RATIONALE FOR SITE SPECIFIC CRITERIA AND USE ATTAINABILITY ANALYSIS (UAA)

1. Saleratus Creek Beneficial Use Assessment

The Saleratus Creek channel travels approximately 29 miles from its headwaters down to a slough near the Bear River. Any seasonal flow in Lower Saleratus Creek is diverted entirely into the Randolph-Woodruff Canal. The Saleratus Creek watershed covers 144 square miles in the southwest part of Rich County, Utah and is located almost entirely on private land. The headwaters of Saleratus Creek start in the foothills on the east side of the Bear River Range at an elevation of approximately 7,000 feet. The upper part of this watershed is characterized as rangeland dominated by sagebrush. Grazing by livestock and wildlife is the predominate use. The lower valleys are characterized as meadows, sub-irrigated meadows, and pastures interspersed with sagebrush hills and flats. Grazing and haying are predominate uses in the lower valleys and irrigation is common.

Saleratus Creek has been altered by water impoundments and diversions. The upper reach of Saleratus Creek is a variously incised channel in a confining valley. A number of water impoundments have been built on the upper part of the stream, storing water for livestock and irrigation. Saleratus Creek is diverted for irrigation at the top of Saleratus Meadow, approximately 6 miles above the county road to Deseret Ranch and 2 miles above the Chapman Canal. Below the Chapman Canal, water in the Saleratus Creek consists of irrigation return flows.

Problem Definition

The purpose of a Use Attainability Analysis (UAA) is to determine whether existing conditions are in agreement with the assigned beneficial use designation for a given water body as defined by water quality standards. According to EPA guidelines for completing a UAA, existing uses are defined as "…those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards"(40CFR131.3(e)). The beneficial use designations assigned to the Bear River and tributaries in Rich County (including Saleratus Creek) are Class 2B, Class 3A and Class 4. A review of recent water quality monitoring data collected from Saleratus Creek has indicated impairment of the assigned beneficial use due to low Dissolved Oxygen (DO) concentrations. Field surveys of the Saleratus Creek watershed have indicated that hydrologic modifications to the upper reaches of Saleratus Creek have resulted in long-term conditions that preclude attainment of the assigned beneficial use. This document proposes to reclassify the beneficial use designation to match the reality of the actual conditions and uses of Saleratus Creek.

Under the current 3A designation, Saleratus Creek does not meet DO criteria. Water quality testing at the State Highway 16 (U16) crossing indicate that approximately 63 percent of DO measurements from Saleratus Creek violated the criteria for early life stages (8.0 mg/l), 16 percent exceeded the criteria for adult life stages (4.0 mg/l) and 32 percent exceeded the 30-day average criteria (6.5 mg/l). Given that this stream occurs on private land and the water right has been appropriated for irrigation use, management actions that could increase DO concentrations to meet the criteria would be difficult to implement. Further, the water impoundments and

diversions dewater large segments of Saleratus Creek below these structures and render the stream unusable as cold water fish habitat.

Methodology

The regulatory approach used to complete this UAA is displayed graphically in Figure 1. Prior to completing this exercise, the existing physical, biological, and chemical factors, and management practices that influence water quality in Saleratus Creek were reviewed. Some of the information used in the assessment included field reconnaissance surveys, 2004 NAIP aerial photography, USGS 1:24,000 topographic maps, and interviews with individuals familiar with the stream and its management. Water quality sampling results collected from Station 4908630 at the County Road crossing to Deseret Ranch and at a second station almost 5 miles lower in the watershed at Station 4908600 at the U16 highway crossing were also used.

Four questions were generally used to guide this analysis including the following:

1. Are existing uses in agreement with the designated uses defined by water quality standards?
2. Are existing uses more stringent than designated uses or vice versa?
3. Is the designated use unattainable due to one of 6 criteria identified in 40CFR131.10 (g)(1-6)?
4. Will downstream uses or other existing uses be protected?

Physical Factors

Saleratus Creek begins at the foothills of the east side of the Bear River Range at an elevation of approximately 7,000 feet (Figure 2). The upper stream channel is confined in a narrow valley. Lake Hollow is a major tributary to Saleratus Creek high in the watershed.

Natural flows through the upper reach of the Saleratus Creek watershed have been altered by the construction of small, on stream reservoirs. Both Saleratus Creek and Lake Hollow have reservoirs, including Saleratus Reservoir Nos. 1, 2, and 3 and Lake Hollow Reservoir Nos. 1 and 2. Division of Water Rights data indicates that the reservoirs on Saleratus Creek were completed in 1906 and 1907, while the reservoirs in Lake Hollow were completed in 1873. The reservoirs were built to provide water storage for irrigation, and the reservoirs continue to provide a small amount of water storage. However, currently the reservoirs on Saleratus Creek are also managed to support a rainbow trout fishery and are not typically drawn completely down (Danvir 2006).

Lower in the watershed, the landform changes as Saleratus Creek enters Saleratus Meadow, from a confining valley to an increasingly wide meadow. As the creek enters the meadow, a diversion diverts water to the west into the High Ditch (Figure 2). Water that flows past the diversion continues down the natural channel for a short distance. The Meadow Ditch intercepts the natural stream channel and all flow is diverted into the ditch and flows along the east side of Saleratus Meadow. This water is used to irrigate the meadow and the water is spread on to the meadow. Sections of the original channel remain in the lower end of the meadow and collect irrigation return flows. Chapman Canal crosses the bottom of Saleratus Meadow from east to west approximately 2.2 miles below the West Ditch diversion and intercepts all return flows in

the original Saleratus stream channel. No Saleratus Creek water is able to flow past the Chapman Canal.

Records or knowledge indicating when the Saleratus Meadow diversions and ditches were constructed were not specifically available. However, they were likely constructed in the same era as the Saleratus Reservoir in 1906 – 1907. Division of Water Rights data does indicate that Neoponset Reservoir, which is filled/emptied with Bear River water via the Chapman Canal, was built in 1924. The canal likely has a similar date of construction.

Below the Chapman Canal, the historic Saleratus Creek drains irrigated and naturally wet and sub-irrigated meadows. Upon reaching the sampling station at the County Road to Deseret Ranch, the historic Saleratus Creek channel maintains a seasonal flow pattern which is comprised primarily of irrigation return flows and a minimal amount of shallow groundwater discharge from the wet meadows located upstream. Thus the water quality measurements reported at this station primarily represent irrigation return flow rather than ambient water quality conditions in Saleratus Creek. The North Fork of Woodruff Creek joins the Saleratus Creek channel just above the U16 highway crossing. After crossing the highway, all flow in the channel is diverted into the Randolph-Woodruff Canal before reaching the Bear River. A wastegate in the canal is located roughly one-quarter mile below the confluence of Saleratus Creek. During high-water years, water can be discharged from this wastegate into the Bear River.

Biological Factors

There are a number of barriers to fish migration on Saleratus Creek. The reservoirs on upper Saleratus Creek present a barrier to fish migration, particularly up-stream migration. In addition, the irrigation diversions and dewatering of Saleratus Creek in Saleratus Meadow represent fish barriers. A little further downstream, the Chapman Canal also interrupts any upstream or downstream fish migration.

As part of the Upper Bear River TMDL, all aquatic population survey data in Rich County was requested from UDWR. This information is included in Chapter 3 of the TMDL assessment. No population survey information was identified for Saleratus Creek. Steve Kearl, a retired UDWR biologist and Rich County resident, has completed an extensive review of Utah pioneer journals in an effort to identify historic wildlife patterns in Utah and adjacent states (Kearl 2006). Based on the review of historic sources, Kearl identified no indication of fish populations in Saleratus Creek.

As noted above in Section 2.1, the reservoirs on Saleratus Creek are managed as a recreational fishery. While the primary fishery is confined to the reservoirs, some fish have likely escaped into the stream (Danvir 2006). In addition, native dace are present in the stream. To maintain the recreational fishery, DLL stocks the ponds with rainbow trout, typically on an annual basis and 10-inch fish can grow to 24 inches by the fall. Winter fish kills have been a problem when the ponds freeze over and DO drops. Winter-time management to alleviate this problem includes releases of 1 to 2 feet of water in order to stir the ponds and increase the DO.

Chemical Factors

Water quality samples have been taken at two stations on Saleratus Creek including Station 4908630 at the County Road crossing to Deseret Ranch and at a second station almost 5 miles lower in the watershed at Station 4908600 at the U16 highway crossing. The Saleratus Creek station was sampled over a 1-year period from the summer of 2003 to the summer of 2004 for a total of nine samples. Of these samples, 55.6 percent exceeded the acute standard, while 22.2 percent of the samples exceeded the chronic standard for DO.

The sampling station at the Highway 16 road crossing was sampled 12 times between 1998 and 1999 and seven times during 2004 for a total of 19 samples. Of these pooled samples, 63.2 percent exceeded the acute threshold, while 31.6 percent of the samples exceeded the chronic threshold for DO.

Existing Uses

In general, there are four uses of the water from Saleratus Creek. As noted above, water in the upper watershed is impounded in a series of three reservoirs that are used to supplement seasonal flows in Saleratus Creek. Irrigation diversions remove all flow from Saleratus Creek as it leaves the foothills. These diversions have been functioning since before 1975 and have remained functional from the time of their construction until the present time. The second appropriated use is as a source for livestock water. In addition, the Saleratus Creek and associated habitats are used by wildlife, migratory birds, and waterfowl. The fourth use of water is for recreational purposes in the upper watershed. As noted above, Saleratus Creek is not known to have supported a historical fishery (Kearl 2006). Some recreational use of the reservoirs located in the upper watershed is known to occur in the summer and fall seasons.

Saleratus Creek comprises a part of the Bird Conservation Habitat Area (BCHA) 7, South Rich, as designated by the Utah Steering committee of the Intermountain West Joint Venture (IWJV), a consortium of private groups and government agencies working to preserve birds and their habitat (Utah Steering Committee 2005). The South Rich BCHA has been identified as important habitat for waterfowl and shorebirds. The wet meadows along the lower reaches of Saleratus Creek are an example of the habitat for which this BCHA was identified. In conjunction with the IWJV, the National Audobon Society has listed Deseret Land and Livestock Ranch as one of 15 Important Bird Areas (IBA) in the State of Utah because of the valuable and diverse habitats on the Ranch (National Audobon Society 2004). The eastern half of the ranch, which included the Saleratus watershed, includes sagebrush-steppe, grassland, riparian, wetland, lakes, ponds, rock and juniper habitats. It consists of flat to rolling topography. As indicated by these designations, Saleratus Creek and the associated environment represent important habitat for many species.

Potential Uses

Potential uses are not significantly different than the existing uses. Irrigation, livestock watering, wildlife habitat and some recreational activities are likely to continue to be the dominant uses of Saleratus Creek in the foreseeable future.

Summary

Based on the data analyzed in this study, Saleratus Creek is impaired due to low DO concentrations. Irrigation diversions are likely a significant cause of the low DO concentrations. Due to the diversions, the water reaching the water quality monitoring stations used in this analysis consist of a combination of irrigation return flow and groundwater discharge in the wetland meadows along the lower historic stream course. Reconnaissance level surveys of Upper Saleratus Creek and a review of existing information indicate that DO conditions above the reservoirs are likely capable of supporting aquatic speices.

The beneficial use designations assigned to the Bear River and tributaries (including Saleratus Creek) in Rich County is Class 2B, Class 3A and Class 4. The existing uses of the lower segments of Saleratus Creek include wildlife (waterfowl and migratory birds) and agriculture. No DO criteria are associated with agriculture beneficial use in Utah. A review of available fish population survey information, discussion with local residents and field reconnaissance information indicate that lower Saleratus Creek does not support viable aquatic habitat. Based on this information, it is anticipated that the highest quality use in existence any time since 1975 for Saleratus Creek below the irrigation diversions has been from waterfowl and migratory birds.

Water quality criteria used by DWQ to protect Class 3A aquatic species are more stringent than those used to protect wildlife (including migratory birds and waterfowl species) and agricultural uses, which characterize the existing use of Saleratus Creek below the irrigation diversions.

Based on the review of available data, the existing designated use (Class 3A) for Lower Saleratus Creek is unattainable due to hydrologic modification. Irrigation diversions preclude the attainment of Class 3A DO criteria in Saleratus Creek below these structures. The long-term influence of removing water from stream segments has generally resulted in a loss of stream channel and riparian habitat needed to support a viable cold water fishery. All water diverted from Saleratus Creek is controlled and managed under privately held water rights.

TABLE 1. GUIDELINES USED TO SUPPORT THE USE ATTAINABILITY ANALYSIS FOR SALERATUS CREEK.

Question	Response
1. Are existing uses in agreement with the designated defined by water quality standards.	No. Existing uses of Saleratus Creek below irrigation diversions consist of irrigation, livestock watering, habitat for waterfowl and migratory birds.
2a. Are existing uses more stringent than designated uses?	No. The designated use for Saleratus Creek includes Class 3A – cold water fishery.
2b. Are designated uses more stringent than the existing uses?	Yes.
3. Is the existing use unattainable due to one of 6 criteria identified in 40CFR131.10 (g)(1-6)	Yes. Criterion 4 (hydrologic modification) and Criterion 5 (lack of proper habitat) preclude attainment of the designated use for Saleratus Creek below irrigation diversions.
4. Will downstream uses or other existing uses be protected?	Yes. The TMDL for the Upper Bear River in Rich County includes load allocations for the Saleratus

	Creek Watershed that will protect all existing and attainable uses in the Bear River down-gradient of Saleratus Creek.

Conclusions

Given that the existing irrigation uses are authorized under water rights law and Saleratus Creek is contained almost entirely on private land, changing management in order to meet the DO criteria associated with the Class 3A beneficial use is unlikely. Therefore, it is recommended that the beneficial use for the lower portion of Saleratus Creek from the upper irrigation diversion down to the confluence with the Bear River be changed from Class 3A to Class 3D. The DO criteria associated with each of these standards is included in Table 2. The beneficial use associated with Class 3D includes waterfowl, shorebirds and other water-oriented wildlife as well as aquatic organisms that are part of the food chain for these species.

Table 2. Dissolved Oxygen criteria associated with Class 3A and Class 3D beneficial use.

Beneficial use class	1-day average Minimum DO (mg/l)		30-day average Minimum DO (mg/l)
Class 3A cold-water aquatic species	4.0 (early life stage)	8.0 (adult life stage)	6.5
Class 3D waterfowl	3.0		5.0

Class 3D beneficial use would not jeopardize existing or future uses of Saleratus Creek or be likely to result in detrimental changes in management practice of the stream or surrounding land. In addition, it is anticipated that changing the criteria from Class 3A to Class 3D will not hinder the maintenance of all existing and attainable beneficial uses downstream of Saleratus Creek. As mentioned previously, Saleratus Creek is diverted after crossing U16 into the Randolph-Woodruff Canal. During high years, some water is released from this canal into the Bear River. As a result, a certain amount of pollutant loading from the Saleratus Creek watershed enters the Bear River in the spring season of wet years. However, BMPS have been recommended for Saleratus Creek as part of the Upper Bear TMDL. These BMPs will continue to reduce pollutant loading that leads to low concentrations of DO.

References

Danvir, R. 2006. Wildlife Manager, Deseret Land and Livestock. Personal communication with J. Stewart, Biologist, Cirrus Ecological Solutions, re. Saleratus creek management. Logan, Utah, January 24.

Kearl, S. 2006. Wildlife Biologist, Utah Division of Wildlife Resources (retired). Personal communication with E. Duffin, Watershed Scientist, Cirrus Ecological Solutions re. historic aquatic species in Rich County. Logan Utah. January 12.

National Audobon Society. 2004. IBA Sites Nominated and Selected-Important Bird Areas Program in Utah. http//www.audubon.org/bird/iba/utah/sites.html. Website accessed on January 17, 2006.

Utah Steering Committee. 2005, Coordinated Implementation Plans for Bird Conservation in Utah. Intermountain West Joint Venture. http://www.iwjv.org/Images/UTPlan2005.pdf. Website accessed on January 17, 2006.

2. Escalante River Beneficial Use Assessment

The Escalante River is currently designated as a cold-water fishery from Boulder Creek to its headwaters. Following extensive field studies and a review of historic data it was concluded that due to natural climatic factors it will never meet the temperature standard of 20°C. Although there is some incidental use by brown trout near Calf Creek, the warm-water fishery designation (3B) is more appropriate in light of its natural characteristics. In addition, we recommended that the downstream reach from Boulder Creek to Lake Powell be upgraded from Category 3C to 3B to more accurately reflect that section's proper beneficial use. This will provide a consistent, appropriate classification for the entire river that is uniform in other related factors.

Fisheries Information

Non-native and native trout (salmonid species) occur in the Escalante River drainage. Information on the current and historical distribution of these cold water species is useful in evaluating the degree to which the cold water beneficial use (Class 3A) is an appropriate use designation for the Escalante River drainage. A useful summary of salmonid fish distribution is provided in the publication by D. Hepworth, M. Ottenbacher, and C. Chamberlain (2001), biologists with the Utah Division of Wildlife Resources. The following information is summarized from their publication.

Little information on the historic distribution of native Colorado River cutthroat trout (Oncorhynchus clarki pleuriticus) in the Escalante River drainage was available prior to the 1990's. The discovery of Colorado River cutthroat trout in East Boulder Creek, a tributary to the Escalante River, in 1990 led to the speculation that the historic distribution of these native salmonids could have extended as far south as the Escalante River drainage. In 1997 and 1998 the Utah Division of Wildlife Resources biologists conducted field surveys throughout the drainage in search of Colorado River cutthroat trout populations. At the same time, they collected information on the distribution of other native and non-native fish species.
The 1997/1998 surveys discovered five remnant populations of Colorado River cutthroat trout in the 17 headwater streams evaluated. The survey also established the distribution of non-native trout species - brook trout, rainbow trout, brown trout, and non-native cutthroat trout in the upper Escalante River drainage. The Colorado River cutthroat trout occur only at higher elevations in the drainage: - the East Fork and West Forks of Boulder Creek, West Branch Pine Creek, White Creek, and Water Canyon (Figure 0-1). Non-native salmonids, such as rainbow trout, generally also occur at the higher elevations, as well as in the lower reaches of spring-fed tributaries to the Escalante River, specifically Death Hollow, Sand Creek, Calf Creek, and Boulder Creek.
Trout have been stocked in various locations in the watershed beginning in the 1960's. Utah Division of Wildlife Resources surveys in the 1960's and 1970's found Calf Creek, lower Boulder Creek, and lower Deer Creek void of trout. The biologists noted that these streams (and Death Hollow) are in narrow sandstone canyons, which experience frequent flash floods and

high summer water temperatures. Brown trout have survived in these streams since the 1980's, but such locations are unlikely historic year-round habitat for native salmonids.
The Utah Division of Wildlife Resource biologists describe the main Escalante River as providing seasonal fish passage, but not as year-round habitat. Note that the Escalante River is mapped as "Non-trout habitat or intermittent" in Figure 0-1. Brown trout were stocked in Calf Creek in 1967. "From Calf Creek brown trout evidently invaded lower portions of Death Hollow, Sand, Boulder, and Deer Creek using the Escalante River for access. During extended periods of low flow and clear water, we found brown trout relatively common in the upper reaches of the river, although it does not provide year-round trout habitat" (Hepworth, et al., 2001).

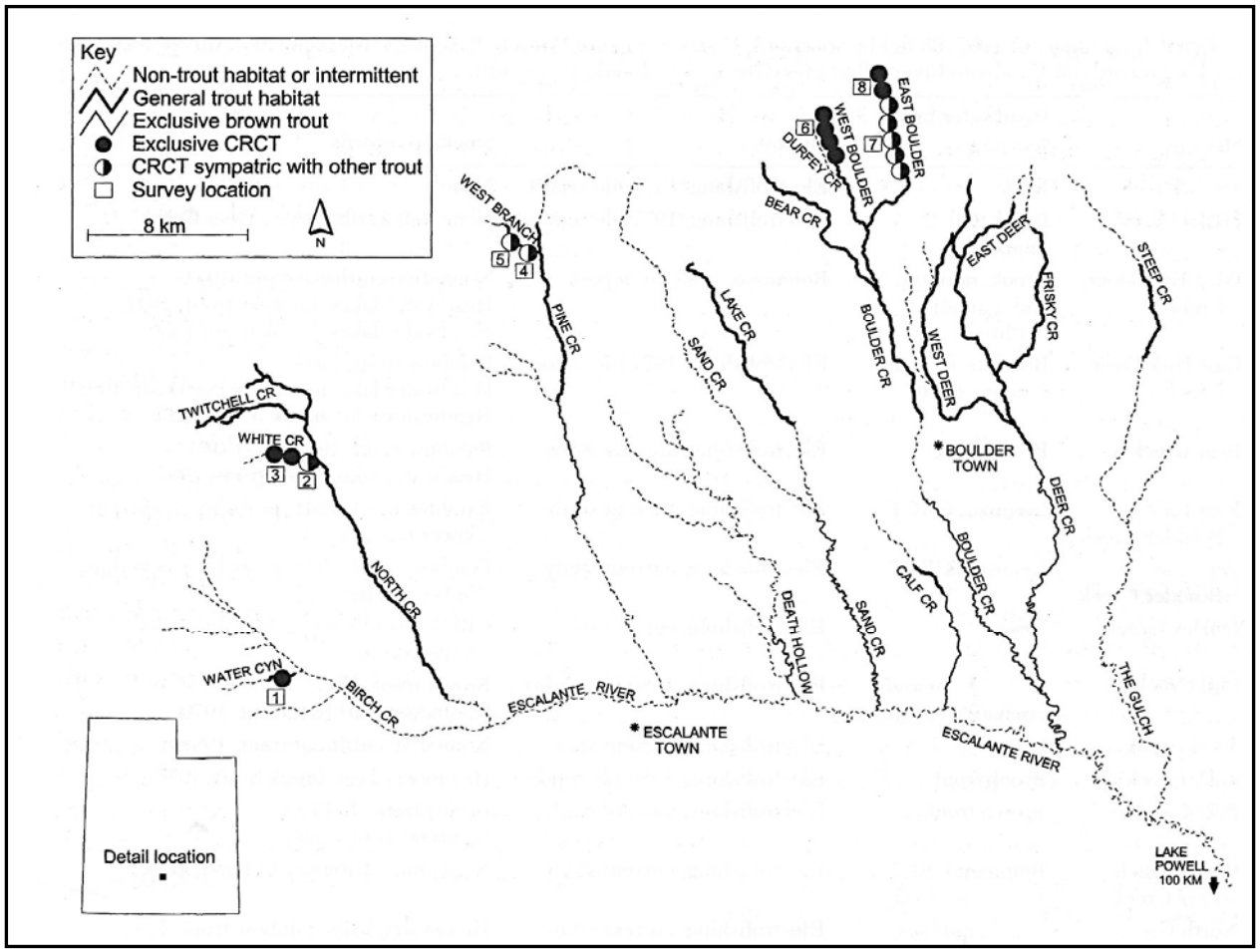

Figure 0-1 Trout Habitat and Distribution of Colorado River Cutthroat Trout in the Upper Escalante River Drainage (from Hepworth, et al., 2001)

Use Attainability Analysis

Options for addressing use attainability analysis and the TMDL components were described in the Data Evaluation Report (MSE 2003). Subsequent field experience, data analysis, and

discussion with the DWQ Project Manager led to the following approach based on the conditions observed in the Escalante River. Elements of the approach are outlined below.

Reach Differentiation

There are different sub-reaches within the study area with respect to stream temperature regimes, flows, pollutant sources, natural versus human causes of temperature increase, and land management practices. Therefore, different approaches for addressing use attainability analysis and management practices are appropriate for each group of similar reaches. For these reasons, the Escalante River is differentiated according to the following reaches:

Escalante River, Boulder Creek to Pine Creek; and
Escalante River, Pine Creek to North Creek/Birch Creek

Use-Attainability

The distribution of native and introduced species of trout in the Escalante River drainage has been well documented by Utah Division of Wildlife Resources (Hepworth and others 2001). The native Colorado River cutthroat trout occurred at higher elevations in North Creek, Pine Creek, and Boulder Creek watersheds. Introduced salmonid species, brown trout and rainbow trout, occur in the major spring-fed tributaries to the Escalante River or in the upper watersheds of these tributaries where higher elevation and vegetative conditions support cooler water temperature regimes. The temperature regime under relatively natural conditions along the Escalante River and tributaries at the lower elevations do not support sufficiently cold water temperatures to meet the statewide water quality criteria throughout the year.

The spring-fed tributaries on the north side of the Escalante River between Pine Creek and Boulder Creek have sufficiently cool temperature regimes and currently support salmonid fish species, even though water temperatures recorded in 2003 in these tributaries were typically above 20 degrees Celsius (see temperature profiles for Pine Creek, Sand Creek, and Calf Creek in Appendix 4). The Escalante River from Boulder Creek to its headwaters serves as a potential migratory corridor for brown trout in the fall, winter and spring, but does not provide habitat during the summer.

As described in Section **Error! Reference source not found.**, water temperature at all locations sampled in 2003 exceed the State temperature criteria of 20 degrees Celsius for Class 3A waters the majority of the time during the critical summer period.

Calf Creek provides a good indicator of existing conditions that support cold-water species. Calf Creek is located in the Grand Staircase Escalante National Monument and is managed as primitive recreational area with minimal human disturbance. An established population of brown trout occurs in Calf Creek that provides a popular sport fishery. In addition, the cold-water fish survive in this tributary because of the influence of cold spring water that provides suitable habitat during critical periods of elevated warm water temperatures. In Calf Creek water temperature exceeded the existing State criteria (20 degrees Celsius) 70 percent of the time during the summer in 2003.

Given the existing situation where introduced cold-water species, brown and rainbow trout, occur at naturally high temperatures (above 20 degrees Celsius) in a desert environment it is appropriate to propose a change in beneficial use from 3A (Cold-water fishery) to 3B (Warm-water fishery) that will more accurately reflect the natural temperature regime for this segment of the Escalante River. We also propose to raise the beneficial use classification of the downstream section of the Escalante River (from Boulder Creek to Lake Powell) from 3C to 3B to more accurately reflect that section's proper beneficial use. This will provide a consistent, appropriate classification for this reach that is uniform in other related factors.

Loading Assessment

A loading assessment typically includes quantitative calculation of current loading, loading capacity, margin of safety, wasteload allocation (point sources), load allocation (nonpoint sources) and load reduction. The following observations can be made regarding the applicability of the load assessment process to the unique conditions of the Escalante River.

Escalante River, Boulder Creek to Pine Creek

This segment of the Escalante River is managed by public agencies. Land ownership affects the potential management practices that can be applied to affect temperature regimes. The USFS manages the upper elevations of the watershed primarily as recreational lands or as a wilderness area (the Box-Death Hollow Wilderness). The lower elevations of the watershed are managed by the BLM as the Grand Staircase-Escalante National Monument. The national monument is managed primarily to protect and restore natural processes along the river corridor. The area within the national monument is managed as a primitive area accessible only on foot or horseback. Grazing allotments were retired along the river by a BLM administrative decision in 1999[1]. There are no known anthropogenic heat sources that can logically be quantified for loading assessment or controlled by management practices. There are few management opportunities that have not already been pursued to improve temperature regimes within the national monument boundaries. Continued control of exotic plants including tamarisk and Russian olive, and restoration of cottonwood trees is recommended. Further management options are constrained by access and operating regulations of the national monument. Therefore, this Water Quality Management Plan suggests no additional BMPs for this reach. ***Recommendation:*** *Since the river corridor from Boulder Creek to Death Hollow is managed under natural conditions a loading assessment will not be completed.*

Escalante River, Pine Creek to North Creek/Birch Creek

This segment of the upper Escalante River has elevated water temperatures and does not have sufficient flows to fully support a year-round cold water fish habitat as required for the Class 3A use designation, due to both natural and anthropogenic factors. The existing and foreseeable situation with respect to flow conditions and biological communities can be summarized as follows:

[1] The Record of Decision retired grazing allotments along the mainstem Escalante River, Sand Creek, and Death Hollow. Grazing occurs in benches above Calf Creek, but well outside of the riparian and canyon zone Bureau of Land Management (BLM). 1999. Confirmed with BLM Escalante staff, R. Oiler, February 2005.

- The existing channel experiences very low flows during the summer months as discussed in Section 3.3. The 80th percentile flow (a low flow statistic) for the period of record (49 year record, intermittent data from 1911-2003) ranges from 1.2 cfs in June to 2.3 cfs in September. During normal periodic droughts, the flows are even lower as indicated by 2003 when 80th percentile flows ranged from 0.5 cfs in June to 1.3 cfs in September.
- Flows are low in this reach due to both natural and anthropogenic factors. Average annual precipitation is 10 inches per year as measured at the town of Escalante, Utah weather station, although precipitation in the upper part of the watershed would be expected to be higher. Runoff from the watershed is distributed unevenly throughout the year, associated with snowmelt runoff and late summer and fall thunderstorms. Settlement and stream flow diversions for agricultural irrigation began in the 1870's with the majority of senior water rights filed by the turn of the century and prior to the first long-term flow records. Due to the early history of water use in the upper Escalante River watershed, there is no information to indicate what the pre-settlement conditions of this stream channel would be like with respect to summer base flow, riparian condition, or native fish distribution.
- The Escalante River basin provides naturally fragmented habitat for native Colorado River cutthroat trout. Warm temperatures and high sediment loads restrict native cutthroat use of the main river for much of the year, but allow limited connectivity between tributaries. The existing salmonid fish distribution and habitat conditions suggests that the Escalante River may provide seasonal fish passage to tributaries, but does not support year-round cold water fish use.
- Opportunities to improve flows in this reach are essentially non-existent due to existing water rights appropriated for irrigation, a legacy use dating to the early 1900's. Opportunities to improve the temperature regime are extremely limited, since any improvement in riparian condition is intimately associated with instream flows.
- A heat load assessment is not appropriate in such a severely flow limited reach. An actual heat load assessment would not change the potential projects that are commonly used to reduce heat loading (See Section **Error! Reference source not found.**).

Site Specific Criteria

The following document provides the technical rationale in support of site specific criteria determinations for Total Dissolved Solids (TDS) on the Paria River, Antelope Creek and Indian Canyon Creek within the State of Utah. These recommendations are the result of extensive analyses and source assessments to determine total maximum daily loads for TDS. These studies found the predominant sources of loading originating from uncontrollable natural sources, saline geologic formations that are prevalent throughout these watersheds. Potential anthropogenic sources were found to be controlled to the maximum extent feasible, primarily through the use of efficient irrigation techniques, there are no permitted point source dischargers within these watersheds. The following text has been excerpted from the original documents, *Paria River Water Quality Management Plan*, and *TMDLs for Total Dissolved Solids in the Duchesne River Watershed*.

3. Paria River

In evaluating the water quality data and land use patterns it is apparent that the predominant source of TDS loading into the Paria River is from naturally occurring saline geologic formations prevalent throughout the watershed, particularly Tropic shale. Therefore we are proposing the development of site specific criteria that reflects the natural background concentrations of TDS in the Paria River.

Development of site-specific criteria is recommended for the Listed Sections of the Paria River since the information available indicates that the observed spike in TDS at the lower end of the Paria River Reach-1 is due to inputs from a shallow alluvial aquifer. Paria River Reach-3 is located in a sparsely populated and relatively undeveloped landscape with no known anthropogenic sources of TDS.

Guidance for developing site-specific criteria is summarized in two memorandums issued by EPA. A Region 8 Memorandum (Moon 1997) addressed procedures for *Use Attainability Analysis and Ambient Based Criteria*, and a memorandum from EPA Office of Science and Technology (Davies 1997) addressed the subject: *Establishing Site-Specific Aquatic Life Criteria Equal to Natural Background*. These two memoranda were consulted for guidance and direction in developing site-specific criteria for the Paria River. The applicable points from these memoranda for developing site-specific criteria are:

1. Site-specific criteria are allowed by regulation subject to EPA review and approval;
2. Site-specific numeric aquatic life criteria may be set equal to natural background where natural background is defined as: background concentrations due only to non-anthropogenic sources; and
3. Previous guidance provided the direction to use the 85th percentile of the available representative data for natural ambient water quality conditions.

The Utah Standards of Quality for Waters of the State provide for adjustment of site-specific standards to background where the adjustment does not impair designated beneficial uses.

> *"Total dissolved solids (TDS) limits may be adjusted if such adjustment does not impair the designated beneficial use of the receiving water. The total dissolved solids (TDS) standards shall be at background where it can be shown that natural or un-alterable conditions prevent its attainment. In such cases rulemaking will be undertaken to modify the standard accordingly."*[2]

Paria River Reach-1

Two stations within Paria River Reach-1 were evaluated for setting site-specific criteria. The Paria River at Highway U12 Crossing station (495187) measures TDS in the Paria River

[2] Footnote to Table 2.1.4.1, Numeric Criteria for Domestic, Recreation, and Agricultural Uses, R317-2, Standards of Quality for Waters of the State, UAC R-317-1, March 01, 2004, Utah Department of Administrative Rules.

upstream of Cannonville. The second station, Paria River at Kodachrome Basin Road crossing (495186) is located at the lower end of the reach and below Henrieville Wash.
The data distribution for these two stations is illustrated using box and whisker plots (Figure-1). Box and whisker plots are commonly used for comparing distributions because the center, spread, and overall range of data are graphically apparent. In a box and whisker plot the ends of the box are the upper and lower quartiles, so the box spans the interquartile range, the median is marked by a solid light line inside the box, the mean is marked as a solid heavy line, and the whiskers are the two lines outside the box that extend to the highest and lowest observations. The TDS data used to construct the box and whisker plots for each station were collected between August 2000 and December 2002. The box plot for the upper station (Paria River at Highway U12 Crossing - 495187) shows that the majority of data are below the statewide criteria of 1,200 mg/L; however, at the downstream station (Paria River at Kodachrome Basin Road crossing - 495186) the TDS concentration increases, with 50% of the TDS samples exceeding the 1,200 mg/L criteria.

There are irrigation water withdrawals within the Paria River Reach-1; however, there is not sufficient agricultural use to explain the spike of TDS at the lower end of the reach. There is qualitative information on the high TDS associated with saline aquifers in the area, which appears to be the most logical explanation for the increase in TDS concentrations observed.

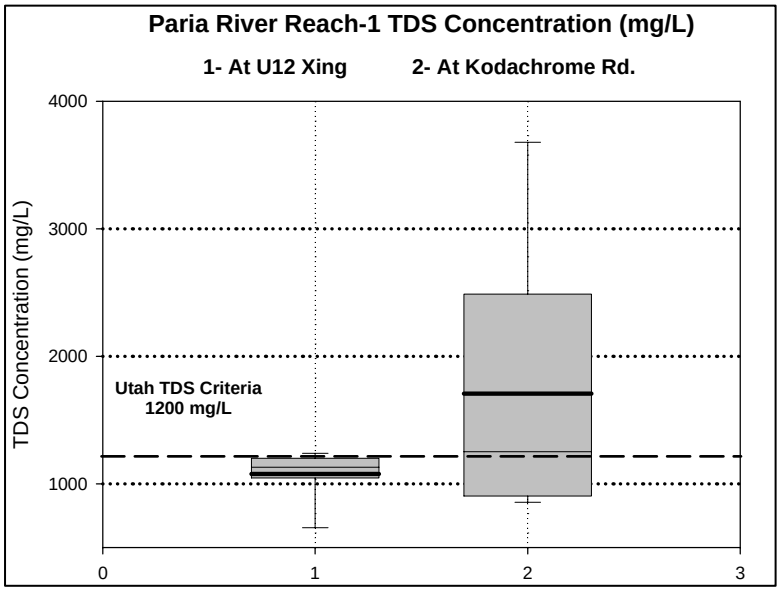

Figure-1 Concentration of TDS at Two Stations on Paria River Reach-1 Compared to the Utah Standard for Irrigation of 1,200 mg/L

Statistics for Paria River at Kodachrome Basin crossing (495186), the station with the highest TDS concentration, are summarized in Table 4-1. We recommend the site-specific criteria be 2,500 mg/L. This will ensure that the site-specific standard is set at an appropriate level that reflects the natural background concentrations of TDS.

Table-1
Statistics and Site-Specific Criteria for Paria River Reach-1
Based on Station 495186 - Paria River at Kodachrome Basin Road Crossing

Statistic	TDS Concentration (mg/L)
Count	15
Mean	1,492
Median	1,094
Min	822
Max	3,444
85th Percentile	2,461
State Criteria - Irrigation	1,200
State Criteria - Stockwater	2,000
Recommended Site-Specific Criteria	**2,500**

Notes: Data period, October, 2000 to December 2002.

Paria River Reach-3

Two stations within Paria River Reach-3 were evaluated for setting site-specific criteria. Paria River at Old Town Site station (599455), measures TDS in the Paria River just above the Listed Section, at river mile 21.5. Cottonwood Creek flows into the river approximately two miles below this site. Cottonwood Creek has a low TDS concentration with a mean of 657 mg/L, less than in the Paria River at that point. The second river station, Paria River at US89 Crossing (495185), located at river mile 9.5 has the highest TDS concentration in the reach. As indicated earlier, the TDS concentration decreases at the State line as measured by the Arizona state monitoring stations (101078 and 101077). (Note: River Miles were measured from the Utah-Arizona state line to provide a point of reference.)

The data distribution for these two stations are also illustrated in box and whisker plots (Figure-2). The data used to construct these box plots included the entire data record at the stations including the TDS values generated from correlation with specific conductance. The majority of data at the upper station, Old Town Site, is below the statewide criteria of 1,200 mg/L. Downstream 12 river miles the TDS concentration increases and 37% of the TDS samples exceeded the 1,200 mg/L criteria.

There are no current (or legacy) human activities in this primitive and mostly road-less reach that would explain this increase in TDS. There is evidence of some illicit off road vehicle use through the river channel in this area but we feel through continued public education and enforcement it can be addressed before it becomes a significant problem in terms of TDS loading The source of TDS is considered a natural condition related to input to surface water from a higher salinity aquifer.

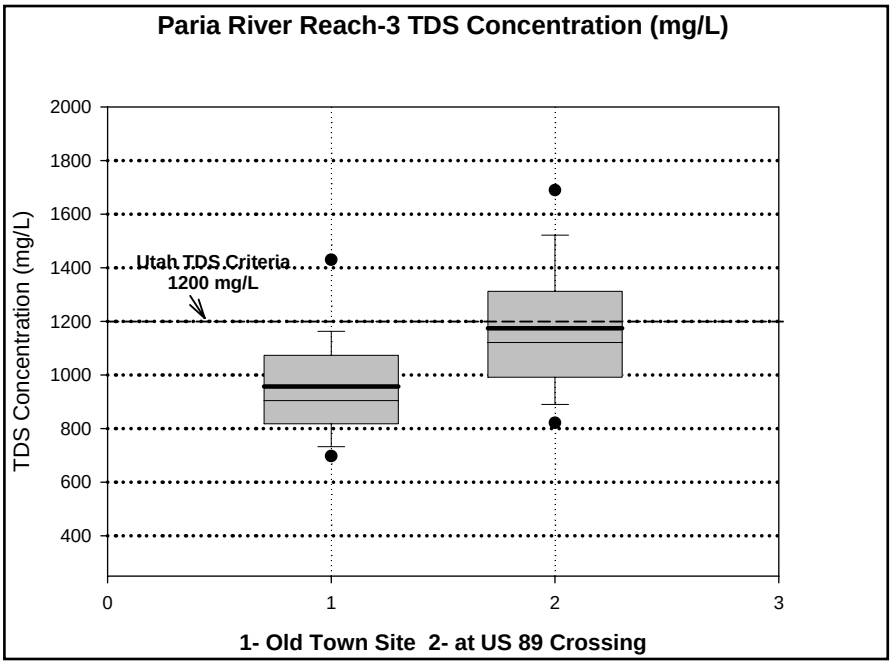

Figure-2 Concentration of TDS at Two Stations on Paria River Reach-3 Compared to the Utah Standard for Irrigation of 1,200 mg/L

We recommend the site-specific criteria be 1,500 mg/L. This will ensure that the site-specific standard is set at an appropriate level that reflects the natural background concentrations of TDS.

Table-2
Statistics and Site-Specific Criteria for Paria River Reach-3
Based on Station 495185 - Paria River at US89 Crossing

Statistic	TDS Concentration (mg/L)
Count	132
Mean	1,174
Median	1,121
Min	325
Max	2,564
85th Percentile	1,467
State Criteria	
Irrigation	1,200
Stockwater	2,000
Recommended Site-Specific Criteria	**1,500**

Notes: Data period, February 1976 to July 2002.

4. Duchesne River and Tributaires (Antelope Creek and Indian Canyon Creek)

Rationale for site specific criteria

Development of site-specific criteria is recommended for the 303(d)-listed segments of Indian Canyon Creek and Antelope Creek.

The Utah Standards of Quality for Waters of the State provide for development of site-specific TDS standards where the adjustment does not impair designated beneficial uses.

> *"Total dissolved solids (TDS) limits may be adjusted if such adjustment does not impair the designated beneficial use of the receiving water. The TDS standards shall be at background where it can be shown that natural or un-alterable conditions prevent its attainment. In such cases rulemaking will be undertaken to modify the standard accordingly."*

In addition, the EPA Region 8 memorandum *Use Attainability Analysis and Ambient Based Criteria* (Moon, 1997) provides guidance for developing site-specific criteria. The memorandum recognizes that ambient-based criteria are usually proposed for sites where the existing water quality (exceeding statewide water quality criteria) is perceived to be "natural" or, alternatively, resulting from "irreversible human-induced conditions." Sites where the local geology may result in naturally elevated concentrations of salts or minerals are those most often proposed as sites warranting ambient-based criteria.

Data are not available for Indian Canyon Creek and Antelope Creek during times of "natural" conditions—prior to the manmade changes to support irrigation in the area. It is assumed that conditions in these watersheds can improve to some extent, based on slight decreases in TDS concentrations over the last decades. However, it is unlikely that these watersheds can feasibly meet the current TDS water quality criterion of 1,200 mg/L due to a combination of naturally saline soils and irreversible modifications from irrigation activities. Of the approximately 62,000 acres included in the Indian Canyon Creek watershed, only 248 acres (<1 percent) are irrigated. Similarly, less than 1 percent of the approximately 800,000 acres of Antelope Creek watershed are irrigated and a majority of the 430 irrigated acres in this watershed have already been treated with salinity control projects.

The proposed site-specific TDS criteria for Antelope Creek and Indian Canyon Creek are based on the 90^{th} percentile concentration of available ambient water quality data. This approach is consistent with other TDS site-specific criteria developed in Utah (e.g., Sevier River, Price River, San Rafael River and Virgin River). The proposed criteria are listed in Table 8-1.

Table-3. Recommended site-specific TDS criteria for Indian Canyon Creek and Antelope Creek

Creek	Proposed Site-Specific TDS Criterion (mg/L)	UDEQ Station Used in Calculation	Station Location
Indian Canyon Creek	2,183	493453	Above confluence with Strawberry River
Antelope Creek	2,655	493423	At U.S. 40 Crossing

As required by Utah Water Quality Standards, the recommended site-specific criteria will support the affected designated uses of irrigation and stock watering. Iowa Department of Natural Resources conducted a review of available water quality standards and literature information regarding levels of TDS and the effect on waterbody uses

(http://www.iowadnr.com/water/standards/files/tdsissue.pdf). Toxicity test data presented in the paper indicate that the safe upper limits of TDS in water consumed by beef cattle and dairy cattle are 10,000 mg/L and 7,150 mg/L, respectively. In addition, the Canadian Water Quality Guidelines identifies 3,000 mg/L as the maximum acceptable limit for livestock drinking water (CCREM, 1987) and The National Academy of Sciences *Water Quality Criteria 1972* (NAS and NAE, 1973) indicates that if TDS is between 1,000 – 2,999 mg/L, the waters should be satisfactory for all classes of livestock and poultry. They may cause temporary and mild diarrhea in livestock not accustomed to them or watery droppings in poultry, but should not affect their health or performance.

The site-specific criteria are also expected to support the water use for crop irrigation. Ayers and Westcot (1994) identified the crop tolerance for more than 70 different field crops related to the salinity of irrigation water. Electrical conductivity values are provided for crop yield potentials of 50 percent, 75 percent, 90 percent and 100 percent. Observed TDS and electrical conductivity measurements from field samples in Indian Canyon Creek and Antelope Creek were used to establish a regression equation of the two parameters (R^2=0.999) for each stream to identify equivalent electrical conductivity values for the proposed TDS criteria. The conductivity values were then compared to the information in Ayers and Westcot (1994), indicating a resulting crop yield of approximately 80 percent for both streams, based on information for alfalfa, a dominate crop in the watersheds.

Table0-4. Summary of TDS data for UDEQ water quality stations recording exceedances of the TDS target

Station ID	Station Description	No. of Samples	Avg (mg/L)	Min (mg/L)	Max (mg/L)	CV	First Sample	Last Sample
493423	Antelope Cr at U.S. 40 crossing	23	2,012.61	334	2,764	0.28	10/15/1980	5/28/1996
493453	Indian Canyon Cr above confluence with Strawberry R	40	1,860.05	290	2,562	0.19	8/1/1979	5/24/2001

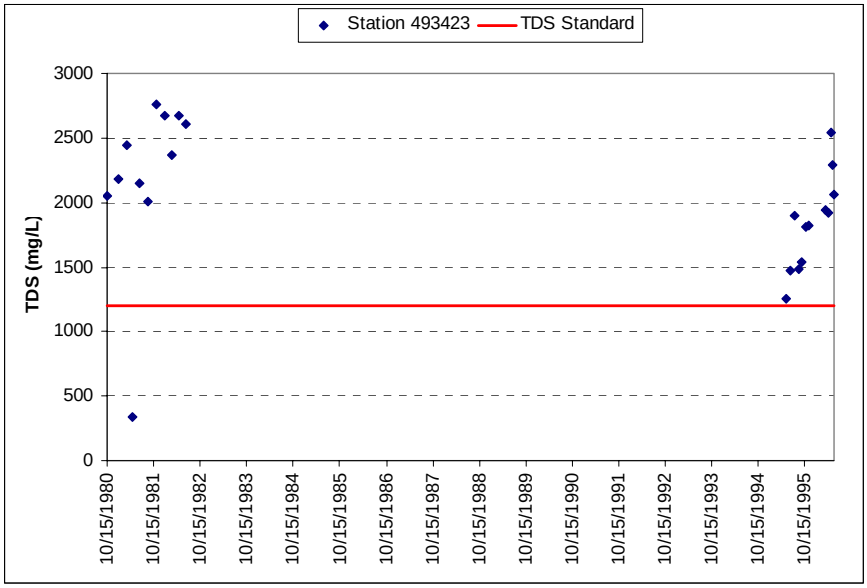

Figure-3. All TDS observations for station 493423 – Antelope Creek at U.S. Highway 40 crossing

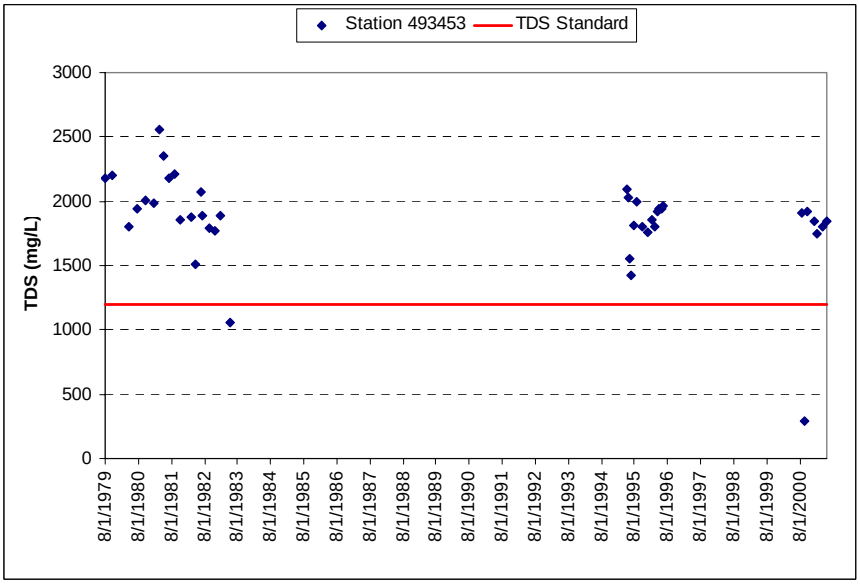

Figure0-4. All TDS observations for station 493453 – Indian Canyon Creek above Strawberry River confluence