Idaho Department of
Environmental Quality

Fivemile and Tenmile Creek Subbasin Assessment

Fivemile Creek

December 2001

Tenmile Creek

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Executive Summary

The Fivemile and Tenmile Creek subwatersheds drain 83 and 74 square miles of rangeland, agricultural land and urban areas, respectively. Both streams are located in the southeast portion of the lower Boise River watershed, which is located in southwest Idaho. Fivemile and Tenmile Creek flow in a northwesterly direction through Ada and Canyon Counties before they join together to form Fifteenmile Creek, which discharges to the lower Boise River four miles upstream of the town of Middleton.

Section 303(d) of the Federal Clean Water Act requires states to develop a Total Maximum Daily Load (TMDL) allocation plan for water bodies determined to be water quality limited. A TMDL allocation plan documents the amount of a pollutant a water body can assimilate without exceeding a state's water quality standards, and allocates that amount as loads to point and nonpoint sources. TMDLs are defined in 40 CFR Part 130 as the sum of the individual Waste Load Allocations (WLA) for point sources and Load Allocations (LA) for nonpoint sources, including a margin of safety and natural background conditions. If the water body is impaired by a section 303(d) listed pollutant, a TMDL and additional pollution control measures may be necessary. The section 303(d) listed pollutants in Fivemile and Tenmile Creek are sediment, nutrients and dissolved oxygen.

Fivemile and Tenmile Creek are designated in the Idaho Water Quality Standards for cold water biota and secondary contact recreation. Recognizing that cold water biota and secondary contact recreation may not be appropriate beneficial uses for highly regulated and irrigation driven systems, Nampa-Meridian and Pioneer Irrigation Districts performed a beneficial use evaluation for Fivemile and Tenmile Creek to characterize the appropriate beneficial uses and submitted it to DEQ. The analysis shows that a modified aquatic life use accurately defines the best attainable conditions in both streams. The modified aquatic life use describes streams that are limited in aquatic life diversity due to factors such as ephemeral or intermittent flow, naturally occurring pollutant levels or long-standing hydrologic modification. The use evaluation also recommends removing all contact recreation designations. However, the secondary contact recreation use will not be removed.

Modified aquatic life and secondary contact recreation are fully supported in Fivemile and Tenmile Creek. Using dissolved oxygen, pH, suspended sediment and algal biomass concentrations as indicators and surrogates of sustainable water quality conditions, the data do not indicate impairment by nutrients, sediment or dissolved oxygen. Surrogates provide an expression of water quality condition in instances where numeric water quality criteria do not exist, as with nutrients and sediment. Dissolved oxygen concentrations and pH levels are also within the criteria ranges, further indicating that aquatic life beneficial uses are not impaired. Due to the lack of beneficial use impairment, TMDLs for sediment, nutrients and dissolved oxygen are not required for Fivemile and Tenmile Creek and DEQ will recommend de-listing during the 2002 303(d) listing cycle.

Bacteria are not listed as a pollutant of concern in Fivemile or Tenmile Creek. However, the data show that E. Coli are exceeding the state standard at all locations in the stream. DEQ recommends listing Fivemile and Tenmile Creek for bacteria on the 2002 303(d) list and establishing a TMDL schedule.

The Snake River-Hells Canyon TMDL is scheduled to be completed in December 2001. Nutrients and sediment are listed as pollutants of concern in the TMDL and will be addressed by assigning load allocations to the major tributaries to the Snake River, including the lower Boise River. When the Snake River-Hells Canyon TMDL allocates a nutrient load to the lower Boise River, load reductions from the tributaries to the lower Boise River will be necessary to meet the Snake River-Hells Canyon allocation to the lower Boise River. The load allocation will likely be given to Fifteenmile Creek, but reductions from Fivemile and Tenmile Creek may be necessary to meet the allocation.

An implementation plan is currently being developed by the Lower Boise River Watershed Advisory Group and supporting agencies to specify the activities needed to meet the sediment and bacteria load allocations identified in the 2000 sediment and bacteria TMDLs for the river proper. The implementation plan will also have placeholders to address nutrient reductions when they become necessary. Upon completion and implementation of the plan, any necessary reductions from the Fifteenmile Creek Subwatershed will be achieved.

Subbasin Watershed Characterization

Fivemile Creek and Tenmile Creek are located in the southeast portion of the lower Boise River watershed (Hydrologic Unit Code (HUC) 17050114), which is located in southwest Idaho (Figure 1). The Fivemile Creek subwatershed drains 83 square miles of rangeland, agricultural lands and urban areas. Fivemile Creek is 28.92 miles long and flows through Ada and Canyon counties and the cities of Boise and Meridian, Idaho (Figure 2). Fivemile Creek flows in a northwesterly direction from its origin near the I-84 Blacks Creek off-ramp east of Boise to its confluence with Tenmile Creek, where the two creeks join to form Fifteenmile Creek. Fifteenmile Creek flows for approximately 3.5 miles before it joins the lower Boise River. The Tenmile Creek subwatershed drains 74 square miles of rangeland, agricultural lands and urban areas. Tenmile Creek is 27.15 miles long and flows through Ada and Canyon counties and the city of Meridian, Idaho (Figure 3). Tenmile Creek flows in a northwesterly direction from its origin at Blacks Creek Reservoir to its confluence with Fivemile Creek.

Topography in both subwatersheds is relatively flat, with gradual drops in elevation as they flow down several step-like terraces to where they form Fifteenmile Creek. Elevation in the Fivemile Creek subwatershed ranges from 3,360 feet at the I-84 rest stop to 2,450 feet at Fifteenmile Creek. Elevation in the Tenmile Creek subwatershed ranges from 3,169 feet at Black Creek Reservoir to 2,450 feet at Fifteenmile Creek. Relief varies according to topography; the terraces are generally level while the drop down to the next terrace ranges from 0.4% to 3.0% slopes.

Geology

Fivemile and Tenmile Creek lie within the western Snake River Plain. The multiple terraces that developed throughout the Quaternary period comprise much of the subwatersheds. All terrace deposits are pebble to cobble gravel with a coarse sand matrix. Thin wind-blown deposits of loess differentially cover the terrace surfaces. Shield volcanoes, basaltic cones, and lava flows bound and cover the subwatershed. Some basalt flows bury former alluvial surfaces and all flows are differentially covered by thin loess deposits (Othberg, 1994).

Soils are derived predominantly from river and wind born materials. The soils generally have weakly developed profiles, are unleached, alkaline, and have high natural fertility. Soil textures found in the subwatershed are silty and sandy loams below the New York Canal and loamy sands and sandy loams above the New York Canal (Collett, 1972).

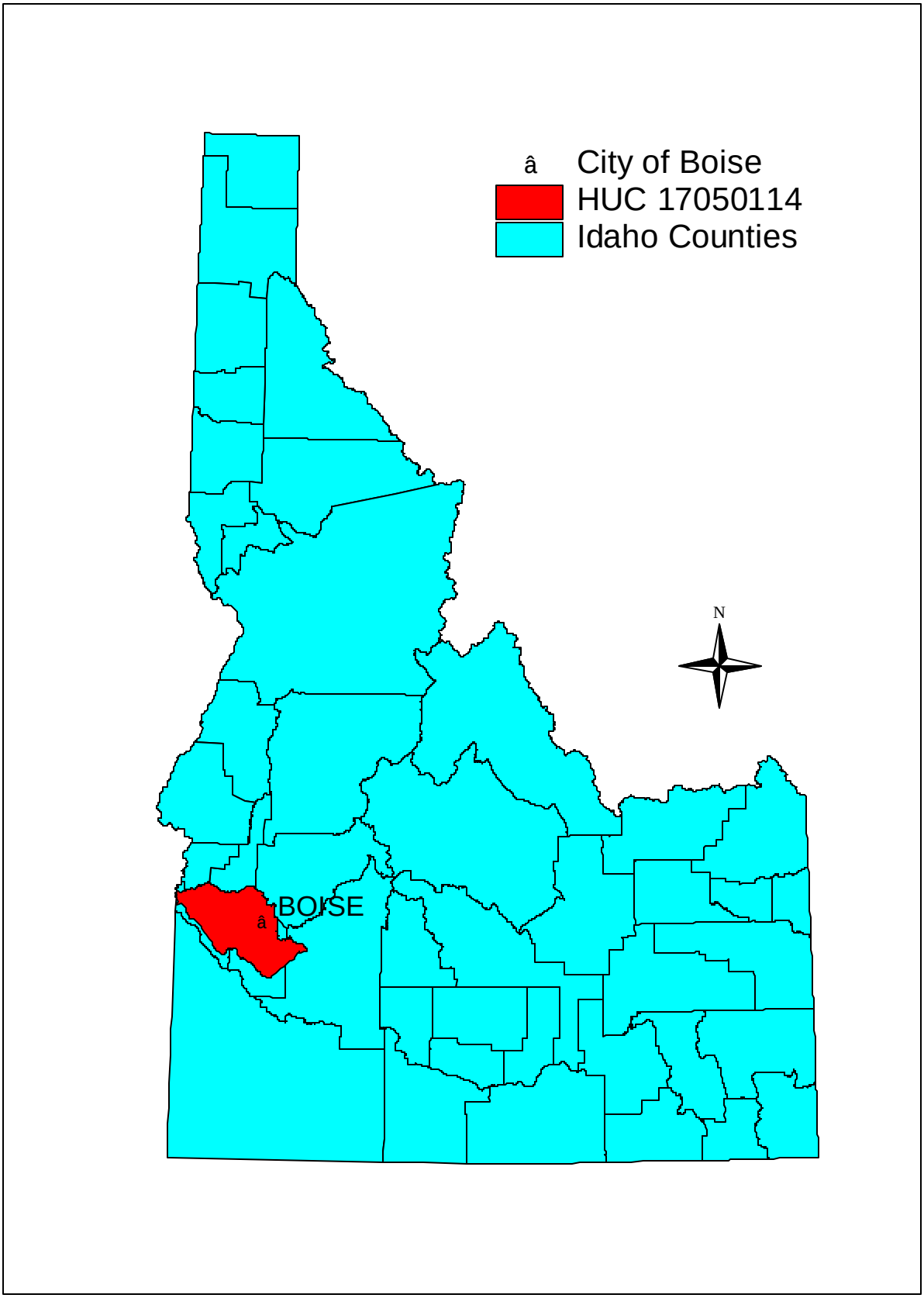


Figure 1. Lower Boise River Watershed

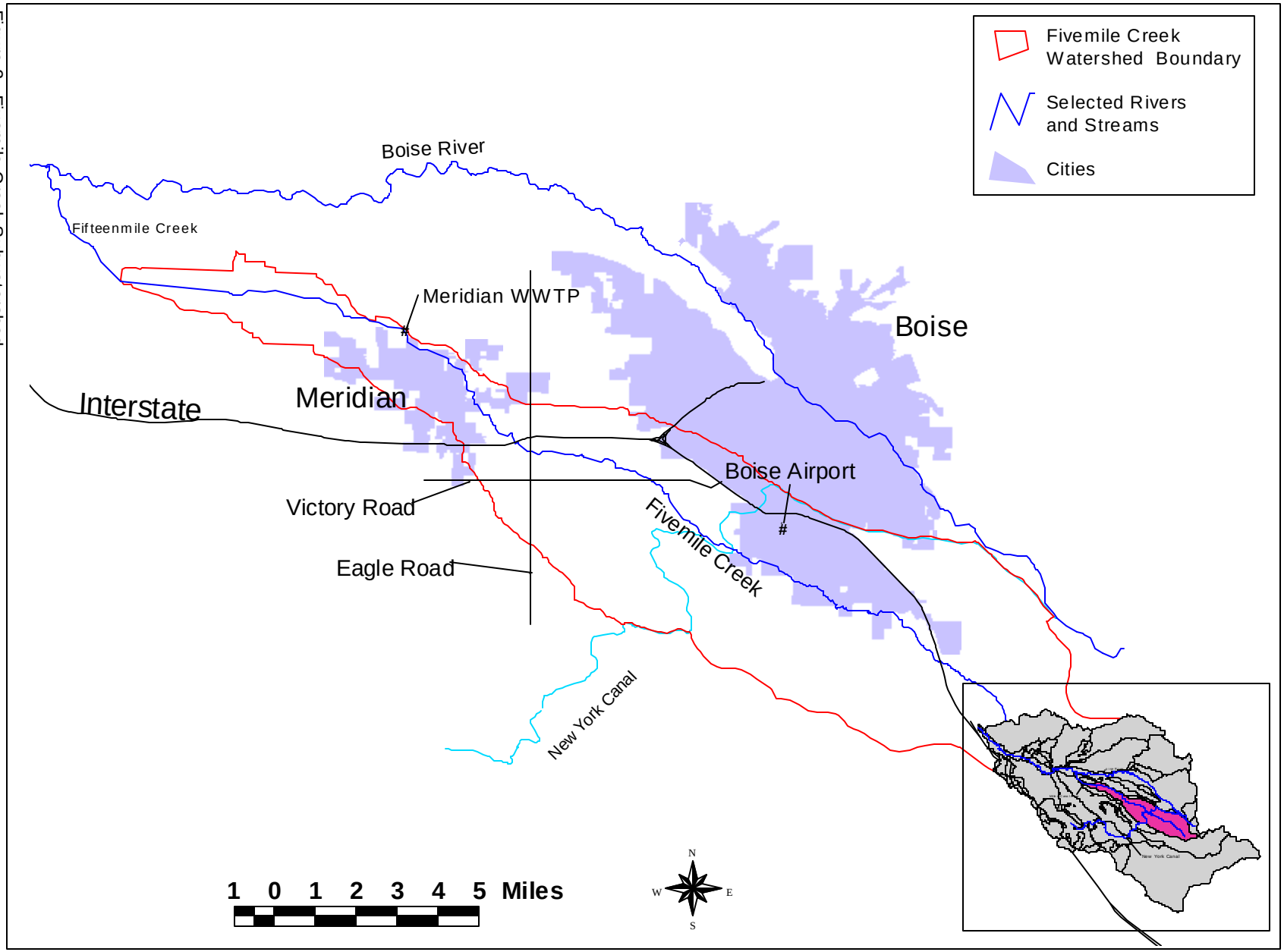


Figure 2. Fivemile Creek Subwatershed

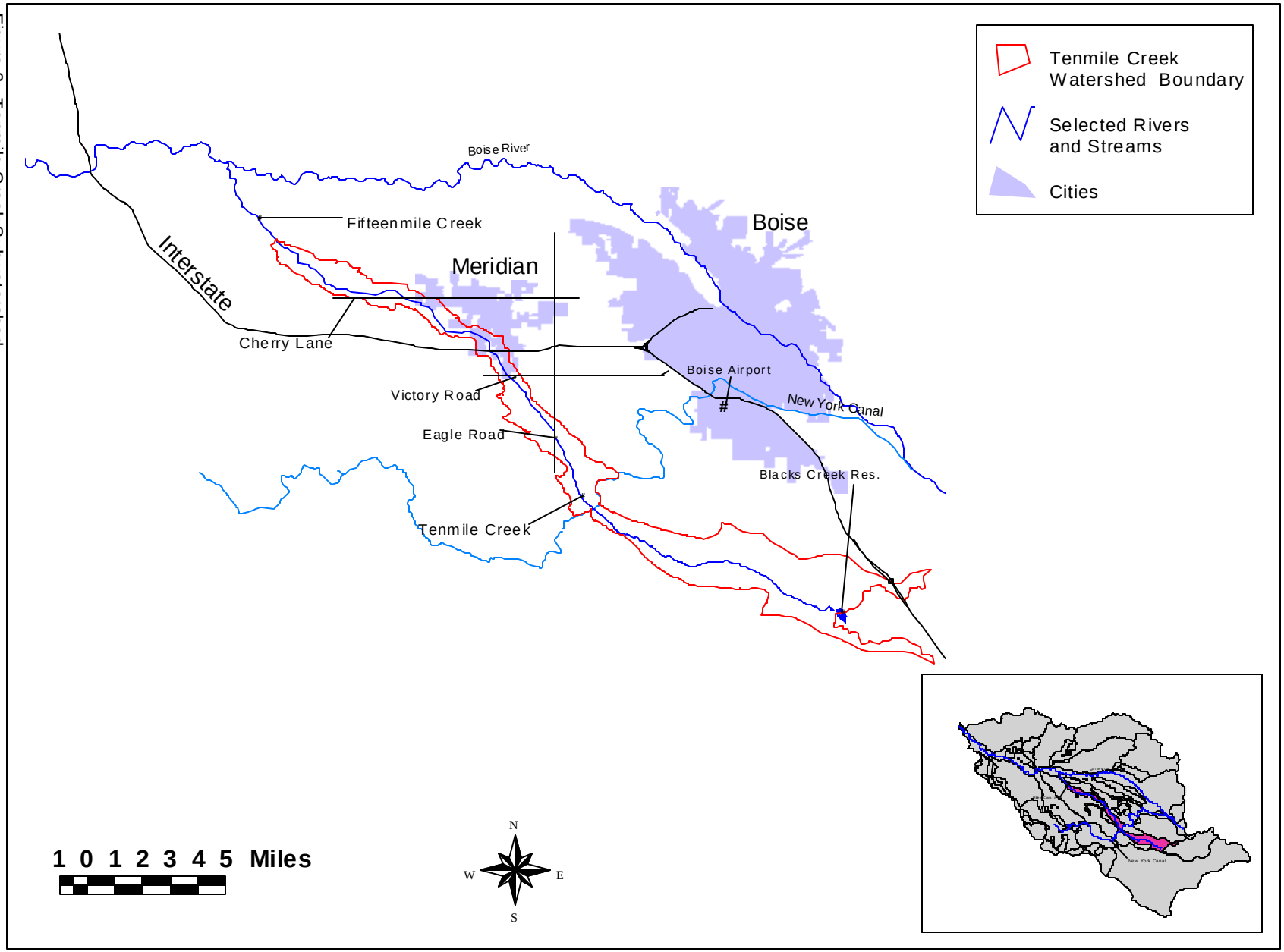


Figure 3. Tenmile Creek Subwatershed

Climate

Climate within the subwatersheds is temperate to arid. The summer months are hot and dry while the winters are cold and wet, though generally not severe. The average maximum summer temperature during the period of 1940 - 2000 was 83.9º Fahrenheit (F) in Boise. The average minimum winter temperature in Boise from 1940 -2000 was 25.9º F (Climate Data Center, 2000). The average annual precipitation during the period of 1940 - 2000 in Boise was 11.9 inches (Climate Data Center, 2000). Most precipitation falls during the colder months. Snow accumulation is typically light and usually melts shortly after it falls.

Surface Hydrology

An intricate system of inputs and withdrawals in combination with the local flood control policies in the lower Boise River watershed have significantly altered the flow regime and the physical and biological characteristics of Fivemile and Tenmile Creek. Historically, both creeks were intermittent from their headwaters to about one mile prior to where they form Fifteenmile Creek. From that point on downstream they were perennial. At present day, Fivemile Creek is intermittent from its headwaters to the Evans Drain and perennial from Evans Drain to its confluence with Tenmile Creek. Tenmile Creek is intermittent from its headwaters to Meridian Road and perennial from Meridian Road to its confluence with Fivemile Creek. Both streams remain perennial in the lower portions due to elevated groundwater levels. Flows increase during the irrigation season (April – September) due to irrigation related return flows.

Lucky Peak Dam, the structure controlling flow at the upstream end of the lower Boise watershed, was constructed and began regulating flow in 1957. Water is released from the reservoir to the lower Boise River just a few miles upstream from Boise. Water releases from the reservoir are managed primarily for flood control and irrigation, which directly effect the hydrology of Fivemile and Tenmile Creek by raising the water table during the irrigation season. Other management considerations that have less of an effect include power generation, recreation, and maintenance of minimum stream flows during low flow periods and release of water to augment salmon migration flows in the Snake River. Figure 4 shows mean monthly flows for the Boise River below Lucky Peak Dam, United States Geological Survey (USGS) Station 13202000, before construction of Lucky Peak Dam and under current regulated flow conditions. Flow regulation for flood control has replaced natural, short duration (two to three months), flushing peak flows with longer (four to six months), greatly reduced, peak flows. Water management has increased discharge during the summer irrigation season and significantly decreased winter low flows.

The regulated annual hydrograph for the perennial portions of Fivemile and Tenmile Creek can be divided into two flow regimes. Low flow conditions generally begin in mid-October after the irrigation season ends. The low flow period extends through the winter until the irrigation season begins again April. Figures 5 and 6 show the mean monthly flows for Fivemile and Tenmile Creek. Due to the highly regulated nature of both systems, these flow regimes are relatively static from year to year.

Dating as far back as 1916 (Paul, 1916), irrigation practices have altered drainage patterns in Fivemile and Tenmile Creek. In many cases, water does not follow natural drainage paths. The natural drainage area in much of the lower portion of the subwatershed has been deepened, lengthened, straightened, and diverted while drains, laterals, and canals have been constructed. The stream alterations and man-made

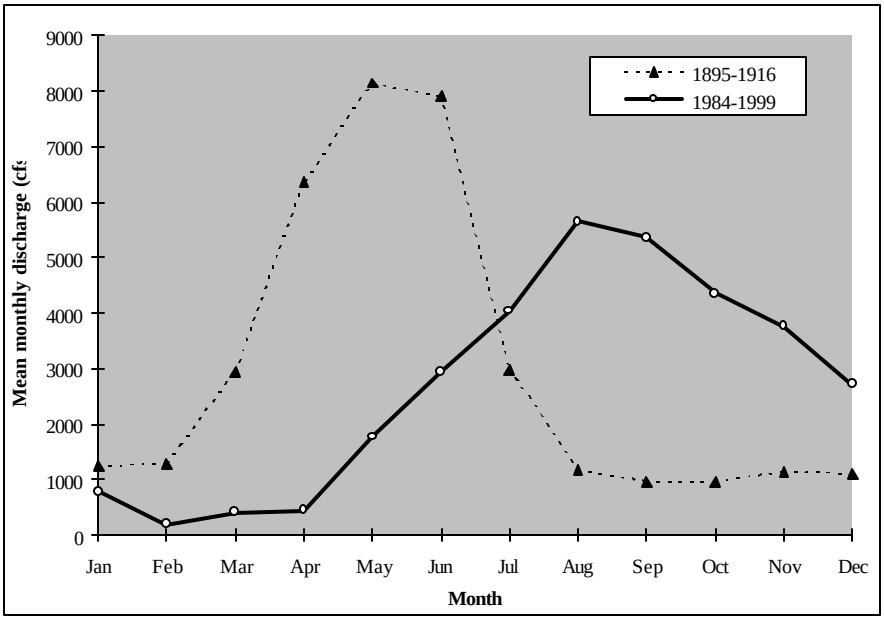


Figure 4. Regulated and unregulated mean monthly discharge in the Boise River near Boise, USGS gaging station 13202000.

waterways have created new drainage areas that are significantly different from the natural subwatershed areas. Figures 7 and 8 depict the current drainage areas of the Fivemile and Tenmile Creek subwatersheds (David Ferguson, unpub. data, 1997). The drainage areas delineated by Ferguson are used for this assessment because they accurately identify the lands that drain to both systems.

Very little flow data exists for Fivemile or Tenmile Creek above the New York Canal. The data that has been located indicates that water is only present for a few weeks during the spring and in some years water is never present. DEQ beneficial use reconnaissance project (BURP) data collected July 10, 1996, south of the Boise airport and June 11, 1998 southeast of the Boise airport found dry channels in Fivemile Creek. Additional surveys in May and June 1999 and 2000 and February 2001 at the same locations also revealed dry channels. Because there are no major diversions above the New York Canal, it was assumed that the creek was also dry above these locations during these years. BURP data collected for Tenmile Creek on July 10 1996, south of the Boise airport, and June 10 1997, below Blacks Creek Reservoir found a dry channel near the airport and a flow of 9.0 cfs below the reservoir. Additional surveys in May and June 1999 and 2000 and February 2001 at the same locations also revealed dry channels. These data verify that Fivemile and Tenmile Creek above the New York Canal are intermittent. According to IDAPA 58.01.02.070.07 water quality standards apply to intermittent waters during optimal flow periods sufficient to support the uses for which the water body is designated, which is 5.0 cfs for contact recreation and 1.0 cfs for aquatic life.

The data indicate that the lower segments of Fivemile and Tenmile Creek are perennial. While the New York Canal does not directly discharge to either system, the water table below the New York canal is substantially higher than above the New York Canal. The high water table and deep stream channel creates a system that is constantly recharged by ground water, even in the winter. During the irrigation season the flows in Fivemile and Tenmile Creek are nearly triple that of winter base flows, primarily due to an extensive network of nonpoint source return flows to the creeks.

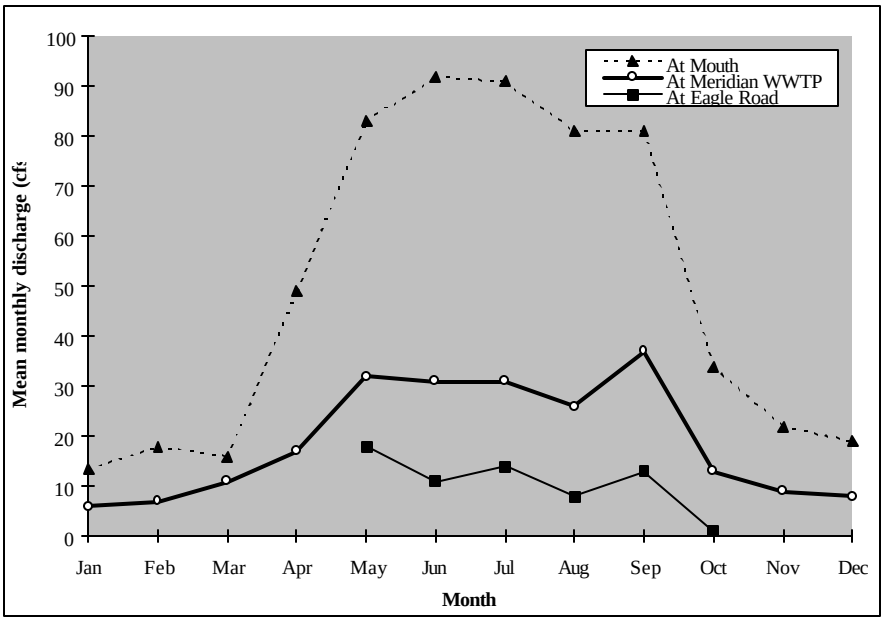


Figure 5. Mean monthly flow in Fivemile Creek at the mouth, at the Meridian WWTP and near Eagle Road, 1998-2000

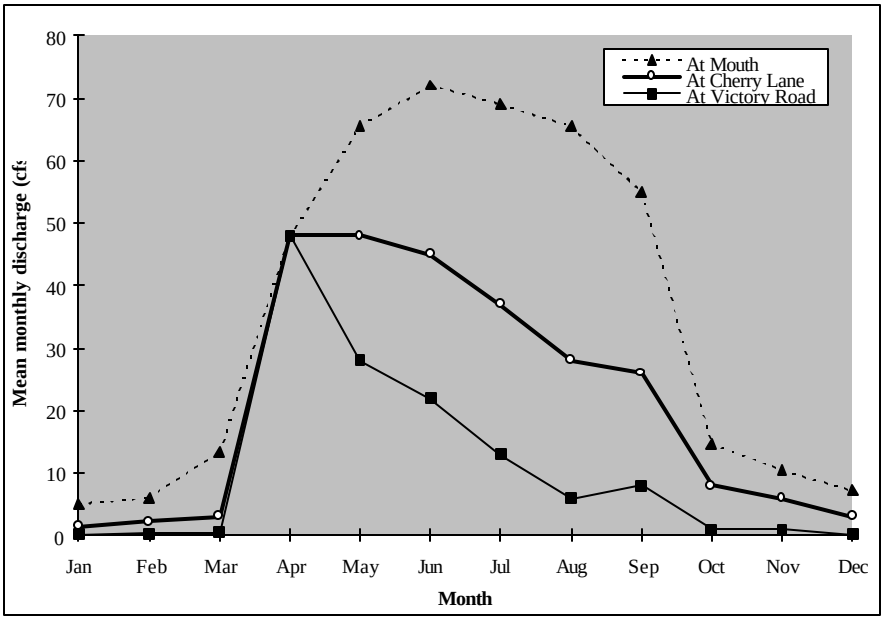


Figure 6. Mean monthly flow in Tenmile Creek at the mouth, at Cherry Lane and near Victory Road, 1998-2000

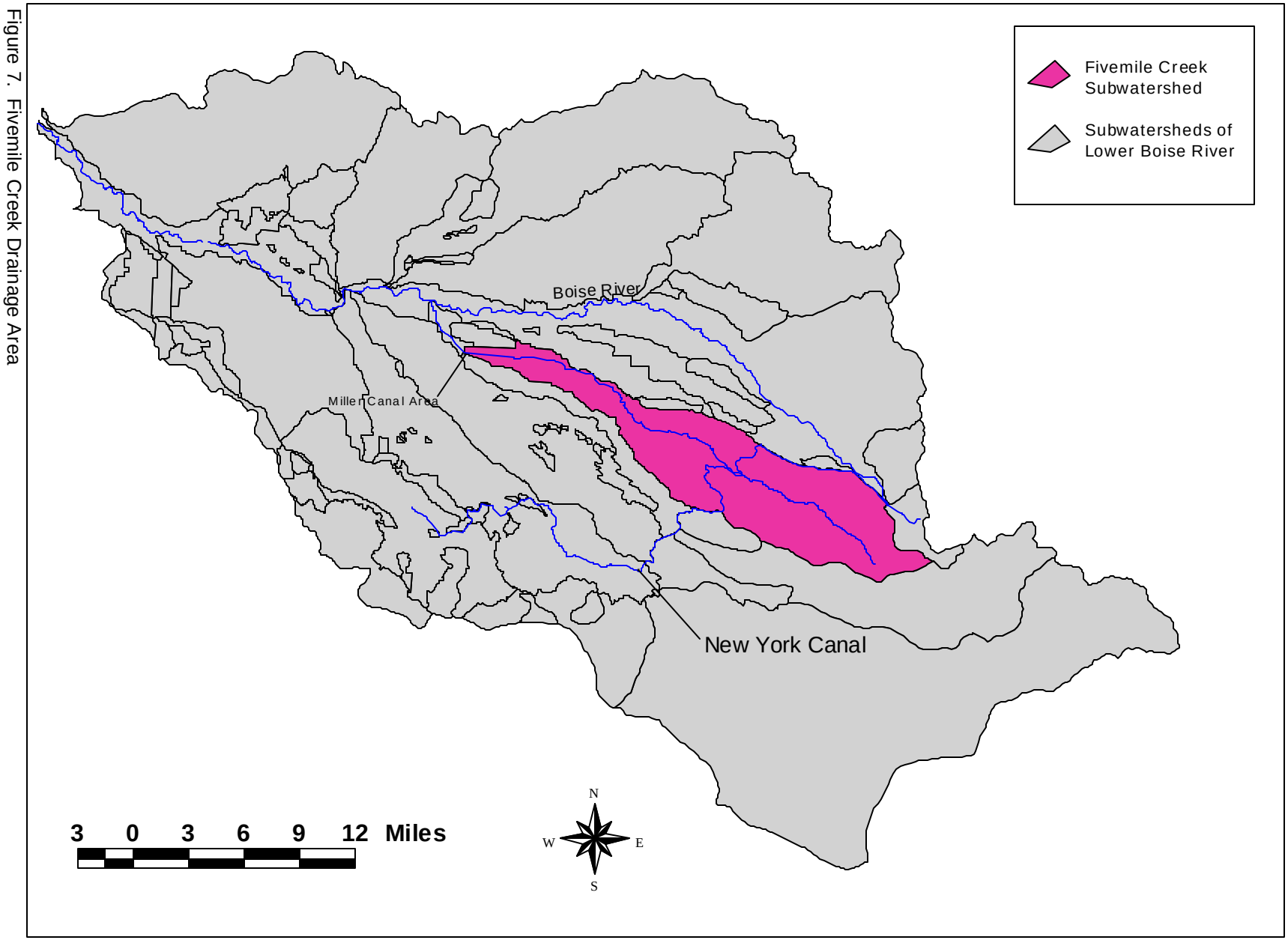


Figure 7. Fivemile Creek Drainage Area

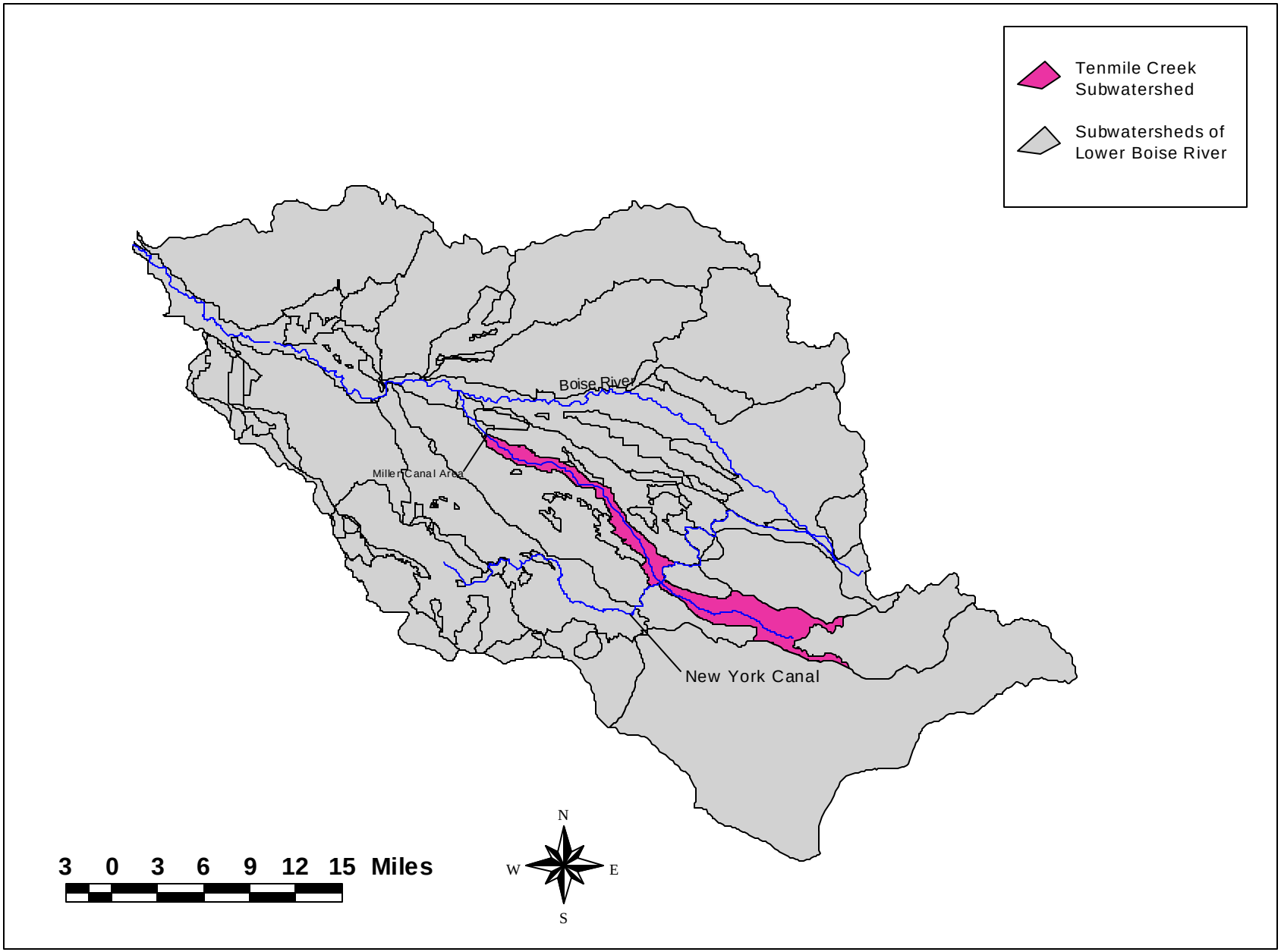


Figure 8. Tenmile Creek Drainage Area

Groundwater Hydrology

A deep, semi-confined to confined Idaho Group aquifer underlies the Fivemile and Tenmile Creek subwatersheds. The boundaries of the confined, semi-confined, and unconfined aquifer system are related to changes in the types and occurrence of lake and river sediments, and crustal faulting. Primary water yielding strata are interbedded sands, silts, and claystones of the Idaho Group (Squires and others, 1992). Studies by Dion (1972) and Burnham (1979) show canal seepage and irrigation application as a source of recharge to the shallow aquifer.

Historically, ground water levels were lower than they are today. Starting as early as the 1860's, farmers in the valley began diverting water from the river for irrigation. As the extent of irrigated area increased, large amounts of water were applied to the surface by flood or furrow irrigation methods and ground water levels rose by tens of feet. High ground water levels began to interfere with soil and crop health. In response, numerous drains were constructed and existing ephemeral drainage ways were deepened and widened in the early 1900's to drain excess ground water.

Ground water levels have been relatively stable or slightly declining since the historic drains and wells were dug in the 1910's and 1920's. Recent studies by Squires and others (1992) and Tungate and Berenbrock (1995) show declining water levels in the Boise City area. Ground water table maps show an average decline of ten feet in 90% of the Boise City area during the period of 1970-1992 (Tungate and Berenbrock, 1995). A slight increase was noticed in five small areas around the Boise River and Boise Front. These declines have been attributed to increased ground water withdrawals and artificially induced ground water gradients from long-term well production in southeast Boise and to the west (Squires and others, 1992).

Fivemile and Tenmile Creek both gain and lose ground water depending on the location and season. Generally, the streams lose to ground water above the New York Canal. Below the New York Canal, they generally gain water due to the artificially high water table.

Channel and Substrate Characteristics

The Fivemile Creek subwatershed is a moderately narrow, gently sloping northwest trending stream that flows toward the lower Boise River. The stream channel can largely be classified as a Rosgen type F from its headwaters to Fifteenmile Creek although, above the New York Canal, the stream displays some type C characteristics (Rosgen, 1996). The F type channel is deeply entrenched, low gradient (<0.02), has a high width/depth ratio, and a riffle/pool morphology. The entrenched aspect of the channel has been amplified by the extensive deepening and widening that occurred in the early part of the century. The C type channel is characterized as low gradient (<0.02) and meandering with a riffle/pool morphology, high width/depth ratio, and a broad, well-defined floodplain. The Tenmile Creek subwatershed is similar to Fivemile in that it slopes to the northwest, is moderately narrow in width and displays the same type of Rosgen stream channel classifications.

The streambeds of both systems from their headwaters to the New York Canal range from sand-size (<2 mm) material to small cobble (64.1-128 mm). From the New York Canal to Fifteenmile Creek the streambeds are primarily sand and silt (<2.5 mm) with a few highly dispersed cobble and gravel areas. In most locations, the cobbles and gravels are

severely embedded. The banks are typically stable and steeply sloped due to past and current maintenance work by the irrigation districts.

Fivemile and Tenmile Creek exhibit other characteristics typical of a stream with regulated flow. The numerous man-modified portions of the streams along with the regulated irrigation flows have caused a narrowing and straightening of the stream channels. Braiding and sinuosity caused by divergent and out of bank flow events are largely absent. Regulated flow and the ongoing conversion of riparian areas to residential and commercial uses have essentially eliminated the floodplains in the lower portion of the streams. These factors have resulted in changes in stream morphology, hydrology and water quality. In many locations, the banks have been armored to prevent loss of land during high irrigation flow conditions.

Terrestrial and Aquatic Wildlife Characteristics

The lands adjacent to Fivemile and Tenmile Creek are home to numerous species of wildlife. The stream corridor is home to several species of waterfowl, including ducks and geese. Several mammal species also live on or near the streams, including fox, rabbit, beaver, muskrat, and other mammal and fowl species.

Fivemile Creek is currently home to numerous non-game fish species (CH2M Hill, 1996). Fish surveys conducted by CH2M Hill in 1996 above and below the Meridian wastewater treatment plant located redside shiner, northern pike minnow, speckled dace, bridglip sucker, Chinese winter loach, carp, smallmouth bass and chub. While no recent data exists to show salmonids reside in Fivemile Creek, the Idaho Fish and Game has indicated that information exists on file that shows rainbow trout resided in the creek before November 28, 1975 (IDFG written correspondence, 1997).

A fish survey was performed in Tenmile Creek at Amity Road in May 2000. While only one Chinese winter loach was found at this location, it is likely that additional fish species are present in the lower portion of the stream. Idaho Fish and Game has indicated that rainbow trout have been documented in the lower segment of Tenmile Creek (IDFG written correspondence, 1997)

Cultural Characteristics

The Boise River valley and Fivemile and Tenmile Creek were first explored in 1811 by overland explorers of the Pacific Fur company. Gold discoveries in 1862 in the nearby mountains prompted the founding of Boise City and the Boise valley was settled in 1863.

The subwatersheds began to change with the coming of the Oregon Shoreline Railroad in 1887 and the completion of the Phyllis and Ridenbaugh Canals in 1890 and 1891 respectively. These canals provided water to the southern portion of the Boise River watershed and enabled settlement beyond the river bottomlands. By 1900 it is estimated that 465 miles of canals, ditches, and laterals had been constructed in the Boise Valley, capable of delivering water to 100,000 acres of land (United States Bureau of Reclamation, 1996), many of those within the Fivemile and Tenmile Creek drainways. The Federal Reclamation Act of 1902 allocated funds to support the Boise Project (1904), that allowed further development of the Boise Valley. The Boise Project, overseen by the U.S. Bureau of Reclamation, included construction of the following: Diversion Dam (1908), the New York Canal (1909 and 1912) and others.

The Boise Project, completed in 1915, provided irrigation water to many acres beyond the Boise River floodplain. Additional canals and diversions were added throughout the valley to further supplement irrigation efforts by 1927. However, problems with excessive standing water in the Fivemile and Tenmile Creek drainages began to arise as early as 1910. To combat the rising water table, ditches were constructed, stream channels were deepened and pumps were installed to drain excess ground water (Nace and others, 1957).

Passage of the Clean Water Act in 1972 brought about reductions in point source discharges of pollutants through the National Pollutant Discharge Elimination System (NPDES) permitting program. The permit program is used to control and monitor point sources that discharge into waters of the United States. The only NPDES permitted point source currently discharging to the Fivemile Creek is the Meridian wastewater treatment plant. The design/permit flow of the plant is 7 million gallons per day (MGD).

During the summer, many portions of Fivemile and Tenmile Creek are used for swimming and wading. However, the managing irrigation districts discourage contact recreation due to the dangers of high flow velocities and entrenched channels. Below the New York Canal, where the depths and flows could support contact recreation, the banks are often steep, heavily vegetated and difficult to navigate.

Demographics and Economics

The upper portions of Fivemile and Tenmile Creek (headwaters to New York Canal) have seen little new growth in the past 10 years. The lower portions have experienced rapid growth. Ada County, in which Fivemile and Tenmile Creek are largely located, was one of the fastest growing counties in the United States from 1990 to 1999 with population increases of more than 37%. Most of the development on both systems has been in the form of residential subdivisions. However, as they move through Meridian there are several commercial operations adjacent to the stream.

Land Ownership and Land Use

Figures 9 and 10 and Table 1 illustrate the current land use patterns in the Fivemile and Tenmile Creek subwatersheds. Land ownership is a mixture of federal, state, county, municipal and private ownership in both subwatersheds. The major land uses in Fivemile Creek are rangeland (43%), irrigated cropland (17%) and urban residential (10%). The major land uses in Tenmile Creek are rangeland (80%) and irrigated cropland (14%). Throughout both subwatersheds, especially in the lower portions, agricultural lands are rapidly being converted to suburban residential and commercial land uses. This land use transition will significantly alter the type and complexity of pollutant transport in the subwatersheds.

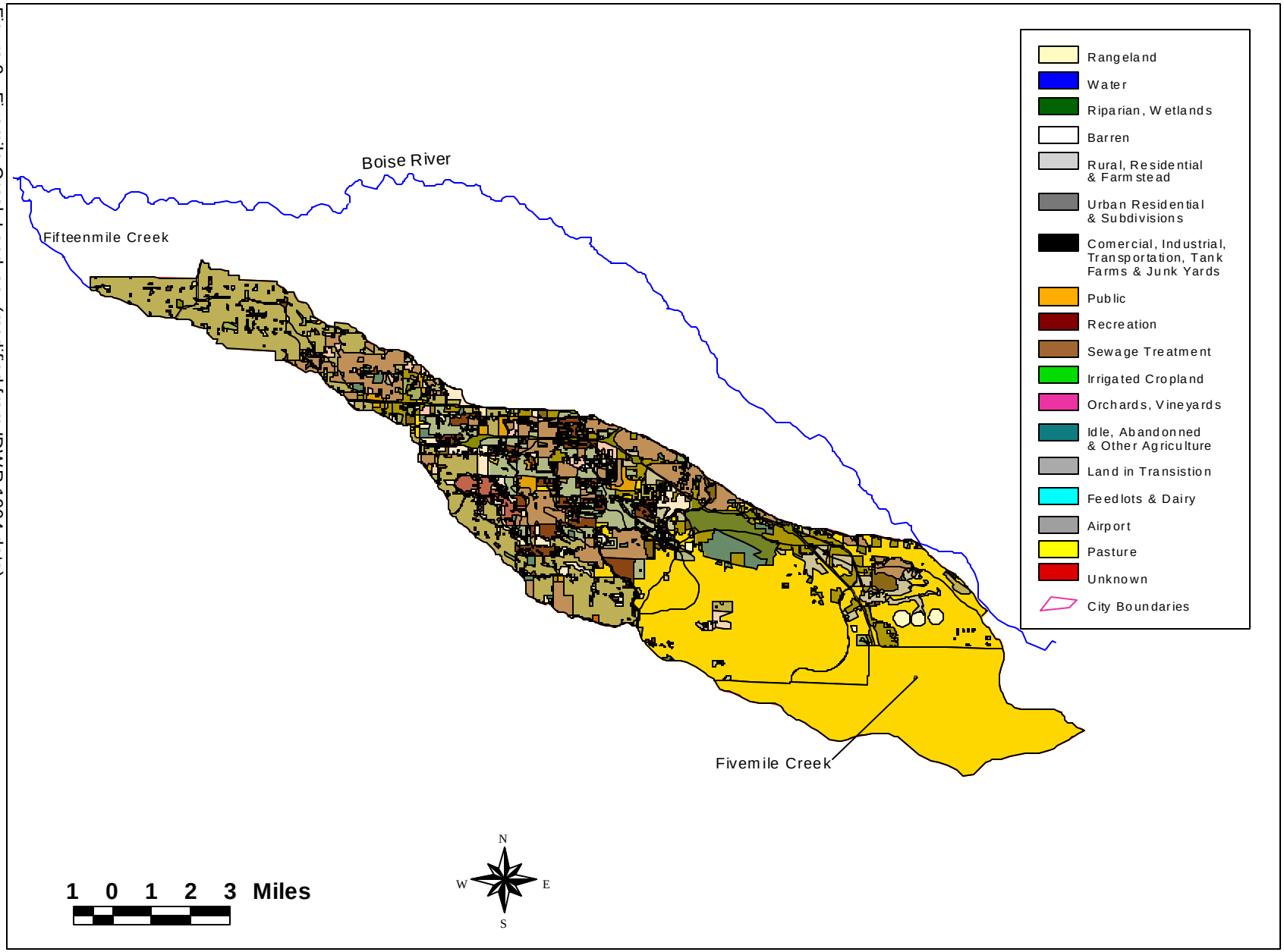


Figure 9. Fivemile Creek Landuse (modified from IDWR 1994 data)

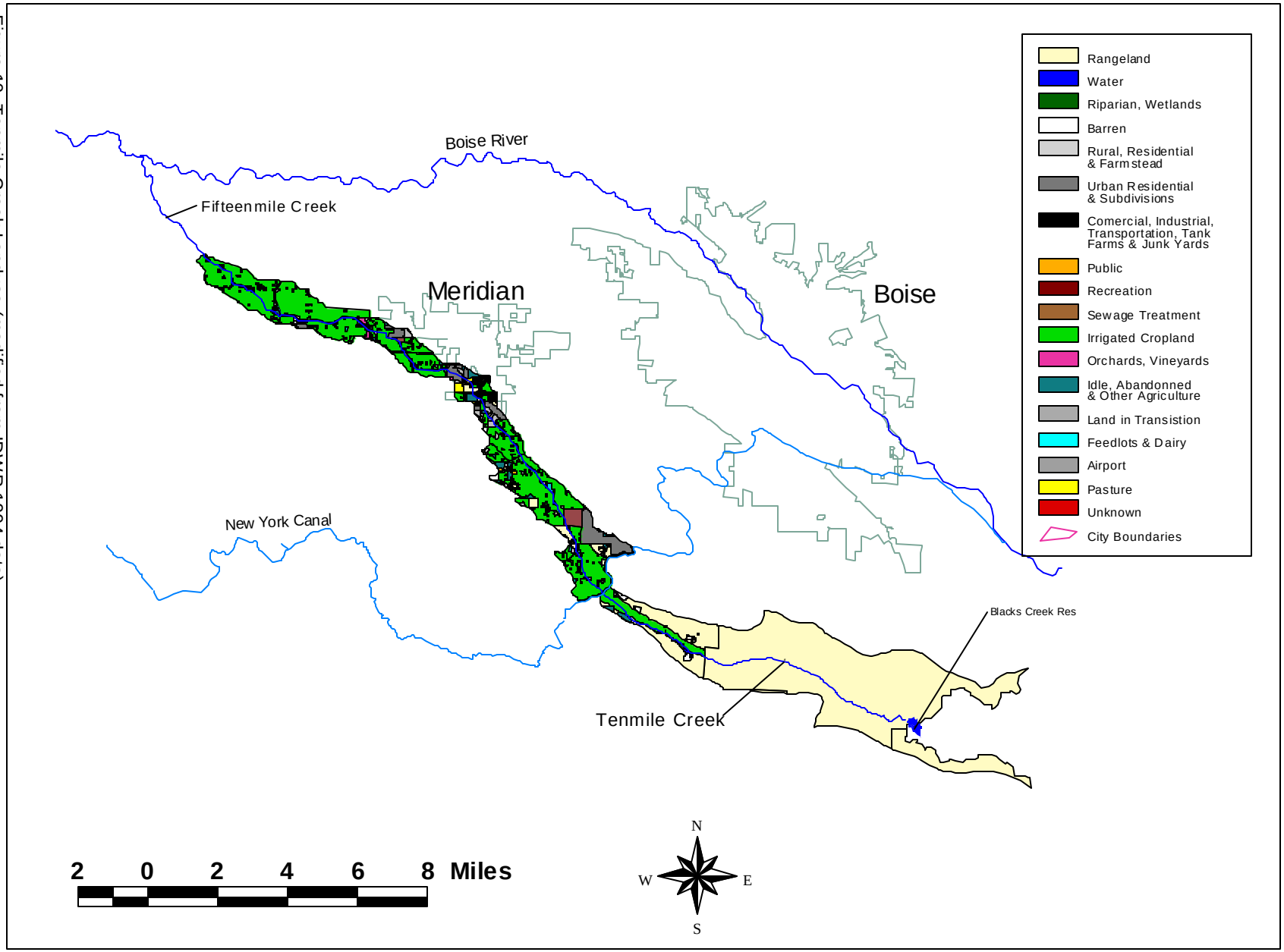


Figure 10. Tenmile Creek Landuse (modified from IDWR 1994 data)

Table 1. Land use pattern in the Fivemile and Tenmile Creek subwatersheds

	Fivemile Creek		Tenmile Creek	
Land Use	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**
Rangeland	23,220	43	37,828	80
Irrigated Cropland	9089	17	6882	14
Urban Residential / Subdivisions	5195	10	784	2
Barren Lands	1235	2	132	1
Commercial, Industrial, Transportation, Tank Farms	3226	6	217	1
Idle, Abandoned & other Agriculture	2291	4	333	1
Land in Transition	434	1		
Pasture	3014	6		
Public Lands	952	2		
Recreation	461	1		
Rural Residential & Farmstead	2812	4	630	1
Sewage Treatment	306	1		
Airport	807	2		
Water	299	1		

Public Involvement

Idaho Code Section 39-3611 states that TMDLs shall be developed in accordance with Idaho Code Section 39-3614 (duties of the basin advisory groups), 39-3616 (duties of each watershed advisory group) and the Federal Clean Water Act. Two groups within the lower Boise Valley are actively working to enhance the health and environment of the lower Boise River. The Lower Boise River Water Quality Plan (LBRWQP) was formed in 1992 by stakeholders interested in water quality in the river, and was designated as the Watershed Advisory Group (WAG) for the lower Boise River watershed in July 1996. As the WAG, the group is responsible for advising the DEQ on the development of TMDLs in

the watershed as well as preparing the TMDL implementation plan. Additionally, WAGs are to develop and recommend actions needed to effectively control sources of pollution in the watershed. Boise River 2000 focuses on issues related to the management of water quantity and flood control, but focuses primarily in the Boise River proper. Both groups are comprised of representatives from local and state government, environmental and recreation groups, agriculture, industry, flood control and drainage districts and concerned citizens. The primary goal of each group is to help improve and maintain the overall quality of the Boise River system.

Subwatershed Water Quality Concerns and Status

Fivemile and Tenmile Creek (water quality limited segments 2734 and 2736) are listed as water quality limited on the 1998 §303(d) list for the state of Idaho (Table 2). The §303(d) listed boundaries are the headwaters to Fifteenmile Creek for both streams. Both streams are listed for dissolved oxygen, sediment and nutrients throughout.

Table 2. Summary of §303(d) listed segments for Fivemile and Tenmile Creek.

Name	**Boundaries**	**Pollutants** **1998 §303(d) list**
Fivemile Creek	Headwaters to Fifteenmile Creek	Dissolved Oxygen, Sediment, Nutrients
Tenmile Creek	Headwaters to Fifteenmile Creek	Dissolved Oxygen, Sediment, Nutrients

Surface Water Beneficial Use Classifications

Surface water beneficial use classifications are intended to protect the various uses of the state's surface water. Idaho waterbodies that have designated beneficial uses are listed in the Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02) and are comprised of five categories: aquatic life, recreation, water supply, wildlife habitat and aesthetics.

Aquatic life classifications are for waterbodies that are suitable or intended to be made suitable for protection and maintenance of viable aquatic life communities of aquatic organisms and populations of significant aquatic species. Aquatic life beneficial uses include cold water biota, warm water biota, seasonal cold water biota, modified communities and salmonid spawning.

Recreation classifications are for waterbodies that are suitable or intended to be made suitable for primary and secondary contact recreation. Primary contact recreation is prolonged and intimate human contact with water where ingestion is likely to occur, such as swimming, water skiing and skin diving. Secondary contact recreation consists of recreational uses where raw water ingestion is not probable, such as wading and boating.

Water supply classifications are for waterbodies that are suitable or intended to be made suitable for agriculture, domestic and industrial uses. Industrial water supply applies to all waters of the state. Wildlife habitat waters are those which are suitable or intended to be made suitable for wildlife habitat. Aesthetics is a use that applies to all waters of the state.

IDAPA 58.01.02.140 designates beneficial uses for selected waterbodies in the Southwest Idaho Basin. Undesignated waterbodies are presumed to support cold water biota and primary or secondary contact recreation unless the Department of Environmental Quality determines that other uses are appropriate.

Beneficial Uses in Fivemile and Tenmile Creek

Beneficial uses are designated in IDAPA 58.01.02.140 for Fivemile Creek from the headwaters to the Miller Canal, which is different than the 303(d) listed boundaries. The Miller Canal runs adjacent to Fivemile Creek where it combines with Tenmile Creek to form Fifteenmile Creek. Beneficial uses are also designated for Tenmile Creek from the Blacks Creek Reservoir Dam to the Miller Canal. The designated uses for Fivemile and Tenmile Creek are shown in Table 3.

Table 3. Designated beneficial uses for Fivemile and Tenmile Creek.

Stream Name	**Designated Beneficial Uses**
Fivemile Creek (Headwaters to Miller Canal)	Cold Water Biota Secondary Contact Recreation
Tenmile Creek (Blacks Creek Reservoir Dam to Miller Canal)	Cold Water Biota Secondary Contact Recreation

In instances where the designated uses cannot be met or are simply not appropriate, a beneficial use evaluation must be performed to justify the use change. 40 CFR 131.10(g) provides the conditions under which a presumed or designated use may be changed to a less restrictive use. If one or more of the conditions are met, the use may be changed to a less restrictive use. The conditions are:

(1) Naturally occurring pollutant concentrations prevent the attainment of the use; or
(2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or
(3) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
(4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or
(5) Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

(6) Controls more stringent than those required by Sections 301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.

Recognizing that the designated beneficial uses of cold water biota and secondary contact recreation may not be appropriate in highly man-modified, irrigation driven systems such as Fivemile and Tenmile Creeks, the Nampa-Meridian Irrigation District and Pioneer Irrigation District chose to perform a beneficial use evaluation for both systems. After a review of the physical, chemical and biological data and a multitude of other information, and in consultation with DEQ and the WAG, the aquatic life beneficial use of modified was recommended. The modified aquatic life use describes streams that are limited in aquatic life diversity due to factors such as ephemeral or intermittent flow, naturally occurring pollutant levels or long-standing hydrologic modification. It was also recommended that the contact recreation beneficial use be completely removed. Appendix A details the analysis describing how these proposed changes were reached. After reviewing the proposed use recommendations, and after receiving comments from EPA and others, the DEQ determined that the change to modified aquatic life was appropriate, but that removing the contact recreation designation altogether was not appropriate at this time. Appendix B outlines DEQ's rationale for not removing the contact recreation designation from Fivemile and Tenmile Creeks. A recent (November 2001) DEQ board decision directed DEQ to develop a 'contact' beneficial use specific to agricultural drains. Upon development of this use, DEQ will reconsider requests to change secondary contact recreation. Table 4 outlines the beneficial use changes as they remain.

Table 4. Existing beneficial uses for Fivemile and Tenmile Creek

Stream Name	**Existing Uses**
Fivemile Creek (headwaters to Miller Canal)	Modified Secondary Contact Recreation
Tenmile Creek (Blacks Creek Reservoir Dam to Miller Canal)	Modified Secondary Contact Recreation

Applicable Water Quality Criteria

The *Idaho Water Quality Standards and Wastewater Treatment Requirements* contain numeric criteria necessary to protect surface water beneficial uses in the state of Idaho. The numeric criteria are designed such that they are protective of the aquatic life and/or contact recreation beneficial uses to which they apply. For the Modified (MOD) aquatic life use, no statewide numeric criteria have been developed. IDAPA 58.01.02.250.05 indicates that when designated as such, site-specific water quality criteria for the modified aquatic life use will be determined on a case-by-case basis. The criteria should reflect the chemical, physical and biological conditions necessary to fully support the existing aquatic life community. Once developed, the criteria will be adopted into the *Idaho Water Quality Standards and Wastewater Treatment Requirements.*

Following this guidance, the DEQ determined that the site specific water criteria for the modified community in Fivemile and Tenmile Creek should be consistent with the seasonal cold water biota criteria, except that they will apply throughout the year. This is because a mix of cool water fish, including incidentally located rainbow trout during the

summer, has been documented in recent investigations. The only seasonal cold water biota specific criterion that pertains to this analysis is dissolved oxygen. Other than for dissolved oxygen, all other applicable cold water biota criteria apply.

The following water quality criteria are applicable to the pollutants of concern listed on the 1998 Section 303(d) list for Fivemile and Tenmile Creek. The criteria represent water quality conditions that are protective of the existing aquatic life community in the stream. No site-specific criteria were developed for nutrients and sediment, yet IDAPA 58.01.02.200 indicates that the standards for nutrients and sediment apply to all surface waters of the state. To address the lack of numeric criteria, methods to determine whether the narrative nutrient and sediment standards are met have been established and are discussed in the data analysis and interpretation section.

Sediment

Sediment shall not exceed quantities specified in IDAPA § 250 and § 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in section 350 (IDAPA 58.01.02.200.08).

Turbidity

Turbidity below any applicable mixing zone set by the Department of Health and Welfare, Idaho Division of Environmental Quality, shall not exceed background turbidity by more than 50 Nephelometric Turbidity Units (NTU) instantaneously or more than 25 NTU more than 10 consecutive days (IDAPA 58.01.02.250.02.d).

Excess Nutrients

Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses (IDAPA 58.01.02.200.06).

pH

Hydrogen Ion Concentration (pH) values within the range of six point five (6.5) to nine point five (9.5) (IDAPA 58.01.02.250.01.a)

Dissolved Oxygen

For the modified communities in Fivemile and Tenmile Creek, waters are to exhibit the following characteristics.

> Dissolved oxygen concentrations exceeding four (4) mg/l at all times (IDAPA 58.01.02.250.05)

Summary of Existing Water Quality Data

Numerous sources of data are available within the Fivemile and Tenmile Creek subwatersheds to describe the physical and chemical water quality and the biological communities in the streams. Table 5 summarizes that available data. The DEQ surveyed Fivemile Creek in 1996, 1997 and 1998 using the Beneficial Use Reconnaissance Project

(BURP) process. Tenmile Creek was surveyed in 1996, 1997 and 2000. Additionally, in 2000, the DEQ collected chemical and benthic and suspended chlorophyll-a data at two locations in both streams. The USGS, through a multi-year monitoring plan jointly funded by the DEQ, LBRWQP and USGS collected chemical data at the mouths of the streams in 2000. In 1998 and 1999, the Idaho Department of Agriculture collected chemical data at three locations in the lower portion (below the New York Canal) of Fivemile Creek. They also collected similar data at three locations on Tenmile Creek. The Meridian WWTP, pursuant to their 1999 NPDES permit requirements have and continue to collect chemical water quality data above and below the Fivemile Creek discharge point. In 1996 CH2M Hill prepared a report that characterized the integrity of Fivemile Creek above and below the Meridian WWTP. Physical, chemical, and biological data were collected. The effort was funded by the Meridian WWTP. Figure 11 illustrates the locations of the major sampling sites established by the DEQ, USGS and the Idaho Department of Agriculture.

Table 5. Available physical, chemical and biological data for Fivemile and Tenmile Creek

Name/Agency	**Monitoring Regime**	**Data Type**	**Current Status**
Idaho Department of Environmental Quality	6/00 – 10/00 (2 sites per stream)	Chemical, Biological	Complete
	BURP: 1996-98, 2000	Biological	Complete
US Geological Survey	4/00 – Current (1 site @ mouth of Five and Tenmile)	Chemical	Ongoing
Idaho Department of Agriculture	4/98 – 4/99 (3 sites per stream)	Chemical	Complete
Meridian WWTP	Current at plant, Fivemile Creek	Chemical	Ongoing
CH2M Hill	1995, Fivemile Creek	Physical, Chemical, Biological	Complete

Data Analysis and Interpretation

The DEQ used chemical water quality, biological and physical habitat data to assess the support status of beneficial uses in Fivemile and Tenmile Creek. The concentration of listed pollutants in comparison to the applicable water quality criteria are used to assess the status of beneficial uses and pollutants contributing to impairment. In any location where the respective criteria are exceeded by a listed pollutant on a chronic basis (>10%), the associated beneficial uses are likely to be impaired. In the case of nutrients and sediment, the state of Idaho does not have numeric water quality standards in place. Rather, the standards for nutrients and sediment are narrative and open to interpretation by the state. The interpretation of these standards typically occurs on a site-specific basis and is largely based on the sensitivity and reaction of the beneficial uses that require protection. If a Section 303(d) listed pollutant is impairing beneficial uses, a TMDL for that pollutant is required. If beneficial uses appear to be impaired by a non-303(d) listed

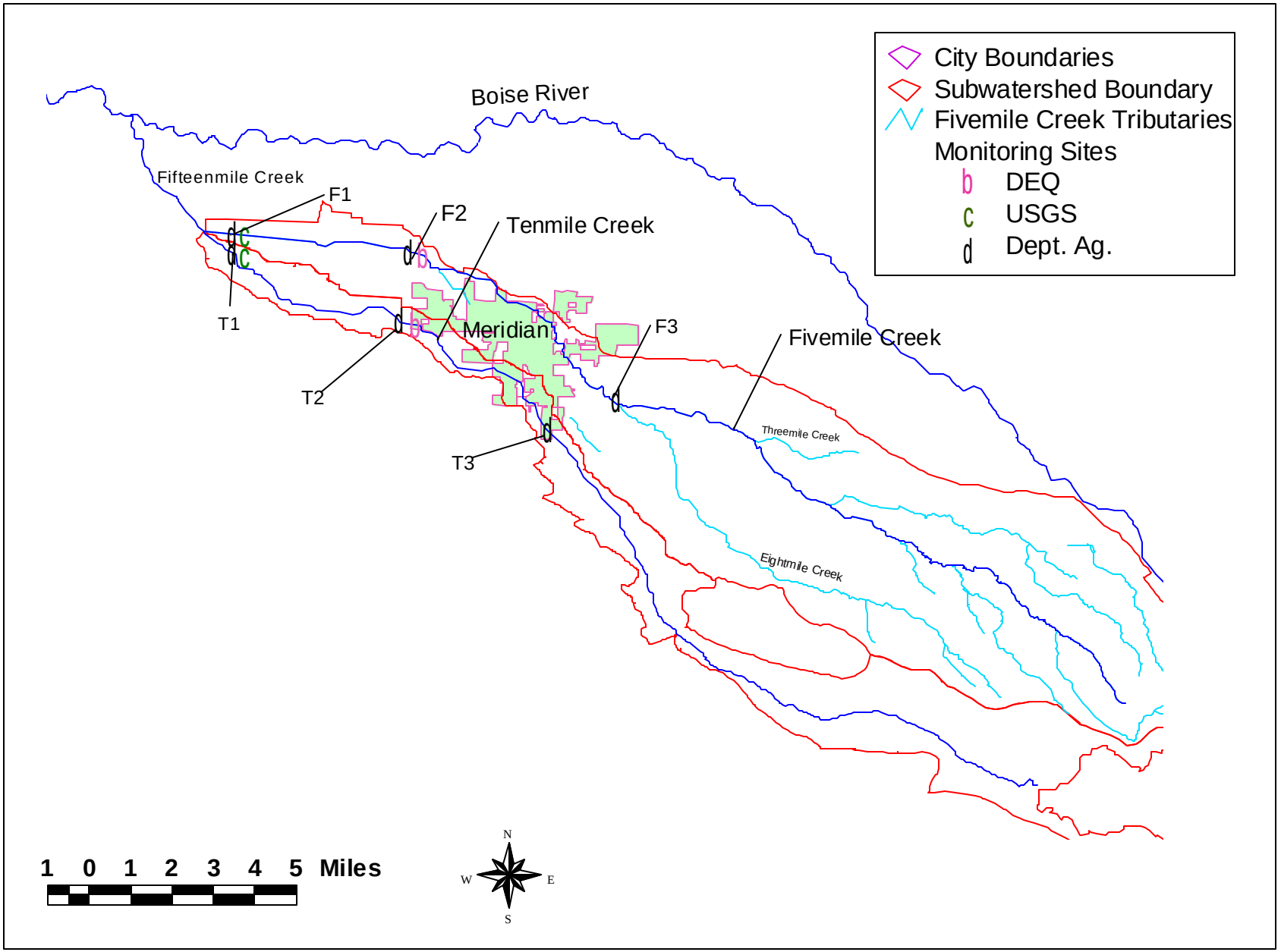


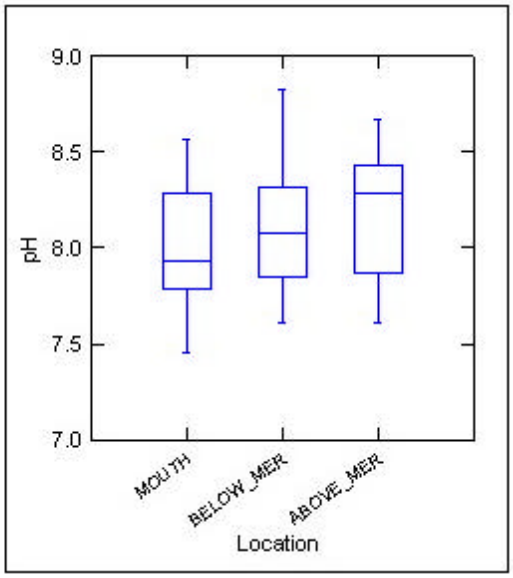
Figure 11. Fivemile and Tenmile Creek Sampling Locations

pollutant the DEQ has the option of preparing a TMDL at the current time or postponing the TMDL until a later date when additional data can be collected to validate the suspected impairment.

pH

pH is a measure of the concentration of hydrogen ions. Streams that display a very high or very low ionic concentration typically have restricted flora and fauna, in both species richness and abundance (Allan 1995). The effects of excess nutrients on pH levels in lotic waters are in part a function of the nutrient-algae relationship, and ultimately a function of the algal biomass in the system. When algal biomass conditions become excessive the water body typically experiences an increased volume of carbon dioxide in the water at night due to plant respiration. This increase in carbon dioxide beyond the normal range disrupts the streams ability to buffer itself. When carbon dioxide levels increase the pH typically drops to abnormal levels.

Figure 12 shows the range of pH values in Fivemile Creek from the years 1998 to 2000. The data were collected on a monthly basis by the Idaho State Department of Agriculture and the USGS and include values from the growing season of each year when pH sags would occur. The mean pH value in the stream drops slightly from 8.16 above Meridian to 7.9 at the mouth, but all locations in the stream, even considering the minimum values, the state criteria are met.



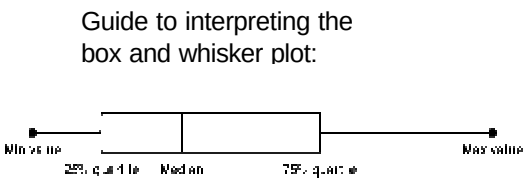


Figure 12. pH values in Fivemile Creek, 1998 – 2000

Figure 13 shows the range of pH values in Tenmile Creek from the years 1998 to 2000. The data were collected on a monthly basis by the Idaho State Department of Agriculture and the USGS and include values from the growing season of each year. The mean pH in the stream remains essentially the same, with the values being 8.1 above Meridian and 8.05 at the mouth. At all locations in the stream, even considering the minimum values, the state criteria are met.

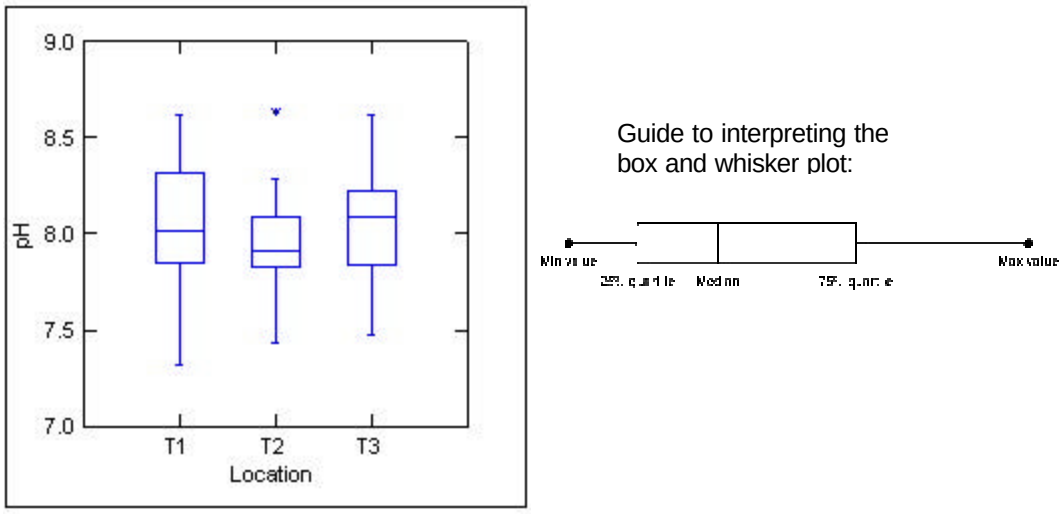


Figure 13. pH values in Tenmile Creek, 1998 – 2000

Dissolved Oxygen

Dissolved oxygen can be a direct indicator of nuisance aquatic growth in that as aquatic algae biomass increases, the amount of night-time respiration increases as well. As respiration increases, the volume of oxygen removed from the water increases. In excessive algae growth situations, the result is often low DO concentrations that stress or even kill sensitive species of fish and macroinvertebrates.

For Fivemile Creek, a very robust dissolved oxygen data set is available from the Meridian WWTP, spanning the years 1990-1999. In all, 5,134 data points are available for analysis. The data is from the facility's monthly discharge monitoring reports (DMR). From 1990 to 1997 the measurements were collected daily at locations upstream and downstream of the discharge point. One-half of the 90-97 data were collected upstream of the discharge point. The remaining one-half were collected downstream of the discharge point. The 1998 and 1999 measurements are monthly averages taken upstream of the discharge point.

Of the 90-97 upstream data, 79 values (3%) are below 6.0 mg/l. Of the 90-97 downstream data, 145 points (5%) are below 6.0 mg/l. None of the 98-99 data are below 6.0 mg/l, most likely because in 1998 the Meridian WWTP upgraded their post-aeration facilities to meet the NPDES DO requirements. Of the values that are below 6.0 mg/L, 76% occurred in 1992, which is the lowest water year on record for the Lower Boise River watershed. A review of the 1992 daily effluent DO concentrations from the Meridian WWTP revealed only one criteria violation. This suggests that the 1992 low flow in Fivemile Creek is the primary reason such a large number of criteria violations occurred that year, not increased BOD in the Meridian WWTP discharge.

To address the possibility of a diurnal dissolved oxygen crash in Fivemile Creek, the DEQ collected pre-dawn dissolved oxygen and pH data at the monitoring locations above and below the City of Meridian in mid-October 2000. Pre-dawn dissolved oxygen data typically represent the lowest concentrations because of the cumulative plant respiration that has occurred throughout the night. At the upstream monitoring location the dissolved oxygen concentration at 6:30 a.m. was 5.89 mg/L. At the downstream location the dissolved

oxygen concentration at 7:02 a.m. was 8.13 mg/L. At both locations the pH was normal, being 7.48 and 7.83, respectively.

EPA's 1996 Guidelines for Preparing State Water Quality Assessments indicate that for conventional pollutants, of which dissolved oxygen is included, not more than 10% of the measurements should exceed the criterion. If the number of criteria exceedences is less than 10% of the total number of measurements, the water body in question can be classified as Fully Supporting. This essentially means the pollutant is not impairing the associated beneficial use(s). Following this guidance, the dissolved oxygen levels in Fivemile Creek are not such that they are impairing beneficial uses.

For Tenmile Creek, the dissolved oxygen data were collected by the Idaho Department of Agriculture, USGS and DEQ. The data span the years 1998-2000 and were collected at locations upstream (T3) and downstream (T1 and T2) of the City of Meridian. Figure 14 displays the data. The concentration does not fall below 6.0 mg/L on any occasion.

To address the possibility of a diurnal dissolved oxygen crash in Tenmile Creek, the DEQ collected pre-dawn dissolved oxygen and pH data at the monitoring locations above and below the City of Meridian in mid-October 2000. Pre-dawn dissolved oxygen data typically represent the lowest concentrations because of the cumulative plant respiration that has occurred throughout the night. At the upstream monitoring location the dissolved oxygen concentration was 7.75 mg/L. At the downstream location the dissolved oxygen concentration 5.89 mg/L. At both locations the pH was normal, being 7.64 and 7.35, respectively.

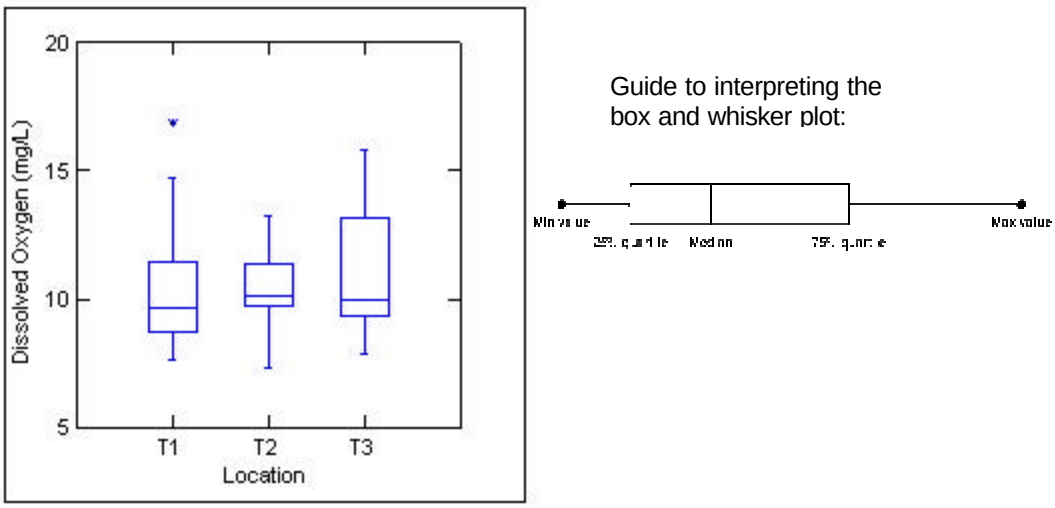


Figure 14. Dissolved oxygen concentrations in Tenmile Creek, 1998 – 2000

Sediment

Suspended sediment (TSS) concentrations can be used as an indicator of sediment conditions in water bodies in that they can provide a direct measure of water column clarity. Suspended sediment is defined as the sediment fraction that is suspended in the water column (typically <0.1mm). Excessive suspended sediment can adversely effect aquatic life in a number of ways. Most fish species can tolerate acutely high levels of suspended sediment. However, when suspended sediment levels become chronically high, sensitive salmonid and macroinvertebrate species show negative affects.

Newcombe and Jensen (1996) reported that for juvenile rainbow trout, concentrations of 50 to 100 mg/L suspended sediment for 14 to 60 days yielded significantly reduced growth rates or lethal effects. Thruston et al (1979) concluded that 25 mg/L TSS would provide high protection, 80 mg/L would provide moderate protection and >400 mg/L would provide low protection for juvenile rainbow trout. From an acute exposure standpoint, adult rainbow trout can withstand significantly higher levels of TSS than juvenile trout. Newcombe and Jensen's 1996 model suggests that adult salmonids can withstand TSS levels of 1097 mg/L for up to six days without experiencing mortality.

Total suspended sediment concentrations in Fivemile and Tenmile Creek fluctuate with the irrigation season flows (Figures 15 and 16). At the monitoring locations in both streams suspended sediment concentrations in the stream increase during the irrigation season and decrease during the non-irrigation season, primarily due to surface erosion from agricultural lands. Additionally, there is a cumulative increase in suspended sediment concentrations in the lower portions of the streams. The TSS concentrations at the mouths are notably higher than the upstream concentrations, suggesting that irrigation return flows contribute to the overall suspended sediment load in the stream.

The lower Boise River sediment TMDL (2000) established an instream TSS target of 50 mg/L for no longer that 60 days, and 80 mg/L for no longer than 14 days for the lower Boise River proper. These targets are consistent with Newcombe and Jensen's (1996) recommended thresholds. The 50/80 targets were specifically chosen for the lower Boise River because they are protective of juvenile rainbow trout and hence the salmonid spawning designation. Based on this premise, the in-stream targets for the lower Boise River proper are not appropriate for Fivemile and Tenmile Creek because neither stream is listed for salmonid spawning, nor do the available data show salmonid spawning to be an existing use. Electrofishing surveys conducted by CH2M Hill (1996) and DEQ in Fivemile Creek did not locate any salmonid species. Table 6 identifies the fish species identified during these efforts.

No salmonids were present in the electrofishing surveys and they likely do not reside in the streams on an annual basis. However, it is likely that salmonids (and other species for that matter) temporarily enter the streams via the canal system. Based on the flow related operational regime of Fivemile and Tenmile Creek and fisheries data from similarly operated adjacent watersheds, it is reasonable to assume that a small adult rainbow trout population resides in Fivemile and Tenmile Creek during the irrigation season. This is partially substantiated by Idaho Fish and Game (IDFG) reports, which indicate that adult rainbow trout were present in Fivemile Creek prior to 1975. The fish are likely flushed into the streams during the irrigation charge in April and reside in the streams until anglers catch them or they move back into the Boise River. Antecdotal evidence from landowners within the Fivemile Creek subwatershed indicates that adult rainbow trout are present in the stream during the fishing season.

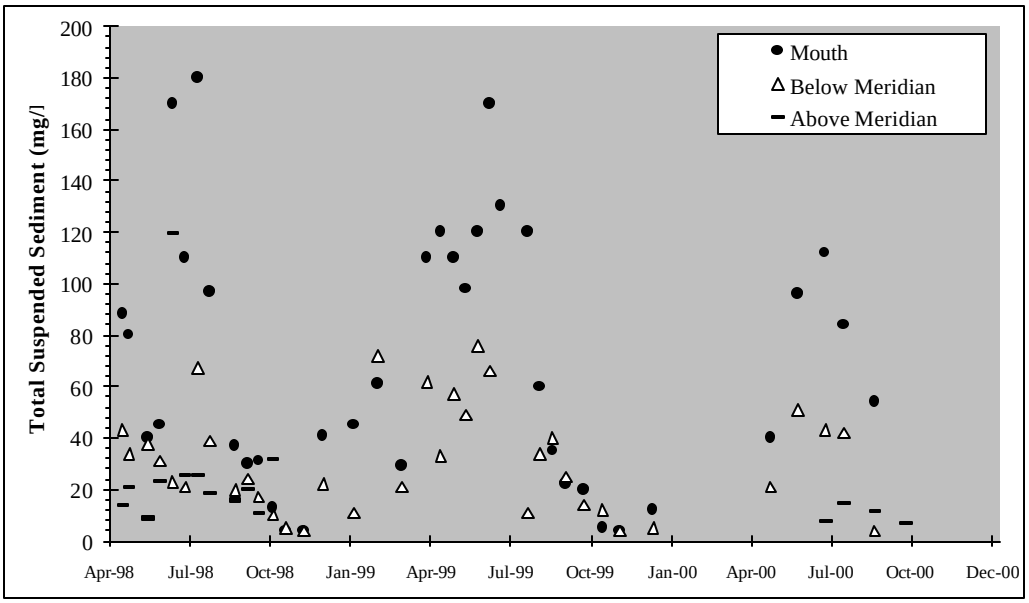


Figure 15. Total Suspended Sediment levels in Fivemile Creek above Meridian, below Meridian and at the mouth: 1998-2000.

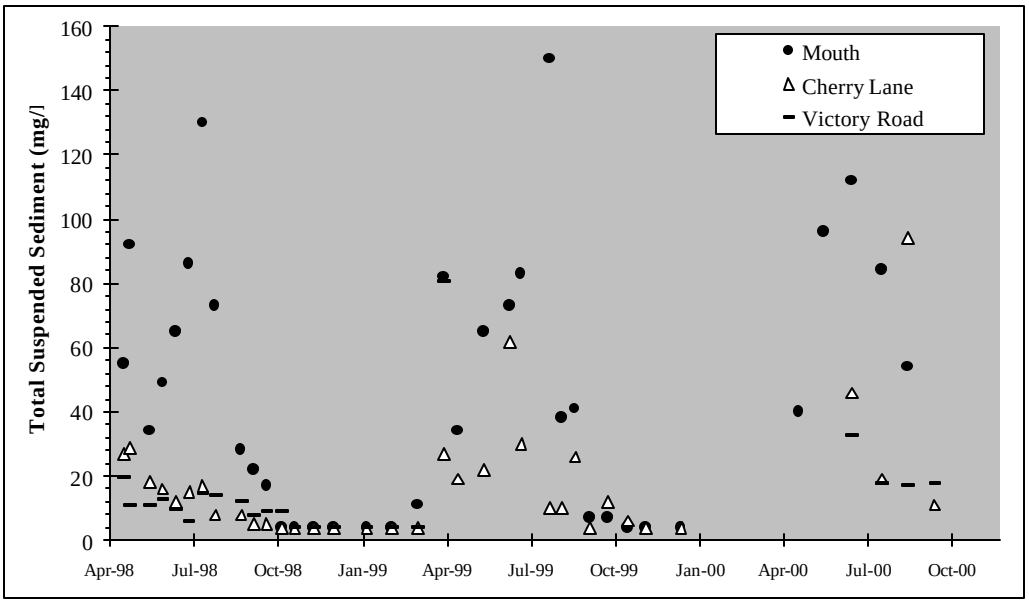


Figure 16. Total Suspended Sediment levels in Tenmile Creek at Cherry Lane, Victory Road and at the mouth: 1998-2000.

While a population of transient adult rainbow trout likely resides in Fivemile and Tenmile Creek, further protection from water column sediment is not necessary. The existing TSS concentrations at the monitoring sites above the mouths of both streams rarely exceed 50 mg/L, which is a threshold for juvenile fish, and hence overly stringent for adult fish. At the mouth of Fivemile Creek, the TSS concentrations range from about 80 mg/L to 180 mg/L during the irrigation season with an average concentration of 86 mg/L. During the non-irrigation season the concentrations range from about 5 mg/L to 65 mg/L with an average of 22 mg/L. At the mouth of Tenmile Creek the TSS concentrations range from about 7 mg/L to 150 mg/L during the irrigation season with an average concentration of 62 mg/L. During the non-irrigation season the concentrations range from about 4 mg/L to 11 mg/L with an average of 5 mg/L. Using Newcombe and Jensen's TSS threshold model as a guide (Appendix C), adult salmonids can withstand TSS concentrations of 148 mg/L for up to four months without experiencing lethal effects. The TSS levels in Fivemile and Tenmile Creek are well below this threshold. This suggests that the current TSS concentrations do not need to be reduced to protect the transient salmonid populations.

Table 6. Fish species identified in Fivemile Creek during 1996 and 2000 electrofishing efforts.

Name	**Common Name**
1996 Effort, CH2M Hill At Meridian WWTP	Redside shiner, Northern squawfish, Speckled dace, Bridgelip sucker, Chinese winter loach, Carp, Smallmouth bass, Chub
2000 Effort, IDEQ Above Meridian	Chinese winter loach, Speckled Dace

Contact Recreational Response to Surface Sediment

Excess sediment can impair recreational beneficial uses in a number of ways. Excess surface sediment can alter the channel form by increasing deposition or scouring, which creates abrupt and unexpected changes in channel form. Additionally, and over abundance of fine substrate sediment can create unsafe swimming and wading conditions by physically interfering with body movement. It typically takes a very large volume of sediment for this effect to occur. Excess sediment can also decrease the aesthetic appeal of the water by making the water appear muddy and murky.

While the data indicate there is fine material in Fivemile and Tenmile Creek, the sediment levels do not appear to be impairing secondary contact recreation. During the 2000 monitoring season, DEQ employees walked both streams on a monthly basis and did not note any significant difficulty navigating the channel due to excess sediment. In addition, the DEQ has received no complaints about poor swimming or wading conditions due to sediment. Contact recreation occurs or can potentially occur in at several locations in Fivemile and Tenmile Creek, although the irrigation districts discourage it.

Turbidity

None of the agencies that have collected data for Fivemile and Tenmile Creek have collected turbidity data. Furthermore, ambient turbidity monitoring is not part of the Meridian wastewater treatment plants monitoring requirements. No current turbidity data exists for Fivemile or Tenmile Creek.

Phosphorus

High concentrations of phosphorus have been recorded in Fivemile and Tenmile Creek from 1998 to 2000 (Figures 17 and 18). Based on numerous studies (Bothwell 1988 and Horner and others 1983), the water column total phosphorus (TP) concentrations in both streams are more than sufficient to support algae growth, which when at nuisance levels, is typically the surrogate for contact recreation support status. Additionally, EPA's gold book criterion for water column total phosphate phosphorus is 0.10 mg/L. EPA indicates the potential for eutrophication exists at this level, although in many systems it does not occur. This information, along with the direct effects of nutrients on aquatic life and contact recreation beneficial uses, should be considered when determining the effects of nutrients in a water body.

As with the TSS concentrations, the TP concentrations in Fivemile Creek fluctuate with the irrigation season. Table 7 shows the irrigation and non-irrigation seasonal average concentrations at the three monitoring locations for the years 1998 to 2000. The TP concentrations range from as low as 0.09 mg/L to as high as 0.67 mg/L. These data show that the EPA gold book criterion is exceeded in nearly every sampling event, however the data do not directly indicate beneficial use impairment. As they relate to nutrients, aquatic life beneficial use impairment is generally based on surrogate measures such as dissolved oxygen concentrations and pH levels.

TP concentrations in Tenmile Creek do not fluctuate with the irrigation season as closely as Fivemile Creek. Table 6 shows the irrigation and non-irrigation seasonal average concentrations at the three monitoring locations for the years 1998 to 2000. The TP concentrations range from as low as 0.05 mg/L to as high as 0.41 mg/L.

The dissolved-orthophosphate concentrations in Fivemile and Tenmile Creek are typically 65% - 75% of the total phosphorus concentration, which is consistent with the ratio found in the river proper.

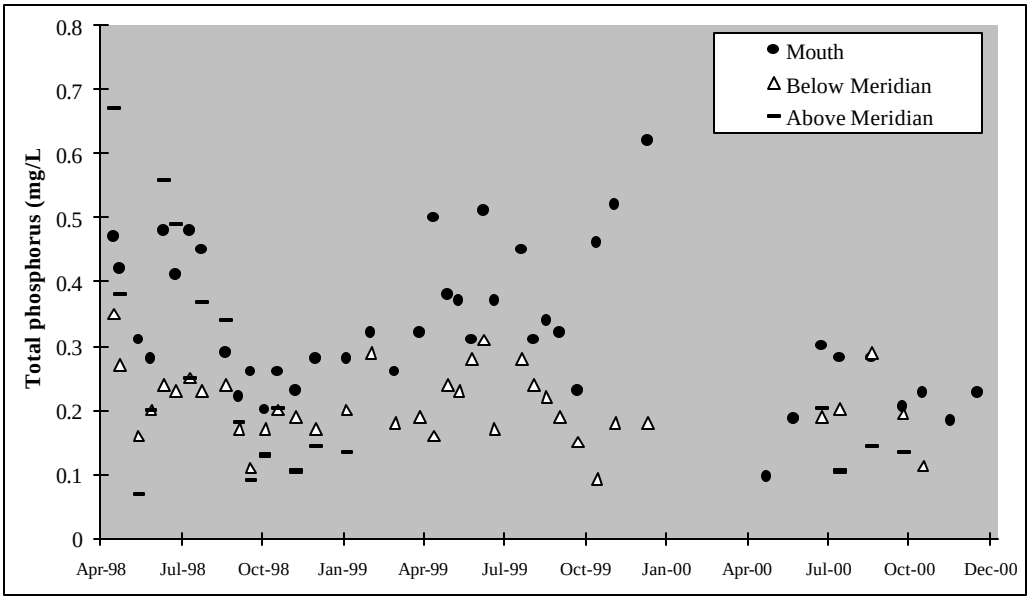


Figure 17. Total phosphorus levels in Fivemile Creek above Meridian, below Meridian and at the mouth: 1998-2000.

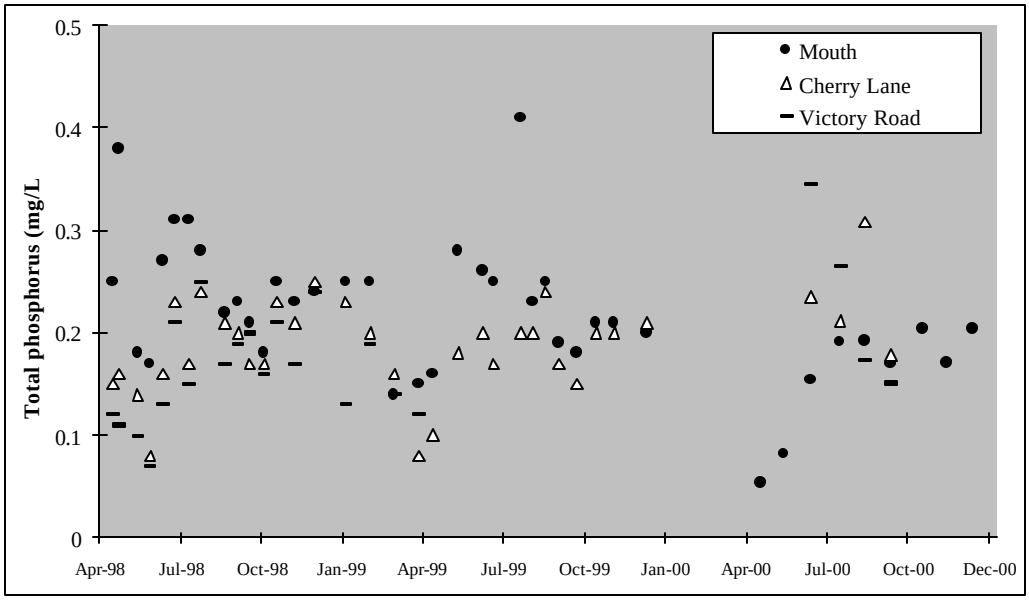


Figure 18. Total phosphorus levels in Tenmile Creek at Cherry Lane, Victory Road and at the mouth: 1998-2000.

Table 7. Irrigation and non-irrigation season TP concentration averages in Fivemile and Tenmile Creek.

Stream Name / Location	Irrigation Season Ave	Non-Irrigation Season Ave.
Fivemile Creek - Above the confluence with Tenmile Creek (mouth)	0.35 mg/L	0.29 mg/L
Fivemile Creek - Below Meridian	0.22 mg/L	0.18 mg/L
Fivemile Creek - Above Meridian	0.28 mg/L	0.14 mg/L
Tenmile Creek - Above the confluence with Fivemile Creek (mouth)	0.22 mg/L	0.21 mg/L
Tenmile Creek - Below Meridian	0.18 mg/L	0.21 mg/L
Tenmile Creek - Above Meridian	0.17 mg/L	0.17 mg/L

Benthic Chlorophyll –a

Periphytic (benthic) algae grow on pebbles, cobbles and boulders along the streambed. In streams that do not experience an over abundance of nutrients, periphytic algae grow as single celled organisms called diatoms that are limited in biomass by the grazing of aquatic insects. When nutrient availability exceeds the basic needs of diatoms, other periphytic species, including bulky, filamentous algae such as *Cladophora* may grow on the streambed. When the filamentous algae become excessive they can impede intergravel flow which decreases intergravel dissolved oxygen necessary for young fish and macroinvertebrates.

The state of Idaho does not have a numeric criterion for periphytic chlorophyll-a. Several authors have suggested that periphyton chlorophyll-a values from 100 to 200 mg/m^2 constitute a nuisance threshold, above which aesthetics are impaired (Horner and others, 1983, Watson and Gestring, 1996; Welch, and others, 1988; Welch, and others, 1989). However, no thresholds have been proposed in relation to the adverse impacts to aquatic life. Impacts to aquatic life are generally based on DO and pH problems and the reduction of living space for aquatic organisms due to excessive algae biomass.

The exact biomass level at which algae growth becomes quantified as “nuisance” is not well defined. The nutrient level and the mass of algae itself that constitutes a nuisance characterization is different in nearly every water body. Nuisance algae growth is often dictated by other limiting factors such as water velocity, substrate composition, ground water nutrient concentration and in the case of attached macrophytes, substrate nutrient concentration.

The benthic chlorophyll-a data for Fivemile and Tenmile Creek are sparse. However, the data that are available are likely representative of the overall benthic algal conditions in the streams. This assumption is based on the relative similarity in flow regime, substrate

condition, water clarity, nutrient enrichment and riparian shading throughout the systems, all of which directly effect periphytic algae growth.

Fivemile Creek

Two samples collected by the DEQ above and below Meridian in September 2000 revealed benthic chlorophyll-a levels of 8.4 mg/m2, and 9.2 mg/m2, respectively. Both are well below the minimum nuisance threshold of 100 mg/m2.

Tenmile Creek

Two samples collected by the DEQ above and below Meridian in September 2000 revealed benthic chlorophyll-a levels of 2.13 mg/m2, and 11.5 mg/m2, respectively. Both are well below the minimum nuisance threshold of 100 mg/m2.

The low benthic chlorophyll-a levels in Fivemile and Tenmile Creek are not surprising given the growth limiting factors in the stream. The substrate surveys that have been conducted in both streams below the New York Canal show that the stream bottoms are dominated by silt and sand with sporadically distributed areas of gravel and cobble, which is typically highly embedded. Silt and sand are unstable and do not provide a desirable attachment point for benthic algae. Additionally, the peak growing season for benthic algae corresponds with the irrigation season (April – September) in the lower Boise River basin, when TSS concentrations are elevated. The result is decreased light penetration during the growing season. This decrease in light penetration inhibits photosynthesis and limits the mass of algae that can grow.

Water Column Chlorophyll –a

Chlorophyll-a is the essential photosynthetic pigment found in aquatic plants. The amount of chlorophyll-a in water column (suspended) algae and in the algae attached to rocks (periphyton) is commonly used to measure algal productivity. While chlorophyll-a concentrations vary from species to species, it remains a viable surrogate for algae biomass (Carlson 1980, Watson et al. 1992). The EPA also suggests that chlorophyll-a is a desirable endpoint because it can usually be correlated to loading conditions (EPA 1999). While the state of Idaho does not have a numeric criterion for chlorophyll-a, Oregon's threshold is 15 ug/l. When the Oregon threshold is exceeded in an average of three samples collected over consecutive months at a representative location, a follow-up is made to ascertain if a beneficial use is adversely impacted. Hence, a value of greater than 15 ug/l does not necessarily indicate impairment. Additionally, North Carolina has a chlorophyll-a criterion of 40 ug/l, which according to the state of North Carolina indicates impairment.

As with benthic chlorophyll-a, the water column chlorophyll-a data for Fivemile and Tenmile Creek are sparse. However, it is again assumed that the data that are available are representative of the overall water column algal conditions in the stream. This assumption is based on the relative similarity in water clarity, nutrient enrichment and riparian shading throughout the systems, all of which directly effect water column algae growth.

Fivemile Creek

Two samples collected by the DEQ above and below Meridian in July 2000 revealed water column chlorophyll-a levels of 0.5 µg/L and 2.4 µg/L, respectively. Both are well below the most stringent nuisance threshold value of 15 µg/L.

Tenmile Creek

Two samples collected by the DEQ above and below Meridian in July 2000 revealed water column chlorophyll-a levels of 2.9 µg/L and 1.9 µg/L, respectively. Both are well below the most stringent nuisance threshold value of 15 µg/L.

The factor that is probably limiting water column algae in Fivemile and Tenmile Creek the most is water clarity. The peak growing season for benthic algae corresponds with the irrigation season (April – September) in the lower Boise River basin. The result is decreased water clarity, and hence, decreased light penetration during the irrigation season.

Macrophytes and Other Bulky Species

During the growing season Fivemile and Tenmile Creek exhibit significant macrophyte growth in the upper perennial segments. Macrophytes are not as significant in the lower segments. Both streams lack a shade-providing riparian canopy. Thus, emergent macrophytes have ample light with which to grow. Additionally, the upper segments exhibit low point velocities due to the low gradient and low flow. Flow measurements conducted by DEQ during the 2000 growing season show that point velocities in Fivemile Creek above Meridian are frequently below 1.6 fps, which is the threshold velocity above which most macrophytes and other benthic algae species find it difficult to attach themselves (Thomann and Mueller, 1987). The average point velocity above Meridian for the months of June through August was .63 fps. Below Meridian, the velocities are closer to 1.6 fps. This factor in combination with shallow depth above Meridian, which allows for more light penetration when macrophyte buds are re-generating, contribute to the macrophyte growth in Fivemile Creek. Field surveys conducted from June through October 2000 at locations above Meridian identified macrophytes covering between 50% and 90% of the cross-sectioned stream channel. The aquatic macrophyte that dominates the population is *Potamogeton pectinatus* L (Sago Pondweed).

Sago pondweed is adapted to and highly tolerant of a large range of currents and water level fluctuations due to its narrow leaves (McCombie and Wile, 1971). The anatomy of its leaves also allows it to grow well in silty streams because the leaves do not accumulate sediment. Sago pondweed growth is frequently noted in nutrient-rich waters, particularly in the lower reaches where pollution loads are usually the greatest (Howard-Williams 1981). Sago pondweed production is typically associated with elevated levels of phosphorus in the water column (Zaky 1960, Jones and Cullimore 1973, Anderson 1978, Collins et al. 1987, Penuelas and Sabater 1987), although the plant uses its roots and shoots to obtain nutrients from the sediment (Welsh and Denny 1979). While most aquatic plants are able to absorb nutrients over the entire plant surface due to a thin cuticle (Denny 1980), bottom sediments serve as the primary nutrient source for most substratum attached macrophytes (Chambers et al 1999).

Many authors (Welsh and Denny 1979, Chambers et al 1999) suggest that other than harvesting and chemical treatment, the most efficient way of controlling Sago pondweed growth is by controlling sedimentation rates. This is substantiated by the United States

Department of Agriculture's 1999 report entitled "A Procedure to Estimate the Response of Aquatic Systems to Changes in Phosphorus and Nitrogen Inputs". The report indicates that in terms of management, the best method for controlling macrophyte growth in small macrophyte-dominated streams is to control surface erosion and sedimentation. Based on this premise, a reduction in surface sediment in Fivemile and Tenmile Creek would reduce the mass of macrophytes. To meet the lower Boise River sediment TMDL requirements (DEQ 2000), both streams must reduce total suspended sediment loads by 37%. While the link between TSS and surface sediment in the lower Boise River basin is not well defined, it is inherent. Most of the management practices (BMPs) that are used to control TSS are ultimately designed to prevent all surface erosion and sediment delivery to receiving water bodies. Thus, attempts to control TSS loading to Fivemile and Tenmile Creek will inherently result in a reduced level of surface sediment loading.

Bacteria

The lower Boise River bacteria TMDL allocated a 95% reduction in fecal coliform concentrations in Fifteenmile Creek to meet bacteria standards in the river (50 CFU/100 ml). The fecal coliform geometric mean at the mouth was 992 CFU/100 ml. Reductions will also have to be made in Fivemile and Tenmile Creek to meet this target. Since the river TMDL was developed, the state of Idaho has moved to an E. Coli bacteria standard, which is a 30-day geometric mean of 126 organisms/100ml for both primary and secondary contact recreation.

Data collected in 1998 and 1999 at Fivemile and Tenmile Creek monitoring locations indicate that during the recreation season (May-August), both streams exceed the E.Coli standard at all locations (Table 8). The data are not represented as a monthly geometric mean, but clearly show that the recreation season concentrations are above the standard.

Table 8. Bacteria concentrations in Fivemile and Tenmile Creek

Location	Year (May-Aug)	Geo-mean (#/100ml)
T1 (mouth)	1998	650
	1999	518
T2 (below Meridian)	1998	757
	1999	544
T3 (above Meridian)	1998	687
	1999	No Data
F1 (mouth)	1998	779
	1999	511
F2 (below Meridian)	1998	581
	1999	656
F3 (above Meridian)	1998	516
	1999	No Data

DEQ recommends listing Fivemile and Tenmile Creek for bacteria on the 2002 303(d) list from the New York Canal to the mouth. Upon listing the streams, DEQ will establish a TMDL schedule. It makes more sense to evaluate the need for bacteria TMDLs after the lower Boise River bacteria implementation plan is complete and being implemented. The

management practices that are initiated as a result of the implementation plan may reduce the bacteria reductions necessary to meet standards in Fivemile and Tenmile Creek.

Status of Beneficial Uses

The data indicate that sediment, nutrients and dissolved oxygen are not impairing modified aquatic life or secondary contact recreation uses in Fivemile and Tenmile Creek. Consequently, DEQ does not recommends preparing TMDLs for the pollutants and recommends removing sediment, dissolved oxygen and nutrients as pollutants of concern from the 2002 303(d) list. Table 9 summarizes the beneficial use support status for both streams.

Table 9. Beneficial Use Support Status in Fivemile and Tenmile Creek.

Segment	Designated Use	Existing Use	Impaired Use	Pollutant(s) Causing Impairment
Headwaters to Fifteenmile Creek	CWB, SCR	MOD, SCR	SCR	Bacteria
Headwaters to Fifteenmile Creek	CWB, SCR	MOD, SCR	SCR	Bacteria

In providing water to their respective clients, the Nampa-Meridian Irrigation District and the Pioneer Irrigation District are the entities that largely control the flow regime of Fivemile and Tenmile Creek. One of the districts' responsibilities is to clean and maintain the stream channel to ensure the flow of water is not significantly impeded. The districts have the authority to remove any obstructions from the stream channel that is interfering with the delivery of water (IDAPA 37.03.07.025.03). In doing so, they do not need to secure a stream channel alteration permit provided no equipment is working in the channel proper. This routine stream channel maintenance has resulted in deep, straight, narrow channels with little riparian growth and little in-stream habitat complexity. While the districts' work is authorized, it does contribute to the overall reduction of aquatic life diversity. Habitat modification and stream channel authorization does not fall under TMDL authority. It is DEQ's position that habitat modification and flow alteration, which may adversely affect beneficial uses, are not pollutants under Section 303(d) of the Clean Water Act. There are no water quality standards for habitat or flow, nor are they suitable for estimation of load capacity or load allocations. Because of these practical limitations, TMDLs will not be developed to address habitat modification or flow alteration.

While the available data do not indicate nutrient induced beneficial use impairment in Fivemile and Tenmile Creek, high nutrient concentrations imply that nutrients are a potential threat to aquatic life and recreational uses in the lower Boise River. However, recent analysis in the river indicates that beneficial uses are not impaired by nutrients. The DEQ does not recommend developing nutrient TMDLs for Fivemile or Tenmile Creek with the intention of restoring beneficial uses in streams. However, nutrient reductions will likely be needed from Fivemile and Tenmile Creek in order to meet the Snake River-Hells Canyon TMDL nutrient load allocation to the Boise River. The load allocation will most likely be given to Fifteenmile Creek, but reductions from Fivemile and Tenmile Creek may be necessary to meet the allocation. A similar scenario exists for sediment. While TSS is

not impairing the MOD aquatic life communities in Fivemile and Tenmile Creeks, TSS reductions still need to be achieved for the lower Boise River sediment TMDL.

Data Gaps

This assessment has identified several data gaps that limit full assessment of the effects of the listed pollutants on beneficial uses. While the best available data was used to develop the current assessment, DEQ acknowledges there are unresolved questions, as outlined in Table 10.

Efforts to gather additional sediment and nutrient data either are underway or have been planned by DEQ, the WAG and various stakeholders. The USGS, through a jointly funded plan by the DEQ, LBRWQP and USGS collects data on the tributaries to the river as well as the river itself. The Department of Agriculture also collects data on selected tributaries, including Fivemile and Tenmile Creek. In 2001, the Nampa-Meridian Irrigation District, in cooperation with many of the water-users in the valley, embarked on a large-scale monitoring effort on all of the tributaries to the river and the river itself. The information developed through these efforts may be used to revise the appropriate portions of the assessment, and determine and adjust appropriate implementation methods and control measures. Changes in the assessment will not result in the production of a new document. Minor changes will be handled through a letter amending the existing document(s); changes that are more extensive will be handled through supplementary documentation or replacing sections or appendices. The goal will be to build upon rather than replace the original work wherever practical. The revision of this assessment is consistent with current and developing EPA guidance that emphasizes an iterative approach to TMDL development and implementation. Any additional effort on the part of DEQ to revise the assessment must be addressed on a case-by-case basis, as additional funding becomes available.

Table 10. Data gaps identified during development of the Fivemile and Tenmile Creek SBA

Pollutant or other Factor	Data Gap
Sediment	Only instantaneous suspended sediment data available; cannot evaluate duration of concentrations
	Additional surface sediment data at multiple locations; cannot establish an annual trend
	Discrete substrate and water column particle size distribution data
	Stream bank erosion rates
	Surface and suspended sediment data for all flow regimes (low, average, high)
Nutrients	Only instantaneous data available; cannot evaluate duration of concentrations
	Nutrient data for all flow regimes (low, average, high)
Biological	Benthic and suspended algae (biomass) data for hot summer drought conditions as well throughout the growing season
	A quantified determination of macrophyte density throughout the stream
	A quantifiable method of interpreting macroinvertebrate data for modified (MOD) waters
Other	Additional diurnal dissolved oxygen data

Pollution Source Inventory

Sediment and nutrients enter Fivemile and Tenmile Creek primarily from nonpoint sources. The Meridian wastewater treatment plant, which discharges to Fivemile Creek below the City of Meridian, is subject to relatively strict effluent limits in their NPDES permit. The reasonable assurance analysis that is associated with the NPDES permitting process typically ensures that the effluent discharge will not contribute to the degradation of water quality.

Nonpoint sources of sediment include agricultural activities, stormwater runoff, runoff from construction activities and bank erosion. An unknown amount of internal re-suspension also occurs at any given location. The most significant sources of sediment from agricultural practices are likely surface irrigated cropland and streambank trampling due to unrestricted use of streamside areas by livestock. Construction activities on sites that exceed five acres are subject to a general NPDES permit that requires best management practices to limit sediment releases. Construction in the stream channel is subject to

stream alteration permits issued by the Idaho Department of Water Resources. These permits generally include requirements for best management practices (BMPs) to reduce sediment releases to the stream. Agricultural activities that can generate sediment include surface irrigated row crops and surface irrigated pastures. Sediment that erodes from agricultural lands has the potential to be delivered to the multiple drains, canals and laterals and may be liberated during the irrigation charge in April. Sediment can also be liberated from the stream substrate when irrigators alter instream structures to improve diversions.

Most large confined animal feeding operations (CAFOs), confined feeding areas (CFAs) and dairies are subject to discharge limits under general NPDES permits. To be regulated under a general NPDES permit, CAFOs and CFAs must meet size criteria and be considered significant contributors of pollutants. All dairies that have a permit to sell milk are subject to the Idaho Department of Agriculture (IDA) dairy inspection program. Dairies are required to have adequate waste management practices subject to the Rules Governing Dairy Waste, IDAPA 58.01.02.350.03.g and IDAPA 02.04.14. Smaller CAFOs and pasture grazing are not regulated. Animal waste that is removed from dairies, CAFOs and CFAs in liquid or solid form may be applied to agricultural lands as a soil amendment. Operators subject to an NPDES permit are required to land apply waste at agronomic rates and maintain adequate record keeping of waste management. The IDA has rules in place to ensure proper management of land applied animal waste at other facilities, but these activities are currently unregulated. The extent to which land application of animal waste is a source of nutrients is unknown.

Nonpoint sources of nutrients include runoff from agricultural operations, stormwater runoff and ground water. Nutrients that enter the stream from ground water generally have their source in the same land use activities that contribute nutrients directly to surface water. A notable exception is septic systems. In areas that lack sewering and wastewater treatment, septic systems may contribute nutrients to ground water that eventually reach the stream directly or via drains.

Pollution Control Efforts

Nonpoint Sources

In both Ada and Canyon Counties, there are existing water quality programs for nonpoint source pollutant reductions. Most of the agricultural programs are either state or federally funded through the Idaho Soil Conservation Commission (ISCC) or the Natural Resource Conservation Service (NRCS). These programs are targeted at the agricultural community to assist with conservation practices. For example, the Ada Soil & Water Conservation District and the Canyon Soil Conservation District (SCD) have Water Quality Program for Agriculture (WQPA) money available to address on-the-farm pollutant reductions. WQPA is a State of Idaho water quality program to provide cost share incentives to local operators for pollutant reductions. The agricultural community, through the local conservation districts and other funding sources has demonstrated a willingness to protect water quality in the lower Boise River valley. Ada SWCD and Canyon SCD work with agricultural operators in the respective counties to provide technical assistance for implementation of BMPs.

Other state and federal funding sources include the federal 319 program, the Resource Conservation and Rangeland Development Program, and the Federal Environmental Quality Incentive Program (EQIP). Participation from local operators has been competitive

and is based on the availability of funds from the programs. Other sources of funding include private sources such as Ducks Unlimited, The Nature Conservancy and colleges and universities.

Stormwater within the City of Boise is subject to a stormwater NPDES permit. Ada County Highway District, Drainage District 3, the City of Boise, Idaho Department of Transportation, District 3, and Boise State University are all co-applicants for the permit, which was recently issued. The permit requires implementation of BMPs to control stormwater runoff within the affected area. In the future, the City of Meridian will likely be subject to Phase II NPDES storm water requirements. Based on the City of Meridian's rapidly growing population and its proximity to the City of Boise, it likely meets the criteria for a Phase II stormwater permit. The Phase II requirements take effect in 2002.

The Idaho OnePlan web site (www.oneplan.org) is an on-line tool to help farmers and ranchers create their own farm and ranch conservation plans. Developed as a cooperative effort between multiple state and federal agencies, the OnePlan will assist producers in meeting the ongoing demands for sustainable agriculture. As an example, a OnePlan Nutrient Management Plan could assist an Idaho dairy farmer to meet the rigorous demands of Idaho's new dairy regulations. The OnePlan web site offers many additional on-line tools such as crop nutrient demands and crop water consumption charts.

Point Sources

The Meridian wastewater treatment plant is the only discrete point source in the Fivemile Creek subwatershed. No point sources are located in the Tenmile Creek subwatershed. The Meridian plant, which provides tertiary treatment of wastewater from Meridian, can discharge to Fivemile Creek or the Boise River, but uses Fivemile Creek as its primary discharge water.

As part of the discharge monitoring element of their NPDES permit, the Meridian WWTP is required to monitor their effluent to determine compliance with their permit. The monthly discharge monitoring reports are sent to EPA and DEQ as well as kept on file at the facility.

In 1996 EPA reissued the Idaho general NPDES permit for CAFOs. This new general permit allows permitted facilities to discharge animal waste only during unusual climatic events. The new permit also requires permitted facilities to land apply animal waste at agronomic rates, and requires record keeping of animal waste management practices. It is believed these provisions will reduce discharges to surface waters, and reduce impacts to ground water.

Reasonable Assurance

The Fivemile and Tenmile Creek subwatersheds have a combination of point and nonpoint sources. However, the pollution distribution is such that potential nutrient reduction goals can only be achieved by including a degree of nonpoint source reductions. The overall reductions must incorporate reasonable assurance that nonpoint source reductions will be implemented and effective in achieving the Snake River- Hells Canyon load allocation (EPA, 1991). If the appropriate load reductions are not achieved from nonpoint sources through existing regulatory and voluntary programs, then additional reductions must come from point sources. The cost effectiveness of additional point source reductions would be closely evaluated before this would occur.

The state has responsibility under Sections 401, 402 and 404 of the Clean Water Act to provide water quality certification. Under this authority, the state reviews dredge and fill, stream channel alteration and NPDES permits to ensure that the proposed actions will meet the Idaho's water quality standards.

Under Section 319 of the Clean Water Act, each state is required to develop and submit a nonpoint source management plan. Idaho's most recent Nonpoint Source Management Program was finalized in September 1999. The plan was submitted to and approved by the EPA. Among other things, the plan identifies programs to achieve implementation of nonpoint source BMPs, includes a schedule for program milestones, outlines key agencies and agency roles and is certified by the state attorney general to ensure that adequate authorities exist to implement the plan and identifies available funding sources.

Idaho's nonpoint source management program describes many of the voluntary and regulatory approaches the state will take to abate nonpoint pollution sources. One of the prominent programs described in the plan is the provision for public involvement, such as the formation of Basin Advisory Groups (BAGs) and Watershed Advisory Groups (WAGs) (IDAPA 58.01.02.052). The WAGs are to be established in high priority watersheds to assist DEQ and other state agencies in formulating specific actions needed to decrease pollutant loading from point and nonpoint sources that affect water quality limited waterbodies. The Lower Boise River Water Quality Plan (LBRWQP) is the designated WAG for the lower Boise River watershed, which includes Fivemile and Tenmile Creek.

The Idaho water quality standards refer to existing authorities to control nonpoint pollution sources in Idaho. Some of these authorities and responsible agencies are listed in Table 11.

Table 11. State of Idaho's regulatory authority for nonpoint pollution sources

Authority	IDAPA Citation	Responsible Agency
Rules Governing Solid Waste Management	58.01.02.350.03(b)	Idaho Department of Health and Welfare
Rules Governing Subsurface and Individual Sewage Disposal Systems	58.01.02.350.03(c)	Idaho Department of Health and Welfare
Rules and Standards for Stream-channel Alteration	58.01.02.350.03(d)	Idaho Department of Water Resources
Rules Governing Exploration and Surface Mining Operations in Idaho	58.01.02.350.03(e)	Idaho Department of Lands
Rules Governing Placer and Dredge Mining in Idaho	58.01.02.350.03(f)	Idaho Department of Lands
Rules Governing Dairy Waste	58.01.02.350.03.(g)	Idaho Department of Agriculture

The state of Idaho uses a voluntary approach to address agricultural nonpoint sources. However, regulatory authority can be found in the water quality standards (IDAPA 58.01.02.350.01 through 58.01.02.350.03). IDAPA 58.01.02.054.07 refers to the Idaho Agricultural Pollution Abatement Plan (Ag Plan) (IDHW and SCC, 1993) which provides direction to the agricultural community approved BMPs. A portion of the Ag Plan outlines responsible agencies or elected groups (SCDs) that will take the lead if nonpoint source pollution problems need to be addressed. For agricultural activity, it assigns the local SCDs to assist the landowner/operator with developing and implementing BMPs to abate nonpoint pollution associated with the land use. If a voluntary approach does not succeed in abating the pollutant problem, the state may seek injunctive relief for those situations that may be determined to be an imminent and substantial danger to public health or environment (IDAPA 58.01.02.350.02(a)).

The Idaho Water Quality Standards and Wastewater Treatment Requirements specify that if water quality monitoring indicates that water quality standards are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request that the designated agency evaluate and/or modify the BMPs to protect beneficial uses. If necessary the state may seek injunctive or other judicial relief against the operator of a nonpoint source activity in accordance with the Director of the Department of Health and Welfare's authority provided in Section 39-108, Idaho Code (IDAPA 58.01.02.350).

The water quality standards list designated agencies responsible for reviewing and revising nonpoint source BMPs; the Soil Conservation Commission for grazing and agricultural activities; the Department of Transportation for public road construction; the Department of Agriculture for aquaculture; and DEQ for all other activities (IDAPA 58.01.02.003).

IDAPA 58.01.02.054.06 indicates that pollutant trading is an appropriate mechanism for restoring water quality limited water bodies to compliance with water quality standards. In the lower Boise River proper, nutrients do not appear to exceed the narrative water quality standard and hence are not impairing beneficial uses. However, the nutrients in the river are contributing to the impairment of beneficial uses in the Snake River. For this reason, effluent trading will be a cost-effective way for helping improve water quality in the river. With inherent nutrient reduction requirements for point and non-point sources serving as the impetus, an effluent trading demonstration project was initiated in January 1998. The effluent trading framework revolved around developing a conceptual framework for activating trades between the multiple sources in the valley. The Meridian WWTP is a candidate for nutrient trading.

References

Allen, J.D. 1995. Stream Ecology: Structure and function of running waters. Chapman and Hall. New York City, NY. USA.

Anderson, M. G. 1978. Distribution and production of sago pondweed (Potamogeton pectinatus L.) on a northern prairie marsh. Ecology 59:154-160.

Bothwell, M.L. 1988. Growth rate responses of lotic periphyton diatoms to experimental phosphorus enrichment: The influence of temperature and light. Canadian Journal of Fisheries and Aquatic Science 45, pp.261 - 269.

Burnham, W.L. 1979. Groundwater report - Southwest community waste management study. Ada County Planning Association Technical Memorandum 308.04g.

Carlson, RE. 1980. More complications in the chlorophyll-Secci disk relationship. Limnology and Oceanography. 25:378-382.

CH2M Hill. 1996. Field assessment of biological, physical and chemical conditions of Fivemile Creek in the vicinity of the City of Meridian's Wastewater Treatment Facility: Prepared for City of Meridian, USEPA and IDEQ.

Chambers, P.A., R.E. DeWreede, E.A. Irlandi, and H. Vandermuelen. 1999. Management issues in aquatic macrophyte ecology: A Canadian perspective. Can. J. Bot. 77:471-487.

Collett, R.A. 1972. Soil survey of Ada County area Idaho. United States Department of Agriculture, Soil Conservation Service, 327 p., maps.

Collins, C. D., R. B. Sheldon, and C. W. Boylen. 1987. Littoral zone macrophyte community structure: distribution and association of species along physical gradients in Lake George, New York, U.S.A. Aquat. Bot. 29:177-194.

Denny, P. 1980. Solute movement is submerged angiosperms. Biol. Rev. 55:65-92.

Dion, N P. 1972. Some effects of land use on the ground water system in the Boise-Nampa area, Idaho. Idaho Department of Water Administration Water Information Bulletin 26, 47 p.

EPA. 1991. Guidance for water quality-based decisions: The TMDL process. U.S. Environmental Protection Agency 440/4-91-001, Washington, D.C., 58 p.

EPA. 1999. National Nutrient Assessment Strategy: An overview of available endpoints and assessment tools.

Horner, R.R., E.B. Welch and R.B. Veenstra. 1983. Development of nuisance periphytic algae in laboratory streams in relation to enrichment and velocity. In Periphyton of Freshwater Ecosystems, Wetzel, R. G. (ed.), Dr. W. Junk Publishers, The Hague.

Howard-Williams, C., and B. R. Allanson. 1981. Phosphorus cycling in a dense Potamogetonpectinatus L. bed. Oecologia 49:56-66.

Idaho Department of Environmental Quality. 2000. Lower Boise River TMDL Subbasin assessment and Total Maximum Daily Loads. September 1999.

Idaho Department of Fish and Game. 1997. Written communication from Tracey Trent (IDFG) with Idaho Department of Environmental Quality. February 18, 1997.

IDHW and SCC. 1993. Idaho Agricultural Pollution Abatement Plan, 1991. Idaho Soil Conservation Commission, Boise, Idaho.

Jones, C., and D. R. Cullimore. 1973. Influence of macronutrients on the relative growth of water plants in the Qu'Appelle lakes. Environ. Pollut. 4:283-290.

Maguire, T. 1997. Environmental planning tools and techniques. 1997. Idaho Department of Health and Welfare, Division of Environmental Quality, Boise.

McCombie, A. M., and I. Wile. 1971. Ecology of aquatic vascular plants in southern Ontario impoundments. Weed Sci. 19:225-228.

Nace, R.L., S.W. West, and R.W. Mower. 1957. Feasibility of ground-water features of the alternate plan for the Mountain Home Project, Idaho. U. S. Geological Survey Water Supply Paper 1376, 121 p.

Nampa-Meridian, and Pioneer Irrigation Districts. 2001. Use attainability analysis for Fivemile, Tenmile and Fifteenmile drains.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: A synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16, No. 4, pp. 693-727.

Othberg, K.L. 1994. Geology and geomorphology of the Boise Valley and adjoining areas, western Snake River Plain, Idaho. Idaho Geological Survey, Bulletin 29, 54 p.

Paul, D.J. 1916. Report on drainage investigation of Pioneer and Nampa-Meridian districts in Boise Valley for the year 1916. U.S. Bureau of Reclamation.

Penuelas, J., and F. Sabater. 1987. Distribution of macrophytes in relation to environmental factors in the Ter River, N.E. Spain. Int. Rev. Hydrobiol. 72:41-58.

Rosgen, D.L. 1996. A Classification of Natural Rivers. Catena, Vol. 22, pp. 169-199.

Squires, E., S.H. Wood, and J.L. Osiensky. 1992. Hydrogeologic framework of the Boise aquifer system, Ada County, Idaho. Idaho Water Resources Institute, University of Idaho, Moscow, Idaho, Research Technical Completion Report 14-08-0001-G1559-06, 114 p.

Thomann, R.V. and J.A. Mueller, 1987. Principles of Surface Water Quality Modeling and Control. Harper & Row, New York.

Thruston, R.V., R.C. Russo, C.M. Fetterrolf, T.A. Edsall, and T.M. Barber Jr., editor. 1979. Review of EPA Red Book: Quality Criteria for Water. Water Quality Section, American Fisheries Society, Bethesda, MD. 313 pg.

Tungate, A. M. and C. Berenbrock. 1995. Configuration of the water table, 1970 and 1992, and water-table change between 1970 and 1992 in the Boise area, Idaho. U.S. Geological Survey Water Resources Investigations Report 94-4116, 1 plate.

United States Bureau of Reclamation. 1996. A description of Bureau of Reclamation system operation of the Boise and Payette Rivers: Bureau of Reclamation, Boise, Idaho Office, 40 p., appendices.

United States Department of Agriculture. 1999. A procedure to estimate the response of aquatic systems to changes in phosphorous and nitrogen inputs: Department of Agriculture.

Watson, S., E. McCauley, and J.A. Downing. 1992. Sigmoid relationships between phosphorous, algal biomass, and algal community structure. Canadian Journal of Fish and Aquatic Science. 49:2605-2610.

Watson, V. and B. Gestring. 1996. Monitoring algae levels in the Clark Fork River. Intermountain Journal of Sciences 2, No. 2, pp. 17-26.

Welsh, R. P. H., and P. Denny. 1979. The translocation of 32p in two submerged aquatic angiosperm species. New Phytol. 82 645-656.

Welch, E. B., R. R. Horner and C. R. Patmont. 1989. Prediction of nuisance periphytic biomass: A management approach. Water Resources 23, No. 4, pp. 401 - 405.

Welch, E. B., J. M. Jacoby, R. R. Horner and M. S. Seeley. 1988. Nuisance biomass levels of periphytic algae in streams. Hydrobiologia 157, pp. 161 - 166.

Zaky, S. 1960. The effect of wind on the distribution and density of Potamogeton pectinatus in Nozha Hydrodrome. Notes and Memoires 44. Alexandria Inst. Hydrobiol. 33 pp.

Acronyms

(BAG)	Basin Advisory Group
(BMP)	Best Management Practices
(BURP)	Beneficial Use Reconnaissance Project
(CAFO)	Confined Animal Feeding Operation
(CFA)	Confined Feeding Areas
(CFR)	Code of Federal Regulation
(CWB)	Cold Water Biota
(DEQ)	Idaho Division of Environmental Quality
(DO)	Dissolved Oxygen
(EPA)	Environmental Protection Agency
(EQIP)	Environmental Quality Incentive Program
(HUC)	Hydrologic Unit Code
(IDA)	Idaho Department of Agriculture
(IDAPA)	Idaho Administrative Procedures Act
(IDFG)	Idaho Fish and Game
(IDHW)	Idaho Department of Health and Welfare
(IDWR)	Idaho Department of Water Resources
(LA)	Load Allocation
(LBRWQP)	Lower Boise River Water Quality Plan
(MOD)	Modified Aquatic Life (beneficial use)
(MOU)	Memorandum of Understanding
(NRCS)	Natural Resource Conservation Service
(NPDES)	National Pollutant Discharge Elimination System
(NTU)	Nephelometric Turbidity Units
(SCC)	Soil Conservation Commission
(SCD)	Soil Conservation District
(SCR)	Secondary Contact Recreation
(SBA)	Subbasin Assessment
(TP)	Total Phosphorus
(TSS)	Total Suspended Sediment
(TMDL)	Total Maximum Daily Load
(USBR)	United States Bureau of Reclamation
(USGS)	United States Geological Survey
(WAG)	Watershed Advisory Group
(WLA)	Wasteland Allocation
(WQPA)	Water Quality Programs for Agriculture
(WWTP)	Wastewater Treatment Plants

Glossary of Terms

Algal bloom - Rapid growth of algae on the surface of lakes, streams, or ponds; stimulated by nutrient enrichment.

Average flow - The average of annual volumes converted to a rate of flow for a single year; (measured in cubic feet per second cfs).

Base flow - Streamflow derived primarily from groundwater contributions to the stream.

Basin - A physiographic region bounded by a drainage divide; consists of a drainage system comprised of streams and often natural or man-made lakes. Also called drainage basin or watershed.)

Bed load - The larger or heavier particles of the stream load moved along the bottom of a stream by the moving water and not continuously in suspension or solution.

Beneficial use - Any water use that enables the user to derive economic or other benefit from such use.

Benthic fauna - Organisms attached to or resting on the bottom or living in the bottom sediments of a water body.

Biological community - All of the living things in a given environment.

Biota - The plant and animal life of a region.

Channelization - The artificial enlargement or realignment of a stream channel.

Climate - Meteorological elements that characterize the average and extreme conditions of the atmosphere over a long period of time at any one place or region of the earth's surface.

Confluence - The place where streams meet.

Dissolved oxygen (DO) – The amount of oxygen freely available in water and necessary for aquatic life and the oxidation of organic materials.

Diversion - The transfer of water from a stream, lake, aquifer, or other source of water by a canal, pipe, well, or other conduit to another watercourse or to the land, as in the case of an irrigation system.

Diversity - The distribution and abundance of different kinds of plant and animal species and communities in a specified area.

Ecology - The study of the interrelationships of living things to one another and to the environment.

Effluent - The sewage or industrial liquid waste that is released into natural waters by sewage treatment plants, industry, or septic tanks.

Growing season - The number of consecutive days having a minimum temperature above 32^{o}F.

Habitat – The native environment where a plant or animal naturally grows or lives.

Headwaters - The source and upper reaches of a stream; also the upper reaches of a reservoir.

Hydrograph - A graph showing the changes in discharge of a stream or river with the passage of time.

Hydrology - The science of waters of the earth; water's properties, circulation, principles, and distribution.

Impairment - A detrimental effect on the biological integrity of a water body caused by impact that prevents attainment of the designated or existing use.

Irrigation - The controlled application of water to cropland, hayland, and/or pasture to supplement that supplied through nature.

Irrigation return flow - Nonconsumptive irrigation water returned to a surface or ground water supply.

National Pollutant Discharge Elimination System (NPDES) - A permit program under Section 402 of the Clean Water Act that imposes discharge limitations on point sources by basing them on the effluent limitation capabilities of a control technology or on local water-quality standards.

Nonpoint source pollution - Pollution discharged over a wide land area, not from one specific location or discrete source.

Nutrients - Elements or compounds essential to life, including carbon, oxygen, nitrogen, phosphorus, and many others.

Organic matter - Plant and animal residues, or substances made by living organisms.

Perennial stream - A stream that flows from source to mouth throughout the year.

pH - An expression of both acidity and alkalinity on a scale of 0-14, with 7 representing neutrality; numbers less than 7 indicate increasing acidity and numbers greater than 7 indicate increasing alkalinity.

Point-source pollution - Pollution discharged through a pipe or some other discrete source from municipal water-treatment plants, factories, confined animal feedlots, or combined sewers.

Riparian area - Land areas directly influenced by a body of water. Usually have visible vegetation or physical characteristics showing this water influence. Stream sides, lake borders, and marshes are typical riparian areas.

Sediment - Fragmented organic or inorganic material derived from the weathering of soil, alluvial, and rock materials; removed by erosion and transported by water, wind, ice, and gravity.

Sedimentation - The deposition of sediment from a state of suspension of water or air.

Silt - Sedimentary particles smaller than sand particles, but larger than clay particles.

Subbasin - Subdivision of a major river basin, drained by tributaries or groups of tributaries, including associated closed basins.

Total maximum daily load (TMDL) - The total allowable pollutant load to a receiving water such that any additional loading will produce a violation of water-quality standards.

Tributary - A stream that contributes its water to another stream or body of water.

Turbidity - Cloudiness caused by the presence of suspended solids in water; an indicator of water quality.

Waste water treatment - Any of the mechanical, chemical or biological processes used to modify the quality of waste water in order to make it more compatible or acceptable to man and his environment.

Water quality - A term used to describe the chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

Water quality standard - Recommended or enforceable maximum contaminant levels of chemical parameters (e.g., BOD, TDS, iron, arsenic, and others) of water. These parameters are established for water used by municipalities, industries, agriculture, and recreation.

Watershed - Area of land that contributes surface runoff to a given point in a drainage system.

Appendices

Appendix A

Use Attainability Analysis for Fivemile, Tenmile and Fifteenmile Drains, Nampa-Meridian Irrigation and Pioneer Irrigation District, 2001

Appendix B

DEQ Response to Public Comment for Proposed Beneficial Use Changes

Appendix C

Derivation of a TSS target for Modified (MOD) waters in the Lower Boise River Basin, based on Newcombe and Jensen (1996).