3.2 Water Resources

Introduction

The Project Area is located within the Colorado River Basin near the south end of the Wasatch Plateau. All drainage from the area flows to Quitchupah Creek or its tributaries, including East Spring Canyon, Water Hollow, and North Fork (See **Figure 3-1**). A 1,700-foot or more elevation difference between the upstream and downstream ends of the Project Area influences the flow regimes and fluvial morphology of the streams within it. Precipitation ranges from averages of nine inches annually near the lower elevations of the Project Area to more than 20 inches annually near the top of the Plateau.

The upstream reach of the Quitchupah Creek stream channel, from the confluence with Water Hollow and continuing upstream, is known as Convulsion Canyon; flow in the highest elevation part of this upstream reach is intermittent, with perennial flow beginning in Convulsion Canyon near the wetland at about station 48+00. As it continues downstream, Quitchupah Creek receives significant amounts of flow from mine discharge into its North Fork, and from irrigation return flow near the eastern project boundary. The SUFCO Mine monitors flow rate and water quality on a quarterly basis at several sites along Quitchupah Creek. Flow rate varies seasonally, but the region's larger perennial streams, such as Quitchupah Creek, typically peak in May and June as a result of snow melt runoff. However, later summer thunderstorms can also produce extremely high flows for short time periods (Thiros and Cordy, 1991). Runoff events in the ephemeral watercourses that feed Quitchupah Creek most commonly occur in July, August, and September from intense thunderstorms. Salinity, as measured by total dissolved solids (TDS), and sulfates increase in a downstream direction in Quitchupah Creek, in part because of geologic changes. Quitchupah Creek is morphologically an active stream, and became entrenched early this century. It conveys high sediment loads, and receives sediments from both upland and in-channel sources. Quitchupah Creek provides water for irrigation and stock watering (water rights are discussed under a separate heading below).

Water Hollow flows into upper Quitchupah Creek from the southwest. It flows perennially, but no stream flow or water quality records are available. The Water Hollow Benches, south of Quitchupah Creek and east of Water Hollow, are dissected by numerous ephemerally flowing channels that drain primarily east and north. These ephemeral channels contribute to a high drainage density that results in extensive hydrologic connectivity of most parts of the watershed, and in turn results in high peak flows and rapid watershed response to intense thunderstorm events. This connectivity can have implications in regard to transfer of eroded materials from upland watershed areas to down-gradient receiving streams.

The headwaters of Quitchupah Creek are close to 9,000 feet above mean sea level (AMSL); at the western end of the proposed project, elevation of the creek is about 7,700 feet. Convulsion Canyon conveys flows from the Broad Hollow, Spring Hollow, and East Spring Canyon tributaries to Quitchupah Creek. These flows join with Water Hollow and the North Fork about midway through the Project Area. Numerous ephemeral channels are also tributary to Quitchupah Creek in the Project Area, including Link Canyon, which crosses the existing road near the eastern project boundary. To the south, the Water Hollow Benches area is drained by steep, entrenched, ephemerally flowing channels that trend primarily northeastward toward Quitchupah Creek. Elevation of Quitchupah Creek at the eastern project boundary is slightly more than 6,000 feet, and at that location, Quitchupah Creek drains an area of about 100 square miles.

Stream Classification

The approximately 2.5 miles of Convulsion Canyon and its tributaries, that are within the boundaries of the Fishlake National Forest, are categorized by the State of Utah as "Category 1 High Quality Water" as

defined at R317-2-12.1 in the Utah Water Quality Standards. In general, the State's antidegradation policy calls for Category 1 waters to be maintained at their "existing high quality". However, "Projects such as.... roads will be considered where pollution will result only during the actual construction activity, and where best management practices will be employed to minimize pollution effects" (R317-2-3.2).

Downstream of the Project Area, and upstream of its confluence with Ivie Creek, Quitchupah Creek was listed on the State of Utah's 2004 303(d) list as a TDS-limited stream segment, which means that it did not support its Class 4 (agriculture) beneficial use designation. (Other beneficial use classes applying to Quitchupah Creek are 2B (secondary contact recreation and aesthetics) and 3A (cold water aquatic wildlife); these uses are apparently supported under the existing water quality of the creek). The Department of Water Quality (DWQ), in its West Colorado Watershed Management Unit Water Quality Assessment Report (UDEQ, 2000), states that the probable sources for TDS in that stretch of Quitchupah Creek were natural and agricultural practices. The recently completed Total Maximum Daily Load (TMDL) (UDEQ, 2004) report for this area echoes that conclusion. As discussed further in the water quality section below, a new site-specific TDS standard has been approved by the State of Utah for Quitchupah Creek below SR10. That stream reach will effectively be removed from the 303(d) list once the proposed rule is formally adopted (UDEQ, 2005).

In addition, all tributaries to the Colorado River, including Quitchupah Creek are managed under the Colorado River Salinity Control Act. The goal of this act is to reduce sediment and salt loading in the Colorado River Basin.

Stream Channel Descriptions

Within the Fishlake National Forest, the upstream reaches of Convulsion Canyon/Quitchupah Creek and most of its tributaries are contained within narrow corridors between steep canyon walls. Functional flood plains in these upper reaches are essentially non-existent due to the canyon confinement, basin position, gradient, and flow regime. The stream-side areas where floods occur are not extensive, flat-surfaced overbank areas, nor do they possess extensive stream-lain alluvium, bar features, or other characteristics indicative of a functioning floodplain. Instead they are typically narrow extensions of the active channel where flood flows are conveyed within the confinement of the canyon walls.

Typically, once out of the confines of the canyons, these types of streams are generally freer to develop a floodplain. The extent of the floodplain depends in part upon the flow regime and the available material to construct the floodplain. At one time, Quitchupah Creek appears to have been a small, narrow stream with adjacent floodplains that supported homesteading and farming activities (Historical Committee of Emery, 1981).

Currently, Quitchupah Creek within much of the State of Utah, BLM, and private land areas is confined within a relatively narrow corridor between terraces, having vertically abandoned its historic floodplain. The stream was formerly at the surface of relatively thick, aggraded alluvium overlying the bedrock. But, as is typical of many streams in the region, it incised dramatically through that alluvium. This resulted in an entrenched channel with a new base level with banks 50 or more feet high. Much of that incision apparently occurred as a result of a single runoff event in 1912 (Historical Committee of Emery, 1981). The magnitude of the event was likely affected by the overgrazing that had occurred since the turn of the century. Since that time, a limited floodplain has formed and it functions between the incised banks. Field observations indicate that tributary channels have also been, and continue to be, undergoing rejuvenation to match this base elevation. In addition, the flashy, widely fluctuating stream flows, and the large amount of available sediments available for transport, make the possibility of Quitchupah Creek obtaining a true, dynamic equilibrium relatively unlikely without changes in land management (i.e.

grazing) and the passage of time. Down-cutting and head-cutting through the terrace materials are still occurring, although apparently to a lesser degree than during the main period of incision. The terrace materials, barren and over-steepened, are also subject to significant sloughing and mass wasting into the channel. These areas are sensitive to alterations, including such outside influences as: removing the toe slope through meander adjustments; loading of top surfaces such as could occur with road construction; and locally modifying runoff that could cause piping and headcutting. The latter influences are currently occurring along the existing road.
These over-steepened terrace slopes, as well as other upland slopes at or near angle of repose, appear to be subject to periodic sloughing or other forms of mass wasting. Whether the result of head-cutting from the mainstem or side tributaries, piping due to runoff, rock toppling, or other mechanisms, alteration of the terrain on the small scale appears common and frequent in the general area. The existing road also appears to exacerbate this type of erosion as well.

Stream stability ratings have been described in the Final Water Resources Technical Report Quitchupah Creek Road EIS (JBR, 2001b) and provide information about the stability of Quitchupah Creek at this "newer" base level. Quitchupah Creek's stability generally decreases with distance downstream; the more stable reaches are those within national forest lands. No reaches were rated as excellent; the majority were within the fair range. In general though, the reaches show signs of recovery (as indicated by riparian vegetation growth) within the newer base level of the active stream. It is interesting to note that the three Quitchupah Creek aquatic sites (**Section 3.6** Fisheries & Aquatics) were generally rated more stable than the nearby reaches. The lower Water Hollow site had the second-best rating out of all locations studied. The implication of these ratings is that the already less stable reaches may be more susceptible to alterations in flow, sediment loading, or bank/bed manipulation by the installation of stream crossings or similar disturbances. Damage to the more stable reaches, although less likely, could still occur.

The median diameter of the bed particles (grain size) at the bed surface of each of the locations where the stream stability ratings were done indicates that the uppermost sites are generally sand and smaller sizes. The majority of the reaches were within the medium gravel sizes. These particle sizes would be readily moved as either suspended load or bedload during moderate runoff events.

The relative fineness of the bed particles reflects a stream system that conveys large quantities of sediments. Field observations during what appeared to be a fairly typical thunderstorm runoff event provide an indication of the level of sediments Quitchupah Creek conveys. While mapping channel features and collecting bed materials as part of the fisheries investigation (JBR, 2001c), an increase in bed deposits of approximately 0.75 feet vertical height was noted on the inside of a meander bed after a slightly more than bankfull flow event. The source of this material, while not known specifically, could easily have been from upland sources (tributary channels were observed to be running very turbid, overland flow was sediment laden), in-channel erosion of old terrace banks, or in-channel rearrangement of previously deposited sediments from further upstream channel bed, banks, or bars. Highly erodible soils are present throughout much of the watershed (JBR, 2001d) and provide upland sources of sediment. Past and current land uses, including grazing, have likely altered runoff and also contribute to high sediment yields in the watershed. In summary, there is no shortage of available, easily transported sediment sizes currently in the system, due either to natural sources or long term land uses.

Flow Information
Quitchupah Creek has been the subject of numerous studies where flow monitoring has occurred over recent years. Much of this data has been reported and analyzed by Mayo and Associates (1997).

Flow measurements near the upper end of Convulsion Canyon (Station 046 on **Figure 3-1**), made by Canyon Fuel Company on a quarterly schedule since 1983 (Canyon Fuel Company, 1999a), range from 0.01 cubic feet per second (cfs) to 0.52 cfs. Downstream from that location, flows from East Spring Canyon, a pump house that discharges excess water from a water well, discharge from a mine sediment pond in East Spring Canyon, and numerous small ephemeral tributaries can all contribute flow to Quitchupah Creek above its confluence with the North Fork. The channel in East Spring Canyon drains an area of about 8.5 square miles; Thiros and Cordy (1991) predict its average annual flow at about 1.8 cfs, and its 10-year peak at about 191 cfs. The SUFCO Mine (Canyon Fuel Company, 1999a) records of quarterly flow monitoring since 1983 show flows at the mouth of East Spring Canyon (Station 047A on **Figure 3-1**) ranging from 0.09 cfs to 1.1 cfs.

Observations of lower Water Hollow in winter 2000 indicated that, at least during those observed base flow conditions, this tributary to Quitchupah Creek supplies an amount of flow at least equal to the amount of flow in the main stem channel.

The North Fork is one of the primary tributaries to Quitchupah Creek. It is the receiving stream for the current Utah Pollutant Discharge Elimination System (UPDES) discharge point of about 1,000 to 1,500 gallons per minute (gpm) of groundwater intercepted from the existing SUFCO Mine. The discharge is essentially constant at that rate, and is anticipated to continue for at least the next several years. Generally, flow from the North Fork, including the mine discharge water, supplies about two-thirds to three-fourths of the flow in Quitchupah Creek at its confluence with the North Fork, according to Mayo and Associates (1997) and according to analysis of SUFCO mine water quality records submitted to the Utah Division of Oil, Gas and Mining.

Irrigation also affects flows in Quitchupah Creek and in the lowermost reach of Link Canyon. **Figure 3-1** shows two locations where canal diversions remove water from Quitchupah Creek on a seasonal basis. Further, field observations show that irrigation return flow from the Muddy Creek Canal enters both Link Canyon and Quitchupah Creek near the eastern project boundary.

Stream flows in the ephemeral channels that drain the Water Hollow Benches are not recorded, but can be expected to be erratic and flashy due to the nature of the precipitation events that produce them.

Water Quality Information

The Colorado River Basin Salinity Control Act, as amended in 1995, requires that USFS and BLM focus on minimizing salt contributions to the Colorado River from the lands that they administer. TDS concentrations are a measure of salinity. Specific conductance, and therefore, TDS varies seasonally within Quitchupah Creek (Thiros and Cordy, 1991). It also varies spatially, with a noted increase in a downstream direction. Both concentration and type of major ions change as the geology through which the flow passes changes, experiencing a dramatic difference as flow crosses the Mancos Shale area, noted for highly soluble salts. Mayo and Associates (1997) note that Quitchupah Creek begins to cross through Mancos Shale approximately one-half mile downstream of its confluence with the North Fork, and they further note that Mancos Shale is known "to greatly increase the TDS of creek waters". Thiros and Cordy (1991) state that:

> "The predominant chemical constituents found in surface water upstream from the lower part of the Blackhawk Formation in the Quitchupah Creek drainage area are calcium, magnesium, and bicarbonate plus carbonate. Surface water collected downstream, having flowed across the lower part of the Blackhawk Formation, Star Point Sandstone, and the upper part of the Mancos Shale, shows an increase in the concentration of sulfate."

In addition, analysis of water monitoring information obtain from the SUFCO mine and from the State of Utah's electronic data base (UDOGM, 2005) shows that on average, TDS increases from about 600 mg/l just below the confluence of the North Fork and Quitchupah to about 900 mg/l at the Highway 10 crossing. Using this same source of information, total TDS load in Quitchupah downstream of Highway 10 and the unnamed drainage encompassing Water Hollow and upstream of Christiansen Wash, averages about 7,900 tons/year. Based upon information from the recent TMDL report(UDEQ 2004), by far the biggest nonpoint sources of TDS loading at this location are natural or ambient sources (about 1,800 tons/year), upland surface erosion (about 1,600 tons/year, and irrigation (about 900 tons/year). Smaller nonpoint sources would included existing roads and streambank erosion.

The noted TDS in the ranges in Quitchupah Creek, just above the confluence of the North Fork, apparently do not hinder the existing beneficial uses of stock watering and irrigation. Other designated beneficial uses of Quitchupah include secondary contact recreation and aesthetics and cold water aquatic wildlife; these uses do not have associated TDS standards.

The segment of Quitchupah Creek that is located immediately downstream of the Project Area is on the State of Utah's 2004 303(d) list as being water quality limited for TDS. This means that this stream segment is thought to be unable to support its agricultural beneficial uses due to elevated TDS levels. The State of Utah recently completed a Total Maximum Daily Load (TMDL) study for the portion of the West Colorado Watershed Management Unit that includes Quitchupah Creek (UDEQ 2004). The TMDL report concluded that, even with the successful implementation of recommended BMPs and waste load allocations, the agricultural TDS standard of 1,200 mg/l cannot be met in Quitchupah Creek. This is due to the large quantity of natural, ambient TDS sources that contributes to the overall salt load. Therefore, the State of Utah has approved the TMDL recommended change in the TDS standard in Quitchupah Creek, immediately downstream of the Project Area, to a site-specific limit of 2,600 mg/l. (The TDS standard in the upstream reaches of Quitchupah Creek, alongside the existing Quitchupah Creek Road, would remain at 1,200 mg/l.) This change in the standard will effectively remove Quitchupah Creek (UDEQ 2005) from the 303(d) list, although the 303(d) reports itself will not be generated again until 2006.

The DWQ has the regulatory authority for the Storm Water Discharge Permits that would be required for the proposed project; they would also have to provide 401 Water Quality Certifications for any wetland (Section 404) permits that the project would require. Further, the State Division of Water Rights would be required to ensure that any Stream Alteration Permits (SAP) they grant for road crossings would meet water quality certification requirements.

The existing water quality in Quitchupah Creek below its confluence with the North Fork is influenced by SUFCO's permitted release of mine discharge water, which apparently comprises the majority of the North Fork flow. This discharge averages about 4.3 cfs and represents about three-fourths of the flow in Quitchupah Creek below the Quitchupah/North Fork confluence. TDS at the mouth of the North Fork averages about 560 mg/l, based upon an average of three samples per year since 1983. TDS in Quitchupah Creek above the North Fork averages 680 mg/l, based upon a similar number of samples during the same time period. In effect, the mine discharge water serves to improve the natural water salinity at that location as measured by concentration; however total salt load is increased. SUFCO recently obtain a new UPDES discharge permit for this release, after DWQ performed a "Total Maximum Daily Load Analysis" (TMDL) to ensure that the receiving water quality and its beneficial use designations would be maintained. Since its flow generally contributes most of the flow in the North Fork, the average 560 mg/l TDS is well within the existing water quality standard of 1,200 mg/l for TDS

for Class 4 uses for this upper reach of Quitchupah Creek, and within the new site-specific standard for the downstream reaches.

The aforementioned SUFCO Mine data do not include sediment analysis. However, suspended sediment data from various locations in the upper Quitchupah watershed show that area streams typically convey highly sediment-laden water during thunderstorm events; the Quitchupah Creek watershed seems particularly prone to this given the prevalence of highly erodible soils (JBR, 2001d).
While some of this sediment load may be from natural sources, geology, soil chemistry, climate, and especially historic land uses have exacerbated this. Grazing, instream cattle watering, slumping terraces, and the proximity of the existing, unstable Quitchupah Creek Road are all potential causes of increased sediment loading. Because some of the erodible watershed soils are also saline (JBR, 2001d), sources of sediment must also be considered as sources of TDS.

Data are not available for Water Hollow, but it likely has a similar water quality to upper Quitchupah Creek above the North Fork, given the similar geology through which it flows.

Groundwater Resources
As noted in the Final Geology Technical Report for this project (JBR, 2001e), the Quitchupah Creek Road alignment would be constructed primarily on Quaternary fluvial deposits and gravel terrace deposits adjacent to Quitchupah Creek. These unconsolidated alluvial and colluvial deposits are generally permeable, but are discontinuous and of varying thicknesses. Given these characteristics, they historically functioned as minor valley aquifers with rapid recharge and discharge capabilities, and were closely tied to streamflow, storm runoff, and precipitation patterns. Currently, much of the alluvium is separated vertically from Quitchupah Creek's active fluvial system (as a result of its incision). Once storing enough groundwater to enhance farming activities (Historical Committee of Emery, 1981), these abandoned floodplains now only function as terraces; these materials no longer represent a source of shallow groundwater.

Bedrock formations that are adjacent to (or are overlain by) the alluvial deposits through which all of the road Alternatives (B, C, and D) would cross are the lower Blackhawk Formation, Star Point Sandstone, and three members of the Mancos Shale Formation (the Masuk Shale, the Emery Sandstone, and the Blue Gate Shale). These formations consist of interbedded horizons of varying thicknesses of sandstone, siltstone, mudstone, and shales. The coarser of these horizons support groundwater, while the more impermeable, finer beds impede its vertical movement and redirect its horizontal flow. Movement and discharge of groundwater is stratigraphically controlled by these interbedded layers and by secondary permeability via faults and fractures. Recharge areas are spatially limited. For these reasons, as demonstrated by others (Mayo and Associates, 1997; Thiros and Cordy, 1991), groundwater in the general vicinity of the Project Area is typically localized within small, perched zones, and is inactive. Consequently, the Project Area does not overlie any regional aquifers capable of supporting significant water usage.

Water Rights
Information from the Utah State Engineers' office indicates that there are numerous water rights held in the vicinity of all of the alternate road alignments. A listing of water rights was presented in the Water Resources Technical Report prepared for this project (JBR Environmental Consultants, Inc. 2001b). The majority of these are rights for stock watering directly on Quitchupah Creek, Water Hollow, and their ephemeral tributaries. In fact, essentially all water courses, both perennial and ephemeral, within the Project Area are subject to these in-channel stock watering rights. Typically, these surface water rights for stock water do not give specific quantities of water; instead, they specify a stream reach and duration

whereupon a given number of livestock may drink.

Two points of diversion of irrigation water from the creek are also located near the proposed road upgrade, as shown on **Figure 3-1**. The quantity of water associated with the upstream diversion is four cubic feet per second (cfs).

Environmental Consequences To Water Resources

The Environmental Consequences of each Alternative, in regard to water resources, are discussed below. First, regulatory consequences are described and then potential impacts to the resource itself.

REGULATORY

NO ACTION - ALTERNATIVE A

There would be no change to the current state of water resources and existing influences on it as a result of the No Action Alternative in regard to regulatory impacts. No Stream Alteration Permits would be needed under this Alternative. There would be no change in water quality as a result of No Action that would have implications in regard to the State's High Quality Water category for the streams on national forest lands. There would be no change in water quality as a result of No Action that would have implications in regard to the State's 303(d) listing – or its de-listing - for Quitchupah Creek downstream of the Project Area. However, existing sources of accelerated erosion would continue to affect the High Quality Water and 303(d) reaches of Quitchupah. Further, there would be no potential to impact the regulatory issues of water rights or floodplains, should the No Action Alternative be chosen.

QUITCHUPAH CREEK ROAD ALIGNMENT - ALTERNATIVE B

The Army Corps of Engineers (COE) requires that individual federal permits be obtained for all dredge and fill activities taking place within the nation's waters ("Waters of the U.S."). Waters of the U.S. include all wetlands, defined by saturated soils and the presence of obligate wetland plants, as well as all waters having a current or past use in interstate or foreign commerce. A General Permit for Storm Water Discharges would need to be obtained during construction activities as well as numerous approvals for work in Waters of the U.S. For this project, the COE has indicated that it would take the lead for all of the wetland and Waters of the U.S. permitting so that Stream Alteration Permits from the State would not be needed. Other state regulatory considerations would be related to Utah water quality designations of High Quality Category I waters on national forest lands and 303(d) listed waters downstream of the Project Area. As noted in **Section 3.4**, the reaches of Quitchupah Creek that are on the current 303(d) list are likely to be removed during the 2006 cycle due to completion of the TMDL and enactment of a greater site-specific TDS standard. Lastly, floodplains and existing water rights would also be regulatory issues, discussed in more detail under the Potential Impacts section (below).

ALTERNATE JUNCTION AND ALTERNATE DESIGN - ALTERNATIVE C

Regulatory impacts would generally be the same as for Alternative B.

WATER HOLLOW ALTERNATE ALIGNMENT - ALTERNATIVE D

Regulatory impacts would generally be the same as for Alternative B.

Potential Impacts To Water Resources

The proposed road would be engineered to meet AASHTO standards, in order to ensure its long-term stability. BMPs that would be required under any of the build Alternatives would further help to ensure that impacts related to sediment, salinity, erosion, drainage crossings, and other water quality and quantity impacts would be reduced as much as possible. These BMPS are mentioned throughout Chapter 2 and

are contained in total in **Appendix B**; they include construction, operation, and maintenance aspects of the proposed road project. The elimination of livestock grazing from 4.7 miles of the riparian corridor within the public land stretches of Quitchupah Creek would eventually benefit the stream ecosystem.

The high level of expected use of this toll road means that the proponents have a large stake in seeing that the road remains driveable at all times, at least during the initial years while the mine is still operating. Culvert failure, fill erosion, or even a temporary ditch/culvert overflow situation could easily render the road impassable, thus, halting traffic and becoming an unacceptable situation for economic reasons. Therefore, engineering designs that include specific measures for a high degree of water and sediment management have minimized the potential for these types of failures. Further, the monitoring and inspection procedures that would be adopted along with each of the build Alternatives would result in rapid identification of problems and ensure their timely correction. While the proponents' primary interest in keeping the road passable may be economic, the resultant effect is that water-caused damage that introduces sediments to the stream system would also be minimized by those same design, BMP, monitoring, and maintenance features. These considerations are taken into account in the impacts assessments for each Alternative.

The fact that an existing road is in place and is currently in poor condition is also relevant to this analysis of Alternatives. The existing road is a source of sediment and runoff alteration, and it receives little or no maintenance. Under Alternative B, all but about one mile of this existing road would be obliterated or reclaimed. Under Alternative C, all but about 3.7 miles of the existing road would be obliterated or reclaimed. Under Alternative D, approximately 7 miles of the existing road's 9.15 mile length would remain unreclaimed, minimally maintained, and in use.

Lastly, predicted impacts are based upon detailed road designs, BMPs, construction techniques, reclamation, aggressive monitoring, timely maintenance schedules, and other environmental commitments as provided in Chapter 2, **Appendix B**, and the Monitoring Plan. **Appendix D** includes discussions on other foreseeable actions upon which cumulative impact analysis is based.

NO ACTION - ALTERNATIVE A

There would be no change to the current state of water resources and existing influences on it as a result of the No Action Alternative. The existing road alongside Quitchupah Creek crosses erodible soils, is in close proximity to the stream for much of its length, and relies upon the native unconsolidated terrace deposits for much of its substrate. As a result, it currently adds sediment to the stream. Under No Action, Quitchupah Creek would continue to convey sediments at occasionally high concentrations, the existing road would continue to be a source of sediment to the stream, and the stream would, at least in the near-term, continue to be susceptible to destabilization. The salinity of the stream would also continue to be influenced by sedimentation due to the erosion of saline soils. The existing road would remain in place and in use, and the existing 16 primary watercourse crossings (8 perennial and 8 ephemeral) would remain as fords (or culvert, in the case of the East Spring Canyon crossing). Most of the perennial stream fords appear to be fairly stable; many of the ephemeral fords appear to be subject to failure through headcutting, piping, and down-road diversion. Maintenance does not appear to be frequent or very successful along the existing road, which is inconsistent with BMPs for pollutant sources under the Clean Water Act. At times, these existing crossing problems, as well as other road drainage problems, cause the existing road to be impassable. This would be expected to continue in the future under the No Action Alternative.

QUITCHUPAH CREEK ROAD ALIGNMENT - ALTERNATIVE B

Stream Crossing Impacts

The proposed Quitchupah Creek Road alignment would require 18 primary watercourse crossings and 25 secondary crossings. Six primary crossings of perennial waters would be required: 4 culverted Quitchupah Creek crossings; 1 culverted crossing at East Spring Canyon; and 1 culverted crossing at North Fork. Two additional primary crossings would be required at the upper end of Convulsion Canyon, which flows intermittently. Ten defined ephemeral wash primary crossings would be needed, including at Link Canyon. These make up the afore-mentioned 18 primary crossings. The remaining secondary crossings would be ephemerally flowing minor channel or swale crossings.
As noted above, the existing Quitchupah Creek road already has a total of 16 primary crossings (8 perennial and 8 ephemeral); all of those crossings would be either replaced with culverts on the new road, or abandoned and reclaimed where the new road diverges from the existing road. Therefore, the net increase in number of primary crossings would be two (18-16). **Table 3.2-1** shows the number of primary crossings on the existing Quitchupah Creek road alignment, the number required for this Alternative, and the net based upon whether the existing primary road crossings would remain or be replaced/removed.

All crossing culverts (both primary and secondary) would be designed to pass the 100-year peak flow, as well as associated sediment and debris. In addition, as described in Chapter 2 and in **Section 3.5**, several of these culverts would be designed (based on input from the Utah Division of Wildlife Resources) so that fish passage would not be hindered. Various other BMPs that would be applied to culverted crossing during construction and operation are described in **Appendix B**; these would reduce impact potential from culverts during the design flow and during more regular flows.

Table 3.2-1 Primary Watercourse Crossings - Alternative B: Proposed Quitchupah Creek Road

Stream Regime	Alternative A Existing Quitchupah Creek Road (denotes primary crossings that are currently in place)	Alternative B Proposed Quitchupah Creek Road (denotes number of primary crossings placed during construction of new road)	Existing Primary Crossings that would be removed or replaced during construction	Net number of Primary Crossings after construction of new road and removal of existing road
Perennial	8	6	8	6
Intermittent	0	2	0	2
Ephemeral	8	10	8	10
Total	16	18	16	18

Note that all but one of the existing primary crossings on the existing Quitchupah Creek Road are fords; the only culvert that is currently in place is at the East Spring Canyon Crossing. As discussed above under the No Action Alternative, most of the existing perennial stream fords appear to be relatively stable, in contrast with many of the ephemeral wash crossings, where erosion and runoff problems are often apparent.

Table 3.2-2 provides measurements made in the field at selected larger crossings associated with Alternative B. Most of these are designated primary crossings; the majority of secondary crossings would not affect waters of the U.S. The volume per foot column represents the approximate volume of defined waters (under or stream-ward of the Ordinary High Water Mark (OHWM)) per foot through the width of the crossing that would be filled either by the culvert itself or associated back fill. The total volume of fill associated with each crossing would be greater than the amount that is relevant to the Stream Alteration

Permit; there would also be fill associated with each crossing that is placed above the elevation of the OHWM to up to the roadbed elevation. The total volume of fill at each crossing would be indicative of sediment levels that could be contributed to the stream should the crossing fail entirely.

Table 3.2-2 Waters of the U.S. or State at Selected Crossings - Alternative B Quitchupah Creek Road

Station	OHWM Width (inches)	OHWM Depth (inches)	Volume per Foot below OHWM (cu. ft.)	Fill Length (feet)	Channel Description
11+00	30	6	1.25	60	Intermittent Section of Quitchupah Creek
18+00	30	6	1.25	180	Intermittent Section of Quitchupah Creek
66+00	40	11	3.06	170	East Spring Canyon (perennial)
94+00	40/23	2	0.44	200	ephemeral tributary
186+50	52/42	6	1.95	350	ephemeral tributary
201+00	33/21	8	1.60	250	ephemeral tributary
213+50	32/21	8	1.50	250	ephemeral tributary
228+50	108/48	18	9.75	210	Quitchupah Creek (perennial)
232+50	108/48	18	9.75	250	Quitchupah Creek (perennial)
250+00	156/72	30	23.75	80	North Fork (perennial)
251+50	166	18	20.75	130	Quitchupah Creek (perennial)
256+50	166	18	20.75	80	Quitchupah Creek (perennial)
271+00	102/78	10	6.25	200	ephemeral tributary
268+00	57/48	5	1.82	90	ephemeral tributary
451+00	114/97	12	8.79	250	Link Canyon (ephemeral)

The risk associated with these culvert installations, defined here as the likelihood that culvert capacity will be exceeded, can be quantified by using the recurrence interval of the design flow and the assumed design life of the project. For all proposed primary and secondary culverts on the Quitchupah Creek Road, the former is 100 years and the latter is assumed to be 20 years. Applying the formula given below, the probability of failure is thus 18 percent that culvert capacity would be exceeded, or, conversely, 82 percent that it wouldn't be exceeded. Although there would be a one percent chance of exceedance in any given year, the probability of failure over 20 years would be 18 percent. (As will be seen in the sections discussing Alternatives C and D, because design recurrence interval and design life are the same for all of the build Alternatives, all have an equivalent calculated probability of failure.)

$$P_n = 1-((T_r-1)/T_r)^n$$

where:

P_n = probability of occurrence
T_r = recurrence interval in years
n = design life in years

Should capacity of a given culvert be exceeded, it may or may not fail or be completely washed out. However, assuming a total wash-out of all fill material placed in association with the culverts, a comparison of the consequences of accepting the 18 percent risk among the various build Alternatives can be based upon the total approximate volume of fill at all crossings for a given Alternative. Because this does not in any way imply that these actual total quantities of materials would enter a stream system, either over time or in one instance, volumes are not given here. Instead, Alternative B is given a ranking of 1, and the other Alternatives are compared to this ratio. Alternative A has minimal existing road fills and would have no new construction fills. As such, Alternative A ratio is >0 and <1. As will be seen in the discussions of Alternatives C and D, Alternative B has the lowest ranking of any of the build Alternatives.

The perennial stream reaches where most of the primary culverted crossings would occur are located in the western half of the Project Area. The Phankuch (1978) method of stability rating was used in analysis and these "procedures were developed to systemize measurements and evaluations of the resistive capacity of mountain stream channels to the detachment of bed and bank materials and to provide information about the capacity of the streams to adjust and recover from potential changes in flow and/or increases in sediment production." These reaches coincide with areas of the stream that were rated better in the Phankuch stability rating than the eastern reaches, where no perennial and few other primary watercourse crossings would be required. The better Phankuch rating, in general, means that these reaches should adapt better to presence of the culvert than a lower reach with poorer stability. However, even in these more adaptable reaches, proper design, placement, and maintenance would be key to ensuring that these reaches maintain their current stability. The upstream reaches also, in general, convey less sediment, so sediment plugging would be less likely to occur in these culverts. (Note that westernmost reach of stream - which received the highest Phankuch rating - would be obliterated by the road alignment and replaced essentially by a road ditch; in this case, the resiliency and adaptability of the original channel, as described by its rating, has no bearing on the future stability or instability of the replacement conveyance.)

Commonly, culverted crossings, and other road drainage features, serve to extend the drainage network and result in higher local runoff rates and volumes. However, crossing and road drainage BMPs given in Chapter 2 and **Appendix B** would function to reduce those potential effects.

Lastly, in regard to the fact that perennial crossings would only be required in the upper reaches, is the issue of fish passage. As described in the Aquatics Technical Report (JBR, 2001c), few fish were found in the upper reaches, both in number and in diversity. In order to not further contribute to reduced number, where fish were found during baseline surveys, culvert passage (either meaning sufficient depth during low flows or reduced velocities during high flows) would be provided for in the final design phase based upon the fish species present and their specific seasonal requirements as determined through consultation with the Utah Division of Wildlife Resources. This is discussed further in **Section 3.5**.

The existing Quitchupah Creek bridge on SR-10 near the terminus of the alignment would need to be widened 8 feet to the west and 32 feet to the east, almost doubling its current width, and the COE 404 issues would have to be considered as part of that activity.

Realignment/Floodplain Impacts

Primarily in the upstream reaches of the project, some areas of overbank or floodplain fill would also be associated with the culvert crossings, as well as with stream impingement in the Convulsion Canyon, East Spring Canyon, and Rock Art realignment areas, and with reaches along Quitchupah Creek where the road toe may infringe on a channel meander bend. Avoidance of all impingement or realignment is not feasible given the topographic constraints. However, filling of such areas will be avoided to the extent possible, and would be restricted to areas directly associated with the required road alignment where needed due to topographic constraints. As described in Chapter 2 and in **Appendix B**, the realigned channels and reaches where the road fills toe out in or close to stream channels, would be designed to minimize the potential for redirecting flows and stream energy to opposite banks, instigating bed/bank scour. Any wetlands associated with these areas would be properly dealt with through the COE 404 permitting process as described in the Vegetation Technical Report (JBR, 2001k) and in Section 3.6.

These upstream overbank areas may not be floodplains in the morphological sense of an extensive alluvial overbank area subject to frequent reworking by stream flows; however, they may be considered floodplains in a regulatory sense. The existing so-called floodplain areas do not function as a morphological floodplain feature more typical in the downstream valley areas (there are not extensive alluvial deposits that retain flood flows, hold overbank water for riparian uses, or reduce flood peaks), therefore impacts to these flood plains would be expected to be negligible in the upstream reaches where realignment is proposed, not withstanding the fact that during realignment, the active and overbank channels would be obliterated. In the downstream valley area on the eastern half of the project, there are few if any encroachments due to the road alignment and design, however potential impacts due to redirecting flows would also be minimized through the stated BMPs and design features should these encroachments occur. Impacts due to realignment of the Convulsion Canyon and East Spring Canyon reaches are discussed below.

The approximately 2,800 feet (from road stations 13+50 to 15+50 and 19+00 to 45+00) of Convulsion Canyon channel that would require realignment flows intermittently. These reaches are currently confined between the steep canyon slope on one side and the existing Quitchupah Creek road on the other side. Gradient is currently approximately 7.5 percent, with very little meandering. The cross section of the bed is generally flat and contains riparian vegetation; the banks are steep and oversteepened with sloughing present in areas. The single Phankuch stability rating done within this segment had the highest rating of any along the Project Area (however, given the intermittent nature of the stream in this location it was not well suited to the methodology).

Given the topographic constraints, the realigned segment would be straightened to a grade of approximately 9 percent, and would likely be more ditch-like, and have a narrower, more uniform channel bottom that the existing channel has. (During final design for this section, slight meanders may be placed should topography allow; however initial designs indicate this would not be possible, therefore impact analysis assumes the same.) To accommodate the higher velocities associated with new cross section and profile, an engineered channel, using a combination of riprap, grade control, and/or vegetation, would be placed to maintain stability. There would be a loss of riparian vegetation (see Vegetation Impacts Section), and erosion of the intercepted steep natural slope would likely contribute sediments to the channel in this location. The resiliency of this stream reach as inferred by the high Phankuch rating would be lost as the reach is replaced by a more ditch-like channel. Where appropriate, the BMPs listed in **Appendix B** would be used to minimize this potential for erosion/sediment impacts. Transitional treatments would be done to ensure that, at the downstream end of the realigned reach, velocities and flow area are returned to their original conditions, as described in **Appendix B**. Some of the sediments contributed by this reach would eventually be trapped within the wetland mitigation area immediately

downstream of the realigned reach.

Approximately 1,100 feet (between 65+00 and 75+00) of East Spring Canyon that would be filled and require realignment flows perennially. Because the topographic constraints are not as overwhelming in this area as on the Convulsion Canyon realignment, a more naturally functioning stream can be designed as described in Chapter 2. After an initial period of adjustment, this stream realignment would not be expected to be impacted or impact adjacent stream reaches.

A portion of an existing meander and cutoff channel, that recently diverted the stream from its former course through a meander bend in Quitchupah creek just upstream of the original junction with North Fork, would be shortened 130 feet in order to accommodate the road fill. This would occur between stations 249+00 to 250+00. Since the cutoff of the meander is a recent event, the remaining dry portion of the meander still retains an unobstructed channel downstream to the original junction with North Fork. The north curve of the meander where the cutoff channel is located would be filled and the meander shortened slightly due to the fill. The diversion of 130 feet of the stream from the cutoff back into the meander would restore about 350 feet of the stream channel and decrease the grade from 7.6 percent to 2.3 percent (Strip Map 9).This realignment would be designed to maintain velocities and bed elevations. After an initial period of adjustment, it would not be expected to cause stream instability. The planned monitoring would insure that unforeseen impacts would be corrected.

Erosion, Sedimentation and Salinity Impacts

Road construction and related ground disturbing activities can often cause accelerated erosion and introduction of sediment into stream channels. Given the geologic environment of the Project Area, introduction of sediments also results in introduction of salts (dissolved solids). Various types of erosion and sediment controls, described as BMPs in **Appendix B**, would be implemented in order to maintain water quality during and immediately after construction. These controls include such structures as silt fences, and such practices as limiting the areas for construction activities. When properly implemented, such techniques can dramatically reduce potential sediment and dissolved solids loads. Thus, the use of BMPs as contained in **Appendix B**, and required designed criteria as specified in Chapter 2, are anticipated to substantially reduce the potential delivery of sediment and salts during and following construction. Even with the BMPs and other design criteria, sediment levels would likely be higher than background conditions, based upon increased area of disturbance at the least. However, the riparian fencing along 4.7 miles of Quitchupah Creek would, over time, have the potential to enhance the stream's stability. Fencing will begin within the intermittent reach and continue to the FS boundary, 2.4 miles. It will also be fenced along 1.1 miles of BLM land and 1.2 miles of SITLA land. The length of riparian fencing on each side of the stream would be 4.7 miles, for a total length of 9.4 miles.

Once construction has been completed, disturbances associated with the finished roadway can also provide a source of sediment and salts to streams. The disturbance corridor would be reclaimed, including areas no longer in use as well as road fill, slope, and borrow areas (Section 2.4, Reclamation). Surfaces immediately adjacent to the paved roadway (i.e. shoulders/borrow areas) may revegetate fairly quickly, because they receive additional runoff water from the road surface. Larger, steeper fills and cuts may reclaim more slowly and some erosion may occur. BMPs in **Appendix B** for other slope treatments would minimize erosion potential. And as also described in **Appendix B**, these reclaimed areas would be protected from grazing with electric fence, in order to facilitate revegetation efforts. Sediment loading from rilling or from small mass failures such as slumps occurring on these fill- and cut-slopes could contribute additional sediment to the stream. In turn, this sediment could also contribute increased dissolved solids that could degrade water quality. Once again, slope treatment BMPs, planned monitoring of the road drainage system, and a commitment to timely maintenance are all designed to reduce these

events.

Any changes in water quality (as expressed by sediment or dissolved solids loading) due to the proposed road or Alternatives would be difficult to reasonably quantify. In part, this is due to the variable - but often high - dissolved solids and sediment loads currently conveyed by the stream, and the lack of data on contributing sources. Any prediction of erosion rates (from surface sheet erosion, mass failure, or culvert failure, for example) would be highly speculative due to the geologic, land use, and topographic complexities and interactions, and the existing spatial and temporal variability in the Quitchupah watershed. Further, once the erosion rate was predicted, sediment loading would also have to be modeled, with additional uncertainties introduced. Finally, based upon that prediction, salinity loading estimates would be needed, and would have to account for the fact that different sediment sources produce differing levels of salinity, again adding layers of estimation without adequate data. While it would be possible to model, all of these uncertainties would require that the final predictions be given in the form of a wide range of predicted values.

Given the scale of the Quitchupah Creek watershed at the downstream project boundary (100 square miles) in relation to the area of disturbance (92.3 acres), the predicted modeled background range would be much greater than any additional incremental impact from the small percentage of disturbance that would be predicted, as well as the incremental improvement resulting from the closure and reclamation of the existing road. Even at a finer scale typical of one of the small ephemeral drainages crossed, the percentage of the watershed to be newly disturbed by the road is quite small (in the range of one percent maximum), making an accurate modeling prediction unrealistic. However, these smaller watersheds are, in reality, where greater impacts typically occur; relative increases in stream flows, energy, and sediments can be extreme at these scales, due to drainage areas being increased through draining ditch lines, increased hydrologic connectivity, and other means. The design measures in Chapter 2 and the BMPs in **Appendix B** would reduce these potential effects by spacing cross drains adequately, avoiding drainage capture, and insuring effective dispersal mechanisms, among other means. The planned monitoring and maintenance of the road drainage features would further minimize these kinds of effects.

Qualitatively, we know that: (1) the existing road surface and nearby surfaces are already experiencing erosion at “above background” rates; (2) the new disturbances associated with the construction corridor and cut/fill slopes for the new road would also have the potential to erode at “above background” rates; and (3) the larger contributions of sediments from the watershed are currently coming from sources other than roads. Given the design criteria, BMPs, required monitoring, and the applicant-committed environmental protection measure to install riparian fencing, is it reasonable to assume that, on balance, accelerated erosion associated with the proposed road project would occur but may be less than other contributing factors.

In any case, the closer the road is to the stream, the more likely it is that any eroded material could make its way to the stream and degrade water quality. To provide a relative indication of this, **Table 3.2-3** provides a comparison of the existing condition (equivalent to No Action) and the other Alternatives in regard to proximity to a perennial stream reach. Using this information, the distance of the road from the stream channels can be used as a quantitative means to compare and contrast Alternatives, rather than attempting to model predicted salt or sediment loads.

Table 3.2-3 Proximity to Perennial Stream - Quitchupah Creek Road and Alternatives

Proximity to Stream	Existing Road (Same as Alternative A) (feet)	Alternative B (with existing road reclaimed) (feet)	Alternative C (with much of the existing road reclaimed) (feet)	Alternative D (with much of the existing road left unreclaimed) (feet)
<50 feet	2,500	2000	2000	2500
<500 feet	35,400	33,800	32,300	38,900

In essence, construction of Alternative B would result in a reduction of the length of Quitchupah Creek roadway within 50 feet of perennial stream by 500 feet. It would result in a reduction of length within 500 feet by 1,600 feet.

While the total road width and extent cut and fill slopes associated with the proposed road would be much greater than the width associated with the existing road, the engineering and construction techniques of the new road (constructed to AASHTO & UDOT Standards), coupled with the BMPs contained in **Appendix B** for road drainage, construction reclamation, and maintenance), as well as the aggressive monitoring and maintenance plan that would be implemented, would tend to negate the width difference as far as sediment or runoff concerns. (It is important to note that while revegetation of the existing road reaches that would be abandoned, construction corridor areas, and cut/fill slopes would be done where possible, vegetation is not the primary mechanism for soil stabilization in this area, nor would it be relied up totally to provide erosion control. As discussed in **Appendix B**, other techniques and materials would be used as well as vegetation; and where used, vegetation efforts would be a continuing maintenance item where needed.)

A compacted roadway with proper control of drainage and storm runoff, and use of imported materials such as rock, fill, and/or retaining walls, where necessary, would be an improvement over the current road situation with its native, un-engineered substrate and no drainage controls. However, a tradeoff would be the risks associated with primary and secondary channel crossings as described previously. Further, the existing road receives little or no maintenance through most of its length and little usage. This means that problems that currently develop on it, such as head-cutting up from a side-drainage, go unnoticed and add sediments to the stream on a chronic basis. In contrast, the proposed road would have frequent traffic, primarily with trucks that are dependant upon the road to get their product out, so maintenance would be frequent and problems would be quickly reported and rectified.

It is important to note that the upper terrace banks along Quitchupah Creek are often very unstable, sediment loads are currently high, the stream channel is active, and the stream flow regime is very flashy, so there is always potential for large channel changes caused by changes in its watershed or by rare flow events.

Under normal, typical circumstances, the road may perform well, and cause little or no increase in sedimentation. However, during rare events, destabilization could occur and result in a short term, larger pulse of sediment into the stream. Using a culvert failure as an example, should a greater-than-design event occur, streamflow would likely overtop the road. It may (1) simply cross the road, and continue across the fill without major damage, (2) result in a wedge of roadway and associated fill being eroded away, or (3) it could result in a catastrophic breach. Assuming proper design, placement, and maintenance of culverts (which would be assured by agency review of design specifications, and

implementation of the BMPs contained in **Appendix B**), the calculated risk associated with failure is based upon probabilities, as discussed under the *Stream Crossing Impacts* section above.

Culvert failure could result in a pulse of sediment into the stream. Depending upon circumstance, such a pulse would immediately be carried downstream, or be redeposited close to the failure, or some combination of transport/deposition over some undetermined amount of time. Large, longer term instabilities as a result of crossing failure, such as headcutting back up the drainage that failed, would not be expected because timely repair and maintenance would be done in order to keep the road operational. A larger, more catastrophic failure could have more significant effects, but such a failure is considered unlikely given the specified design criteria, implemented BMPs, and the aggressive monitoring/maintenance programs.

Impacts to Category 1 Waters and 303(d) Listed Waters

Any sediment increases would indirectly have the potential to increase TDS, a parameter of concern in the 2004 303(d) listed stream segment downstream of the property. This would depend upon the nature of the eroded materials, which is further discussed in the Soils Technical Report (JBR, 2001d). As noted above, salinity greatly increases in a downstream direction already, and the Utah Division of Water Quality, in its West Colorado Watershed Management Unit Water Quality Assessment Report (UDEQ, 2000) and its companion TMDL (UDEQ 2004), states that the dominant sources for TDS in the 303(d) listed stretch of Quitchupah Creek were natural and agricultural practices.

The implications of the Quitchupah Creek reach downstream of the project being on the 2004 303(d) list, of the uppermost part of Quitchupah Creek within the Project Area being a Category 1 stream, and the entire Project Area being subject to the Colorado River Salinity Control Act all represent potential regulatory issues related to introduction of TDS. Because the 303(d)-listed reach is likely to have a TDS site-specific standard in place by the time the project would be constructed, and because this new (higher) standard would be the basis for DWQ project water quality assessment, as described in Chapter 3, the 303(d) issue may be a moot point. The Division of Water Quality would oversee this aspect of the permitting through its issuance of a permit for storm water discharges during construction, through any issuance of Stream Alteration Permits associated with any crossings and realignments where waters of the State are present, and through the State's 401C Water Quality Certification needed for any wetland permits. Potential temporary, construction related impacts are allowed to occur in streams that have these designations, as long as measures are used to reduce those impacts to the extent feasible. These measures are partially described in BMPs in **Appendix B** and would be further developed with the preparation of the Storm Water Pollution Prevention Plan that would be required. However, some construction-related sediment loading may occur even with these BMPs. This project would not require any new point source discharges of wastewater, which would be much more difficult or impossible to permit in Category 1 or 303(d) listed segments. However, the upper reaches of Convulsion Canyon (a Category 1 reach) that would require realignment may represent a longer term, post-construction source of sediments and salts entering the stream from ongoing erosion of the intercepted steep natural slope adjacent to the realigned channel segments. The wetland enhancement and replacement efforts immediately downstream of the realigned reaches, the agency committed measures, and applicant-committed environmental protection measure for the irrigated areas would help to reduce these potential impacts.

Other Water Quality Impacts

Vehicle accidents that result in release of coal, fuel, or other transported materials would be possible on the proposed road, as they are on any road or highway where trucks travel. During most accident occurrences, roadside ditches, cross drains, and many of the culvert crossings would likely be dry. In those instances, should spillage of coal, fuel, or other materials occur, it should be able to be cleaned and

mitigated without contacting storm water runoff or perennial waters. However, there would be some potential for an accident to result in direct release of pollutants such as coal or fuel to Quitchupah Creek itself, either by spilling into the stream itself, or into a culvert crossing during a runoff event. Standard response and cleanup for this type of spill would occur, as directed by a BMP specific to this occurrence as described in **Appendix B**, but there could be some short term effects on water quality and biotic stream components. However, the potential for such accidents to occur would be low. According to SUFCO, over the past five years, only two truck accidents have occurred on the steep, winding Acord Lakes Road, out of an estimated 50 trucks per hour at peak times.

Sand, mixed with deicing chemicals such as commonly used road salt, would be needed during the winter to insure safe driving conditions. BMPs, as described in **Appendix B**, would be applied to ensure that these materials are used in an appropriate manner to minimize contributions to stream sedimentation and salinity, and to protect riparian vegetation and stream biota from the effects of excess salt.

Snow removal would be done according to agency standards so as to minimize effects to stream channels and vegetation.

As specified in the **Appendix B** BMPs, coal trucks would be cleaned prior to entering the road, so their potential to chronically contribute coal dust or other coal particulates would be reduced. However, some minimal potential for coal introduction would always remain.

Other effects on water quality, as indicated by bacteriological, radiological, organic, and trace metal parameters, that are regulated for recreation or cold water aquatics beneficial uses, are not expected to occur as a result of the proposed project. This is because no sources for these types of constituents would be expected to be conveyed along the route on any kind of routine basis.

Water Quantity/Flow Impacts

As noted, while it has not been subject to long term stream flow gauging, Quitchupah Creek is known to experience a wide fluctuation in stream flow due to intense storm activity. In part, this is due to the watershed characteristics and condition, which primarily result in a high ratio of runoff to precipitation. In general, disturbances such as road construction tend to locally increase runoff within the area of disturbance when compared to the pre-disturbed condition, and this would be the case for this road as well. In addition, road drainage features such as cross drains, ditches, etc. typically increase the hydrologic connectivity of the system, increasing (at least locally) peak flows associated with any given event. Currently, the existing road has a high degree of connectivity with Quitchupah Creek; because it would be reclaimed, the connectivity it currently provides would diminish. The proposed road would not have a high degree of connectivity due to the planned storm drainage features such as draining ditch lines before they reach channels so that water and sediments can infiltrate/redeposit, draining ditch lines frequently to prevent concentrated overland flow, and other related BMPs described in **Appendix B**.

Whether or not the proposed road would locally increase peak flows would be dependent on the net effect of: (1) removing some of the existing connectivity that occurs from the existing road; (2) minimizing connectivity due to new road drainage features; (3) increasing the distance of the road away from the channel over what is currently; (4) increasing the width of disturbance and runoff production potential; and (5) improving riparian conditions due to grazing reductions. On balance, at least some increase in localized peak flow would be likely. However, the net affect on the hydrologic regime in Quitchupah Creek, already noted to be extremely flashy and variable in flow, and which is and would remain dominated by precipitation patterns and current soil/vegetation characteristics, would likely go unnoticed (Section 2.2 Stream Crossing and Road Culverts).

Water Rights Impacts
Water right holders currently have the authority to use Quitchupah Creek waters for instream stock watering and irrigation. The integrity and functioning of the irrigation system would be maintained with the construction of the road; access to those features would be maintained. Although the applicant-committed measure to install riparian fencing and watering stations may redirect instream stock-watering to specific locations on- or off-stream, water right holders' ability to use their water rights would not be compromised. Further, the project would not reduce the amount or quality of available water to meet those rights.

Groundwater Impacts
Impacts to groundwater would be minimal, if any, due to its limited extent and depth. Road cuts and drainage ditches are not likely to intercept or redirect groundwater. Field vegetative evidence, direct observations of existing near-road surfaces during various seasons, and soil survey information all indicate little potential for any extensive areas of shallow groundwater that would be likely to be intercepted. However, some very localized areas of seasonal shallow subsurface water related to snow melt may appear at some cut faces. If so, it would be expected to enter inner roadway ditches and be directed to the nearest ditch relief culvert. Any groundwater associated with the impacted wetlands would be minimal in extent and those impacts would be mitigated under the COE 404 permit, as discussed in the wetlands section of the Vegetation Technical Report (JBR, 2001k) and in **Section 3.4**.

ALTERNATE JUNCTION AND ALTERNATE DESIGN - ALTERNATIVE C
Potential impacts would generally be the same as for Alternative B, although as shown in **Table 3.2-4**, this alternative would require four more primary crossings than would Alternative B. Further, construction of Alternative C would result in a reduction of the length of Quitchupah Creek roadway within 50 feet of perennial stream by 500 feet as compared with the No Action existing condition. It would result in a reduction of length within 500 feet by 3,100 feet as compared with the No Action existing condition. When compared to Alternative B, Alternative C would result in the same amount of perennial stream within 50 feet of the roadway, and somewhat less within 500 feet as was shown in **Table 3.2-3**.

Table 3.2-4 Primary Stream Crossings - Alternative C - Alternate Junction

Stream Regime	Alternative A Existing Quitchupah Creek Road (denotes primary crossings that are currently in place)	Alternative C Alternate Junction (denotes primary number of crossing placed during construction of new road)	Existing Primary Crossings that would be removed or replaced during construction	Net number of Primary Crossings after construction of Alternative C and removal of existing road
Perennial	8	6	8	6
Intermittent	0	2	0	2
Ephemeral	8	14	8	14
Total	16	22	16	22

Table 3.2-5 provides measurements made in the field at selected larger crossings associated with Alternative C. Most of these are designated primary crossings; the majority of secondary crossings would not likely affect waters of the U.S. The volume per foot column represents the approximate volume of defined waters (under or stream-ward of the OHWM) per foot through the width of the crossing that

would be filled either by the culvert itself or associated back fill. The total volume of fill associated with each crossing would be greater than the amount that is relevant to the waters of the U.S. permitting; there would also be fill associated with each crossing that is placed above the elevation of the OHWM to up to the roadbed elevation. The total volume of fill at each crossing would be indicative of sediment levels that could be contributed to the stream should the crossing fail entirely.

Table 3.2-5 Waters of the U.S. or State at Selected Crossings – Alternative C Quitchupah Creek Road - Alternative Junction

Station	OHWM Width (inches)	OHWM Depth (inches)	Volume per Foot below OHWM (cu. ft.)	Fill Length (feet)	Channel Description
11+00	30	6	1.25	30	Intermittent Section of Quitchupah Creek
18+00	30	6	1.25	180	Intermittent Section of Quitchupah Creek
66+00	40	11	3.06	170	East Spring Canyon (perennial)
94+00	40/23	2	0.44	200	ephemeral tributary
186+50	52/42	6	1.95	350	ephemeral tributary
201+00	33/21	8	1.60	250	ephemeral tributary
213+50	32/21	8	1.50	250	ephemeral tributary
228+50	108/48	18	9.75	210	Quitchupah Creek (perennial)
232+50	108/48	18	9.75	250	Quitchupah Creek (perennial)
250+00	156/72	30	23.75	80	North Fork (perennial)
251+50	166	18	20.75	130	Quitchupah Creek (perennial)
256+50	166	18	20.75	80	Quitchupah Creek (perennial)
271+00	102/78	10	6.25	200	ephemeral tributary
268+00	57/48	5	1.82	90	ephemeral tributary
392+00	240	18	30	150	ephemeral wash
410+00	70	8	6	150	ephemeral wash
422+50	220	18	27	200	ephemeral wash
434+50	180	12	15	200	Link Canyon
463+00	180	12	15	240	ephemeral wash

The calculated probability of failure associated with these culvert installations would be a one percent chance of exceedance in any given year; the probability of failure over 20 years would be 18 percent. Using the means of comparison described previously, the consequences of accepting the 18 percent risk under Alternative C is 1.2 times the assigned Alternative B ranking of 1.

WATER HOLLOW ALTERNATE ALIGNMENT - ALTERNATIVE D

Under Alternative D, the majority of the existing Quitchupah Creek Road would remain in place and the 16 existing primary watercourse crossings would continue to be used by local traffic. The existing unpaved and little-maintained road would not be reclaimed. However, it would receive increased maintenance and slightly improved drainage with the applicant committed measure to construct water bars, but it would continue to be an erosion/sedimentation source to Quitchupah Creek. In addition, construction of the Water Hollow alignment would require primary watercourse crossings in 20 locations, as shown in **Table 3.2-6**, or two more than in Alternative B. Appropriate permitting and consultations with the COE would be required at some of these. **Table 3.2-7** provides measurements made in the field at the majority of the crossings.

Table 3.2-6 Primary Stream Crossings -Alternative D - Water Hollow Alternate Alignment

Stream Regime	Alternative A Existing Quitchupah Creek Road (denotes primary crossings that are currently in place)	Alternative D Water Hollow Alternate Route (denotes number of primary crossing placed during construction of new road)	Existing Primary Crossings that would be removed or replaced during construction	Net number of Primary Crossings after construction of Alternative D and partial removal of existing road
Perennial	8	3	1	10
Intermittent	0	2	0	2
Ephemeral	8	15	1	20
Total	16	20	2	32

Table 3.2-7 Waters of the U.S. or State at Selected Crossings – Alternative D - Water Hollow Alternate Alignment

Station	OHWM Width (inches)	OHWM Depth (inches)	Volume per Foot below OHWM (cu. ft.)	Fill Length (feet)	Channel Description
11+00	30	6	1.25	60	Intermittent Section of Quitchupah Creek
18+00	30	6	1.25	180	Intermittent Section of Quitchupah Creek
66+00	40	11	3.06	170	East Spring Canyon (perennial)
94+00	40/23	2	0.44	200	ephemeral tributary
121+50	120	12	10.0	250	Quitchupah Creek
177+00	120	12	10.0	400	Water Hollow
229+50	36	5	1.25	200	Unnamed Ephemeral Wash
255+00	60	8	2.1	150	Unnamed Ephemeral Wash
338+00	12	4	0.3	270	Unnamed Ephemeral Wash
339+50	48	6	2.0	130	Unnamed Ephemeral Wash

Station	OHWM Width (inches)	OHWM Depth (inches)	Volume per Foot below OHWM (cu. ft.)	Fill Length (feet)	Channel Description
341+50	60	6	2.5	150	Unnamed Ephemeral Wash
366+50	72	10	5.0	270	Unnamed Ephemeral Wash
384+50	30	5	1.0	300	Unnamed Ephemeral Wash
412+50	10	4	0.3 cu. ft.	150	Unnamed Ephemeral Wash
419+00	48	6	2.0 cu. ft.	150	Unnamed Ephemeral Wash
432+00	96	6	4.0 cu. ft.	250	Unnamed Ephemeral Wash
463+00	48	10	3.3 cu. ft.	300	Unnamed Ephemeral Wash
471+00	48	10	3.3 cu. ft.	350	Unnamed Ephemeral Wash

Where wildlife crossings (either bridges or large culverts) would supplant 5 of these crossings, fill volume may differ from that listed above.

The calculated probability of failure associated with these culvert installations, is 18 percent that culvert capacity would be exceeded, or, conversely, 82 percent that it wouldn't be exceeded, the same as for Alternative B. Using the means of comparison described above for Alternative B, the consequences of accepting the 18 percent risk under Alternative D is 1.4 times the Alternative B ranking of 1 and 1.17 times the Alternative C ranking. For the five crossings where wildlife bridges would be used, probability of culvert failure would not apply.

Crossings on the Water Hollow alignment would in general have greater total amounts of fill, and the roadway itself would have steeper and longer cut and fill slopes, when compared to Alternative B, because the Water Hollow Alternative contains more highly dissected topography. Consequently, the effectiveness of many of the BMPs under this Alternative may be more difficult to ensure.

This route would avoid the majority of Quitchupah Creek, including its middle and lower reaches that are most susceptible to instability impacts. As shown in **Table 3.3-3**, construction of Alternative D would result in no change in length of roadway within 50 feet of perennial stream, and a net increase of 3,500 feet of roadway within 500 feet of perennial stream. These numbers include both the new road corridor and the portions of the old road which would remain. Because this alternative would result in larger cut and fill slopes, greater crossing risk, higher connectivity near Water Hollow crossing, and because the existing road would remain, it may result in greater impacts associated with erosion and sedimentation than under Alternatives B and C. However, risk to perennial waters due to truck spills and due to subsidence of soluble salt-laden soils would be less under this alternative than under Alternatives B and C.

Impacts due to the realignment of the upper stream reaches would be the same as for Alternative B, as would the implications of the High Quality Waters Category 1 areas.

This Alternative would not require any activities associated with the Quitchupah Creek bridge crossing at SR-10. The Water Hollow crossing would be designed to allow passage of fish through the culvert at this

location. Due to the design constraints associated with this fill and crossing, the road as it approaches Water Hollow would be below grade for over 2500 feet, consequently road runoff, sediments, deicing substances, and any spilled materials would drain directly to Water Hollow.

Wetland mitigation activities, impacts to water right holders, and ground water impacts would be the same for this alternative as previously described for Alternative B.

MITIGATION AND MONITORING FOR BUILD ALTERNATIVES

Required design criteria, applicant-committed environmental protection measures, and BMPs are identified in Chapter 2 and in **Appendix B**. The potential impacts discussions and conclusions assume that these measures are implemented and effective. All of these measures would be monitored and the treatment repeated or redesigned until satisfactory results occur, as described in the Monitoring Plan. Unintended or unforeseen impacts revealed by monitoring would be remedied to the satisfaction of the landowners.

A monitoring program for the stream realignment at East Spring Canyon would be implemented as described in the Monitoring Plan for Alternatives B and C. A monitoring program to track water quality changes due to the improved irrigation efficiencies is also described in the Monitoring Plan for Alternatives B and C.

To reduce the impacts of accidents and spills, a spill prevention program would be developed and all coal truck drivers would be instructed on what to do in the event of a spill. A spill prevention plan would include a checklist of necessary equipment to be carried on each truck hauling coal. Some examples of equipment to be carried include fire extinguisher, shovel, and absorbent material. In addition, all trucks would need to pass routine inspections and have proper maintenance performed on them regularly. Spills, leaks, and contaminated soils would be cleaned up as per a SUFCO Mine program, to prevent pollution to surface or ground waters. BMPs would be utilized and are described in **Appendix B** and/or in permits obtained in associated with the Proposed Action in **Table 1.5-1**.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES AND RESIDUAL ADVERSE IMPACTS

Provided that the BMPs, the applicant-committed environmental protection measures, and the aggressive monitoring/maintenance programs are effective, impacts due to construction would be short term for all alternatives. Over the long term, all alternatives would have the potential to contribute sediment and salts to Quitchupah Creek, as this would be inherent in any road project. However, the use of BMPS, applicant-committed environmental protection measures, and the aggressive monitoring/maintenance programs would reduce this potential as much as possible. Truck accidents could introduce coal and fuel into the streams, however this would be minimized by BMPs for spill kits, training, and rapid response. In some instances however, a spill could produce residual adverse impacts to water resources from Alternatives B, C or D. Alternative D's generally greater distance from perennial waters would reduce this possibility. Construction of any of these build alternatives would be expected to require a substantial commitment of maintenance time and expense for Sevier County, both during and after its use as a coal road, as outlined in the Monitoring Plan.

CUMULATIVE EFFECTS

For the purposes of water resources, the cumulative area is defined as the Quitchupah Creek watershed and tributaries downstream to the location where SR-10 crosses the stream. This represents the downstream location of the proposed project.

Several types of past, present, and ongoing land uses (i.e. livestock grazing/trailing, mining, recreation, etc.) occur within the Quitchupah Creek watershed in the vicinity of the Project Area. These uses and related activities may have contributed to upland watershed conditions and exacerbated erosion of already erosion-prone soils. Grazing is a likely cause of erosion; disturbances associated with the SUFCO mine may also be prone to erode. While the SUFCO mine's erosion is mitigated by BMPs and includes sedimentation reduction treatments such as silt fences, erosion from grazing remains untreated and may be more likely to contribute sediments to receiving streams. The proposed project would also have the potential to contribute sediments; under Alternatives B and C, however, much of the existing sediment contribution from the existing road would be eliminated. Under all build alternatives, the BMPs and applicant committed measures have been designed to reduce sediment loading to the extent possible. The applicant committed measure to install riparian fencing on public land adjacent to Quitchupah Creek could also provide reductions in erosion and sediment loading over time. Any increases in sediment from the proposed road would add to the remaining base load, but should be small assuming BMPs are effective and monitoring allows adaptations as needed.

Sediment sources are also sources of salinity. The TMDL study for this area notes high background, ambient salinity loading. The primary point source contributors of TDS in the area are a combined 3,600 tons/year from the SUFCO and CONSOL mine discharges. Using information obtained from the TMDL study, surface erosion and irrigation are responsible for 37 and 21 percent, respectively, of the nonpoint TDS loading in the Quitchupah Creek area. The riparian fencing would also reduce salt loading over time, though the TMDL study indicates that less than one percent of the nonpoint salt loading comes from streambank erosion. Any increases in salt load from the proposed road would add to the remaining base load, but should be small assuming BMPs are effective.

All of these land uses have also contributed (and will continue) to alterations in flow rates in Quitchupah: upland grazing due to vegetation and soils disturbance; irrigation due to withdrawals; and the mine due to discharge of groundwater. The proposed project would be negligible compared with these.