

# EXECUTIVE SUMMARY

## Project Summary

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In 1998 one reach of Crow Creek was listed as impaired by the Wyoming Department of Environmental Quality (DEQ) and placed on the Clean Water Act (CWA), Section 303(d) list of waters not meeting CWA goals. The listed impairments were ammonia, cadmium, and fecal coliform. The Laramie County Conservation District (LCCD) held a public meeting in February 1999 to determine if there was local support for a watershed planning effort and to solicit volunteers. Volunteers from local government, F.E. Warren Air Force Base, private industry, farming, ranching, and local citizens became the Watershed Steering Committee for the local watershed planning effort. The mission identified by the volunteer group was to 'Develop a watershed management plan for Crow Creek that considers: water quality, water quantity, property rights, sustainable and diverse wildlife communities, legal requirements, defensible data, planned development, land use planning, and functions of riparian and flood plain areas.' LCCD sponsored the planning effort and the Natural Resources Conservation Service (NRCS) and other agencies provided technical assistance.

## Background

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The headwaters of Crow Creek begin in the mountains of the Medicine Bow National Forest in Albany County (see Map 2.1). The upper watershed is represented by state lands, national forest lands and private lands surrounding municipal water supply reservoirs. These reservoirs and tributaries are potentially affected by forest management, livestock grazing, recreational uses, and development for small acreage housing. The middle section is characterized as urban, suburban, and industrial use with suspected affects on water quality stemming from storm sewers, street and parking lot runoff, wastewater treatment facilities, and housing development. The lower section of Crow Creek from Cheyenne to the Wyoming/Colorado border is represented predominantly by dryland farming, center pivot irrigation, livestock grazing, and small acreage housing development uses. Affects in this area result from storm water carryover, wastewater treatment facilities, livestock grazing, small acreage housing, and irrigation practices.

Crow Creek consists of a diverse cross section of Class 2 perennial streams, municipal-use water reservoirs, and intermittent streams. LCCD has implemented a water quality monitoring program for Crow Creek. The Wyoming DEQ, United States Geological Survey (USGS), and F. E. Warren Air Force Base are all monitoring portions of the stream. LCCD's monitoring efforts revealed that ammonia in the lower reach of Crow Creek has been determined to be coming from the City of Cheyenne Board of Public Utilities (BOPU) Wastewater Treatment Plants and will be addressed when the plants' expansions are completed and online about 2007. Cadmium could no longer be detected and in 2002 was removed from the 303(d) list for Crow Creek. Fecal coliform is still a problem and will be addressed with Best Management Practices (BMPs) installed by landowners and the City of Cheyenne.

## Process

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The Steering Committee identified concerns and issues and from those developed the following vision and mission statements, goals, objectives and action items for the Crow Creek Watershed:

### **VISION STATEMENT**

Promote actions that lead to a healthy and sustainable watershed.

### **MISSION STATEMENT OF CROW CREEK WATERSHED**

Develop a watershed management plan for Crow Creek that considers water quality, water quantity, property rights, sustainable and diverse wildlife communities, legal requirements, defensible data, planned development, land-use planning, and functions of riparian and flood plain areas.

#### **GOAL #1:**

**To enhance communication with local, state and federal agencies and the steering committee, agree on objectives, and utilize agency expertise and programs.**

#### **GOAL # 2:**

**Improve the quality and quantity of water in the Crow Creek watershed by identifying the general relationship of flow patterns and fluctuations on water quality and identify water management alternatives.**

#### **GOAL # 3:**

**Define the origin, type, degree and geographic extent of impairments.**

**GOAL # 4:**

**Elevate public awareness on the listing of Crow Creek as an impaired water body and the importance of improving water quality.**

**GOAL # 5:**

**Develop a watershed plan, which can be successfully implemented to achieve water quality goals and delisting of Crow Creek from the 303(d) list of impaired water bodies.**

**GOAL #6:**

**Gain public acceptance and support of the plan by considering the needs and concerns of all stakeholders in the Crow Creek Watershed.**

## Sampling History

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Laramie County Conservation District (LCCD) has been sampling Crow Creek for ammonia, cadmium and fecal coliform since April of 2000. Ammonia was not detected anywhere other than below the two City wastewater treatment plants during the 2001 monitoring season and no samples were collected in 2002. The Crow Creek Steering Committee and LCCD decided to reestablish monitoring for ammonia on a quarterly basis and it is included in the 2003 Sampling Plan.

Cadmium was not detected in the sampling sites. Sampling by other agencies was well below the Standards Maximum Contaminant Level (MCL). In 2002, the combined data was used to remove cadmium from the 303(d) impairment list..

Bacterial sampling will continue during the 2003 season for fecal coliform and *E.coli*. In 2002, it was decided by the Crow Creek Steering Committee and LCCD to introduce *E.coli* monitoring in addition to fecal coliform. This was due to the fact that *E.coli* may prove to be a better indicator of bacterial pollution. The United States EPA and the Wyoming DEQ are in the process of developing standards for *E.coli* that may be in place in 2004.

Fecal coliform exceeded the standards at all sampling sites in Cheyenne. These fecal coliform counts are associated primarily with the storm drains in the City of Cheyenne. The sites below Cheyenne had either trace or low amounts of fecal coliform exceeding the standards occasionally. There were no exceedences for fecal coliform above Cheyenne and below Silver Crown.

The currently established sampling sites for Crow Creek are based on recommendations from the Water Quality Technical Team:

1. Roundtop Road (Above Cheyenne)
2. Martin Luther King, Jr. Park (In Cheyenne)
3. Ames Ave (In Cheyenne)
4. Morrie Ave (In Cheyenne)
5. Above the Crow Creek WWTP (Below Cheyenne)
6. Missile Road 217 (Below Cheyenne)
7. State Section Road 207 (Below Cheyenne)

## Findings/Conclusions

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Urbanization within the Crow Creek Watershed is progressing and probably provides the greatest impacts to the watershed. Impacts include degradation of water quality, increased runoff to Crow Creek, loss of wildlife habitat, open spaces, agricultural lands, and numerous other impacts. The goals, objectives, and action items identified in the Crow Creek Watershed Plan provide a means to minimize adverse impacts and to promote actions that will benefit the community and the watershed. Community involvement in the implementation of this plan will be the key to maintaining or improving conditions in the Crow Creek Watershed.

Cheyenne's waste water treatment plants are a known source of ammonia. The plants will be upgraded in 2007, which will address ammonia discharge into the stream. If ammonia continues to be detected above accepted levels after the facility upgrades, further efforts will be necessary to find additional ammonia sources. High ammonia levels result in negative impacts on aquatic animal life.

In 2002 cadmium was removed from the 303(d) list as a result of sampling by LCCD and USGS. It is not fully understood what led to the cadmium detection. However, regular monitoring shows that cadmium is not a constant presence and does not warrant additional efforts.

Fecal coliform levels in Crow Creek consistently exceed DEQ standards in the urban area of Cheyenne and near the Wyoming/Colorado border. Urban fecal coliform levels are

most likely the result of storm water runoff. It is unlikely that there is cross contamination with sanitary sewage lines. If sewage lines were a contributing factor, bacteria counts would be much higher than what is currently detected. Fecal coliform is most likely runoff related because the highest peaks occur after storm events. Possible contributors include domestic animal waste, wildlife waste, illegal wastewater discharge from RV tanks and septic systems. At this time, the City of Cheyenne is taking steps to correct fecal coliform impairments through increased street sweeping, improved maintenance of storm drains, and the construction of wetlands and infiltration trenches. They are also conducting a storm drain system analysis to assess the current storm drain system in Cheyenne (Map 2.6). Homeowners can address fecal coliform impairments through proper design, operation and maintenance of septic systems and pet waste disposal.

In the rural area near the Colorado/Wyoming border, fecal coliform levels are also storm related because high peaks occur following storm events. Possible contributors to fecal coliform in this area include septic systems, livestock waste and wildlife waste. To correct these high levels, BMPs (Appendix E) should be implemented to address septic systems and livestock waste. It was also noted that reaches of the stream with healthy riparian areas tended to have lower fecal coliform counts. The riparian area acts as a buffer to keep sediment out of the stream and help filter impurities out of the water.

At this time, the reach of stream in urban Cheyenne is the highest priority for BMPs. The implementation plan places greater focus on this area of Crow Creek because fecal coliform counts are much higher than in rural areas and greater public access to the stream in urban areas poses increased human health risks.

## Recommendations

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The Crow Creek Steering Committee recommends implementing the action items described in the Crow Creek Watershed Plan. This is by no means a complete list of the actions that will be necessary to solve this problem, but should provide tools and direction to land managers and landowners on the types of projects that can be voluntarily installed to improve the quality of water in Crow Creek. Another key component of the watershed plan is communication throughout the process. Communication between agencies at all levels (local, state and federal) and communication with the stakeholders is integral to the success of the Crow Creek Watershed Plan.

# Acknowledgements

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## **Crow Creek Watershed Steering Committee**

|                          |                             |
|--------------------------|-----------------------------|
| Mark Reid.....           | Laramie County Government   |
| Doug Vetter.....         | City of Cheyenne            |
| Bud Spillman.....        | Board of Public Utilities   |
| Rob Miknis.....          | F. E. Warren Air Force Base |
| Jon and Yvonne Ware..... | Town of Carpenter           |
| Floyd Humphrey.....      | Farming                     |
| John Francis.....        | Ranching                    |
| Jeff Fanning.....        | Water quality/ quantity     |
| Lloyd Eisenhauer.....    | Recreation                  |
| Verle Ellis.....         | Urban                       |
| Thomas Annear.....       | Wildlife                    |
| Mel Wilkenfeld.....      | Industry                    |
| Elbert (El) Spencer..... | Public Lands                |
| Keith Schoene.....       | Conservation District       |
| Tom Farrell.....         | Conservation District       |

## **Planning Team**

|                    |   |
|--------------------|---|
| John Ungerer.....  | Wyoming Association of Conservation Districts |
| George Cleek.....  | NRCS  |
| Arla Strasser..... | NRCS  |
| Steve Kadas.....   | NRCS  |
| Jim Cochran.....   | Laramie County Conservation District          |
| Liberty Blain..... | Laramie County Conservation District          |
| Cary Allen.....    | Laramie County Conservation District          |
| Suzi Eklund.....   | Laramie County Conservation District          |

## **Laramie County Conservation District**

### **Board of Supervisors**

Tom Farrell  
Keith Schoene  
Jay Berry  
Kevin Lumsden  
Duane Cook

## **Water Quality Technical Team**

Thomas Annear  
Melanie Clark, U.S.G.S  
Jeff Fanning  
Thomas Smith  
Mel Wilkenfeld  
Linda Wobbie

## **Other Volunteers that have served on the Committee**

|                 |                 |              |
|-----------------|-----------------|--------------|
| Cindy Schneider | Glen Verplancke | James Harker |
| Gary Smith      | Ben Recker      | Lia Spiegel  |
| Bobbie Frank    | Jane Cramer     |              |

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Appendix

# 1. INTRODUCTION

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The Crow Creek Watershed consists of a diverse cross section of Class 2 perennial streams, municipal-use water reservoirs, and intermittent streams. In 1998 one reach of Crow Creek was listed as impaired by the Wyoming Department of Environmental Quality (DEQ) and placed on the Clean Water Act (CWA), Section 303(d) list of waters not meeting CWA goals. The listed impairments were ammonia, cadmium, and fecal coliform. DEQ compiles this list every two years. Impaired waters are those waters that are not meeting their designated uses based on the stream's classification. The reach of Crow Creek from the City of Cheyenne to the Wyoming/Colorado border was listed for these impairments. The Laramie County Conservation District (LCCD) feels strongly that the placement of any water body on the 303(d) list should occur based on sound scientific data.

Water quality is a very important issue that affects all people within the watershed. Resolving this issue will require local people making and implementing local solutions. LCCD applied for and has received CWA Section 319 grant funding from the United States Environmental Protection Agency (EPA), administered by the Wyoming DEQ to develop the Crow Creek Watershed Plan.

The Laramie County Conservation District (LCCD) held a public meeting in February 1999 to determine if there was local support for a watershed planning effort and to solicit volunteers. Volunteers from local government, F.E. Warren Air Force Base, private industry, farming, ranching, and local citizens became the Watershed Steering Committee for the local watershed planning effort. LCCD sponsored the planning effort and the Natural Resources Conservation Service (NRCS) and other agencies provided technical assistance.

Further driving the need for this planning effort was the reclassification of Crow Creek in 2001 from a Class 4 stream (supports agriculture, municipal use, and contact recreation) to a Class 2AB (supports drinking water and game fish) above Avenue C in Cheyenne and a class 2C (supports non-game fish) below Avenue C. The change in stream classification from Class 4 to Class 2C has resulted in the City of Cheyenne Board of Public Utilities (BOPU) initiating an upgrade to their wastewater treatment plants to reduce ammonia from the plants' effluent flow stream.

## 1.1 Need for Planning Effort

### Explanation of 303(d) List

The driving force behind the Crow Creek Watershed Plan was the 1998 303(d) listing of segments of Crow Creek as a water impaired by ammonia, cadmium, and fecal

coliform. It was this listing that led LCCD to pursue the development of a locally led watershed plan resulting in this document.

LCCD has implemented a water quality monitoring program for Crow Creek. The Wyoming DEQ, United States Geological Survey (USGS), and F. E. Warren Air Force Base are also monitoring water quality of the stream. LCCD's monitoring efforts revealed that ammonia has only been detected below the BOPU Waste Water Treatment Plants and will be addressed when the plants' expansions are completed about 2007. Sampling completed prior to January 2001 revealed cadmium could no longer be detected and has subsequently been removed from the 303(d) list for Crow Creek completed in 2002. Fecal coliform concentrations exceed the standard within the City of Cheyenne and near Carpenter. Contamination is both a point source and non point source problem. Point sources of fecal coliform can be addressed through National Pollution Discharge Elimination Permits (NPDES) and non point sources through Best Management Practices (BMPs).

Wyoming DEQ is required under section 305(b) of the CWA to complete an assessment of Wyoming's surface waters every two years. From this assessment a 303(d) list of impaired water bodies is developed. These are waters that are not currently meeting their designated uses because of impairments to the waters.

#### Stream Classification (the designated uses that are assigned to Crow Creek)

In 2001 the classification for Crow Creek changed from being solely Class 4 (Agriculture, Industry, Recreation and Wildlife) to various segments receiving classifications as indicated below:

- Class 2AB (supports drinking water & game fish) Above Avenue C in Cheyenne
- Class 2C (supports non-game fish) Below Avenue C in Cheyenne to the Wyoming/Colorado border
- Some tributaries (higher in the watershed) are Class 2AB
- Some tributaries (lower in the watershed) are Class 3B (supports other aquatic life use)

For a more complete reference to the stream classification table refer to the Wyoming DEQ Water Quality Rules and Regulations, Chapter 1, Wyoming Surface Water Quality Standards, Section 4 (Appendix D).

## 1.2 Authority for Planning

Local conservation districts are charged under Wyoming Statute, 11-16-103 (b) to “provide for the conservation of the soil and water resources of this state, and for the control and prevention of soil erosion and for flood prevention or the conservation, development, utilization, and disposal of water, and thereby to stabilize ranching and farming operations to preserve natural resources, protect the tax base, control floods, prevent impairment of dams and reservoirs, preserve wildlife, protect public lands, and protect and promote the health, safety and general welfare of the people of this state.”

Further, Wyoming Statute 11-16-122(b)(v) grants conservation district’s the authority to “conduct surveys, investigations and research and disseminate information relating to range management, the character of soil erosion, flood prevention or the conservation, development, utilization and disposal of water, and the prevention and control measures and works of improvement needed. But in order to avoid duplication of research activities, no district shall initiate any research program except in cooperation with the government of this state or its agencies, or with the United States or its agencies.”

Based on the above referenced statutory authority LCCD has the legal authority to lead the watershed planning process. Further, in 1996 Wyoming Conservation Districts with the support of the Natural Resources Conservation Service (NRCS) and the Wyoming Department of Agriculture (WDA) saw an increasing need for conservation districts to represent local interests and take the lead in watershed planning efforts. As a result they developed the Watershed Strategic Plan to guide this process. This document was developed prior to the Total Maximum Daily Loads (TMDL) issue in Wyoming and shows the responsibility and leadership role districts have exercised towards locally led watershed planning.

## 1.3 Background

The development of the Crow Creek Watershed Plan began in 1998 when Crow Creek was included on the 303(d) list of impaired water bodies. This section is a chronology of events starting with the listing of Crow Creek on the 303(d) list in 1998 and ending with the completion of the final draft of the Crow Creek Watershed Plan in 2004.

*May/June 1998*

- Clean Water Act 303(d) list of impaired streams included the listing of Crow Creek, from the confluence of Dry Creek to the Wyoming/Colorado border, for three impairments (ammonia, cadmium, and fecal coliform).

September 1999, the Laramie County Conservation District (LCCD) applied for a Clean Water Act, Section 319 grant for:

- Collection of credible water quality information.
- Compilation, assimilation and summarization of all available historical water quality information.
- Development of information and education on the water quality issue, and the need for a local watershed plan.
- Initiation of the formation of a Steering Committee and the development of a watershed plan to address and alleviate the known water quality concerns.

*January 2000 – First watershed meeting with LCCD and NRCS*

- Crow Creek on 303d list for ammonia, cadmium, and fecal coliform.
- LCCD decided on a public meeting to address a watershed plan or TMDLs.
- LCCD will collect baseline data for the watershed, delineate watershed boundaries, and identify stakeholders.
- LCCD received CWA 319 grant.

*February 2000 – Second watershed meeting with LCCD and NRCS*

- LCCD recommended forming a Steering Committee.
- LCCD would be lead in planning effort and serve as representative on the Steering Committee.

*May 2000 – Third watershed meeting with LCCD and NRCS*

- Reviewed status of Sampling Analysis Plan.
- Completed Agenda for the Public Meeting.

*May 2000 – Public meeting*

- Determined public interest in watershed plan or TMDLs – Crow Creek Watershed Steering Committee selected.
- Compiled letter to Crow Creek landowners stating Steering Committee makeup/function.

*July 2000 - First Steering Committee meeting*

- Each Steering Committee member explained “Why they volunteered to serve on the committee.”
- Reviewed and agreed upon the planning process.
- Discussed Steering Committee members’ roles and responsibilities.
- Identified a Water Quality Technical Team to help with historic water quality review.
- The Steering Committee discussed chairmanship and facilitation.

*September 2000 – Steering Committee meeting*

- Finalized Vision Statement and Mission Statement.
- Approved monitoring sites on Crow Creek.
- Began work on Issues, Concerns and Opportunities.

*January 2001*

- Assisted in securing a DEQ 319 Water Quality Grant for the City of Cheyenne.
- Continued to develop issue statements.

*March 2001*

- Completed issue statements.
- Began work on Goals & Objectives.

*September 2001*

- Updated water quality monitoring plan.
- Completed Goals & Objectives.
- Developed an outline for the watershed plan.

*January 2002*

- Developed an informational brochure on progress of Crow Creek Watershed Plan and mailed to stakeholders in watershed.
- Met with DEQ to discuss delisting Crow Creek for cadmium.
- LCCD received an additional CWA Section 319 Grant.

*May 2002*

- Developed action items for the watershed plan.
- Approval of several small acreage grazing demonstration projects.

*November 2002*

- Received grant from Wyoming Department of Agriculture.
- Completed first draft of watershed plan.

*May 2003*

- Completed second draft of watershed plan.

*October 2003*

- Completed final draft of watershed plan.

*November 2003*

- Sent plan out for public review and comment.
- Open House hosted to present the plan to the public.

### *December 2003*

- Public comment period ended.
- 2004 Draft 303(d) list includes North Branch and Middle Fork of Crow Creek for fecal coliform impairment.

### *January 2004*

- Steering Committee reviewed and responded to public comments.
- Crow Creek Watershed Plan approved by Steering Committee.

### *February 2004*

- Final watershed plan submitted to LCCD Board of Supervisors for approval.
- Final watershed plan submitted to DEQ for approval.

## Steps in Watershed Planning

The Steering Committee adopted the following steps:

- Know and understand your watershed, inventory and assessment
- Decide and prioritize issues
- Set goals and objectives based on issues
- Develop and document actions/ policy to implement
- Find resources to implement course of action
- Implement
- Evaluate
- Adopt plan

## 2. WATERSHED DESCRIPTION

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### **2.1 Project Area**

The Crow Creek Watershed is located in Laramie and Albany Counties in Southeastern Wyoming. Crow Creek (water body ID #WYSP 10190009-002) consists of a diverse cross section of Class 2 perennial streams, municipal-use water reservoirs, and a number of intermittent streams. Map 2.1 depicts the Crow Creek Watershed.

There are three distinct partitions of the Crow Creek watershed:

- 1) The upper watershed is represented by state lands, national forest lands, and private lands surrounding municipal water supply reservoirs. These reservoirs and tributaries are potentially affected by forest management, livestock grazing, intense recreational uses, and development for small acreage housing.
- 2) The middle section is characterized as urban, suburban, and industrial use with suspected affects on water quality stemming from storm sewers, street and parking lot runoff, wastewater treatment facilities, and housing development.
- 3) The lower section of Crow Creek from Cheyenne to the Wyoming/Colorado border is represented predominantly by dryland farming, center pivot irrigation, livestock grazing, and small acreage housing development uses. Affects in this area result from storm water carry-over, wastewater treatment facilities, livestock grazing, small acreage housing, and irrigation practices.

The major urban areas served by this watershed include the City of Cheyenne, F.E. Warren Air Force Base, as well as the unincorporated town of Carpenter. There are two major interstate highways (I-80 and I-25) that intersect near Cheyenne. Also, within the watershed, the main line of the Union Pacific Railroad runs through the county along with the Burlington Northern Railroad and the Santa Fe Railroad. Both bus and air services are also available and located within the watershed.

Elevations range from 8,200 feet in the western part to 4,800 feet in the eastern part of the watershed. The surrounding county landscape is mostly rolling prairie, which is primarily used for grazing, dry cropland and irrigated cropland.

Crow Creek is a tributary to the South Platte River. Within Wyoming the Crow Creek watershed consists of about 247,470 acres, which lies in both Laramie and Albany Counties. The Crow Creek watershed is the most populated watershed within the State of Wyoming.

| <b>Landownership</b> | <b>Acres</b> | <b>% of Watershed</b> |
|----------------------|--------------|-----------------------|
| Private              | 224,657      | 90                    |
| State                | 12,221       | 5                     |
| Federal              | 9,912        | 4                     |
| Water                | 680          | 1                     |

| <b>Land use</b>    | <b>Acres</b> | <b>% of Watershed</b> |
|--------------------|--------------|-----------------------|
| Rangeland          | 177,970      | 72                    |
| Urban & resident   | 50,000       | 20                    |
| Irrigated cropland | 12,000       | 5                     |
| Dry cropland       | 7,500        | 3                     |

## **2.2 Climate**

The climate in Laramie County is temperate with cool, moist springs; warm, moist summers; and cold, dry winters. The average annual precipitation ranges from 14 to 17 inches in the plains region of the county and from 17 to 19 inches in the Laramie Mountains. The frost-free period ranges from 120 to 140 days in the eastern part of the county and about 90 to 100 days in the western part.

## **2.3 Soils**

The Crow Creek Watershed originates in the Laramie Mountains on very shallow steep soils. These types of soils make up 37% of the Crow Creek Watershed and have a high rate of water runoff potential. The other area in the watershed where high runoff occurs is the Cheyenne area. 3% of the watershed is made up of the town of Cheyenne that has mostly impermeable areas from rooftops, streets and parking lots. These areas have a high potential for runoff water to reach the stream during storm events. This also makes these areas more likely to contribute pollutants to the stream during storm events.

Most of the remaining watershed area, 60%, has soils with a moderate to low rate of water runoff potential. These soils consist of deep well-drained loamy textures. Although these soils can contribute runoff to the stream during larger storm events or if they are in close proximity to the stream, they are more likely to contribute pollutants to groundwater. Map 2.2 depicts Crow Creek Watershed runoff potential.

## **2.4 Social / Economic**

Cheyenne is the largest and only incorporated town in the Crow Creek Watershed with a population of about 53,000. However, with the growth surrounding Cheyenne, the population of the greater Cheyenne area is over 70,000. Not all of this development lies within the Crow Creek watershed boundaries, but a significant portion of it does.

Other population centers include Carpenter, F.E. Warren Air Force Base, South Cheyenne, and a subdivision development in the Table Mountain area west of Cheyenne.

Laramie County population has increased steadily over the last 40 years. Growth in number of residents has gone from 60,149 in 1960 to 81,607 in 2000 (Census data). The towns and Census Designated Places (CDPs) in the watershed make up the majority of the county's population. Cheyenne houses about 65% of the county's population.

Approximately 33% of the population resides in unincorporated areas. The unincorporated areas also saw the largest percentage of growth, up by almost 25% since the 1990 Census.

Many areas of the state are expected to see population declines, but urban and resort areas are expected to continue to experience growth. Laramie County is one of these "urban" areas. The county is home to F.E. Warren Air Force Base and the state's capitol, which will play a large role in the economic and demographic growth patterns of the future. In addition, Laramie County sits at the northern end of the growth corridor that extends along I-25. This placement will likely impact the positive growth predicted (Laramie County Comprehensive Plan 2001).

One of the biggest trends in the agricultural community and agriculture in general is conversion of agriculture land to other uses. A shift away from resource development toward urban development is causing this. It can be seen in the subdivision of land over time in the county. Subdivision of the land was quite dramatic in the second half of the 1970s with a total of 11,539 acres being given to subdivision. However, much of that subdivided land remains vacant today. The period from 1980 to 1994 saw only 3,767 acres (270 acres per year) being subdivided with 1,478 new residential lots. However, from 1994 through 2000, approximately 7,400 acres (over 1,000 acres per year) with 1,337 new residential lots were created.

Laramie County and the Crow Creek Watershed have seen continual, steady growth over time. It is predicted that population growth will continue. Most of the growth can be contributed to housing F.E. Warren Air Force Base within the county as well as the state capitol, along with being "urban" and part of the "front range" growth corridor.

## **2.5 Wildlife Fisheries**

The Wyoming Game and Fish Department (WGFD) has conducted numerous fish surveys throughout the Crow Creek Watershed, from the town of Carpenter to the Shell Back Ranch above the City of Cheyenne. The fish species that were found during these surveys and the locations are shown in Table 2.1:

Table 2.1. Fish Collection On Crow Creek  
 X indicates species present/shaded areas indicate game fish

| <b>Fish Species Collected</b> | <b>Above Cheyenne</b> | <b>Within Cheyenne</b> | <b>Below Cheyenne</b> |
|-------------------------------|-----------------------|------------------------|-----------------------|
| Brown Trout                   | X                     | X                      |                       |
| Brook Trout                   | X                     |                        |                       |
| Brassy Minnow                 |                       | X                      | X                     |
| Carp                          |                       |                        | X                     |
| Common Shiner                 | X                     | X                      | X                     |
| Creek Chub                    | X                     | X                      | X                     |
| Fathead Minnow                | X                     | X                      | X                     |
| Green Sunfish                 |                       | X                      | X                     |
| Johnny Darter                 | X                     | X                      | X                     |
| Longnose Dace                 | X                     | X                      | X                     |
| Longnose Sucker               |                       | X                      |                       |
| Plains Killfish               |                       |                        | X                     |
| Stoneroller                   | X                     | X                      |                       |
| White Sucker                  | X                     | X                      | X                     |

There were eleven total fish capture sites, two above Cheyenne, two within Cheyenne, and seven below Cheyenne. Information was gathered from WGFD reports (early 1990's).

### Surface Water Quality Classes and Uses

Stream classification is directly related to what types of fish are found in the creek, whether they are game fish or non-game fish. There are three game species located in Crow Creek; they are the Brown Trout, Brook Trout, and Green Sunfish. Game fish were found above Cheyenne, within Cheyenne and below Cheyenne which is depicted in Table 2.1.

The classification for Crow Creek is:

- Class 2AB (supports drinking water & game fish) Above Avenue C in Cheyenne
- Class 2 C (supports non-game fish) Below Avenue C in Cheyenne to the State line
- Some tributaries (higher in the watershed) are Class 2AB
- Some tributaries (lower in the watershed) are Class 3B (supports other aquatic life use)

The Stream Classification Table shows all the classification specifications. The shaded areas in Table 2.2 indicate classification for Crow Creek.

Table 2.2. Stream Classification  
Shaded areas indicate classification for Crow Creek

| <b>Class</b> | <b>Drinking Water</b> | <b>Game Fish</b> | <b>Non Game Fish</b> | <b>Fish Consumption</b> | <b>Other Aquatic Live</b> | <b>Recreation</b> | <b>Wildlife</b> | <b>Agriculture</b> | <b>Industry Value</b> | <b>Scenic</b> |
|--------------|-----------------------|------------------|----------------------|-------------------------|---------------------------|-------------------|-----------------|--------------------|-----------------------|---------------|
| 1            | Yes                   | Yes              | Yes                  | Yes                     | Yes                       | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 2AB          | Yes                   | Yes              | Yes                  | Yes                     | Yes                       | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 2A           | Yes                   | No               | No                   | No                      | Yes                       | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 2B           | No                    | Yes              | Yes                  | Yes                     | Yes                       | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 2C           | No                    | No               | Yes                  | Yes                     | Yes                       | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 3A           | No                    | No               | No                   | No                      | Yes                       | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 3B           | No                    | No               | No                   | No                      | Yes                       | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 3C           | No                    | No               | No                   | No                      | Yes                       | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 4A           | No                    | No               | No                   | No                      | No                        | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 4B           | No                    | No               | No                   | No                      | No                        | Yes               | Yes             | Yes                | Yes                   | Yes           |
| 4C           | No                    | No               | No                   | No                      | No                        | Yes               | Yes             | Yes                | Yes                   | Yes           |

## 2.6 Rare & Endangered Species

The sensitive animal species known or suspected to occur in the Crow Creek Watershed riparian area are listed in Table 2.3. This information was obtained from the Wyoming Natural Diversity Database.

Table 2.3. Sensitive Animal Species Located in the Crow Creek Watershed

| <b>Species</b>                | <b>Status or Source</b> | <b>Habitat or Distribution</b> |
|-------------------------------|-------------------------|--------------------------------|
| Preble's meadow jumping mouse | Threatened              | Riparian grassland             |

## 2.7 Rare Plants

Approximately twenty sensitive plant species are known or suspected to occur in the County. Specific information can be obtained from the Wyoming Natural Diversity Database at the University of Wyoming. Among these species are two federally protected plants that are listed in Table 2.4. Any occurrence of these species should be treated as an important natural resource deserving avoidance and protection.

Table 2.4. Sensitive Plant Species Located in the Crow Creek Watershed

| <i>Species</i>           | <i>Status</i> | <i>Habitat or Distribution</i> |
|--------------------------|---------------|--------------------------------|
| Colorado butterfly plant | Protected     | Sub-irrigated alluvium         |
| Ute Ladies-tresses       | Protected     | Riparian areas                 |

## 2.8 Credible Data Monitoring

State law requires that only credible data be used in making water quality condition determinations. Credible data means scientifically valid chemical, physical and biological monitoring data collected under a sampling and analysis plan including quality control, quality assurance procedures and available historical data.

The credible data rule is found in Chapter 1, Section 35, of the Wyoming Surface Water Quality Standards and states the following:

- (a) Development of scientifically valid chemical, physical and biological monitoring data shall:
  - (i) Consist of data collection using accepted referenced laboratory and field methods employed by a person who has received specialized training and has field experience in developing a monitoring plan, a quality assurance plan, and employing the methods outlined in such plans; or works under the supervision of a person who has these qualifications. Specialized training includes a thorough knowledge of written sampling protocols and field methods such that the data collection and interpretation are reproducible, scientifically defensible, and free from preconceived bias; and
  - (ii) Includes documented quality assurance consisting of a plan that details how environmental data operations are planned, implemented, and assessed with respect to quality during the duration of the project.

- (b) Credible data shall be collected on each water body, as required in this section and shall be considered for purposes of characterizing the integrity of the water body including soil, geology, hydrology, geomorphology, climate, stream succession and the influences of man upon the system. These data in combination with other available and applicable information shall be used through a weight-of-evidence approach to designate uses and determine whether those uses are being attained. In those instances where numerical standards contained in these rules are exceeded or on ephemeral and intermittent water bodies where chemical and biological sampling may not be practical or feasible, less than a complete set of data may be used to make a decision on attainment.
- (c) All changes to use designations after the effective date of this rule shall include the consideration of credible data relevant to the decision. Changes which involve the removal of a use designation or the replacement of a designation shall be supported by a use attainability analysis (UAA).
- (d) After the effective date of this rule, credible data shall be utilized in determining a water body's attainment of designated uses.

## SAMPLING HISTORY

The Laramie County Conservation District (LCCD) has been sampling Crow Creek for ammonia, cadmium and fecal coliform since April of 2000. Ammonia was not detected anywhere other than below the two wastewater treatment plants during the 2001 monitoring season and was not analyzed for in 2002. However, the Crow Creek Steering Committee and LCCD decided to reestablish monitoring for ammonia on a quarterly basis and it is included in the 2003 Sampling Plan

Cadmium was not detected in the sampling sites by LCCD. Recent sampling by other agencies was well below the Maximum Contaminant Level. This combined data was used to remove cadmium from the 303(d) impairment list.

Fecal coliform exceeded the standards at all sampling sites in Cheyenne (MLK Park, Ames Ave, Morrie Ave) since the spring of 2001. These fecal coliform counts are associated primarily with the storm drains in the City of Cheyenne. The sites below Cheyenne either had trace or low amounts of fecal coliform exceeding the standard occasionally. Please refer to Appendix C for sampling results.

Bacterial sampling will continue during the 2003 season for fecal coliform and *E.coli*. In 2002, it was decided by the Crow Creek Steering Committee and LCCD to introduce *E.coli* monitoring in addition to fecal coliform. This was due to the fact that *E.coli* may prove to be a better indicator of bacterial pollution and the United States

EPA and the Wyoming DEQ are in the process of developing standards for *E.coli* that may be in place in 2004.

The currently established sampling sites for Crow Creek are based on recommendations from the Water Quality Technical Team depicted on Map 2.3:

1. Roundtop Road (Above Cheyenne)
2. Martin Luther King, Jr. Park (In Cheyenne)
3. Ames Ave (In Cheyenne)
4. Morrie Ave (In Cheyenne)
5. Above the Crow Creek WWTP (Below Cheyenne)
6. Missile Road 217 (Below Cheyenne)
7. State Section Road 207 (Below Cheyenne)

Urbanization within the Crow Creek watershed is progressing and probably provides the greatest impacts to the watershed. Impacts include degradation of water quality, increased runoff to Crow Creek, loss of wildlife habitat, open spaces, and agricultural lands, and numerous other impacts. The goals, objectives, and action items identified in the Crow Creek Watershed Plan provide a means to minimize adverse impacts and to promote actions that will benefit the community and the watershed. Community involvement in the implementation of this plan will be the key to maintaining or improving conditions in the Crow Creek Watershed.

## **2.9 Protection of Aquatic Life: Ammonia**

The aquatic toxicity of ammonia varies with pH and temperature and the applicable limitations for Crow Creek are included in the charts in Appendix B. Within the Standard, Section 21, states "...the numeric ammonia criteria apply to all Class 1 and Class 2 waters." Additionally the Standard states in Section 21, "In all Class 3 waters within the State, concentrations of ammonia attributable to or influenced by human activities shall not be present in concentrations which could result in harmful acute or chronic effects to aquatic life which would not fully support existing and designated uses." The reaches of Crow Creek impaired by ammonia are shown on Map 2.4.

## **2.10 Cadmium Levels in Crow Creek**

In the early 1990's the U.S. Geological Survey (USGS) conducted sampling of Crow Creek for cadmium. Test results of this sampling exceeded the Standard for Aquatic Life. These values were enough to put Crow Creek on the DEQ 303(d) list of impaired water bodies in 1998. In 1994 the USGS changed their sampling protocol for cadmium

in surface waters. As a result of this change in protocol and further sampling conducted by the USGS showed that the water in Crow Creek was far below the standard for aquatic life and the detection limit of 0.001 milligrams per liter (mg/L). In 2002 cadmium was taken off the 303(d) list as a result of sampling done by the conservation district and USGS. These standards are from the Wyoming Surface Water Quality Standards Rules and Regulations.

## **2.11 Fecal Coliform and *E.coli* Sampling in Crow Creek**

In 2001 the Laramie County Conservation District (LCCD) began collecting fecal coliform samples at established sites on Crow Creek. In 2002 LCCD began sampling for *E.coli* as well as fecal coliform. This was due in part to the fact that *E.coli* bacteria are a better indicator of a health hazard due to bacterial contamination in surface waters. Please refer to Appendix C for sampling results. The reaches of Crow Creek listed as impaired by fecal coliform are shown on Map 2.5.

The Wyoming Department of Environmental Quality (DEQ) has established a compliance standard for fecal coliform. The standard states, "... during the entire year, fecal coliform concentrations shall not exceed a geometric mean of 200 organisms per 100 milliliters (based on a minimum of not less than five samples obtained during separate 24 hour periods for any 30 day period) nor shall the geometric mean of three separate samples collected within a 24 hour period exceed 400 organisms per 100 milliliters in any Wyoming surface water" (Wyoming Surface Water Quality Standards Rules and Regulations Chapter 1, Section 35).

DEQ is currently proposing a standard for *E.coli* of a 30 day geometric mean of 126 colonies/100 mL for primary contact waters (swimming, white water activities, etc.) This standard will apply from May 1st through September 30th. Also proposed is a Secondary Contact standard for waters that do not have full body contact recreation. This standard is 630 colonies/100 mL. Secondary Contact Criteria also applies on all waters from October 1st through April 30th.

## **2.12 Summary**

Cheyenne's wastewater treatment plants are known sources of ammonia. The plants will be upgraded in 2007, which will address ammonia discharge into the stream. If ammonia continues to be detected above accepted levels after the facility upgrades, further efforts will be necessary to find additional ammonia sources. High ammonia levels result in negative impacts on aquatic animal life.

In 2002 cadmium was removed from the 303(d) list as a result of sampling by LCCD and USGS. It is not fully understood what led to the cadmium detection. However, regular monitoring shows that cadmium is not a constant presence and does not warrant additional efforts.

Fecal coliform levels in Crow Creek consistently exceed DEQ standards in the urban area of Cheyenne and near the Wyoming/Colorado border. Urban fecal coliform levels are most likely the result of storm water runoff. It is unlikely that there is cross contamination with sanitary sewage lines. If sewage lines were a contributing factor, bacteria counts would be much higher than what is currently detected. Fecal coliform is most likely runoff related because the highest peaks occur after storm events. Possible contributors include domestic animal waste, wildlife waste, illegal wastewater discharge from RV tanks and septic systems. At this time, the City of Cheyenne is taking steps to correct fecal coliform impairments through increased street sweeping, improved maintenance of storm drains, and the construction of wetlands and infiltration trenches. They are also conducting a storm drain system analysis to assess the current storm drain system in Cheyenne (Map 2.6). Homeowners can address fecal coliform impairments through proper design, operation and maintenance of septic systems and pet waste disposal.

In the rural area near the Colorado/Wyoming border, fecal coliform levels are also storm related because high peaks occur following storm events. Possible contributors to fecal coliform in this area include septic systems, livestock waste and wildlife waste. To correct these high levels, BMPs (Appendix E) should be implemented to address septic systems and livestock waste. It was also noted that reaches of the stream with healthy riparian areas tended to have lower fecal coliform counts. The riparian area acts as a buffer to keep sediment out of the stream and help filter impurities out of the water.

At this time, the reach of stream in urban Cheyenne is the highest priority for BMPs. The implementation plan places greater focus on this area of Crow Creek because fecal coliform counts are much higher than in rural areas and greater public access to the stream in urban areas poses increased human health risks.

## 3. WATERSHED PLAN

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### 3.1 Goals & Objectives

The Steering Committee identified concerns and issues and from those developed the following goals, objectives and action items for the Crow Creek Watershed:

#### VISION STATEMENT

Promote actions that lead to a healthy and sustainable watershed.

#### MISSION STATEMENT OF CROW CREEK WATERSHED

Develop a watershed management plan for Crow Creek that considers water quality, water quantity, property rights, sustainable and diverse wildlife communities, legal requirements, defensible data, planned development, land-use planning, and functions of riparian and flood plain areas.

**GOAL #1: To enhance communication with local, state and federal agencies and the steering committee, agree on objectives, and utilize agency expertise and programs.**

*OBJECTIVE 1: Identify the affected agencies and organizations.*

#### ACTION ITEMS

- Work with steering committee to develop list of agencies and organizations and contact persons.
- Meet with identified people to gain interest and support.

*OBJECTIVE 2: Define means of communication.*

#### ACTION ITEMS

- Include affected agencies and entities on LCCD's newsletter mailing list.
- Utilize LCCD's web site to include information on the watershed plan.
- Use monthly State Water Forum meetings as an opportunity to keep agencies informed of progress on Crow Creek.
- Newspapers and press releases
- Radio
- Personal contacts
- Representatives (i.e. wildlife, agriculture) on steering committee take an active role in keeping those agencies and organizations informed.

*OBJECTIVE 3: Communicate steering committee activities to affected agencies and entities.*

ACTION ITEMS

- Include steering committee activities and Crow Creek activities in newsletter and on web site.
- Give updates on Crow Creek progress at State Water Forum meetings.
- Submit draft watershed plan to affected agencies and entities.
- Present draft watershed plan to list of agencies and organizations.
- Continue dialogue with agencies to identify strategies to improve water quality.

*OBJECTIVE 4: Consider input from affected agencies and entities in plan development.*

ACTION ITEMS

- Invite agencies to give presentations at Steering Committee Meetings.
- Incorporate suggestions from agencies into watershed plan.
- Provide each affected agency and organization a final watershed plan.

*OBJECTIVE 5: Continue dialogue with agencies to identify strategies to improve water quality.*

ACTION ITEMS

- Meet at least one time annually with list of affected agencies and organizations to provide an annual update of progress.

**GOAL # 2: Improve the quality and quantity of water in the Crow Creek Watershed by identifying the general relationship of flow patterns and fluctuations on water quality and identify water management alternatives.**

*OBJECTIVE 1: Identify users (land uses, major categories of uses) of the Crow Creek Watershed.*

ACTION ITEMS

- Work with City of Cheyenne and Laramie County to develop a GIS map and database of landowners/land use in the watershed.
- Update this database annually.
- Get information from agencies and organizations (i.e. Audubon) that are the users of the watershed.

*OBJECTIVE 2: Identify the uses of water in Crow Creek.*

ACTION ITEMS

- Work with the Wyoming State Engineer's Office (SEO) to develop a GIS map and database of inflows, permitted uses, assigned, water rights and associated beneficial uses from Crow Creek.
- Work with the steering committee and the community to identify other water uses in the watershed (i.e. recreation, fisheries, etc.)
- Transbasin Diversion, (other uses not associated with the SEO), city of Cheyenne, Game and Fish, Frontier Refinery, (NRCS has hydrologist that has ability to calculate the inflows into the Crow Creek Watershed).

*OBJECTIVE 3: Clarify water quality objectives.*

ACTION ITEMS

- Meet or exceed Wyoming water quality standards for ammonia (refer to Appendix B) within 5 years.
- Meet or exceed Wyoming water quality standards for cadmium (refer to Appendix F) within 5 years.
- Meet or exceed Wyoming water quality standards for fecal coliform (refer to Appendix C) within 5 years.

*OBJECTIVE 4: Identify patterns of water use and define flow patterns in various segments.*

ACTION ITEMS

- Work with USGS, SEO, BOPU, DEQ, WWDC, irrigators and monitoring data to identify when and where water is withdrawn from and returned to Crow Creek.
- Work with LCCD, USGS and monitoring data to identify and map flows in various segments of Crow Creek.
- Develop GIS map and database of water use.

*OBJECTIVE 5: Determine water quantity needed to meet water quality objectives. (Identify and explore opportunities for additional water to help water quality objectives.)*

ACTION ITEMS

- Measure and calculate impairment loads from various sources.
- Evaluate urban and agriculture BMPs to conserve water and explore opportunities to redirect salvage water to the stream.

*OBJECTIVE 6: Identify legal constraints and opportunities.*

ACTION ITEMS

- Work with Wyoming Water Development Commission to study effects on Crow Creek.
- Work with the State Engineers office and Board of Control to research

- legal liabilities on the stream.
- Brief discussion of Wyoming Water Law in the plan.

*OBJECTIVE 7: Keep abreast of Stage II Water marketing.*

ACTION ITEMS

- Maintain contact with BOPU and WWDC for update on Stage II Water.
- Determine what changes will occur if Stage II Water is sold out of basin.
- Explore opportunities to use Stage II Water to improve water quality.

**GOAL # 3: Define the origin, type, degree and geographic extent of impairments.**

*OBJECTIVE 1: Use historical data from a variety of sources.*

ACTION ITEMS

- Gather data from all available sources. (DEQ, BOPU, USGS, F.E. Warren Air Force Base)
- Review data for relevant information.
- Compile data in database.
- Create GIS map layer of sampling sites.
- Identify and map impaired areas.

*OBJECTIVE 2: Develop monitoring plan to supplement historical data.*

ACTION ITEMS

- Form a technical advisory group.
- Review historical and current data.
- Design a monitoring plan to meet Steering Committee objectives.
- Review and update the monitoring plan on an annual basis with the Water Quality Technical Team and Steering Committee.

*OBJECTIVE 3: Gather, analyze and submit additional credible data.*

ACTION ITEMS

- Monitor water quality on Crow Creek as per monitoring plan including Quality Assurance and Quality Control.
- Analyze and compare current and historical data for trends.
- Compile data in database.
- Create GIS map layer of sampling sites.
- Identify and map impaired areas.
- Determine the source of contaminants. (point or non-point)
- Monitor water quality to evaluate the effectiveness of watershed plan and/or BMPs.
- Submit data to DEQ to document status of water quality.

*OBJECTIVE 4: Coordinate future testing efforts.*

ACTION ITEMS

- Identify agencies or organizations conducting water quality monitoring on Crow Creek
- Coordinate LCCD monitoring with DEQ, USGS and F.E. Warren Air Force Base.

**GOAL # 4: Elevate public awareness on the listing of Crow Creek as an impaired water body and the importance of improving water quality.**

*OBJECTIVE 1: Identify and develop methods and strategy of public outreach, involvement and education.*

ACTION ITEMS

- Contract with public relations firm.
- Stencil all storm drains within the watershed (Dump no Waste, Drains to Crow Creek).
- Hold three tours or seminars addressing NPS pollution prevention.
- Teach NPS pollution in 105 classroom presentations.
- Distribute NPS pollution prevention information at six public events.
- Develop NPS pollution prevention brochure and provide to Laramie County Planning Department to be distributed with all new building permit requests.
- Provide lawn watering educational brochures and rain gauges to 1000 local residents.
- Hold annual tour or other event to highlight the progress of the implementation of the Crow Creek Watershed Plan.

*OBJECTIVE 2: Make a special effort to reach out to potentially affected interests.*

ACTION ITEMS

- Identify potential opponents to the implementation of the watershed plan.
- Identify potential proponents or beneficiaries of the watershed plan.
- Steering committee and LCCD jointly make one-on-one contacts to encourage support and involvement.

*OBJECTIVE 3: Identify the implications of listing and the benefits of local management.*

ACTION ITEMS

- Hold public meeting and illustrate the differences between a watershed plan and TMDLs.
- Hold open house or other event to present the draft watershed plan.

- Provide a legal notice in local newspapers with a draft plan and allow for public comment.
- Analyze and incorporate public comments in the final watershed plan.

**GOAL # 5: Develop a watershed plan, which can be successfully implemented to achieve water quality goals and delisting of Crow Creek from the 303(d) list of impaired water bodies.**

*OBJECTIVE 1: Recommend possible solutions within the limits of available data.*

**ACTION ITEMS**

- Complete a study on feasibility of improving the quality of water discharge from Cheyenne's storm water drains.
- Recommend potential solutions identified in the feasibility study.

*OBJECTIVE 2: Identify other areas that need BMPs and work with landowners to install.*

**ACTION ITEMS**

- Develop list of urban and agriculture BMPs to improve water quality within Crow Creek (including the following):
- Develop wetlands.
- Fence riparian areas and develop off-site water.
- Develop small acreage grazing demonstration sites.
- Plant tree rows for riparian buffers.

*OBJECTIVE 3: Coordinate activities related to implementing the plan.*

**ACTION ITEMS**

- LCCD will provide leadership for implementing and updating the Crow Creek Watershed Plan.

*OBJECTIVE 4: Ensure acceptance by appropriate state and federal agencies.*

**ACTION ITEMS**

- Submit completed plan to DEQ for approval.
- Identify which BMPs will need state and/or federal approval.
- LCCD will provide assistance for obtaining the necessary permits.

*OBJECTIVE 5: Ensure that plan components are voluntary and are effectively implemented.*

#### ACTION ITEMS

- LCCD will provide assistance in obtaining cost share incentives and technical support to affected entities and landowners.
- Ensure that BMPs are installed to accepted standards.

### **GOAL #6: Gain public acceptance and support of the plan by considering the needs and concerns of all stakeholders in the Crow Creek Watershed.**

*OBJECTIVE 1: Ensure that needs and concerns are clearly defined.*

#### ACTION ITEMS

- Utilize Steering Committee Members to represent their area of interest in identifying needs and concerns of stakeholders.

*OBJECTIVE 2: Work with affected users to assure public acceptance and support.*

#### ACTION ITEMS

- LCCD will provide technical assistance to develop conservation plans to meet users needs.
- Define the benefits of the watershed plan.
- Provide information to stakeholders regarding the benefits of the watershed plan.

## **3.2 Plan Implementation**

The Crow Creek Watershed Plan should be implemented in a cycle which involves selecting and acting on the most important elements, monitoring the watershed's response, reviewing the results, updating the plan and resuming implementation of the most important elements. The duration of each work plan cycle should be three to five years to obtain adequate physical, chemical, and biological data as well as political and institutional support and resources.

It is necessary to select the elements from the list of BMPs, which address the most pressing issues in the watershed. At the same time, it is prudent to start work on some actions that are most promising in terms of the expected benefits to be attained from their implementation, or are most critical to future decision-making. This should also include those strategies which may take many years to fully implement but do not require a large amount of effort to start.

In order to obtain commitment to move forward with implementation, it is necessary to assign responsibilities for work plan items and to estimate the cost associated with the selected actions. Expectantly, the following plan of work will begin to show improvements in Crow Creek's water quality.

It is also recognized that many of the recommended actions do not fit precisely into the mandate or constrained budget of any single agency, group or organization. Accordingly, it is expected that to make reasonable progress in watershed management, it will be necessary to cultivate partnerships between agencies and across various sectors of watershed interests for effective delivery of watershed actions.

On a regular basis, the Crow Creek Watershed Plan needs to be reviewed and updated based on the additional information gathered through the monitoring activities, on the completion of tasks in the work plan, and on the need to respond to emerging issues and concerns in the watershed. A bi-annual report on progress is desirable to keep the community focused on the watershed and our conservation activities. This report should coincide with the 305(b) report issued by DEQ and include the following:

- Progress made on watershed management actions listed in the work plan.
- Observed trends in watershed conditions as indicated by monitoring efforts, correlated as much as possible with the BMPs which have been implemented.
- Changes in external influences on watershed conditions since the last review.
- Modifications to the overall strategy, as determined through dialogue and consensus- building among watershed stakeholders.
- Priority actions to be pursued for the next phase of watershed management work.

As part of its ongoing watershed management program, LCCD accepts the coordinating role, in consultation with municipalities, the county government, federal and state departments, the Crow Creek Watershed Steering Committee and other non-governmental organizations to ensure that the periodic review, analysis and watershed reporting is done in an efficient manner through an open and accountable process.

### **3.3 Plan of Work**

**Goal 1: To enhance communication with local, state and federal agencies and the steering committee, agree on objectives, and utilize agency expertise and programs.**

*Objective 1: Identify the affected agencies and organizations*

| Action   | Product     | Completed by                           | Completion date                   |
|--|-------------|--|-----------------------------------|
| Work with Steering Committee to develop list of agencies and organizations and contact persons | 10 Contacts | Steering Committee<br>District Manager | November 2003<br><b>COMPLETED</b> |
| Meet with identified people to gain interest and support                                       | 10 Contacts | District Manager<br>Water Specialist   | February 2004                     |

*Objective 2: Define means of communication*

| Action   | Product      | Completed by                                   | Completion date |
|--|--------------|--|-----------------|
| Include affected agencies and entities on district newsletter mailing list                                     | 10 Contacts  | Administrative Assistant                       | On-going        |
| Utilize LCCD's web site to include information on the watershed plan   | 1 Site       | Education Specialist                           | On-going        |
| Use monthly State Water Forum meetings as an opportunity to keep agencies informed of progress on Crow Creek   | Monthly      | Water Specialist                               | On-going        |
| Newspapers and press releases  | 4/Year       | District Manager<br>Education Specialist       | On-going        |
| Radio  | 1/Year       | District Manager<br>Water Specialist           | On-going        |
| Personal contacts  | 100 Contacts | Steering Committee<br>LCCD Board<br>LCCD Staff | February 2004   |
| Representatives on Steering Committee take an active role in keeping those agencies and organizations informed | 10 Contacts  | Steering Committee                             | On-going        |

*Objective 3: Communicate Steering Committee activities to affected agencies and entities*

| Action  | Product | Completed by                             | Completion date |
|---|---------|--|-----------------|
| Include Steering Committee activities and Crow Creek activities in newsletter and on web site | 3/Year  | Water Specialist<br>Education Specialist | On-going        |
| Give updates on Crow Creek progress at State Water Forum meetings                             | Monthly | Water Specialist                         | On-going        |

|   |             |  |               |
|---|-------------|--|---------------|
| Submit draft watershed plan to affected agencies and entities                   | 1 Plan      | District Manager<br>Administrative Assistant | December 2003 |
| Present draft watershed plan to list of agencies and organizations              | 1 Plan      | Steering Committee<br>LCCD Board             | December 2003 |
| Continue dialogue with agencies to identify strategies to improve water quality | 10 Contacts | Water Specialist<br>Wildlife Specialist      | On-going      |

*Objective 4: Consider input from affected agencies and entities in plan development*

| Action   | Product          | Completed by                         | Completion date               |
|--|------------------|--------------------------------------|-------------------------------|
| Invite agencies to give presentations at Steering Committee meetings | 10 Presentations | District Manager                     | July 2002<br><b>COMPLETED</b> |
| Incorporate suggestions from agencies in watershed plan              | 10 Contacts      | District Manager<br>Water Specialist | December 2003                 |
| Provide each affected agency and organization a final watershed plan | 10 Contacts      | Administrative Assistant             | January 2004                  |

*Objective 5: Continue dialogue with agencies to identify strategies to improve water quality*

| Action   | Product        | Completed by                         | Completion date |
|--|----------------|--------------------------------------|-----------------|
| Meet at least one time annually with list of affected agencies and organizations to provide an annual update of progress | Yearly meeting | District Manager<br>Water Specialist | On-going        |

**Goal 2: Improve the quality and quantity of water in the Crow Creek watershed by identifying the general relationship of flow patterns and fluctuations on water quality and identify water management alternatives.**

*Objective 1: Identify users (land uses, major categories of uses) of the Crow Creek Watershed*

| Action  | Product | Completed by                       | Completion date                  |
|---|---------|------------------------------------|----------------------------------|
| Work with City of Cheyenne and Laramie County to develop a GIS map and database of landowners/land-use in the watershed | 1 Map   | Water Specialist<br>GIS Technician | January 2002<br><b>COMPLETED</b> |

|   |           |                                      |               |
|---|-----------|--------------------------------------|---------------|
| Update this database annually   | 1 Update  | GIS Technician                       | Yearly        |
| Get information from agencies and organizations that are the users of the watershed | All users | District Manager<br>Water Specialist | November 2004 |

*Objective 2: Identify the uses of water in Crow Creek*

| Action  | Product | Completed by   | Completion date |
|---|---------|--|-----------------|
| Work with the SEO to develop a GIS map and database of inflows, permitted uses, assigned water rights, and associated beneficial uses from Crow Creek | 1 Map   | Water Specialist<br>GIS Technician                       | November 2004   |
| Work with the Steering Committee and the community to identify other water uses in the watershed  | 1 Map   | Steering Committee<br>Water Specialist<br>GIS Technician | November 2004   |
| Identify other uses not associated with SEO   | 1 Map   | Water Specialist<br>GIS Technician                       | November 2004   |

*Objective 3: Clarify water quality objectives*

| Action   | Product  | Completed by                                   | Completion date                  |
|--|----------|--|----------------------------------|
| Meet or exceed Wyoming Water Quality Standards for ammonia               | 1 Stream | Steering Committee<br>LCCD Board<br>LCCD Staff | January 2008                     |
| Meet or exceed Wyoming Water Quality Standards for cadmium<br>LCCD Staff | 1 Stream | Steering Committee<br>LCCD Board               | January 2008<br><b>COMPLETED</b> |
| Meet or exceed Wyoming Water Quality Standards for fecal coliform        | 1 Stream | Steering Committee<br>LCCD Board<br>LCCD Staff | January 2008                     |

*Objective 4: Identify patterns of water use and define flow patterns in various segments.*

| Action  | Product | Completed by                       | Completion date |
|---|---------|------------------------------------|-----------------|
| Work with USGS, SEO, BOPU, DEQ Irrigators and monitoring data to identify when and where water is withdrawn from and returned to Crow Creek | 1 Map   | Water Specialist<br>GIS Technician | November 2004   |
| Work with LCCD, USGS and monitoring data to identify and map flows in various segments of Crow Creek  | 1 Map   | Water Specialist<br>GIS Technician | November 2004   |

|   |       |                                    |               |
|---|-------|------------------------------------|---------------|
| Develop GIS map and database of water use | 1 Map | Water Specialist<br>GIS Technician | November 2004 |
|---|-------|------------------------------------|---------------|

*Objective 5: Determine water quantity needed to meet water quality objectives*

| Action  | Product                     | Completed by                            | Completion date |
|---|-----------------------------|---|-----------------|
| Measure and calculate impairment loads from various sources   | Cheyenne Storm Water System | Water Specialist                        | November 2003   |
| Evaluate urban and agriculture BMPs to conserve water and explore opportunities to redirect salvage water to the stream | 5 BMPs                      | Water Specialist<br>Wildlife Specialist | January 2004    |

*Objective 6: Identify legal constraints and opportunities*

| Action   | Product | Completed by                         | Completion date                   |
|--|---------|--------------------------------------|-----------------------------------|
| Work with WWDC to study effects on Crow Creek                                | 1 Study | District Manager<br>Water Specialist | November 2004                     |
| Work with the SEO and Board of Control to research liabilities on the stream | 1 Study | District Manager<br>Water Specialist | November 2003                     |
| Brief discussion of Wyoming Water Law in the plan                            | 1 Plan  | District Manager                     | December 2003<br><b>COMPLETED</b> |

*Objective 7: Keep abreast of Stage II Water marketing*

| Action   | Product       | Completed by                         | Completion date |
|--|---------------|--------------------------------------|-----------------|
| Maintain contact with BOPU and WWDC for update on Stage II Water         | Yearly update | Water Specialist                     | On-going        |
| Determine what changes will occur if Stage II Water is sold out of basin | 1 Study       | District Manager<br>Water Specialist | November 2004   |
| Explore opportunities to use Stage II Water to improve water quality     | 1 Study       | District Manager<br>Water Specialist | November 2004   |

**Goal 3: Define the origin, type, degree and geographic extent of impairments.**

*Objective 1: Use historical data from a variety of sources.*

| Action  | Product   | Completed by     | Completion date                  |
|---|-----------|------------------|----------------------------------|
| Gather historical data from all available sources | 5 Sources | Water Specialist | January 2002<br><b>COMPLETED</b> |

|   |            |                  |                                  |
|---|------------|------------------|----------------------------------|
| Review historical data for relevant information   | 1 Review   | Water Specialist | January 2002<br><b>COMPLETED</b> |
| Compile historical data in database               | 1 Database | Water Specialist | January 2002<br><b>COMPLETED</b> |
| Create GIS map layer of historical sampling sites | 1 Map      | Water Specialist | January 2002<br><b>COMPLETED</b> |
| Identify and map impaired areas                   | 1 Map      | Water Specialist | January 2002<br><b>COMPLETED</b> |

*Objective 2: Develop monitoring plan to supplement historical data*

| Action  | Product  | Completed by     | Completion date                   |
|---|----------|------------------|-----------------------------------|
| Form a technical advisory group   | 1 Group  | Water Specialist | February 2002<br><b>COMPLETED</b> |
| Review historical and current data  | 1 Review | Water Specialist | February 2002<br><b>COMPLETED</b> |
| Design a monitoring plan to meet Steering Committee objectives  | 1 Plan   | Water Specialist | February 2002<br><b>COMPLETED</b> |
| Review and update the monitoring plan on an annual basis with the Water Quality Technical Team and Steering Committee | 1 Plan   | Water Specialist | On-going                          |

*Objective 3: Gather, analyze and submit additional data*

| Action   | Product        | Completed by     | Completion date                  |
|--|----------------|------------------|----------------------------------|
| Monitor water quality on Crow Creek as per monitoring plan including QA/QC         | Credible data  | Water Specialist | On-going                         |
| Analyze and compare current and historical data for trends                         | Measure change | Water Specialist | On-going                         |
| Compile sampling results in database   | 1 Database     | Water Specialist | On-going                         |
| Create GIS map layer of sampling sites   | 1 Map          | GIS Technician   | On-going                         |
| Identify and map impaired areas  | 1 Map          | Water Specialist | January 2002<br><b>COMPLETED</b> |
| Determine the source of contaminates (point or non-point)                          | 1 Map          | Water Specialist | January 2003<br><b>COMPLETED</b> |
| Monitor water quality to evaluate the effectiveness of the watershed plan and BMPs | Measure change | Water Specialist | On-going                         |
| Submit data to DEQ to document status of water quality                             | Yearly         | Water Specialist | On-going                         |

*Objective 4: Coordinate future testing efforts*

| Action  | Product | Completed by                         | Completion date |
|---|---------|--------------------------------------|-----------------|
| Identify agencies or organizations conducting water quality monitoring        | Yearly  | District Manager<br>Water Specialist | On-going        |
| Coordinate district monitoring with DEQ, USGS, and F.E. Warren Air Force Base | Yearly  | Water Specialist                     | On-going        |

**Goal 4: Elevate public awareness on listing of Crow Creek as an impaired water body and the importance of improving water quality**

*Objective 1: Identify and develop methods and strategy of public outreach, involvement and education.*

| Action  | Product          | Completed by                             | Completion date |
|---|------------------|--|-----------------|
| Contract with public relations firm   | 1 Contract       | District Manager                         | July 2004       |
| Stencil all storm drains and greenway corridor within the watershed                           | 200 / Year       | Education Specialist                     | December 2006   |
| Hold three tours or seminars addressing NPS pollution prevention                              | 1/ Year          | District Manager<br>Education Specialist | December 2005   |
| Distribute NPS pollution prevention info at six public events                                 | 2/ Year          | LCCD Staff                               | December 2005   |
| Develop NPS pollution prevention brochure   | 1000 Brochures   | Education Specialist<br>LCCD Staff       | May 2004        |
| Provide lawn watering educational brochures and rain gauges                                   | 1000 Brochures   | LCCD Staff                               | December 2004   |
| Teach NPS pollution prevention classes  | 105 Classes      | Education Specialist                     | December 2004   |
| Hold annual event to highlight progress on Crow Creek Watershed Plan                          | 1/ Year          | LCCD Staff                               | On-going        |
| Coordinate with City of Cheyenne, Laramie County and WYDOT for Phase II stormwater permitting | Annual Agreement | District Manager                         | On-going        |

*Objective 2: Make a special effort to reach out to potentially affected interest*

| Action   | Product | Completed by       | Completion date |
|--|---------|--------------------|-----------------|
| Identify potential opponents to implementation of the watershed plan | 1 List  | Steering Committee | May 2004        |

|   |              |                                  |               |
|---|--------------|----------------------------------|---------------|
| Identify potential proponents or beneficiaries of the watershed plan                              | 1 List       | Steering Committee               | May 2004      |
| Steering Committee and LCCD jointly make one-on-one contacts to encourage support and involvement | 100 Contacts | LCCD Board<br>Steering Committee | December 2003 |

*Objective 3: Identify the implications of listing and the benefits of local management*

| Action  | Product    | Completed by                                   | Completion date                  |
|---|------------|--|----------------------------------|
| Hold public meeting and illustrate the differences between a watershed plan and TMDLs     | 1 Meeting  | LCCD Board<br>LCCD Staff                       | May 2000<br><b>COMPLETED</b>     |
| Hold open house or other event to present the draft watershed plan                        | 1 Event    | Steering Committee<br>LCCD Board<br>LCCD Staff | October 2003<br><b>COMPLETED</b> |
| Provide a legal notice in local newspapers with a draft plan and allow for public comment | 2 Notices  | District Manager                               | October 2003<br><b>COMPLETED</b> |
| Analyze and incorporate public comments in the final watershed plan                       | Final Plan | Steering Committee                             | January 2004<br><b>COMPLETED</b> |

**Goal 5: Develop a watershed plan, which can be successfully implemented to achieve water quality goals and de-listing of Crow Creek from the 303(d) list of impaired water bodies.**

*Objective 1: Recommend possible solutions within the limits of available data.*

| Action  | Product   | Completed by                         | Completion date |
|---|-----------|--------------------------------------|-----------------|
| Complete a study on feasibility of improving the quality of water discharged from Cheyenne's storm water drains | 1 Study   | Water Specialist<br>City of Cheyenne | January 2004    |
| Recommend potential solutions identified in the study   | 1 Meeting | LCCD Staff<br>City of Cheyenne       | January 2004    |

*Objective 2: Identify other areas that need BMPs and work with landowners to install.*

| Action   | Product | Completed by     | Completion date                  |
|--|---------|------------------|----------------------------------|
| Develop list of urban and agricultural BMPs to improve water quality within Crow Creek | 1 List  | Water Specialist | January 2003<br><b>COMPLETED</b> |

|  |                       |   |                                  |
|--|-----------------------|---|----------------------------------|
| Develop wetlands at (1) Dry Creek to treat all runoff prior to convergence with Crow Creek; (2) Ames Ave where highest level of fecal coliform is found; and (3) Missile Drive to provide a highly visible wetland demonstration | 3 Wetlands            | Water Specialist<br>Wildlife Specialist | January 2005                     |
| Fence riparian areas at the North Crow Reservoir and North Crow Diversion to reduce fecals from storm water runoff entering municipal drinking water supply and develop off-site stock water                                     | 18,000<br>Linear feet | Water Specialist<br>Wildlife Specialist | January 2005                     |
| Develop small acreage grazing demonstration sites in highly visible areas surrounding Cheyenne to reduce sediment and storm water runoff   | 5 sites               | Wildlife Specialist<br>Water Specialist | January 2005                     |
| Plant tree rows for riparian buffers below Hereford Reservoir #2 to reduce storm water runoff and buffer the affects from livestock grazing  | 9,000<br>Linear feet  | Wildlife Specialist<br>Tree Specialist  | January 2005<br><b>COMPLETED</b> |

*Objective 3: Coordinate activities related to implementing the plan.*

| Action   | Product | Completed by             | Completion date |
|--|---------|--------------------------|-----------------|
| LCCD will provide leadership for implementing and updating the Crow Creek Watershed Plan | 1 Plan  | LCCD Board<br>LCCD Staff | On-going        |

*Objective 4: Ensure acceptance by appropriate state and federal agencies.*

| Action   | Product | Completed by                         | Completion date               |
|--|---------|--------------------------------------|-------------------------------|
| Submit completed plan to DEQ for approval                        | 1 Plan  | District Manager                     | December 2003                 |
| Identify which BMPs will need state and/or federal approval      | All     | Water Specialist                     | July 2003<br><b>COMPLETED</b> |
| LCCD will provide assistance for obtaining the necessary permits | All     | District Manager<br>Water Specialist | January 2005                  |

*Objective 5: Ensure that plan components are voluntary and are effectively implemented.*

| Action  | Product   | Completed by  | Completion date |
|---|-----------|---|-----------------|
| LCCD will provide assistance in obtaining cost share incentives and technical support to affected entities and landowners | As needed | District Manager<br>Water Specialist<br>Wildlife Specialist | January 2005    |

|  |           |                          |              |
|--|-----------|--------------------------|--------------|
| Ensure that BMPs are installed to accepted standards | As needed | LCCD Board<br>NRCS Staff | January 2005 |
|--|-----------|--------------------------|--------------|

**Goal 6: Gain public acceptance and support of the plan by considering the needs and concerns of all stakeholders in the Crow Creek Watershed.**

*Objective 1: Ensure that needs and concerns are clearly defined.*

*Objective 2: Work with affected users to assure public acceptance and support.*

| Action   | Product          | Completed by                     | Completion date               |
|--|------------------|----------------------------------|-------------------------------|
| LCCD will provide technical assistance to develop conservation plans to meet users needs | As needed        | LCCD Staff<br>NRCS Staff         | On-going                      |
| Define the benefits of the watershed plan  | All stakeholders | Steering Committee<br>LCCD Board | July 2003<br><b>COMPLETED</b> |
| Provide information to stakeholders regarding the benefits of the watershed plan         | All stakeholders | LCCD Staff                       | July 2003                     |

## RECOMMENDATIONS

The Crow Creek Steering Committee recommends implementing the action items described in the Crow Creek Watershed Plan. This is by no means a complete list of the actions that will be necessary to solve this problem, but should provide tools and direction to land managers and landowners on the types of projects that can be voluntarily installed to improve the quality of water in Crow Creek. Another key component of the watershed plan is communication throughout the process. Communication between agencies at all levels (local, state and federal) and communication with the stakeholders is integral to the success of the Crow Creek Watershed Plan.

# APPENDIX

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## **APPENDIX A**

The Crow Creek Steering Committee developed the following list of issues, concerns and opportunities early in the planning process. This list was then prioritized, and the top priorities were used to develop goals for the watershed plan. This list is included in the Appendix so that the many important points generated do not get lost in the planning process. Even though most of these items did not have specific goals generated in the plan, the Laramie County Conservation District (LCCD) will still strive to address the issues, concerns and opportunities presented here in the implementation of the Crow Creek Watershed Plan.

### ISSUES, CONCERNS AND OPPORTUNITIES

- A. Avoiding imposition of regulatory mandates.
- B. What will be scope of plan-both area and specific actions of plan?
- C. Education of community at large.
- D. Clean water action plan.
- E. Flood plains and areas acting as flood control.
- F. Plan has to identify strategies to address Total Maximum Daily Load (TMDL) contamination (specific pollutants).
- G. Instream flow (maintain, water quantity, water in creek, adjudicated rights).
- H. Stream modification in urban and rural areas.
- I. Finite natural resources.
- J. Enhance community pride/ownership in Crow Creek.
- K. Give equal consideration of all stakeholders.
- L. Endangered species.
- M. Documentation from Wyoming Department of Environmental Quality (DEQ) and City of Cheyenne Board of Public Utilities (BOPU) of wastewater treatment and improvement in allocation (timing and extent or certainty).
- N. Biotic health (function, composition).
- O. Funding.
- P. Be sure current, relevant, and pertinent data is used for decision-making.
- Q. How can we monitor compliance with plan?
- R. Minimize contaminants by treating with upland buffer and filter riparian strips and wetlands.
- S. Opportunity to preserve open space through conservation agreement purchases, property acquisition etc., to preserve water quality goals.
- T. Federal state and community standards.

- U. Establish a working relationship with regulatory and non-regulatory agencies to help implement recommendations in plan.
- V. Further degradation is a possibility.
- W. Strike a balance between rights of individuals and failure to act on entire community.
  - a. Reasonable requests and demands.
- X. Stimulate or improve natural functions.
- Y. Become involved with State's water planning effort when it shifts to non-point drainage.
- Z. Solutions and strategies need to be enforceable and permanent.
  - a. Identify other practices that will avoid future problems.
- AA. Clearly Identify limit of legal abilities and present those in final plan. What can we really legally do? What powers do we have?
- BB. Influence storm water plan of City/County.
  - a. Provide for future updates of plan: keep it current.
  - b. Engage Wyoming State Engineer's Office (SEO) to promote water management discussion-strategize water management practices.
  - c. Encourage developers to use open space design principles e.g. clustering-preserve open space.
  - d. Develop public outreach/participation plan.
  - e. Group needs to call shots the way they see them and not become politicized.

Below is the list of issues, concerns and opportunities that ranked the highest for the Committee and from this list the goals for the Crow Creek Watershed Plan were developed. Each issue was looked at more in-depth by answering two questions. What is the current situation? What are the true issues?

### **Issues, Concerns and Opportunities**

1. Establish a working a relationship with regulatory and non-regulatory agencies to help implement recommendations in plan.
2. Plan has to identify strategies to address TMDL contamination (specific pollutants).
3. Instream flow (maintain water quantity, water in creek, adjudicated rights).
4. Be sure current, relevant, and pertinent data is used for decision-making.
5. Education of community at large.
6. Avoiding imposition of regulatory mandates.
7. Develop public outreach participation plan.

## **1. REGULATORY AND NON-REGULATORY AGENCIES**

- a. What is the current situation?
  - Lack of consistent outreach.
  - Lack of communication within organizations.
- b. What are the true issues?
  - How can the agencies help the Steering Committee?
  - The Committee needs to identify the agencies.
  - The Committee needs to write an issue statement, and then be able to write a goal statement.

## **2. WHAT ARE THE STRATEGIES TO ADDRESS TMDLS?**

- a. What is the current situation?
  - Credible Data needed to confirm current questionable data.
  - Crow Creek is currently listed as impaired water body with a level of uncertainty as to where problem exists.
  - Implementation will have a real impact on some stakeholders.
- b. What are the true issues?
  - Three known contaminants are ammonia, cadmium and fecal coliform.
  - Don't know where they are coming from.
  - The Steering Committee was formed to try and solve the problems without getting US Environmental Protection Agency (EPA) and DEQ to mandate changes.
  - The Committee needs to pinpoint where action is needed.

## **3. INSTREAM FLOW**

- a. What is the current situation?
  - Need to increase flow in Crow Creek to decrease levels of contamination.
  - Lack of or inadequate consistent flow contributes to the problem.
  - Water management versus water rights.
  - Current water management strategies encourage maximum consumptive use.
  - Flow may differ from various segments of Crow Creek (availability and need).
- b. What are the true issues?
  - The lack of a cohesive Water Management Plan.
  - Some segments have a more reliable source of water, some have less reliable or no dependable source
  - Some areas have competing demands.
  - The majority of water flow below the City of Cheyenne is from wastewater treatment plants.

## **4. BE SURE CURRENT, RELEVANT, AND PERTINENT DATA IS USED FOR DECISION-MAKING.**

- a. What is the current situation?
  - Old data, current data and who knows what else; we don't know how reliable it is.
  - Sparse and questionable data.
  - No consistent data collection.
  - Monitoring sites have been selected.
  - Who will collect the water quality data
- b. What are the true issues?
  - The need to have adequate data, and to have a greater degree of confidence in decision-making.
  - The need to determine if we have the political, social and financial support to complete the data gathering process is available.
  - Testing needs to be completed in a manner that will allow for de-listing of unimpaired Crow Creek segments and pinpoint problem areas.
  - Coordination and interpretation of data collected by other agencies.

## **5. EDUCATION OF COMMUNITY AT LARGE**

- a. What is the current situation?
  - There is a need for education.
  - Public is either not informed or not aware of the problem.
  - Community is not aware of the value of Crow Creek or the implications of stream classification.
  - Don't have a good mechanism for education.
  - People don't believe that the classification or listing of Crow Creek will affect them.
  - People don't see how their actions affect Crow Creek.
- b. What are the true issues?
  - Develop an effective educational plan, one that is progressive in nature and able to change as the Watershed Management Plan is developed.
  - Public needs to be part of the solution.
  - There is a need for public input throughout the process.
  - Need to identify and separate target groups for development of educational strategies that are appropriate for each group.
  - Apathy of community towards Crow Creek water quality issues.

## **6. AVOIDING IMPOSITION OF REGULATORY MANDATES**

### a. What is the current situation?

- If nothing is addressed in the Crow Creek Watershed, there will be mandates from regulatory agencies.
- Voluntary options do exist, and people need to know and understand that the options are there.
- There is no watershed management plan currently in place.

### b. What are the true issues?

- Develop a sound plan that will be supported and adopted by local governmental entities as well as stakeholders.
- How will the regulatory agencies deal with the Watershed Plan if no change in water quality occurs?
- Identify whether problems are point or non point source pollution (NPS).
- NPS pollution problems are difficult to solve through regulation.

## **7. DEVELOP A PUBLIC OUTREACH PARTICIPATION PLAN**

### a. What is the current situation?

- An effective public outreach participation plan does not currently exist.
- There are very few people representing the stakeholders in the watershed.
- The Committee does not receive much feedback from the public.

### b. What are the true issues?

- Find a way to engage public involvement in the process.
- Motivate the public into actively participating in the process.
- Public acceptance of the plan must be obtained.

## APPENDIX B

### PROTECTION OF AQUATIC LIFE: AMMONIA

DEQ Water Quality Rules and Regulations, Chapter 1, Wyoming Surface Water Quality Standards, Section 21 **Protection of Aquatic Life**, provides the following information:

- a. The aquatic toxicity of ammonia varies with pH and temperature and the applicable limitations are included in the table below. The numeric ammonia criteria apply to all Class 1 and Class 2 waters.
- b. In all Class 3 waters, concentrations of ammonia attributable to or influenced by human activities shall not be present in concentrations which could result in harmful acute or chronic effects to aquatic life, or which would not fully support existing and designated uses.
- c. The ammonia values in the tables below are expressed in milligrams ammonia nitrogen per liter (mg N/L) and vary with temperature and/or pH, fish species or fish life-stage.

| Table B1. pH-Dependent Values of the Acute Criterion (CMC)(1) for Ammonia |                      |                  |
|---|----------------------|------------------|
| pH  | Acute Values, mg N/L |                  |
|   | Salmonids Present    | Salmonids Absent |
| 6.5   | 32.6                 | 48.8             |
| 6.6   | 31.3                 | 46.8             |
| 6.7   | 29.8                 | 44.6             |
| 6.8   | 28.1                 | 42.0             |
| 6.9   | 26.2                 | 39.1             |
| 7.0   | 24.1                 | 36.1             |
| 7.1   | 22.0                 | 32.8             |
| 7.2   | 19.7                 | 29.5             |
| 7.3   | 17.5                 | 26.2             |
| 7.4   | 15.4                 | 23.0             |
| 7.5   | 13.3                 | 19.9             |
| 7.6   | 11.4                 | 17.0             |
| 7.7   | 9.65                 | 14.4             |
| 7.8   | 8.11                 | 12.1             |
| 7.9   | 6.77                 | 10.1             |
| 8.0   | 5.62                 | 8.40             |
| 8.1   | 4.64                 | 6.95             |
| 8.2   | 3.83                 | 5.72             |
| 8.3   | 3.15                 | 4.71             |
| 8.4   | 2.59                 | 3.88             |
| 8.5   | 2.14                 | 3.20             |
| 8.6   | 1.77                 | 2.65             |
| 8.7   | 1.47                 | 2.20             |
| 8.8   | 1.23                 | 1.84             |
| 8.9   | 1.04                 | 1.56             |
| 9.0   | 0.885                | 1.32             |

Table B2. Ammonia Toxicity Criteria  
 Temperature and pH Dependent Values of the Chronic Criterion (CCC)  
 for Fish Early Life Stages Present

| Temperature, °C |       |       |       |       |       |       |       |       |       |       |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| pH              | 0     | 14    | 16    | 18    | 20    | 22    | 24    | 26    | 28    | 30    |
| 6.5             | 6.67  | 6.67  | 6.06  | 5.33  | 4.68  | 4.12  | 3.62  | 3.18  | 2.80  | 2.46  |
| 6.6             | 6.57  | 6.57  | 5.97  | 5.25  | 4.61  | 4.05  | 3.56  | 3.13  | 2.75  | 2.42  |
| 6.7             | 6.44  | 6.44  | 5.86  | 5.15  | 5.52  | 3.98  | 3.50  | 3.07  | 2.70  | 2.37  |
| 6.8             | 6.29  | 6.29  | 5.72  | 5.03  | 4.42  | 3.89  | 3.42  | 3.00  | 2.64  | 2.32  |
| 6.9             | 6.12  | 6.12  | 5.56  | 4.89  | 4.30  | 3.78  | 3.32  | 2.92  | 2.57  | 2.25  |
| 7.0             | 5.91  | 5.91  | 5.37  | 4.72  | 4.15  | 3.65  | 3.21  | 2.82  | 2.48  | 2.18  |
| 7.1             | 5.67  | 5.67  | 5.15  | 4.53  | 3.98  | 3.50  | 3.08  | 2.70  | 2.38  | 2.09  |
| 7.2             | 5.39  | 5.39  | 4.90  | 4.31  | 3.78  | 3.33  | 2.92  | 2.57  | 2.26  | 1.99  |
| 7.3             | 5.08  | 5.08  | 4.61  | 4.06  | 3.57  | 3.13  | 2.76  | 2.42  | 2.13  | 1.87  |
| 7.4             | 4.73  | 4.73  | 4.30  | 3.78  | 3.32  | 2.92  | 2.57  | 2.26  | 1.98  | 1.74  |
| 7.5             | 4.36  | 4.36  | 3.97  | 3.49  | 3.06  | 2.69  | 2.37  | 2.08  | 1.83  | 1.61  |
| 7.6             | 3.98  | 3.98  | 3.61  | 3.18  | 2.79  | 2.45  | 2.16  | 1.90  | 1.67  | 1.47  |
| 7.7             | 3.58  | 3.58  | 3.25  | 2.86  | 2.51  | 2.21  | 1.94  | 1.71  | 1.50  | 1.32  |
| 7.8             | 3.18  | 3.18  | 2.89  | 2.54  | 2.23  | 1.96  | 1.73  | 1.52  | 1.33  | 1.17  |
| 7.9             | 2.80  | 2.80  | 2.54  | 2.24  | 1.96  | 1.73  | 1.52  | 1.33  | 1.17  | 1.03  |
| 8.0             | 2.43  | 2.43  | 2.21  | 1.94  | 1.71  | 1.50  | 1.32  | 1.16  | 1.02  | 0.897 |
| 8.1             | 2.10  | 2.10  | 1.91  | 1.68  | 1.47  | 1.29  | 1.14  | 1.00  | 0.879 | 0.773 |
| 8.2             | 1.79  | 1.79  | 1.63  | 1.43  | 1.26  | 1.11  | 0.973 | 0.855 | 0.752 | 0.661 |
| 8.3             | 1.52  | 1.52  | 1.39  | 1.22  | 1.07  | 0.941 | 0.827 | 0.727 | 0.639 | 0.562 |
| 8.4             | 1.29  | 1.29  | 1.17  | 1.03  | 0.906 | 0.796 | 0.700 | 0.615 | 0.541 | 0.475 |
| 8.5             | 1.09  | 1.09  | 0.990 | 0.870 | 0.765 | 0.672 | 0.591 | 0.520 | 0.457 | 0.401 |
| 8.6             | 0.920 | 0.920 | 0.836 | 0.735 | 0.646 | 0.568 | 0.499 | 0.439 | 0.386 | 0.339 |
| 8.7             | 0.778 | 0.778 | 0.707 | 0.622 | 0.547 | 0.480 | 0.422 | 0.371 | 0.326 | 0.287 |
| 8.8             | 0.661 | 0.661 | 0.601 | 0.528 | 0.464 | 0.408 | 0.359 | 0.315 | 0.277 | 0.244 |
| 8.9             | 0.565 | 0.565 | 0.513 | 0.451 | 0.397 | 0.349 | 0.306 | 0.269 | 0.237 | 0.208 |
| 9.0             | 0.486 | 0.486 | 0.442 | 0.389 | 0.342 | 0.300 | 0.264 | 0.232 | 0.204 | 0.179 |

| Table B3. Ammonia Toxicity Criteria<br>Temperature and pH Dependent Values of the Chronic Criterion (CCC)<br>for Fish Early Life Stages <u>Absent</u> |       |       |       |       |       |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Temperature, °C   |       |       |       |       |       |       |       |       |       |       |
| pH  | 0-7   | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15*   | 16*   |
| 6.5   | 10.8  | 10.1  | 9.51  | 8.92  | 8.36  | 7.84  | 7.35  | 6.89  | 6.46  | 6.06  |
| 6.6   | 10.7  | 9.99  | 9.37  | 8.79  | 8.24  | 7.72  | 7.24  | 6.79  | 6.36  | 5.97  |
| 6.7   | 10.5  | 9.81  | 9.20  | 8.62  | 8.08  | 7.58  | 7.11  | 6.66  | 6.25  | 5.86  |
| 6.8   | 10.2  | 9.58  | 8.98  | 8.42  | 7.90  | 7.40  | 6.94  | 6.51  | 6.10  | 5.72  |
| 6.9   | 9.93  | 9.31  | 8.73  | 8.19  | 7.68  | 7.20  | 6.75  | 6.33  | 5.93  | 5.56  |
| 7.0   | 9.60  | 9.00  | 8.43  | 7.91  | 7.41  | 6.95  | 6.52  | 6.11  | 5.73  | 5.37  |
| 7.1   | 9.20  | 8.63  | 8.09  | 7.58  | 7.11  | 6.67  | 6.25  | 5.86  | 5.49  | 5.15  |
| 7.2   | 8.75  | 8.20  | 7.69  | 7.21  | 6.76  | 6.34  | 5.94  | 5.57  | 5.22  | 4.90  |
| 7.3   | 8.24  | 7.73  | 7.25  | 6.79  | 6.37  | 5.97  | 5.60  | 5.25  | 4.92  | 4.61  |
| 7.4   | 7.69  | 7.21  | 6.76  | 6.33  | 5.94  | 5.57  | 5.22  | 4.89  | 4.59  | 4.30  |
| 7.5   | 7.09  | 6.64  | 6.23  | 5.84  | 5.48  | 5.13  | 4.81  | 4.51  | 4.23  | 3.97  |
| 7.6   | 6.46  | 6.05  | 5.67  | 5.32  | 4.99  | 4.68  | 4.38  | 4.11  | 3.85  | 3.61  |
| 7.7   | 5.81  | 5.45  | 5.11  | 4.79  | 4.49  | 4.21  | 3.95  | 3.70  | 3.47  | 3.25  |
| 7.8   | 5.17  | 4.84  | 4.54  | 4.26  | 3.99  | 3.74  | 3.51  | 3.29  | 3.09  | 2.89  |
| 7.9   | 4.54  | 4.26  | 3.99  | 3.74  | 3.51  | 3.29  | 3.09  | 2.89  | 2.71  | 2.54  |
| 8.0   | 3.95  | 3.70  | 3.47  | 3.26  | 3.05  | 2.86  | 2.68  | 2.52  | 2.36  | 2.21  |
| 8.1   | 3.41  | 3.19  | 2.99  | 2.81  | 2.63  | 2.47  | 2.31  | 2.17  | 2.03  | 1.91  |
| 8.2   | 2.91  | 2.73  | 2.56  | 2.40  | 2.25  | 2.11  | 1.98  | 1.85  | 1.74  | 1.63  |
| 8.3   | 2.47  | 2.32  | 2.18  | 2.04  | 1.91  | 1.79  | 1.68  | 1.58  | 1.48  | 1.39  |
| 8.4   | 2.09  | 1.96  | 1.84  | 1.73  | 1.62  | 1.52  | 1.42  | 1.33  | 1.25  | 1.17  |
| 8.5   | 1.77  | 1.66  | 1.55  | 1.46  | 1.37  | 1.28  | 1.20  | 1.13  | 1.06  | 0.990 |
| 8.6   | 1.49  | 1.40  | 1.31  | 1.23  | 1.15  | 1.08  | 1.01  | 0.951 | 0.892 | 0.836 |
| 8.7   | 1.26  | 1.18  | 1.11  | 1.04  | 0.976 | 0.915 | 0.858 | 0.805 | 0.754 | 0.707 |
| 8.8   | 1.07  | 1.01  | 0.944 | 0.885 | 0.829 | 0.778 | 0.729 | 0.684 | 0.641 | 0.601 |
| 8.9   | 0.917 | 0.860 | 0.806 | 0.756 | 0.709 | 0.664 | 0.623 | 0.584 | 0.548 | 0.513 |
| 9.0   | 0.790 | 0.740 | 0.694 | 0.651 | 0.610 | 0.572 | 0.536 | 0.503 | 0.471 | 0.442 |

\* At 15° C and above, the criterion for fish early life stages absent is the same as the criterion for fish early life stages present.

## APPENDIX C

### FECAL COLIFORM BACTERIA

DEQ Water Quality Rules and Regulations, Chapter 1, Wyoming Surface Water Quality Standards, Section 27 **Fecal Coliform Bacteria**, provides the following information:

During the entire year, fecal coliform concentrations shall not exceed a geometric mean of 200 organisms per 100 milliliters (mL) (based on a minimum of not less than 5 samples obtained during separate 24 hour periods for any 30 day period), nor shall the geometric mean of 3 separate samples collected within a 24 hour period exceed 400 organisms per 100 mL in any Wyoming surface water.

#### FECAL COLIFORM – Colonies/mL

| <i>Site</i>         | <i>4/16/2001</i> | <i>4/20/2001</i> | <i>4/24/2001</i> | <i>4/27/2001</i> | <i>4/30/2001</i> | <i>Geo Mean</i> |
|---------------------|------------------|------------------|------------------|------------------|------------------|-----------------|
| <b>Smith</b>        | 350              | 570              | 240              | 72               | 190              | 231             |
| <b>State Sec</b>    | 600              | 270              | 830              | 230              | 4                | 165             |
| <b>Humphrey</b>     | 330              | 450              | 350              | 72               | 86               | 200             |
| <b>WWTP</b>         | 220              | 76               | 580              | 62               | 100              | 143             |
| <b>Morrie</b>       | 24               | 16               | 320              | 100              | 67               | 61              |
| <b>Ames</b>         | 110              | 450              | 630              | 125              | 820              | 317             |
| <b>MLK Park</b>     | 34               | 38               | 27               | 48               | 24               | 33              |
| <b>Roundtop</b>     | 2                | 2                | 2                | 10               | 2                | 3               |
| <b>Silver Crown</b> | 2                | 2                | 2                | 6                | 2                | 2               |
| <b>Ames 84" SD</b>  |                  |                  |                  |                  |                  |                 |
| <b>Clear Creek</b>  |                  |                  |                  |                  |                  |                 |
| <b>Dry Creek</b>    |                  |                  |                  |                  |                  |                 |

| <i>Site</i>         | <i>5/8/2001</i> | <i>5/18/2001</i> | <i>05/23/01</i> | <i>5/24/2001</i> | <i>5/29/2001</i> | <i>Geo Mean</i> |
|---------------------|-----------------|------------------|-----------------|------------------|------------------|-----------------|
| <b>Smith</b>        | 46              | 190              | 56              | 110              | 230              | 104             |
| <b>State Sec</b>    | 54              | 60               | 88              | 97               | 430              | 104             |
| <b>Humphrey</b>     | 58              | 98               | 94              | 82               | 330              | 108             |
| <b>WWTP</b>         | 57              | 140              | 30              | 12               | 230              | 58              |
| <b>Morrie</b>       | 22              | 440              | 50              | 68               | 350              | 103             |
| <b>Ames</b>         | 120             | 1000             | 150             | 220              | 410              | 277             |
| <b>MLK Park</b>     | 62              | 33               | 16              | 20               | 46               | 31              |
| <b>Roundtop</b>     | 58              | 12               | 10              | 12               | 18               | 17              |
| <b>Silver Crown</b> | 18              | 2                | 16              | 46               | 36               | 16              |
| <b>Ames 84" SD</b>  |                 |                  |                 |                  |                  |                 |
| <b>Clear Creek</b>  |                 |                  |                 |                  |                  |                 |
| <b>Dry Creek</b>    |                 |                  |                 |                  |                  |                 |

| <i>Site</i>         | <i>6/18/2001</i> | <i>6/19/2001</i> | <i>6/21/2001</i> | <i>6/28/2001</i> | <i>6/29/2001</i> | <i>Geo Mean</i> |
|---------------------|------------------|------------------|------------------|------------------|------------------|-----------------|
| <b>Smith</b>        | 160              | 200              | 240              | 130              | 100              | 158             |
| <b>State Sec</b>    | 160              | 180              | 150              | 94               | 170              | 147             |
| <b>Humphrey</b>     | 960              | 530              | 580              | 700              | 1900             | 829             |
| <b>WWTP</b>         | 120              | 210              | 390              | 450              | 400              | 282             |
| <b>Morrie</b>       | 400              | 770              | 410              | 420              | 1150             | 572             |
| <b>Ames</b>         | 1600             | 1500             | 2300             | 1300             | 1700             | 1649            |
| <b>MLK Park</b>     | 120              | 170              | 180              | 220              | 280              | 187             |
| <b>Roundtop</b>     | 64               | 79               | 140              | 46               | 400              | 105             |
| <b>Silver Crown</b> | 33               |                  |                  |                  |                  |                 |
| <b>Ames 84" SD</b>  | 1900             |                  |                  |                  |                  |                 |
| <b>Clear Creek</b>  |                  | 2                |                  |                  |                  |                 |
| <b>Dry Creek</b>    |                  |                  | 300              |                  |                  |                 |

| <i>Site</i>         | <i>7/18/2001</i> | <i>7/19/2001</i> | <i>7/20/2001</i> | <i>7/23/2001</i> | <i>7/24/2001</i> | <i>Geo Mean</i> |
|---------------------|------------------|------------------|------------------|------------------|------------------|-----------------|
| <b>Smith</b>        | 88               | 32               | 90               | 210              | 165              | 97              |
| <b>State Sec</b>    | 88               | 300              | 360              | 235              | 180              | 209             |
| <b>Humphrey</b>     | 1900             | 325              | 300              | 240              | 330              | 430             |
| <b>WWTP</b>         | 430              | 370              | 600              | 300              | 30,000           | 970             |
| <b>Morrie</b>       | 800              | 500              | 700              | 860              | 30,000           | 1,485           |
| <b>Ames</b>         | 2600             | 2000             | 1600             | 2900             | 30,000           | 3,732           |
| <b>MLK Park</b>     | 830              | 360              | 540              | 750              | 24,000           | 1,238           |
| <b>Roundtop</b>     | 170              | 70               | 60               | 80               | 380              | 117             |
| <b>Silver Crown</b> |                  |                  |                  |                  |                  |                 |
| <b>Ames 84" SD</b>  |                  | 2000             |                  |                  |                  |                 |
| <b>Clear Creek</b>  |                  |                  |                  |                  |                  |                 |
| <b>Dry Creek</b>    |                  |                  | 190              |                  |                  |                 |

| <i>Site</i>        | <i>8/22/2001</i> | <i>8/24/2001</i> | <i>8/28/2001</i> | <i>8/30/2001</i> | <i>8/31/2001</i> | <i>Geo Mean</i> |
|--------------------|------------------|------------------|------------------|------------------|------------------|-----------------|
| <b>Smith</b>       | 180              | 120              | 180              | 120              | 150              | 148             |
| <b>State Sec</b>   |                  |                  |                  |                  |                  |                 |
| <b>Humphrey</b>    | 300              | 150              | 330              | 1000             | 2400             | 513             |
| <b>WWTP</b>        | 270              | 1000             | 400              | 220              | 240              | 356             |
| <b>Morrie</b>      | 400              | 900              | 420              | 350              | 330              | 445             |
| <b>Ames</b>        | 1500             | 1600             | 1600             | 1000             | 880              | 1276            |
| <b>MLK Park</b>    | 810              | 535              | 300              | 930              | 130              | 436             |
| <b>Roundtop</b>    | 10               | 1700             | 40               | 120              | 300              | 120             |
| <b>Ames 84" SD</b> |                  | 5400             |                  |                  |                  |                 |

| <i>Site</i>      | <i>9/27/2001</i> | <i>9/28/2001</i> | <i>10/2/2001</i> | <i>10/9/2001</i> | <i>10/10/2001</i> | <i>Geo Mean</i> |
|------------------|------------------|------------------|------------------|------------------|-------------------|-----------------|
| <b>Smith</b>     | 20               | 30               | 190              | 170              | 160               | 79              |
| <b>State Sec</b> | 40               | 160              | 385              | 90               | 290               | 145             |
| <b>Humphrey</b>  | 40               | 40               | 40               | 380              | 50                | 66              |
| <b>WWTP</b>      | 40               | 160              | 160              | 80               | 370               | 125             |
| <b>Morrie</b>    | 200              | 280              | 430              | 210              | 180               | 247             |
| <b>Ames</b>      | 680              | 510              | 1200             | 250              | 500               | 554             |
| <b>MLK Park</b>  | 150              | 70               | 320              | 120              | 430               | 177             |
| <b>Roundtop</b>  | 80               | 20               | 70               | 20               | 25                | 35              |
| <b>84" SD</b>    |                  |                  |                  |                  |                   |                 |

| <i>Site</i>      | <i>12/18/2001</i> | <i>12/19/2001</i> | <i>12/27/2001</i> | <i>Geo Mean</i> |
|------------------|-------------------|-------------------|-------------------|-----------------|
| <b>Smith</b>     | 12                | 4                 | 16                | 9               |
| <b>State Sec</b> | 8                 | 4                 | 12                | 7               |
| <b>Humphrey</b>  | 12                | 56                | 32                | 28              |
| <b>WWTP</b>      | 30                | 12                | 28                | 22              |
| <b>Morrie</b>    | 100               | 160               | 75                | 106             |
| <b>Ames</b>      | 320               | 280               | 430               | 338             |
| <b>MLK Park</b>  | 175               | 740               | 600               | 427             |
| <b>Roundtop</b>  | 10                | 4                 |                   |                 |
| <b>84" SD</b>    | 200               |                   |                   |                 |

| <i>Site</i>       | <i>4/23/2002</i> |
|-------------------|------------------|
| <b>Missile Rd</b> | 300              |
| <b>Lowham</b>     | 4                |
| <b>84" SD</b>     | 190              |
| <b>LA Outfall</b> | 4                |

| <i>Site</i>       | <i>5/14/2002</i> | <i>5/15/2002</i> | <i>5/21/2002</i> | <i>5/22/2002</i> | <i>5/29/2002</i> | <i>Geo Mean</i> |
|-------------------|------------------|------------------|------------------|------------------|------------------|-----------------|
| <b>Missile Rd</b> | 65               | 73               | 90               | 340              | 120              | 112             |
| <b>WWTP</b>       | 25               | 15               | 15               | 35               | 28               | 22              |
| <b>Morrie</b>     | 90               | 40               | 45               | 85               | 72               | 63              |
| <b>Ames</b>       | 1400             | 420              | 400              | 360              | 530              | 538             |
| <b>MLK Park</b>   | 10               | 25               | 15               | 25               | 44               | 21              |
| <b>Roundtop</b>   | 5                | 5                | 5                | 5                | 24               | 7               |
| <b>84" SD</b>     |                  | 1100             |                  |                  |                  |                 |
| <b>LA Outfall</b> |                  |                  | 5                |                  |                  |                 |

| <i>Site</i>       | <i>9/23/2002</i> | <i>10/7/2002</i> | <i>10/8/2002</i> | <i>10/15/2002</i> | <i>10/21/2002</i> | <i>Geo Mean</i> |
|-------------------|------------------|------------------|------------------|-------------------|-------------------|-----------------|
| <b>Missile Rd</b> | 16               | 32               | 20               | 4                 | 4                 | 11              |
| <b>WWTP</b>       | 170              | 8                | 20               | 28                | 12                | 25              |
| <b>Morrie</b>     | 52               | 125              | 8                | 24                | 4                 | 22              |
| <b>Ames</b>       | 970              | 300              | 300              | 1300              | 100               | 408             |
| <b>MLK Park</b>   | 32               | 36               | 24               | 16                | 12                | 22              |
| <b>Roundtop</b>   | 16               | 4                | 4                | 4                 | 4                 | 5               |
| <b>84" SD</b>     |                  |                  |                  |                   |                   |                 |
| <b>LA Outfall</b> |                  |                  |                  |                   |                   |                 |

| <i>Site</i>       | <i>11/6/2002</i> | <i>11/12/2002</i> | <i>11/18/2002</i> | <i>11/19/2002</i> | <i>12/10/2002</i> | <i>Geo Mean</i> |
|-------------------|------------------|-------------------|-------------------|-------------------|-------------------|-----------------|
| <b>Missile Rd</b> | 12               | 4                 | 4                 | 4                 | 12                | 6               |
| <b>WWTP</b>       |                  | 4                 | 4                 | 4                 | 4                 | 4               |
| <b>Morrie</b>     | 290              | 7                 | 4                 | 4                 | 12                | 13              |
| <b>Ames</b>       | 72               | 68                | 220               | 640               | 410               | 195             |
| <b>MLK Park</b>   | 64               | 12                | 4                 | 8                 | 16                | 13              |
| <b>Roundtop</b>   |                  |                   |                   |                   |                   |                 |
| <b>84" SD</b>     |                  |                   |                   |                   |                   |                 |
| <b>LA Outfall</b> |                  |                   |                   |                   |                   |                 |

| <i>Site</i>       | <i>4/14/03</i> | <i>4/16/03</i> | <i>4/22/03</i> | <i>4/28/03</i> | <i>4/29/03</i> | <i>Geo Mean</i> |
|-------------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| <b>State Sec</b>  |                | 170            | 180            | 400            | 280            | 1,223           |
| <b>Missile Rd</b> | 440            | 8,000          | 900            | 1,200          | 720            | 242             |
| <b>WWTP</b>       | 44             | 780            | 600            | 76             |                | 199             |
| <b>Morrie Ave</b> | 28             | 280            | 24             | 56             | 8              | 38              |
| <b>Ames Ave</b>   | 320            | 360            | 420            | 320            | 260            | 332             |
| <b>MLK Park</b>   | 20             | 15             | 12             | 30             | 8              | 15              |
| <b>Roundtop</b>   | 16             | 10             | 4              | 40             | 4              | 10              |

| <i>Site</i>       | <i>6/11/03</i> | <i>6/23/03</i> | <i>6/25/03</i> | <i>Geo Mean</i> |
|-------------------|----------------|----------------|----------------|-----------------|
| <b>State Sec</b>  | 440            | 310            | 295            | 343             |
| <b>Missile Rd</b> | 380            | 205            | 190            | 246             |
| <b>Morrie Ave</b> | 1,720          | 400            | 700            | 784             |
| <b>Ames Ave</b>   | 1,440          | 2,700          | 2,500          | 2,134           |
| <b>MLK Park</b>   | 780            | 220            | 290            | 368             |
| <b>Roundtop</b>   | 3,500          | 430            | 170            | 635             |

| <i>Site</i>                | <i>8/25/03</i> | <i>8/26/03</i> | <i>8/27/03</i> | <i>9/8/03</i> | <i>9/9/03</i> | <i>Geo Mean</i> |
|----------------------------|----------------|----------------|----------------|---------------|---------------|-----------------|
| <b>Missile Rd<br/>WWTP</b> | 64             | 60             | 96             | 100<br>6,600  | 76<br>6,850   | 78              |
| <b>Morrie Ave</b>          | 660            | 270            | 3,800          | 3,300         | 8,300         | 1,793           |
| <b>Ames Ave</b>            | 3,700          | 1,600          | 9,900          | 3,300         | 9,500         | 4,496           |
| <b>MLK Park</b>            | 180            | 160            | 1,600          | 5,100         | 1,400         | 801             |
| <b>Roundtop</b>            | 170            | 110            | 140            | 760           | 120           | 189             |

| <i>Site</i>                | <i>12/1/03</i> | <i>12/2/03</i> | <i>12/3/03</i> | <i>Geo Mean</i> |
|----------------------------|----------------|----------------|----------------|-----------------|
| <b>State Sec</b>           | 54             | 44             | 16             | 34              |
| <b>Missile Rd<br/>WWTP</b> | 8<br>170       | 10<br>36       | 8<br>12        | 9<br>42         |
| <b>Morrie Ave</b>          |                |                | 52             |                 |
| <b>Ames Ave</b>            | 430            | 260            | 450            | 369             |
| <b>MLK Park</b>            | 52             | 48             | 40             | 46              |

| <i>Site</i>              | <i>4/2001</i> | <i>5/2001</i> | <i>6/2001</i> | <i>7/2001</i> | <i>8/2001</i> | <i>9/10/2001</i> | <i>12/2001</i> |
|--------------------------|---------------|---------------|---------------|---------------|---------------|------------------|----------------|
| <b>Smith</b>             | 231           | 104           | 158           | 97            | 148           | 79               | 9              |
| <b>State Sec</b>         | 165           | 104           | 147           | 209           |               | 145              | 7              |
| <b>Humphrey<br/>WWTP</b> | 200<br>143    | 108<br>58     | 829<br>282    | 430<br>970    | 513<br>356    | 66<br>125        | 28<br>22       |
| <b>Morrie</b>            | 61            | 103           | 572           | 1485          | 445           | 247              | 106            |
| <b>Ames</b>              | 317           | 277           | 1649          | 3732          | 1276          | 554              | 338            |
| <b>MLK Park</b>          | 33            | 31            | 187           | 1238          | 436           | 177              | 427            |
| <b>Roundtop</b>          | 3             | 17            | 105           | 117           | 120           | 35               |                |
| <b>Silver Crown</b>      | 2             | 16            |               |               |               |                  |                |

| <i>Site</i>                | <i>5/2002</i> | <i>9/10/2002</i> | <i>11/12/2002</i> |
|----------------------------|---------------|------------------|-------------------|
| <b>Missile Rd<br/>WWTP</b> | 112<br>22     | 11<br>25         | 6<br>4            |
| <b>Morrie</b>              | 63            | 22               | 13                |
| <b>Ames</b>                | 538           | 416              | 195               |
| <b>MLK Park</b>            | 21            | 22               | 13                |
| <b>Roundtop</b>            | 7             | 5                |                   |
| <b>84" SD</b>              | 1100          |                  |                   |

| <i>Site</i>       | <i>4/2003</i> | <i>6/2003</i> | <i>8/9/2003</i> | <i>12/2003</i> |
|-------------------|---------------|---------------|-----------------|----------------|
| <b>State Sec</b>  | 1,223         | 343           |                 | 34             |
| <b>Missile Rd</b> | 242           | 246           | 78              | 9              |
| <b>WWTP</b>       | 199           |               | 6,724           | 42             |
| <b>Morrie</b>     | 38            | 784           | 1,793           |                |
| <b>Ames</b>       | 332           | 2,134         | 4,496           | 369            |
| <b>MLK Park</b>   | 15            | 368           | 801             | 46             |
| <b>Roundtop</b>   | 10            | 635           | 189             |                |

# Chart C1

## Fecal Coliforms Crow Creek April

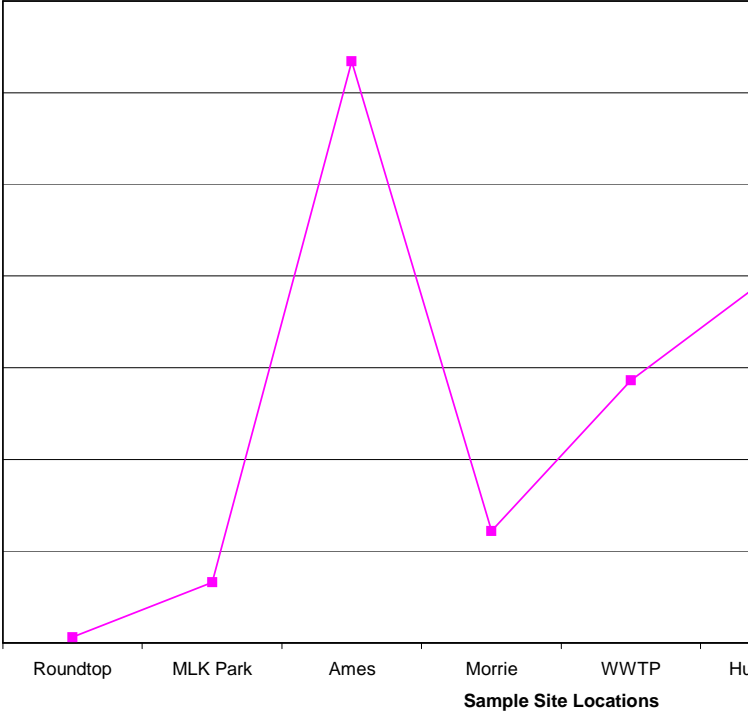


Chart C2

Fecal Coliforms Crow Creek July

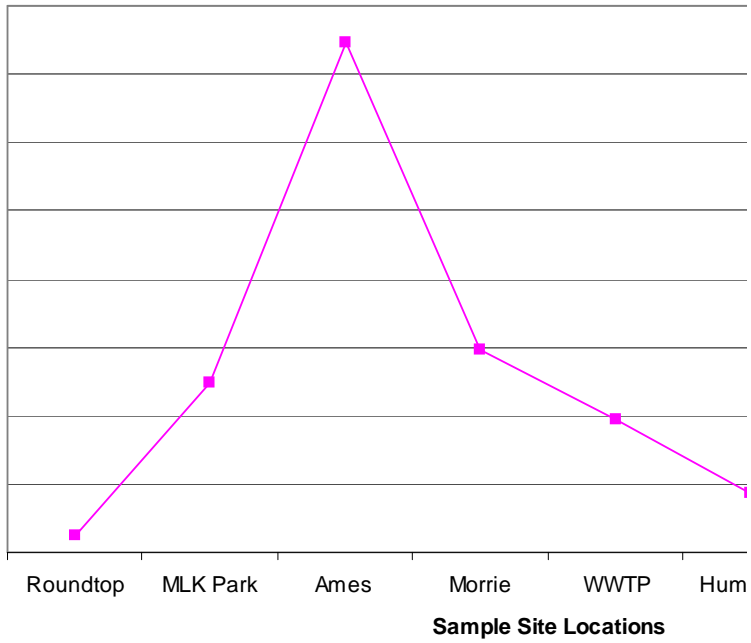
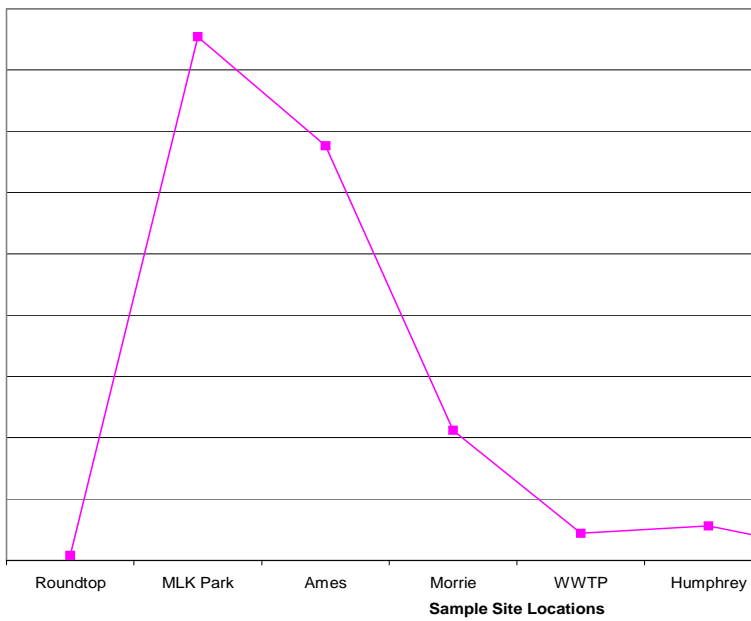


Chart C3

Fecal Coliforms Crow Creek December 2007



## **APPENDIX D**

### **SURFACE WATER QUALITY CLASSES AND USES**

DEQ Water Quality Rules and Regulations, Chapter 1, Wyoming Surface Water Quality Standards, Section 4 **CLASSES AND USES**, provides the following information:

#### **Class 1 OUTSTANDING WATERS**

Class 1 waters are those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed.

#### **Class 2 FISHERIES & DRINKING WATER**

Class 2 waters are waters, other than those designated as Class 1, that are known to support fish or drinking water supplies or where those uses are attainable.

- 2AB Supports game fish and drinking water
- 2A Does not support game fish, supports drinking water
- 2B Supports game fish; does not support drinking water
- 2C Supports non-game fish, does not support drinking water

#### **Class 3 AQUATIC LIFE OTHER THAN FISH**

Class 3 waters are waters, other than those designated as Class 1, that are intermittent, ephemeral or isolated waters and because of natural habitat conditions, do not support nor have the potential to support fish populations or spawning or certain perennial waters which lack the natural water quality to support fish (e.g., geothermal areas).

- 3A Isolated waters and wetlands not supporting fish or drinking water
- 3B Tributary waters including wetlands not supporting fish or drinking water
- 3C Perennial waters w/o natural quality to support fish or drinking water, but support wetlands

#### **Class 4 AGRICULTURE, INDUSTRY, RECREATION, AND WILDLIFE**

Class 4 waters are waters, other than those designated as Class 1, where it has been determined that aquatic life uses are not attainable pursuant to the provisions of Section 33, **Reclassification and Site Specific Criteria** of the Standard.

- 4A Artificial canals/ditches not known to support fish
- 4B Non-perennial streams with infrequent wetlands or lacks hydrologic potential to support /sustain aquatic life
- 4C Lacks normal potential to support or sustain aquatic life (e.g., effluent dominated)

| Table D1. Stream Classification |                |           |               |                  |               |            |          |             |          |              |
|---------------------------------|----------------|-----------|---------------|------------------|---------------|------------|----------|-------------|----------|--------------|
|                                 | Drinking Water | Game Fish | Non Game Fish | Fish Consumption | Other Aquatic | Recreation | Wildlife | Agriculture | Industry | Scenic Value |
| 1                               | Yes            | Yes       | Yes           | Yes              | Yes           | Yes        | Yes      | Yes         | Yes      | Yes          |
| 2AB                             | Yes            | Yes       | Yes           | Yes              | Yes           | Yes        | Yes      | Yes         | Yes      | Yes          |
| 2A                              | Yes            | No        | No            | No               | Yes           | Yes        | Yes      | Yes         | Yes      | Yes          |
| 2B                              | No             | Yes       | Yes           | Yes              | Yes           | Yes        | Yes      | Yes         | Yes      | Yes          |
| 2C                              | No             | No        | Yes           | Yes              | Yes           | Yes        | Yes      | Yes         | Yes      | Yes          |
| 3A                              | No             | No        | No            | No               | Yes           | Yes        | Yes      | Yes         | Yes      | Yes          |
| 3B                              | No             | No        | No            | No               | Yes           | Yes        | Yes      | Yes         | Yes      | Yes          |
| 3C                              | No             | No        | No            | No               | Yes           | Yes        | Yes      | Yes         | Yes      | Yes          |
| 4A                              | No             | No        | No            | No               | No            | Yes        | Yes      | Yes         | Yes      | Yes          |
| 4B                              | No             | No        | No            | No               | No            | Yes        | Yes      | Yes         | Yes      | Yes          |
| 4C                              | No             | No        | No            | No               | No            | Yes        | Yes      | Yes         | Yes      | Yes          |

Class 1 waters are not protected for all uses in all circumstances. For example, all waters in the National Parks and Wilderness are Class 1; however, all do not support fisheries or other aquatic life uses (e.g., hot springs, ephemeral waters, wet meadows, etc.). For stormwater permitting, 401 Certification, and water quality assessment purposes, the actual uses on each particular water must be determined independently.

## **APPENDIX E**

### **Best Management Practices**

Standard, Section 2. Definitions (b) (v) provides:

“Best Management Practices (BMPs)” means a practice or combination of practices that after problem assessment, examination of alternative practices, and in some cases public participation, are determined to be the most technologically and economically feasible means of managing, preventing or reducing non-point source pollution. Most BMPs will require permits from the State Engineer’s Office, Army Corps of Engineers or the US Fish & Wildlife Service.

**The BMPs for the Crow Creek Watershed are described as follows:**

**Bioretention** utilizes soils and both woody and herbaceous plants to remove pollutants from storm water runoff. The treatment area consists of a grass buffer strip, sand bed, pond area, organic layer or mulch layer, planting soil, and plants.

**Canopy Development** is the establishment of trees and shrubs along a stream bank to enhance aquatic habitat by cooling the temperature of the water.

**Conservation Tillage** is an agricultural practice of leaving crop residue on fields to reduce wind and water erosion of topsoil.

**Dry Ponds** temporarily detain a portion of storm water runoff for up to twenty-four hours after a storm event. The ponds are normally dry between storm events and do not have any permanent standing water.

**Grass Swales** are grass areas designed to catch water from a down spout or driveway. The design lets the water seep into the ground rather than run into the street.

**Grassed Waterways** are impressions or ditches lined with vegetation that reduces the force of runoff and acts as a filter to catch sediment.

**Grazing Management** is the management of livestock by providing offsite stock water, fencing off riparian areas, rotational grazing of pastures, etc. This practice ensures good health of livestock as well as leaving some vegetation for re-growth and preventing soil erosion.

**Infiltration Trenches** is a trench filled with permeable material such as gravel and sand and lined with a fabric liner. These trenches are designed to collect and filter runoff.

**Irrigation Water Management** is the practice of controlling the volume, frequency and application rate of water and also prevents soil erosion and pesticide runoff from agricultural fields.

**Offsite Water Development** is an agricultural practice providing water for livestock away from sensitive areas such as streams, lakes and rivers.

**Retention Ponds** are similar to artificial wetlands. They collect storm water runoff, filter sediment and have control structures to release excess water.

**Riparian Buffer Strips** are vegetative strips within the riparian zone along a stream or river that provide habitat for wildlife and act as a sediment filter.

**Riparian Fencing** is the practice of constructing fences around the riparian zone to exclude livestock to protect the vegetation, reduce soil erosion and reduce sediment to the stream.

**Riprap** refers to large rocks used to line or “armor” stream and riverbanks, lake or lagoon shores to prevent bank erosion and dissipate water energy.

**Sheet Pile** is used to create temporary or permanent retaining structures to control or exclude water and/or sediment.

**Splash Pools** are small check dams made of concrete or large rocks constructed in the stream channel to aerate and dissipate gases from surface water.

**Storm Septors** are devices designed like a “vault” that are incorporated into a storm sewer system in urban areas to filter and collect debris caused by storm runoff.

**Stream Bank Re-vegetation** is the practice of planting shrubs, grass or trees along stream banks where re-construction has taken place after bank erosion has occurred.

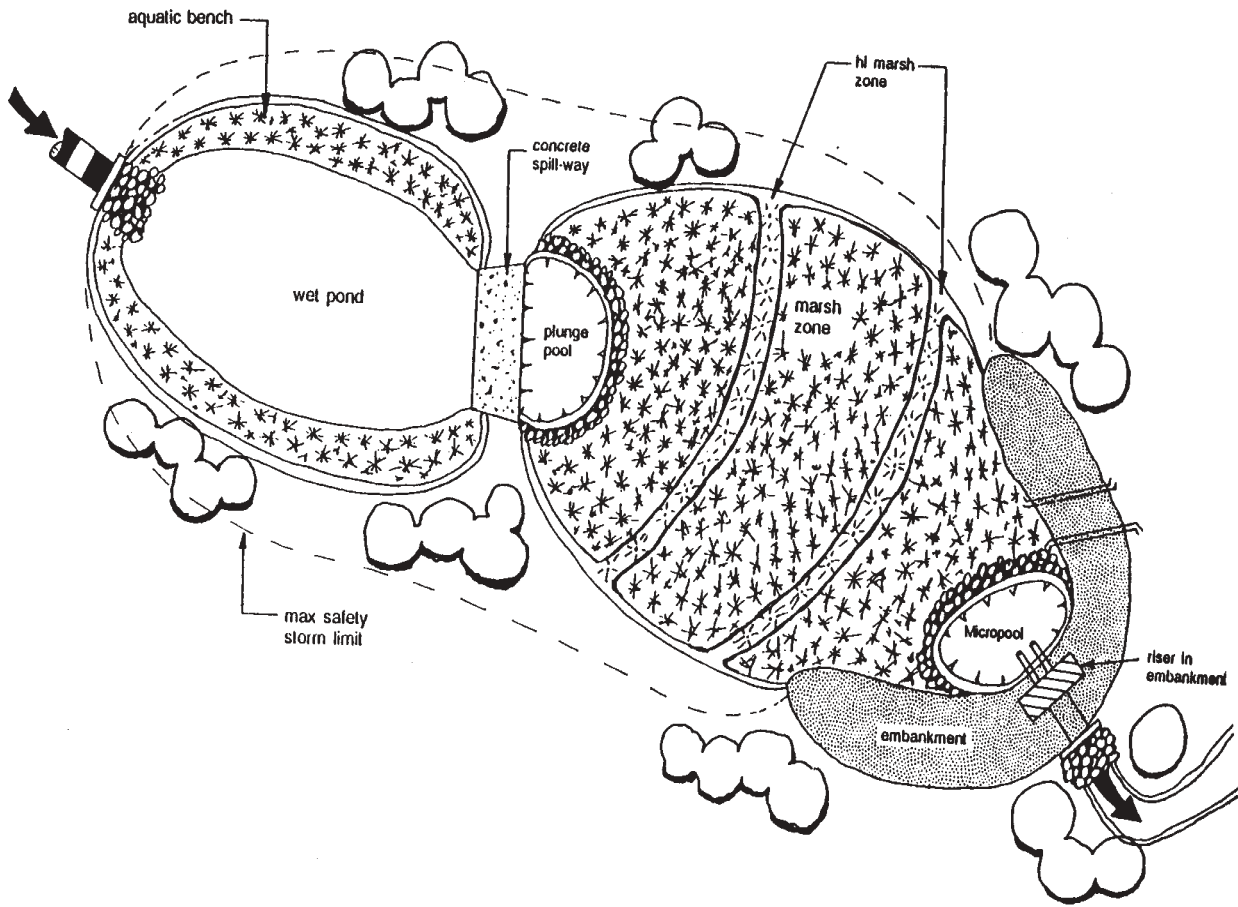
**Street Sweeping** is a mechanical means of cleaning debris, litter and, sand/salt from urban streets thus preventing this debris from traveling down storm sewers and eventually into a stream or river.

**Tree and Shrub Revetments** are whole or parts of trees placed along stream banks that provide aquatic habitat and prevent soil erosion from stream banks.

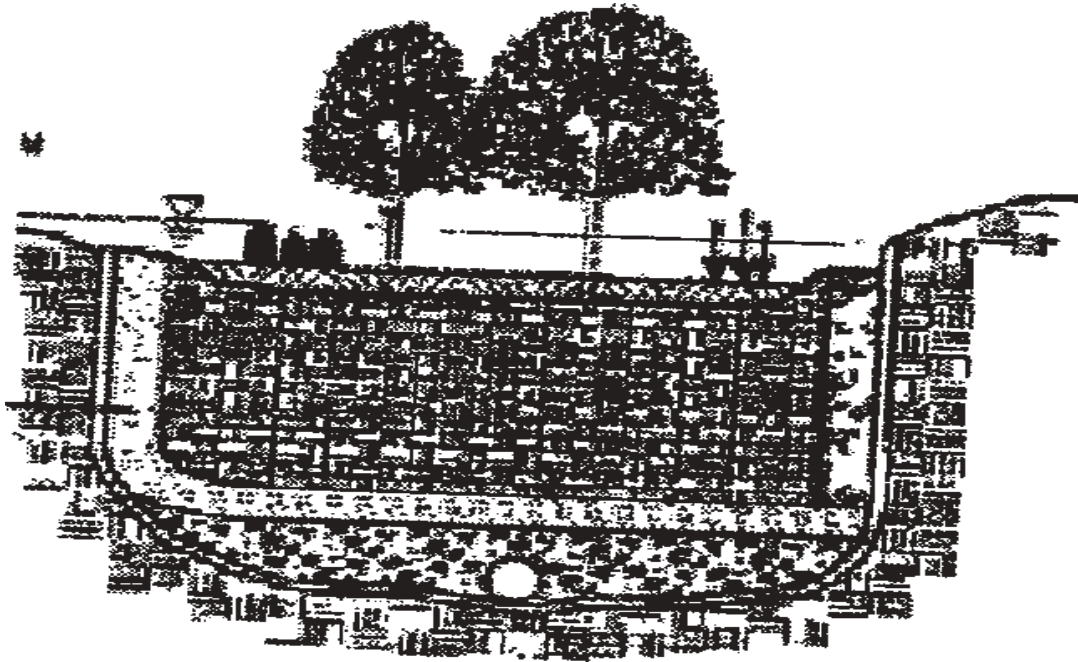
**Water Treatment** is the process of filtering, aeration and chemigation of sewer effluent to reduce or remove bacteria, nutrients, (i.e. Ammonia), oils or greases and sediments before it is released into a water body such as a stream or river.

**Wetlands** are defined as, “those areas which are saturated or inundated by surface or ground water at a frequency and duration sufficient to support and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions.” Artificial wetlands can be constructed to act as water control structures and to serve as “filters” to trap sediment and to filter excess nutrients from surface water.

**Willow Sprigging** is the placement of willow shoots and stakes along stream banks to stabilize and prevent erosion.



## ARTIFICIAL WETLAND



## BIORETENTION

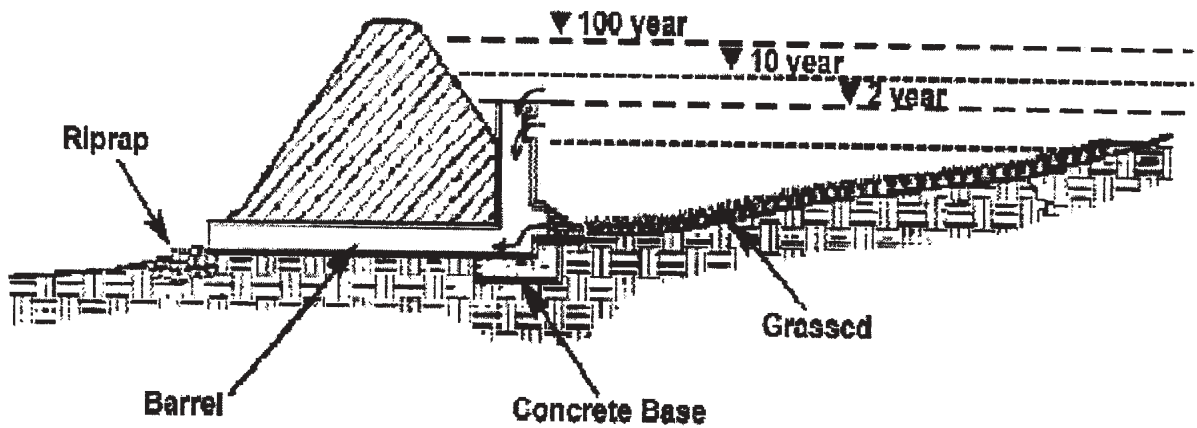
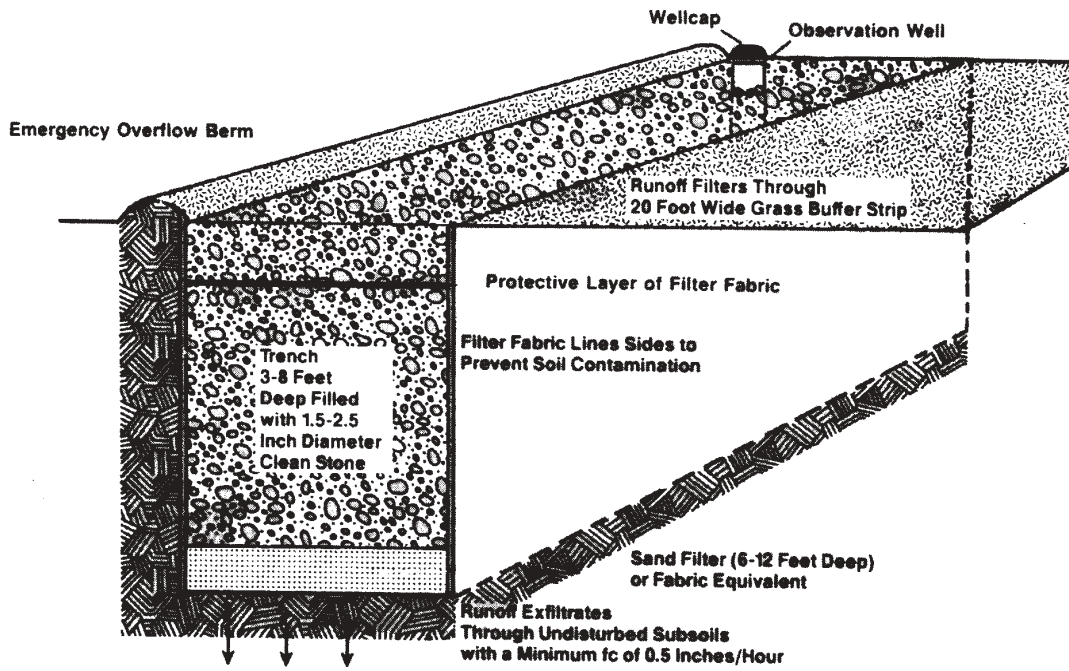


Figure 1: Typical Dry Pond

Source: NVPDC, 1992

## DRY POND



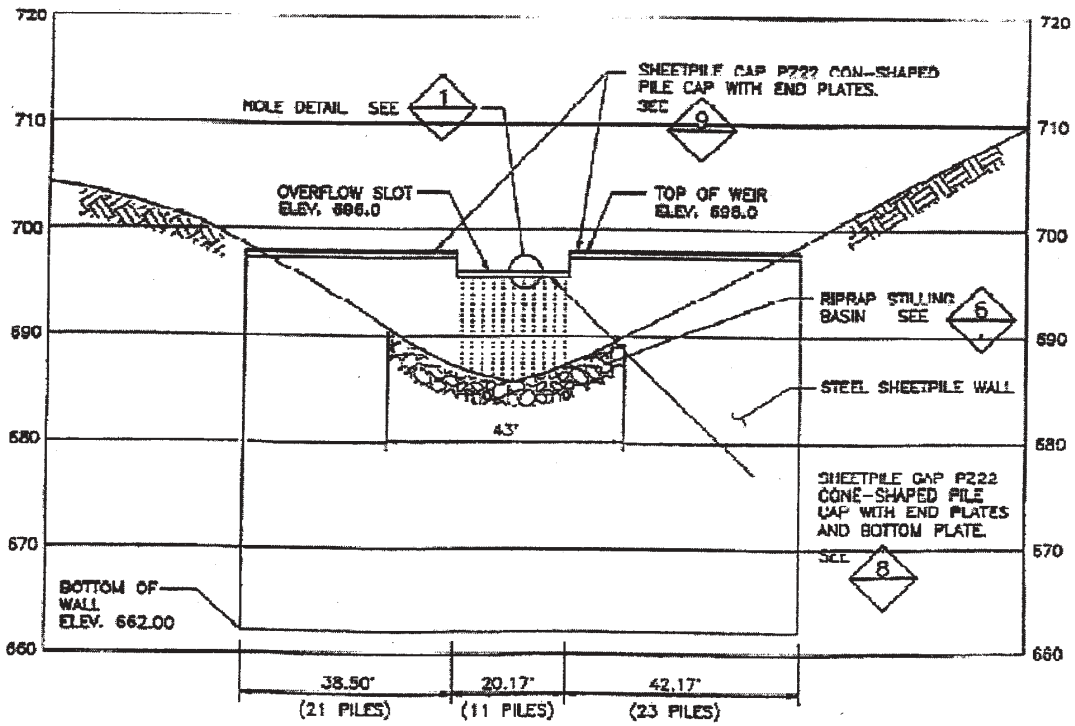
## INFILTRATION TRENCH



## ROCK RIPRAP

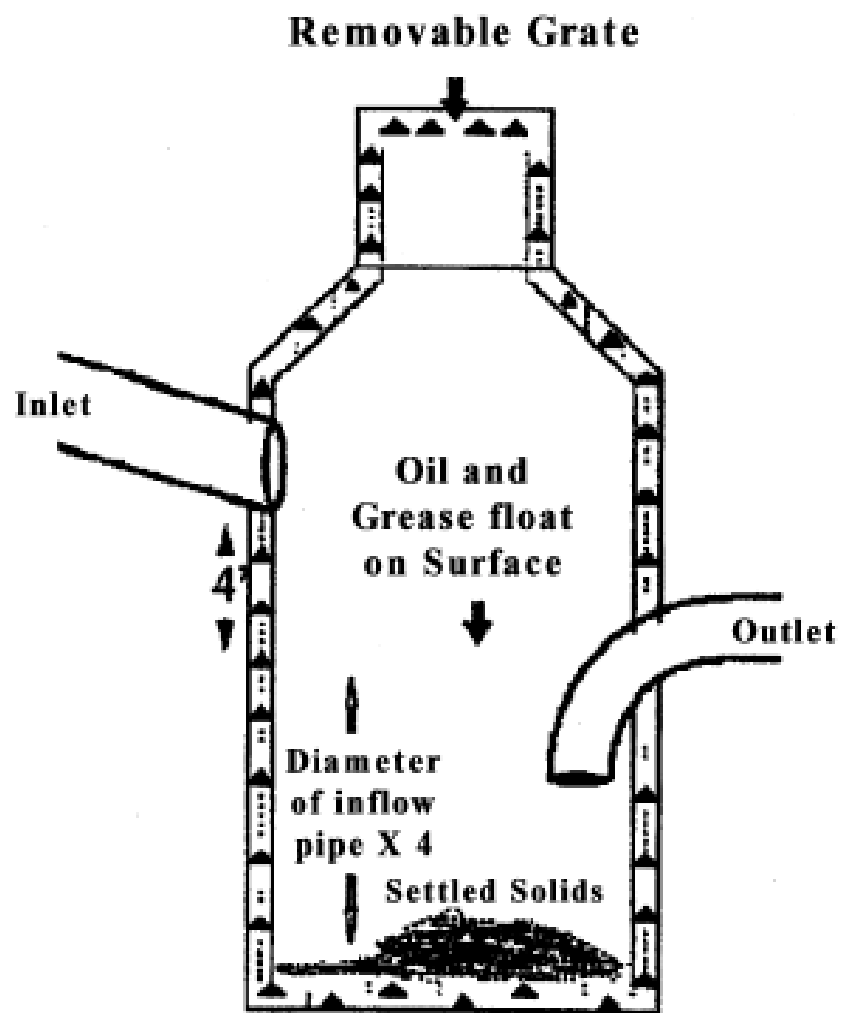


SECTION: STEEL SHEETPILE WITH 3" DIA. HOLES



## SHEET PILE

# STORM SEPTOR



## APPENDIX E

**Table E1. Best Management Practices**

| <u>Practices</u>          | <u>Urban</u> | <u>Rural</u> | <u>Primary Treatment</u> | <u>Secondary Treatment</u> |
|---------------------------|--------------|--------------|--------------------------|----------------------------|
| Riparian Buffer Strips    | x            | x            | Sediment/Nutrients       | Fecal coliform             |
| Riparian Fencing          |              | x            | Sediment/Nutrients       | Fecal coliform             |
| Offsite Water Development |              | x            | Fecal Coliform           |                            |
| Wetlands                  | x            | x            | Sediment/Nutrients       | Fecal coliform             |
| Storm Septors             | x            |              | Sediment/Nutrients       | Fecal coliform             |
| Canopy Development        | x            | x            | Temperature              |                            |
| Infiltration Trenches     | x            |              | Sediment/Nutrients       | Fecal coliform             |
| Grassed Waterways         | x            | x            | Sediment/Nutrients       | Fecal coliform             |
| Water Treatment           | x            |              | All                      |                            |
| Grazing Management        |              | x            | Sediment/Nutrients       | Fecal coliform             |
| Street Sweeping           | x            |              | Sediment/Nutrients       | Fecal coliform             |
| Irrigation Water Mgmt.    | x            | x            | Sediment/Nutrients       | Fecal coliform             |
| Tree & Shrub Revetments   | x            | x            | Bank stabilization       |                            |
| Rip Rap                   | x            | x            | Bank stabilization       |                            |
| Stream Bank Re-vegetation | x            | x            | Bank stabilization       |                            |
| Willow Sprigging          | x            | x            | Bank stabilization       |                            |
| Conservation Tillage      |              | x            | Sediment/Nutrients       | Fecal coliform             |
| Splash Pools              | x            |              | Volatile gasses          |                            |
| Retention Ponds           | x            | x            | Sediment/Nutrients       | Fecal coliform             |
| Grass Swales              | x            |              | Sediment/Nutrients       | Fecal coliform             |

## APPENDIX F

### Crow Creek 303 (d) Listing Data

This data from the U.S.G.S. was used to list Crow Creek as an impaired water body.

| Table F1. Crow Creek Near Archer<br>Station Number 06756060 |                          |                                  |                          |                 |                 |     |
|---|--------------------------|----------------------------------|--------------------------|-----------------|-----------------|-----|
| Date  | Water Temp.<br>Degrees C | Fecal Coliform<br>Colonies/100mL | Hardness<br>Total Mg/Las | Cadmium<br>ug/L | Ammonia<br>mg/L | pH  |
| 10/22/92  | 13.0                     | 120                              | 250                      | 3.0             | —               | 7.5 |
| 1/21/93   | 4.0                      | 270                              | 210                      | 3.0             | 8.9             | 7.5 |
| 4/20/93   | 10.0                     | 9                                | 240                      | <1.0            | 3.2             | 7.6 |
| 7/22/93   | 16.0                     | 230                              | 250                      | 3.0             | 3.3             | 7.5 |
| 10/21/93  | 7.0                      | 440                              | 240                      | <1.0            | 1.5             | 7.6 |
| 1/19/94   | 4.0                      | 600                              | 240                      | <1.0            | 5.8             | 7.7 |
| 4/19/94   | 12.0                     | 80                               | 240                      | <1.0            | 7.3             | 7.4 |
| 8/19/94   | 16.0                     | 260                              | 200                      | <1.0            | 7.9             | 8.1 |
| 12/1/94   | 3.0                      | 200                              | 230                      | <1.0            | 1.3             | 8.3 |
| 2/21/95   | 8.0                      | 52                               | 190                      | 1.0             | 10.0            | 8.0 |
| 6/5/95  | 12.0                     | 370                              | 200                      | <1.0            | 0.55            | 8.0 |
| 8/3/95  | 22.0                     | 360                              | —                        | —               | 0.27            | 8.5 |
| 10/11/95  | 17.0                     | 120                              | —                        | —               | 0.49            | 8.1 |
| 2/7/96  | 7.0                      | 150                              | —                        | —               | 3.4             | 8.1 |
| 5/13/96   | 13.0                     | 135                              | —                        | —               | 3.5             | 8.2 |
| 8/14/96   | 17.0                     | 300                              | —                        | —               | 1.20            | 8.0 |
| 11/12/96  | 9.0                      | 150                              | —                        | —               | 1.60            | 8.1 |
| 2/18/97   | 3.0                      | 120                              | —                        | —               | 4.50            | 8.0 |
| 5/30/97   | 14.0                     | 6800                             | —                        | —               | 0.86            | 8.1 |
| 9/4/97  | 19.0                     | 490                              | —                        | —               | 0.25            | 8.2 |
| 11/3/97   | 6.0                      | 110                              | —                        | —               | 0.37            | 8.3 |
| 3/25/98   | 15.0                     | 290                              | —                        | —               | 2.7             | 8.5 |
| 5/20/98   | 20.0                     | 1500                             | —                        | —               | 0.44            | 8.3 |
| 8/5/98  | 23.0                     | 390                              | —                        | —               | 1.0             | 8.5 |
| 11/10/98  | 3.0                      | 60                               | —                        | —               | 5.2             | 8.1 |
| 3/3/99  | 7.0                      | 65                               | —                        | —               | 5.3             | 8.5 |
| 5/13/99   | 13.0                     | 200                              | —                        | —               | 0.97            | 8.0 |
| 7/29/99   | 24.0                     | 1500                             | —                        | —               | 2.5             | 7.9 |

Table F2. Crow Creek at F.E. Warren AFB, WY  
Station Number 06755950

| Date     | Water Temp<br>Degrees C | Fecal Coliform<br>Colonies/100mL | Hardness Total<br>mg/Las CaCo <sub>3</sub> | Cadmium<br>ug/L | Ammonia<br>mg/L | pH  |
|----------|-------------------------|----------------------------------|--|-----------------|-----------------|-----|
| 10/22/92 | 7.0                     | K13                              | 230  | 2.0             | 0.03            | 7.6 |
| 1/21/93  | 0.0                     | K10                              | 260  | 3.0             | —               | 7.8 |
| 4/22/93  | 8.0                     | K5                               | 240  | <1.0            | —               | 7.6 |
| 7/22/93  | 13.0                    | 37                               | 280  | 2.0             | —               | 7.4 |
| 10/21/93 | 4.0                     | 5                                | 270  | <1.0            | 0.01            | 7.6 |
| 1/19/94  | 0.0                     | 3                                | 270  | <1.0            | 0.03            | 7.7 |
| 4/19/94  | 9.0                     | 10                               | 230  | 4.0             | 0.05            | 7.4 |
| 8/18/94  | 20.0                    | 14                               | 250  | <1.0            | 0.10            | 8.1 |

## **APPENDIX G**

### **Wyoming Water Law: A Summary**

University of Wyoming  
B-849R (text only version)

James J. Jacobs, Associate Dean and Director, Agriculture Experiment Station  
Patrick T. Tyrrell, State Engineer  
Donald J. Brosz, Professor Emeritus

Wyoming water law dates back to territorial days and is based on the “doctrine of prior appropriation”. Under this doctrine, the first person to put the water to beneficial use has the first right, meaning “first in time is first in right”. Therefore, water rights in Wyoming, and in most of the western states, are regulated by priority. The earliest rights are entitled to water during periods of limited supply, while those with later rights are denied water during these times.

The Wyoming Constitution provides that water from all natural streams, springs, lakes or other collection be the property of the state.

#### **Water administration**

The state engineer is the chief administrator of Wyoming waters. In administering these waters, the state is divided into four water divisions. Water division 1 includes the North Platte, South Platte, Little Snake, and the Niobrara River drainages. Water division 2 includes all drainages north of the Niobrara and North Platte River drainages and east of the Big Horn Mountains. Water division 3 includes the Big Horn and Clark’s Fork River drainages, and water division 4 includes the Green, Bear, and Snake River drainages.

A water division superintendent administers the waters of each water division with assistance from water commissioners and hydrographer commissioners. The four superintendents and the state engineer constitute the State Board of Control. The board of control meets quarterly to adjudicate or finalize water rights and to consider other matters pertaining to water rights such as a change in the point of diversion, amendments, or corrections.

Prior to Wyoming statehood in 1890, a water right could be established by a procedure predicated on the use of water and the filing of a claim with territorial officials. Water rights with priority dates before 1890 are termed “territorial” water rights. Since statehood, the only way a water right can be acquired in Wyoming is by securing a permit from the state engineer. Water rights cannot be obtained by historic use or adverse possession. Wyoming water law requires that certain procedures be followed to obtain a valid water right, and the following is a summary of these procedures for surface water and groundwater.

## Surface water

Wyoming's first surface waters laws were enacted in 1875. More comprehensive laws were adopted along with the state constitution in 1890. These laws state:

- If an individual, association, or corporation wants to use surface water, they must first apply to the state engineer for a permit. Application forms are available from the State Engineer's Office, the Water Division Superintendent's Office, or the County Clerk's Office.
- An engineer or surveyor licensed to practice in Wyoming must make a survey and prepare the maps and plans needed to apply for a permit. Generally, this engineer or land surveyor also has the necessary application forms.
- Submit the application form, maps, and plans, along with a filing fee, to the state engineer as a package. The priority date is established by the date of application acceptance in the State Engineer's Office.
- Upon approval of the application, the state engineer issues a permit for developing the proposed water project.
  - The project must be completed within the time frame specified on the approved permit.
  - The state engineer must be notified on appropriate forms when the construction was completed and when the water was put to beneficial use. The appropriate forms are provided with the approved permit.
  - If, in the time prescribed, the project cannot be completed and the water cannot be put to use, the state engineer may be requested to extend any or all of the time limits. Make the request before the original time limits expire, and cite good cause for needing an extension. If an extension is granted, the date of priority remains the same.

After the water has been put to beneficial use (or a reservoir constructed) and the construction completion and beneficial use notices have been submitted, a final proof of appropriation or construction must be submitted to the appropriate water division superintendent. This proof is advertised in a local newspaper and an inspection of the project is made. Only lands found to be irrigated and / or possessing a reservoir will be accepted for adjudication. If the paperwork is in order and no protests are filed, the proof is submitted to the Board of Control. If the board approves the application, a certificate of appropriation and / or construction is issued and recorded in the County Clerk's Office in the county where the project is located, as well as in the State Engineer's Office. It is then listed in the tabulation of adjudicated rights for the respective division as evidence of an adjudicated water right. Once adjudicated, the water right is permanently attached to the specific land or place of use described on the certificate of appropriation and cannot be removed or changed except by action of the Board of Control. The adjudicated water right takes its place in the list of priorities for

that stream. Water is delivered to that right only when sufficient water is available to meet all earlier water rights on that stream.

- Limits on unstored water for irrigation:
  - Water rights for irrigation are adjudicated on the basis of 1 cubic foot per second (cfs) per 70 acres.
  - Water rights with priority dates of March 1, 1945, or earlier are entitled to an additional 1 cfs per 70 acres. Those individuals who hold such a water right are entitled to divert water in the volume of 2 cfs for each 70 acres of land before any water is made available to the holder of a water right with a priority date after March 1, 1945.

If there is not sufficient water to furnish 2 cfs to each individual with a pre-March 1, 1945, water right, but there is more than enough to furnish 1 cfs to each person, the surplus water is divided among those rights on a pro-rata basis. If there is so little water that each holder of the pre-March 1, 1945, water right cannot receive 1 cfs, they are regulated on a strict priority basis.

Any water beyond that required to furnish 2 cfs for each 70 acres of pre-March 1, 1945, water right is first allocated to rights with priority dates after March 1, 1945, and before March 1, 1985. Wyoming's Excess Water Law states that each water right with a priority date of post-March 1, 1945, but pre-March 1, 1985, is entitled to 2 cfs per 70 acres before any water is made available to post-March 1, 1985, water rights. If there is not sufficient water to furnish 2 cfs to each post-March 1, 1945, and pre-March 1, 1985, water right, but there is more than enough to furnish 1 cfs to each of these rights, the excess water is divided among those rights on a pro-rata basis.

If there is so little water that each post-March 1, 1945, and pre-March 1, 1985, water right cannot receive 1 cfs, the rights are regulated on a strict priority basis. Post-March 1, 1985, water rights are entitled to 1 cfs per 70 acres only after all pre-March 1, 1985, rights have received 2 cfs per 70 acres. Under the Excess Water Law, the post-March 1, 1985, water right also may receive 2 cfs if water is available.

- The granting of a water right by the state engineer does not include the granting of ditch easements and right-of-ways. These must be negotiated with the affected landowners.

## **Simplified Filing Procedures**

For some water facilities and developments, a simplified filing process is acceptable, which does not require maps and plans prepared by a registered engineer or surveyor. The following types of water uses are covered under the surface water special application procedure:

- Construction of small reservoirs for stock purposes, fishing, reserve waters, and wetland ponds, where the capacity of such a reservoir does not exceed 20 acre-feet of water or the height of the dam does not exceed 20 feet.

- Construction of flood detention dams that:
  - Store 50 acre-feet of water or less
  - Have a dam height not exceeding 20 feet
  - Have, as a minimum, an outlet 18 inches in diameter
  - Have a dead storage that does not exceed 20 acre-feet
- Development of springs may be filed on by one of two methods, depending upon the rate of flow and how the water will be applied. The conditions that determine the method to use are described below:
  - If the spring flows 25 gallons per minute (gpm) or less and if the water is to be used only for stock watering and / or domestic uses, which includes watering lawns and gardens not exceeding 1 acre in size, the spring shall be filed as groundwater. No map is required. After the approval of the application, some type of artificial diversion must be constructed to qualify for a water right. The proposed method of spring development and the means of conveying the water to the point of use must be described on the application under the section titled *Remarks*.
  - If the spring flows in excess of 25 gpm (0.056 cfs) and is to be used for stock purposes only, surface water special application procedures must be followed. The use will be limited to 25 gpm (0.056cfs).
  - All springs flowing in excess of 25 gpm (0.056 cfs) or for other uses will be filed using surface water filing procedures.
- Domestic uses of water directly from a stream can be permitted under the special application process for uses up to 25 gallons per minute (gpm)
- Any system using a catchment apron to collect direct flow for storage in a cistern or tank for later use in a guzzler (drinking trough) can be filed using surface water special application procedures.

## **Reservoir storage**

A reservoir is entitled to be filled in priority once each year if water is available. If water remains unused in the reservoir at the end of the normal use period, the water is designated as carry-over storage and counts toward providing water to meet the following year's supply for appropriation.

## **Instream flow**

The 1986 Legislature declared that instream flow for maintenance or improvement of existing stream fisheries is a beneficial use of water that can be provided from natural stream flows or from storage water. A statutory procedure was established for the state, represented by the Wyoming Water Development Commission (WWDC), to appropriate specified flow rates for instream flows in segments of streams identified by studies and reports of the Wyoming Game and Fish Commission. The WWDC must conduct a

hydrologic study to determine whether the instream flow can be provided from the natural flow of the stream or whether storage water from an existing or new reservoir will be needed for part or all of the instream use. The WWDC report is supplied to the state engineer for consideration. If storage water is needed from a new reservoir project, normal legislative project authorization procedures must be followed by WWDC.

After receiving reports from the Game and Fish Commission and WWDC, the state engineer may conduct an evaluation of the proposed appropriations for instream use. Before granting or denying a permit for instream flow in the specified stream segment, the state engineer must conduct a public hearing and consider all available reports and information. If granted, an instream flow permit can contain a condition for review of continuation of the permit at a future time.

The instream flow appropriation goes into effect the date the state engineer approves the permit. The water right cannot be adjudicated by the Board of Control for three years thereafter. An instream water right priority date is the date the application was received and recorded by the state engineer, and all senior priority water rights must be recognized in administration of the stream.

The state engineer cannot issue an instream flow permit if it will result in the loss of a portion of Wyoming's consumptive share of water allocated by interstate compact or U.S. Supreme Court decree, or if it will result in more water leaving Wyoming than is allocated for uses downstream.

Other persons can appropriate water downstream from an instream flow segment to within one mile of the Wyoming state line or within one mile upstream from major reservoirs on the Big Horn, Green, Snake, and North Platte Rivers.

## **Groundwater**

The first Wyoming groundwater laws were enacted in 1945 and amended in 1947. A new groundwater law went into effect March 1, 1958, repealing and replacing the 1945 and 1947 laws. Major amendments were made in 1969.

## **Priority of wells**

- For all wells drilled prior to April 1, 1947, the priority date is the date the well was completed if a claim for the well was filed before March 1, 1958, as provided by the law.
- For wells drilled between April 1, 1947, and March 1, 1958, the date the well was registered established its priority date.
- After March 1, 1958, the priority date is the date the application for a permit to drill the well is accepted in the State Engineer's Office.
- An exception to the above is a well used solely for stock and / or domestic purposes. Until the enactment of the 1969 amendment to the groundwater law, these wells were exempt from filing and held a preferred right over wells used for all other purposes.

- Under the 1969 amendment, all domestic and / or stock wells drilled after May 24, 1969, and all wells drilled for other purposes establish priority on the date the application for permission to drill is received in the State Engineer's Office.
- Under the 1969 amendment, all stock and / or domestic wells drilled and used before May 24, 1969, and registered with the state engineer before December 31, 1972, established a priority date as of the well's completion and water use.

### **Domestic and stock water uses (Groundwater)**

The law defines domestic use as household use, including lawn and garden watering for noncommercial family use where the area to be irrigated does not exceed 1 acre. The quantity of water to be pumped for family or stock use shall not exceed 25 gpm. A well may supply water to more than one, but not more than three, single-family dwellings and still be considered a domestic use provided that:

- The yield does not exceed 25 gpm
- The total area of lawns and gardens to be watered does not exceed 1 acre
- No charge, hidden or otherwise, is levied for the use of the water
- The water is not used in conjunction with a commercial endeavor

Stock watering use is defined as normal livestock watering. This includes any project whereby water will be piped to no more than four points of use within one mile of the well. Large feedlot operations or any project whereby the water will be piped to five or more points of use or where the points of use are greater than one mile from the well are considered miscellaneous use.

### **Groundwater permitting procedures**

The same general procedures for acquiring surface water rights apply to acquiring groundwater rights:

- Before a well is drilled, an application must be filed and approved by the state engineer. This requirement applies to all wells used for any purpose.
- Forms to be filed with the state engineer are available from that office, the Water Division Superintendent's Office, or the County Clerk's Office.
- A permit to construct a well will generally be granted as a matter of course by the state engineer. An exception may be in a groundwater control area. The Board of Control may designate a groundwater control area where:
  - The use of groundwater is approaching a use equal to the current recharge rate
  - Groundwater levels are declining or have declined excessively
  - The waste of water is occurring or may occur

- Other conditions exist or may arise that require regulation for protection of the public interest
- The well must be completed and the water applied to beneficial use before the dates specified on a permit. The proper notice(s) verifying compliance must then be submitted to the State Engineer's Office.
- If an individual cannot complete construction of the well or put the water to use in the time prescribed, an extension may be requested (in writing) to the state engineer. "Good cause" should be stated in the request.
- A plat, showing the location of the well(s) and the point(s) of use and distribution system, is required when the final proof of appropriation and beneficial use is filed. This plat must be certified by an engineer or land surveyor licensed to practice in Wyoming.
- After the final proof of application has been filed, the division water superintendent inspects the project and the proof is advertised. If everything is in order and no protests are filed, a certificate of appropriation is issued by the Board of Control. The certificate is recorded in both the County Clerk's Office and in the State Engineer's Office. This is evidence of an adjudicated water right.

## **Changes in location and depth**

Within the same aquifer, well location may be changed in the vicinity of the original location. The well depth also may be changed without loss of priority, provided approval is obtained from the Board of Control – if the groundwater right has been adjudicated or has not been adjudicated but the water has been applied to beneficial use. In cases involving domestic and stock water wells that are not adjudicated but whose water has been applied to beneficial use, the state engineer may approve a change of location. If the right is not adjudicated and the water has not been applied to beneficial use, approval for the change in location may be granted by the state engineer. For all wells, the state engineer may approve a change in well location, even if the water has not been put to a beneficial use.

## **Special water right conditions for groundwater**

- The permit to appropriate groundwater carries with it no guarantee of a continued water level or artesian pressure.
- Where underground waters in different aquifers are so interconnected as to constitute one source of supply or underground water and surface water are so interconnected as to constitute one source of supply, priorities of rights to the use of the interconnected waters shall be correlated and a single schedule of priorities shall relate to the common water supply.
- By-product water is water that has not been put to prior beneficial use, is a by-product of some nonwater-related economic activity, and has been developed only as a result of another activity such as oil and gas production or mining.

## **Preferred uses**

Wyoming water law defines the preferred uses of both surface water and groundwater and lists them in the following order:

- Drinking water for both humans and livestock
- Water for municipal purposes
- Water for steam engines and general railway use; water for cooking, laundering, bathing, and refrigerating (including ice manufacturing); water for steam and hot-water heating plants and steam power plants
- Water for industrial purposes

## **Non-preferred uses**

All water uses other than those listed as preferred uses are considered non-preferred. When the water supply is insufficient to meet water rights, rights with a preferred use do not take precedence over a non-preferred use. The priority date of a water right, preferred or non-preferred, determines who is entitled to water. The only way to obtain a preferred right for a non-preferred prior right is by purchase or condemnation through court action. The right of condemnation cannot be used by industrial concerns to obtain water rights. However, groundwater wells yielding 25 gpm or less and used solely for domestic and stock purposes do have preferred rights over wells for all other uses, regardless of the priority date.

For example, an irrigation water right (non-preferred use) with an early priority is entitled to use water even when it may involve denying water to a municipality (preferred use) with a later right. The municipality may acquire, through condemnation if necessary, the earlier irrigation right and change it to municipal use, provided just compensation is paid.

## **Keeping water rights valid**

To keep a water right valid when changes are made in the point of diversion, location of a well, location of an irrigation ditch, or similar circumstances, permission must be secured. If the water right is adjudicated, petition the Board of Control. If it is not adjudicated, send the petition to the State Engineer's Office.

In most instances, obtaining permission for changes does not change the priority date of the water right but keeps the water right up-to-date and legal. Public hearings on the changes may be held to ensure that no injury occurs to the other water right holders because of the change. Keep the water right in proper standing so no legal questions are raised concerning its validity.

## **Change in use**

Those individuals who own an adjudicated water right and wish to change it from its current use or from its place of use must file a petition with the Board of Control requesting permission for a change. The petition must set forth all pertinent facts about the existing use and the proposed change in use. When requesting a change in place of use, all pertinent information about the existing use and the proposed place of use should be specified in the petition. The Board of Control may require that an advertised public hearing be held at the petitioner's expense. The

petitioner must provide a transcript of the public hearing to the Board of Control. The change of use, or change in place of use, may be allowed.

If such an allowance is granted, the quantity of water transferred by the granting of the petition should not exceed the amount of water historically diverted under the existing use. Furthermore, the historic rate of water diversion and the amount consumed cannot exceed that diverted and consumed under the existing use. Finally, such a petition, if allowed, should not decrease the historic amount of return flow or in any manner injure other existing lawful appropriators. The Board of Control will consider all facts it believes pertinent to the transfer. These may include the following:

- The economic loss to the community and the state if the use from which the right is transferred is discontinued.
- The extent to which such economic loss will be offset by the new use
- Whether other sources of water are available for the new use

In all cases where the matter of compensation is in dispute, the question of compensation shall be submitted to the proper district court for determination.

## **Subdivisions with attached water rights**

Wyoming law provides that any time a parcel of land with water rights attached is subdivided, the developer must dispose of the water rights in one of three ways:

- Voluntarily abandon the water rights, removing them from the land forever
- Transfer the water rights to other owned lands that have no other water right from the same source
- Develop a subdivision irrigation plan showing which lands have the water right, amount of the water right, supply and waste ditches, and other information necessary for the protection of individual lot owners in retaining the water right on the land

Each of these actions requires review by the State Engineer's Office or the Board of Control before the subdivision can be approved by the respective county.

## **Water right abandonment**

A water right for surface water or groundwater not used for five successive years (when water is available to satisfy the right) is considered abandoned, but a statutory procedure must be followed to bring about legal abandonment. The law provides a procedure for abandonment. The abandonment process must be initiated by an affected water user who has a priority equal or junior to the right being abandoned or by the state engineer. If a right is declared abandoned, the user forfeits all water rights, easements, ditch rights, and the like, and the water again becomes subject to appropriation. Water must have been available but not used for an abandonment to take place. Wyoming law provides standing so that abandonment action can be brought by a pre-March 1, 1945, water right holder, even though senior in priority, against another pre-March 1, 1945, water right holder to protect the right to surplus water.

## **Wyoming water law**

There are seven basic precepts to Wyoming water law.

- Beneficial use is the basis, measure, and limit to the right to use water at all times.
- To bring about a more economical use of the available water supply, two or more water users may rotate the use of their combined water rights after obtaining permission of the water division superintendent.
- The landowner is responsible for ditch maintenance so the water does not flood or damage the property of others.
- The landowner is responsible for waste water at all times.
- In administering water to the various appropriations on a stream, the state is obligated to deliver the full amount of any appropriation in priority at its head gate out of the stream. Any ditch loss between the head gate and the appropriator's land is the responsibility of the appropriator.
- Temporary rights to water uses, such as for oil well drilling, highway construction, etc., may be granted by the state engineer upon proper application.
- In a case where a ditch was in place before any houses or other property, the property owners are compelled to protect themselves from any damage created by seepage from the ditch. If, because of seepage, a newly built ditch creates damage to property that was present before the ditch was built, the ditch owners shall be liable for any damage.

## **Interstate compacts and court decrees**

As a headwaters state, Wyoming is party to seven interstate compacts and two U.S. Supreme Court decrees. Many of the river basins have established interstate commissions to ensure compliance with the allocations made under these compacts and decrees.

## **Summary**

In Wyoming, a valid right to the use of water may be acquired only by following the procedures established by state law for both surface water and groundwater.

Water users should be sure of the status of their water rights. Check the records in the County Clerk's Office or through the State Engineer's Office. The records indicate the appropriation amount, priority of the right, and how and where the water is to be used. If there are any questions, check with the State Engineer's Office and request complete information on the status of the water right in question.

## APPENDIX H

### PUBLIC COMMENTS

November 3 through December 17, 2003

| Comment   | Committee Response  |
|---|---|
| Is the dog run at Clear Creek a problem?  | Based on a site visit and low fecal coliform concentrations in Clear Creek, the dog run is not considered a contributor to the fecal coliform levels found in Crow Creek.   |
| <p>City dumps bio-waste on Wyoming Hereford Ranch next to Crow Creek. Even though Cheyenne has EPA permit, there is no buffer between pasture where waste is spread and Crow Creek. I think the permit should be reviewed and re-thought.</p> | <p>Committee requested further information from the Cheyenne BOPU Wastewater Division. The following is their response:</p> <p>The BOPU does not “dump” waste. The Wastewater Division land-applies dry, treated Biosolids (sewage sludge) at various locations, including the Hereford Ranch, for beneficial use including soil-moisture retention and nutrient enhancement. Cheyenne’s wastewater treatment residuals are covered by EPA Permit # WYG650000. Permit requirements include specific limitations, monitoring requirements, and management practices for the generation, treatment and the use/disposal of Biosolids. Site-restrictions and management practices are strictly followed during Biosolid application in accordance with permit limitations.</p> <p>The Biosolids generated at the BOPU wastewater treatment facilities are extensively treated prior to land application. Treatment includes anaerobic digestion, air drying and aeration (periodic turning of drying material). On average this treatment process takes 8 to 10 months to complete. Biosolids are strictly monitored for pathogen reduction requirements (fecal coliform limits) and chemical pollutant concentrations including: arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium and zinc. Tests for nutrient quality</p> |

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|---|---|
|   | <p>are also conducted on the Biosolids prior to application and include testing for nitrogen, phosphorus and potassium. Prior to application the land is also tested for nitrogen, phosphorus, and ten different metals. The sites are monitored for up to 5 years after application, to ensure there are no adverse effects resulting from the Biosolids application. Material that fails regulatory limits in any of the categories cannot be land applied. Specific to the comment "...there is no buffer between pasture where waste is spread and Crow Creek", the permit BOPU utilizes states: "Sewage sludge shall not be applied to land 10 meters or less from waters of the United States"(1). The BOPU standard is 15 meters. Additionally, less than 25% of BOPU application sites are adjacent to Crow Creek or other waters; most are dry land pastures. Allowable "agronomic" application rates can vary from site to site and are determined by the nitrogen content of the Biosolids and the type of vegetation or crop on each site. The County Agent determines the nitrogen uptake (requirement) of local vegetation or crops. A calculation is made to determine a ton per acre rate of application. Generally the maximum allowable application rate is about 8 tons per acre, but the BOPU applies Biosolids at a rate of about 5 tons per acre.</p> <p>At present the Biosolids produced at the BOPU facilities meet class B standards making them acceptable for a wide variety of beneficial uses. The application of Biosolids on private land is completed only after obtaining written permission from the landowner. Landowners invite the BOPU to properly apply Biosolids on their properties to improve yields of hay and improve vegetation on pastures.</p> <p style="text-align: right;">(1)40 CFR Part 122.2</p> |
| <p>The geometric means have been calculated using an incorrect formula.</p> | <p>The geometric means were recalculated using the correct formula.</p>   |

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|---|--|
| Add North Branch and Middle Fork of Crow Creek to watershed plan  | The North Branch and Middle Fork will be addressed either separate from this watershed plan or as an amendment to the Crow Creek Watershed Plan.                             |
| Dynamic Plan – will be continuously updated and reevaluated as projects are completed and new monitoring assessed.  | No Action – this concept is already stated in the watershed plan.  |
| <b>Remove:</b> Fecal coliform is a non point source (NPS) pollution problem and will be addressed with best management practices (BMPs) implemented by landowners and the City of Cheyenne.<br><b>Add:</b> Contamination is both a point source and non point source problem. Point sources of fecal coliform can be addressed through National Pollution Discharge Elimination Permits (NPDES) and non point sources through Best Management Practices (BMPs). | Make recommended change.   |
| <b>Remove:</b> Public selected watershed plan and LCCD solicited volunteers for the Steering Committee.<br><b>Add:</b> Crow Creek Watershed Steering Committee selected.  | Make recommended change.   |
| Goal 1, Objective 2, Action 1<br><b>Remove:</b> Completed, February 2003<br><b>Add:</b> On-going  | Make recommended change.   |
| Goal 2, Objective 6, Action 3<br>Brief discussion of Wyoming Water Law is not included in the watershed plan  | Wyoming Water Law Summary was added to the appendix.   |
| DEQ will want to know where and why each BMP will be installed.   | Details added to planned BMPs in Goal 5, Objective 2   |
| Is the Greenway corridor included?  | Greenway corridor added to Goal 4, Objective 1, Action 2.  |
| How do you expect to keep the City of Cheyenne as a member of the committee and keep them aware of the storm water problem?   | LCCD has an annual agreement with the City of Cheyenne, Laramie County and WYDOT for Phase II Storm Water Permitting. This agreement added to Goal 4, Objective 1, Action 9. |
| Table B1. pH-Dependent Values of the Acute Criterion for Ammonia: Temperature values missing from the table.  | Temperature tables added.  |

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|--|--|
| Table E1. Best Management Practices:<br>More information needs to be added including secondary treatments. | Make recommended change.                     |
| Table F1 and F2. USGS Data:<br>pH values missing from tables.  | pH values added to tables.                   |
| Definitions are missing for Dry Pond, Bioretention, and Sheet Pile.  | Definitions added to Appendix E              |
| Storm Septor picture in Appendix E is difficult to read.   | Storm Septor picture replaced in Appendix E. |

## **APPENDIX I**

### **ACRONYMS AND GLOSSARY**

**BMPs** – Best Management Practices  
**BOPU** – City of Cheyenne Board of Public Utilities  
**CWA** – Clean Water Act  
**DEQ** - Department of Environmental Quality  
**EPA** – United States Environmental Protection Agency  
**GIS** – Geographic Information System  
**LCCD** – Laramie County Conservation District  
**MCL** – Maximum Contaminant Level  
**mg/L** – Milligram per Liter  
**NPDES** – National Pollution Discharge Elimination System  
**NPS** – Non-Point Source  
**NRCS** – Natural Resource Conservation Service  
**SEO** – State Engineers Office  
**TMDL** – Total Maximum Daily Loads  
**ug/L** – Microgram per Liter  
**USGS** – United States Geological Survey  
**WDA** – Wyoming Department of Agriculture  
**WGFD** – Wyoming Game and Fish Department

### **GLOSSARY**

**Alluvium** – sediment deposited from flowing water.

**Ammonia** – a gas caused by the bacterial decomposition of decaying matter. In water it can be used as an indicator of pollution. In high concentrations it can be toxic to aquatic life (Dependent on water temperature and pH).

**Best Management Practices** – or BMPs are described as “Guidelines for managing the use of a resource in a manner that protects the resource and promotes ecological and economic sustainability.

**Cadmium** – a metallic element that is naturally occurring and is used in electroplating, batteries, insecticides, etc. As a heavy metal it is bio-accumulative and can be toxic to aquatic life as well as humans.

**CWA Section 319 Grant** – enables States, Territories and Tribes to address the problems caused by NPS pollution. The grant also provides funding from the U.S. Environmental Protection Agency for monitoring, mitigation and education.

**CWA Section 303(d) list** – as required under the CWA, this is a listing prepared by DEQ identifying all waters within the State; identifying and prioritizing severity of pollution, taking into account the use of the waters.

**CWA Section 305(b) report** – an assessment of the State's water quality and indicates the degree to which each water body supports the designated uses of a State's Water Quality Standards.

**Designated uses** – those uses specified in water quality standards for each water body or segment whether or not they are being attained.

**Ephemeral Stream** – a stream which flows only in direct response to a single precipitation in the immediate watershed or in response to a single snow melt event, and which has a chemical bottom that is always above the prevailing water table.

***Escherichia coli* – (*E.coli*)** is a type of bacteria found in the intestinal tract of humans and other warm blooded animals. It is used as an indicator of bacterial pollution of water.

**Fecal Coliform** – are another group of bacteria that are used as an indicator of pollution. They are found in the excremental waste of warm blooded animals and are defined as rod shaped bacteria that ferment lactose to form gas within 48 hours of being placed (Incubated) in lactose broth at 35 degrees C.

**Impairment** – an exceedance of a chemical, physical or biological standard that prevents a water body from meeting its designated uses.

**Intermittent Stream** – are streams that flow only during high water tables (If ground water fed) or in direct response to precipitation from runoff or snowmelt.

**Maximum Contaminant Level** – is the highest level of a contaminant that is allowed in water.

**Microgram per Liter** – parts per billion. One part per billion corresponds to one minute in 2,000 years, or one penny in \$10,000,000.

**Milligram per Liter** – parts per million. One part per million corresponds to one minute in two years, or one penny in \$10,000.

**Non-Point Source Pollution** – is a source of pollution of undetermined origin. An example would be runoff from urban areas, agricultural lands and erosion of soil.

**Non-Priority Pollutant** – means any substance or combination of substances other than those listed by EPA under Section 307(a) of the Federal Clean Water Act.

**Ogallala Formation** – is a geological water bearing formation made up of fine to coarse sand stone and produces good to very good water. The extent of this formation is from central Texas, northward through Oklahoma, Kansas, Nebraska, south central South Dakota, southeast Wyoming, eastern Colorado and northeast New Mexico.

**Perennial Stream** – is a stream that flows throughout the year and is usually fed by ground water.

**Priority Pollutant** – means those substances or combination of substances that are listed by EPA under Section 307(a) of the Federal Clean Water Act.

**Point Source Pollution** – is defined as a known source of pollution such as a pipe from a factory or a waste water treatment facility and is discharged into a nearby water body.

**Quality Assurance** – is an integrated system of management procedures and activities used to verify that the quality control system is operating within acceptable limits and to evaluate the quality of data.

**Quality Control** – a system of technical procedures and activities developed and implemented to produce measurements of requisite quality.

**Total Maximum Daily Loads** – is the amount of a pollutant that a water body can receive and still meet water quality standards.

**Water Body Identification Number** – is a number assigned to a particular stream, lake, river or other water and is entered in a national data base giving its location, water quality and other factors that identify that water body.