If reclamation is not effective or if there are unintended and unforeseen erosional or water quality impacts, additional treatments and/or mitigation measures would be applied to alleviate the impact. See the monitoring plan.

- Inspection, maintenance and/or repairs to drainage crossings, slopes, road drainage network, etc. would occur in a timely manner to prevent continuing or extensive erosion/sedimentation problems. This BMP is described more fully in the Monitoring Plan document, which is incorporated by reference.

References:

Bureau of Land Management. Undated. Internal Document, Price Field Office Hydrologic Modification Standards for Roads.

Copstead, Ronald L., PE, et al. September 1998. Water/Road Interaction Technology Series: Introduction to Surface Cross Drains.

Flanagan, Sam A. December 1998. Water/Road Interaction Technology Series: Methods for Inventory and Environmental Risk Assessment of Road Drainage Crossings.

Furniss, Michael J. et al. December 1997. Water/Road Interaction Technology Series: Diversion Potential at Road-Stream Crossings.

Moll, Jeffry E., P.E. August 1999. Water/Road Interaction Technology Series: Minimizing Low Volume Road Water Displacement.

State of Utah, March 1995. Nonpoint Source Management Plan for Hydrologic Modifications.

USFS, 2001. Ski Area BMPS (Best Management Practices): Guidelines for Planning, Erosion Control, and Reclamation. Prepared by Wasatch-Cache National Forest.