Water Quality Impacts

I-25 Improvements Project Technical Memorandum

CDOT Project No. IM 0252-316

Project Control No. 12210

Colorado Department of Transportation

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1.0 Project Description

1.1 Proposed Action

The Proposed Action would widen Interstate 25 (I-25) from South Academy Boulevard (Exit 135) to State Highway 105 (Exit 161, Monument), a distance of approximately 26 miles. Within these limits, a six-lane cross-section (three through-lanes in each direction) would be built south of the U.S. Highway 24 Bypass to South Academy and north of Briargate to State Highway (SH) 105. Additionally, for the 12-mile central portion from the US 24 Bypass (Exit 139) to Briargate Parkway (Exit 151), the Proposed Action consists of an eight-lane cross section (four through-lanes in each direction).

In the eight-lane cross-section, the inside (left-most) lane in each direction would be open to general traffic during off-peak hours; during morning and evening peak hours, this lane would be reserved for use by carpools and buses only. To accommodate this flexible use, the high-occupancy-vehicle (HOV) lane would not be barrier-separated from the general-purpose lanes, but would be demarcated by appropriate signage and striping.

The non-barrier HOV treatment also allows for decommissioning of the lanes back to general-purpose operation in the event that the lanes do not result in adequate peak-period usage to justify HOV operations. This will depend in part upon public willingness to fund expanded transit operations that would use the HOV lanes. The HOV lanes are projected to be marginally successful without transit system expansion, but could become solidly successful if used by buses on hypothetical future routes (currently unfunded). Express bus service between Colorado Springs and Monument began in 2002 as a 3-year "demonstration project."

In conjunction with the additional laneage, the Proposed Action includes interchange reconstruction at several locations. These include major reconstruction of existing interchanges at:

- Exit 141 – Cimarron (U.S. Highway 24)
- Exit 142 – Bijou Street
- Exit 145 – Fillmore
- Exit 147/148 – North Nevada Avenue and Rockrimmon Boulevard (consolidated)
- Exit 156 – North Gate Road, plus freeway-to-freeway ramps for Powers Boulevard
- Exit 158 – Baptist Road

For each of the interchange reconstruction projects, numerous design alternatives were considered and evaluated. These alternatives were presented for review and input at advertised public meetings.

Additionally, minor geometric changes will be made at Exit 146, Garden of the Gods Road. The existing southbound-only ramps at Exit 147 A (Corporate Centre Drive) will be closed, with access via a local street connection to the reconfigured Nevada/Rockrimmon interchange. In conjunction with freeway widening on U.S. Air Force Academy property, the Ackerman Overlook will be relocated to a safer location.

1.2 Water Quality Overview

The major water courses within the proposed highway improvement project are Fountain Creek and Monument Creek. Monument Creek runs in a north-to-south direction along I-25 and meets Fountain Creek, which begins on the western slopes and flows east, at Cimarron. Fountain Creek continues to parallel I-25 as far as Pueblo where it meets the Arkansas River. Approximately 25 miles of I-25 and 12 major interchanges drain directly into Monument and Fountain Creeks.

Under the Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Commission Regulation No. 32, classification and numeric standards for the Arkansas River Basin have been established. Segment 1 of the Fountain Creek River Basin, which is defined as the mainstem of Fountain Creek from the source to the point immediately above the confluence with the Monument Creek, is classified as a Cold Water Aquatic Life Class 1 stream with a Recreation Classification of 2 and beneficial uses for Water Supply and Agriculture. Segment 2a includes the mainstem of Fountain Creek from a point immediately above the confluence point with Monument Creek to immediately above the confluence with Steele Hollow Creek and is downstream from Segment 1. Segment 6 is the mainstem of Monument Creek from the boundary of National Forest lands to the confluence with Fountain Creek. CDPHE has established water quality standards that are suitable in maintaining the water quality to preserve the beneficial uses or improve the water quality of the stream. The established water quality standards for the stream segments in the project area are listed in Table 1.

Currently, Segments 1, 2a, and 6 are not on the Colorado September 10, 2002 303(d) List of Impaired Waters that identifies water bodies and parameters for which the Water Quality Control Division has determined that one or more assigned uses or standards are not currently attained. However, Segment 1 is on the Monitoring and Evaluation List for sediment because there is reason to suspect water quality problems in the stream segment, but uncertainty exists in one or more factors to make a determination.

TABLE 1
Stream Classifications and Water Quality Standards

Segments for Fountain Creek Basin	Designation	Classification	Physical & Biological Standards	Inorganic (mg/L)	Metals (µg/L)
1	None	Aq Life Cold 1 Recreation 2 Water Supply Agriculture	D.O.=6.0 mg/L D.O.(sp)=7.0 mg/L pH=6.5-9.0 F.Coli=200/100ml	NH_3(ac)=TVS* S=0.002 NH_3(ch)=0.02 B=0.75 Cl_2(ac)=0.019 NO_2=0.5 Cl_2(ch)=0.011 NO_3=10 CN=0.005 Cl=250 SO_4=250 As(ac)=50 (Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS* Cu(ac/ch)=TVS*	Fe(ch)=300(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS* Mn(ch)=50(dis) Hg(ch)=0.01(tot) Ni(ac/ch)=TVS* Se(ac/ch)=TVS* Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS*
2a	Use Protected	Aq Life Warm 2 Recreation 2 Water Supply Agriculture	D.O.=5.0 mg/L pH=6.5-9.0 F.Coli=2000/100ml	NH_3(ac)=TVS* S=0.002 NH_3(ch)=0.10 B=0.75 Cl_2(ac)=0.019 NO_2=1.0 Cl_2(ch)=0.011 NO_3=10 CN=0.005 Cl=250 SO_4=330 As(ac)=50 (Trec) Cd(ac/ch)=TVS* CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS* Cu(ac/ch)=TVS*	Fe(ch)=300(dis) Fe(ch)=8000(Trec) Pb(ac/ch)=TVS* Mn(ch)=50(dis) Hg(ch)=0.01(tot) Ni(ac/ch)=TVS* Se(ac)=TVS* Se(ch)=6 Ag(ac/ch)=TVS* Zn(ac/ch)=TVS*
6	Use Protected	Aq Life Warm 2 Recreation 2 Water Supply Agriculture	D.O.=6.0 mg/L pH=6.5-9.0 F.Coli=200/100ml	NH_3(ac)=TVS* B=0.75 NH_3(ch)=0.10 NO_2=0.5 Cl_2(ac)=0.019 NO_3=10 Cl_2(ch)=0.011 Cl=250 CN=0.005 SO_4=250 As(ac)=50 (Trec) Cd(ac/ch)=TVS* CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS* Cu(ac/ch)=TVS*	Fe(ch)=300(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS* Mn(ch)=71(dis) Hg(ch)=0.01(tot) Ni(ac/ch)=TVS* Se(ac/ch)=TVS* Ag(ac/ch)=TVS* Zn(ac/ch)=TVS*

*TVS = Table Value Standards. These standards are a function of hardness of the receiving stream.

2.0 Existing Conditions

2.1 Fountain Creek Watershed

The I-25 improvement project is within the Fountain Creek Watershed (Figure 1, which follows Section 9.0). The Fountain Creek Watershed is subdivided into four subwatersheds: Fountain Creek Subwatershed (northwest section), Monument Creek Subwatershed (northeast section), Colorado Springs Composite Subwatershed (central section), and Lower Fountain Creek Subwatershed (south section). Based on the *Fountain Creek Watershed Plan* (1999) by the Pikes Peak Area Council of Governments (PPACG), each of these subwatersheds has a continual issue with erosion, sedimentation, and flooding. These issues vary in priority for each subwatershed as identified by the Plan.

The Watershed Plan provides an overview of the priority issues in the Fountain Creek Watershed. It states that the Monument Creek subwatershed erosion is a priority issue. The floodplain is constrained in numerous reaches by fill, dikes, and structures built to maximize the use of floodplain space for development. Also, Cottonwood Creek has several reaches that have continual erosion issues due to the significant drainage issues that have occurred during the past years. In the Fountain Creek Subwatershed, the primary issues are erosion and sedimentation. Steep slopes, intense storms, and cohesionless soils can generate sediment from roadside and other unprotected areas. The Watershed Plan states that the Fountain Creek headwaters generally display considerably less bedload sediment transport than the Monument Creek portion of the watershed. It also states that, throughout the Colorado Springs Composite Subwatershed, the priority issues are erosion and flooding. Streambank erosion and channel degradation are the primary issues in the metropolitan Colorado Springs area. Erosion damage occurs on a chronic and acute basis that requires continual repair and maintenance. In addition, the plan states that recent development has renewed drainage issues in some older areas. Base flows have increased above the natural flowrates. Sediment is produced in large quantities from several tributaries to Monument Creek and is transported downstream. Historically, Fountain Creek would dry up during the summer months of the year. At present, Fountain Creek flows throughout the year and continuously delivers sediment to the confluence with the Arkansas River.

2.2 Water Supplies in the Watershed

Presently, Colorado Springs Utilities has two surface water diversions for drinking water supply that are located in the vicinity of I-25 through the project area. These are:

- Stubbs-Miller Diversion located on the Pinello Ranch property on the west side of Fountain Creek south of the Academy Boulevard bridge over Fountain Creek
- Owen and Hall Diversion located at Clear Spring Ranch

Although the proposed action will not affect these facilities, coordination with Colorado Springs Utilities is required during design to ensure that temporary best management practices (BMPs) are implemented to completely avoid the potential for increased pollutant loads due to construction activities.

2.3 Drainage Basin Hydrology

The U.S. Geological Survey (USGS) conducted an analysis in 2000 showing trends in precipitation, streamflow, and morphologic changes in Fountain Creek. The USGS report states that streamflow statistics indicated that the low flow has significantly increased throughout most of the watershed, particularly since the early 1980s. Low flow in Fountain Creek has increased even though the average annual precipitation in Colorado Springs is 16 inches characterized by high intensity short-duration storm events. The report states that the increase in low flows is attributed to the increases in wastewater effluent discharges, management of Fountain Creek trans-basin return-flows, and return flow from lawn watering and crop irrigation. The USGS analysis showed that there have been minor increases in instantaneous peak flow of high return frequency-flow events. These increased peak flows are likely the result of basin development and greater impervious surface area in the watershed. As a result of the increased development, low flows have also increased in lower Fountain Creek, Cottonwood Creek, and Kettle Creek, which flow continuously. These creeks previously dried up seasonally.

2.4 Drainage Basin Water Quality

The *Water Quality Management Plan for the Pikes Peak Region* (1999) (WQM Plan) reports existing water quality problems in Fountain and Monument Creek in the study area, particularly sediment. According to this report, the reach from Pikeview to Bijou Street on Monument Creek drains 14 percent of the Monument Creek basin and produces approximately 60 percent of the annual suspended sediment load near the mouth of Monument Creek. This drainage area of the Monument Creek basin is mostly urbanized. Erosion in Williams, Sand, and Jimmy Camp Creeks contribute to these instream problems as well. Return flows from irrigated agriculture and pastureland along Fountain Creek also deliver loads of sediment. Much of the streambank erosion downstream of Colorado Springs is related to the change of flow regime due to urbanization. Also, a significant increase in sediment load has been noted at the USGS Pikeview gauge on Monument Creek. This is due to sediment loading from streams that have drainage basins underlain by easily eroded Dawson Formation and Quaternary deposits, and also the urbanization of the Cottonwood and Pine Creek drainage basins. The Natural Resource Conservation Service has documented major areas of sediment impacts, including developments in the area of Gleneagle, Briargate, Cimarron Hills, Colorado Centre, Security, and Fountain. High intensity, short-duration storms from May-August result in significant erosion in these areas, ultimately impacting Monument and Fountain Creeks.

Urban stormwater runoff in El Paso County and the City of Colorado Springs has been noted by the PPACG to have the highest potential for nonpoint source impact on the water quality of Fountain Creek. Throughout the Fountain Creek Watershed, stormwater runoff from urban areas contributes to stream flow and bank erosion. In addition to erosion, the

increased flow of urban stormwater runoff is highly variable and may be affected by a myriad of potential pollution-causing activities. Major construction activity is expected to occur in the Kettle Creek, Pine Creek, Elkhorn Creek, Cottonwood Creek, Sand Creek, and Jimmy Camp Creek sub-basins. The construction will impact water quality in the mainstems of Monument and Fountain Creeks. Fountain Creek provides a small source (15 percent) of drinking water for Colorado Springs during the drier times of the year (August-April).

2.5 Highway Drainage Design

Highway design features can impact the type and quantity of pollutants reaching receiving waters. For example, highway runoff channeled through drains from a bridge deck, sewer systems, or paved systems will essentially discharge all of the available highway pollutants into the receiving water. In contrast, vegetated ditches and detention basins used to convey and treat runoff will retain larger quantities of highway-generated pollutants. Vegetated swales can reduce contamination by promoting sedimentation and other conditions that result in removal of the dissolved fraction of metals.

The existing highway drainage conditions of I-25 through the project area is not entirely known at this stage of the project. Based on field visits and review of subdrainage maps developed by Wilson & Company, the utilization of detention or retention basins is not a common practice. Swales are present, although were not necessarily designed to act as water quality features. Much of the drainage area along the highway in the northern section, where the watershed is adjacent to the highway right-of-way, is not heavily developed. Drainage from the highway is conveyed in roadside ditches to a low point. It then flows towards the west and directly into Monument Creek. At some points, the highways drainage flows into drainage channels or naturals draws which may contain wetlands. This drainage also flows into Monument Creek.

In the southern portion of the I-25 project, primarily south of Woodmen Road, the highway parallels Monument and Fountain Creek very closely and most of the highway drainage is not collected. Most frequently the drainage is sheet flow along the east side of the highway that flow directly into the creek. During the field visit, it was noted that vegetation within the swales was sparse. Most roadside ditches contained large amounts of sand which appeared to negatively affect the vegetation in the swales. Some areas along the highway had noticeable mounds of sand (about 0.50 inches in height) along the roadside, probably from winter sanding practices.

2.6 Traffic Considerations

The quantity of and quality of highway runoff constituents can also be affected by traffic characteristics including speed, volume (average daily traffic), vehicular mix (cars/trucks), congestion factors, and state regulations controlling exhaust emissions. The Federal Highway Administration (FHWA) has indicated a strong correlation between average daily traffic (ADT) and total solids accumulation. Driscoll, categorized highways by ADT values into two categories: urban (ADT>30,000) and rural (ADT<30,000) in order to differentiate the quality of the runoff produced. In addition, the FHWA concluded that paved roadways with ADT greater than 30,000 vehicles produced runoff with two to five times the pollutant

levels present in runoff from rural areas. It is anticipated that with an increase in traffic volume, greater pollutant accumulation would be expected on the highway surfaces.

From traffic data supplied by Wilson & Company, the 24-hour average weekday two-way volumes (AWDT) at various segments of the project area are above 30,000. Approximately five miles at the beginning of northern project limits and the end of southern limits have AWDT values that are below 60,000. The majority of the project area, approximately 90 percent, has existing traffic volumes that are significantly beyond rural traffic volumes of approximately 30,000. Furthermore, projected AWDT volumes for design year 2025 are all approximately double the existing volume. The entire project area from milepost 132 – 161, is predicted to have AWDT values over 100,000 with the exception of two smaller segments in the north where AWDT values are projected to be between 80,000 – 100,000. It is likely that the current traffic volumes already produce pollutant levels. These levels will increase due to the predicted increase in traffic volumes. In addition, the increase in traffic volume includes an increase in the use of the interstate by trucks, thus increasing the potential for accidental spills and increased particulate emissions from the combustion of diesel fuel.

2.7 Surrounding Land Use

Changes in land use, particularly urbanization and industrialization, can alter the natural vegetation and infiltration characteristics of a watershed, causing runoff from the area to have a much higher surface flow component and quantity of pollutants. In general, certain conclusions can be drawn from the nature and extent of pollutant constituents and loads to receiving waters in a particular land use area.

The City of Colorado Springs PPACG Population Growth 2000-2025 Report contains various Geographic Information System (GIS) maps of projected land use and population growth. Based on these maps, it appears that the northern section of the project area is growing primarily through residential and commercial developments. South of Woodmen Road, through Colorado Springs, the land uses at present are primarily high intensity commercial, industrial, and residential, resulting in an ultra-urban environment where population density in the majority of town is over 25,000 persons per square mile. Also, population projections show that the majority of the growth will occur from Hwy 105 to the Garden of the Gods interchange. More industrial and regional center land use expansion is forecast for the northern stretch of I-25 and around the Colorado Springs Airport. In general, the entire industrial corridor along I-25 is projected to increase according to the Population Growth 2000-2025 Report.

As a result of the high growth in the area, it is anticipated that the percent imperviousness area for the northern section will increase over the next 20 years. Under the current land use in the southern section of the project, the percent imperviousness area is estimated at above 30 percent. With such a change in watershed imperviousness it can be reasoned that there will be changes in the local hydrology because of the lack of infiltration. The majority of the drainage will be conveyed as surface runoff. Without the implementation of mitigation measures, it can be anticipated that the increase in flows will increase scouring in the drainage channels and discharge higher levels of pollutants into the various receiving waters. With substantial urbanization and redevelopment of older areas it is reasonable to assume that return flows will increase the baseflow rates above that which existed naturally

in the drainage basin. Stream bank erosion and channel degradation could be expected to be a continuing problem in the Fountain Creek watershed. This will impact those portions of the highway drainage system receiving these additional flows.

2.8 Maintenance Activities

There is a potential for water quality impacts to receiving waters from deicing activities. Deicing abrasives, such as sand, when applied to highways can contribute to the solids loadings of receiving water. The abrasive action of the sand also accelerates pavement wear that contributes to the pollutant load.

The Colorado Department of Transportation (CDOT) performs mechanical sweeping of sand, dirt, and debris from paved surfaces, shoulders, curbs, gutters and median barriers to ensure roadway drainage, maintain the environmental and aesthetic quality of the roadway, and for air pollution concerns. CDOT sweeps approximately 10,063 miles of roadway in CDOT Region 2 that encompasses the I-25 Corridor project area. One of CDOT's high priorities is the removal of snow from state highways, which is tracked by the various CDOT Regions on an annual basis. According to the CDOT National Pollutant Discharge Elimination System (NPDES) Stormwater Permit Annual Report submitted to the Colorado Department of Health and Public Environment on October 1, 2001, CDOT applied 836, 164 gallons of liquid deicer and 60, 156 tons of a salt/sand mixture and 30 tons of abrasive in Regions 2 during the period of January – June 2001. Solid deicing materials other than salt/sand mixtures are not applied in Region 2.

It is anticipated that with the increase traffic volume and highway surface area, an increase in the application of deicing material will occur on the I-25 Corridor. Based on the CDOT regional maintenance data, the use of liquid deicers may double since the highway is nearly doubling in size, which may result in comparable quantities of material usage, deicers, and salt/sand mixture to that of Region 1 along the I-70 corridor where frequent snowfall events occur on the west slope . It is expected that solids loadings from material usage will double, and potential impacts from deicers/sand to the receiving water are expected to increase.

3.0 Methodology

3.1 Water Quality Assessment Approach

The water quality assessment utilized guidance developed by the Federal Highway Administration (FHWA) to determine the impacts of highway improvement projects in accordance to NEPA guidelines. The initial analysis included determination of existing conditions or "baseline conditions." Predicted conditions that would result from the proposed alternative were determined. The existing and predicted conditions were compared either qualitatively or quantitatively to determine impacts from the project. Specifically, annual pollutant mass loadings from highway runoff was evaluated for existing and proposed conditions. This method of estimating mass loading due to highway runoff is the Driscoll method. The FHWA probabilistic dilution model developed with Driscoll was used to determine the impacts of highway runoff on the receiving waters.

Data analysis procedures developed by Colorado Department of Public Health and Environment (CDPHE), *Guidance on Data Requirements and Data Interpretation Methods Used in Stream Standards and Classification Proceedings*, were followed to determine the existing water quality conditions in the project area in Segments 1, 2a, and 6 in the Fountain Creek Watershed.

Water quality data were obtained from the USGS for several monitoring stations in Fountain and Monument Creeks. Additionally, water quality data were requested from various other organizations such as the U.S. Air Force Academy, CDPHE, El Paso County, the City of Colorado Springs, PPACG, U.S. Environmental Protection Agency (USEPA), City of Fountain, City of Monument, and Fort Carson. However, these organizations either did not have any available monitoring data or referenced the USGS water quality data. Table 2 provides a description of the USGS monitoring stations used in the water quality assessment of current conditions. Figure 2 (following Section 9.0) shows the locations of the stations relative to the project area. Numerous physical, biological, inorganic, and metal parameters were evaluated for each USGS station to determine existing ambient water quality. The parameters evaluated include instantaneous discharge, water temperature, specific conductance, dissolved oxygen, biochemical oxygen demand, pH, fecal coliform bacteria, suspended solids, total ammonia, dissolved ammonia, total nitrite, dissolved nitrite, total nitrite plus nitrate, total phosphorus, dissolved sulfate, dissolved chloride, hardness, dissolved magnesium, total arsenic, total cadmium, dissolved cadmium, total chromium, total copper, dissolved copper, total iron, dissolved iron, total lead, dissolved lead, dissolved manganese, total nickel, dissolved nickel, total zinc, and dissolved zinc.

TABLE 2
Water Quality Monitoring Stations on Monument and Fountain Creek Used in This Study

USGS Station Number	Stream Segment Number	USGS Survey Station Name	Data Collection Period (years)
07103700	1	Fountain Creek near Colorado Springs, CO	1990-1999
07103707	1	Fountain Creek below 8th St., Colorado. Springs, CO	3/1998-8/1999
07103780	6	Monument Creek above North Gate Blvd. at the USAF Academy, CO	1990-1999
07103970	6	Monument Creek above Woodmen Rd. at Colorado Springs, CO	1996-1999
07104000	6	Monument Creek at Pikeview, CO	1990-1999
07104905	6	Monument Creek at Bijou St., Colorado Springs, CO	1990-1999
07105500	2A	Fountain Creek at Colorado Springs, CO	1990-1999
07105530	2A	Fountain Creek below Janitell Rd. below Colorado Springs, CO	1990-1999
07105800	2A	Fountain Creek at Security, CO	1990-1999
07106000	2A	Fountain Creek near Fountain, CO	1990-1999

Additional water quality monitoring data were obtained from the Colorado Springs Utilities. Table 3 summarizes this data and describes the water quality monitoring stations. Only average values for water quality parameters were provided. The data set contained the following parameters: temperature, conductivity, pH, fecal coliform bacteria, total dissolved solids, total ammonia, dissolved sulfate, hardness, dissolved cadmium, total chromium, dissolved copper, total iron, dissolved iron, dissolved lead, dissolved manganese, total nickel, dissolved nickel, total zinc, and dissolved zinc.

TABLE 3
Colorado Springs Utilities Water Quality Monitoring Stations Used in This Study

Station Number	Stream Segment Number	Station Name	Data Collection Period (years)
FC_I25	2A	Fountain Creek at I-25 and Cimarron Street	1/1995-12/2001
FC_33_IN	1	Fountain Creek at 33rd Street Intake	1/2001-12/2001

3.1 Determination of Water Quality Parameters of Concern

Runoff from highways and urban areas has long been recognized as a source of contaminants that could affect the nation's water resources. The contaminants of greatest concern in highway runoff are those that arise from highway construction, maintenance, and vehicles. Various conditions have been identified as major influences that can impact the runoff characteristics at a particular site:

- Storm intensity and duration affect runoff quantity and pollutant concentrations.
- Seasonal climate changes may impact pollutant concentrations in runoff.
- Surrounding land-use is an important influence on highway runoff characteristics. Research has shown that highways in more urbanized areas contribute higher concentrations of pollutants than highways in rural areas (Federal Highway Administration [FHWA, 1981]).
- Construction activities in the highway right-of way or adjacent to the highways could disturb underlying soils, thus increasing the potential for erosion and increased sediment loadings in runoff.
- Other potential influential factors may be related to the road surface types. For example, asphalt has a tendency to be have a rougher surface than concrete. As a result, surface runoff velocities on asphalt would be slower relative to a concrete surface, thus allowing a longer detention time and an increase in the potential for pollutants to concentrate before discharging into a receiving waterway.

Pollutants of concern were developed based on a review of the literature available on highway runoff. Table 4 lists the typical highway runoff constituents, their primary sources, and the water quality impacts.

TABLE 4
Typical Water Quality Pollutants of Concern

Constituent	Source	Basis for Inclusion
Suspended Solids	Pavement wear, vehicles, atmosphere, maintenance, snow/ice abrasives, sediment disturbance.	Excessive sediment can be detrimental to aquatic life (primary producers, benthic invertebrates, and fish) by interfering with photosynthesis, respiration, growth, and reproduction.
Zinc	Tire wear, motor oil, and grease.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Cadmium	Tire wear, insecticide application.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Arsenic	Lead slag waste when smelter slag is used as the abrasive blast material for removal of surface coatings. This slag is likely to contain arsenic and mercury in hazardous quantities.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Nickel	Diesel fuel and gasoline, lubricating oil, metal plating, brake line wear, asphalt paving.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Copper	Metal plating, bearing wear, engine parts, brake lining wear, fungicides, and insecticides.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Iron	Auto body rust, steel highway structures, engine parts.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Lead	Leaded gasoline, tire wear, lubricating oil and grease, bearing wear, atmospheric fallout.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Manganese	Engine parts.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Chromium	Metal plating, engine parts, brake lining wear.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Nitrite and Nitrate Nitrogen	Atmosphere, roadside fertilizer use, sediments.	Can result in accelerated growth of vegetation or algae resulting in impaired use of water; un-ionized ammonia can be toxic to freshwater fish.
Total Phosphorus	Atmosphere, roadside fertilizer use, sediments.	Can result in accelerated growth of vegetation or algae resulting in impaired use of water.
Total Coliforms	Soil litter, bird droppings, truck hauling livestock/stockyard waste.	Common bacteria found in stormwater that can lead to the closure of adjacent swimming areas, and may increase the cost of treating drinking water at water supply reservoirs.
Fecal Coliforms	Soil litter, bird droppings, truck hauling livestock/stockyard waste.	Common bacteria found in stormwater that can lead to the closure of adjacent swimming areas, and may increase the cost of treating drinking water at water supply reservoirs.
Polyaromatic Hydrocarbon (PAH)	Fuels.	Toxic to aquatic organisms. Toxicity of PAHs is additive where, even though no single PAH concentration exceeds a water quality standard, the sum of the PAHs can, under certain circumstances, be toxic.
Magnesium	Engine parts.	Toxic to aquatic organisms, can bioaccumulate, and has the potential to contaminate drinking water supplies.
Sodium	Deicing salts.	Potentially can be detrimental to plants and animals. Can increase salinity that could impact groundwater, streams, and lakes.
Chloride	Deicing salts.	Potentially can be detrimental to plants and animals. Can increase salinity that could impact groundwater, streams, and lakes.

TABLE 4
Typical Water Quality Pollutants of Concern

Constituent	Source	Basis for Inclusion
Sulfates	Roadway beds, fuel, deicing salts.	Lowers pH (increases acidity) in streams, which stresses aquatic life and leaches toxic metals out of sediment and rocks. High acidity and concentrations of heavy metals can be fatal to aquatic organisms, and may eliminate entire aquatic communities.
Chemical Oxygen Demand	Oxygen-demanding substances include plant debris, street litter, animal waste, and organic matter commonly found in stormwater.	An important water quality determinate because it estimates the level of oxygen demand in polluted waters, and is also indicative of the sustainable level of aquatic life.
Biochemical Oxygen Demand	Oxygen-demanding substances include plant debris, street litter, animal waste and organic matter commonly found in stormwater.	Often used to determine the amount of organic pollution in surface waters.
Oil and Grease	Spills, leaks, motor lubricants, antifreeze, hydraulic fluids, asphalt surface leachate.	Contain a wide array of hydrocarbon compounds, some of which are toxic to aquatic organisms at low concentrations.

Based on the available in-stream USGS data, the parameters listed in Table 4 were assessed to establish a baseline water quality for the stream segments and water quality standards for designated uses of Fountain and Monument Creeks. However, data did not exist for all the parameters in Table 4. A comparison of the available stormwater runoff water quality data from Colorado Springs, CDOT highway characterization data, and literature data from the Nationwide Urban Runoff Program (NURP) and the FHWA was performed. Further analysis was conducted to determine the increase in annual mass loading rates from the project area. This analysis used nutrient, metal, and other parameters of concern where data were available. The method of estimating mass loading due to highway runoff used is often refered to as the Driscoll method. This included steps required to determine the annual pollutant mass loads include calculation of the runoff quantity at the site and identification of the average pollutant concentration in the runoff. Site characteristics were used directly in equations to determine discharge flow rate, runoff volume, and pollutant mass loading rate. The results of the mass loading analysis were incorporated into a model that FHWA developed with Driscoll facilitate the evaluation of impacts from pollutants contributed by highway segments in the watershed. This dilution model was applied to evaluate in-stream impacts. However, the model is only calculated the potential impacts from lead, copper, and zinc on aquatic life. The model assumes that these metals have the largest impact and if controlled then other pollutants contributed by highway stormwater runoff will also be controlled. However, it does provide information regarding the water quality trends that may result from the highway expansion such as impacts of variations in stream hardness and flow. Several approaches were applied throughout the assessment to analyze the available data. Supplemental literature data was incorporated into the analysis to qualitatively and quantitatively estimate the highway runoff impacts from the project area.

3.2 Existing Water Quality

A statistical summary was developed for each USGS gauging station for the water quality pollutants of concern, as listed in Table 4, to provide baseline water quality conditions. The summary covers the past five years of the available data (1995- 2001). These data are included in Attachment A (Tables A-3 through A-14). Existing water quality was

determined from following guidelines outlined by the CDPHE Water Quality Control Division. Existing water quality is defined as the 85th percentile unionized ammonia, nitrate, and dissolved metals, the 50th percentile for total recoverable metals, the 15th percentile of such data for dissolved oxygen, the geometric mean of such data for fecal coliform and E. Coli, and the range between the 15th and 85th percentiles for pH. Comparison of the existing water quality to the water quality standards for segments 1, 6, and 2A of the Fountain Creek basin provides a reasonable estimate of the assimilative capacity of the water body to protect against degradation. Those parameters where the ambient water quality data exceeded the water quality numeric standards for their stream segment are noted and summarized in Table 5.

Ambient water quality concentration standards, classified as "chronic" and "acute," were established at each of the USGS stations. Chronic standards were assessed for each USGS station by evaluating the available chemical data values to determine if the ambient water quality concentration falls outside the percentile ranges established by CDPHE guidelines. Acute standards were assessed by comparing individual sample values against the standard.

The analysis of the existing USGS water quality data showed several trends for Fountain and Monument Creek. These are:

1. **Flow.** The median values of instantaneous annual streamflow were larger downstream of Fountain Creek and Monument Creek due to the combined flows of upper Fountain Creek and Monument Creek. As shown in Figure 3, streamflow increases from 20.5 cubic feet per second (cfs) at the most upstream gauge station on Monument Creek (07103780) to 151 cfs at the confluence (07105500), and then increases again to 182 cfs downstream near Security (07106000).

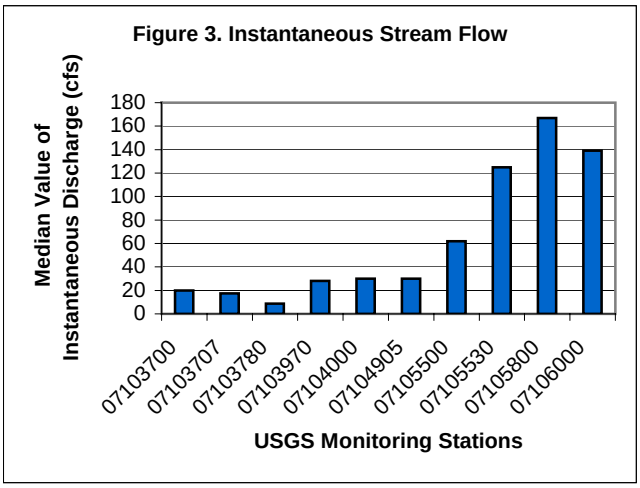


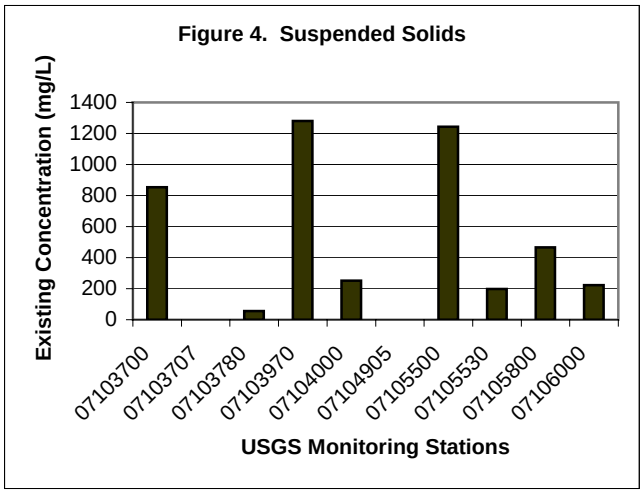
TABLE 5
Baseline Water Quality Conditions which currently exceed water quality standards at Monument and Fountain Creek

USGS Station Number	Stream Segment Number	USGS Survey Station Name	Data Collection Period (years)	Non-Attainment of Numeric Standards	Number of Values	Number of Censored Values	Existing Water Quality	Numeric Standards	Non-Attainment of Classified Uses
07103700	1	FOUNTAIN CREEK NEAR COLORADO SPRINGS, CO.	1990-1999	Dissolved lead –chronic criteria (only 5 data points used)	62	57	3.44	2.45[A]	Aquatic Life[B]
07103707	1	FOUNTAIN CREEK BL 8TH ST., AT COLO. SPRINGS, CO.	3/1998-8/1999	Dissolved Sulfate	19	0	280	250*,[D]	Drinking Water Supply
				Dissolved Manganese-chronic criteria	22	0	305	50*,[D]	Drinking Water Supply
07103780	6	MONUMENT C AB N.GATE BLVD AT USAF ACADEMY, CO.	1990-1999	---	---	---	---	---	---
07103970	6	MONUMENT CR ABV WOODMEN RD AT COLORADO SPRINGS, CO	1996-1999	Fecal Coliform Bacteria	30	15	389	200	Existing Water Quality Standard is 200/100mL, which is inconsistent with the Recreation 2 designation.[C]
				Total Iron-chronic criteria	29	0	1400	1000*	Aquatic Life
07104000	6	MONUMENT CREEK AT PIKEVIEW, CO.	1990-1999	Total Iron-chronic criteria	41	0	2000	1000*	Aquatic Life
07104905	6	MONUMENT CR AT BIJOU ST., AT COLO. SPRINGS, CO.	1990-1999	Total Iron-chronic criteria	50	0	1980	1000*	Aquatic Life
07105500	2A	FOUNTAIN CREEK AT COLORADO SPRINGS, CO.	1990-1999	---	---	---	---	---	---
07105530	2A	FOUNTAIN CR BL JANITELL RD BL COLO. SPRINGS, CO.	1990-1999	Dissolved Manganese-chronic criteria	12	1	69	50*,[D]	Drinking Water Supply
07105800	2A	FOUNTAIN CREEK AT SECURITY, CO.	1990-1999	---	---	---	---	---	---
07106000	2A	FOUNTAIN CREEK NEAR FOUNTAIN, CO.	1990-1999	---	---	---	---	---	---

[A]Hardness as calcium carbonate used to determine TVS, 97.9 mg/L. [B]Data set is comprised of less than ten samples. [C]Recreation 2 classification and numeric standards are not consistent. [D] Existing ambient quality exceeds National Secondary Drinking Water Standard. *Standard is ambient quality-based. ---, date is in compliance with numeric and ambient standards.

2. **Suspended Solids.** Figure 4 illustrates that the largest existing concentrations observed for suspended solids were at Fountain Creek east of Manitou Springs (07103700) 854 mg/L with median value of 33 mg/L; Woodmen Road and I-25 (07103970) 1280 mg/L with a median value of 168 mg/L; and just south of the confluence point (07105500) 1243 mg/L with a median value of 290 mg/L. Station 07104905 (at Bijou St.) has no sediment data available.

   The source of these high values are not known. It should be noted that these samples were taken during dry weather and are not the result of a storm event. The USGS station (07105500) at the confluence point confirms that there is a high sediment load contribution upstream from both Fountain and Monument Creeks. Larger concentrations for suspended solids are expected to occur downstream on Fountain Creek because of the inflow from Monument Creek. Existing suspended solids concentrations are smaller, 198 mg/L with a median value of 51 mg/L, at station 07105530, Fountain Creek below the Colorado Springs wastewater treatment plant. Sediment trends observed are consistent with the suspected water quality concerns for sediment expressed by the CDPHE in the *Colorado 2002 Monitoring and Evaluation List.*



3. **Nutrients.** Nutrient water quality trends were observed for Monument and Fountain Creek. The nutrients evaluated included levels of nitrate, nitrite, and total phosphorus. The existing concentrations of dissolved nitrite plus nitrate consistently increased from USGS station USGS 07103700 (upper Fountain Creek) and 07103780 (upper reaches of Monument Creek) to USGS 07106000 at Fountain, CO (lower reach of Fountain Creek) (See Figure 5). The cause of this increase could not be determined based on the limited data. Likely sources include runoff from agricultural land, highway runoff, runoff from residential lands or instream nitrification (bacterial conversion of ammonia to nitrite and nitrate). There are several wastewater treatment plants in the area: Academy Water and Sanitation District, Donala Water and Sanitation District, Forest Lakes and Triview Metropolitan Districts, City of Colorado Springs Wastewater Treatment Plant, Monument, Palmer Lake and Woodmoor Water and Sanitation District, Garden Valley Water and Sanitation District, Security Sanitation District, Widefield Water and Sanitation District, and Fountain Sanitation District.

As shown in Figure 6, total phosphorus concentrations at station 07104905, near Bijou and I-25, show the highest existing concentration (4 mg/L) of all of the evaluated gauging stations, which typically have concentrations between 0.23 –1.70 mg/L. Although trends were observed for nutrient parameters in the USGS data set, no water quality problems were indicated through the evaluation of the data set.

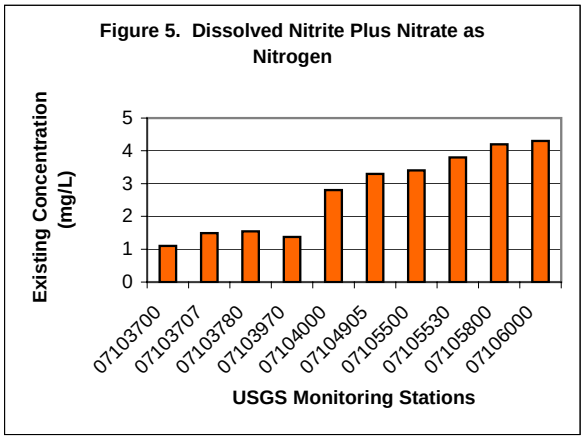


Figure 5. Dissolved Nitrite Plus Nitrate as Nitrogen

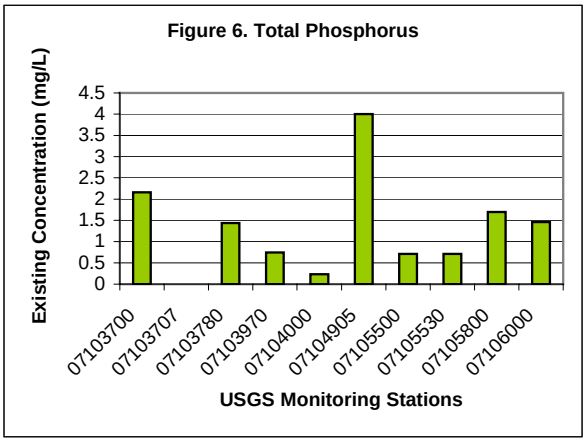
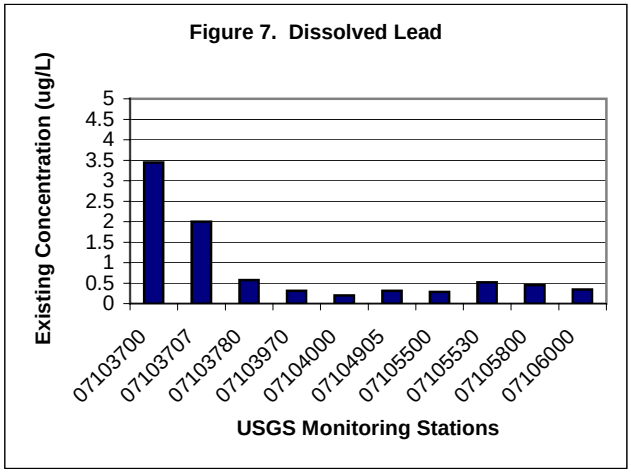
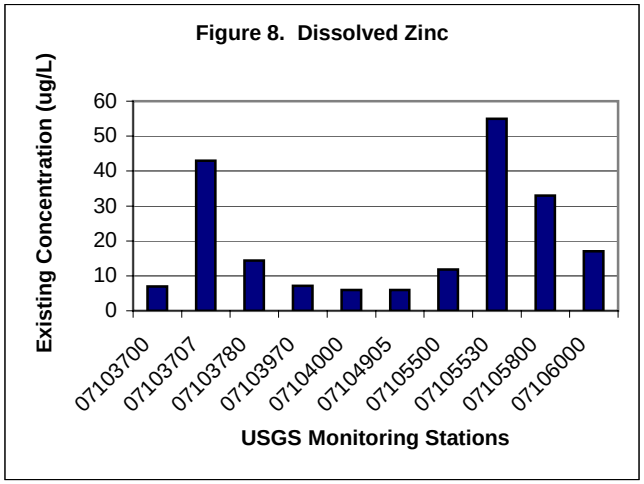
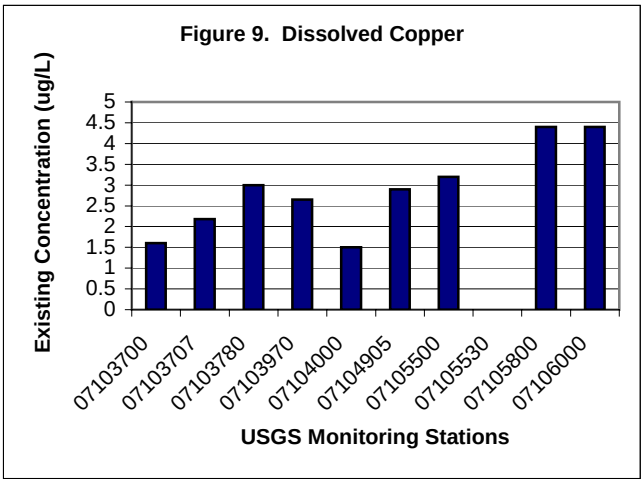


Figure 6. Total Phosphorus

4. **Metals.** Trends in the existing metal concentrations were also observed. The existing dissolved lead concentration, 3.44 mg/L, exceeded the chronic standards in Segment 1 of Fountain Creek at station 07103700 (upper Fountain Creek) as shown in Figure 7. Existing dissolved lead concentrations in Monument Creek and lower Fountain Creek are lower and do not exceed the water quality standards. Existing dissolved zinc concentrations, shown in Figure 8, significantly increase below the confluence point as well as above the confluence point on Fountain Creek at station 07103707, but do not exceed the water quality standards. Existing dissolved nickel concentrations increase consistently downstream along upper Fountain Creek and Monument Creek down to lower Fountain Creek. Total iron concentration in Monument Creek, north of the confluence point, are generally much higher than in Fountain Creek, possibly due to naturally occurring iron-rich soil. For stations closest to the confluence on Monument Creek, total iron concentrations exceed the chronic standard. Total iron concentrations increase more dramatically than dissolved iron, which can be an indication of higher sediment levels in the mainstem of Fountain Creek. As shown in Figure 9, dissolved copper concentrations increase downstream along Monument Creek and upper Fountain Creek down to lower Fountain Creek. The existing dissolved manganese concentration, at station 07103707 (at 8th St.) is 305 mg/L. Dissolved manganese concentrations in lower Fountain Creek and Monument Creek are relatively low compared to station 07103707 data. Increases in metal concentrations for stations 07103707 and 07105530 are noted for dissolved zinc as well, but do not exceed water quality standards. One potential source of the high metals is the Gold Hill Mesa tailing pile, which is located adjacent to Fountain Creek.







3.3 Impacts Assessment

The objective of this analysis is to estimate general water quality impacts of the highway expansion and highway runoff on the receiving water bodies adjacent to the I-25 Corridor project and to suggest mitigation measures.

To assess the impact from a particular highway project, it is necessary to evaluate the baseline water quality conditions, the surrounding land use, and the current highway layout and drainage design featuresThe evaluation was based on data and findings from literature, USGS in-stream water quality data, current applicable federal, state, and local water quality or stormwater regulations, and a simple FHWA dilution model.

3.3.1 Comparison of Runoff Characterization Data

The relevant importance of constituents in runoff varies depending on the existing quality of the receiving water, the base flow of the receiving water, ambient water quality, and the quantity and quality of runoff. Ranges of average event mean concentration (EMC) values in runoff are shown in Table 6. These data were obtained from monitoring performed by the City of Colorado Springs and CDOT as part of the application requirements for their municipal stormwater permits, literature values from the FHWA, and the Nationwide Urban Runoff Program (NURP) study data for an I-25 Denver site. Constituents listed in Table 6 were compared to determine where CDOT highway runoff data may fit relative to the surrounding area and nation-wide FHWA runoff data. Typical pollutants of concern present in highway runoff as shown in Table 4 were compared.The wide range of values for concentrations as well as loading rates emphasizes the high variability in highway runoff quality. Particularly, total suspended solids (TSS) and metal concentrations would be expected to be significantly higher in highway runoff than commercial or residential runoff in Colorado Springs with the exclusion of total arsenic and chromium for which lower highway runoff concentration ranges have been reported than for Colorado Springs. In comparing all of the data sets, some of the reported CDOT highway runoff concentrations are much greater or comparable to the Colorado Springs and/or FHWA data. CDOT nutrient concentrations are within similar ranges for all of the available site data. Furthermore, CDOT metal concentration ranges are significantly higher than for Colorado Springs, but are within the range of the FHWA data. Fecal coliform data for CDOT and Colorado Springs residential use data are within similar ranges, which is significantly higher than the FHWA data range. In contrast, total organic carbon (TOC) concentrations for CDOT runoff are within FHWA range and slightly lower than the Colorado Springs data. The NURP stormwater monitoring data for the I-25 site in Denver is consistent with the CDOT runoff characterization data and is within range of the FHWA data.

Based on the comparison of the runoff characterization data, CDOT pollutant concentrations are consistent with nutrients, metals, and TOC found in the highway runoff data ranges developed by the FHWA. It is also evident from this comparison that the CDOT highway runoff characterization data can be expected to contain pollutants that may contribute the in-stream loading of these parameters.

TABLE 6
Summary of Pollutant EMC Concentrations for Colorado Springs, Highway Runoff, and I-25 Denver

Constituent	City of Colorado Springs		CDOT MS4 Permit Discharge Data[2]	FHWA Highway Data[3]	NURP I-25 Denver Site Data[4]
	Commercial Use[1]	Residential Use[1]			
TSS (mg/L)	121-1400	116-848	114-2910	437-1147	----
Total Phosphorus (mg/L)	0.12-1.0	0.22-1.20	0.27-0.88	0.11-0.99	----
Total Kjedahl Nitrogen (TKN) (mg/L)	0.9-7.4	1.6-5.3	3.1-4.3	0.34-55.0	----
Zinc, Total Recoverable (ug/L)	140-730	110-310	290-690	56-929	644
Lead, Total Recoverable (ug/L)	23-350	32-170	24-260	73-1780	705
Copper, Total Recoverable (ug/L)	9-70	8-44	32-75	22-7033	145
Arsenic, Total (ug/L)	1-13	3-5	1-4	58	---
Chromium, Total Recoverable (ug/L)	14-71	18-49	4-27	0-40	---
Nickel, Total (ug/L)	---	---	7-22	53	---
Fecal Coliform (cols/100 mL)	250-368	8,200-45,500	1,650-38,000	50-590	----
Phenols, Total (ug/L)	2.33-26	9-11	7-21	---	---
Total Organic Carbon (mg/L)	29-240	18-100	55-80	24-77	----
Oil and Grease (mg/L)	1-10	5-6	2-11	2.7-27	----

[1]City of Colorado Springs, Permit No. COS-000004
[2]CDOT MS4 discharge characterization data, Permit No. COS-000005
[3]FHWA, *Evaluation and Management of Highway Runoff Water Quality*
[4]FHWA, *Pollutant Loadings and Impacts From Highway Stormwater Runoff*

3.3.2 Comparison of Annual Mass Loading

Mass Loading Approach

As stated previously, in the absence of site-specific loading data for the I-25 corridor, a mass loading -calculation developed by FHWA (sometimes referred to as the Driscoll method) was used to determine annual mass loadings for I-25 from milepost 135 through 161 in Colorado Springs. Since there are no improvements planned from milepost 131 – 161, the mass loading model was not applied for this area. Site characteristic data was used directly in mathematical equations to determine discharge flow runoff volume, and pollutant mass loading rate. FHWA obtained site characteristic data on a regional basis from previous studies, which was used to determine the annual and event pollutant mass load, including the calculation of the runoff quality at the site and average pollutant concentration in the runoff. This method was limited to determining the pollutant loads contributed only by the highway segments within the watershed.

Mass loadings for urban stormwater runoff were estimated using methodology from the *Federal Highway Administration Evaluation and Management of Highway Runoff* (1996). Pollutant loading rates were determined from the site median concentrations of pollutant for urban highways based on an average daily traffic more than 30,000 vehicles per day, the coefficient of variation of the pollutant event mean concentration, drainage area and pervious area, and rainfall characteristics available for the Denver area. Complete statistical information was obtained from the Denver data set provided by the FHWA; some of the data parameters such as coefficients of variations are not available for the Colorado Springs area. Due to limited project drainage information, the project area spanning from mileposts 135-161 was treated as a single, 100-percent impervious drainage area with existing and proposed lanes as shown in Table 7.

TABLE 7
Project Area Highway Lanes

I-25 Milepost	Existing Lanes	Proposed Lanes
151 – 161	4	6
139 – 151	4	8
135 – 139	4	6

Mass Loading Results

In general, pollutants in the stormwater runoff from the highway are expected to increase approximately 57 percent with the additional impervious area added to the existing highway (Table 8). The expected percent increase in annual load from the highway is only an estimate, and should not be viewed as an exact value. Actual site-specific stormwater monitoring data and well defined highway drainage basin calculations would be necessary to determine site-specific loading data information.

Since the annual mass loading estimation is based on various parameters such as the mean annual rainfall volume and the average number of storm events per year, the expected annual mass loading calculations have limitations. If larger values for the average mean annual rainfall volume and the average number of storm events per year were applied to the analysis, the mean event mass loads and annual mass loadings would increase. However, the percent increase from the existing annual mass loading to proposed annual mass loading would remain at approximately 57 percent because the comparison of mass loads is driven primarily by the drainage area for the project.

TABLE 8
Expected Annual Mass Loading of Pollutants for I-25 Mileposts 135-161

Pollutant	Drainage Area of Existing Highway (ha)	Drainage Area of Proposed Highway (ha)	Average Event Mean Conc. (mg/L)	Existing Annual Mass Loading (kg/yr)	Proposed Annual Mass Loading (kg/yr)	*Percent Increase of Annual Load
Total Suspended Solids	55	97	174	26,056	46,038	57
Total Organic Carbon	55	97	31	4,587	8,105	57
Chemical Oxygen Demand	55	97	140	20,919	36,960	57

TABLE 8
Expected Annual Mass Loading of Pollutants for I-25 Mileposts 135-161

Pollutant	Drainage Area of Existing Highway (ha)	Drainage Area of Proposed Highway (ha)	Average Event Mean Conc. (mg/L)	Existing Annual Mass Loading (kg/yr)	Proposed Annual Mass Loading (kg/yr)	*Percent Increase of Annual Load
Nitrate + Nitrite	55	97	0.93	140	246	57
Phosphorus (as PO4)	55	97	0.49	73	130	57
Total Copper	55	97	0.066	10	17.5	57
Total Lead	55	97	0.49	73	130	57
Total Zinc	55	97	0.40	60	107	57

*Percent increase of annual load from the highway due to the increase in highwayimpervious area.

3.3.3 Model Evaluation

Model Approach

The FHWA has developed a screening-level model to evaluate highway runoff water quality impacts. The FHWA model was applied to evaluate on a qualitative basis the impacts for the I-25 Corridor Improvements Projects based on simplified pollutant load estimation and dilution in the waterbody. The basis of the model approach was developed from the findings of the NURP that reported that "heavy metals (especially copper, lead, and zinc) are by far the most prevalent pollutant constituents found in urban runoff " (USEPA, 1983). Therefore, the model is limited to the analysis of dissolved metals for copper, lead, and zinc.

The FHWA impact analysis provides a range of information on the potential increases in copper, lead, and zinc, and compares them with the water quality standard. The FHWA procedure is a probabilistic dilution model that applies the stormwater quality data obtained from the NURP study. The model calculations compute an estimation and frequency of occurrence of in-stream concentrations of pollutants that are produced by stormwater runoff. This model also provides supporting information on the overall water quality trends of Monument and Fountain Creek that may result from the highway expansion. These trends were also used as a basis to identify project areas of concerns.

Model Assumptions

In applying the FHWA water quality assessment procedures the following assumptions were made for the I-25 Corridor Improvements Project. The data assumptions were organized in spreadsheets to apply the FHWA model calculations at each major interchange of the I-25 project.

Site data was adapted primarily from the I-25 Denver site from the NURP study because the site had a complete statistical data set, which is unavailable for the I-25 Colorado Springs location. Specifically, extensive statistical data for rainfall (intensity, duration, interval, and various coefficient of variations), and pollutant concentrations (site median EMCs of pollutants, coefficient of variations) is not available to be applied in the model to achieve site-specific results.

The Colorado Springs MS4 Permit did report event mean concentrations. However, this data, based on sampling, was limited to between 3 and 14 samples. This data set is insufficient to generate the necessary statistical parameters for the model analysis. Therefore, the closest representative available data, the Denver I-25 NURP site, was applied for the Colorado Springs I-25 site.

Site Characteristics

- The total area of the state highway right-of-way (ROW) is composed entirely of the linear highway segment crossing that particular drainage shed. The pervious areas within the state highway ROW are unknown as well as additional highway impervious areas such as entrance and exit ramps. This assumption is conservative and each contributing highway drainage area is considered 100 percent impervious. The total state highway ROW consists of only the linear highway segment; it excludes any pervious areas and impervious non-linear highway segments.

Rainfall Characteristics

- Precipitation event statistics included in the model are for Denver rather than Colorado Springs. This Denver data is from the NURP study. Use of the Denver data was necessary because of the lack of a sufficient data base for Colorado Springs. While the mean monthly precipitation for Colorado Springs is generally less than Denver, Colorado Springs has significantly more monthly events than Denver. The average storm event rainfall depth for storms producing runoff applied in the analysis should be less than for Denver (0.43 inches). The 0.22 inches estimated in the NURP study is appropriate for use for Colorado Springs.

Surrounding Area Type

- I-25 24-hour average weighted weekday two-way volume traffic (AWDT) projections for year 2025 as well as existing AWDT values for year 2000 were based on data provided by Wilson & Company. Based on the AWDT data, both existing and proposed AWDT values classify the I-25 from mileposts (mp) 132-163 as urban.

Pollutant Analysis

- Statistical EMC data for copper, lead, and zinc was obtained from the NURP study at the Denver I-25 site. As stated previously, this data is consistent with EMC data collected from highways nationwide and with the City of Colorado Spring's EMCs.

Receiving Water Target Concentration for Stream

- Surface water total hardness was obtained from the nearest USGS gauge station upstream of the subdrainage basin in which the highway segment is located.

- Acute and chronic criterion for the protection of freshwater aquatic life were obtained from CDPHE Water Quality Control Commission Regulation No. 32, the *Classification and Numeric Standards for the Arkansas River Basin*. The model calculates compliance with the acute standards usually applied as single-day maximums, and the model was modified to evaluate compliance with the chronic standards.

- Threshold effect levels were established in the NURP study. It was estimated that these concentrations could produce the mortality of the most sensitive individual of the most sensitive species from the short-duration, intermittent exposures produced by stormwater runoff.
- Although the threshold effect levels were used in the analysis, results were based on the comparison of acute and chronic standards.

Watershed Drainage Area

- The total watershed area contributing flow to the stream that receives the highway stormwater drainage is the delineated subdrainage basin (data provided by Wilson & Company) in which the interchange of concern is located.

Average Annual Stream Flow

- The model requires the annual average stream flow be input rather than the low flow for the stream. This acknowledges that the impacts will occur during a storm event and therefore, the stream will not be at a low flow condition. The coefficient of variation for daily stream flow of 1.5 was recommend for the Colorado area by the FHWA. The estimated annual average stream flow at the point of discharge was acquired from the closest USGS stream gauge station. If there is no gauge station on the stream close to the discharge point, the desired average flow and drainage area were extracted from the records of nearby gauges for which this information was available.

Highway Runoff Coefficient

The runoff coefficient or the fraction of rainfall that becomes runoff is estimated from the impervious fraction of the drainage area. A relationship from FHWA was used to determine the runoff coefficient.

Model Limitations

The model has several limitations. The model does not take into account the characteristics of the subwatershed basin in which the highway segment is located. Highly impervious drainage sheds in the most congested part of Colorado Springs are treated the same as highway segments located in rural subwatersheds. This is an important factor to consider when comparing water quality impacts from highway runoff. An urban subwatershed will discharge more runoff from its drainage basin into the stream than an rural subwatershed of the same area, where most of the flow is expected to infiltrate. As a whole, the urban drainage basin is contributing to the impairment of the receiving water. For a rural subwatershed, the contribution of pollutant loadings from highway runoff compared to the watershed would be insignificant if the receiving stream flow was high enough to dilute the highway discharge. However, for the project area of concern, rural areas in the north discharge into a very low flowing stream that does not have enough dilution capacity.

Another model limitation is the statistical NURP rainfall data used for Denver in the model analysis. The model analysis is sensitive to various parameters, particularly rainfall data. If the rainfall volume and the number of events per year are increased while holding other rainfall data constant, such as intensity, the model results would show an unchanged ratio of the annual average stream flow to the runoff flow rate produced by the mean storm

event. Coupled with an increase in the rainfall volume and the number of annual events, the stream concentration predicted by the model that will be exceeded at once in 3 years decreases, which would decrease the potential for exceeding the acute and chronic standards for lead, copper, and zinc. However, if the rainfall volume, the number of events per year, and the intensity were to be increased, then the model results would show a decrease in the ratio of the annual average stream flow to the runoff flow rate produced by the mean storm event. Therefore, the potential for violation of the acute and chronic standards increases. The rainfall sensitivity does not change the observed water quality trends, but it may shift the boundaries to the north or south of mp 149 by approximately one or two interchanges where impacts from dilution can be expected.

3.2.3.4 Recommendations and Conclusions

After applying the above assumptions into the FWHA probabilistic dilution model for lead, copper, and zinc, the basic output for a given flow ratio for the receiving stream, is the predicted in-stream concentrations that are not be exceeded more frequently than once in 3 years. The results indicate that, from Hwy 105 (mp 161) to approximately mp 155, that possible pollutant loadings could potentially cause the acute and chronic standards to be exceeded for lead, copper, and zinc. From mp 153-149, the chronic standard would potentially be exceeded for lead and this condition would continue downstream. Based on the model calculations, the potential of exceeding the standard of the receiving stream segments for various interchanges between mp 161–153 increases by 24 to 84 percent downstream from when compared with the existing and proposed conditions.

A general water quality trend can be expected for the other parameters based on the results of the model. These are:

1.) The hardness increases downstream of Monument Creek and downstream of lower Fountain Creek. The result is that the acute and chronic water quality standards, which are based on the hardness of the stream, increase. Thus the pollutant loadings are of less significance.

2.) The flow increases from approximately 10 cfs at Hwy 105 to 99 cfs at the confluence point of Monument Creek and Fountain Creek and continues to rapidly increase downstream in lower Fountain Creek to 163 cfs at station 07105530 near Janitell Road. As a result of the increased dilution of highway drainage flows downstream with the creek flows, the potential for impacts decreases. Therefore, the highway segments south of mp 149 were not analyzed using the dilution model because impacts on the water quality could not be effectively assessed given the significant increase in flows and hardness downstream.

Based on the limited model results, mitigation is recommended for highway segments between mp 161 – 149. Best Management Practices that have significant removal rates for metal constituents, especially lead, copper, and zinc, should be used. Also, for highway segments crossing a rural subwatershed draining into receiving stream with low dilution capacity, mitigation should be implemented as well as in congested urban areas.

4.0 Impacts of No-Action Alternative

Adoption of the No-Action Alternative for the I-25 corridor through Colorado Springs would result in impacts to water quality. The No-Action Alternative would result in other impacts, such as increased highway congestion, and cause contaminant concentrations in the highway runoff to increase due to high ADT values. Further water quality degradation would be anticipated to Monument and Fountain Creek as well as the surrounding wetlands because no BMPs currently are in place to address the new pollutant loadings.

5.0 Direct Impacts of Proposed Action

The main effect of highway construction on water quality is an increase of pollutants in runoff due to erosion. The main pollutant resulting from erosion is sediment. Metals and nutrients are also associated with minerals exposed by erosion. The proposed highway expansion will result in widening the existing highway approximately two-fold. Therefore, doubling the existing impervious area of the highway and contributing twice as many pollutants on annual basis.

The proposed action will increase impervious surfaces adjacent to the Monument and Fountain Creek in the CDOT ROW. Coupled with the anticipated increase in watershed imperviousness from population growth and land development, the increases in imperviousness will result in changes to local hydrology.

By incorporating highway drainage improvements during the proposed expansion project, drainage design and water quality of the highway runoff prior to discharge would be expected to improve from the existing conditions. Because the I-25 project is a significant CDOT highway redevelopment project as defined by CDOT in their New Development and Redevelopment Program, applicable regulations would serve as regulatory drivers in improving highway runoff quality prior to discharge into receiving waters, which in turn would benefit Monument and Fountain Creek water quality. Some of the benefits of implementing best management practices for water quality and quantity during the expansion project would include preventing erosion at highway discharge points to try to combat the current problems of erosion, sedimentation, and flooding in Monument and Fountain Creek.

The additional highway segments and construction activities associated with the Proposed Action are expected to have a long-term impacts on the water quality of the receiving waters due to increased pollutant loadings as a result of increased highway impervious areas, maintenance activities, and traffic volumes. The project is located near a receiving stream where low dilutive capacities exist in the north (mp 161 to mp 149) and where runoff directly discharges to poorly flushed areas of the wetlands drainage channels.

6.0 Indirect Impacts of Proposed Action

The Proposed Action would result in an area with increased impervious surfaces. The proximity of the additional highway segments and construction activities are expected to have long-term impacts on the water quality of the receiving waters due to the increased pollutant loadings as result of an increase in highway impervious areas, maintenance activities, and traffic volumes. The project is located near a receiving stream where low dilutive capacities exists in the north (mp 161 – 149) and where runoff directly discharge to poorly flushed areas of the wetlands drainage channels.

7.0 Mitigation

7.1 Regulatory Compliance

The primary federal regulatory drivers for the current stormwater program are the Phase I and Phase II Stormwater Regulations under the Clean Water Act, which, among other requirements, require regulated entities to acquire a National Pollutant Discharge Elimination System (NPDES) Permit for their stormwater discharges. Requirements for obtaining an NDPES Permit include implementation of controls on municipal wet weather runoff and on good housekeeping activities in municipal operations. Under Phase I, NPDES Permits are required for municipal separate storm sewers serving large- or medium-sized populations (greater than 250,000 or 100,000 people, respectively) and for industrial stormwater discharges. Phase II regulations apply to all point source discharges of stormwater from commercial, retail, and institutional facilities, and from municipal separate storm sewer systems serving populations under 100,000. CDOT was obligated to obtain a Phase I NPDES Permit and is in the process of obtaining a Phase II Permit.

CDOT obtained its CDPS Permit for Municipal Separate Storm Sewer Systems (MS4), Permit No. COS-000005 on January 15, 2001. CDOT's permit covers "state and interstate highways and their right-of-ways within the jurisdictional boundary of CDOT served by, or otherwise contributing to discharges to state waters from, municipal separate storm sewers owned or operated by CDOT." As a requirement of the Permit (Part I.B.1.b), CDOT was required to "develop and implement a program that ensures that new highway projects and significant highway modifications are reviewed for the need to include permanent stormwater best management practices." This Program is intended to reduce the "discharge of pollutants after construction is complete, from areas of new highway development and significant redevelopment and associated drainages." Planning procedures are under development to define "significant highway modifications" for determining the highway projects that should comply with CDOT Permit conditions established in the New Development and Redevelopment Program. The draft criteria are as follows: (1) any highway modification projects in Phase I and Phase II municipalities where the project will disturb more than 1 acre (or smaller construction activities that disturb one acre of land over a period), and (2)

other highway modification projects to be determined based on potential water quality impacts. The New Development and Redevelopment Program is required to be submitted 24 months (or on January 15, 2003) after the permit effective date, January 15, 2001. CDOT needs to apply the established criteria and procedures to all highway projects.

CDOT has established procedures that call for additional measures where the receiving water is considered "sensitive." The developed CDOT sensitive waters criteria include: (1) waters listed on the 303(d) List, (2) high quality water classification, which includes the following criteria: Domestic Water Supply, Recreation Class 1a or 1b, Cold Water Life Class 1, and Outstanding Waters, and (3) existence of threatened or endangered species. The northern portion of project from State HWY 105 to Cimarron Ave. area parallels Monument Creek Segment 6. The southern portion of the project parallels lower Fountain Creek Segment 2a.

Although both Segment 1 and 6 are not on the 2002 303(d) List, the segments have high quality classifications and there are threatened and endangered species habitat(s) adjacent to the water bodies. In applying the proposed procedures of the New Development and Redevelopment Program required by CDOT's MS4 Permit, the I-25 Corridor Improvements Project would be considered a significant highway modification requiring permanent BMPs.

7.2 Temporary and Permanent BMPs

Every effort should be made to minimize both temporary and permanent impacts to water quality to ensure the proposed action will not affect the wildlife, fish, and vegetation dependent on the water. Disturbances during construction can produce an inordinately high area of erodible surfaces; therefore, it is important to control sediment flows and minimize impacts during construction. The following permanent BMPs should be employed in an effort to minimize both short-term and permanent impacts to water bodies as a result of construction:

- NPDES guidelines for stormwater quality, including obtaining a stormwater construction permit, will be followed during construction.
- All work performed on the project will conform to Section 107.25 (Water Quality) and Section 208 (Erosion Control) of the CDOT *Standard Specifications for Road and Bridge Construction*.
- A Stormwater Management Plan (SWMP) will be developed that will detail the BMPs to be used for construction. Practices from the *Erosion Control and Stormwater Quality Guide* (ECSQG), CDOT, 2002 are outlined below:
  - Adjacent disturbed slopes will be revegetated with native plant species to protect exposed soils from erosion (See BMP EC 1, ECSQG).
  - Where temporary or permanent seeding operations are not feasible due to seasonal constraints, mulch or other CDOT-approved methods of stabilization will be applied to protect soils from erosion (See BMP EC 2, ECSQG).

  - Erosion control blankets will be used as appropriate on newly seeded slopes to control erosion and promote the establishment of vegetation (See BMP EC 5, ECSQG).
  - Temporary berms will be given priority consideration for protecting the sensitive areas in the project area (See BMP EC 8, ECSQG). Additional erosion control measures such as silt fences and erosion bales can be implemented, but with care and not as the sole erosion control system at the construction site. Erosion bales will be free of noxious weeds.
  - Erosion bales can be used as sediment barriers and filters along the toe-of-fills adjacent to water surface waterways and drainages, and at the cross-drain inlets where appropriate with additional reinforcement and in conjunction with other erosion control measures such as temporary berms (See BMP EC 1, ECSQG).
  - Where appropriate, silt fences can be used to intercept sediment-laden runoff before it enters a water body, such as a wetland, only when they are used in conjunction with other erosion control measures such as temporary berms (See BMP EC 3, ECSQG).
  - Where appropriate, slope drains will be used to convey concentrated runoff from the top to the bottom of disturbed slopes (See BMP EC 7, ECSQG). Slope and cross drain outlets will be constructed to trap sediment.
  - Check dams will be used where appropriate to slow the velocity of water through roadside ditches and swales (See BMP EC 9, ECSQG).
- Construction access at the site, for items such as haul roads, crane paths, and concrete washout areas, will be planned carefully in order to leave any sensitive habitats undisturbed.
- Concrete wash out area will be constructed at the improvement site with the following specifications:
  - Suitable locations within the CDOT right-of-way will be set a side for a concrete truck washout area. A pit with sufficient capacity to hold all anticipated wastewaters will be constructed at least 50 feet away from any state waters and the bottom of the pit will be at least 5 feet higher than groundwater. The area will be signed as a concrete wash water clean-out area and the access road leading to a paved road or highway should have a stabilized construction entrance as detailed in the *Erosion Control and Stormwater Quality Guide*. No fertilizer, hydrofertilizer, or hydromulching will be allowed adjacent to any stream or wetland.
- Permanent BMPs will be constructed where practical for use during the construction phase to improve the water quality control at the site.
- Permanent BMPs will be designed and constructed in compliance with CDOT's New Development and Redevelopment Program. All highway runoff will be collected and treated to the level required by the CDOT New Development and Redevelopment Program. Adequate storm drainage system for the existing and proposed improvements near the interchange should be developed to prevent high levels of sediment and

pollutants to be carried into the wetlands and Monument and Fountain Creeks. Non-structural BMPs such as street sweeping will be employed to improve water quality in conjunction with BMP implementation.

8.0 References Cited

City of Colorado Springs PPACG: I-25 Environmental Assessment, Population Growth 2000-2025 and Population Density 2000-2025.

Colorado Department of Public Health and Environment. July, 1993. Guidance on Data Requirements and Data Interpretation Methods Used in Stream Standards and Classification Proceedings. Colorado Water Quality Control Division.

Colorado Department of Public Health and Environment. October 30, 2001. Regulation No. 31: The Basic Standards and Methodologies for Surface Water (F CCR 1002-31). Colorado Water Quality Control Commission.

Colorado Department of Public Health and Environment. April 30, 2002. Regulation No. 32: Classifications and Numeric Standards for Arkansas River Basin. Colorado Water Quality Control Commission.

Colorado Department of Public Health and Environment. May, 2002. Policy for Characterizing Ambient Water Quality for Use in Determining Water Quality Standards Based Effluent Limits. Policy # WQP-19, Colorado Water Quality Control Division.

Colorado Department of Transportation. 2001. NPDES Stormwater Permit Annual Report for January 1, 2001 – June 30, 2001.

Colorado Department of Transportation. 1994. Standard and Specifications for Road and Bridge Construction. State Department if Highways, Division of Highways, State of Colorado.

Colorado Department of Transportation. 2002. Erosion Control and Stormwater Quality Guide. State Department if Highways, Division of Highways, State of Colorado.

Federal Highway Administration. June 1996. Evaluation and Management of Highway Runoff Water Quality. Office of Environment and Planning, Washington, DC. Publication No. FHWA-PD-96-032.

Federal Highway Administration. 1997. Ultra-Urban Best Management Practices. Federal Highway Administration, Washington, D.C. FHWA-PD-xx-xxx Draft.

Federal Highway Administration. April, 1990. Volume I: Design Procedure. FHWA-RD-88-006.

Federal Highway Administration. April, 1990. Volume II: User Guide for Interactive Computer Implementation of Design Procedure. FHWA-RD-88-007.

Federal Highway Administration. April, 1990. Volume III: Analytical Investigation and Research Report. FHWA-RD-88-008.

Federal Highway Administration. April, 1990. Volume IV: Research Report Data Appendix. FHWA-RD-88-009.

Federal Highway Administration. 1990. Pollutant Loadings and Impacts from Highway Stormwater Runoff, Volumes I-IV. FHWA/RD-88-006-9.

Federal Highway Administration. 1981. Constituents of Highway Runoff, Volumes I-VI. FHWA/RD-81-042-046.

Pikes Peak Area Council of Governments. 1999. Water Quality Management Plan for the Pikes Peak Region. PPACG Colorado Springs, Colorado.

Pikes Peak Area Council of Governments. 1999. Fountain Creek Watershed Plan. PPACG Colorado Springs, Colorado.

9.0 Attachments

Attachment A I-25 Water Quality Assessment Data – Current Conditions
Attachment B Site Characteristics of I-25 Interchanges

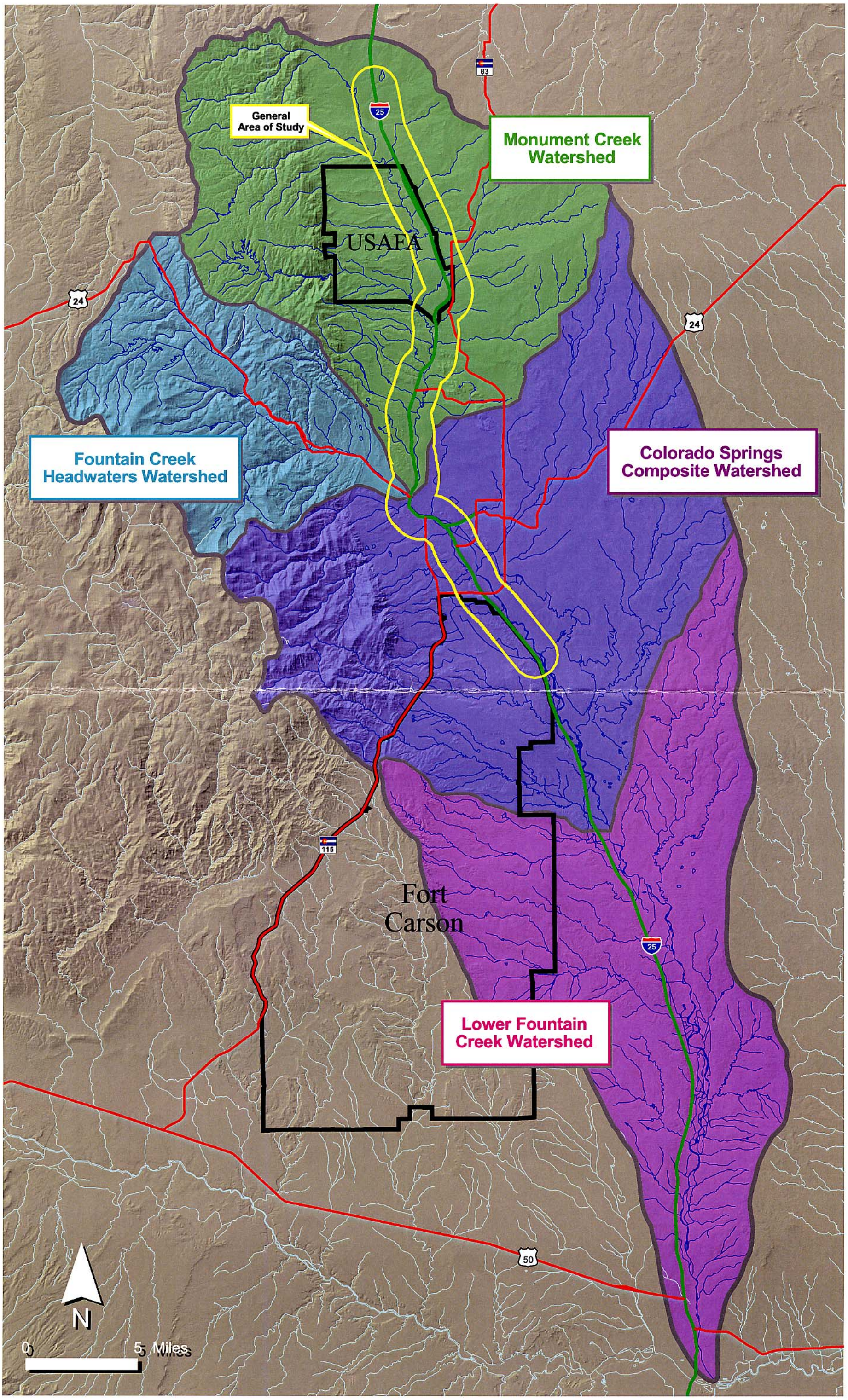


Figure 1: Fountain Creek Watershed

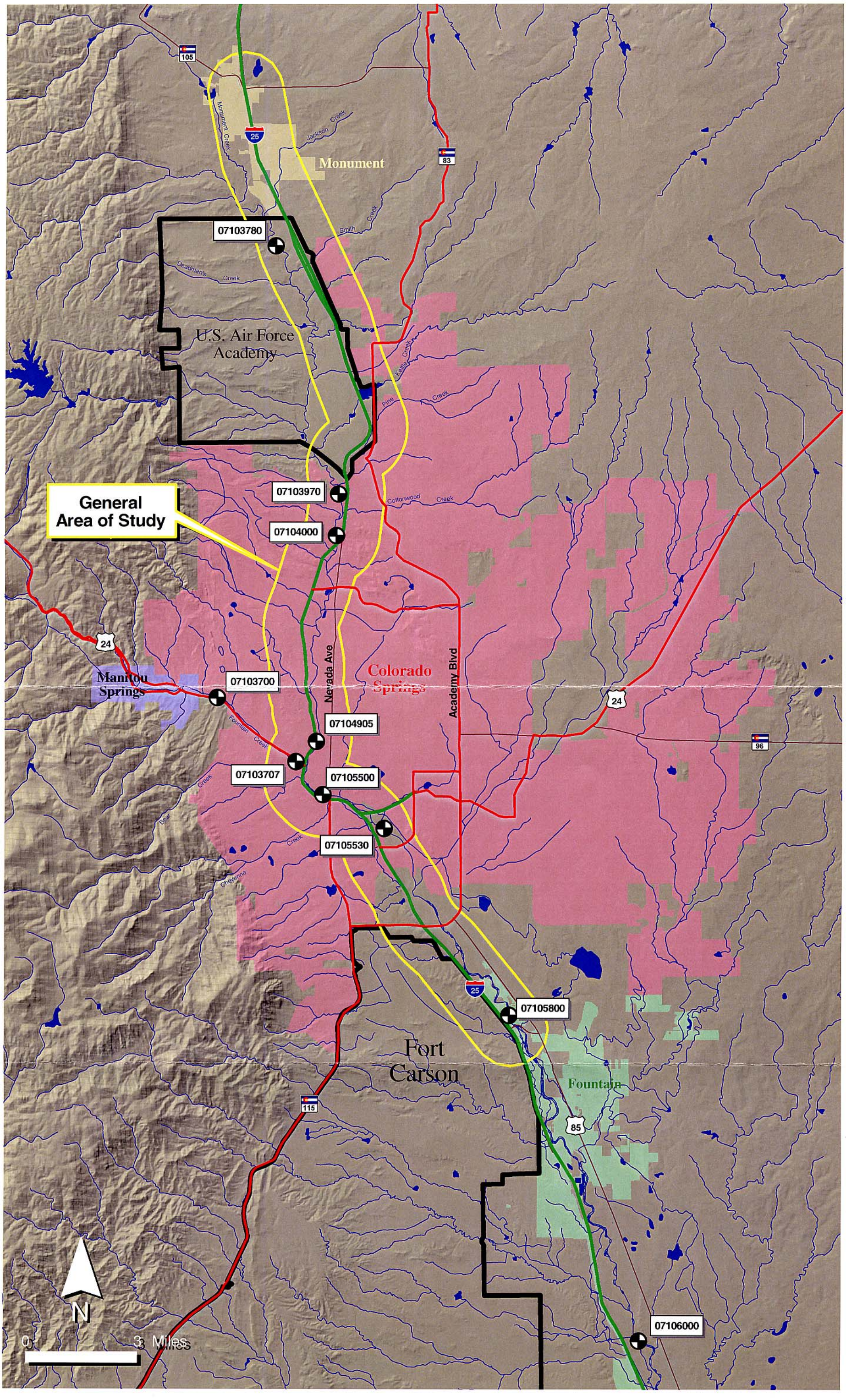


Figure 2: USGS Stations Analyzed

ATTACHMENT A

I-25 Water Quality Assessment Data – Current Conditions

I-25 Water Quality Assessment Data-Current Conditions

TABLE A-1
Water Quality Monitoring Stations on Monument and Fountain Creek Used in This Study

USGS Station Number	Stream Segment Number	USGS Survey Station Name	Data Collection Period (years)	Non-Attainment of Numeric Standards	Number of Values	Number of Censored Values	Existing Water Quality	Numeric Standards	Non-Attainment of Classified Uses
07103700	1	FOUNTAIN CREEK NEAR COLORADO SPRINGS, CO.	1990-1999	Dissolved lead–chronic criteria (only 5 data points used)	62	57	3.44	2.45[A]	Aquatic Life[B]
07103707	1	FOUNTAIN CREEK BL 8TH ST., AT COLO. SPRINGS, CO.	3/1998-8/1999	Dissolved Sulfate	19	0	280	250*,[D]	Drinking Water Supply
				Dissolved Manganese – chronic criteria	22	0	305	50*,[D]	Drinking Water Supply
07103780	6	MONUMENT C AB N.GATE BLVD AT USAF ACADEMY, CO.	1990-1999	---	---	---	---	---	---
07103970	6	MONUMENT CR ABV WOODMEN RD AT COLORADO SPRINGS, CO	1996-1999	Fecal Coliform Bacteria	30	15	389	200	Existing Water Quality Standard is 200/100mL, which is inconsistant with the recreation 2 designation.[C]
				Total Iron – chronic criteria	29	0	1400	1000*	Aquatic Life
07104000	6	MONUMENT CREEK AT PIKEVIEW, CO.	1990-1999	Total Iron – chronic criteria	41	0	2000	1000*	Aquatic Life
07104905	6	MONUMENT CR AT BIJOU ST., AT COLO. SPRINGS, CO.	1990-1999	Total Iron – chronic criteria	50	0	1980	1000*	Aquatic Life
07105500	2A	FOUNTAIN CREEK AT COLORADO SPRINGS, CO.	1990-1999	---	---	---	---	---	---
07105530	2A	FOUNTAIN CR BL JANITELL RD BL COLO. SPRINGS, CO.	1990-1999	Dissolved Manganese – chronic criteria	12	1	69	50*,[D]	Drinking Water Supply
07105800	2A	FOUNTAIN CREEK AT SECURITY, CO.	1990-1999	---	---	---	---	---	---

TABLE A-1
Water Quality Monitoring Stations on Monument and Fountain Creek Used in This Study

USGS Station Number	Stream Segment Number	USGS Survey Station Name	Data Collection Period (years)	Non-Attainment of Numeric Standards	Number of Values	Number of Censored Values	Existing Water Quality	Numeric Standards	Non-Attainment of Classified Uses
07106000	2A	FOUNTAIN CREEK NEAR FOUNTAIN, CO.	1990-1999	---	---	---	---	---	---

[A]Hardens as calcium carbonate used to determine TVS, 97.9 mg/L.
[B]Data set is comprised of less than ten samples.
[C]Recreation 2 classification and numeric standards are not consistant.
[D]Existing ambient quality exceeds National Secondary Drinking Water Standard.
*Standard is ambient quality-based.
---, data are in compliance with numeric and ambient standards.

TABLE A-2
Colorado Springs Utilities Water Quality Monitoring Stations Used in This Study

Station Number	Stream Segment Number	Station Name	Data Collection Period (years)	Non-Attainment of Numeric Standards Based on Available Average Data
FC_I25	2A	Fountain Creek at I-25 and Cimmaron Street	1/1995-12/2001	---
FC_33_IN	1	Fountain Creek at 33rd Street Intake	1/2001-12/2001	---

---, cannot be determined from limited data set.

TABLE A-3
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103700 Fountain Creek Near Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	201	0	1/1995-9/2001	56.1	118	3.7	12	20	44	1000	---	---	---	---
Water Temperature	°C	188	0	1/1995-9/2001	8.81	5.21	0	4.5	9	13.0	22	85th	14.5	Max 20°C	---
Specific Conductance	µS/cm	176	0	1/1995-9/2001	280	97	129	199	267	352	565	85th	389	---	---
Dissolved Oxygen	mg/L	58	0	1/1995-9/2001	9.57	1.33	7.5	8.4	9.75	10.8	12	15th	7.9	6.0 7.0 (spawning)	---
Biological Oxygen Demand, 5-day	mg/L	59	22	1/1995-9/2001	1.31	1.99	0.20	0.40	0.60	1.0	9.3	85th	2.1	---	---
pH	Standard	61	0	1/1995-9/2001	8.08	0.24	7.6	7.9	8.1	8.3	8.5	Range of 15th-85th	7.8-8.3	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	61	19	1/1995-9/2001	732	2368	22	65.5	140	480	15000	Geometric Mean	195	200	---
Suspended Solids	mg/L	83	0	1/1995-9/2001	766	1940	2	10	33	303	10400	85th	854	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Total Ammonia	mg/L	35	7	1/1990-12/1992	0.0018	0.0029	0.00019	0.00049	0.00065	0.0013	0.013	85th	0.0032	ac=0.12 ch=0.02	---
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	58	38	1/1995-9/2001	0.0011	0.0018	0.00006	0.00023	0.00049	0.0011	0.0075	85th	0.0012	ac=0.12 ch=0.02	---
Dissolved Ammonia as Nitrogen	mg/L	58	38	1/1995-9/2001	0.034	0.026	0.007	0.02	0.027	0.043	0.10	85th	0.054	---	---

TABLE A-3
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103700 Fountain Creek Near Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Nitrite as Nitrogen	mg/L	28	14	1/1990-12/1992	0.016	0.008	0.01	0.01	0.01	0.02	0.03	85th	0.02	0.05	---
Dissolved Nitrite as Nitrogen	mg/L	58	48	1/1993-9/1997	0.014	0.0052	0.01	0.01	0.01	0.02	0.02	85th	0.02	---	---
Total Nitrite Plus Nitrate as Nitrogen	mg/L	35	0	1/1990-12/1992	0.77	0.33	0.08	0.53	0.70	0.95	1.5	85th	1.18	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	62	0	1/1995-9/2001	0.78	0.26	0.12	0.58	0.77	1	1.3	85th	1.1	---	---
Total Phosphorus	mg/L	25	10	10/1998-8/2000	0.72	1.23	0.02	0.04	0.13	0.2	4.06	85th	2.16	---	---
Dissolved Sulfate	mg/L	53	12	1/1995-8/2000	15.0	3.42	7.2	12	15	17	22	85th	20.7	250	---
Dissolved Chloride	mg/L	93	3	1/1993-9/1997	17.4	8.2	6.3	12	16	22	66	85th	24	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	62	0	1/1995-9/2001	97.9	31.3	49	70.5	95.5	123.7	184.8	Mean	97.9	---	---
Dissolved Magnesium	mg/L	62	0	1/1995-9/2001	5.9	2.0	2.7	4.5	5.9	7.7	11.7	85th	8.2	---	---
Total Arsenic	μg/L	30	22	3/1998-9/2001	5.38	5.88	1.0	1.0	1.5	10.75	14.0	50th	1.5	ac=50	---
Total Cadmium	μg/L	61	53	1/1995-9/2001	1.46	1.69	0.14	0.27	0.65	2.14	4.6	50th	0.65	---	---
Dissolved Cadmium	μg/L	62	60	1/1995-9/2001	0.13	0.064	0.08	0.10	0.13	0.15	0.17	85th	0.16	ac(tr)=3.60 ch=2.20	---

TABLE A-3
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103700 Fountain Creek Near Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Chromium	µg/L	60	47	1/1995-9/2001	7.92	11.6	1.0	1.0	2.0	6.0	38	50th	2.0	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	59	15	1/1995-9/2001	5.39	12.34	0.7	1.2	1.95	3.53	73.7	50th	1.95	---	---
Dissolved Copper	µg/L	60	36	1/1995-9/2001	1.30	0.56	0.60	1.0	1.2	1.43	3	85th	1.60	ac=13.07 ch=8.74	---
Total Iron	µg/L	59	0	1/1995-9/2001	2723	7417	130	225	670	1250	50200	50th	670	ch=1000	---
Dissolved Iron	µg/L	61	17	1/1995-9/2001	71	250	10	20	25	40	1680	85th	50	ch=300	---
Total Lead	µg/L	62	36	1/1995-9/2001	25.4	67.4	1.0	1.75	3.0	7.5	296	50th	3.0	---	---
Dissolved Lead	µg/L	62	57	1/1995-9/2001	1.78	2.26	0.15	0.25	0.89	2.0	5.6	85th	3.44	ac(tr)=62.27 ch=2.45	**X** chronic
Dissolved Manganese	µg/L	62	1	1/1995-9/2001	48	166	3	19	26	35	1320	85th	40	ch=50	---
Total Nickel	µg/L	63	35	1/1995-9/2001	8.5	19.7	1.0	1.5	2.0	4.5	92	50th	2.0	---	---
Dissolved Nickel	µg/L	62	49	1/1995-9/2001	1.92	0.69	1.06	1.50	1.77	2.23	3.27	85th	2.59	ac=451.38 ch=50.47	---
Total Zinc	µg/L	62	25	1/1995-9/2001	67.8	170.2	3	7	12	30	834	50th	12	---	---
Dissolved Zinc	µg/L	62	43	1/1995-9/2001	5.37	3.24	2	3	5	6	17	85th	7	ac=113.44 ch=114.36	---

*[ft^3/s, cubic feet per second; µS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; µg/L, micrograms per liter; µg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-4
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103707 Fountain Creek Below 8th Street, at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	22	0	3/1998-8/2001	20	20.4	1.6	4.8	17.5	27.8	87.6	---	---	---	---
Water Temperature	°C	22	0	3/1998-8/2001	10.4	7.6	0	4.6	9	15.8	25.2	85th	19.7	Max 20°C	---
Specific Conductance	µS/cm	21	0	3/1998-8/2001	607	320	243	379	532	728	1380	85th	989	---	---
Dissolved Oxygen	mg/L	21	0	3/1998-8/2001	9.15	1.77	6.2	8	9.3	10.2	12.1	15th	7	6.0 7.0 (spawning)	---
Biological Oxygen Demand, 5-day	mg/L	22	16	3/1998-8/2001	1.57	0.57	1.0	1.1	1.45	2.03	6	85th	2.15	---	---
pH	Standard	22	0	3/1998-8/2001	8.2	0.2	7.8	8.0	8.1	8.3	8.6	Range of 15th-85th	8.0 - 8.3	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	22	7	3/1998-8/2001	297	400	25	65	78	315	1400	Geometric Mean	144	200	---
Suspended Solids	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	19	10	3/1998-8/2001	0.0011	0.0011	0	0.00024	0.00068	0.0019	0.0028	85th	0.0023	ac=0.18 ch=0.02	---
Dissolved Ammonia as Nitrogen	mg/L	19	10	3/1998-8/2001	0.047	0.032	0.012	0.03	0.04	0.06	0.12	85th	0.06	---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	0.05	---
Dissolved Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---

TABLE A-4
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103707 Fountain Creek Below 8th Street, at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	22	0	3/1998-8/2001	1.17	0.50	0.6	0.9	1.0	1.38	2.86	85th	1.49	---	---
Total Phosphorus	mg/L	18	7	3/1998-8/2001	0.079	0.79	0.02	0.04	0.05	0.08	0.3	85th	0.12	---	---
Dissolved Sulfate	mg/L	19	0	3/1998-8/2001	149	127	45	55	100	224	472	85th	280	250	**X**
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	22	0	3/1998-8/2001	215.5	115	84	130	179	246	498	Mean	215.5	---	---
Dissolved Magnesium	mg/L	22	0	3/1998-8/2001	18.4	11.8	6.2	9.6	14.6	22.2	49.4	85th	31.6	---	---
Total Arsenic	µg/L	22	7	3/1998-8/2001	3.36	2.45	1.0	1.85	2.0	5.0	10.0	50th	2.0	ac=50	---
Total Cadmium	µg/L	21	11	3/1998-8/2001	0.19	0.09	0.11	0.13	0.16	0.19	0.40	50th	0.16	---	---
Dissolved Cadmium	µg/L	22	17	3/1998-8/2001	0.13	0.12	0.08	0.08	0.08	0.08	0.34	85th	0.18	ac(tr)=8.45 ch=3.93	---
Total Chromium	µg/L	21	13	3/1998-8/2001	1.48	0.68	1	1.08	1.18	1.63	3.0	50th	1.18	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	18	0	3/1998-8/2001	2.46	1.96	0.8	1.42	1.69	3.06	9	50th	1.69	---	---
Dissolved Copper	µg/L	21	6	3/1998-8/2001	1.43	0.68	0.66	0.75	1.7	1.9	2.5	85th	2.18	ac=27.43 ch=17.11	---

TABLE A-4
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103707 Fountain Creek Below 8th Street, at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Iron	µg/L	19	0	3/1998-8/2001	760	944	40	225	500	763	4060	50th	500	ch=1000	---
Dissolved Iron	µg/L	21	12	3/1998-8/2001	17.1	9.7	10	10	12	20	40	85th	20	ch=300	---
Total Lead	µg/L	22	5	3/1998-8/2001	7.24	13.18	1.0	1.86	2	6	54.7	50th	2.0	---	---
Dissolved Lead	µg/L	22	20	3/1998-8/2001	0.4	0.16	0.29	0.35	0.40	0.46	0.51	85th	0.48	ac(tr)=145.0 ch=5.71	---
Dissolved Manganese	µg/L	22	0	3/1998-8/2001	142	156	29	52	76	136	538	85th	305	ch=50	**X**
Total Nickel	µg/L	22	2	3/1998-8/2001	3.79	1.32	2.0	2.88	4	4.7	6	50th	4	---	---
Dissolved Nickel	µg/L	22	3	3/1998-8/2001	3.19	1.32	1.6	2.0	2.9	4.3	5.4	85th	4.8	ac=878.12 ch=98.18	---
Total Zinc	µg/L	21	0	3/1998-8/2001	39.2	34.5	8	18	26	41	140	50th	26	---	---
Dissolved Zinc	µg/L	22	1	3/1998-8/2001	25.6	31.4	4	8	13	26	134	85th	43	ac=220.92 ch=222.71	---

*[ft^3/s, cubic feet per second; µS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; µg/L, micrograms per liter; µg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-5
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103780 Monument Creek Above N. Gate Blvd at USAF Academy, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	128	0	1/1995-9/2001	20.5	37	2.5	5	8.6	21	281	---	---	---	---
Water Temperature	°C	127	0	1/1995-9/2001	12.04	7.6	0	6.4	11.5	19	26.8	85th	21	---	---
Specific Conductance	µS/cm	126	0	1/1995-9/2001	289	81	106	236	296	342.8	463	85th	372	---	---
Dissolved Oxygen	mg/L	50	0	1/1995-9/2001	9.2	1.4	6.7	8	9.2	10.3	11.7	15th	7.7	6.0	---
Biological Oxygen Demand, 5-day	mg/L	50	5	1/1995-9/2001	1.53	1.12	0.2	1.1	1.4	1.6	8.3	85th	1.8	---	---
pH	Standard	52	0	1/1995-9/2001	8.22	0.29	7.6	8	8.2	8.4	8.9	Range of 15th-85th	7.9 - 8.5	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	51	28	1/1995-9/2001	84.1	52.2	16	48	75	115	220	Geometric Mean	59.0	200	---
Suspended Solids	mg/L	12	1	12/1999-8/2001	44.6	95.8	2	6	9	13.5	322	85th	55	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	53	16	1/1995-9/2001	0.0031	0.0044	5.6E-11	0.00077	0.0016	0.0034	0.024	85th	0.0049	ac=0.26 ch=0.10	---
Dissolved Ammonia as Nitrogen	mg/L	53	16	1/1995-9/2001	0.10	0.12	0.011	0.03	0.06	0.145	0.68	85th	0.17	---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	0.50	---

TABLE A-5
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103780 Monument Creek Above N. Gate Blvd at USAF Academy, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Nitrite as Nitrogen	mg/L	32	15	1/1995-9/1997	0.022	0.0097	0.01	0.02	0.02	0.02	0.04	85th	0.036	---	---
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	53	2	1/1995-9/2001	0.83	0.71	0.06	0.30	0.06	1.25	3.2	85th	1.54	---	---
Total Phosphorus	mg/L	17	0	10/1998-8/2001	0.79	0.47	0.1	0.4	0.7	1.09	1.55	85th	1.44	---	---
Dissolved Sulfate	mg/L	49	3	1/1995-9/2001	23.8	8.6	9.6	16.3	25.5	29.8	40	85th	33	250	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	53	0	1/1995-9/2001	87	20	45	79	89	98	136	Mean	87	---	---
Dissolved Magnesium	mg/L	53	0	1/1995-9/2001	4.7	1.8	2.2	4	4.6	5.2	11.2	85th	5.6	---	---
Total Arsenic	µg/L	18	0	3/1998-8/2001	1.15	1.0	1.09	1.09	1.09	1.18	1.27	50th	1.09	ac=50	---
Total Cadmium	µg/L	52	2	1/1995-9/2001	---	---	< 0.10	---	---	---	0.15	50th	---	---	---
Dissolved Cadmium	µg/L	53	48	1/1995-9/2001	0.46	0.0089	0.04	0.04	0.04	0.05	0.06	85th	0.054	ac=3.17 ch=2.01	---
Total Chromium	µg/L	52	50	1/1995-9/2001	3.46	3.25	1.16	2.31	3.46	4.61	5.76	50th	3.46	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	40	1	1/1995-9/2001	2.38	1.09	0.95	1.65	2	3.09	4.57	50th	2.0	---	---

TABLE A-5
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103780 Monument Creek Above N. Gate Blvd at USAF Academy, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Copper	µg/L	41	5	1/1995-9/2001	2.11	1.07	0.75	1	2	3	5	85th	3.0	ac=11.69 ch=7.90	---
Total Iron	µg/L	53	0	1/1995-9/2001	704	598	259	363	480	766	3240	50th	480	ch=1000	---
Dissolved Iron	µg/L	49	0	1/1995-9/2001	82	44	16	50	77	110	220	85th	119	ch=300	---
Total Lead	µg/L	53	38	1/1995-9/2001	1.95	1.9	1	1.06	1.39	2.27	5	50th	1.39	---	---
Dissolved Lead	µg/L	53	42	1/1995-9/2001	0.35	0.21	0.13	0.23	0.29	0.42	0.78	85th	0.57	ac(tr)=54.77 ch=2.16	---
Dissolved Manganese	µg/L	53	0	1/1995-9/2001	49.3	23.2	23.9	37.4	43.5	56	178	85th	62.6	ch=71	---
Total Nickel	µg/L	53	17	1/1995-9/2001	2.34	1.24	1	1.4	2	3	6.65	50th	2.0	---	---
Dissolved Nickel	µg/L	53	19	1/1995-9/2001	1.92	1.14	0.83	1	1.7	2.15	5.56	85th	3.11	ac=408.61 ch=45.69	---
Total Zinc	µg/L	53	30	1/1995-9/2001	15.3	6.5	8	10.5	13	20	32	50th	13	---	---
Dissolved Zinc	µg/L	53	20	1/1995-9/2001	10.9	3.95	4	8	10	14	20	85th	14.4	ac=102.68 ch=103.51	---

*[ft^3/s, cubic feet per second; µS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; µg/L, micrograms per liter; µg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-6
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103970 Monument Creek Above Woodmen Road at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	156	0	1/1995-9/2001	99	257	9	17	28	80	2790	---	---	---	---
Water Temperature	°C	150	0	1/1995-9/2001	13.2	7.3	0	7.1	14.5	19	28.2	85th	21	---	---
Specific Conductance	µS/cm	134	0	1/1995-9/2001	309	84	130	248	316	377	482	85th	403	---	---
Dissolved Oxygen	mg/L	29	0	3/1998-8/2001	8.8	1.7	6.5	7.2	9	9.9	11.7	15th	6.9	6.0	---
Biological Oxygen Demand, 5-day	mg/L	34	17	3/1998-8/2001	4.2	2.9	1	1.4	3.2	6.2	9.1	85th	6.9	---	---
pH	Standard	31	0	3/1998-8/2001	8.1	0.2	7.7	8	8.1	8.3	8.6	Range of 15th-85th	8.0 - 8.3	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	30	15	1/1995-9/2001	6644	15918	25	69	120	4850	61000	Geometric Mean	389	200	**X**
Suspended Solids	mg/L	81	0	12/1999-8/2001	684	1531	5	52	168	519	11000	85th	1280	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	17	5	10/1999-8/2001	0.0022	0.0023	4.64E-11	0.0008	0.0013	0.003	0.0078	85th	0.0047	ac=0.26 ch=0.10	---
Dissolved Ammonia as Nitrogen	mg/L	17	5	10/1999-8/2001	0.093	0.077	0.007	0.024	0.074	0.15	0.25	85th	0.17	---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	0.50	---

TABLE A-6
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103970 Monument Creek Above Woodmen Road at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	32	0	3/1998-8/2001	0.98	0.46	0.39	0.59	0.85	1.26	2.1	85th	1.38	---	---
Total Phosphorus	mg/L	27	1	3/1998-8/2001	0.49	0.60	0.12	0.2	0.3	0.53	3.2	85th	0.74	---	---
Dissolved Sulfate	mg/L	29	3	3/1998-8/2001	38.2	12.6	18	27.3	39	48	60	85th	50	250	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	19	0	1/1995-9/2001	113	42	49	69	134	147	170	Mean	113	---	---
Dissolved Magnesium	mg/L	32	0	10/1999-8/2001	5.33	1.93	2.15	3.65	5.38	6.86	8.28	85th	7.60	---	---
Total Arsenic	µg/L	32	4	3/1998-8/2001	2.34	1.78	1	1.12	1.88	3.01	9.31	50th	1.88	ac=50	---
Total Cadmium	µg/L	31	20	3/1998-8/2001	0.30	0.34	0.07	0.11	0.18	0.23	1.02	50th	0.18	---	---
Dissolved Cadmium	µg/L	19	16	3/1998-8/2001	0.087	0.021	0.07	0.075	0.08	0.095	0.11	85th	0.10	ac=4.21 ch=2.44	---
Total Chromium	µg/L	31	16	10/1999-8/2001	3.85	2.47	1	1.81	4	5	9.81	50th	4	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	29	0	10/1999-8/2001	8.39	9.41	1.3	2.12	3.6	11.7	36	50th	3.6	---	---

TABLE A-6
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07103970 Monument Creek Above Woodmen Road at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Copper	μg/L	19	1	3/1998-8/2001	1.76	0.77	0.60	1.23	1.65	1.9	3.7	85th	2.65	ac=14.96 ch=9.87	---
Total Iron	μg/L	29	0	10/1999-8/2001	5270	8282	230	631	1400	5310	34400	50th	1400	ch=1000	**X**
Dissolved Iron	μg/L	18	3	3/1998-8/2001	34	21	10	20	30	40	80	85th	49	ch=300	---
Total Lead	μg/L	32	11	10/1999-8/2001	19.27	23.90	1.76	3.04	8.32	30	96.8	50th	8.32	---	---
Dissolved Lead	μg/L	19	9	3/1998-8/2001	0.22	0.074	0.15	0.16	0.20	0.28	0.34	85th	0.31	ac(tr)=72.74 ch=2.86	---
Dissolved Manganese	μg/L	19	0	3/1998-8/2001	37	33	7	16	26	44	137	85th	65	ch=71	---
Total Nickel	μg/L	32	1	10/1999-8/2001	5.91	4.85	1.76	3	4.13	6.67	23.7	50th	4.13	---	---
Dissolved Nickel	μg/L	19	5	3/1998-8/2001	2.3	0.45	1.59	2.3	2.4	2.4	3.2	85th	2.53	ac=509.4 ch=56.96	---
Total Zinc	μg/L	32	0	10/1999-8/2001	69	158	5	12	18	51	872	50th	18	---	---
Dissolved Zinc	μg/L	18	4	3/1998-8/2001	5.57	1.28	4	5	5	6	8	85th	7.1	ac=128.06 ch=129.09	---

*[ft^3/s, cubic feet per second; μS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; μg/L, micrograms per liter; μg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-7
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07104000 Monument Creek at Pikeview, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	124	0	1/1995-9/2001	108	453	3	21	30	61	4890	---	---	---	---
Water Temperature	°C	109	0	1/1995-9/2001	12.8	7.9	0	7	12	19	28.5	85th	21.5	---	---
Specific Conductance	µS/cm	108	0	1/1995-9/2001	395	109	130	323	414	653	108	85th	499	---	---
Dissolved Oxygen	mg/L	39	0	1/1995-9/2001	8.3	1.5	6.2	7.0	8.2	9.4	11.4	15th	6.7	6.0	---
Biological Oxygen Demand, 5-day	mg/L	42	7	1/1995-9/2001	1.0	0.7	0.3	0.7	0.9	1.1	4.2	85th	11	---	---
PH	Standard	41	0	1/1995-9/2001	8.3	0.2	7.8	8.2	8.3	8.4	8.7	Range of 15th-85th	7.9 - 8.5	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	39	23	1/1995-9/2001	222	188	54	93	160	255	720	Geometric Mean	163	200	---
Suspended Solids	mg/L	18	0	10/1994-8/1997	601	1007	48	95	251	494	4250	85th	251	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	39	19	1/1995-9/2001	0.0017	0.0016	1.73E-11	0.0052	0.0011	0.0026	0.0054	85th	0.0031	ac=0.26 ch=0.10	---
Dissolved Ammonia as Nitrogen	mg/L	39	19	1/1995-9/2001	0.54	0.077	0.015	0.02	0.02	0.03	0.26	85th	0.057	---	---

TABLE A-7
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07104000 Monument Creek at Pikeview, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	0.50	---
Dissolved Nitrite as Nitrogen	mg/L	32	13	1/1995-8/1997	0.014	0.005	0.01	0.01	0.01	0.02	.02	85th	0.02	---	---
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	42	0	1/1995-8/1997	1.85	0.75	0.44	1.33	1.9	2.4	3.1	85th	2.8	---	---
Total Phosphorus	mg/L	6	0	1/1995-9/2001	0.22	0.41	0.2	0.2	0.2	0.2	0.3	85th	0.23	---	---
Dissolved Sulfate	mg/L	42	0	1/1995-9/2001	1.2	0.2	0.6	1	1.1	1.3	1.6	85th	1.4	250	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	42	0	10/1999-8/2001	150	36	65	129	161	175	208	Mean	150	---	---
Dissolved Magnesium	mg/L	42	0	10/1999-8/2001	6.6	1.5	3.1	5.9	6.8	7.6	8.8	85th	8.0	---	---
Total Arsenic	µg/L	10	3	1/1995-9/2001	1.56	0.38	1.15	1.25	1.44	1.84	2.13	50th	1.89	ac=50	---
Total Cadmium	µg/L	41	34	1/1995-9/2001	0.27	0.09	0.11	0.23	0.29	0.34	0.37	50th	0.29	---	---
Dissolved Cadmium	µg/L	42	42	1/1995-9/2001	---	---	< 0.07	---	---	---	< 0.07	85th	---	ac=5.71 ch=3.01	---

TABLE A-7
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07104000 Monument Creek at Pikeview, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Chromium	µg/L	41	28	1/1995-9/2001	2.4	1.7	1.1	1.4	1.6	2	6.1	50th	1.6	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	39	0	1/1995-9/2001	4.5	5.1	1.4	3	3.2	4.1	33	50th	3.2	---	---
Dissolved Copper	µg/L	38	15	1/1995-9/2001	1.3	0.6	0.9	1	1	1.2	3.7	85th	1.5	ac=19.51 ch=12.57	---
Total Iron	µg/L	41	0	1/1995-9/2001	2399	1427	830	1510	2000	2700	9100	50th	2000	ch=1000	**X**
Dissolved Iron	µg/L	41	17	1/1995-9/2001	18.9	18.9	3	9.5	14.5	20.5	97	85th	27.8	ch=300	---
Total Lead	µg/L	41	0	1/1995-9/2001	5.1	7.4	1	2	3	4.9	43	50th	3	---	---
Dissolved Lead	µg/L	42	39	1/1995-9/2001	0.18	0.027	0.16	0.17	0.17	0.19	0.21	85th	0.20	ac(tr)=98.64 ch=3.88	---
Dissolved Manganese	µg/L	42	2	1/1995-9/2001	22.6	13.5	3.3	10.8	20.5	30.5	50	85th	36.6	ch=71	---
Total Nickel	µg/L	41	1	1/1995-9/2001	3.3	2.4	1	2	2.1	3.7	11	50th	2.1	---	---
Dissolved Nickel	µg/L	42	17	1/1995-9/2001	2.2	1.9	1	1	1.4	2.4	7.7	85th	3.5	ac=646.9 ch=72.3	---
Total Zinc	µg/L	41	5	1/1995-9/2001	21.6	18.4	10	10	17	22.5	90	50th	17	---	---
Dissolved Zinc	µg/L	42	29	1/1995-9/2001	5.1	1.1	4	4	5	6	8	85th	6	ac=162.6 ch=163.9	---

TABLE A-7
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07104000 Monument Creek at Pikeview, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard

*[ft^3/s, cubic feet per second; μS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; μg/L, micrograms per liter; μg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-8
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07104905 Monument Creek at Bijou St., at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	54	0	1/1995-8/2001	46.2	50.4	10	20.3	30	44.3	305	---	---	---	---
Water Temperature	°C	54	0	1/1995-8/2001	14.5	8.9	0	7.4	14.8	23	30	85th	26	---	---
Specific Conductance	µS/cm	54	0	1/1995-8/2001	403	298	0.01	0.39	523	646	855	85th	696	---	---
Dissolved Oxygen	mg/L	52	0	1/1995-8/2001	234	336	6.2	7.9	9.7	670	901	15th	7.1	6.0	---
Biological Oxygen Demand, 5-day	mg/L	37	13	1/1995-8/2001	1.4	1.1	0.2	1.0	1.1	1.5	5.5	85th	1.9	---	---
pH	Standard	54	17	1/1995-8/2001	8.35	0.17	7.7	8.2	8.4	8.5	8.6	Range of 15th-85th	8.2 - 8.5	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	24	10	1/1995-8/2001	331	305	40	118	228	503	1100	Geometric Mean	218	200	---
Suspended Solids	mg/L	---	---	1/1995-8/2001	---	---	---	---	---	---	---	85th	---	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	10	5	10/1999-8/2001	0.0021	0.0012	0.00087	0.0011	0.0015	0.00229	0.0038	85th	0.0033	ac=0.28 ch=0.10	---
Dissolved Ammonia as Nitrogen	mg/L	10	5	10/1999-8/2001	0.021	0.01	0.011	0.013	0.021	0.022	0.037	85th	0.028	---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	0.50	---

TABLE A-8
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07104905 Monument Creek at Bijou St., at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Total Nitrite Plus Nitrate as Nitrogen	mg/L	17	2	1/1995-8/1997	0.47	0.19	0.2	0.39	0.4	0.56	0.99	85th	0.6	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	12	0	10/1999-8/2001	2.7	0.65	1.5	2.5	2.8	3.0	3.7	85th	3.3	---	---
Total Phosphorus	mg/L	35	0	1/1995-8/2001	0.92	1.88	1.76	0.1	0.3	0.92	3.9	85th	4	---	---
Dissolved Sulfate	mg/L	53	0	1/1995-8/2001	90	54	13	29	100	140	180	85th	150	250	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	12	0	1/1995-9/2001	250	41	139	240	256	267	306	Mean	250	---	---
Dissolved Magnesium	mg/L	54	0	1/1995-8/2001	334	33	4.6	12	15	76	110	85th	85	---	---
Total Arsenic	µg/L	22	0	1/1995-8/2001	1.9	1.0	1	1.7	2	2	6	50th	2	ac=50	---
Total Cadmium	µg/L	53	32	1/1995-8/2001	0.25	0.11	0.10	0.16	0.24	0.27	0.6	50th	0.24	---	---
Dissolved Cadmium	µg/L	---	---	---	---	---	---	---	---	---	---	85th	---	ac=10.16 ch=4.46	---
Total Chromium	µg/L	53	19	1/1995-8/2001	2.7	2.3	1	1.6	2	3	12	50th	2	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	49	2	1/1995-8/2001	4.3	3.8	1	2	3.7	5.7	23	50th	3.7	---	---

TABLE A-8
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07104905 Monument Creek at Bijou St., at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Copper	μg/L	12	2	1/1995-8/2001	2.4	1.0	1.3	1.6	2.4	2.8	4.7	85th	2.9	ac=32.24 ch=19.81	---
Total Iron	μg/L	50	0	1/1995-8/2001	2887	3856	2	4.6	1980	3400	20000	50th	1980	ch=1000	**X**
Dissolved Iron	μg/L	12	10	1/1995-8/2001	30	14	20	25	30	35	40	85th	37	ch=300	---
Total Lead	μg/L	53	16	1/1995-8/2001	6	7	1	3	4	6	42	50th	4	---	---
Dissolved Lead	μg/L	12	7	1/1995-8/2001	0.23	0.13	0.15	0.15	0.16	0.22	0.45	85th	0.31	ac(tr)=173.7 ch=6.8	---
Dissolved Manganese	μg/L	12	1	1/1995-8/2001	8.6	6.4	3	4	6	12.5	20	85th	17	ch=71	---
Total Nickel	μg/L	54	5	1/1995-8/2001	4.8	3.4	1	2	4	6	17	50th	4	---	---
Dissolved Nickel	μg/L	12	0	1/1995-8/2001	3.6	0.7	2.2	3.4	3.6	3.9	4.7	85th	4.2	ac=1015.4 ch=113.5	---
Total Zinc	μg/L	53	12	1/1995-8/2001	20.5	27.4	4	6	11	20	160	50th	11	---	---
Dissolved Zinc	μg/L	12	2	1/1995-8/2001	4.9	1.3	3	4	4.5	6	7	85th	6	ac=255.5 ch=257.6	---

*[ft^3/s, cubic feet per second; μS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; μg/L, micrograms per liter; μg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-9
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07105500 Fountain Creek at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	255	0	1/1995-8/2001	151	264	11	41	62	142	2960	---	---	---	---
Water Temperature	°C	238	0	1/1995-8/2001	13	7.3	0	7	14	19	28.5	85th	20.5	---	---
Specific Conductance	µS/cm	214	0	1/1995-8/2001	573	173	185	436	588	701	916	85th	749	---	---
Dissolved Oxygen	mg/L	89	0	1/1995-8/2001	9.0	1.7	6.4	7.5	8.9	10.4	12.2	15th	7.3	5.0	---
Biological Oxygen Demand, 5-day	mg/L	93	41	1/1995-8/2001	2.2	2.7	0.3	0.8	1.2	2.0	11	85th	4	---	---
pH	Standard	88	0	1/1995-8/2001	8.2	0.17	7.8	8.1	8.2	8.3	8.5	Range of 15th-85th	8.0 - 8.5	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	62	31	1/1995-8/2001	3125	10772	25	80	220	510	55000	Geometric Mean	277	2000	---
Suspended Solids	mg/L	69	0	1/1995-8/2001	1073	2334	20	102	290	569	12100	85th	1243	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	34	11	10/1999-8/2001	0.0022	0.0038	3.3E-11	0.00022	0.0008	0.0019	0.015	85th	0.0042	ac=0.27 ch=0.10	---
Dissolved Ammonia as Nitrogen	mg/L	34	11	10/1999-8/2001	0.056	0.072	0.004	0.015	0.022	0.044	0.22	85th	0.17	---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	1.0	---

TABLE A-9
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07105500 Fountain Creek at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	34	0	10/1999-8/2001	2.35	0.95	0.80	1.72	2.39	3	4.1	85th	3.4	---	---
Total Phosphorus	mg/L	52	0	1/1995-8/2001	0.77	1.55	0.058	0.17	0.2	0.33	8.24	85th	0.71	---	---
Dissolved Sulfate	mg/L	62	0	1/1995-8/2001	107	47	28	62	110	150	200	85th	160	330	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	19	0	10/1999-8/2001	190.6	85.6	66.1	109	210	264	322	Mean	270	---	---
Dissolved Magnesium	mg/L	64	0	1/1995-8/2001	12.1	5.2	2.6	7.6	12.9	17	24	85th	18	---	---
Total Arsenic	µg/L	37	2	1/1995-8/2001	5.9	6.7	1	1.8	2	10.1	25	50th	2	ac=50	---
Total Cadmium	µg/L	63	13	1/1995-8/2001	1.0	1.4	0.1	0.2	0.3	1.5	5.4	50th	0.3	---	---
Dissolved Cadmium	µg/L	19	17	10/1999-8/2001	0.08	0.014	0.07	0.075	0.08	0.085	0.09	85th	0.087	ac=7.41 ch=3.59	---
Total Chromium	µg/L	61	15	1/1995-8/2001	6.1	8.6	1	1.5	2.6	5.1	39	50th	2.55	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	61	1	1/1995-8/2001	18.9	43.2	1	3	4.2	7.8	221	50th	4.17	---	---

TABLE A-9
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07105500 Fountain Creek at Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Copper	μg/L	19	1	10/1999-8/2001	2.2	0.83	0.7	1.5	2	2.7	3.8	85th	3.2	ac=24.5 ch=15.4	---
Total Iron	μg/L	61	0	1/1995-8/2001	10547	21149	560	1660	2780	5990	122000	50th	2780	ch=8000	---
Dissolved Iron	μg/L	19	10	10/1999-8/2001	39	22	10	20	40	60	70	85th	60	ch=300	---
Total Lead	μg/L	64	0	1/1995-8/2001	27	57	1	2.3	4	11.7	277	50th	4.0	---	---
Dissolved Lead	μg/L	19	4	10/1999-8/2001	0.23	0.051	0.17	0.19	0.22	0.28	0.28	85th	0.28	ac(tr)=127.6 ch=5.0	---
Dissolved Manganese	μg/L	19	0	10/1999-8/2001	23.9	16.5	1	9.5	22	37.5	49	85th	45.6	ch=50	---
Total Nickel	μg/L	63	3	1/1995-8/2001	9.6	14.9	1	2.2	4	6.5	78	50th	4	---	---
Dissolved Nickel	μg/L	19	2	10/1999-8/2001	3.2	0.9	1.8	2.4	3.1	3.9	4.4	85th	4.2	ac=729.1 ch=88.7	---
Total Zinc	μg/L	64	1	1/1995-8/2001	89	178	10	15	26	41	940	50th	26	---	---
Dissolved Zinc	μg/L	19	3	10/1999-8/2001	7.1	3.9	3	4	7	8	16	85th	11.8	ac=199.5 ch=201.1	---

*[ft^3/s, cubic feet per second; μS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; μg/L, micrograms per liter; μg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-10
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07105530 Fountain Creek Below Janitell Road Below Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	145	0	1/1995-8/2001	163	126	68	101	125	179	1000	---	---	---	---
Water Temperature	°C	145	0	1/1995-8/2001	15	5.2	4.7	11	15	20	24.5	85th	21.1	---	---
Specific Conductance	µS/cm	145	0	1/1995-8/2001	684	124	245	634	714	766	1010	85th	789	---	---
Dissolved Oxygen	mg/L	81	0	1/1995-8/2001	8.2	1.1	6.1	7.4	8.2	9.1	12.2	15th	7.1	6.0	---
Biological Oxygen Demand, 5-day	mg/L	82	12	1/1995-8/2001	5.5	4.1	1	2.4	4	7.6	19	85th	9.6	---	---
pH	Standard	81	0	1/1995-8/2001	7.9	0.2	7.4	7.8	7.9	8	8.3	Range of 15th-85th	7.7 - 8.1	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	53	18	1/1995-8/2001	421	749	56	123	240	375	4400	Geometric Mean	240	2000	---
Suspended Solids	mg/L	11	0	1/1995-8/2001	93	77	30	38	51	140	231	85th	198	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	27	1	10/1999-8/2001	0.0094	0.011	0.00055	0.0020	0.0044	0.011	0.049	85th	0.018	ac=0.26 ch=0.10	---
Dissolved Ammonia as Nitrogen	mg/L	27	1	10/1999-8/2001	0.88	1.17	0.037	0.069	0.32	1.44	4.4	85th	1.78	---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	1.0	---

TABLE A-10
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07105530 Fountain Creek Below Janitell Road Below Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	27	0	10/1999-8/2001	3.0	0.7	1.7	2.5	2.9	3.4	4.5	85th	3.8	---	---
Total Phosphorus	mg/L	44	0	1/1995-8/2001	0.47	0.37	0.086	0.21	0.32	0.56	2.0	85th	0.71	---	---
Dissolved Sulfate	mg/L	53	0	1/1995-8/2001	147	32	54	120	160	170	190	85th	180	330	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	12	0	10/1999-8/2001	205	19	161	199	208	217	227	Mean	205	---	---
Dissolved Magnesium	mg/L	54	0	1/1995-8/2001	15.8	3.0	6.3	13.6	16.4	18	20.8	85th	18.8	---	---
Total Arsenic	µg/L	27	2	1/1995-8/2001	2.1	0.79	1.0	1.97	2.0	2.1	4.4b	50th	2.0	Ac=50	---
Total Cadmium	µg/L	53	39	1/1995-8/2001	0.21	0.11	0.11	0.14	0.18	0.23	0.53	50th	0.18	---	---
Dissolved Cadmium	µg/L	12	8	10/1999-8/2001	0.093	0.017	0.07	0.085	0.095	0.10	0.11	85th	0.105	ac=8.0 ch=3.8	---
Total Chromium	µg/L	54	18	1/1995-8/2001	1.97	0.81	1.0	1.2	1.9	2.6	3.6	50th	1.9	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	52	0	1/1995-8/2001	5.01	1.79	2.0	3.43	4.93	6.23	8.7	50th	4.93	---	---

TABLE A-10
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07105530 Fountain Creek Below Janitell Road Below Colorado Springs, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Dissolved Copper	µg/L	---	---	---	---	---	---	---	---	---	---	85th	---	ac=26.2 ch=16.4	---
Total Iron	µg/L	51	0	1/1995-8/2001	1611	1397	268	610	860	2180	6100	50th	860	ch=8000	---
Dissolved Iron	µg/L	12	0	10/1999-8/2001	3.29	1.45	1	2.33	3.35	4.35	5.2	85th	5.1	ch=300	---
Total Lead	µg/L	54	2	1/1995-8/2001	4.4	4.7	1	2	2	5.6	25.5	50th	2	---	---
Dissolved Lead	µg/L	12	0	10/1999-8/2001	0.40	1.13	1.18	0.34	0.4	0.48	0.58	85th	0.52	ac(tr)=137.5 ch=5.4	---
Dissolved Manganese	µg/L	12	0	10/1999-8/2001	61	11	43	56	59	69	81	85th	69	ch=50	**X**
Total Nickel	µg/L	51	0	1/1995-8/2001	4.2	1.9	1.3	3	4	5	10	50th	4	---	---
Dissolved Nickel	µg/L	12	0	10/1999-8/2001	4.6	1.3	2.4	4	4.4	4.8	7.9	85th	5.2	ac=841.9 ch=94.1	---
Total Zinc	µg/L	54	0	1/1995-8/2001	42	15	10	30	40	54	69	50th	40	---	---
Dissolved Zinc	µg/L	12	1	10/1999-8/2001	44	11	30	33	44	53	63	85th	55	ac=211.8 ch=213.5	---

*[ft^3/s, cubic feet per second; µS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; µg/L, micrograms per liter; µg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-11
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07105800 Fountain Creek at Security, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	162	2	1/1998-8/2001	241	237	70	118	167	240	1480	---	---	---	---
Water Temperature	°C	161	0	1/1998-8/2001	16	6.6	2.5	10.1	17.5	21.5	29	85th	22.5	---	---
Specific Conductance	µS/cm	138	0	1/1998-8/2001	709	152	239	639	741	817	965	85th	843	---	---
Dissolved Oxygen	mg/L	57	0	1/1998-8/2001	8.4	1.4	6.4	7.1	8.4	9.6	11.7	15th	6.9	6.0	---
Biological Oxygen Demand, 5-day	mg/L	59	7	1/1998-8/2001	5.9	4.6	1.1	2.3	4.1	9.2	18	85th	10.4	---	---
pH	Standard	58	1	1/1998-8/2001	8.2	0.14	7.8	8.1	8.2	8.3	8.4	Range of 15th-85th	8.0 - 8.3	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	30	14	1/1998-8/2001	7019	13313	48	288	505	4750	45000	Geometric Mean	554	2000	---
Suspended Solids	mg/L	54	0	1/1998-8/2001	941	2729	16	100	150	232	15800	85th	465	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	34	1	1/1998-8/2001	0.014	0.014	4.57E-11	0.0041	0.0086	0.017	0.053	85th	0.029	ac=0.27 ch=0.10	---
Dissolved Ammonia as Nitrogen	mg/L	34	1	1/1998-8/2001	0.61	0.79	0.022	0.10	0.19	0.94	3	85th	1.34	---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	0.50	---
Dissolved Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---

TABLE A-11
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07105800 Fountain Creek at Security, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	60	0	1/1998-8/2001	3.1	1.2	0.7	2.3	3.1	3.8	5.6	85th	4.2	---	---
Total Phosphorus	mg/L	52	0	1/1998-8/2001	1.3	2.0	0.2	0.4	0.6	0.9	8.2	85th	1.7	---	---
Dissolved Sulfate	mg/L	30	0	1/1998-8/2001	144	56	41	102	150	185	250	85th	207	330	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	19	0	10/1999-8/2001	191	72	66	128	212	256	276	Mean	191	---	---
Dissolved Magnesium	mg/L	32	0	1/1998-8/2001	15	6	3	10	16	21	23	85th	22	---	---
Total Arsenic	µg/L	32	0	1/1998-8/2001	10.6	17.9	1.6	2	3	10.7	94.3	50th	3.0	ac=50	---
Total Cadmium	µg/L	31	3	1/1998-8/2001	1.4	1.9	0.1	0.2	0.3	1.6	7.1	50th	0.3	---	---
Dissolved Cadmium	µg/L	19	8	10/1999-8/2001	0.12	0.049	0.07	0.09	0.11	0.15	0.24	85th	0.16	ac=7.4 ch=3.6	---
Total Chromium	µg/L	31	1	1/1998-8/2001	12.1	16.3	1	2	3	16.3	58	50th	3.0	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	30	0	1/1998-8/2001	35.4	49.5	1.8	6.7	8.9	41	190	50th	8.9	---	---
Dissolved Copper	µg/L	19	0	10/1999-8/2001	3.2	1.3	1.4	1.8	3.2	4.1	5.9	85th	4.4	ac=24.5 ch=15.4	---

TABLE A-11
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07105800 Fountain Creek at Security, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Iron	µg/L	27	0	1/1998-8/2001	20724	32970	705	1620	4290	20000	118000	50th	4290	ch=8000	---
Dissolved Iron	µg/L	18	5	10/1999-8/2001	32	20	10	20	20	40	70	85th	46	ch=300	---
Total Lead	µg/L	32	1	1/1998-8/2001	71	126	1	3	7	79	538	50th	7	---	---
Dissolved Lead	µg/L	19	1	10/1999-8/2001	0.54	0.89	0.18	0.25	0.32	0.40	4.1	85th	0.45	ac(tr)=127.6 ch=5.0	---
Dissolved Manganese	µg/L	19	0	10/1999-8/2001	29	24	1	9	23	42	100	85th	45	ch=50	---
Total Nickel	µg/L	30	0	1/1998-8/2001	20	27	4	7	9	14	114	50th	9	---	---
Dissolved Nickel	µg/L	19	0	10/1999-8/2001	4.3	1.4	1.7	3.3	4.5	5.5	6.7	85th	5.8	ac=793.1 ch=88.7	---
Total Zinc	µg/L	32	0	1/1998-8/2001	225	353	28	40	48	209	1480	50th	48	---	---
Dissolved Zinc	µg/L	19	2	10/1999-8/2001	23	11	5	16	21	29	44	85th	33	ac=199.5 ch=201.1	---

*[ft^3/s, cubic feet per second; µS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; µg/L, micrograms per liter; µg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-12
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07106000 Fountain Creek Near Fountain, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	22	0	1/1998-8/2001	182	114	66	113	139	238	486	---	---	---	---
Water Temperature	°C	22	0	1/1998-8/2001	15.5	6.4	5	10.2	15.3	20.4	27	85^{th}	23.7	---	---
Specific Conductance	µS/cm	22	0	1/1998-8/2001	886	128	685	742	923	984	1050	85^{th}	1017	---	---
Dissolved Oxygen	mg/L	21	0	1/1998-8/2001	8.1	1.2	6.2	7.3	8	8.9	10.3	15^{th}	6.5	6.0	---
Biological Oxygen Demand, 5-day	mg/L	22	5	1/1998-8/2001	2.9	1.5	1.4	1.7	2.9	3.2	6	85^{th}	4.4	---	---
PH	Standard	22	0	1/1998-8/2001	8.2	0.09	8	8.2	8.2	8.3	8.4	Range of 15th-85th	8.1 - 8.3	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	21	12	1/1998-8/2001	588	969	40	180	220	480	3100	Geometric Mean	259	2000	---
Suspended Solids	mg/L	11	0	1/1998-8/2001	213	213	65	108	174	190	836	85^{th}	223	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	12	2	1/1998-8/2001	0.0059	0.0066	0.0011	0.0019	0.0031	0.0074	0.022	85^{th}	0.011	ac=0.27 ch=0.10	---
Dissolved Ammonia as Nitrogen	mg/L	12	2	1/1998-8/2001	0.17	0.21	0.18	0.03	0.087	0.16	0.67	85^{th}	0.32	---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	0.50	---
Dissolved Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---

TABLE A-12
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07106000 Fountain Creek Near Fountain, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	22	2	1/1998-8/2001	3.6	0.8	1.8	3.1	3.7	4.2	5.2	85th	4.3	---	---
Total Phosphorus	mg/L	18	0	1/1998-8/2001	0.60	0.29	0.27	0.41	0.50	0.61	1.46	85th	0.81	---	---
Dissolved Sulfate	mg/L	21	0	1/1998-8/2001	235	37	160	200	250	260	290	85th	270	330	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	12	0	10/1999-8/2001	299	39	216	288	307	327	353	Mean	299	---	---
Dissolved Magnesium	mg/L	22	0	1/1998-8/2001	24	3.8	16.3	20.8	25.3	27.6	28.3	85th	27.9	---	---
Total Arsenic	µg/L	22	0	1/1998-8/2001	3.7	2.8	2.0	2.5	3.0	3.1	15	50th	3.0	ac=50	---
Total Cadmium	µg/L	21	2	1/1998-8/2001	0.29	0.22	0.14	0.17	0.21	0.29	0.89	50th	0.21	---	---
Dissolved Cadmium	µg/L	12	2	10/1999-8/2001	0.11	0.32	0.08	0.08	0.11	0.13	0.17	85th	0.14	ac=12.0 ch=5.0	---
Total Chromium	µg/L	22	2	1/1998-8/2001	2.9	2.3	1.0	1.9	2.3	3.0	9.7	50th	2.3	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	21	0	1/1998-8/2001	9.2	4.6	3.9	6.1	7.8	10.9	23.7	50th	7.8	---	---
Dissolved Copper	µg/L	12	0	10/1999-8/2001	3.6	0.8	2.2	3.3	3.7	4.1	4.8	85th	4.4	ac=37.3 ch=22.6	---

TABLE A-12
Summary Statistics for Selected Water Quality Constituents at USGS Station Number 07106000 Fountain Creek Near Fountain, CO

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Iron	μg/L	19	0	1/1998-8/2001	3072	2690	548	1495	1810	4105	11900	50th	1810	ch=8000	---
Dissolved Iron	μg/L	11	8	10/1999-8/2001	13.3	5.8	10	10	10	15	20	85th	17	ch=300	---
Total Lead	μg/L	10.3	20.5	1/1998-8/2001	10.3	20.5	1.4	2	4.4	6.8	87	50th	4.4	---	---
Dissolved Lead	μg/L	12	0	10/1999-8/2001	0.28	0.095	0.16	0.23	0.28	0.30	0.51	85th	0.34	ac(tr)=204.2 ch=8.0	---
Dissolved Manganese	μg/L	12	0	10/1999-8/2001	10.4	6.6	3	4.4	11	14.5	24	85th	16.4	ch=50	---
Total Nickel	μg/L	22	0	1/1998-8/2001	9.1	3.4	5	6.3	8	10.3	18.6	50th	8	---	---
Dissolved Nickel	μg/L	12	0	10/1999-8/2001	5.6	0.9	3.6	5.2	5.8	6.0	7.4	85th	6.3	ac=1157.4 ch=129.4	---
Total Zinc	μg/L	22	0	1/1998-8/2001	42	27	23	32	36	39	141	50th	36	---	---
Dissolved Zinc	μg/L	12	1	10/1999-8/2001	20	7	9	17	21	24	30	85th	17	ac=291.3 ch=293.7	---

*[ft^3/s, cubic feet per second; μS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; μg/L, micrograms per liter; μg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-13
Summary Statistics for Selected Water Quality Constituents at Station Number FC-I25 Fountain Creek at I-25 and Cimmaron Street

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	---	---	1/1995-12/2001	---	---	---	---	---	---	---	---	---	---	---
Water Temperature	°C	75	---	1/1995-12/2001	8.15	---	< 0	---	---	---	19	85th	---	---	---
Conductivity	μmhos	76	---	1/1995-12/2001	637	---	206	---	---	---	1500	85th	---	---	---
Dissolved Oxygen	mg/L	---	---	1/1995-12/2001	---	---	---	---	---	---	---	15th	---	6.0	---
Biological Oxygen Demand, 5-day	mg/L	---	---	1/1995-12/2001	---	---	---	---	---	---	---	85th	---	---	---
pH	Standard	76	---	1/1995-12/2001	8.03	---	7.34	---	---	---	8.57	Range of 15th-85th	---	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	51	---	1/1995-12/2001	933	---	9.6	---	---	---	29999	Geometric Mean	---	2000	---
Total Dissolved Solids	mg/L	8	---	1/1995-12/2001	247	---	129	---	---	---	392	85th	---	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	---	---	1/1995-12/2001	---	---	---	---	---	---	---	85th		ac=0.19 ch=0.10	---
Total Ammonia	mg/L	12	---	1/1995-12/2001	< 0.1	---	< 0.1	---	---	---	< 0.1	85th		---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	1.0	---
Dissolved Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---

TABLE A-13
Summary Statistics for Selected Water Quality Constituents at Station Number FC-I25 Fountain Creek at I-25 and Cimmaron Street

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Total Phosphorus	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Sulfate	mg/L	20	---	1/1995-12/2001	165	---	26	---		---	458	85th	---	330	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	76		1/1995-12/2001	229		72				574	Mean	229	---	---
Dissolved Magnesium	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Total Arsenic	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	ac=50	---
Total Cadmium	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	---	---
Dissolved Cadmium	µg/L	12	---	1/1995-12/2001	< 0.2	---	0.95	---	---	---	< 0.2	85th	---	ac=9.0 ch=4.1	---
Total Chromium	µg/L	13	---	1/1995-12/2001	< 0.4	---	1.3	---	---	---	< 0.4	50th	---	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	---	---
Dissolved Copper	µg/L	13	---	1/1995-12/2001	8.48	---	2.60	---	---	---	17.0	85th	---	ac=29.0 ch=18.0	---
Total Iron	µg/L	40	---	1/1995-12/2001	638	---	15	---	---	---	4200	50th	---	ch=8000	**---**
Dissolved Iron	µg/L	46	---	1/1995-12/2001	13.13	---	< 10	---	---	---	133	85th	---	ch=300	---

TABLE A-13
Summary Statistics for Selected Water Quality Constituents at Station Number FC-I25 Fountain Creek at I-25 and Cimmaron Street

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Lead	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	---	---
Dissolved Lead	µg/L	13	---	1/1995-12/2001	< 1	---	< 1	---	---	---	< 1	85th	---	ac(tr)=154.5 ch=6.1	---
Dissolved Manganese	µg/L	46	---	1/1995-12/2001	47	---	< 10	---	---	---	660	85th		ch=50	---
Total Nickel	µg/L	7	---	1/1995-12/2001	< 5	---	< 5	---	---	---	< 5	50th	---	---	---
Dissolved Nickel	µg/L	1	---	1/1995-12/2001	< 5	---	< 5	---	---	---	< 5	85th	---	ac=924 ch=103	---
Total Zinc	µg/L	14	---	1/1995-12/2001	24	---	< 20	---	---	---	72	50th	---	---	---
Dissolved Zinc	µg/L	15	---	1/1995-12/2001	15	---	< 10	---	---	---	92	85th	---	ac=233 ch=234	---

*[ft^3/s, cubic feet per second; µS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; µg/L, micrograms per liter; µg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit]

TABLE A-14
Summary Statistics for Selected Water Quality Constituents at Station Number FC_33_IN Fountain Creek at 33rd Street Intake

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Physical and Biological Parameters															
Instantaneous Discharge	ft^3/s	---	---	1/2001-12/2001	---	---	---	---	---	---	---	---	---	---	---
Water Temperature	°C	12	---	1/2001-12/2001	7.0	---	0	---	---	---	16	85th	---	---	---
Conductivity	μmhos	12	---	1/2001-12/2001	400	---	308	---	---	---	497	85th	---	---	---
Dissolved Oxygen	mg/L	---	---	1/2001-12/2001	---	---	---	---	---	---	---	15th	---	6.0	---
Biological Oxygen Demand, 5-day	mg/L	---	---	1/2001-12/2001	---	---	---	---	---	---	---	85th	---	---	---
pH	Standard	12	---	1/2001-12/2001	8.08	---	7.54	---	---	---	8.52	Range of 15th-85th	---	6.5-9.0	---
Fecal Coliform Bacteria	Colonies/ 100mL	11	---	1/2001-12/2001	431	---	38	---	---	---	1467	Geometric Mean	---	200	**X***
Total Dissolved Solids	mg/L	---	---	1/2001-12/2001	---	---	---	---	---	---	---	85th	---	---	---
Inorganic Parameters															
Un-ionized Ammonia as Nitrogen, Dissolved Ammonia	mg/L	---	---	1/2001-12/2001	---	---	---	---	---	---	---	85th		ac=0.19 ch=0.10	---
Total Ammonia	mg/L	1	---	1/2001-12/2001	< 0.1	---	< 0.1	---	---	---	< 0.1	85th		---	---
Total Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	0.05	---
Dissolved Nitrite as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---

TABLE A-14
Summary Statistics for Selected Water Quality Constituents at Station Number FC_33_IN Fountain Creek at 33rd Street Intake

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Nitrite Plus Nitrate as Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Total Phosphorus	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Dissolved Sulfate	mg/L	4	---	1/2001-12/2001	21.4	---	20.5	---	---	---	22	85th	---	250	---
Dissolved Chloride	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	250	---
Metal Parameters															
Hardness as Calcium Carbonate	mg/L	12	---	1/2001-12/2001	132	---	78	---	---	---	170	Mean	132	---	---
Dissolved Magnesium	mg/L	---	---	---	---	---	---	---	---	---	---	85th	---	---	---
Total Arsenic	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	ac=50	---
Total Cadmium	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	---	---
Dissolved Cadmium	µg/L	3	---	1/2001-12/2001	< 0.2	---	< 0.2	---	---	---	< 0.2	85th	---	ac=4.9 ch=2.7	---
Total Chromium	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	CrIII(ac)=50 CrVI(ac)=16 CrVI(ch)=11	---
Total Copper	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	---	---
Dissolved Copper	µg/L	3	---	1/2001-12/2001	4.43	---	1.10	---	---	---	10.0	85th	---	ac=17.3 ch=11.3	---
Total Iron	µg/L	2	---	1/2001-12/2001	37	---	32	---	---	---	41	50th	---	ch=1000	---
Dissolved Iron	µg/L	8	---	1/2001-12/2001	50	---	< 10	---	---	---	331	85th	---	ch=300	---

TABLE A-14
Summary Statistics for Selected Water Quality Constituents at Station Number FC_33_IN Fountain Creek at 33rd Street Intake

Constituent	Units*	Number of Values	Number of Censored Values	Period of Record (month/ year)	Mean	Standard Deviaton	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Existing Quality (Percentile)	Existing Quality	Water Quality Standard	Exceeds WQ Standard
Total Lead	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	---	---
Dissolved Lead	µg/L	3	---	1/2001-12/2001	< 1	---	< 1	---	---	---	< 1	85th	---	ac(tr)=85.0 ch=3.4	---
Dissolved Manganese	µg/L	8	---	1/2001-12/2001	< 10	---	< 10	---	---	---	28	85th	---	ch=50	---
Total Nickel	µg/L	---	---	---	---	---	---	---	---	---	---	50th	---	---	---
Dissolved Nickel	µg/L	3	---	1/2001-12/2001	< 5	---	< 5	---	---	---	< 5	85th	---	ac=580.0 ch=64.9	---
Total Zinc	µg/L	1	---	1/2001-12/2001	< 10	---	< 10	---	---	---	< 10	50th	---	---	---
Dissolved Zinc	µg/L	3	---	1/2001-12/2001	< 10	---	< 10	---	---	---	< 10	85th	---	ac=146.0 ch=147.0	---

*[ft^3/s, cubic feet per second; µS/cm, microsiemens/cm at 25 °C; mg/L, milligrams per liter; µg/L, micrograms per liter; µg/L, micrograms per liter; --- no stream standard or no value; ac, acute water quality standard; ch, chronic water quality standard; tr, trout; censored values, values below the reporting limit; *, based on mean value]

TABLE A-15
Expected Annual Mass Loading of Pollutants for I-25 mp 135-161

Pollutant	Drainage Area of Existing Highway (ha)	Drainage Area of Proposed Highway (ha)	Runoff Coeifficient	Rainfall Volume (mm)	Volume of Runoff for Mean Storm Event (m^3)	Site Median EMC (mg/L)	Average Event Mean Conc. (mg/L)	Existing Mean Pollutant Mass Loading (kg/event)	Existing Annual Mass Loading (kg/yr)	Proposed Mean Pollutant Mass Loading (kg/event)	Proposed Annual Mass Loading (kg/yr)	Percent Increase of Annual Load
Total Suspended Solids	55	97	0.80	5.6	4346	142	174	428	26,056	757	46,038	57
Volatile Suspended Solids	55	97	0.80	5.6	4346	39	48	118	7,156	208	12,644	57
Total Organic Carbon	55	97	0.80	5.6	4346	25	31	75	4,587	133	8,105	57
Chemical Oxygen Demand	55	97	0.80	5.6	4346	114	140	344	20,919	608	36,960	57
Nitrate + Nitrite	55	97	0.80	5.6	4346	0.76	0.93	2.3	140	4.05	246	57
Phosphorus (as PO4)	55	97	0.80	5.6	4346	0.40	0.49	1.2	73	2.13	130	57
Total Copper	55	97	0.80	5.6	4346	0.054	0.066	0.16	10	0.29	17.5	57
Total Lead	55	97	0.80	5.6	4346	0.40	0.49	1.2	73	2.13	130	57
Total Zinc	55	97	0.80	5.6	4346	0.329	0.40	1.0	60	1.75	107	57

ATTACHMENT B

Site Characteristics of I-25 Interchanges

HWY 105 Interchange (mp 161)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	6.912	6.912	6.912	10.360	10.360	10.360
Paved surface	AHWY	acres	5.530	5.530	5.530	8.290	8.290	8.290
Percent impervious	IMP	%	80.006	80.006	80.006	80.019	80.019	80.019
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	81.000	81.000	81.000	81.000	81.000	81.000
Acute criterion value	ACV	mg/L	0.051	0.011	0.097	0.051	0.011	0.097
Chronic criterion value	CCV	mg/L	0.002	0.007	0.097	0.002	0.007	0.097
Threshold Effect Level	CTT	mg/L	0.255	0.287	0.567	0.255	0.287	0.567
Watershed Drainage Area								
Total contributing area upstream of highway	ATOT	square miles						

Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile						
Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500
Average stream flow	MQS	cfs	8.900	8.900	8.900	8.900	8.900	8.900
Highway Runoff Characteristics								
Compute Runoff Coefficient								
Percent impervious	IMP	%	80.006	80.006	80.006	80.019	80.019	80.019
Runoff coefficient	Rv	ratio	0.660	0.660	0.660	0.660	0.660	0.660
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.147	0.147	0.147	0.221	0.221	0.221
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	3643.373	3643.373	3643.373	5461.625	5461.625	5461.625
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.185	0.033	0.170	0.277	0.049	0.255
Annual mass load from runoff	AN(MASS)	pounds/year	11.232	2.005	10.350	16.837	3.006	15.515
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	60.459	60.459	60.459	40.331	40.331	40.331
Stream Impact Analysis								
Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an average of once in 3 years)	CU	mg/L	0.699	0.699	0.699	0.870	0.870	0.870
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644

Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400
Acute criteria value (dissolved conc)	ACV	mg/L	0.051	0.011	0.097	0.051	0.011	0.097
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0020	0.0074	0.0974	0.0020	0.0074	0.0974
Threshold effects level (dissolved conc)	TEL	mg/L	0.255	0.287	0.567	0.255	0.287	0.567
Existing ambient water quality (total conc)	TAWQ	mg/L						
Existing ambient water quality (dissolved conc)	DAWQ	mg/L						
Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.049	0.029	0.180	0.061	0.036	0.224
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.973	2.658	1.863	1.211	3.309	2.318
Potential for threshold violation	CO/TEL	ratio	0.193	0.101	0.318	0.241	0.126	0.395
Potential for chronic criteria violation	CO/CCV	ratio	24.716	3.911	1.848	30.763	4.868	2.300
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				24.464	24.464	24.464
Percent increase in threshold violation		percent				24.464	24.464	24.464
Percent increase in exceeding existing ambient water quality		percent						
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.031	0.018	0.112
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.605	1.654	1.159
Potential for threshold violation	CO/TEL	ratio				0.120	0.063	0.198
Potential for chronic criteria violation	CO/CCV	ratio				15.381	2.434	1.150
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000

Baptist Interchange (mp 158)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	6.912	6.912	6.912	10.360	10.360	10.360
Paved surface	AHWY	acres	5.530	5.530	5.530	8.290	8.290	8.290
Percent impervious	IMP	%	80.006	80.006	80.006	80.019	80.019	80.019
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	84.000	84.000	84.000	84.000	84.000	84.000
Acute criterion value	ACV	mg/L	0.053	0.011	0.100	0.053	0.011	0.100
Chronic criterion value	CCV	mg/L	0.002	0.008	0.100	0.002	0.008	0.100
Threshold Effect Level	CTT	mg/L	0.270	0.032	0.583	0.270	0.032	0.583
Watershed Drainage Area								
Total contributing area upstream of highway	ATOT	square miles						

Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile						
Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500
Average stream flow	MQS	cfs	14.700	14.700	14.700	14.700	14.700	14.700
Highway Runoff Characteristics								
Compute Runoff Coefficient								
Percent impervious	IMP	%	80.006	80.006	80.006	80.019	80.019	80.019
Runoff coefficient	Rv	ratio	0.660	0.660	0.660	0.660	0.660	0.660
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.147	0.147	0.147	0.221	0.221	0.221
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	3643.373	3643.373	3643.373	5461.625	5461.625	5461.625
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.185	0.033	0.170	0.277	0.049	0.255
Annual mass load from runoff	AN(MASS)	pounds/year	11.232	2.005	10.350	16.837	3.006	15.515
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	99.859	99.859	99.859	66.615	66.615	66.615
Stream Impact Analysis								
Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an average of once in 3 years)	CU	mg/L	0.449	0.449	0.449	0.646	0.646	0.646
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400

Acute criteria value (dissolved conc)	ACV	mg/L	0.053	0.011	0.100	0.053	0.011	0.100
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0021	0.0077	0.1005	0.0021	0.0077	0.1005
Threshold effects level (dissolved conc)	TEL	mg/L	0.270	0.032	0.583	0.270	0.032	0.583
Existing ambient water quality (total conc)	TAWQ	mg/L						
Existing ambient water quality (dissolved conc)	DAWQ	mg/L						
Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.032	0.019	0.116	0.046	0.027	0.166
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.601	1.650	1.160	0.864	2.374	1.669
Potential for threshold violation	CO/TEL	ratio	0.117	0.584	0.198	0.169	0.840	0.285
Potential for chronic criteria violation	CO/CCV	ratio	15.259	2.436	1.151	21.953	3.504	1.656
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				43.875	43.875	43.875
Percent increase in threshold violation		percent				43.875	43.875	43.875
Percent increase in exceeding existing ambient water quality		percent						
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.023	0.013	0.083
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.432	1.187	0.835
Potential for threshold violation	CO/TEL	ratio				0.084	0.420	0.143
Potential for chronic criteria violation	CO/CCV	ratio				10.977	1.752	0.828
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000

Northgate Interchange (mp 156)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	4.360	4.360	4.360	6.550	6.550	6.550
Paved surface	AHWY	acres	3.490	3.490	3.490	5.240	5.240	5.240
Percent impervious	IMP	%	80.046	80.046	80.046	80.000	80.000	80.000
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	87.000	87.000	87.000	87.000	87.000	87.000
Acute criterion value	ACV	mg/L	0.055	0.012	0.103	0.055	0.012	0.103
Chronic criterion value	CCV	mg/L	0.0022	0.0079	0.1035	0.0022	0.0079	0.1035
Threshold Effect Level	CTT	mg/L	0.285	0.034	0.600	0.285	0.034	0.600
Watershed Drainage Area								
Total contributing area upstream of highway at USGS guage #07103780	ATOT	square miles	81.700	81.700	81.700	81.700	81.700	81.700
Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile	0.251	0.251	0.251	0.251	0.251	0.251

Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500
Average stream flow	MQS	cfs	20.500	20.500	20.500	20.500	20.500	20.500
Highway Runoff Characteristics								
Compute Runoff Coefficient								
Percent impervious	IMP	%	80.046	80.046	80.046	80.000	80.000	80.000
Runoff coefficient	Rv	ratio	0.660	0.660	0.660	0.660	0.660	0.660
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.093	0.093	0.093	0.139	0.139	0.139
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	2299.169	2299.169	2299.169	3452.348	3452.348	3452.348
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.117	0.021	0.107	0.175	0.031	0.161
Annual mass load from runoff	AN(MASS)	pounds/year	7.088	1.266	6.531	10.643	1.900	9.807
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	220.678	220.678	220.678	146.965	146.965	146.965
Stream Impact Analysis								
Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an average of once in 3 years)	CU	mg/L	0.245	0.245	0.245	0.287	0.287	0.287
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400
Acute criteria value (dissolved conc)	ACV	mg/L	0.055	0.012	0.103	0.055	0.012	0.103
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0022	0.0079	0.1035	0.0022	0.0079	0.1035
Threshold effects level (dissolved conc)	TEL	mg/L	0.285	0.034	0.600	0.285	0.034	0.600
Existing ambient water quality (total conc)	TAWQ	mg/L	0.0014	0.0020	0.0130	0.0014	0.0020	0.0130
Existing ambient water quality (dissolved conc)	DAWQ	mg/L	0.00057	0.0030	0.0144	0.00057	0.0030	0.0144

Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.017	0.010	0.063	0.020	0.012	0.074
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.315	0.871	0.615	0.369	1.020	0.720
Potential for threshold violation	CO/TEL	ratio	0.061	0.304	0.105	0.071	0.356	0.123
Potential for chronic criteria violation	CO/CCV	ratio	8.014	1.290	0.610	9.384	1.511	0.714
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio	507.194	52.000	49.538	507.194	52.000	49.538
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio	30.303	3.397	4.383	35.485	3.978	5.132
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				17.102	17.102	17.102
Percent increase in threshold violation		percent				17.102	17.102	17.102
Percent increase in exceeding existing ambient water quality		percent				17.102	17.102	17.102
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.010	0.006	0.037
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.185	0.510	0.360
Potential for threshold violation	CO/TEL	ratio				0.035	0.178	0.062
Potential for chronic criteria violation	CO/CCV	ratio				4.692	0.755	0.357
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio				253.597	26.000	24.769
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio				17.743	1.989	2.566
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000

Uknown Interchange (mp 155)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	5.087	5.087	5.087	7.630	7.630	7.630
Paved surface	AHWY	acres	4.070	4.070	4.070	6.110	6.110	6.110
Percent impervious	IMP	%	80.008	80.008	80.008	80.079	80.079	80.079
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. Events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	90.000	90.000	90.000	90.000	90.000	90.000
Acute criterion value	ACV	mg/L	0.057	0.012	0.106	0.057	0.012	0.106
Chronic criterion value	CCV	mg/L	0.002	0.008	0.107	0.002	0.008	0.107
Threshold Effect Level	CTT	mg/L	0.300	0.035	0.618	0.300	0.035	0.618
Watershed Drainage Area								
Total contributing area upstream of highway	ATOT	square miles	2.500	2.500	2.500	2.500	2.500	2.500

Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile	16.040	16.040	16.040	16.040	16.040	16.040
Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500
Average stream flow	MQS	cfs	40.100	40.100	40.100	40.100	40.100	40.100
Highway Runoff Characteristics								
Compute Runoff Coefficient								
Percent impervious	IMP	%	80.008	80.008	80.008	80.079	80.079	80.079
Runoff coefficient	Rv	ratio	0.660	0.660	0.660	0.661	0.661	0.661
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.108	0.108	0.108	0.163	0.163	0.163
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	2681.459	2681.459	2681.459	4024.944	4024.944	4024.944
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.136	0.024	0.125	0.204	0.036	0.188
Annual mass load from runoff	AN(MASS)	pounds/year	8.267	1.476	7.617	12.408	2.215	11.434
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	370.125	370.125	370.125	246.581	246.581	246.581
Stream Impact Analysis								
Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an average of once in 3 years)	CU	mg/L	0.161	0.161	0.161	0.231	0.231	0.231
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400

Acute criteria value (dissolved conc)	ACV	mg/L	0.057	0.012	0.106	0.057	0.012	0.106
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0022	0.0081	0.1065	0.0022	0.0081	0.1065
Threshold effects level (dissolved conc)	TEL	mg/L	0.300	0.035	0.618	0.300	0.035	0.618
Existing ambient water quality (total conc)	TAWQ	mg/L						
Existing ambient water quality (dissolved conc)	DAWQ	mg/L						
Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.011	0.007	0.041	0.016	0.010	0.060
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.200	0.555	0.393	0.287	0.796	0.563
Potential for threshold violation	CO/TEL	ratio	0.038	0.191	0.067	0.054	0.275	0.096
Potential for chronic criteria violation	CO/CCV	ratio	5.075	0.824	0.389	7.282	1.182	0.559
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				43.478	43.478	43.478
Percent increase in threshold violation		percent				43.478	43.478	43.478
Percent increase in exceeding existing ambient water quality		percent						
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.008	0.005	0.030
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.143	0.398	0.282
Potential for threshold violation	CO/TEL	ratio				0.027	0.137	0.048
Potential for chronic criteria violation	CO/CCV	ratio				3.641	0.591	0.279
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000

Interquest Interchange (mp 153)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	3.637	3.637	3.637	5.450	5.450	5.450
Paved surface	AHWY	acres	2.910	2.910	2.910	4.360	4.360	4.360
Percent impervious	IMP	%	80.011	80.011	80.011	80.000	80.000	80.000
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	93.000	93.000	93.000	93.000	93.000	93.000
Acute criterion value	ACV	mg/L	0.059	0.012	0.109	0.059	0.012	0.109
Chronic criterion value	CCV	mg/L	0.002	0.008	0.110	0.002	0.008	0.110
Threshold Effect Level	CTT	mg/L	0.315	0.037	0.635	0.315	0.037	0.635
Watershed Drainage Area								
Total contributing area upstream of highway	ATOT	square miles						

Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile						
Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500
Average stream flow	MQS	cfs	59.700	59.700	59.700	59.700	59.700	59.700
Highway Runoff Characteristics								
Compute Runoff Coefficient								
Percent impervious	IMP	%	80.011	80.011	80.011	80.000	80.000	80.000
Runoff coefficient	Rv	ratio	0.660	0.660	0.660	0.660	0.660	0.660
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.077	0.077	0.077	0.116	0.116	0.116
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	1917.199	1917.199	1917.199	2872.564	2872.564	2872.564
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.097	0.017	0.090	0.146	0.026	0.134
Annual mass load from runoff	AN(MASS)	pounds/year	5.910	1.055	5.446	8.856	1.581	8.160
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	770.695	770.695	770.695	514.375	514.375	514.375
Stream Impact Analysis								
Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an ave	CU	mg/L	0.084	0.084	0.084	0.125	0.125	0.125
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400

Acute criteria value (dissolved conc)	ACV	mg/L	0.059	0.012	0.109	0.059	0.012	0.109
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0023	0.0084	0.1095	0.0023	0.0084	0.1095
Threshold effects level (dissolved conc)	TEL	mg/L	0.315	0.037	0.635	0.315	0.037	0.635
Existing ambient water quality (total conc)	TAWQ	mg/L						
Existing ambient water quality (dissolved conc)	DAWQ	mg/L						
Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.006	0.003	0.022	0.009	0.005	0.032
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.100	0.280	0.198	0.150	0.418	0.296
Potential for threshold violation	CO/TEL	ratio	0.019	0.095	0.034	0.028	0.142	0.051
Potential for chronic criteria violation	CO/CCV	ratio	2.546	0.416	0.197	3.802	0.622	0.294
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				49.343	49.343	49.343
Percent increase in threshold violation		percent				49.343	49.343	49.343
Percent increase in exceeding existing ambient water quality		percent						
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.004	0.003	0.016
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.075	0.209	0.148
Potential for threshold violation	CO/TEL	ratio				0.014	0.071	0.025
Potential for chronic criteria violation	CO/CCV	ratio				1.901	0.311	0.147
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000

Briargate Interchange (mp 151)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	5.091	5.091	5.091	10.180	10.180	10.180
Paved surface	AHWY	acres	4.073	4.073	4.073	8.145	8.145	8.145
Percent impervious	IMP	%	80.004	80.004	80.004	80.010	80.010	80.010
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	96.000	96.000	96.000	96.000	96.000	96.000
Acute criterion value	ACV	mg/L	0.061	0.013	0.112	0.061	0.013	0.112
Chronic criterion value	CCV	mg/L	0.002	0.009	0.112	0.002	0.009	0.112
Threshold Effect Level	CTT	mg/L	0.330	0.038	0.652	0.330	0.038	0.652
Watershed Drainage Area								
Total contributing area upstream of highway	ATOT	square miles						

Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile						
Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500
Average stream flow	MQS	cfs	79.300	79.300	79.300	79.300	79.300	79.300
Highway Runoff Characteristics								
Compute Runoff Coefficient								
Percent impervious	IMP	%	80.004	80.004	80.004	80.010	80.010	80.010
Runoff coefficient	Rv	ratio	0.660	0.660	0.660	0.660	0.660	0.660
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.108	0.108	0.108	0.217	0.217	0.217
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	2683.456	2683.456	2683.456	5366.193	5366.193	5366.193
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.136	0.024	0.125	0.272	0.049	0.251
Annual mass load from runoff	AN(MASS)	pounds/year	8.273	1.477	7.623	16.543	2.954	15.244
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	731.398	731.398	731.398	365.748	365.748	365.748
Stream Impact Analysis								
Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an average of once in 3 years)	CU	mg/L	0.090	0.090	0.090	0.163	0.163	0.163
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400

Acute criteria value (dissolved conc)	ACV	mg/L	0.061	0.013	0.112	0.061	0.013	0.112
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0024	0.0086	0.1125	0.0024	0.0086	0.1125
Threshold effects level (dissolved conc)	TEL	mg/L	0.330	0.038	0.652	0.330	0.038	0.652
Existing ambient water quality (total conc)	TAWQ	mg/L						
Existing ambient water quality (dissolved conc)	DAWQ	mg/L						
Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.006	0.004	0.023	0.011	0.007	0.042
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.104	0.292	0.208	0.189	0.528	0.376
Potential for threshold violation	CO/TEL	ratio	0.019	0.099	0.036	0.035	0.178	0.064
Potential for chronic criteria violation	CO/CCV	ratio	2.648	0.436	0.206	4.790	0.789	0.373
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				80.910	80.910	80.910
Percent increase in threshold violation		percent				80.910	80.910	80.910
Percent increase in exceeding existing ambient water quality		percent						
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.006	0.003	0.021
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.094	0.264	0.188
Potential for threshold violation	CO/TEL	ratio				0.017	0.089	0.032
Potential for chronic criteria violation	CO/CCV	ratio				2.395	0.395	0.187
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000

Academy Interchange (mp 150)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	7.275	7.275	7.275	14.550	14.550	14.550
Paved surface	AHWY	acres	5.820	5.820	5.820	11.640	11.640	11.640
Percent impervious	IMP	%	80.000	80.000	80.000	80.000	80.000	80.000
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	99.000	99.000	99.000	99.000	99.000	99.000
Acute criterion value	ACV	mg/L	0.063	0.013	0.115	0.063	0.013	0.115
Chronic criterion value	CCV	mg/L	0.002	0.009	0.115	0.002	0.009	0.115
Threshold Effect Level	CTT	mg/L	0.345	0.040	0.669	0.345	0.040	0.669
Watershed Drainage Area								
Total contributing area upstream of highway	ATOT	square miles						

Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile						
Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500
Average stream flow	MQS	cfs	98.900	98.900	98.900	98.900	98.900	98.900
Highway Runoff Characteristics								
Compute Runoff Coefficient								
Percent impervious	IMP	%	80.000	80.000	80.000	80.000	80.000	80.000
Runoff coefficient	Rv	ratio	0.660	0.660	0.660	0.660	0.660	0.660
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.155	0.155	0.155	0.310	0.310	0.310
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	3834.478	3834.478	3834.478	7668.956	7668.956	7668.956
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.194	0.035	0.179	0.389	0.069	0.358
Annual mass load from runoff	AN(MASS)	pounds/year	11.821	2.111	10.892	23.642	4.221	21.785
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	638.359	638.359	638.359	319.180	319.180	319.180
Stream Impact Analysis								
Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an average of once in 3 years)	CU	mg/L	0.105	0.105	0.105	0.189	0.189	0.189
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400

Acute criteria value (dissolved conc)	ACV	mg/L	0.063	0.013	0.115	0.063	0.013	0.115
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0025	0.0088	0.1154	0.0025	0.0088	0.1154
Threshold effects level (dissolved conc)	TEL	mg/L	0.345	0.040	0.669	0.345	0.040	0.669
Existing ambient water quality (total conc)	TAWQ	mg/L						
Existing ambient water quality (dissolved conc)	DAWQ	mg/L						
Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.007	0.004	0.027	0.013	0.008	0.049
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.117	0.331	0.236	0.211	0.595	0.425
Potential for threshold violation	CO/TEL	ratio	0.021	0.111	0.040	0.039	0.199	0.073
Potential for chronic criteria violation	CO/CCV	ratio	2.984	0.495	0.234	5.372	0.891	0.422
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				80.000	80.000	80.000
Percent increase in threshold violation		percent				80.000	80.000	80.000
Percent increase in exceeding existing ambient water quality		percent						
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.007	0.004	0.024
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.106	0.298	0.213
Potential for threshold violation	CO/TEL	ratio				0.019	0.100	0.036
Potential for chronic criteria violation	CO/CCV	ratio				2.686	0.446	0.211
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000

Woodmen Interchange (mp 149)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	10.180	10.180	10.180	10.180	10.180	10.180
Paved surface	AHWY	acres	4.073	4.073	4.073	8.145	8.145	8.145
Percent impervious	IMP	%	40.010	40.010	40.010	80.010	80.010	80.010
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	113.000	113.000	113.000	113.000	113.000	113.000
Acute criterion value	ACV	mg/L	0.073	0.015	0.128	0.073	0.015	0.128
Chronic criterion value	CCV	mg/L	0.003	0.010	0.129	0.003	0.010	0.129
Threshold Effect Level	CTT	mg/L	0.415	0.043	0.746	0.415	0.043	0.746
Watershed Drainage Area								
Total contributing area upstream of highway	ATOT	square miles	181.000	181.000	181.000	181.000	181.000	181.000
Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile						
Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500

Average stream flow	MQS	cfs	99.000	99.000	99.000	99.000	99.000	99.000
Highway Runoff Characteristics								
Compute Runoff Coefficient								
Percent impervious	IMP	%	40.010	40.010	40.010	80.010	80.010	80.010
Runoff coefficient	Rv	ratio	0.380	0.380	0.380	0.660	0.660	0.660
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.125	0.125	0.125	0.217	0.217	0.217
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	3089.863	3089.863	3089.863	5366.193	5366.193	5366.193
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.157	0.028	0.144	0.272	0.049	0.251
Annual mass load from runoff	AN(MASS)	pounds/year	9.526	1.701	8.777	16.543	2.954	15.244
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	792.996	792.996	792.996	456.609	456.609	456.609
Stream Impact Analysis								
Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an average of once in 3 years)	CU	mg/L	0.080	0.080	0.080	0.135	0.135	0.135
							0.135	
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400
Acute criteria value (dissolved conc)	ACV	mg/L	0.073	0.015	0.128	0.073	0.015	0.128
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0029	0.0099	0.1291	0.0029	0.0099	0.1291
Threshold effects level (dissolved conc)	TEL	mg/L	0.415	0.043	0.746	0.415	0.043	0.746
Existing ambient water quality (total conc)	TAWQ	mg/L						
Existing ambient water quality (dissolved conc)	DAWQ	mg/L						

Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.006	0.003	0.021	0.010	0.006	0.035
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.078	0.223	0.161	0.131	0.376	0.272
Potential for threshold violation	CO/TEL	ratio	0.014	0.077	0.028	0.023	0.131	0.047
Potential for chronic criteria violation	CO/CCV	ratio	1.973	0.338	0.160	3.325	0.569	0.269
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				68.539	68.539	68.539
Percent increase in threshold violation		percent				68.539	68.539	68.539
Percent increase in exceeding existing ambient water quality		percent						
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.005	0.003	0.017
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.065	0.188	0.136
Potential for threshold violation	CO/TEL	ratio				0.011	0.065	0.023
Potential for chronic criteria violation	CO/CCV	ratio				1.662	0.284	0.135
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000

Nevada (mp 148)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	4.360	4.360	4.360	8.725	8.725	8.725
Paved surface	AHWY	acres	3.490	3.490	3.490	6.980	6.980	6.980
Percent impervious	IMP	%	80.046	80.046	80.046	80.000	80.000	80.000
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	150.000	150.000	150.000	150.000	150.000	150.000
Acute criterion value	ACV	mg/L	0.099	0.020	0.163	0.099	0.020	0.163
Chronic criterion value	CCV	mg/L	0.004	0.013	0.164	0.004	0.013	0.164
Threshold Effect Level	CTT	mg/L	0.600	0.060	0.945	0.600	0.060	0.945
Watershed Drainage Area								
Total contributing area upstream of highway	ATOT	square miles	204.000	204.000	204.000	204.000	204.000	204.000
Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile						

Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500
Average stream flow	MQS	cfs	108.000	108.000	108.000	108.000	108.000	108.000
Highway Runoff Characteristics								
Compute Runoff Coefficient								
Percent impervious	IMP	%	80.046	80.046	80.046	80.000	80.000	80.000
Runoff coefficient	Rv	ratio	0.660	0.660	0.660	0.660	0.660	0.660
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.093	0.093	0.093	0.186	0.186	0.186
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	2299.169	2299.169	2299.169	4598.738	4598.738	4598.738
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.117	0.021	0.107	0.233	0.042	0.215
Annual mass load from runoff	AN(MASS)	pounds/year	7.088	1.266	6.531	14.177	2.531	13.064
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	1162.594	1162.594	1162.594	581.246	581.246	581.246
Stream Impact Analysis								
Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an average of once in 3 years)	CU	mg/L	0.062	0.062	0.062	0.115	0.115	0.115
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400
Acute criteria value (dissolved conc)	ACV	mg/L	0.099	0.020	0.163	0.099	0.020	0.163
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0039	0.0126	0.1640	0.0039	0.0126	0.1640
Threshold effects level (dissolved conc)	TEL	mg/L	0.600	0.060	0.945	0.600	0.060	0.945
Existing ambient water quality (total conc)	TAWQ	mg/L						
Existing ambient water quality (dissolved conc)	DAWQ	mg/L						

Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.004	0.003	0.016	0.008	0.005	0.029
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.044	0.132	0.098	0.082	0.244	0.181
Potential for threshold violation	CO/TEL	ratio	0.007	0.043	0.017	0.013	0.079	0.031
Potential for chronic criteria violation	CO/CCV	ratio	1.126	0.205	0.097	2.079	0.379	0.180
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				84.677	84.677	84.677
Percent increase in threshold violation		percent				84.677	84.677	84.677
Percent increase in exceeding existing ambient water quality		percent						
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.004	0.002	0.015
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.041	0.122	0.091
Potential for threshold violation	CO/TEL	ratio				0.007	0.040	0.016
Potential for chronic criteria violation	CO/CCV	ratio				1.040	0.190	0.090
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000

Garden of the Gods (mp 146)

Site Characteristics	Parameter	Units	Existing			Proposed		
			Lead	Copper	Zinc	Lead	Copper	Zinc
Drainage Area of Highway Segment								
Total right-of-way	AROW	acres	4.360	4.360	4.360	8.725	8.725	8.725
Paved surface	AHWY	acres	3.490	3.490	3.490	6.980	6.980	6.980
Percent impervious	IMP	%	80.046	80.046	80.046	80.000	80.000	80.000
Rainfall Characteristics								
Mean Values								
Volume	MVP	inch	0.220	0.220	0.220	0.220	0.220	0.220
Intensity	MIP	inch/hour	0.032	0.032	0.032	0.032	0.032	0.032
Duration	MDP	hour	9.100	9.100	9.100	9.100	9.100	9.100
Interval	MTP	hour	144.000	144.000	144.000	144.000	144.000	144.000
COEF of Variation								
Volume	CVVP	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Intensity	CVIP	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Duration	CVDP	dimensionless	1.150	1.150	1.150	1.150	1.150	1.150
Interval	CVTP	dimensionless	0.920	0.920	0.920	0.920	0.920	0.920
Number of storm events per year	NST	no. events	60.833	60.833	60.833	60.833	60.833	60.833
Surrounding Area Type								
Urban (ADT values over 30,000 vehicles/day)	Urban		X	X	X	X	X	X
Rural (ADT values under 30,000 vehicles/day)	Rural							
Pollutant Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Receiving Water Target Concentration for Stream								
Surface water total hardness	TH	mg/L	190.000	190.000	190.000	190.000	190.000	190.000
Acute criterion value	ACV	mg/L	0.127	0.024	0.199	0.127	0.024	0.199
Chronic criterion value	CCV	mg/L	0.005	0.015	0.200	0.005	0.015	0.200
Threshold Effect Level	CTT	mg/L	0.800	0.075	1.150	0.800	0.075	1.150
Watershed Drainage Area								
Total contributing area upstream of highway	ATOT	square miles						
Average Annual Stream Flow								
Unit area flow rate per square mile	QSM	cfs/square mile						
Coef of variation of stream flows	CVQS	dimensionless	1.500	1.500	1.500	1.500	1.500	1.500
Average stream flow	MQS	cfs	83.280	83.280	83.280	83.280	83.280	83.280

Highway Runoff Characteristics

Compute Runoff Coefficient								
Percent impervious	IMP	%	80.046	80.046	80.046	80.000	80.000	80.000
Runoff coefficient	Rv	ratio	0.660	0.660	0.660	0.660	0.660	0.660
Compute Runoff Flow Rates								
Flow rates from mean storm	MQR	cfs	0.093	0.093	0.093	0.186	0.186	0.186
Coefficient of variation of runoff flows	CVQR	dimensionless	1.130	1.130	1.130	1.130	1.130	1.130
Compute Runoff Volumes								
Volume from mean storms	MVR	cubic feet	2299.169	2299.169	2299.169	4598.738	4598.738	4598.738
Coefficient of variation of runoff volumes	CVVR	dimensionless	1.490	1.490	1.490	1.490	1.490	1.490
Compute Mass Loads								
Site median concentration	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Coef of variation of site EMCs	CVCR	dimensionless	0.570	0.970	0.590	0.570	0.970	0.590
Number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Mean event concentration	EMC	mg/L	0.811	0.145	0.748	0.811	0.145	0.748
Mean event mass load	M(MASS)	pounds	0.117	0.021	0.107	0.233	0.042	0.215
Annual mass load from runoff	AN(MASS)	pounds/year	7.088	1.266	6.531	14.177	2.531	13.064
Compute Flow Ratio								
Ratio of average stream flow	MQS/MQR	ratio	896.489	896.489	896.489	448.206	448.206	448.206

Stream Impact Analysis

Compute the Event Frequency for a 3-Year Recurrence Interval								
Average number of storms per year	NST	number	60.833	60.833	60.833	60.833	60.833	60.833
Compute the probability (%) of the 3-year event	PR	%	0.548	0.548	0.548	0.548	0.548	0.548
Stream concentration of highway runoff pollutant (exceeded an average of once in 3 years)	CU	mg/L	0.072	0.072	0.072	0.136	0.136	0.136
Select Pollutant for Analysis								
Pollutant		name	Lead	Copper	Zinc	Lead	Copper	Zinc
Site median concentration (total conc)	TCR	mg/L	0.705	0.104	0.644	0.705	0.104	0.644
Soluble fraction	FSOL	fraction	0.100	0.400	0.400	0.100	0.400	0.400
Acute criteria value (dissolved conc)	ACV	mg/L	0.127	0.024	0.199	0.127	0.024	0.199
Chronic criteria value (dissolved conc)	CCV	mg/L	0.0050	0.0154	0.2002	0.0050	0.0154	0.2002
Threshold effects level (dissolved conc)	TEL	mg/L	0.800	0.075	1.150	0.800	0.075	1.150
Existing ambient water quality (total conc)	TAWQ	mg/L						
Existing ambient water quality (dissolved conc)	DAWQ	mg/L						
Compute the Once in a 3-year Stream Pollutant Concentration								
Pollutant concentration	CO	mg/L	0.005	0.003	0.019	0.010	0.006	0.035

Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio	0.040	0.123	0.094	0.076	0.233	0.177
Potential for threshold violation	CO/TEL	ratio	0.006	0.040	0.016	0.012	0.076	0.031
Potential for chronic criteria violation	CO/CCV	ratio	1.019	0.195	0.093	1.923	0.369	0.175
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Compare Existing to Proposed Conditions								
Percent increase in criteria violation		percent				88.643	88.643	88.643
Percent increase in threshold violation		percent				88.643	88.643	88.643
Percent increase in exceeding existing ambient water quality		percent						
Mitigation								
BMP Removal								
Reduction in metal concentrations	RE	fraction				0.500	0.500	0.500
Site median concentration (total conc)	TCR-TCR*RE	mg/L				0.353	0.052	0.322
Soluble fraction	FSOL	fraction				0.100	0.400	0.400
Pollutant concentration	CO	mg/L				0.005	0.003	0.018
Compare with Target Concentration								
Potential for acute criteria violation	CO/ACV	ratio				0.038	0.116	0.088
Potential for threshold violation	CO/TEL	ratio				0.006	0.038	0.015
Potential for chronic criteria violation	CO/CCV	ratio				0.961	0.184	0.088
Potential for exceeding existing ambient water quality	TCR/TAWQ	ratio						
Potential for exceeding existing ambient water quality	CO/DAWQ	ratio						
Proposed Conditions with Mitigation								
Percent decrease in criteria violation		percent				50.000	50.000	50.000
Percent decrease in threshold violation		percent				50.000	50.000	50.000
Percent decrease in exceeding existing ambient water quality		percent				50.000	50.000	50.000