Utah Department of Environmental Quality
Division of Water Quality
TMDL Section

Ashley Creek TMDL

Waterbody ID	Ashley-Brush Watershed: Lower Ashley Creek, from confluence with Green River upstream approximately 8 miles HUC #14060002
Location	Uintah County, Northeastern Utah
Pollutant of Concern	Selenium (Se)
Impaired Beneficial Uses	Class 3B: Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
Current Load Loading Capacity (TMDL) Load Reduction	1,637 lbs/yr 361 lbs/yr 1,276 lbs/yr (78%)
Wasteload Allocation UPDES #UT0024511 (Lagoons) UPDES #UT0025348 (WWTP) Load Allocation Margin of Safety	 0 lbs/yr 72 lbs/yr 271 lbs/yr 18 lbs/yr
Defined Targets/Endpoints	1) Total maximum load as an annual average of less than 361 lbs/yr 2) Load reduction of 1,276 lbs/yr 3) Water quality target of 4.75 ug/L
Implementation Strategy	1) Closure of Ashley Valley Sewage Lagoons (completed in 2001) 2) Irrigation water and riparian best management practices
This document is identified as a TMDL for waters in the Ashley Creek drainage and is submitted under §303d of the Clean Water Act to U.S. EPA for review and approval.	

Utah Department of Environmental Quality
Division of Water Quality
TMDL Section

Ashley Creek TMDL

Waterbody ID	Ashley-Brush Watershed: Lower Ashley Creek, from confluence with Green River upstream approximately 8 miles HUC #14060002
Location	Uintah County, Northeastern Utah
Pollutants of Concern	Total Dissolved Solids (TDS)
Impaired Beneficial Uses	Class 4: Protected for agricultural uses including irrigation of crops and stock watering.
Current Loading Loading Capacity (TMDL) Load Reduction	36,247 tons/yr 29,053 tons/yr 7,194 tons/yr (20%)
Wasteload Allocation UPDES #UT0024511 (Lagoons) UPDES #UT0025348 (WWTP) Load Allocation Margin of Safety	 0 tons/yr 3,794 tons/yr 23,806 tons/yr 1,453 tons/yr
Defined Targets/Endpoints	1) Total maximum load as an annual average of less than 29,053 tons/yr 2) Load reduction of 7,194 tons/yr 3) Water quality target of 1,140 mg/L
Implementation Strategy	1) Closure of Ashley Valley Sewage Lagoons (completed in 2001) 2) Irrigation water and riparian best management practices
This document is identified as a TMDL for waters in the Ashley Creek drainage and is submitted under §303d of the Clean Water Act to U.S. EPA for review and approval.	

Table of Contents

List of Figures

List of Tables

Executive Summary

This document addresses water quality impairments within the lower Ashley Creek watershed through the establishment of Total Maximum Daily Loads (TMDLs) for Selenium (Se) and Total Dissolved Solids (TDS). The purpose of this TMDL is to improve water quality and protect or restore designated beneficial uses. Lower Ashley Creek, from the confluence with the Green River upstream approximately 8 miles, is listed on the State's 303D list of impaired waters and has been designated as not meeting its warm water fishery beneficial use (3B) due to high concentrations of Se and its agricultural beneficial use (4) due to high concentrations of TDS. The source of impairment originates primarily from seepage from the Ashley Valley Sewage Lagoons through an outcrop of Mancos shale, a naturally occurring geologic formation that borders the east side of Ashley Creek. Permitted point source discharges in the watershed include the Ashley Valley Water Reclamation Facility, a mechanical waste water treatment plant, and five oil wells in the Ashley Oil Field.

The Ashley Creek Watershed is located in the northeast corner of the State of Utah and encompasses 393 square miles. Elevations range from over 9,500 feet in the Uinta Mountains to the north, down to 5,000 feet at the confluence with the Green River. Vegetation types are characteristic of the Rocky Mountains and Colorado Plateau with coniferous forests dominating the high elevations, Pinyon-Juniper forests at mid-elevations and sagebrush-grass and agricultural lands in the valley bottom. Ashley Creek is the primary drainage in the watershed flowing from the Uinta Mountains in the north, through Ashley Valley and into the Green River forty-five miles to the southeast. Flows in Ashley Creek vary widely due to spring snow melt, irrigation diversions, and occasional thunderstorms. During spring runoff stream flows average 195 cubic feet per second (cfs), 24 cfs during irrigation season and 34 cfs during the winter near Jensen above the confluence with the Green River.

Approximately 12,000 people reside within the watershed with the majority living in the city of Vernal. The economy of the watershed is based upon tourism, fossil fuel production and agriculture. Recreational opportunities abound on nearby National Forest lands, Dinosaur National Monument and Green River.

Because of the natural geologic sources of Se and TDS that underlie Ashley Valley there will always be some Se and TDS non-point source loading into Ashley Creek. However, several projects currently underway within the watershed will improve the water quality and riparian habitat of Ashley Creek. A locally led watershed planning effort, the Ashley Creek Restoration and Stabilization Committee, is addressing chronic flooding, water quality and riparian habitat issues on Ashley Creek. The Army Corps of Engineers is about to begin implementation on a riparian restoration project on Ashley Creek above the Steinaker diversion, the Ashley Valley Sewer Improvement District has recently constructed a new wastewater treatment plant, and the Uintah County Water Conservancy District, in cooperation with the Bureau of Reclamation and Natural Resources Conservation Service, is implementing salinity control projects on irrigated lands throughout the watershed. It is important to recognize that data collection in support of this TMDL is an ongoing effort and that as new data is collected this TMDL will be revised as needed.

1.0 Background

EPA's *Water Quality Planning and Management Regulations* (40 CFR 130) require states to develop Total Maximum Daily Loads (TMDLs) for waters that exceed water quality standards. This document presents TMDLs for Ashley Creek, which is listed on Utah's 2002 303(d) for impairments associated with excess concentrations of Selenium (Se) and Total Dissolved Solids (TDS).

Ashley Creek, a tributary of the Green River, is located in the western portion of the Ashley-Brush hydrologic unit (HUC 14060002) on the southeastern slope of the Uinta Mountains in northeastern Utah (Figure 1-1). Utah's Division of Water Quality (UDWQ) has assessed lower Ashley Creek (from the mouth of the river to the County Road crossing above the old Vernal Lagoons) and its tributaries and has determined that this segment is not supporting its agricultural classification due to violations of the water quality criterion for TDS and its warm water fisheries classification due to violations of the criterion for Se. This stream segment also has a fish consumption advisory on it because of elevated levels of Se found in fish tissue.

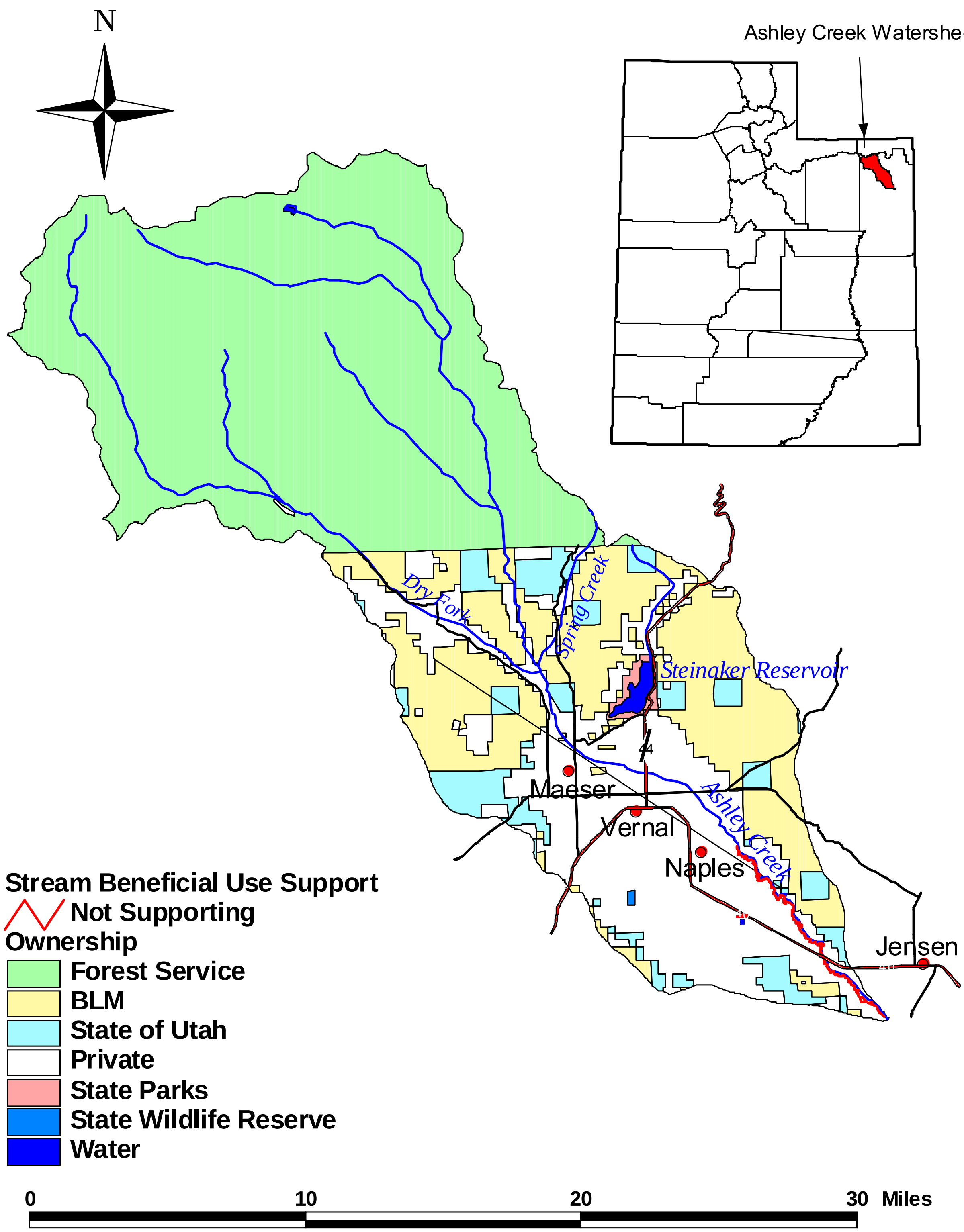
Ashley Creek has a priority ranking of low. Although Ashley Creek has been listed as a low priority for TMDL development on the State's 2002 303(d) list, the initiation of water quality improvement projects directed by various federal, state and local agencies as well as the voluntary support of local stewards to address water quality problems in the watershed has elevated it to a higher priority. The development of this TMDL has not disrupted the state's scheduled completion of TMDLs for high priority waterbodies. Table 1-1 presents the 2002 303(d) list information for Ashley Creek.

Table 1-1. Ashley Creek listed waterbody characteristics

Waterbody Name	HUC Code	Designated Uses*	Pollutants of Concern	Primary Source of Impairment
Ashley Creek	14060002	2B, 3B, 4	Total Dissolved Solids, Selenium	Sewage lagoon seepage, irrigation return flows, natural geologic formations

* 2B = Recreational use and aesthetics: secondary contact recreation;
3B = Protected for warm water species of game fish and other warm water aquatic life including the necessary aquatic organisms in their food chain
4 = Agriculture: including irrigation of crops and stock watering

Figure 1-1. Location of the Ashley Creek Watershed



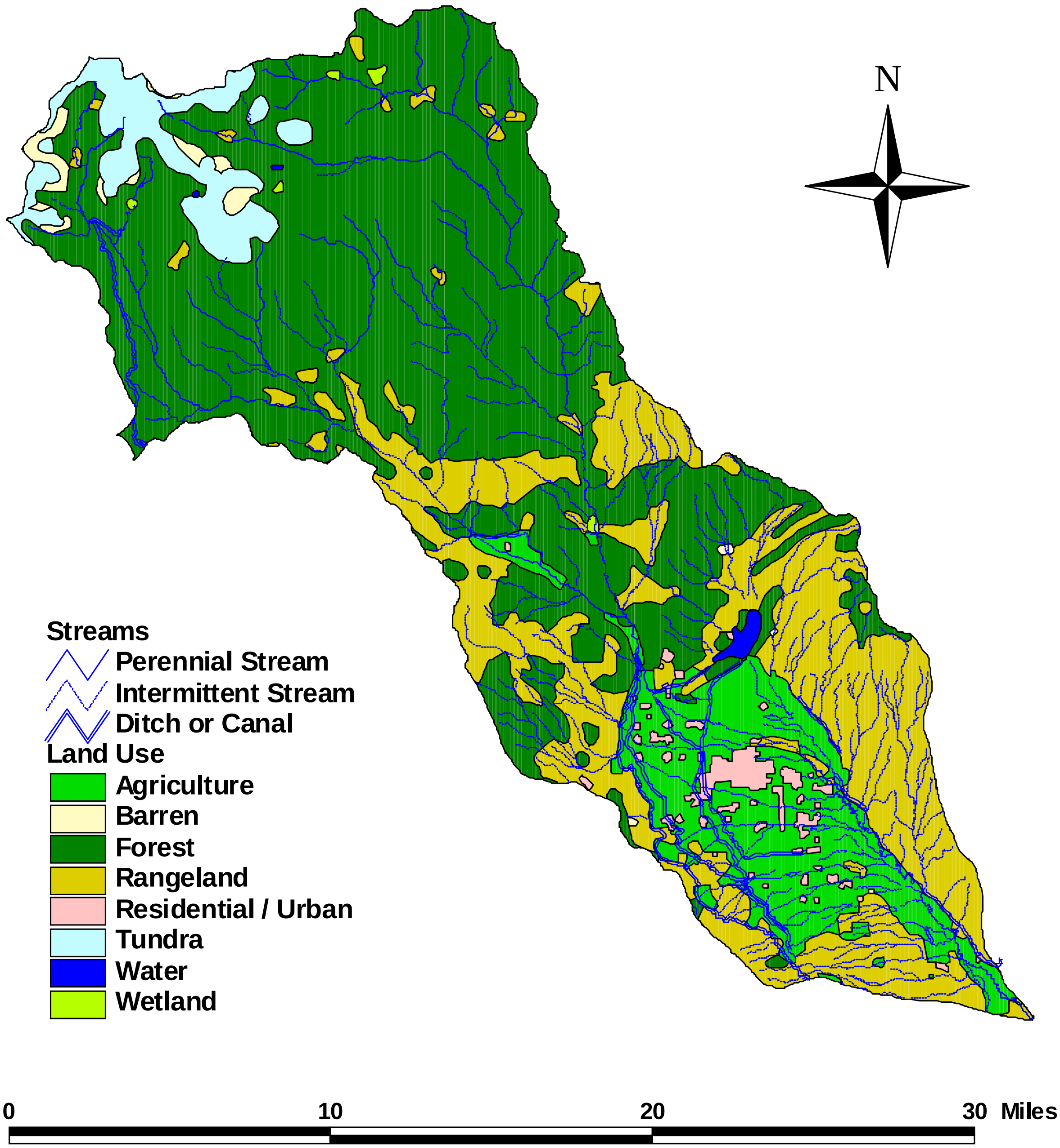
The Ashley Creek watershed encompasses 251,817 acres and is encircled by the Uinta Mountains to the north, Asphalt Ridge to the west and the Buckskin Hills to the east. Vernal, the county seat, has the highest population within the watershed with an estimated 7,714 residents. Other communities within the watershed include Naples with 1,300 residents and Maeser with 2,855 residents (2000 U.S. Census).

Based on 1985 land use data from U.S. Geological Survey's (USGS) Geographic Information Retrieval Analysis System (GIRAS), the Ashley Creek watershed is composed primarily of rangeland and agricultural lands in the lower watershed with forest land dominating the upper watershed. Land use distribution in the watersheds based on the general categories is listed in Table 1-2 and shown in Figure 1-2. It should be noted that the areal extent of these land use categories are approximate and were derived from high altitude aerial photographs with a minimum unit size of 40 acres for natural features. Natural land use features less than 40 acres in size were lumped into larger, adjoining land use categories so that the total size of small isolated features such as wetlands is underestimated.

Table 1-2. Land use distribution in the Ashley Creek watershed

Land Use	Area (acres)	% of total area
Residential/Urban	3,764	2%
Agriculture	31,013	12%
Rangeland	65,326	26%
Forest	137,182	55%
Water	712	<1%
Wetland	431	<1%
Barren	2,271	<1%
Tundra	11,118	4%

Figure 1-2. Land Use Distribution within the Ashley Creek Watershed



The geology of the Ashley Creek watershed has a significant influence on the watershed's vegetation communities, land uses, and water quality. The upper watershed within the Uinta Mountains is predominantly metamorphic quartzite, conglomerate and glacial deposits that have low concentrations of salts and metals (Figure 1-3). At mid-elevations, formations that contain high concentrations of phosphorus are exposed such as the Park City and Morrison formations. Within the lower watershed, including Ashley Valley, formations naturally high in salt and selenium are found including the Mancos and Chinle Shales.

Soils within Ashley Valley are formed from alluvial sediments that have been transported into the valley from the Uinta Mountains and surrounding foothills. The majority of irrigated soils west of Ashley Creek are mainly of medium texture and open structure, with moderate permeability, good available moisture capacity, and relatively low in soluble salt and alkalinity. Soils derived from Mancos shale, including Billings clay and Naples loam, are poorly drained and high in soluble salts, selenium and alkalinity (see Figure 4-2, p.27).

The climate of the Ashley Creek watershed is typified as temperate and arid in Ashley valley and mesic within the Uinta Mountains with rainfall averaging between 7 inches per year in the valley and 30 inches within the high Uintas (Figure 1-4). The majority of precipitation is associated with frontal storms from the Pacific Northwest and falls as snow during the cold winter months. The remaining precipitation is associated with highly variable thunderstorms originating from the Gulf of Mexico during the summer and early fall that can result in localized flash flooding.

The vegetation types found within the Ashley Creek watershed are the result of the environmental factors discussed above, including agricultural and urban development. Vegetation types within the Uinta Mountains include coniferous forests, Aspen, and brush types. On the foothills Pinyon pine, Juniper, and sagebrush are the dominant vegetation types. Within Ashley Valley, agricultural crops, urban development and salt desert scrub predominate (Figure 1-5). The following Table 1-3 summarizes the total area and relative percentage of the different vegetative communities found with the watershed.

Table 1-3. Vegetation Communities within the Ashley Creek watershed

Vegetation Community	Area (acres)	% of total area
Lodgepole Pine	53,046	21%
Spruce / Fir	40,657	16%
Agriculture	34,645	14%
Sagebrush	31,790	13%
Salt Desert Scrub	26,261	10%
Sagebrush / Perennial Grass	22,902	9%
Pinyon Pine / Juniper	15,766	6%
Alpine	6,627	3%
Mountain Fir	6,039	2%
Ponderosa Pine	2,959	1%
Aspen	2,694	1%
Barren	1,974	1%
Urban	1,646	1%
Pinyon Pine	1,248	<1%
Juniper	1,034	<1%
Dry Meadow	887	<1%
Ponderosa Pine / Mt. Shrub	432	<1%
Spruce Fir / Mt. Shrub	394	<1%
Mountain Shrub	297	<1%
Lowland Riparian	297	<1%
Wet Meadow	187	<1%
Wetland	30	<1%

Figure 1-3. Geologic Formations of the Ashley Creek Watershed

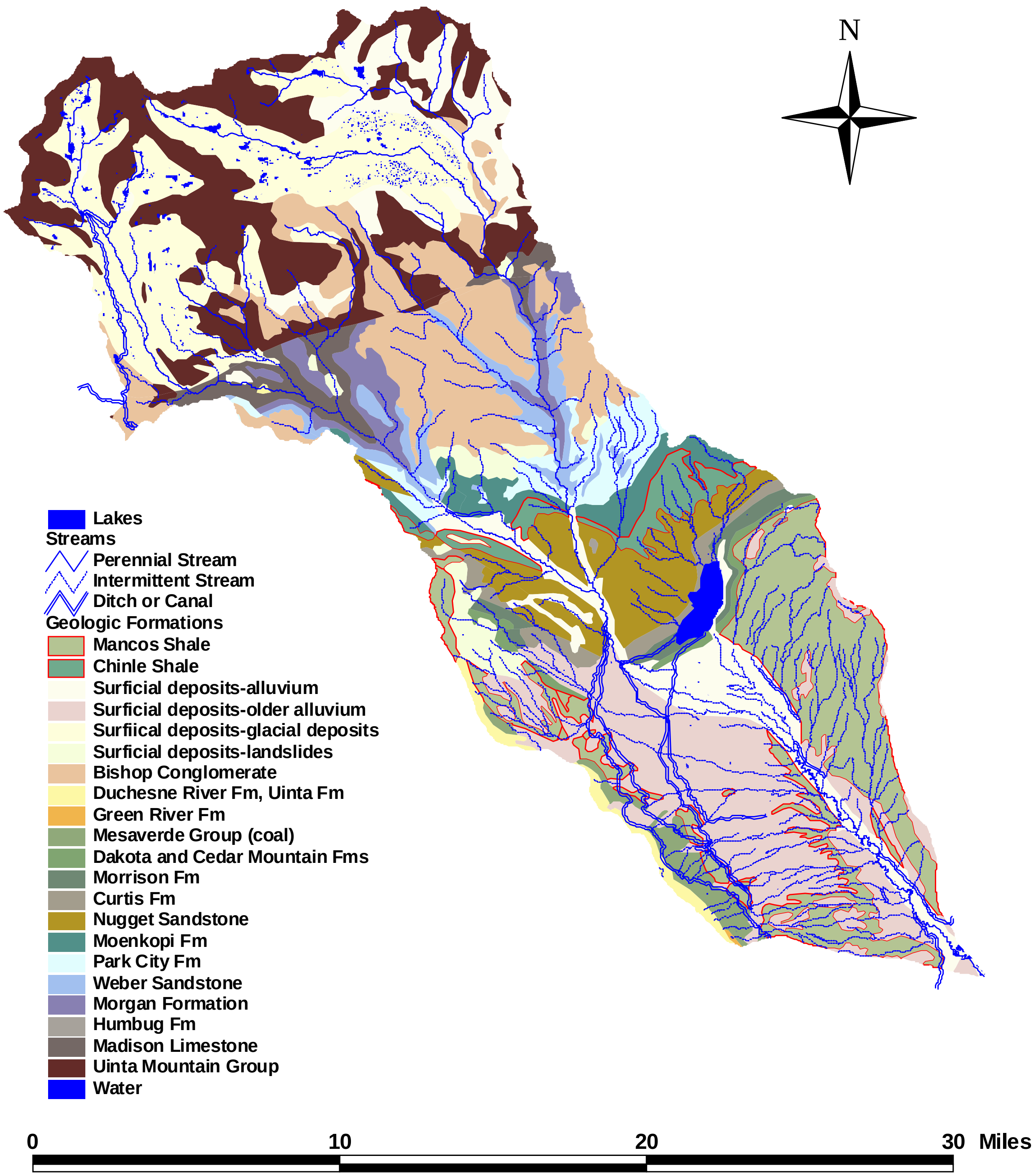


Figure 1-4. Average Annual Precipitation within the Ashley Creek Watershed

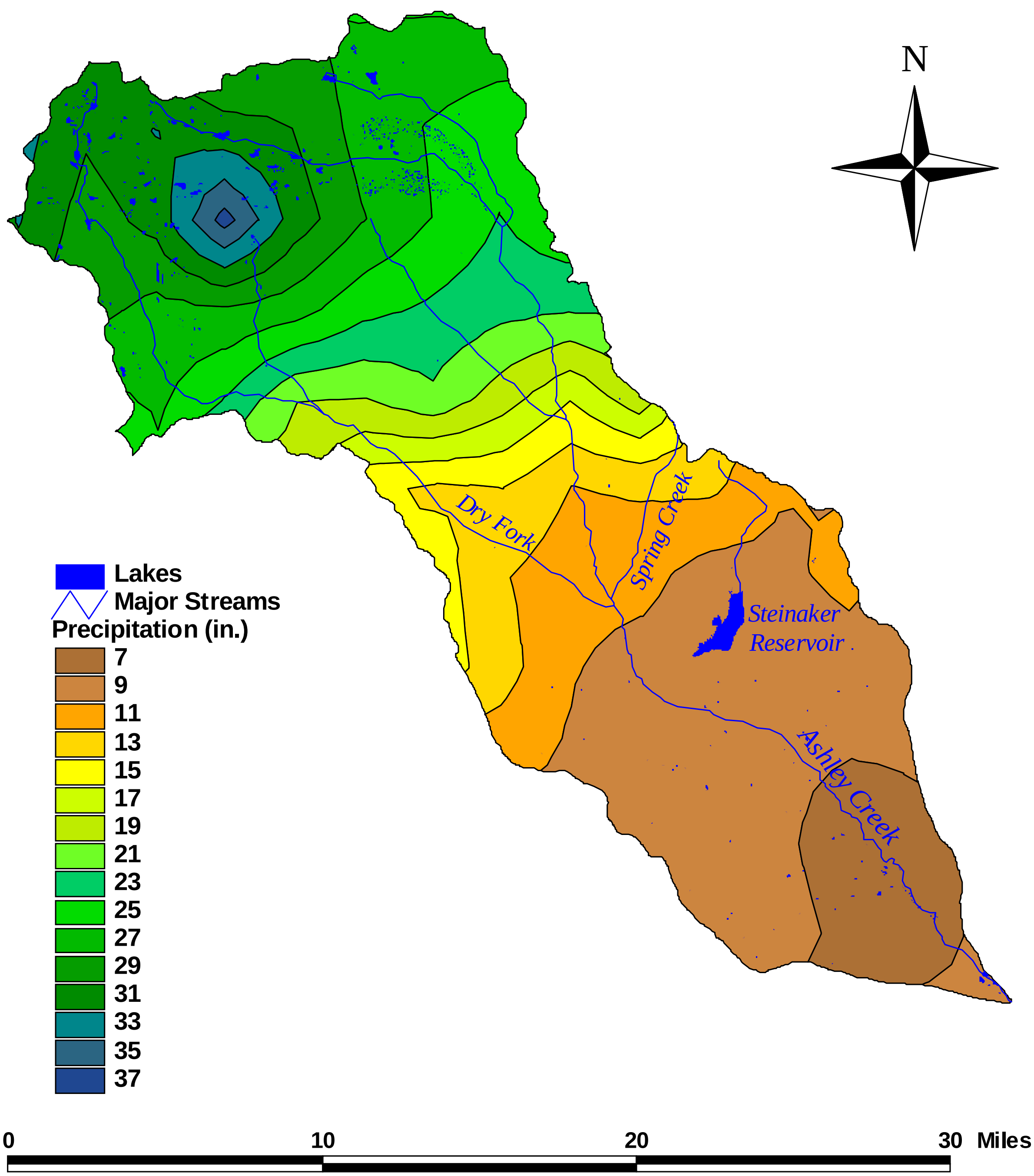
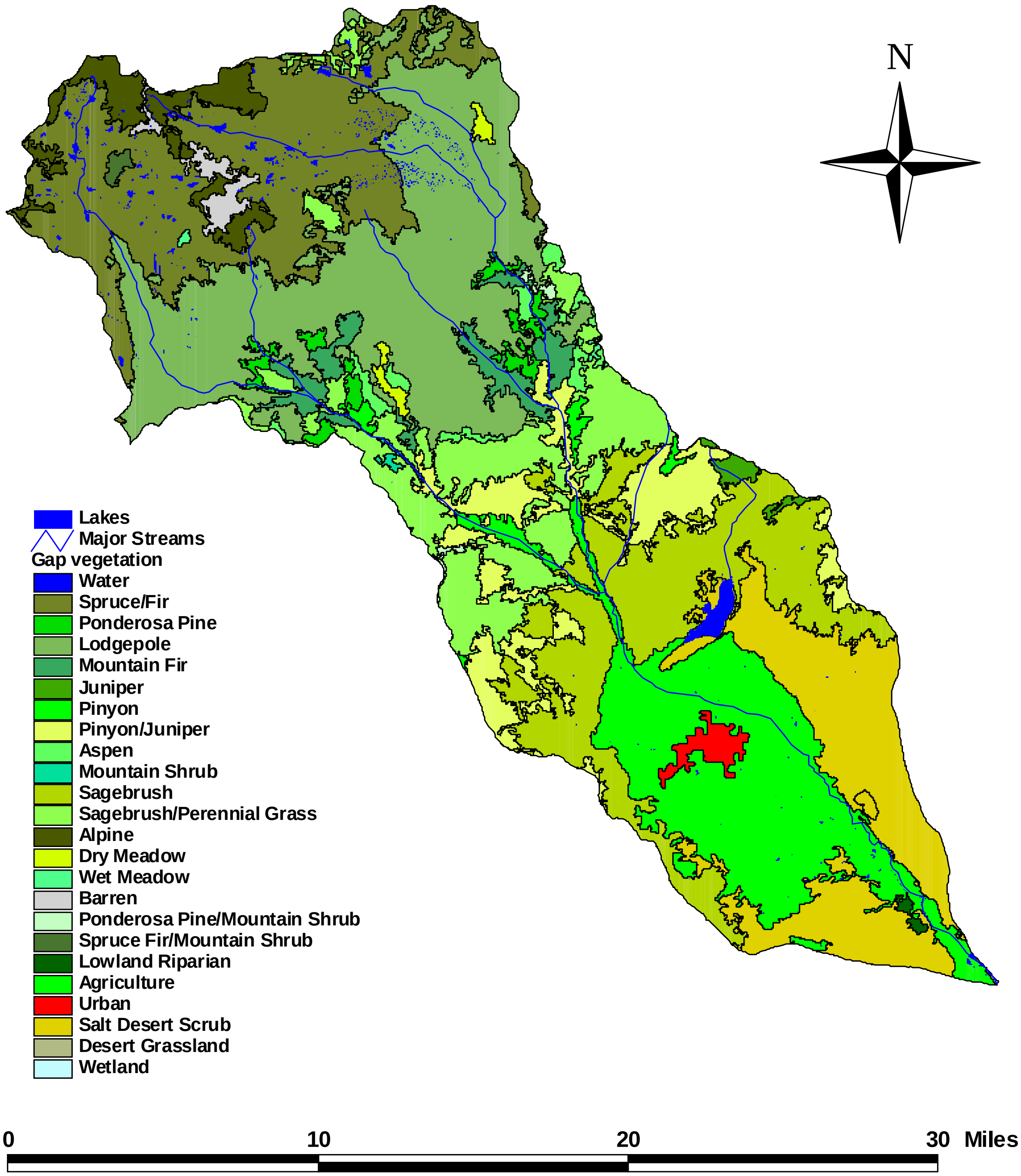


Figure 1-5. Vegetation Communities within the Ashley Creek Watershed



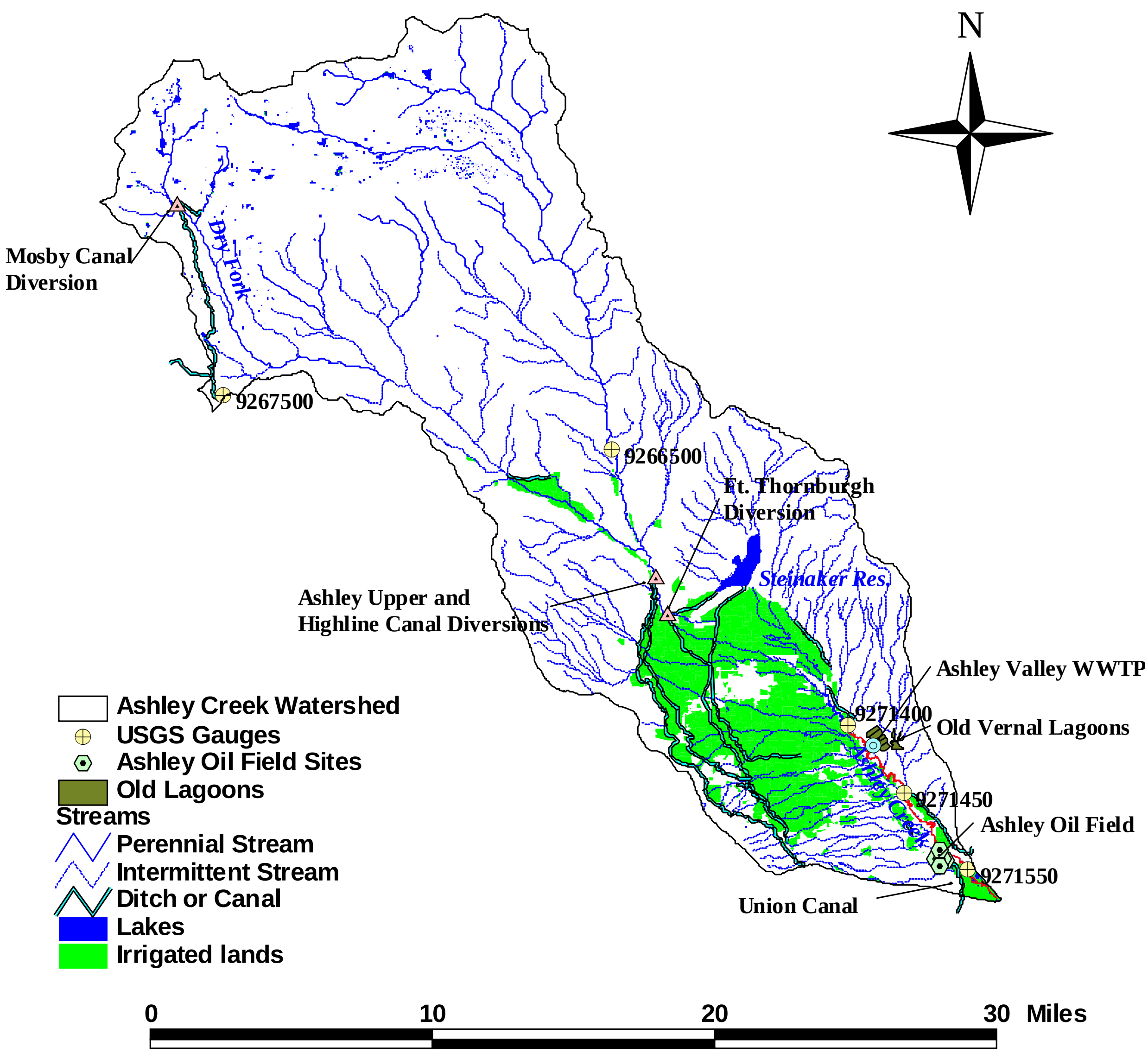
The hydrology of Ashley Creek has been significantly altered as the result of water developments designed to transport and store stream flows for agricultural and municipal use. The average annual streamflow of Ashley Creek is 119,400 acre-feet (ac/ft) while the presently developed water supply totals 88,840 ac-ft (Utah Division of Water Resources, 1999). There are several diversions on Ashley Creek and its tributaries including a trans-basin diversion near the headwaters of Dry Fork into the Mosby Canal, the Ashley Upper and Highline Canals and the Fort Thornburgh diversion (Figure 1-6).

During low flows, Ashley Creek is completely diverted into Steinaker Reservoir via the Fort Thornburgh Diversion. From this point downstream approximately 6.5 miles the channel is generally dry during the summer until groundwater base flows, irrigation return flows and the outfall of the new Ashley Valley Water Reclamation Facility (AVWRF) re-enter the channel. The AVWRF was constructed in 2001 to replace sewage lagoons located on a bench of Mancos Shale above Ashley Creek that were contributing high TDS and Se loads into Ashley Creek.

Approximately 6 miles downstream of the AVWRF's outfall is the Ashley Oil Field, where five permitted discharge facilities are located. All of the facilities are oil wells with wastewater treatment systems that consist of oil/water separator tanks and skimmer ponds that discharge into the Union Canal. The discharge permits for these facilities stipulate the daily maximum concentration of TDS is not to exceed 2,200 mg/L. Analysis from two oil wells indicated TDS concentrations between 1,330-1,900 mg/L with no selenium detected (Stephens et al., 1992, p.77). The Union Canal is used to irrigate approximately 400 acres of alfalfa and grain during irrigation season and for stock watering during the winter. The canal ends below the confluence of Ashley Creek with the Green River. There may be the potential for Union Canal water to reach Ashley Creek during the irrigation season via surface runoff, although salinity control efforts are currently underway that will line the canal and install improved irrigation methods in this area that will greatly reduce the potential for return flows to reach Ashley Creek.

Selenium and TDS loading into Ashley Creek has been significantly reduced recently with the closing of the Ashley Valley Sewage Lagoons (Naftz, pers. comm.) and irrigation improvements associated with the Salinity Control Program. The remaining point source of Se and TDS loading into Ashley Creek includes the seepage from the sewage lagoons. Non-point sources include naturally occurring shallow groundwater, streambank erosion and irrigation return flows. These sources of Se and TDS are described in greater detail in Section 3.0.

Figure 1-6. Hydrology of the Ashley Creek Watershed



2.0 Water Quality Standards

Utah's *Standards of Water Quality for Waters of the State* (Utah Division of Water Quality, 2000) present the applicable water quality criteria for the state of Utah. Table 2-1 presents Utah's water quality criteria for the designated uses of Ashley Creek.

Table 2-1. Applicable Utah Water Quality Criteria

Parameter	Secondary Contact Recreation (2B)	Warm Water Aquatic Life (3B)	Agriculture (4)
Selenium (Dissolved)	-	4 day average (chronic): 5 ug/L 1 hour average (acute): 20 ug/L	Maximum: 50 ug/L
Total Dissolved Solids	-	-	1,200 mg/L

2.1 Utah's Listing Methodology

2.1.1 Selenium

To evaluate attainment of water quality standards Utah uses the acute Selenium criterion of 20 micrograms per liter (ug/L) which is based upon a 1 hour average of samples. In the case of the UDWQ's sampling methodology this typically entails a single grab sample. However, the goal for this TMDL is based upon the chronic Selenium criterion of 5 ug/L, based upon a 4 day average of samples, which is more applicable to loading calculations based upon annual average loads. The 303(d) listing criteria evaluates beneficial use support based on the number of violations of the water quality criterion for toxic parameters as listed in Table 2-2. A minimum of four samples collected at least once each season is required for assessment.

2.1.2 Total Dissolved Solids

Utah uses the Total Dissolved Solids criterion of 1,200 milligrams per liter (mg/L) to evaluate attainment of water quality standards. The 303(d) listing criteria evaluates beneficial use support based on the number of violations of the water quality criterion for conventional parameters as listed in Table 2-2. A minimum of ten samples collected throughout the year (as in an intensive monitoring cycle) is required for assessment.

Table 2-2. 303 (d) Criteria for Assessing Beneficial Use Support

Degree of Use Support	Toxic Parameters* (Se)	Conventional Parameter** (TDS)
Full	For any one pollutant, no more than one violation of criterion.	Criterion exceeded in less than two samples and in less than 10% of the samples if there were two or more exceedances.
Partial	For any one pollutant, two or more violations of the criterion, but violations occurred in less than or equal to 10% of the samples.	Criterion was exceeded two times, and criterion was exceeded in more than 10% but not more than 25% of the samples.
Non-support	For any one pollutant, two or more violations of the criterion, and violations occurred in more than 10% of the samples.	Criterion was exceeded two times, and criterion was exceeded in more than 25% of the samples.

* Based on at least quarterly sampling
** Based on at least 10 samples during an intensive monitoring cycle

2.2 TMDL Endpoints

TMDL endpoints represent water quality targets used in quantifying TMDLs and their individual components. Different TMDL endpoints are necessary for each impairment type (i.e., Se and TDS). Utah's chronic numeric water quality criteria for Se and TDS were used to identify endpoints for TMDL development. Based on water quality observations in lower Ashley Creek (see Section 3.3), the entire time period and all flows were assumed to be the critical conditions in the watershed for both Se and TDS. The TMDL endpoints applied were the chronic Warm Water Aquatic Life criteria for Se of 5 ug/L, and the Agriculture criteria for TDS of 1,200 mg/L, established in Utah's water quality standards (Utah Division of Water Quality, 2000).

3.0 Data Inventory and Review

The data used in the development of Se and TDS TMDLs for Ashley Creek include physiographic data that describes the physical conditions of the watershed and environmental monitoring data that can be used to identify potential pollutant sources, their location, and their loading contribution. Table 3-1 presents the various data types and data sources reviewed in the watershed.

Table 3-1. Inventory of data used for the watershed source assessment

Data Category	Description	Data Source(s)
Watershed Physiographic Data	Land Use	Utah Division of Water Resources
	Stream Reach Coverage	Utah Division of Water Resources, USGS 7.5" Quads
	Stream Characteristics	Utah Division of Water Resources
		Utah Division of Water Quality
	Soils	Natural Resources Conservation Service, USGS
	Geology	Utah Geological Survey
Environmental Monitoring Data	303(d) Listed Waters	Utah Division of Water Quality
	Water Quality Data	Utah Division of Water Quality
	UPDES Facilities	Utah Division of Water Quality
	Streamflow Data	USGS, Utah Division of Water Quality

3.1 Flow Data

Flow records available for USGS flow gages in Ashley Creek watershed are listed in Table 3-1 with their gage names, station IDs, and periods of record. Only those gages with records of daily flows available for dates since 1970 are shown in Figure 3-1.

Table 3-2. USGS Flow Gages in the Ashley Creek Watershed

Station ID	Gage name	Start date	End date
9266500	ASHLEY CREEK NEAR VERNAL, UT	10/1/14	9/30/01
9271550	ASHLEY CREEK BL UNION CANAL DIV NR JENSEN, UT	7/9/91	9/30/01
9271500	ASHLEY CREEK NEAR JENSEN, UTAH	10/1/46	10/1/83
9271450	ASHLEY CREEK BL SADLIER DRAW, NEAR NAPLES, UT	11/18/99	9/30/01
9271400	ASHLEY CREEK NEAR NAPLES, UT	11/23/99	9/30/01

3.2 Water Quality Data

The Utah Division of Water Quality (UDWQ) maintains a water quality database for 36 sites within the Ashley Creek watershed, 7 of these are currently being monitored and are located within the lower watershed as defined by the purposes of this study (Table

3-3). The USGS is currently conducting a detailed study of selenium loading in Ashley Creek in cooperation with the US Bureau of Reclamation (BOR). The objectives of the USGS/BOR study are to: (1) Quantify the change in salinity and selenium loading to Ashley Creek that results from closure of the sewage lagoons. (2) Determine mobility of salinity and selenium under current hydrologic conditions. (3) Determine mobility of salinity and selenium under conditions present after closure of the sewage lagoons. (4) Examine the role of evaporation processes on selenium pathways. The study is anticipated to be completed in September of 2004. A summary of the data available at the stations within the lower watershed is provided in Table 3-3, and station locations are shown in Figure 3-1.

Figure 3-1. Location of Water Quality Monitoring and Flow Gauge Stations in Lower Ashley Creek Watershed

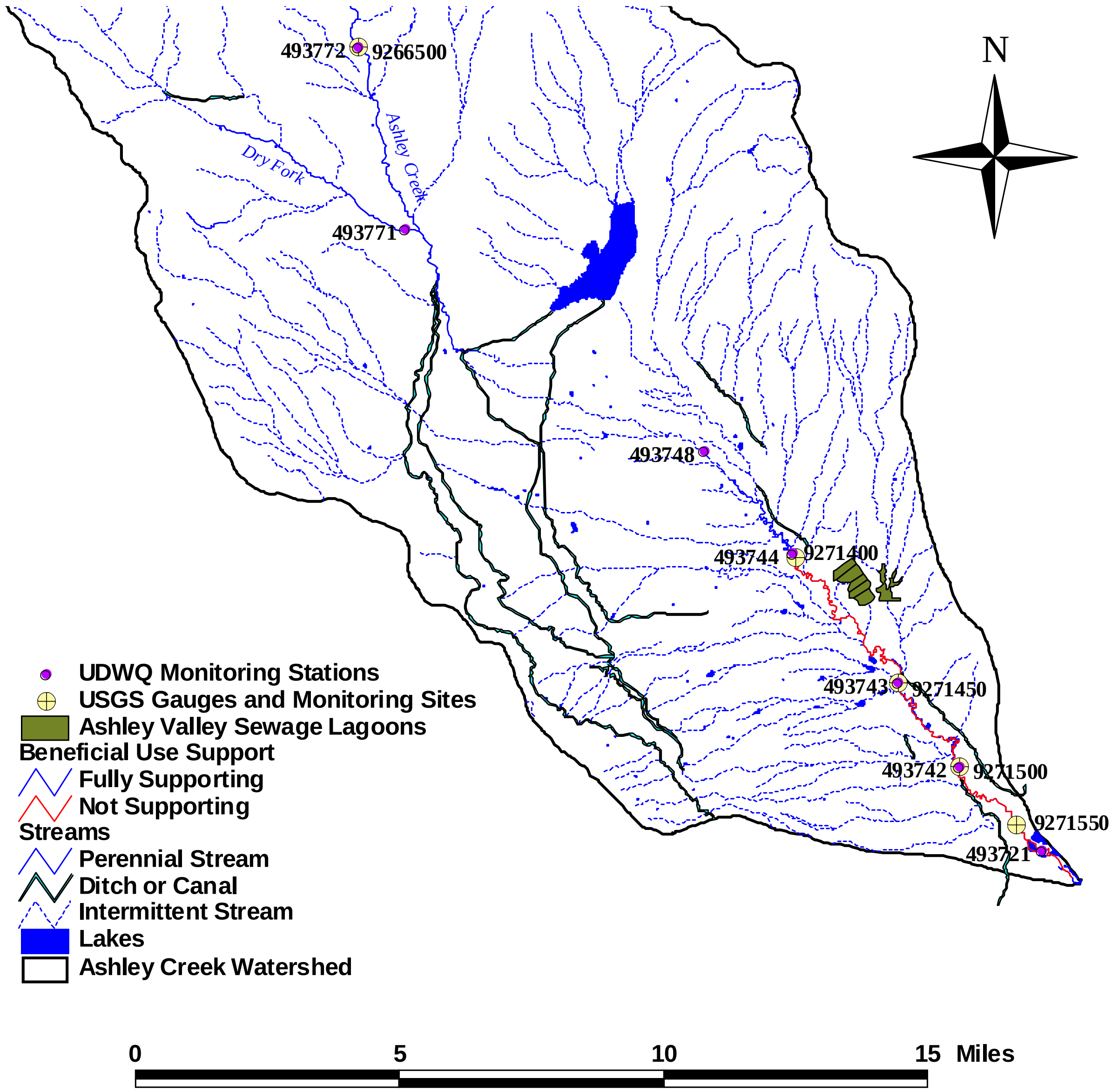


Table 3-3. Inventory of Available Data in Lower Ashley Creek Watershed

Station	Location	Type	Start date	End date	Count
Data from Utah DWQ					
493772	Ashley Ck AB Cnfl / Dry Fork	Ambient	6/2/87	5/23/01	43
493771	Dry Fork AB Cnfl / Ashley Ck	Ambient	3/30/95	6/6/01	28
493748	Ashley Ck NE of Vernal at Diamond Mt Rd Xing	Ambient	1/17/80	6/6/01	36
493744	Ashley Ck AB Vernal Lagoons at County Rd Xing	Ambient	1/17/80	11/12/97	36
493743	Ashley Ck N of US 40 at County Rd Xing	Ambient	7/28/76	6/6/01	27
493742	Ashley Ck at US 40 Xing	Ambient	2/4/75	4/18/96	84
493721	Ashley Ck AB Cnfl / Green R	Ambient	1/17/80	5/1/02	237
Data from US Geological Survey					
9266500	ASHLEY CREEK NEAR VERNAL, UT	Ambient	8/12/55	7/17/91	211
9271400	ASHLEY CREEK NEAR NAPLES, UT	Ambient	1/19/00	9/13/01	20
9271450	ASHLEY CREEK BL SADLIER DRAW, NEAR NAPLES, UT	Ambient	1/19/00	9/13/01	20
9271500	ASHLEY CREEK NEAR JENSEN, UTAH	Ambient	3/19/47	10/23/91	207
9271550	ASHLEY CREEK BL UNION CANAL DIV NR JENSEN, UT	Ambient	4/6/88	9/26/01	73

3.2 Water Quality Analysis

This section provides a summary of the Se and TDS data throughout the watershed collected from July 1991 to September 2001, as well as discussions on the evaluation of any identifiable spatial or temporal patterns in Se and TDS data. The data set was limited to this 10 year period because it was felt it would be more representative of current conditions than if older data were incorporated and is more consistent in terms of monitoring frequency and methodology. It is important to recognize that data collection in support of this TMDL is an ongoing effort and that as new data is collected this TMDL will be revised accordingly.

3.2.1 Summary of Selenium and Total Dissolved Solids Concentrations

Table 3-4 is a summary of the Se data, including the number of samples collected at the site (Count), a summary of exceedances of the chronic 5 ug/L water quality standard, and the average concentration (Mean).

Table 3-4. Summary of observed Se concentrations in Ashley Creek from July 1991 to September 2001

Station	Location	Count	# Exceeding (5 ug/L)	% Exceeding (5 ug/L)	Mean (ug/L)*
Data from UDWQ					
493772	Ashley Ck AB Cnfl / Dry Fork	11	0	0	0.5
493771	Dry Fork AB Cnfl / Ashley Ck	9	0	0	0.5
493748	Ashley Ck NE of Vernal at Diamond Mt Rd Xing	4	0	0	0.5
493744	Ashley Ck AB Vernal Lagoons at County Rd Xing	43	2	5	2.3
493743	Ashley Ck N of US 40 at County Rd Xing	44	39	89	36.3
493742	Ashley Ck at US 40 Xing	6	6	100	48.3
493721	Ashley Ck AB Cnfl / Green R	49	49	100	39.7
Data from USGS					
9266500	ASHLEY CREEK NEAR VERNAL, UT	1	0	0	0.5
9271400	ASHLEY CREEK NEAR NAPLES, UT	20	0	0	2.6
9271450	ASHLEY CREEK BL SADLIER DRAW, NEAR NAPLES, UT	20	18	90	46.8
9271500	ASHLEY CREEK NEAR JENSEN, UTAH	12	12	100	63.8
9271550	ASHLEY CREEK BL UNION CANAL DIV NR JENSEN, UT	69	62	90	41.6

* For results with non-detect values ½ the reporting limit (1 ug/L) was used for mean of sample calculation

Stations where water quality standards for Se are exceeded are all located downstream from the old Ashley Valley Sewage Lagoons (see stations 493743 and 9271450 on Figure 3-1). The influence of lagoon seepage on Se loading to Ashley Creek has been well documented by USGS studies (Stolp, 1999). Potentiometric groundwater studies have shown that ground-water flows away from the lagoons and toward Ashley Creek and Sadlier Draw. The sewage lagoons cover 76 acres and were built directly on Mancos Shale derived soils and on the Mancos Shale itself. This Cretaceous formation contains relatively high concentrations of Se. Three distinct areas of seepage from the lagoons to Ashley Creek have been identified in addition to the potential of more dispersed areas. In joint studies between the BOR and USGS they found that the "… selenium load in Ashley Creek that can be directly attributed to seepage from the sewage lagoons may be a high as 1 kilogram per day." (Stolp 1999) and in another study stated that, "These seeps flow about 2.5 cubic feet per second (cfs) and contribute approximately 9,000 tons of salt and 2,000 pounds of selenium per year to Ashley Creek." (USDI, 1997).

Table 3-5 is a summary of the TDS data collected in the watershed, including the number of samples collected at the site (Count), a summary of exceedances of the 1,200 mg/L water quality standard, and the average concentration (Mean).

Table 3-5. Summary of observed TDS concentrations in Ashley Creek from July 1991 to September 2001

Station	Location	Count	# Exceeding (1,200 mg/L)	% Exceeding (1,200 mg/L)	Mean (mg/L)
Data from UDWQ					
493772	Ashley Ck AB Cnfl / Dry Fork	43	0	0	90
493771	Dry Fork AB Cnfl / Ashley Ck	28	0	0	399
493748	Ashley Ck NE of Vernal at Diamond Mt Rd Xing	36	1	3	408
493744	Ashley Ck AB Vernal Lagoons at County Rd Xing	36	7	19	1018
493743	Ashley Ck N of US 40 at County Rd Xing	24	18	75	1444
493742	Ashley Ck at US 40 Xing	72	53	74	1604
493721	Ashley Ck AB Cnfl / Green R	237	185	78	1735
Data from USGS					
9266500	ASHLEY CREEK NEAR VERNAL, UT	1	0	0	93
9271400	ASHLEY CREEK NEAR NAPLES, UT	20	3	15	992
9271450	ASHLEY CREEK BL SADLIER DRAW, NEAR NAPLES, UT	20	16	80	1572
9271500	ASHLEY CREEK NEAR JENSEN, UTAH	1	1	100	1890
9271550	ASHLEY CREEK BL UNION CANAL DIV NR JENSEN, UT	2	2	100	2055

Stations where water quality standards for TDS are consistently exceeded are located downstream from the old Ashley Valley Sewage Lagoons (see stations 493743 and 9271450 on Figure 3-1). As with Se, the influence of lagoon seepage on TDS loading to Ashley Creek has been well documented by BOR and USGS studies (Stolp 1999). Mancos shale, on which the lagoons are constructed, contains as much as 2 percent soluble salts by weight. While inflow to the sewage lagoons has a dissolved-solids concentration of about 600 mg/L, as the wastewater seeps down and flows through and across the Mancos Shale, salinity and selenium concentrations increase dramatically. TDS concentrations from the seeps have been measured as high as 25,000 milligrams per liter.

3.2.2 Seasonal Effects on Se and TDS Concentrations

In Figures 3-2 and 3-3, the average monthly Se and TDS values are plotted to show the monthly and seasonal patterns for Ashley Creek at its confluence with the Green River (Storet 493721). Because of the relationship between instream concentrations and diluting flows, average monthly flows from the nearby USGS gauge (9271550, Ashley Creek below Union Canal diversion) are also included.

Figure 3-2. Average monthly Se concentrations in Ashley Creek above confluence with the Green River (Storet site 493721).

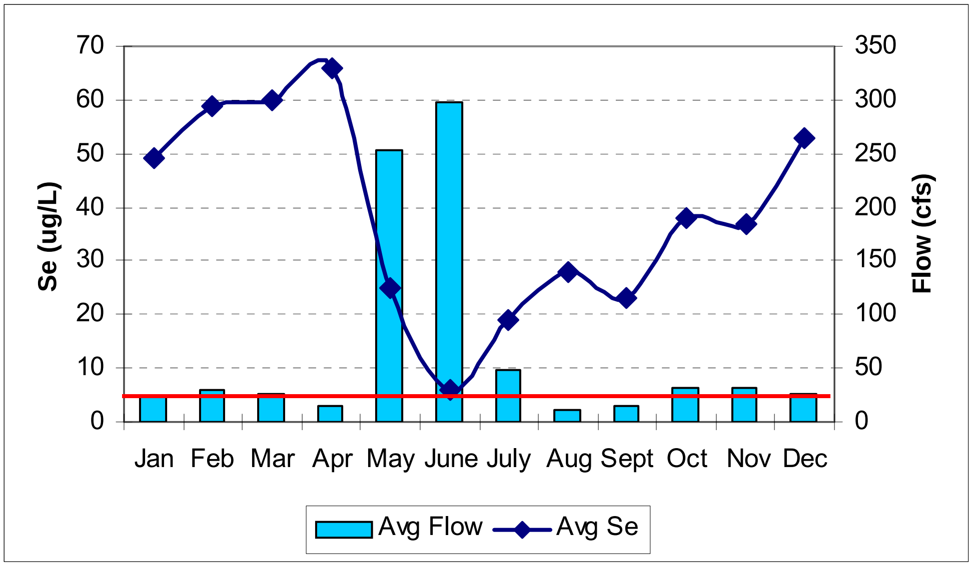
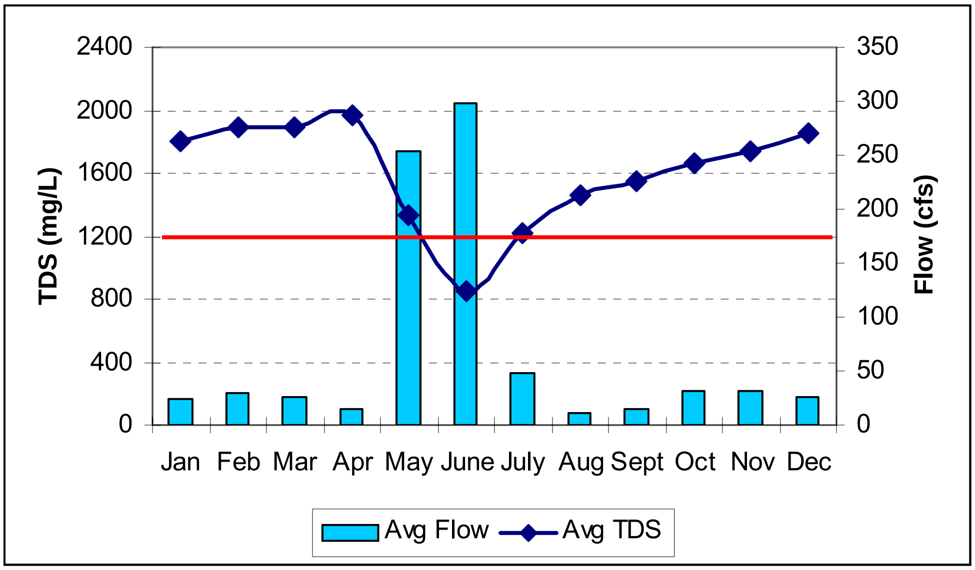


Figure 3-3. Average monthly TDS concentrations in Ashley Creek above confluence with the Green River (Storet site 493721).



The relationship between flows and Se and TDS concentrations is readily apparent from the figures above. During spring runoff (May - June) concentrations are relatively low, gradually rising throughout the rest of the year. This pattern suggests that Se and TDS loading occurs throughout the year and that concentrations are primarily a function of the availability of diluting stream flows, or hydrology, rather than seasonality.

3.2.3 Flow Versus Se and TDS Concentrations

To determine how much influence stream flow has on Se and TDS concentrations the two variables were plotted against each other and regression lines were calculated as shown in Figures 3-4 and 3-5. The coefficient of determination (R^2) indicates the strength of the correlation between the two variables (Se or TDS versus flow).

Figure 3-4. Plot of Se versus flow in Ashley Creek above confluence with the Green River (Storet site 493721).

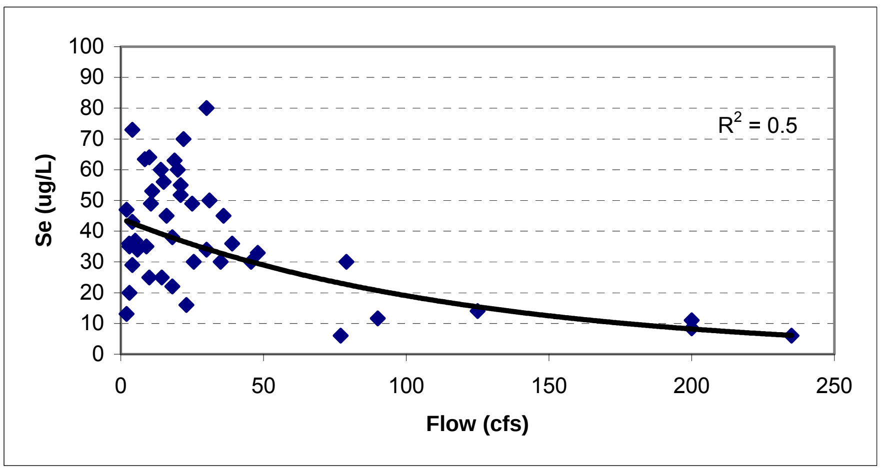
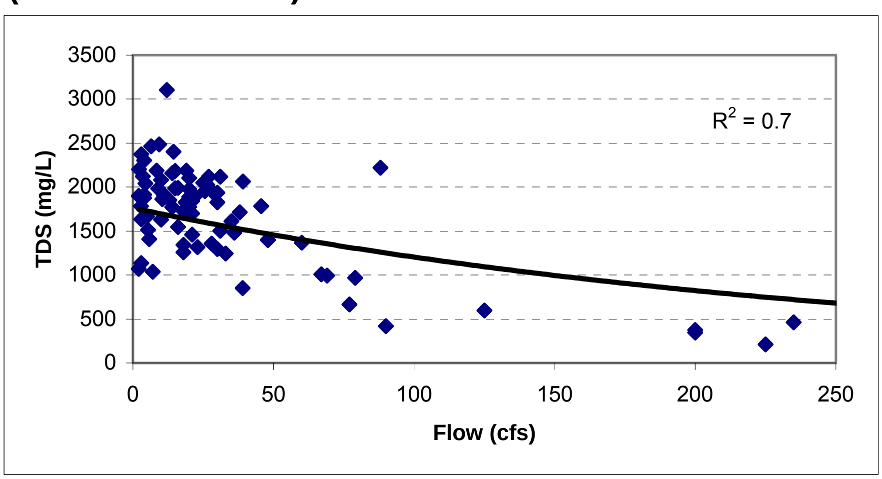


Figure 3-4. Plot of TDS versus flow in Ashley Creek above confluence with the Green River (Storet site 493721).



The plot of TDS versus flow shows a more identifiable trend ($R^2 = 0.7$) than the Se data show ($R^2 = 0.5$). However, both plots show the general trend of decreasing Se and TDS concentrations with increased flow. Se and TDS concentrations are likely the highest during baseflow conditions when groundwater with elevated concentrations provides the majority of the streamflow.

3.3 Critical Conditions

The critical condition represents the time of year or hydrologic event under which water quality standards are exceeded. Analyzing the TMDL in consideration of the critical condition ensures that water quality standards are met under all conditions. When the source of a pollutant is fairly constant in its frequency and magnitude, low flow (i.e., the period of minimum dilution) is typically the critical condition for the receiving water. When pollutant sources are driven by precipitation (e.g., runoff from urban or agricultural land), they affect a receiving water during or just following a storm event, making high flows the critical condition.

Flow patterns and Se and TDS concentrations were reviewed to evaluate the critical conditions for Ashley Creek. Flows in Ashley Creek were sorted by magnitude and divided into percentiles that were matched with the associated Se and TDS data including minimum, average, and maximum Se and TDS concentrations for each flow percentile. This evaluation indicated that elevated Se concentrations and violations of water quality standards occurred in all flow percentiles while elevated TDS concentrations and violations of water quality standards occurred up to the 90^{th} flow percentile as shown in Tables 3-6 and 3-7.

Table 3-6. Se data results by flow percentile group

Flow		Se						
Percentile	Avg. Flow (cfs)	Maximum (ug/L)	Mean (ug/L)	Minimum (ug/L)	Standard Deviation	Mean + Deviation	Mean - Deviation	# of Obs.
0-10%	1	47	26	13	15	41	11	4
10-20%	3	73	43	29	20	63	23	4
20-30%	7	101	52	30	25	77	27	7
30-40%	12	60	57	53	5	62	47	2
40-50%	17	80	50	22	23	73	27	5
50-60%	20	63	51	25	15	66	36	5
60-70%	23	70	45	16	27	72	18	3
70-80%	34	50	39	30	9	48	30	7
80-90%	81	33	18	6	12	30	6	5
90-100%	167	14	9	6	4	13	5	3

Table 3-7. TDS data results by flow percentile group

Flow		TDS						
Percentile	Flow (cfs)	Maximum (mg/L)	Mean (mg/L)	Minimum (mg/L)	Standard Deviation	Mean + Deviation	Mean - Deviation	# of Obs.
0-10%	1	3104	1835	1038	794	2629	1041	7
10-20%	3	2484	2020	1632	332	2352	1688	8
20-30%	7	2464	1977	1408	315	2292	1662	10
30-40%	12	2158	1958	1852	136	2094	1822	4
40-50%	17	2080	1732	1258	297	2029	1435	9
50-60%	20	2188	1853	1630	173	2026	1680	8
60-70%	24	2118	1880	1318	325	2205	1555	5
70-80%	32	2118	1564	852	341	1905	1223	13
80-90%	72	1402	955	376	400	1355	555	9
90-100%	562	598	308	140	153	461	155	8

Figures 3-5 and 3-6 present the Se and TDS data at station 493721 (Ashley Creek above confluence with Green River) and the water quality criterion of 5 ug/L and 1,200 mg/L respectively.

Figure 3-5. Monthly distribution of Se concentrations at station 493721 (Ashley Creek above confluence with the Green River).

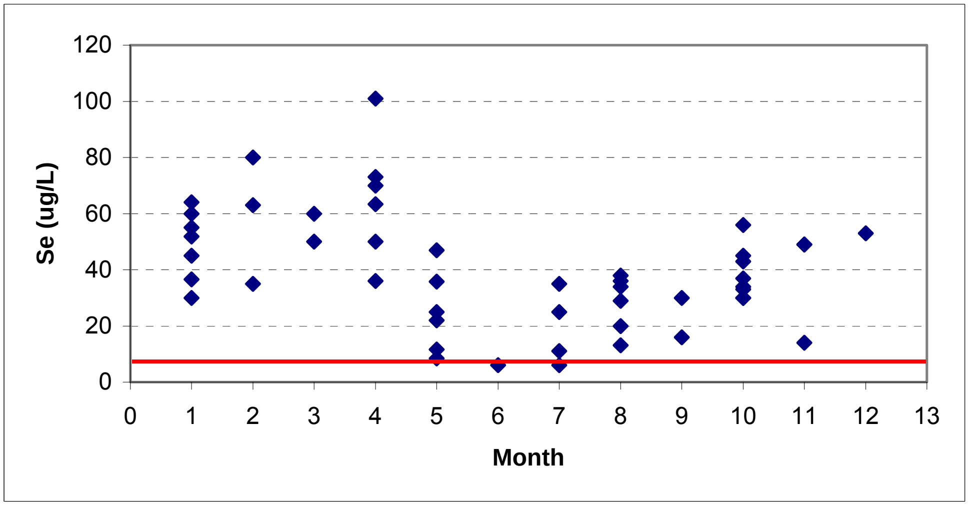
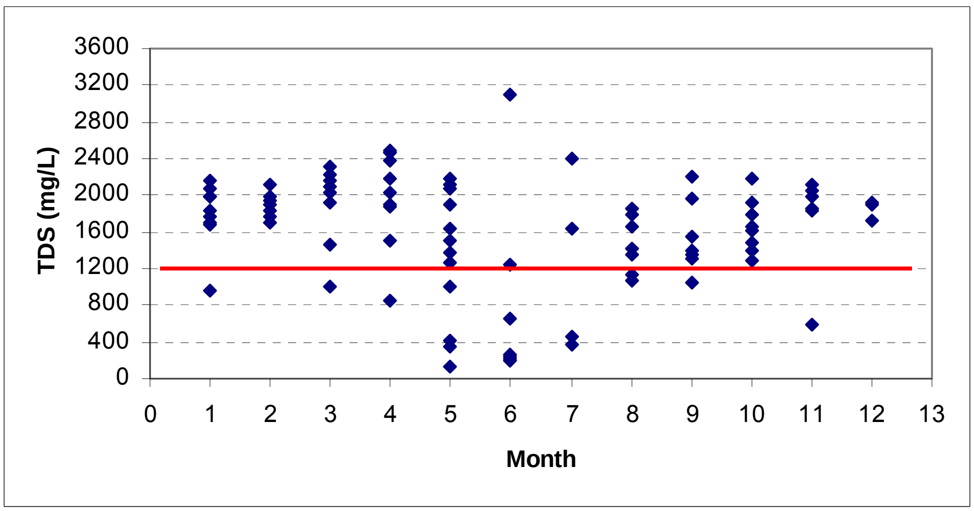


Figure 3-6. Monthly distribution of TDS concentrations at station 493721 (Ashley Creek above confluence with the Green River).



As discussed in Section 3.2 and shown in Figure 3-5, violations of the Se water quality standard occurs during all months of the year. Water quality standards for TDS (Figure 3-6) were also violated throughout the year. Since water quality standards are exceeded in all flows and throughout the year the critical condition is and the TMDLs will be based on an analysis of all flow conditions and will not isolate specific time periods.

4.0 Source Assessment

The evaluation of Se and TDS sources in the Ashley Creek watershed included point and non-point sources. The source assessment is an important part of defining the TMDL for any pollutant. The data and the sources have to be understood to be able to distinguish between point and non-point source impacts. Typically, the point source impacts can be quantified through permit limits and/or direct measurements at a certain location. A source assessment was performed on the Ashley Creek watershed to determine the predominant sources of Se and TDS loading to the system. Se and TDS are related, so it is assumed that the sources contributing to high Se concentrations in Ashley Creek are the same sources that contribute to increased TDS concentrations. Datasets and references used in assessing the pollutant sources in the watershed include National Irrigation Water Quality Program Studies conducted by the BOR and the USGS, USDA Salinity Control Program Reports, the Uintah Basin Area-wide Water Quality Management Plan (Section 208), stream networks and characteristics, watershed boundaries, Utah Pollutant Discharge Elimination System (UPDES) permitted locations, and soil types and characteristics.

4.1 Assessment of Point Sources

Six permitted discharge facilities are located within the Ashley Creek watershed. The Ashley Valley Sewage Lagoons (UPDES Permit #UT0024511) have recently been replaced by the Ashley Valley Water Reclamation Facility (AVWRF), a mechanical wastewater treatment plant (UPDES Permit #UT0025348). Construction of the AVWRF began in May 1999 and was completed in May of 2001. Since this TMDL analysis is based on data collected prior to the completion of the AVWRF, Se and TDS loading from the lagoons will be included in the analysis. However, since the lagoons are no longer in operation they will not be allocated any loading.

The other five facilities are oil wells all located approximately seven miles southeast of Vernal within the Ashley Oil Field. All five facilities' wastewater treatment systems consist of oil/water separator tanks which discharge to skimmer ponds and thence to the Union Irrigation Canal which ends near the Green River downstream of Ashley Creek (see Figure 1-6). The permits specify that discharge from these facilities may reach Ashley Creek, presumably from irrigation return flows, however a salinity control project currently underway will line the canal and install improved irrigation systems that will greatly reduce the potential for return flows to reach Ashley Creek. Therefore the oil wells are not considered a significant source of Se or TDS loading into Ashley Creek.

4.1.1 Ashley Valley Sewage Lagoons

The Ashley Valley Sewage Lagoons were constructed in 1981 to replace a trickling filter plant that discharged directly to Ashley Creek. The facility consists of 76 acres of treatment lagoons, a winter storage reservoir, and pumping facilities. After the facility began operating, the lagoons began to leak at a high rate. Several seeps surfaced along the bluff between Ashley Creek and the lagoons. In 1987, seepage from the lagoons was estimated at 3.3 cfs (Stephens et al., 1992, p. 73). As the water flowed through the soil, it dissolved and carried salts and selenium. High concentrations of selenium in Ashley Creek has had serious adverse environmental impacts on local fish and waterfowl populations. Because of the elevated levels of selenium, the Utah Division of Water Quality and the Tri-County Health Department issued a health advisory in 1991 cautioning people about consumption of fish or waterfowl from the area.

4.2 Assessment of Non-Point Sources

Non-point sources represent contributions from diffuse, non-permitted sources. The predominant land use in the Ashley Creek watershed is irrigated agriculture and grazing lands. Possible non-point sources of Se and TDS to Ashley Creek include irrigation return flows and streambank erosion which are discussed in more detail in the following sections.

4.2.1 Irrigation Return Flows

Significant natural sources of Se and TDS exist in the watershed. The geology of the lower portion of the basin is dominated by the highly saline Mancos shale formation. Whenever water comes into contact with this formation, or the saline soils formed from it, selenium and other salts are dissolved and transported to Ashley Creek via surface runoff or shallow groundwater. There have been numerous studies within the Ashley Creek watershed on the causes and sources of salt and selenium loading and all generally agree that, other than seepage from the sewage lagoons, the most significant human caused sources include irrigation return flows and field drains. However, due to implementation of salinity control efforts in the last 20 years a significant amount of the return flows have been greatly reduced or eliminated. Salinity control practices typically entail converting from flood irrigation to sprinklers or gated pipe and lining or piping ditches to reduce deep percolation.

According to data collected from ephemeral drainages to the west of Ashley Creek that constitute most of the potential return flows, some Se and TDS loading occurs. Of particular concern is the Mantle Gulch drainage that crosses US-40 just west of Ashley Creek. In July of 1988 a Se concentration of 540 mg/L was measured where Mantle Gulch flows into Ashley Creek, although no accompanying flow was given (Stephens et al., 1992). However, when considered in light of the Se and TDS loading from the sewer lagoons, the loads originating from irrigation return flows pale in comparison. Which is not to say that potential Se and TDS loading attributable to irrigation return flows can be dismissed as insignificant, rather at the present time there is insufficient information to conclusively state what the allocation should be. As the sewer lagoons dry up and loading decreases the proportionate contribution from irrigation return flows may increase, thereby justifying the implementation of additional best management practices in this area.

As noted in a recent study conducted by the USGS in western Colorado (Butler, 2001), TDS concentrations in return flows tend to remain relatively constant regardless of the amount of flow. In other words, salinity control efforts have been effective in reducing Se and TDS loading through reduction of return flows but not in reducing concentrations, which requires dilution with high quality water.

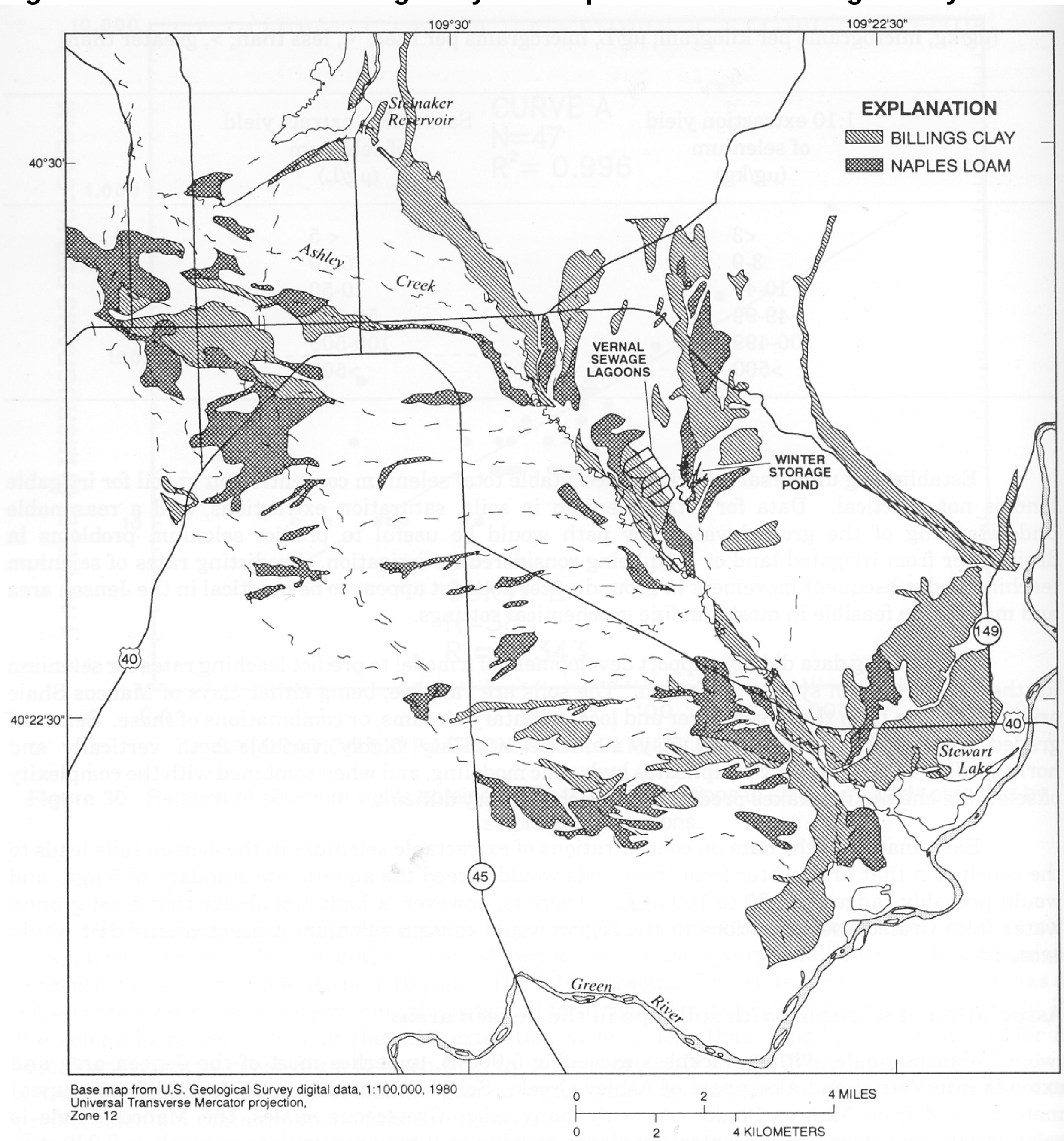
4.2.2 Streambank Erosion

Se and TDS loading attributable to streambank erosion is highly variable from year to year, depending primarily on the magnitude and duration of peak flows and the streambank's soil type.

Figure 4-1. Extensive cut bank along Ashley Creek

Soils in the area of lower Ashley Creek are derived from alluvial material and from Mancos Shale. The two soil types associated with high Se and TDS concentrations include the Billings clay and Naples loam (Figure 4-2). Se concentrations of 2,000 to 8,000 ppb have been reported for six samples of Billings clay loam from Western Colorado, and an alkaline crust resulting from seepage through Billings clay loam contained a Se concentration of 52,000 ppb (Williams and Byers, 1935).

Figure 4-2. Locations of Billings clay and Naples loam soils along Ashley Creek



From "*Detailed Study of Selenium and Selected Elements in Water, Bottom Sediment, and Biota Associated with Irrigation Drainage in the Middle Green River Basin, Utah, 1988-90*." USGS Water Resources Investigations Report 92-4084.

5.0 Technical Approach

Establishing a relationship between the in-stream water quality targets and source loading is a critical component of TMDL development. Identifying the cause-and-effect relationship between pollutant loads and the water quality response is necessary to evaluate the loading capacity of the receiving waterbodies. The loading capacity is the amount of pollutant that can be assimilated by the waterbody while still attaining and maintaining water quality standards. In other words, the load capacity, or maximum allowable load, is calculated by multiplying existing flows by the water quality standard. This section discusses the estimation of the loading capacity and existing Se and TDS loadings in the Ashley Creek watershed.

Together with historical flow records, the water quality target for Se and TDS was used to establish loading capacities for all flows expected to occur in Ashley Creek in a typical year. Existing loads also were estimated for comparison to loading capacities and evaluation of necessary load reductions. Existing loads were calculated based on available monitoring data for Se, TDS and flow. The following sections discuss the approaches used to estimate loading capacity and existing Se and TDS loadings for Ashley Creek.

A percent ranking model based on flow was used to establish associated Se and TDS loads. The available flow record at the USGS Gage 9271550 (Ashley Creek below Union Canal diversion near Jensen) was used to develop the flow duration curves and the loading analyses for the TMDLs. The observed daily USGS flows (7/91 to 9/01) were ranked in order of magnitude and each flow was assigned a percent that reflects the chance of a flow less than or equal to it (Table 5-1). To evaluate the allowable Se and TDS loadings for the watershed, each flow was then multiplied by the 5 ug/L or 1,200 mg/L criterion respectively to calculate a corresponding maximum loading limit for each flow. The individual lines were plotted to present a loading capacity line by flow percentile, as shown in Figures 5-1 and 5-2.

Table 5-1. Summary of flows by percentile at USGS Gage 9271550 (Ashley Creek below Union Canal diversion near Jensen).

Percentile	Average Flow (cfs)	
	Selenium	Total Dissolved Solids
0%-10%	1.1	1.1
10%-20%	3.2	3.3
20%-30%	7.1	7.5
30%-40%	12.5	12.3
40%-50%	17.4	16.9
50%-60%	20	19.9
60%-70%	23	24.4
70%-80%	33.6	32.4
80%-90%	81.4	72.3
90%-100%	167.3	561.6

Figure 5-1. Loading capacity of selenium for all observed flows in Ashley Creek.

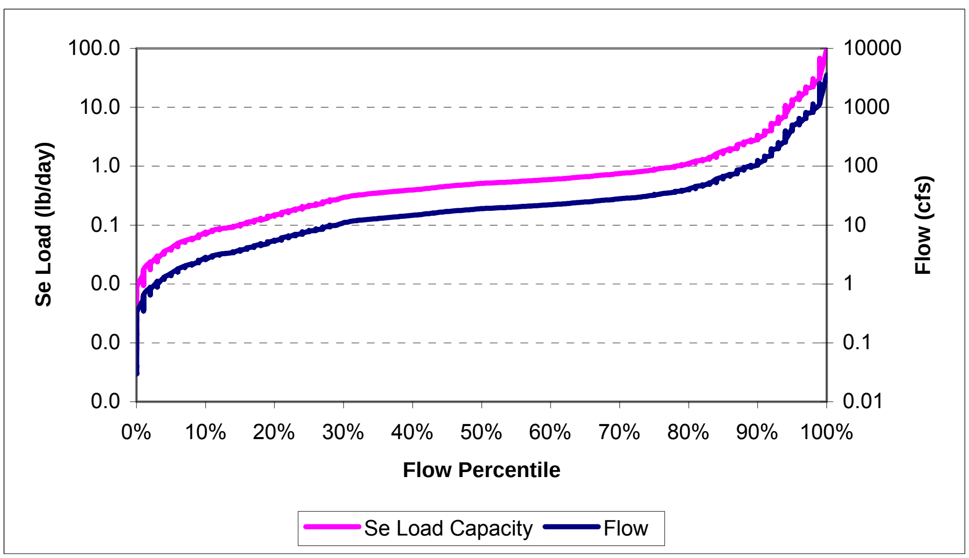
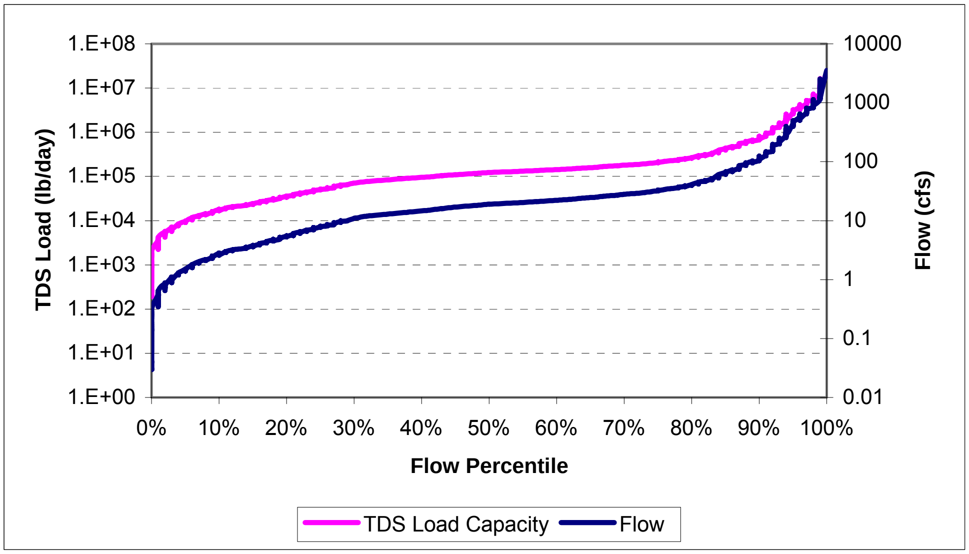


Figure 5-2. Loading capacity of total dissolved solids for all observed flows in Ashley Creek.



5.2 Estimation of Existing Loading

Existing loadings of Se and TDS for the Ashley Creek watershed were calculated using monitoring data for station 493721 (Ashley Creek above confluence with Green River) and flow measurements from USGS gage 9271550 recorded on the same day. Although the USGS has collected Se samples during the same time period it was decided that it would be more appropriate for this analysis to use the UDWQ data set since these data were used for assessing and listing Ashley Creek and UDWQ will continue to monitor it indefinitely, allowing more accurate tracking of changes in water quality over the long term. The average Se concentration of the two data sets are not significantly different, the average over the 10 year analysis period of USGS data is 40.3 ug/L while the UDWQ Se average is 39.7 ug/L. This section presents the methods and results of the analysis of existing Se and TDS loadings in the watershed.

5.2.1 Selenium

Existing Se loadings for Ashley Creek were calculated using Daily Se loads for Ashley Creek were calculated by multiplying the flow by the associated Se concentration collected on the same day (Figure 5-1). The calculated existing loads were then grouped based on the 10 flow percentile groupings from Table 5-1. Table 5-2 summarizes the maximum, minimum, average, and standard deviation of existing Se loads for each of the 10 percentile flow groups for Ashley Creek.

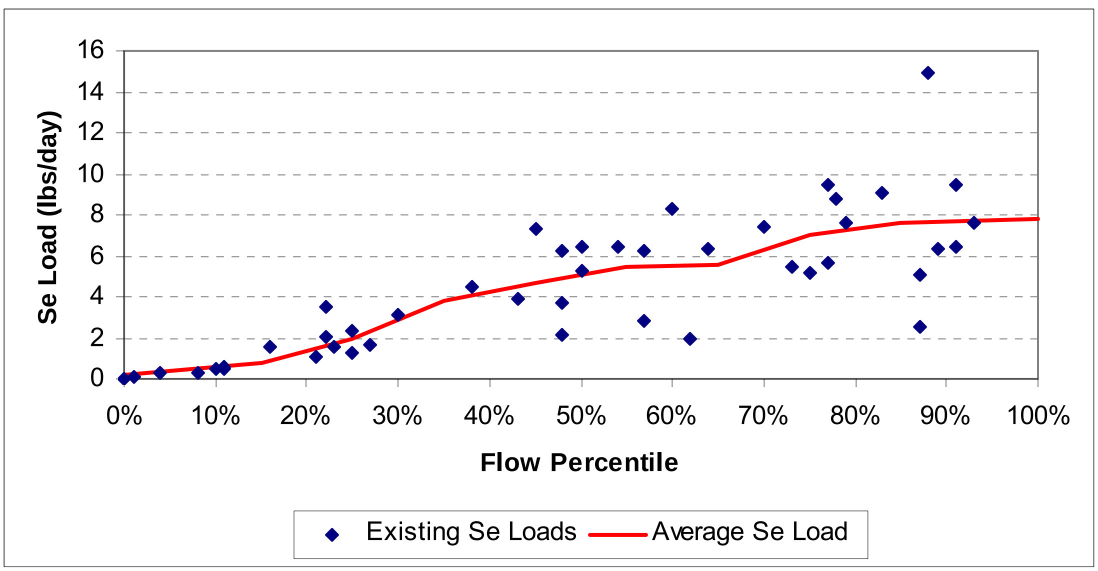
Average Se loads for each flow percentile group were used to establish a line representing existing loading for all flows for Ashley Creek. Figure 5-3 presents all individual existing Se loadings for Ashley Creek and the representative loading line arranged by flow percentile.

Table 5-2. Selenium loading statistics for the Ashley Creek watershed.

Flow Percentile	Avg. Flow (cfs)	No. of Loads[1]	Violations	Existing load summary					Load Capacity[2] (lbs/day)
				Max (lbs/day)	Mean+Std (lbs/day)	Mean (lbs/day)	Mean-Std (lbs/day)	Min (lbs/day)	
0%-10%	1.1	4	4	0.30	0.31	0.17	0.03	0.02	0.03
10%-20%	3.2	4	4	1.57	1.31	0.78	0.25	0.47	0.09
20%-30%	7.1	7	7	3.54	2.78	1.94	1.10	1.06	0.19
30%-40%	12.5	2	2	4.53	4.82	3.84	2.86	3.14	0.34
40%-50%	17.4	5	5	7.34	6.74	4.65	2.56	2.14	0.47
50%-60%	20	5	5	6.47	7.00	5.46	3.92	2.83	0.54
60%-70%	23	3	2	8.31	8.78	5.54	2.30	1.98	0.62
70%-80%	33.6	7	7	9.44	8.74	7.07	5.40	5.18	0.91
80%-90%	81.4	5	2	14.89	12.31	7.58	2.85	2.49	2.20
90%-100%	167.3	3	0	9.44	9.34	7.83	6.32	6.43	4.51

[1]Number of loads calculated using flows within the specified percentile range. This number reflects the number of available paired Se and flow measurements available within the specific flow range.
[2]Based on water quality criterion of 5 ug/L.

Figure 5-3. Existing Selenium loading by flow percentile for Ashley Creek



5.2.2 Total Dissolved Solids

As for Se, existing TDS loadings for Ashley Creek were calculated using monitoring data for station 493721 (Ashley Creek above confluence with Green River) and flow measurements from USGS gage 9271550. Daily TDS loads for Ashley Creek were calculated by multiplying the flow by the associated TDS concentration (Figure 5-2).

The calculated existing loads were then grouped based on the 10 flow percentile groupings from Table 5-1. Table 5-3 summarizes the maximum, minimum, average, and standard deviation of existing TDS loads for each of the 10 percentile flow groups for Ashley Creek.

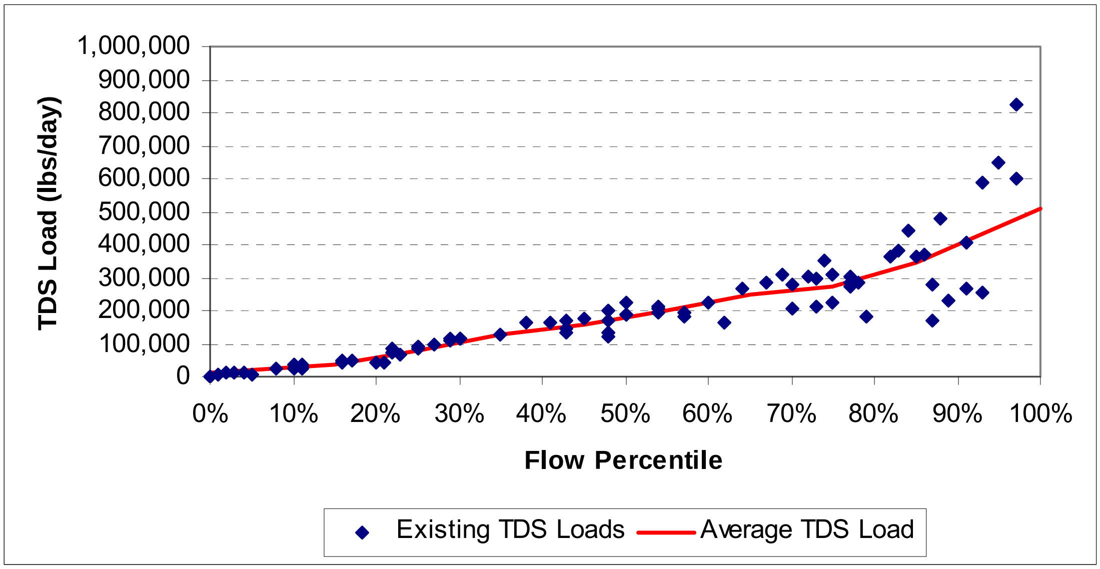
Average TDS loads for each flow percentile group were used to establish a line representing existing loading for all flows for Ashley Creek. Figure 5-3 presents all individual existing Se loadings for Ashley Creek and the representative loading line arranged by flow percentile.

Table 5-3. Total Dissolved Solids loading statistics for the Ashley Creek watershed.

Flow Percentile	Flow (cfs)	No. of Loads[1]	Violations	Existing load summary					Load Capacity[2] (lbs/day)
				Max (lbs/day)	Mean+Std (lbs/day)	Mean (lbs/day)	Mean-Std (lbs/day)	Min (lbs/day)	
0%-10%	1.1	7	4	27,207	19,116	10,916	2,716	1,962	8,608
10%-20%	3.3	8	8	49,709	45,693	36,472	27,251	24,647	24,143
20%-30%	7.5	10	10	113,377	105,330	80,888	56,446	43,281	50,033
30%-40%	12.3	4	4	162,957	153,264	129,866	106,468	113,205	82,136
40%-50%	16.9	9	9	201,943	182,924	157,086	131,248	122,137	107,509
50%-60%	19.9	8	8	224,230	212,354	198,165	183,976	184,629	128,544
60%-70%	24.4	5	5	308,448	305,980	249,136	192,292	163,507	156,829
70%-80%	32.4	13	12	354,145	320,176	269,804	219,432	179,224	209,904
80%-90%	72.3	9	3	480,348	441,586	342,673	243,760	172,385	418,643
90%-100%	561.6	8	0	2,426,120	1,455,152	750,491	45,830	254,856	3,352,059

[1]Number of loads calculated using flows within the specified percentile range. This number reflects the number of available paired TDS and flow measurements available within the specific flow range.
[2]Based on water quality criterion of 1,200 mg/L.

Figure 5-4. Existing Total Dissolved Solids loading by flow percentile for Ashley Creek.



5.3 Comparison of Existing Loading and Loading Capacity

To evaluate the load reductions and controls necessary to maintain water quality standards in Ashley Creek, the existing Se and TDS loadings in each flow percentile group were compared to their respective loading capacities. Figures 5-5 and 5-6 present the estimated loading capacity curve and existing loadings based on monitoring data, arranged by flow percentile, for Se and TDS, respectively. Table 5-2 presents the existing loadings for the Se, grouped into the 10 percentile ranges, and the discrete loading capacity based on the 5 ug/L target and average flow for the percentile grouping (e.g., 1.1 ft^3/s multiplied by the 5 ug/L criterion, multiplied by conversion factors equals 0.03 lb/d). Table 5-3 presents the existing loadings and loading capacity for TDS for each flow range. For Se, all flow percentile groups have a maximum load above the load capacity limit, whereas for TDS all but the highest two flow percentile groups exceed the load capacity, indicating the need for reductions of Se and TDS loads at most flows for Ashley Creek.

By plotting the loading capacities and individual existing loads by flow percentile, the specific dates of flows and loads are removed and the curve can be applied to different time periods. The curve illustrates an average year, with all flows and associated loadings expected to occur during a typical year. Therefore, Figure 5-5 presents the estimated annual existing loading and loading capacity of Se, and Figure 5-6 presents the estimated annual existing loading and loading capacity of TDS.

Figure 5-5. Existing Se loading and loading capacity for Ashley Creek.

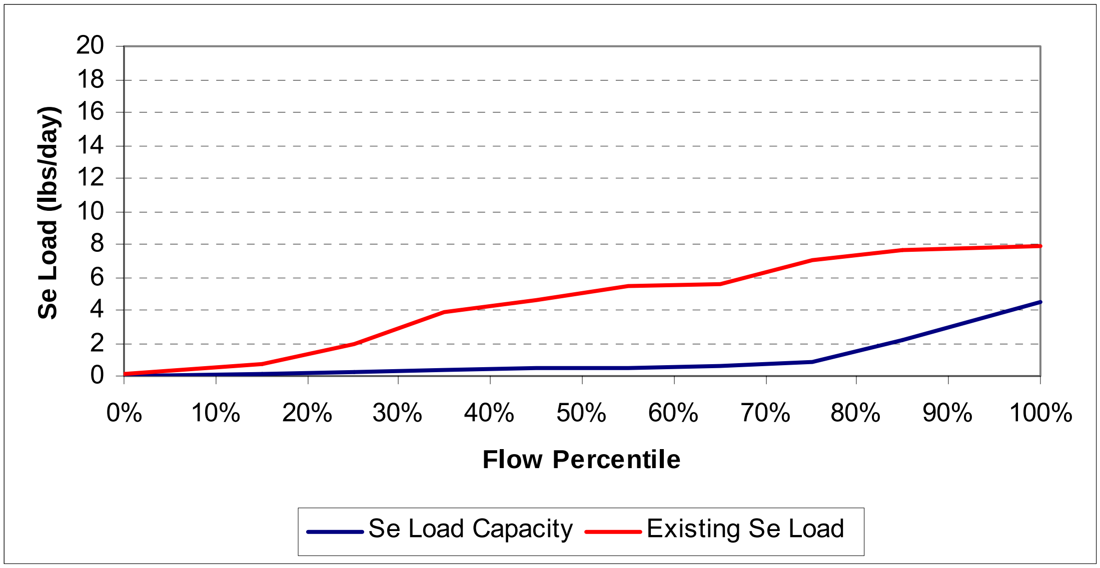
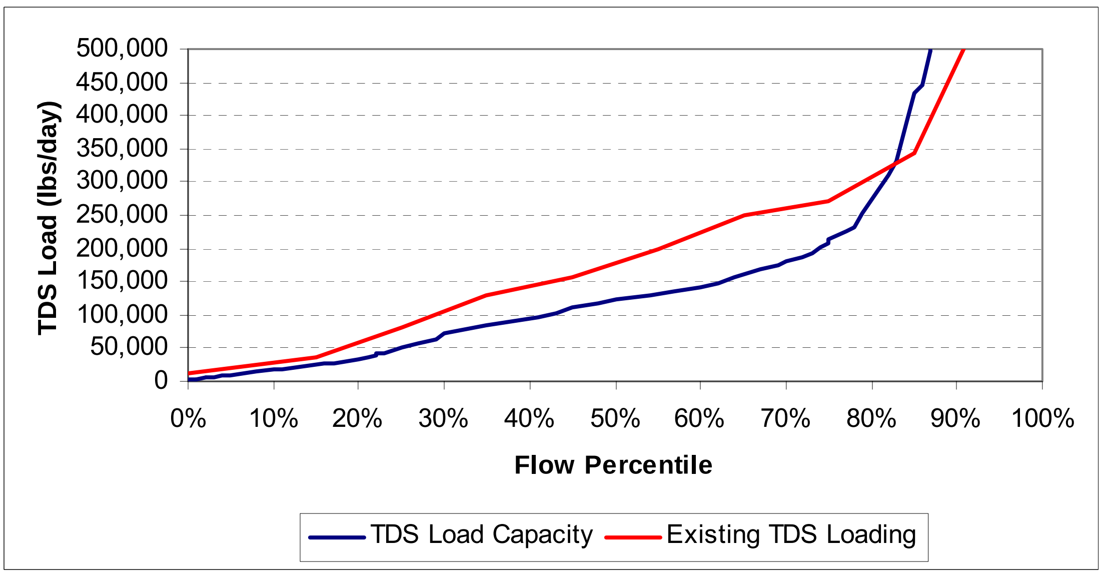


Figure 5-6. Existing TDS loading and loading capacity for Ashley Creek.



6.0 TMDL Allocation

6.1 Description of TMDL Allocation

A TMDL is composed of the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for non-point sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation

$$\text{TMDL} = \Sigma \text{ WLAs} + \Sigma \text{ LAs} + \text{MOS}$$

The TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. The TMDLs for Se and TDS for Ashley Creek are expressed on a mass loading basis.

6.2 Selecting a Margin of Safety

The MOS is a required part of the TMDL development process. There are two basic methods for incorporating the MOS (USEPA, 1991). Implicit methods incorporate the MOS using conservative model assumptions to develop allocations. Explicit methods specify a portion of the total TMDL as the MOS, allocating the remainder to sources.

For the Ashley Creek TMDLs, the MOS was included explicitly by allocating 5 percent of the loading capacity to the MOS.

6.3 Allocation Summary

The TMDLs for Ashley Creek have been developed for the range of flows measured from July 1991 to September 2001 at the USGS gage 9271550 (Ashley Creek below Union Canal diversion near Jensen). Using the observed flows and the targets of 5 ug/L Se and 1,200 mg/L TDS, average annual loading capacities were calculated. Average existing Se and TDS loadings were developed within each flow percentile group using the USGS flow data and the corresponding observed water quality data at UDWQ's Ashley Creek above confluence with Green River (493721) monitoring site. These flow percentile group loadings were used to calculate the annual existing load (average daily loading multiplied by 365). These existing loads were compared to the loading capacity, and necessary reductions were calculated. Tables 6-1 and 6-2 provide summaries of the Se and TDS TMDLs for Ashley Creek, respectively.

Section 6.4 provides more detail on the calculation of the loading capacity and determination of the allocations.

Table 6-1. Summary of Se TMDL for Ashley Creek watershed.

Source	Annual existing Se load	Estimated percent reduction	Annual allocated Se load
Non-point Sources:			
Ashley Creek watershed	271 lbs/yr	0 %	271 lbs/yr
Point Sources:			
Ashley Valley Water Reclamation Facility (UPDES #UT0025348)	10 lbs/yr	0 %	72 lbs
Ashley Valley Sewer Lagoons (UPDES #UT0024511)	1,356 lbs/yr	100 %	0 lbs/yr
Total Existing Load	**1,637 lbs/yr**	**Load Allocation**	**271 lbs/yr**
Total Annual Load Reduction = 78%		**Wasteload Allocation**	**72 lbs/yr**
		Margin of Safety[1]	**18 lbs/yr**
		TMDL = Loading Capacity =	**361 lbs/yr**

[1] **Margin of safety.** The MOS was included in the analysis explicitly by allocating 5 percent of the loading capacity to the MOS.

Table 6-2. Summary of TDS TMDL for Ashley Creek watershed.

Source	Annual existing TDS load	Estimated percent reduction	Annual allocated TDS load
Non-point Sources:			
Ashley Creek watershed	25,580 tons/yr	7 %	23,806 tons/yr
Point Sources:			
Ashley Valley Water Reclamation Facility (UPDES #UT0025348)	1,667 tons/yr	0 %	3,794 tons/yr
Ashley Valley Sewer Lagoons (UPDES #UT0024511)	9,000 tons/yr	100 %	0 tons/yr
Total Existing Load	**36,247 tons/yr**	**Load Allocation**	**23,806 tons/yr**
Total Annual Load Reduction = 20%		**Wasteload Allocation**	**3,794 tons/yr**
		Margin of Safety[1]	**1,453 tons/yr**
		TMDL = Loading Capacity =	**29,053 tons/yr**

[1] **Margin of safety.** The MOS was included in the analysis explicitly by allocating 5 percent of the loading capacity to the MOS.

6.4 Pollutant Loading Scenarios

The TMDL process is designed to establish the total loading a stream can assimilate without causing violation of the water quality standards. Because of the complex hydrology, the interconnectedness of the sources, and the location and temporal record of the monitoring data, the TMDLs do not distinguish between the contribution of Se and TDS from the various tributaries. Therefore, the TMDL analyses focus on and establish the TMDLs for the entire watershed of Ashley Creek based on flow. The TMDLs are calculated on an annual basis to account for complex and varying hydrology and critical conditions in the watersheds and consistent violations of Se and TDS water quality standards.

6.4.1 Existing Conditions

The existing conditions represent Se and TDS loadings in the Ashley Creek watershed calculated from existing monitoring data. As discussed in Section 5.3, existing loads were calculated for days that had recorded Se and TDS concentrations. These individual daily loadings were calculated by multiplying the observed Se and TDS concentrations by the flow for that day and were used to establish the existing loading for each parameter (Figures 5-3 and 5-4). These lines represent the estimated existing Se and TDS loads within each flow percentile group occurring over the 10-year analysis period. The area under the existing loading curve represents the total loading over the analysis period. As summarized in Tables 6-1 and 6-2, the average annual existing Se and TDS loading in the Ashley Creek watershed is 1,637 lbs/yr and 36,247 tons/yr respectively.

6.4.2 Loading Capacity

As discussed in Section 5.1, USGS observed flows were used with the 5 ug/L target to establish the Se loading capacity over the range of observed flows (as shown in Figure 5-5). This results in an average annual loading capacity of 361 lbs/yr of Se for Ashley Creek (Table 6-1). Because 5 percent of the TMDL loading capacity is reserved for the margin of safety the allocatable portion of the loading capacity for Se is 343 lbs/yr.

Likewise, USGS observed flows were used with the 1,200 mg/L target to establish the loading capacity for TDS (Figure 5-6). The analysis resulted in an average annual loading capacity of 29,053 tons of TDS for Ashley Creek, as summarized in Table 6-2. After the 5 percent reservation for the margin of safety, the allocatable portion of the loading capacity for TDS is 27,600 tons/yr.

To illustrate the range of reductions needed at various flow and loading conditions for the TMDLs, Tables 6-3 and 6-4 present the loading capacity and average existing loads used to develop the existing loading (and, therefore, the annual existing loads) in Ashley Creek.

Table 6-3. Se load capacity, existing load, and necessary reduction at various flows.

Flow range	Avg. Flow (cfs)	Existing load (lbs/day)	Loading Capacity (lbs/day)	Percent reduction
0%-10%	1.1	0.17	0.03	82%
10%-20%	3.2	0.78	0.09	88%
20%-30%	7.1	1.94	0.19	90%
30%-40%	12.5	3.84	0.34	91%
40%-50%	17.4	4.65	0.47	90%
50%-60%	20.0	5.46	0.54	90%
60%-70%	23.0	5.54	0.62	89%
70%-80%	33.6	7.07	0.91	87%
80%-90%	81.4	7.58	2.20	71%
90%-100%	167.3	7.83	4.51	42%
Average Annual Load*		1,637 lbs/yr	361 lbs/yr	78%

*Calculated by multiplying the average of existing loads and load capacities by 365.

Table 6-4. TDS load allocation, existing load, and necessary reduction at various flows.

Flow range	Avg. Flow (cfs)	Existing load (lbs/day)	Loading Capacity (lbs/day)	Percent reduction
0%-10%	1.1	10,916	6,842	37%
10%-20%	3.3	36,472	21,602	41%
20%-30%	7.5	80,888	48,479	40%
30%-40%	12.3	129,866	79,289	39%
40%-50%	16.9	157,086	109,314	30%
50%-60%	19.9	198,165	128,642	35%
60%-70%	24.4	249,136	157,930	37%
70%-80%	32.4	269,804	203,979	24%
80%-90%	72.3	342,673	324,769	5%
90%-100%	561.6	511,116	511,116	0%
Average Annual Load (tons)*		36,247	29,053	20%

*Calculated by multiplying the average of existing loads and load capacities by 365.

6.4.3 Waste Load Allocation

Practically all of the Se and TDS load reductions needed to meet the TMDL have been allocated to the Ashley Valley Sewage Lagoons. According to studies conducted by the Bureau of Reclamation and USGS the loading attributable to the sewage lagoons totals approximately 2,000 pounds of selenium and 9,000 tons of salt per year to Ashley Creek (USDI, 1997). With the closure of the lagoons the seeps have begun to dry up and the latest Se and TDS data from Ashley Creek (493721) shows that loads of Se and TDS are decreasing (Figure 6-1). The USGS is continuing to monitor the seeps in a study scheduled to be completed in September of 2003 (Naftz, pers. comm.). Preliminary data shows that the seeps are decreasing in flow and Se concentrations are declining, but there is no identifiable trend in TDS concentrations which is similar to the USGS's findings in Colorado (Butler, 2001).

Figure 6-1. Se and TDS loads and trends from 1998-2002.

Load allocations for Se and TDS have also been established for the AVWRF, based upon the chronic water quality standard concentration of 5 ug/L for selenium and no more than a 400 mg/L increase in TDS concentration from the culinary source, along with the plant's designed capacity outflow of 4.7 million gallons per day. Since the current permit limit for TDS is relative to the concentration at the culinary source, the maximum concentration recorded of 130 mg/L plus the permitted 400 mg/L increase was used in calculating the load allocation to the AVWRF. However, this will not supercede the current permit limit of no more than a 400 mg/L increase from the culinary source. It is recognized that there is the potential for the culinary source to be higher than 130 mg/L, which would not exceed the TMDL unless the annual average concentration also exceeded 130 mg/L in which case the load allocation established by this TMDL would be revised accordingly to account for the natural change in water chemistry.

It should also be noted that current concentrations of Se from the AVWRF's discharge fall well below its established permit limit. The AVWRF's UPDES permit also states that if Se is not detected, or is found in amounts substantially below the permit limits then the AVWRF's monitoring requirement for Se could be eliminated after one year (12 samples). Given the low concentrations of Se currently being discharged by the AVWRF it is proposed that this provision be honored with the State continuing to periodically monitor Se as part of its regular monitoring program. If, at the time of the AVWRF's permit renewal date of January 31, 2006, Se concentrations have not exceeded the permit limit it is proposed that the AVWRF may petition to have Se removed from its UPDES permit.

6.4.4 Load Allocation

Because of the natural geologic sources of Se and TDS that underlie Ashley Valley there will always be some Se and TDS non-point source loading into Ashley Creek. However, due to the past and on-going implementation of salinity control projects within the watershed, the proportion of loading directly attributable to human causes (e.g. irrigation return flows) has and will likely continue to decline. Improving riparian habitat and reducing streambank erosion will also reduce Se and TDS loading, thereby improving aquatic habitat as well. Although only a small non-point source load reduction is needed it is anticipated that efforts to reduce salt loading and improve aquatic habitat will continue with the provision of cost-share funding and other grants directed at improving water quality.

7. Potential Control Options

Although practically all of the required Se and TDS load reductions have been allocated to the Ashley Valley Sewage Lagoons it is important to recognize that other sources associated with natural background (streambank erosion) and non-point sources (irrigation return flows) can and should be controlled to the maximum extent practicable on a voluntary basis through the implementation of best management practices.

Potential options for reducing non-point source Se and TDS loads in the Ashley Creek watershed include:

- Increase irrigation efficiency by providing sprinkler irrigation, properly scheduling irrigation turns, reducing flood length and leveling land.
- Line canals and ditches with open concrete lining or replace them with pipe. Seepage losses in canals and ditches can result in mineral pickup and return flow to streams through springs and drains.
- Construct weirs at turnouts to ensure that proper amounts of water are applied.
- Maintain grassed waterways and construct check dams on return flows.
- Maintain uncultivated buffer strips along streams and channels.
- Re-establish and preserve existing flood plains along Ashley Creek through planning and zoning

In addition to reducing deep percolation of irrigation water it is anticipated that controlling soil erosion from streambanks and uplands will also reduce Se and TDS loading since soils in the lower watershed are slightly to highly saline. Potential control options for reducing soil and streambank erosion include:

- Promoting proper grazing management on uplands and riparian areas to maintain sufficient plant cover to protect the soil.
- Improve condition of riparian areas through plantings, temporary grazing exclusion and development of alternate watering sites.
- Stabilize streambanks through planting deep rooted species of woody plants, placement of rock barbs and revetment to deflect flow away from erosive banks and sloping vertical streambanks to reconnect the stream channel to its floodplain and allow native vegetation to re-establish.

The Ashley Creek Stabilization/Restoration Report, completed in May of 2000 for Uintah County and the Uintah County Water Conservancy District, summarized the results of several studies designed to address problems along Ashley Creek including chronic flooding during spring run-off, lack of riparian habitat and fisheries, water quality and low flow summer conditions. After extensive discussion and consultation with local officials and the general public the authors of the report recommended the construction of an off-stream reservoir within the intermittent Spring Creek drainage to store peak flood stage flows in the spring for gradual release over the summer to provide instream flows necessary for the establishment of riparian habitat and a fishery (Franson-Noble, 2000). Work on this project has begun with a detailed site investigation of the proposed dam-site location currently underway. It is anticipated that this project would ultimately benefit water quality downstream, particularly during the summer, by diluting groundwater base-flows high in TDS that enter the channel in lower reaches.

These TMDLs are based on a representative flow regime that is determined using historical flow records. Therefore the allocated loadings and associated load reductions are calculated to meet water quality standards assuming the flow conditions remain similar to those established in the TMDL. However, it is possible with salinity control efforts focusing on decreasing TDS loads that instream TDS concentrations may increase. This could be the result of less dilution water available from flood irrigation return flows or higher TDS concentrations of groundwater baseflow. To offset this, the control options for the Ashley Creek watershed should focus on minimizing deep percolation of irrigation water through improving the efficiency of irrigation practices and conveyances on saline soils.

To address the possibility that implementation may lead to increased instream TDS concentrations and non-attainment of water quality standards this TMDL will utilize an approach that provides for the implementation of load reduction strategies while continuing to collect additional data. If when the load reductions identified in this TMDL are attained or a reasonable effort towards implementation has occurred, and water quality standards are still violated, the TMDL will be revised accordingly based upon the additional data collected. Regardless of the short-term effect on instream flows and concentrations, the available and recommended control efforts should improve irrigation efficiencies and water quality will ultimately benefit.

The reasonable assurance that these implementation activities will occur and attempt to meet the load reduction goals is that implementation is currently ongoing under the cooperative efforts of local agricultural producers and the USDI/USDA Salinity Control Program. In fact, approximately 17,000 acres of irrigated land within the watershed have already been treated. There is a great deal of local interest among watershed stakeholders to participate in the salinity control program. The availability of cost-share funding is the primary limitation on implementation. It is anticipated that with the establishment of this TMDL for the Ashley Creek watershed some of the funding shortfalls will be alleviated with 319 funding along with the priority status of other sources of funding associated with approved TMDL watersheds.

8. Future Monitoring

Continued water quality monitoring is essential to evaluate the effects of best management practices as well as progress towards meeting water quality goals and beneficial use support. In addition to the regular and intensive monitoring already conducted by the state and USGS, additional monitoring of shallow wells is recommended to determine the influence of groundwater and deep aquifers on surface water Se and TDS concentrations. Periodic monitoring will also be needed on the ephemeral drainages to the west of Ashley Creek, particularly Mantle Gulch, to determine the influence of irrigation return flows versus natural precipitation on Se and TDS loading.

In addition to regular water quality monitoring, upland and riparian areas should be monitored periodically. The purpose for monitoring these areas is to identify where significant sources of sediment and salt originate from. This monitoring will be conducted through the cooperative efforts of the Uintah County Soil Conservation District and the Ashley Creek Stabilization and Restoration Committee.

It is important to recognize that data collection in support of this TMDL is an ongoing effort and that as new data is collected this TMDL will be revised as appropriate.

9. Public Participation

Public participation for this TMDL was accomplished through a series of public meetings with the local Uintah County Soil Conservation District and the Ashley Creek Stabilization and Restoration Committee (ACSRC). The ACSRC is comprised of individuals representing key interests within the watershed.

A public hearing on the TMDLs was held on March 5, 2003 with notification of the hearing published in the local newspaper on February 24, 2003 (Vernal Express). The comment period was opened on February 24 and closed on March 18, 2002. Formal comments and responses are included in Appendix B.

In addition, the TMDL and dates for public comment were posted on the Division of Water Quality's website at (www.deq.state.ut.us/EQWQ/TMDL/TMDL_WEB.HTM).

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