SIXTH WATER AND DIAMOND FORK CREEKS
FINAL 2006 MONITORING REPORT

December 2008

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COVER PHOTOS

Top Left:	Sixth Water Creek.
Bottom:	Confluence of Sixth Water Creek (right) and Diamond Fork Creek (left) during high flow. Notice the turbid water coming from upper Diamond Fork Creek during high flow.
Top Right:	Lower Diamond Fork Creek.

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1.0 INTRODUCTION

1.0 INTRODUCTION

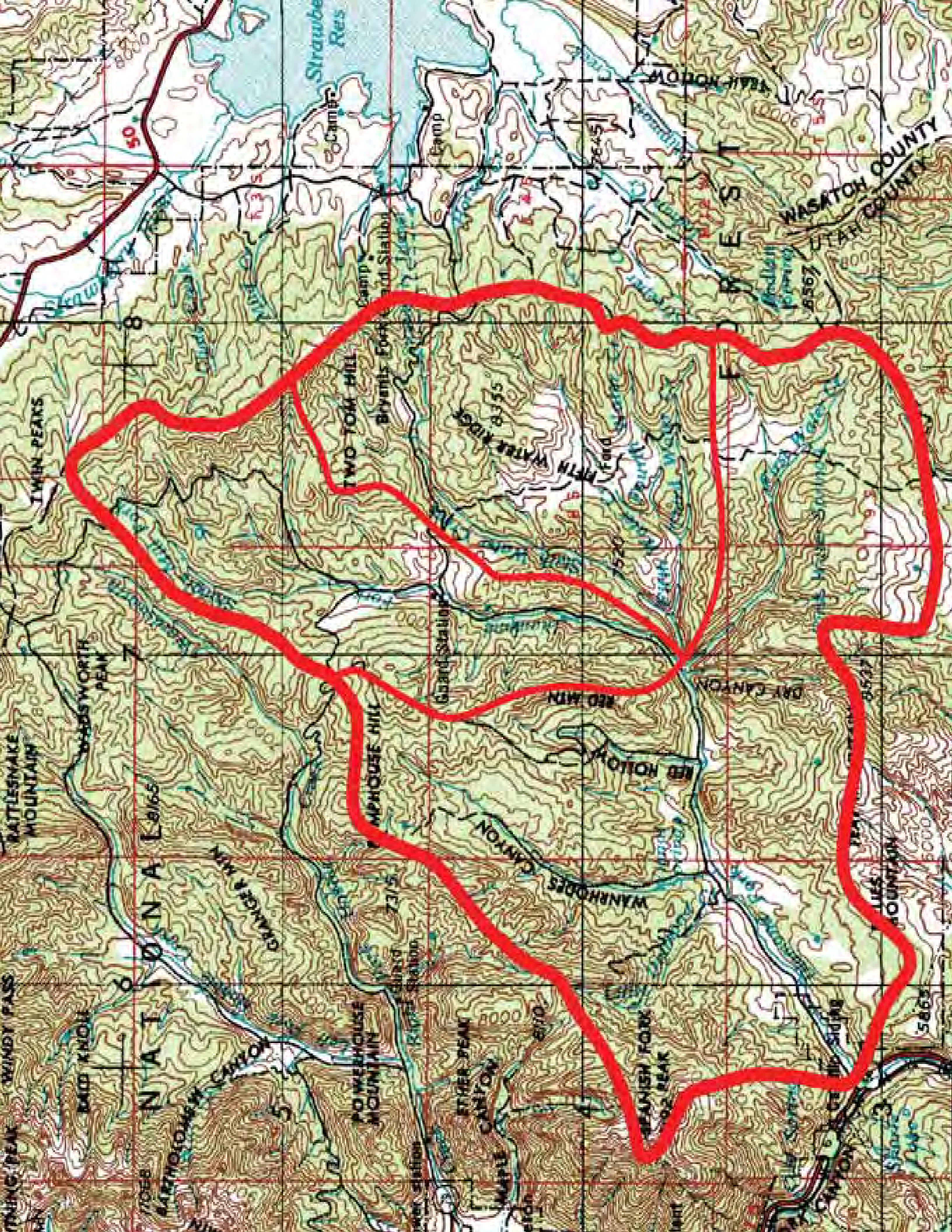
Diamond Fork Creek and its tributary, Sixth Water Creek, are part of the Spanish Fork River Watershed (Figure 1.1). Between 1916 and 2004, these two streams conveyed water diverted from Strawberry Reservoir in the Uinta Basin to the Wasatch Front. This trans-basin diversion increased flows in Diamond Fork Creek and Sixth Water Creek, and caused severe impacts to the stream channels and aquatic ecosystem. Currently, the Diamond Fork System of the Bonneville Unit, Central Utah Project (CUP), completed in 2004, delivers the imported water directly into Diamond Fork Creek just upstream from its confluence with Spanish Fork River (Figure 1.2). Water deliveries from Strawberry Reservoir, with the exception of releases for minimum instream flows, can now completely bypass Sixth Water Creek and Diamond Fork Creek in most years. Opportunities for managing water deliveries into the two streams for ecological restoration objectives may now exist.

The Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) initiated a long-term monitoring project, in conjunction with State and Federal agencies, in order to assess existing geomorphic and ecologic conditions, monitor stream channel response to the altered flow regime, and address aquatic and riparian habitat restoration objectives. This report describes the long-term monitoring project and documents the results of the first 2 years of monitoring for the initial 3-year program.

The report is organized by topic, starting with an overall introduction and project description. The introduction is followed by chapters describing the monitoring methods and results in the following order: Chapter 2 (Cross-section and Longitudinal Profile Surveys), Chapter 3 (Substrate), Chapter 4 (Sediment Transport), and Chapter 5 (Benthic Macroinvertebrates). Chapter 2 details the survey methods used to complete cross-section and longitudinal profile surveys of specific study sites and discusses the results of the 2005 and 2006 surveys. Chapter 3 discusses methods used to monitor the size distribution of bed materials and the results of these monitoring efforts for 2005 and 2006. Chapter 4 describes monitoring methods, results, and load calculations for both bedload and suspended sediment transport at numerous locations in Diamond Fork Creek and Sixth Water Creek. Chapter 4 also includes a discussion of these results and implications after 2 years of monitoring. Chapter 5 discusses the methods and results of benthic macroinvertebrate sampling generally throughout the study area and above and below the sulfur-impacted reach in Diamond Fork Creek above Three Forks. The report concludes with Chapter 6, which is a discussion of results and includes recommendations for the next monitoring session along with possible long-term management implications.

1.1 WATERSHED DESCRIPTION

The Diamond Fork Creek Watershed (Figure 1.1) covers over 150 square miles and is the largest headwater tributary of the Spanish Fork River. Streams in the upper watershed are generally high-gradient and confined between steep side-slopes or within canyons. The lower reaches of Diamond Fork Creek are flatter and much less confined within a relatively wide alluvial valley (Plate 1.1).


Strawberry Res
Camp
WASATCH COUNTY
UTAH COUNTY
8567
TWIN PEAKS
TWO TOM HILL
Bryants Fork Guard Station
FIFTH WATER RIDGE
8355
RED MTN
DRY CANYON
RED HOLLOW
WANRHODES CANYON
RATTLESNAKE MOUNTAIN
WADSWORTH PEAK
GRANGER MTN
8165
POWERHOUSE MOUNTAIN
7315
BALD KNOLL
WINDY PASS
BARTHOLOMEW CANYON
SPANISH FORK PEAK
FISHER PEAK
MAPLE CANYON
5663
N A T I O N A L
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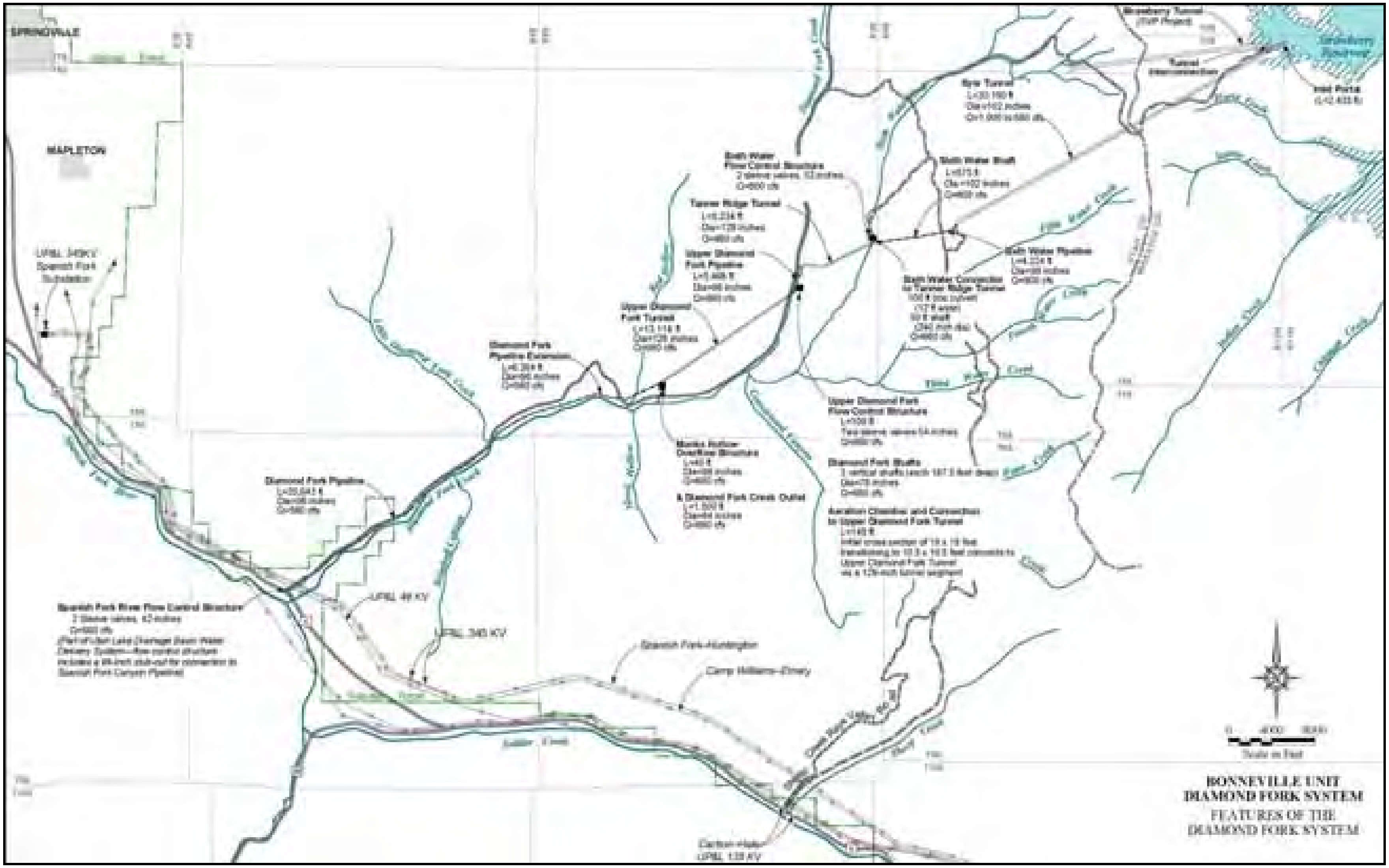


Figure 1.2. The Diamond Fork System, comprised of a series of tunnels and pipelines, delivers water from Strawberry Reservoir to the Spanish Fork River and avoids placing flows directly into Sixth Water Creek and Diamond Fork Creek. Strawberry Tunnel was replaced by Syar Tunnel, but it is still used to convey instream flows to Sixth Water Creek (map provided by the Central Utah Watery Conservancy District [CUWCD]).

Plate 1.1. Channel gradient and floodplain widths are extremely varied between the upper watershed (Sixth Water Creek below Syar Tunnel, top) and lower reaches of Diamond Fork Creek (bottom).

Historically the watershed has been used for agriculture, timber harvesting, livestock grazing, and recreation. Only small portions of the watershed are still used for agriculture and grazing. Some of the watershed is part of the Uinta National Forest and managed by U.S. Forest Service. Recently, the Diamond Fork Watershed has become a popular recreation area because of its many recreational uses including both motorized and non-motorized activities. Numerous improved and unimproved roads exist to allow access to most parts of the watershed. Watershed conditions vary from pristine to highly degraded. The degraded areas of the watershed appear to exhibit high erosion rates and exacerbate siltation problems in the watershed's streams (Plate 1.2).

Diamond Fork Creek and Sixth Water Creek were used as early as 1916 to divert water to the Spanish Fork River from Strawberry Reservoir through Strawberry Tunnel in order to support irrigation needs in the lower watershed area and Utah County (Mitigation Commission 2000). These streams carried a significant amount of imported water during the irrigation season, thereby creating artificially high flows for an extended duration; causing significant changes in the sediment-transport regime; and affecting channel dimensions, pattern, profile, and its interaction with the floodplain. These morphological impacts to the channel and floodplain have in turn affected the type and extent of riparian and wetland vegetation, water quality, and aquatic communities.

1.2 BACKGROUND HISTORY OF THE COLORADO RIVER STORAGE PROJECT ACT (CRSP), CENTRAL UTAH PROJECT (CUP), AND CENTRAL UTAH PROJECT COMPLETION ACT (CUPCA)

The Diamond Fork System is a series of tunnels and pipelines that transport water from Strawberry Reservoir in the Colorado River Basin to Spanish Fork River in the Bonneville Basin. This system is a part of the Bonneville Unit of CUP, which develops a portion of the water from the Upper Colorado River system allocated to Utah under interstate compacts. The CUP was authorized by Congress in 1956 through the Colorado River Storage Project Act (CRSP) of 1956 (43 U.S.C. Sec 620 et seq.). The Bonneville Unit is the largest unit of the CUP (USBOR 2005). The Central Utah Water Conservation District (CUWCD) operates and manages the Bonneville Unit, which is allocated to municipal and industrial uses, irrigation, and instream flows for areas in Utah. Other systems in the Bonneville Unit include the Starvation Collection System, the Strawberry Aqueduct and Collection System (SACS), the Municipal and Industrial System, and the Utah Lake Drainage Basin Water Delivery System (ULS).

Before the present-day Diamond Fork System was completed, imported water went directly into the headwaters of Sixth Water Creek via Strawberry Tunnel. The Strawberry Valley Project, completed by the U.S. Bureau of Reclamation, pre-dates the CUP by several decades. Strawberry Tunnel transported water from Strawberry Reservoir into the headwaters of Sixth Water Creek, down Diamond Fork Creek and Spanish Fork River. In 1990 the Syar Tunnel was constructed as a CUP feature to replace Strawberry Tunnel. By 1996 water from Syar Tunnel flowed through the

Plate 1.2 Roads, unstable slopes, and other nonpoint sources of pollution have been observed to increase sedimentation problems from stormwater runoff at many locations throughout the Diamond Fork Watershed.

Sixth Water Aqueduct and entered Sixth Water Creek 6 miles farther downstream than it had when Strawberry Tunnel was the primary flow conveyance. Strawberry Tunnel is now used to convey minimum instream flows to the head of Sixth Water Creek (USBOR 2005).

In 1992 the U.S. Congress enacted the Central Utah Project Completion Act (CUPCA) (Titles II through VI of Public Law 102-575, as amended), which authorized further construction to complete the Bonneville Unit of the CUP that was started in 1966. The CUPCA also provided the authorization to plan and construct several modifications to the original design of the Bonneville Unit. This legislation also established a minimum instream flow requirement. Currently, this requirement is 25 to 32 cubic feet per second (cfs) for Sixth Water Creek and 60 to 80 cfs for Diamond Fork Creek.

Under CUPCA in 1996, construction began on the Diamond Fork Pipeline, also known as Phase 1 of the Diamond Fork System of the CUP. This phase was completed in 1997 (Mitigation Commission 2000). Construction on Phase 2, the Diamond Fork Tunnel Alternative, was started in 2000 and completed in 2004. The Diamond Fork Tunnel Alternative is a pipeline and tunnel system that carries water from Syar Tunnel to the Diamond Fork Pipeline. The Diamond Fork Pipeline and Diamond Fork Tunnel provide the operational capability to remove most of the flows imported from Strawberry Reservoir to Sixth Water Creek and Diamond Fork Creek, except for minimum instream flows, during most years.

The CUPCA also established the Mitigation Commission, a Federal agency responsible for mitigating impacts from construction of the Bonneville Unit on fish, wildlife, and related recreation resources. Congress also established standards for the Mitigation Commission to follow when coordinating and implementing plans for mitigation projects. The overall mitigation commitments concerning Sixth Water Creek and Diamond Fork Creek are monitoring Ute ladies'-tresses (*Spiranthes diluvialis*) populations, riparian vegetation, leatherside chub (*Gila copei*) populations, water quality and stream channel responses to altered flow regimes following completion of the Diamond Fork System; supporting the June Sucker (*Chasmistes liorus*) Recovery Implementation Program; and planning and implementing restoration measures to the Sixth Water and Diamond Fork ecosystems.

1.3 IMPACTS TO THE DIAMOND FORK SYSTEM

Prior to completion of the Diamond Fork System, trans-basin imports from Strawberry Reservoir increased flow in Sixth Water Creek and Diamond Fork Creek, particularly in the summer growing season during periods of high irrigation demand (Figure 1.3). These artificially high flows caused channel widening and incision, especially in the upper reaches of Sixth Water Creek, in order to accommodate the higher and longer-duration peak flows. The channel also widened and braided in the lower reaches of Diamond Fork Creek in order to accommodate increased sediment loads. The changes in stream geomorphology and flow regime resulted in "severely limited fish production, loss of soils, loss of riparian and wetland habitat, and reduced recreation experiences" (Mitigation Commission 2005).

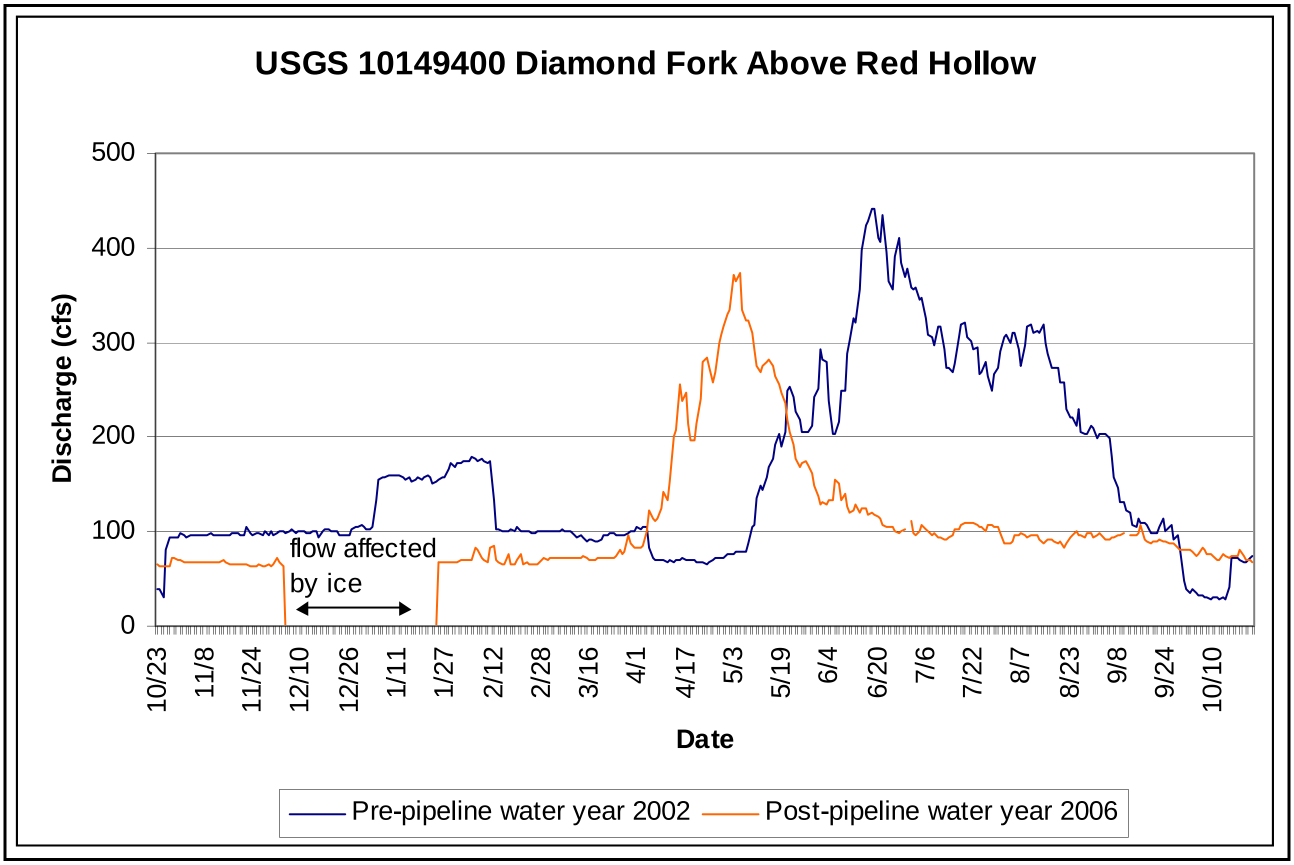


Figure 1.3. Flow before and after pipeline construction in Upper Diamond Fork Creek. (Source: USGS NWIS real-time data.)

Before it was used to transport water from Strawberry Reservoir, Diamond Fork Creek was most likely a single-thread, meandering channel with minor backwaters and an active floodplain estimated to be about 200- to 300-feet wide (Mitigation Commission 2000) from its mouth to Brimhall Canyon. Runoff was largely controlled by spring snowmelt, with peak flow occurring in mid May. Flows would return to baseflow by late June with periodic, short-term increases in flow caused by storms. Gage station data show annual peak flows before 1915 at 200 cfs near Red Hollow and 250 cfs near Brimhall Canyon (Mitigation Commission 2000).

Using the streams to convey imported water resulted in changes in magnitude, duration, and timing of peak flows, which in turn caused major changes to the geomorphology and adjacent riparian areas in both Sixth Water and Diamond Fork Creeks. From 1915 until 2004, when imported water was taken out of the streams, the annual hydrographs of Sixth Water Creek and Diamond Fork Creek were primarily controlled by the releases from Strawberry Reservoir, not natural runoff. Peak flows were approximately 450 cfs sustained for the duration of irrigation season, which lasted approximately 140 days (Mitigation Commission 2000). In Sixth Water Creek bank erosion occurred, and the channel incised an average of 12 to 15 feet. Compared with 1939 conditions, parts of Diamond Fork Creek have become much wider, straighter, and steeper, particularly in the lower 3 miles (Mitigation Commission 2000). Diamond Fork Creek has incised an average of 2 to 4 feet where the channel is confined. In areas where the valley is wide, the channel has become braided in response to higher sediment loads and increased flows (Mitigation Commission 2000).

Removal of much of the riparian forest in the early 1900s for agriculture compounded the impacts of increased flow on the channel and riparian areas. Rapid lateral migration, estimated at as much as 40- to 60-feet per year, further impacted the existing riparian forest. High summer flows altered riparian and wetland communities by increasing the duration and extent of floodplain inundation as well as artificially increasing groundwater elevations.

A plant species of particular concern is the Ute ladies'-tresses, which is listed as threatened by the Federal government. According to recent surveys, populations of this orchid were not documented in the Diamond Fork Watershed until 1992. Currently, the Diamond Fork Watershed populations are thought to contain about 95 percent of all individuals known to occur along the Wasatch Front area of Utah. The species grows in moist areas, particularly near springs and perennial streams. The plants occur primarily within the 2- to 10-year floodplain and seem to be adapted to areas disturbed by channel migration or other sources of disturbance in the floodplain. Much of current habitat for the Ute ladies'-tresses in the Diamond Fork Watershed seems to have developed in areas where lateral stream migration is occurring and willows (*Salix* spp.), cottonwoods (*Populus* spp.), and other types of riparian vegetation have been flooded out. It is possible that impacts from substantially increased flows in Diamond Fork Creek have created conditions that are favorable for Ute ladies'-tresses establishment (Mitigation Commission 2000).

Impacts have also occurred because of Diamond Fork Tunnel Alternative construction activities. Sulfur springs in the watershed were tributary to Diamond Fork Creek prior to tunnel construction. During the construction of Phase 2, an unexpected source of hydrogen sulfide-laden water began flooding the original tunnel. This tunnel was closed and abandoned. A new tunnel with an alternative design route was constructed to complete Phase 2 (CUWCD 2003). The hydrogen sulfide associated with drilling during construction of the original tunnel continues to leak into Diamond Fork Creek upstream of Three Forks, causing some water quality impacts that likely affect fish and benthic macroinvertebrates. Other impacts related to construction of the pipeline have been mitigated with varying amounts of erosion and sediment control, stream restoration, and riparian area restoration.

1.4 ISSUES AND PURPOSE OF STUDY

Mitigation of impacts resulting from the Diamond Fork System is required under CUPCA (1992). The Mitigation Commission has committed to several general areas of mitigation: monitoring Ute ladies'-tresses, riparian vegetation, leatherside chub populations, water quality and stream channel responses to altered flow regimes following completion of the Diamond Fork System, supporting the June Sucker Recovery Program, and planning and implementing restoration measures to the Sixth Water and Diamond Fork ecosystems. These commitments have led the Mitigation Commission to establish a long-term monitoring program to assess the existing geomorphic and ecological conditions and evaluate changes related to altering the flow regime by piping imported water instead of sending it through Sixth Water Creek and Diamond Fork Creek. This report addresses the commitment to assess and evaluate geomorphic and ecological changes in Sixth Water Creek and Diamond Fork Creek as these riverine ecosystems respond to a more natural flow regime.

The need for physical and biological monitoring is threefold:

1. Quantify baseline conditions of the channel affected by altered flow regimes related to transmitting irrigation water deliveries.

2. Acquire adequate data to analyze changes over time in order to set and prioritize restoration objectives and adaptively maintain the riverine and riparian ecosystem in a desirable and functional condition.

3. Use best available scientific knowledge to ensure that the Mitigation Commission meets all commitments to Sixth Water Creek and Diamond Fork Creek as set forth under CUPCA (1992).

The purpose of the work reported herein is to establish and implement a long-term monitoring program that involves periodically measuring channel cross sections, channel longitudinal profiles, areas of inundation, substrate particle-size distribution, sediment loads, and benthic macroinvertebrate assemblages in specific study sites in Sixth Water Creek and Diamond Fork Creek. Monitoring of the ULT and riparian vegetation communities in 2006 is reported separately (BIO-WEST 2008). Geomorphic monitoring results will assist the Mitigation Commission with establishing and prioritizing restoration efforts and returning Sixth Water Creek and Diamond Fork Creek to desirable conditions with functional ecologic, hydrologic, and geomorphic processes.

1.5 MONITORING PLAN

The study area includes four study sites and six sediment monitoring bridges (Figure 1.4). Three study sites are located in the lower reaches of Diamond Fork Creek, and one study site is located on Sixth Water Creek. Channel monitoring, substrate monitoring, and benthic macroinvertebrate monitoring occurred at all four study sites. Channel monitoring consisted of surveying cross sections and longitudinal profiles at low flow. Substrate monitoring consisted of conducting pebble counts through cross sections and on distinct depositional patches, as well as substrate mapping. Benthic macroinvertebrate sampling was also conducted twice at each study site, once during both the spring and fall. Additional study sites were established for macroinvertebrate sampling above and below the area affected by hydrogen sulfide inputs on Diamond Fork Creek above Three Forks.

The six bridges along Diamond Fork Creek and Sixth Water Creek were chosen for sediment sampling sites. Sediment-load monitoring consisted of taking bedload and suspended-sediment samples from the bridge locations throughout the year; most of the samples were collected during the spring runoff period. Bedload samples were also taken during low flow at each sediment sampling site to determine whether the minimum flows were high enough to maintain transport of coarse sediment.

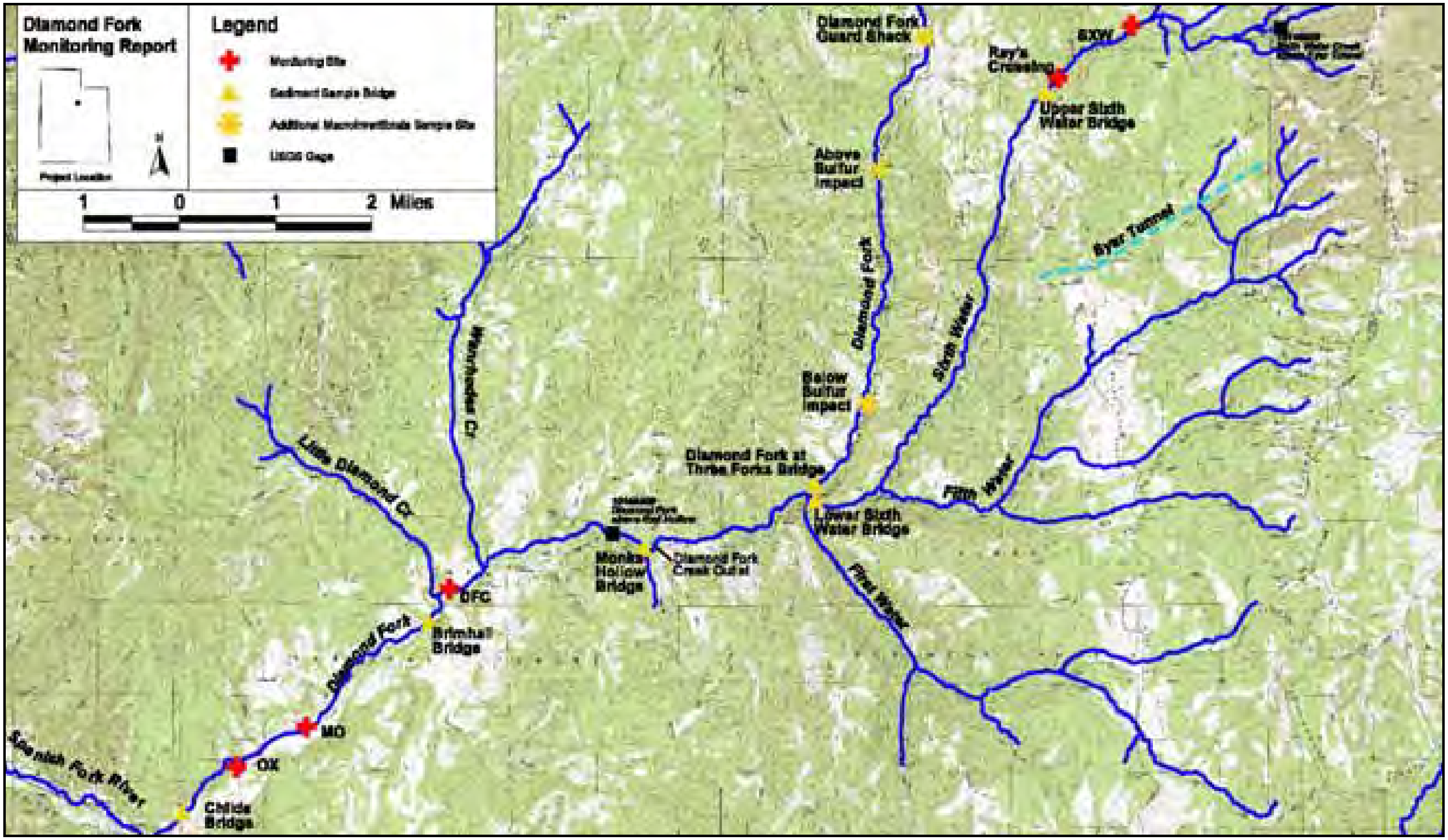


Figure 1.4. Map of the study area showing drainage names and study sites. The Ray's Crossing monitoring site is only for riparian vegetation monitoring.

2.0 CROSS SECTIONS AND LONGITUDINAL PROFILES

2.0 CROSS SECTIONS AND LONGITUDINAL PROFILES

2.1 INTRODUCTION

Initial surveys of the established, permanent transects (cross sections) and longitudinal profile were completed at each of the four study sites in the Diamond Fork Watershed in spring 2005. These surveys were repeated in fall 2006. The 2005 baseline survey data were compared with 2006 survey data to monitor changes in channel geometry, bed complexity, and slope over time. These data may also be used in hydraulic modeling and other analyses that are often the basis for flow recommendations and other adaptive maintenance activities for Diamond Fork and Sixth Water Creeks. Such recommendations and activities will assist the Mitigation Commission and CUWCD with restoring the streams to a desirable condition.

2.2 METHODS

2.2.1 Data Collection

In April 2005 BIO-WEST established permanent transects (cross sections) in each of the four study sites. The four study sites are Sixth Water (SXW) (Figure 2.1), Diamond Fork Campground (DFC) (Figure 2.2), Mother (MO) (Figure 2.3), and Oxbow (OX) (Figure 2.4). The site names Mother and Oxbow are taken from long-standing Ute ladies'-tress monitoring protocols. The SXW and MO sites each contain six transects. The DFC site contains seven transects and the OX site contains eight transects. Transects were also established at the downstream side of each sediment sampling bridge (bridge) (see Figure 1.3). The bridges include Upper Sixth Water (SXW-U), Lower Sixth Water (SXW-L), Diamond Fork at Three Forks (DI), Monks (MK), Brimhall (BR), and Childs (CH). High flows in 2005 washed out the culvert at the Diamond Fork at Three Forks Bridge. Hence a new cross section upstream of the former bridge location was established in November 2006.

Each transect is denoted by two endpoints, one on each side of the stream, marked with an aluminum cap. The endpoints mark either the left endpoint (LEP) or right endpoint (REP), corresponding to the side of the stream (always facing downstream). Each endpoint cap is stamped with the study site abbreviation and transect number. Some transects share endpoints; therefore, each transect associated with an endpoint has the transect number stamped onto the cap. A sub-meter-grade global positioning system (GPS) was used to determine real-world horizontal coordinates in NAD83 data and elevations in NAVD 1988 feet for transect endpoints at the study sites and bridges.

Transect surveys were conducted April 14-20, 2005, using a theodolite (total station), data collector, and prism/rod. In 2006 transects were surveyed in late summer and fall. Sixth Water site transects were surveyed August 8-9, 2006. Transects at the DFC, MO, and OX sites were surveyed November 8-10, 2006. The survey dates were chosen based on accessability and vegetation. The SXW was surveyed earlier because rain and snowfall make the site inaccessible later in the year. The other

Figure 2.1. Sixth Water (SXW) study site map. Aerial photo from 2006. Flow direction is from right to left.

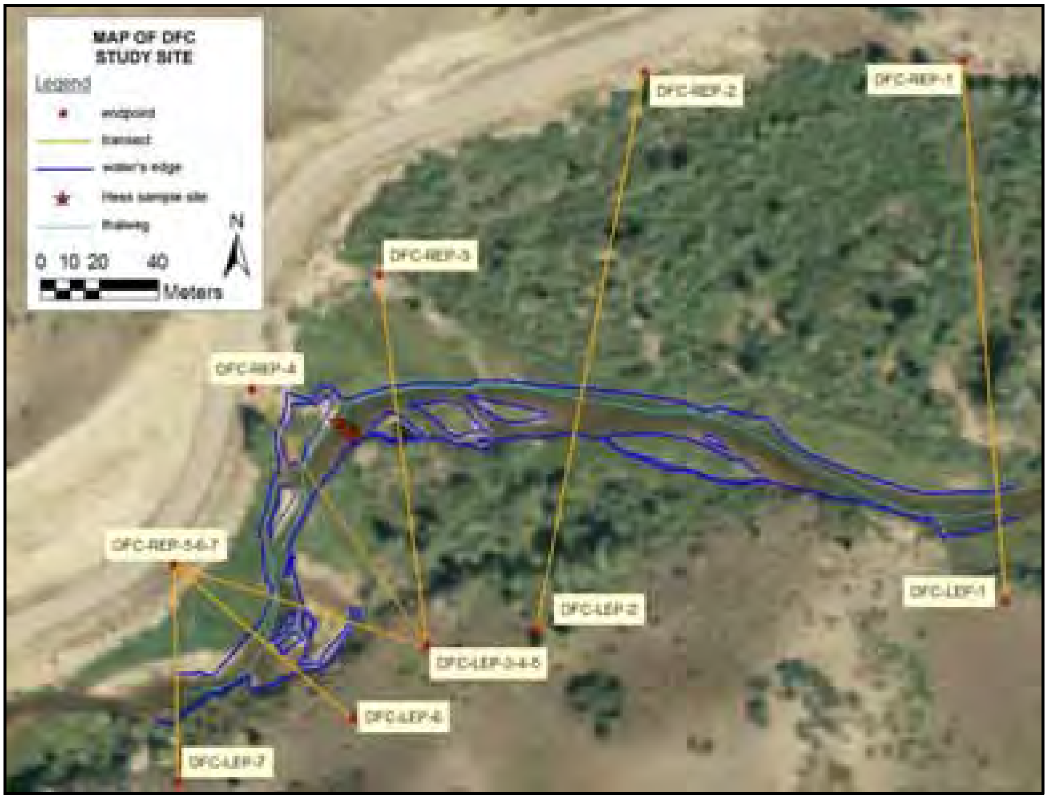


Figure 2.2. Diamond Fork Campground (DFC) study site map. Aerial photo from 2006. Flow direction is from right to left.

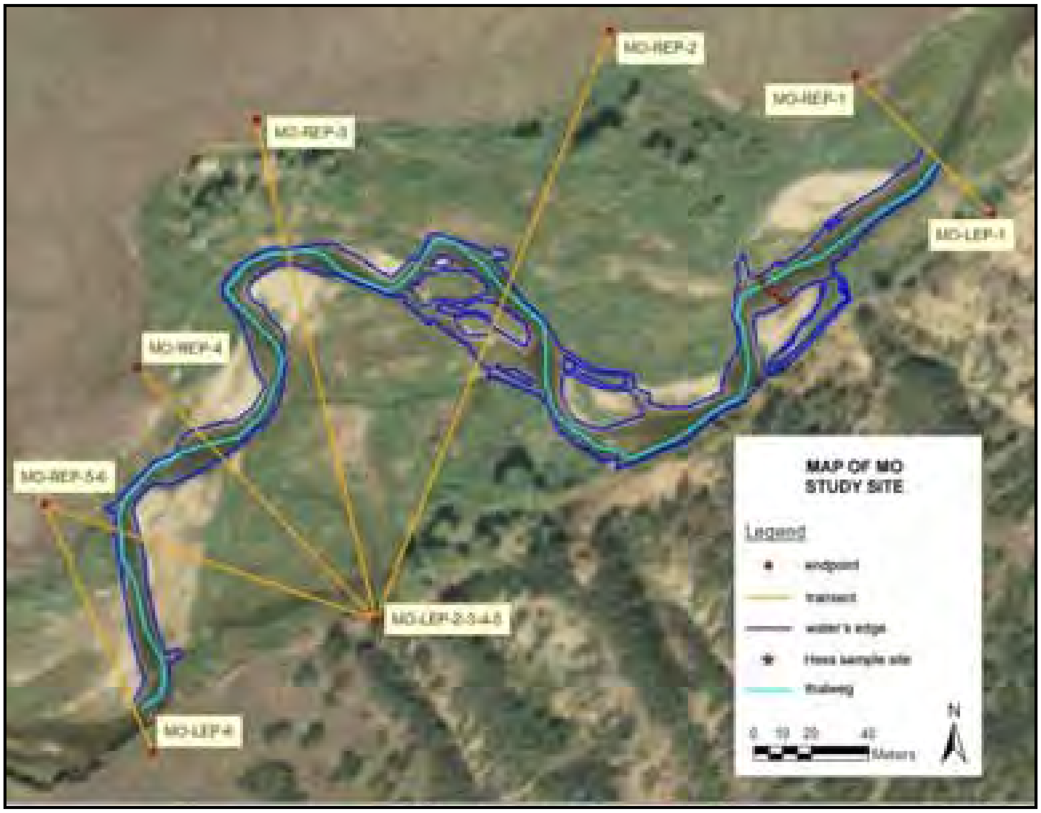


Figure 2.3. Mother (MO) study site map. Aerial photo from 2006. Flow direction is from right to left.

Figure 2.4. Oxbow (OX) study site map. Aerial photo from 2006. Flow direction is from right to left.

sites were surveyed after vegetation, particularly leaves, had fallen, since dense, leafed-out trees often block the line of site along the transect. Sixth Water site endpoints were resurveyed with a total station in August 2006. The endpoints were tied to one set of GPS coordinates for endpoints that matched most closely with total station survey data. The updated endpoint coordinates for SXW are presented in Table 2.1.

To complete a transect, the total station was set up over one endpoint and assigned the real-world coordinates of that endpoint in the datalogger. The corresponding transect endpoint with real-world coordinates was used as the backsight. The survey data have northings, eastings, and elevations relative to the two endpoint caps, thereby placing the subsequent transect survey data in the coordinate system with elevations in NAVD 1988.

First the backsight endpoint cap was resurveyed with the total station to check for differences between the total station survey coordinates and the GPS coordinates for the endpoint. The rod person then placed the rod at points in a straight line (0 degrees plus or minus 5 minutes) between the two endpoints (Figure 2.5). Surveyed points included major changes in topography, both the left and right edges of water, the edges of backwaters, changes in vegetation, channel features such as bars and islands, presence of large woody debris, and the thalweg (deepest part of the stream at the transect). Four photographs of each transect were also taken to show the REP, LEP, and upstream and downstream views of the transect (Appendix 2.1.A).

In 2005 the longitudinal profile was surveyed concurrently with the transects at SXW and MO during low flow. The sub-meter GPS was used to survey the longitudinal profile and edge of water at low flow for OX and DFC. The total station was used to survey the longitudinal profiles at each site in 2006.

2.3 RESULTS

2.3.1 Endpoint Coordinates

Real-world coordinates for study site transect endpoints are compiled in Table 2.1. Bridge transect endpoint coordinates, including the coordinates for the new Diamond Fork at Three Forks transect, are shown in Table 2.2. Northing and easting values are provided in NAD83 UTM meters. Elevations are in NAVD 1988 feet. Transects corresponding to an endpoint are denoted by number on the endpoint label. As described earlier, some study site transects share endpoints. All transects corresponding to a specific endpoint are stamped on the endcap that marks the transect endpoint.

2.3.2 Cross Sections

Photographs of each cross section are included in Appendix 2.1.A. Cross-section plots are compiled in Appendix 2.2.A. These plots include baseline (2005) cross sections and plots of the 2006 transect data. Future surveys will also be conducted and results compared with data from 2005 and 2006 to determine changes in channel geometry over the study period. However, only distance and elevation data from the 2006 cross-section surveys are provided in Appendix 2.2.B. Since SXW site endpoint coordinates were resurveyed for 2006, the elevation data from 2005 were adjusted to match 2006 endpoint elevations. These adjusted transect data are in Appendix 2.2.C.

Table 2.1. Endpoint coordinates for cross sections in study sites using NAD83 UTM meters.

CROSS-SECTION ENDPOINT[a]	NORTHING (METERS)	EASTING (METERS)	ELEVATION (NAVD88 FEET)
SXW 1 REP	4,445,801.13	476,057.70	6,952.05
SXW 2 REP	4,445,787.82	476,020.79	6,949.62
SXW 3 REP	4,445,756.59	475,995.48	6,916.38
SXW 4-5-6 REP	4,445,731.04	475,922.93	6,928.65
SXW 1 LEP	4,445,764.73	476,084.76	6,926.19
SXW 2-3 LEP	4,445,742.51	476,046.11	6,923.57
SXW 4 LEP	4,445,717.89	476,041.60	6,921.66
SXW 5 LEP	4,445,684.05	475,994.53	6,914.02
SXW 6 LEP	4,445,652.31	475,973.60	6,920.56
DFC 1 REP	4,435,557.77	462,855.08	5,190.97
DFC 2 REP	4,435,553.85	462,746.59	5,194.35
DFC 3 REP	4,435,484.22	462,656.15	5,178.00
DFC 4 REP	4,435,445.24	462,612.84	5,185.31
DFC 5-6-7 REP	4,435,385.24	462,586.02	5,183.52
DFC LEP 1	4,435,372.65	462,869.86	5,197.23
DFC LEP 2	4,435,363.03	462,709.62	5,207.53
DFC 3-4-5 LEP	4,435,357.40	462,672.33	5,206.85
DFC 6 LEP	4,435,332.72	462,647.07	5,206.43
DFC 7 LEP	4,435,310.52	462,587.46	5,203.44
MO 1 REP	4,432,997.96	460,101.28	5,073.03
MO 2 REP	4,433,013.97	460,015.58	5,075.86
MO 3 REP	4,432,982.20	459,892.22	5,069.28
MO 4 REP	4,432,895.62	459,850.80	5,065.26
MO 5-6 REP	4,432,848.00	459,818.58	5,061.64
MO 1 LEP	4,432,949.67	460,149.02	5,081.36
MO 2-3-4-5 LEP	4,432,807.72	459,933.75	5,082.52
MO 6 LEP	4,432,761.33	459,856.05	5,073.54
OX 1 REP	4,432,364.02	458,756.92	5,031.04
OX 2-3-4 REP	4,432,308.61	458,693.33	5,028.13
OX 5 REP	4,432,244.07	458,585.88	5,021.99
OX 6-7 REP	4,432,232.76	458,495.21	5,031.94
OX 8 REP	4,432,123.25	458,288.55	5,007.85
OX 1-2 LEP	4,432,250.13	458,850.94	5,026.19
OX 3 LEP	4,432,169.14	458,802.24	5,024.20
OX 4 LEP	4,432,102.14	458,737.36	5,025.39
OX 5 LEP	4,432,054.02	458,621.93	5,020.37
OX 6 LEP	4,432,047.81	458,500.76	5,019.39
OX 7-8 LEP	4,432,122.37	458,374.45	5,017.11

[a] SXW = Sixth Water, DFC = Diamond Fork Campground, MO = Mother, OX = Oxbow, LEP = left endpoint, and REP = right endpoint.

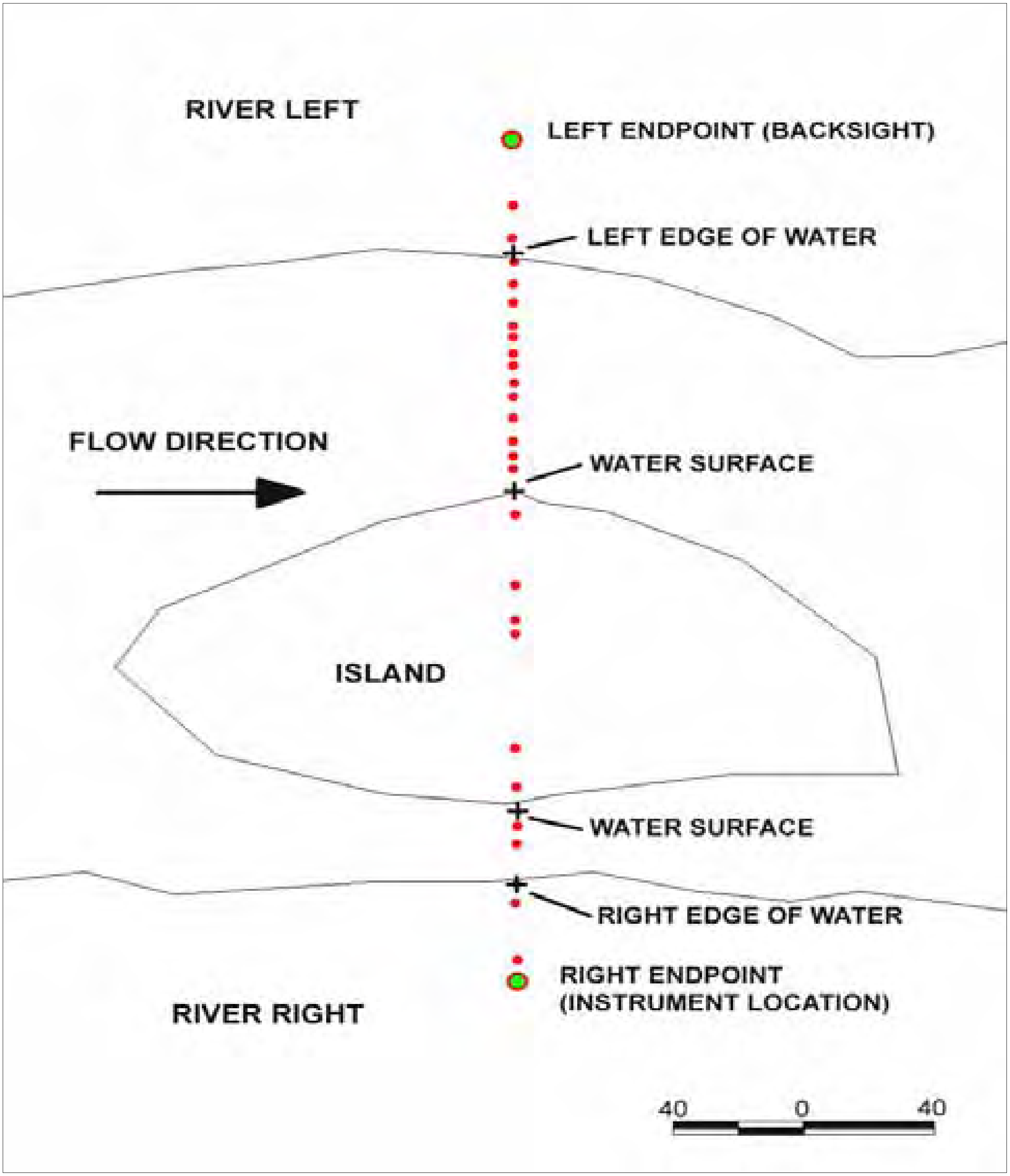


Figure 2.5. Methods for surveying permanent cross sections using a total station. The instrument is set over a permanent endpoint (a labeled aluminum cap on a 3-foot rebar stake) with known coordinates. Survey points are taken along the transect between the endpoints at 20-foot intervals or when the bed elevation changes by more than 0.5 foot. Large cobbles and boulders, therefore, can be seen on cross-section plots. A laser on the total station, not tapes and taglines, is used to align the survey points and determine distances between the endpoints.

Table 2.2. Endpoint information for bedload sediment sampling bridge cross sections in NAD83 UTM meters.

BRIDGE ENDPOINT[a]	NORTHING (METERS)	EASTING (METERS)	ELEVATION (NAVD88 FEET)
SXW-U (UPPER) REP	4,444,563.95	474,339.22	6,678.93
SXW-U (UPPER) LEP	4,444,547.85	474,351.87	6,680.31
SXW-L (LOWER) REP	4,437,175.55	469,738.65	5,532.54
SXW-L (LOWER) LEP	4,437,148.74	469,724.09	5,538.27
MK REP	4,436,163.28	466,530.07	5,345.31
MK LEP	4,436,144.34	466,532.04	5,345.20
BR REP	4,434,815.50	462,310.67	5,148.17
BR LEP	4,434,809.78	462,324.34	5,148.63
CH REP	4,431,335.68	457,521.45	4,977.31
CH LEP	4,431,322.12	457,538.52	4,976.35

[a] SXW-U = Upper Sixth Water, SXW-L = Lower Sixth Water, DI = Diamond Fork at Three Forks), MK = Monks, BR = Brimhall, CH = Childs, LEP = left endpoint, and REP = right endpoint.

Plots of changes in the position of the low-flow edge of water from 2005 to 2006 are shown in Figures 2.6, 2.7, 2.8, and 2.9. Thalweg location shifts are shown in Figures 2.10, 2.11, 2.12, and 2.13.

The SXW site cross sections are on Sixth Water Creek between Strawberry Tunnel and Syar Tunnel. This area was formerly used to deliver water from Strawberry Reservoir to Spanish Fork via Strawberry Tunnel. When Syar Tunnel was completed, minimal flow was sent through Strawberry Tunnel. All six transects are in straight-channel riffle areas, which are typical of the reach. Transect SXW3 crosses the toe of an island, and transect SXW6 is in a wider part of the channel compared with upstream transects. Cross-section plots show no change in cross-section shape between the 2005 and 2006 surveys. Some difference in cross-section elevations between 2005 and 2006 in the SXW site may be related to placing the rod next to (versus on top of) large, boulder-sized material in the channel.

The DFC transects are all downstream of Diamond Fork Campground. Transects DFC1 and DFC2 are in a straight, run-type section. Transect DFC3 marks the transition into a meander and island complex. Transect DFC4 is primarily a riffle, with flow split around islands. Transect DFC6 is in a riffle-type section with many small islands and large woody debris. Transect DFC6 contains a deep pool to river left that starts just downstream of transect DFC5. Transect DFC7 crosses an island on river right. Transect DFC7 is farthest downstream and located where the stream channel starts to cut back toward the road.

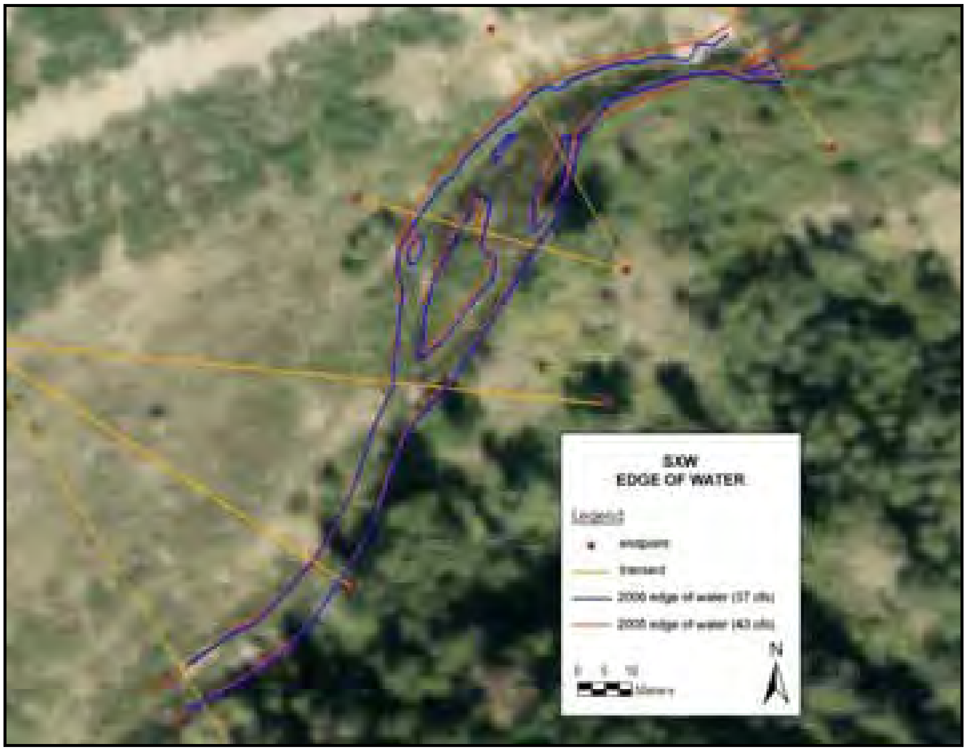


Figure 2.6. Location of the surveyed edge of water at the Sixth Water (SXW) site in 2005 (43 cfs) compared with 2006 (37 cfs). Aerial photograph from 2006.

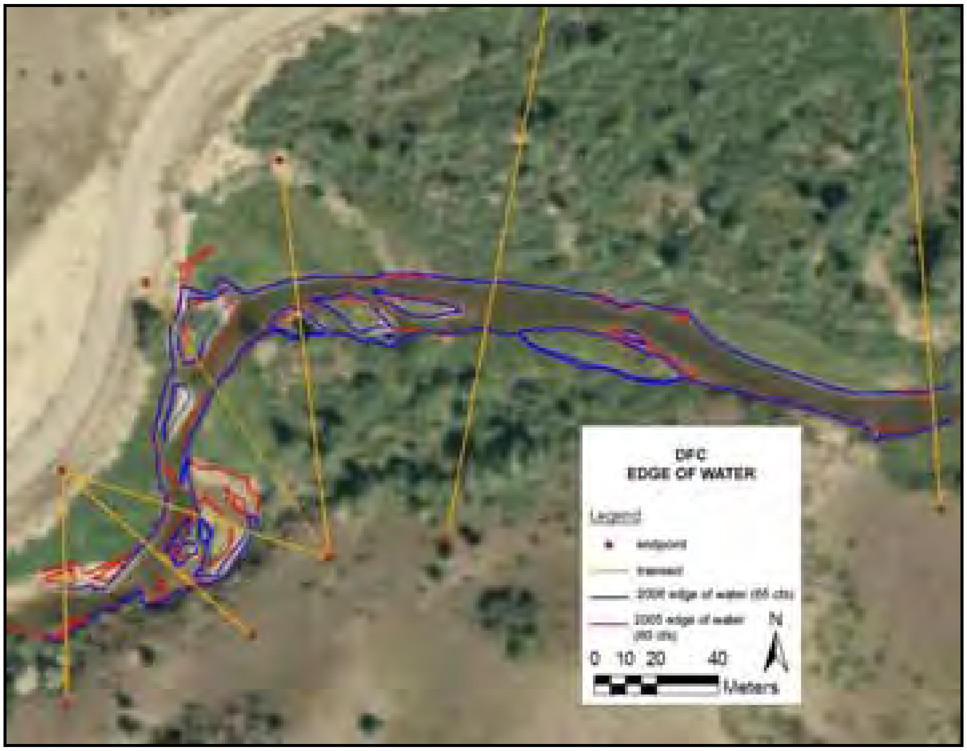


Figure 2.7. Location of the surveyed water edge at the Diamond Fork Campground (DFC) site in 2005 (60 cfs) compared with 2006 (65 cfs). Aerial photograph from 2006.

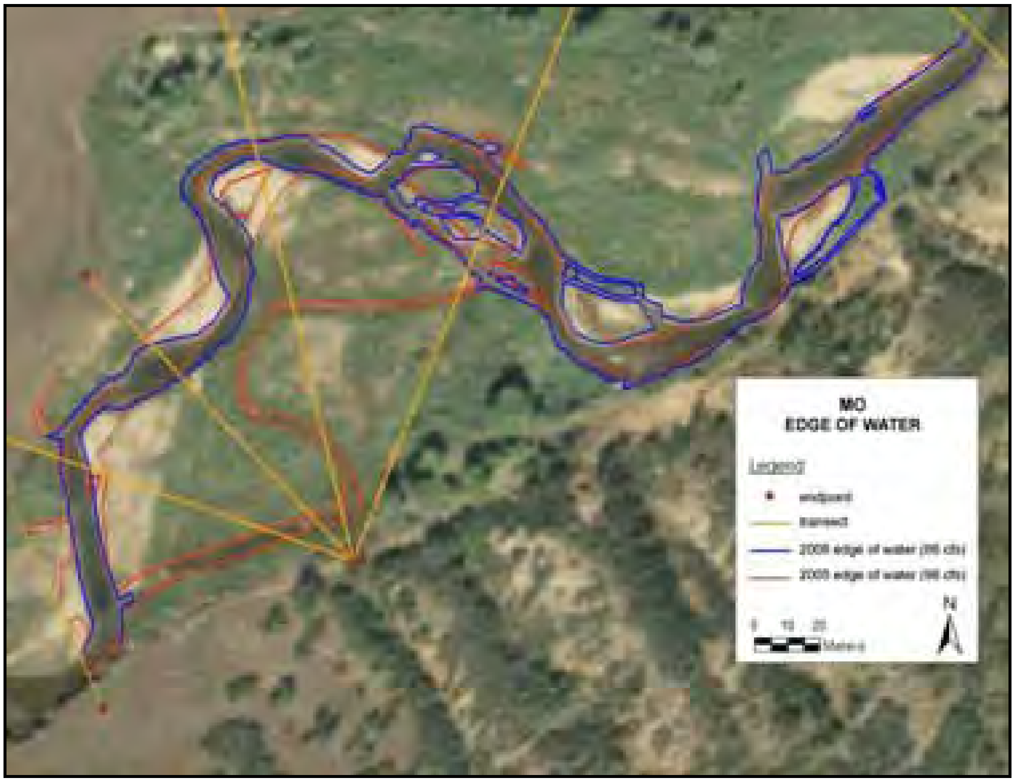


Figure 2.8. Location of the surveyed water edge Mother (MO) site in 2005 (96 cfs) compared with 2006 (66 cfs). Aerial photograph from 2006.

Figure 2.9. Location of the surveyed edge of water at the Oxbow (OX) site in 2005 (60 cfs) compared with 2006 (67 cfs). Aerial photograph from 2006.

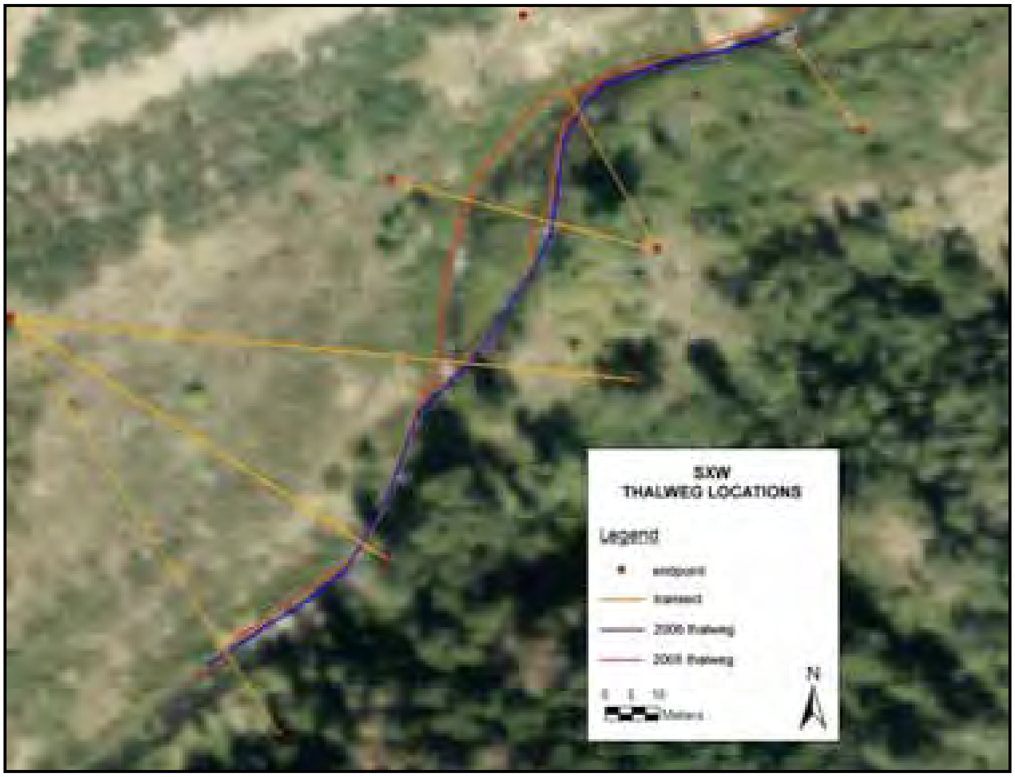


Figure 2.10. Location of the surveyed thalweg at the Sixth Water (SXW) site in 2005 compared with 2006.

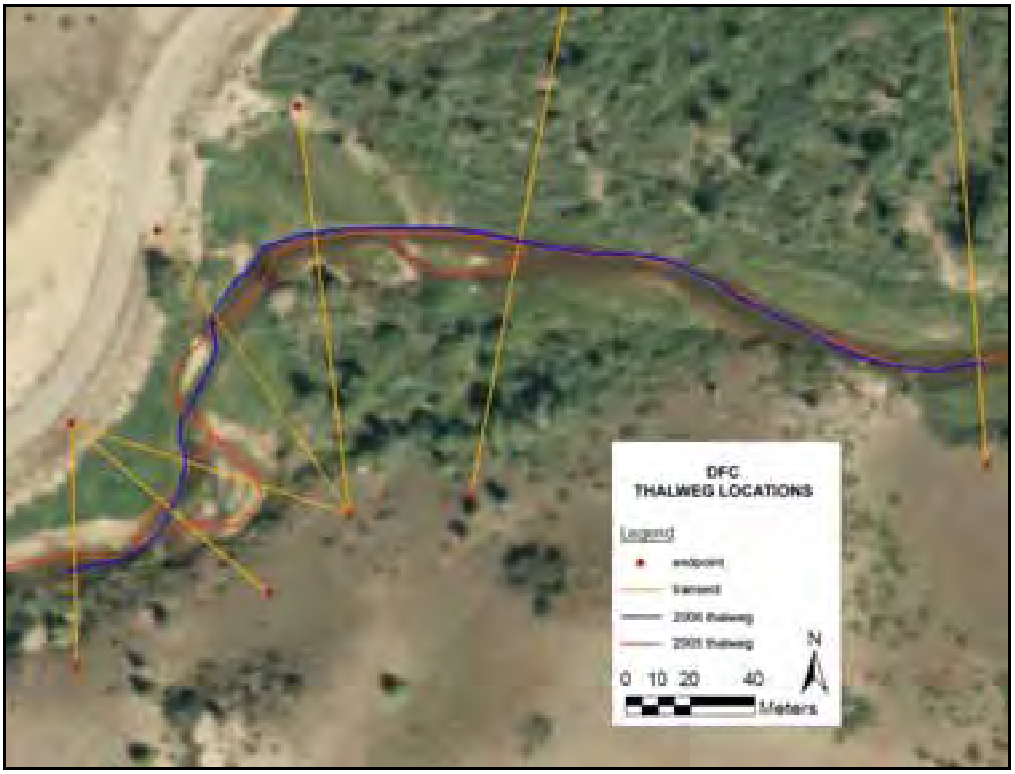


Figure 2.11. Location of the surveyed thalweg at the Diamond Fork Campground (DFC) site in 2005 compared with 2006.

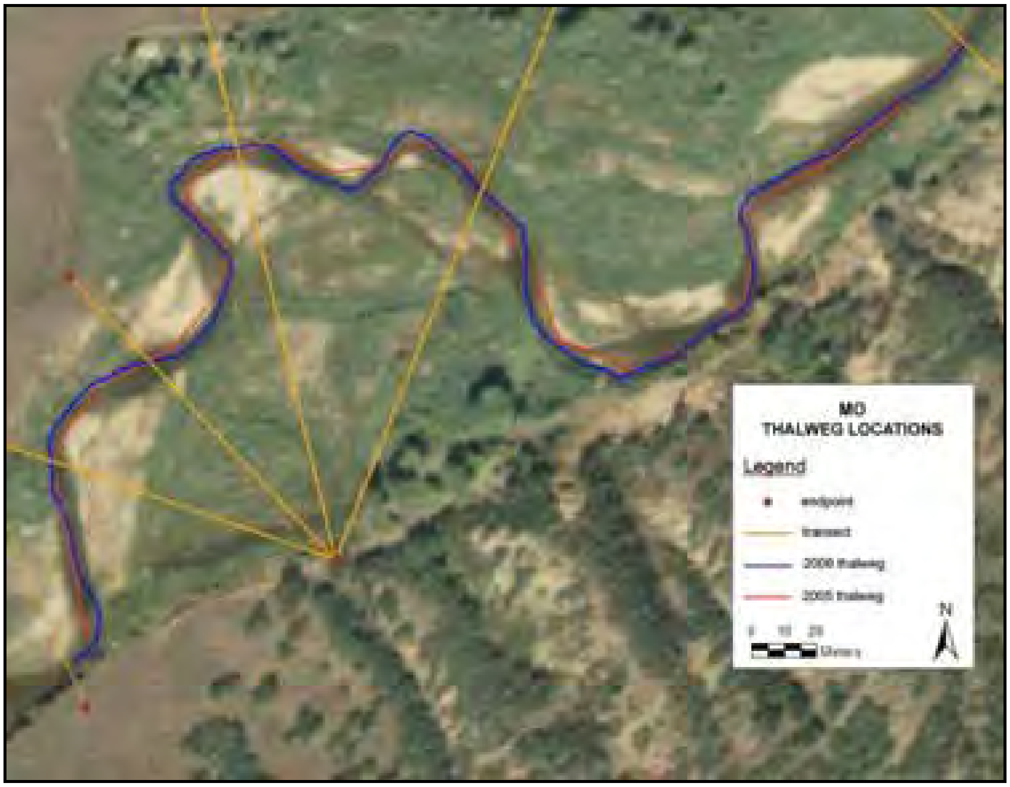


Figure 2.12. Location of the surveyed thalweg at the Mother (MO) site in 2005 compared with 2006.

Figure 2.13. Location of the surveyed thalweg at the Oxbow (OX) site in 2005 compared with 2006.

Changes at the DFC site transects are shown in cross-section plots (Appendix 2.2.A). The large change at DFC 1 on the right bank is not an indication that slope failure occurred. This area is a fairly stable hill slope with piles of dead willows at the toe of the slope. This elevation change is most likely a rod height error. Transects DFC 2 and DFC 3 show very little change between the 2005 and 2006 surveys except that the thalweg is slightly higher in the 2006 transect than it was in the 2005 transect. Transects DFC3 and DFC4 indicate more deposition and bar development in the channel between 2005 and 2006. All of these transects are in a relatively straight section of the site.

Cross-section changes between the 2005 and 2006 surveys are more noticeable in transects DFC4 and DFC5. The channel begins to meander in this part of the site. Additionally, the channel narrows and then becomes substantially wider just before transect DFC5. In this wider channel area, the in-stream features—such as bars and location of pools, riffles, and side channels—are more dynamic. Some of these changes might be seen at 150 feet from the LEP in transect DFC5. The transect does show deepening of pools along the outside meander at transect DFC5. These in-stream feature changes may be more apparent in the substrate mapping. Some erosion occurred on the left bank at DFC6, but the rest of the transect did not change between 2005 and 2006. Changes in the plot of the left bank of transect DFC7 could be indicative of bank erosion, but they could also reflect rod placement as indicated by the squareness of the 2006 plot. Aggradation can also be seen in transect DFC7.

The plots of water edge and thalweg changes also reflect the relatively stable nature of the upstream half of the DFC site and the more dynamic nature of the downstream half of the site (Figure 2.7, Figure 2.11). In addition to shifts in the size and shape of islands, the spring floods in 2005 and 2006 eroded a large portion (about 15-feet wide and 25-feet long) of the right bank just upstream of DFC5 (Figure 2.7). Another significant change was the erosion of the gravel bar that was attached to the island spanned by DFC4 in 2005 and the deposition of a new gravel bar downstream between DFC4 and DFC5 (Figure 2.7).

The MO transects are in a geomorphically complex section of Diamond Fork, which contains many small islands and bars. Transect MO1 is in a straight, run-type section. Transects MO2 and MO3 are farther downstream in the meandering section of the study site. These transects cross an island and two side channels. Transects MO4 and MO5 have deep pools on river right and cross the side channel closest to the left bank. Transect MO6 is the farthest downstream cross section and in a riffle section with flow split around an island. This cross section is also downstream of the active side channel crossed by transects MO2-MO5.

Comparing 2005 and 2006 plots of the MO transects shows some change at each transect in the site. Transect MO1 shows approximately 3 feet of erosion on the left bank and aggradation in the channel and floodplain. Transect MO2 shows aggradation of up to 2 vertical feet in the channel. The bed at MO2 in the main channel is higher than in 2005. There may also be some initiation of change in the side channel on the left bank. Since substrate tends to be cobble sized or smaller in this section of the stream, measured elevational differences reflect true channel bed changes, not just the difference between placing the survey rod on top of or in between boulders. At MO3, the thalweg has become deeper by approximately 3 feet, with some deposition occurring mid channel. Transect MO4 shows about 10 feet of erosion at the left bank of the main channel but fairly minimal change across the remainder of the transect. It appears that the side channel along the left-side hill is also filling in. Alternatively, transects MO5 and MO6 each show incision in the main channel. Data plots of MO5 show the area near the right bank eroding slightly and the channel becoming deeper by 2 feet along the right bank. Transect MO6 shows the thalweg becoming deeper by about 1 foot and the channel becoming wider due to erosion of the bar deposit on the right side of the thalweg.

The dynamic nature of the MO site is also reflected in the thalweg and edge of water plots (Figure 2.8, Figure 2.12). In addition to the changes observed at the surveyed transects, shifts also occurred in between transects. The side channel along the right side of the point bar upstream of MO2 became active at low flow, and the side channel to the left of the islands crossed by MO2 now carries more flow than in 2005 (Figure 2.8). Significant bank erosion along the outside of the bends within the lower half of the site also is evident, suggesting that sinuosity may be increasing (Figure 2.8). This tendency toward increased sinuosity is also reflected in the thalweg plots (Figure 2.12).

The OX site is the farthest downstream monitoring site in the watershed and contains eight transects. Transect OX1 is the farthest upstream and crosses a relatively narrow section of the stream at a riffle. Transect OX2 is similar to OX1, except it crosses the stream at a bend. Transect OX3 crosses a mid-channel island that splits flow around the island. This transect is located on a meander bend. Transect OX4 crosses a riffle at the downstream end of the bend. Transect OX5 is located in the middle of a relatively straight section of Diamond Fork. This straight section has a large floodplain area to the south and an eroding terrace to the north. Transect OX5 also crosses a backwater that extends farther into the floodplain. Transect OX6 marks the lower boundary of the straight section and is the start of a large meander bend. Transect OX7 crosses this meander bend just below OX6. The transect cuts across a point bar and part of a backwater that is initiated farther downstream. Transect OX8 is the most downstream cross section. Like OX1, this cross section is in a straight, single channel section of the stream with no major changes in channel features or backwaters. Because of their length, all transects in the OX site also cover the active, present-day floodplains, as well as large areas of abandoned floodplains that formed as Diamond Fork and Sixth Water Creeks began to downcut when these channels were used to transport water.

Transect OX1 did not change between 2005 and 2006. Transect OX2 showed some deepening (1.3 feet) of the thalweg in 2006 and some deposition and bar building. Several changes between 2005 and 2006 are noticeable at OX3. The thalweg has moved to the right, eroding part of the mid-channel island, and the stream has deposited material near the left bank. Some of this deposition may be material from the left bank upstream of transect OX3, which eroded substantially between the 2005 and 2006 surveys (Figure 2.9). Transect OX4 shows the same trend as OX3, with the thalweg migrating toward the right bank and deposition converting what was previously a shallowly inundated gravel bar into a flow-splitting, mid-channel bar (Figures 2.9 and 2.13). Plots of transect OX5 show some deposition in the backwater area to the left of the main channel in 2006. No significant change is shown at transect OX6 between the 2005 and 2006 surveys. Plots of water edge and thalweg changes also indicate relatively stable conditions within this straight, central portion of the study site (Figure 2.9, Figure 2.13). Transect OX7 shows the channel becoming shallower. The thalweg on the right side of the channel has moved toward the left (see Figure 2.13) and filled in. The deep part of the channel near the left bank is the thalweg in 2006. The left bank also eroded by about 20 feet at OX7. Significant changes also occurred in the meandering reach below transect OX7 (Figure 2.9, Figure 2.13). Bank erosion occurred at the outsides of bends, suggesting a trend toward increasing sinuosity similar to the MO site. A new gravel bar formed just downstream of transect OX7 and below that the island-bar complex was reshaped between 2005 and 2006 (Figure 2.9). Transect OX8 is another straight section of the site and did not change significantly in 2006.

2.3.3 Longitudinal Profiles

Similar to cross-section (or transect) plots, the longitudinal profile plots illustrate the in-channel habitat diversity of the study sites. Longitudinal profiles for each study site are included in Appendix 2.3.A. Distance and elevation data used in longitudinal profile plots are in Appendix 2.3.B. The starting and ending points and total survey distance (thalweg length) differ slightly between the 2005 and 2006 surveys (BIO-WEST 2006) due to (1) channel changes and (2) the ability of the surveyor to locate the exact starting and ending position from year to year in the field. The profiles for the two years are not plotted on the same graph because the difference in starting and ending points makes it hard to overlay lines (with distance and elevation data) without illustrating erroneous plotting differences, not actual differences, in the channel. Therefore, general trend lines were plotted separately and analysis of specific parts of the data with reference to cross section location was used to determine change in the 2005 and 2006 longitudinal profile data.

In 2005 and 2006, the SXW longitudinal profile shows a relatively smooth and steeply sloped channel bed (slope = 3%), with few defined pools. The DFC, MO, and OX site longitudinal profiles showed a greater range of pool and riffle features, and much shallower slopes of 0.9 percent, 0.6 percent, and 0.7 percent, respectively. Channel sinuosity (channel length divided by valley length) is lowest at SXW (1.04), second lowest at DFC (1.07), highest at MO (1.71), second highest at OX (1.55), and corresponds inversely with channel slope, except for the DFC site where sinuosity is strongly influenced by a long, straight section between DFC 1 and DFC 2. However, there are many more defined pools and riffles at the DFC site than at the SXW site (mostly between DFC 2 and DFC 7), even though the sites have similar sinuosities. There are only slight differences in overall sinuosity at any site between the 2005 and 2006 surveys, certainly within the error of the measurement from aerial photographs.

The 2006 longitudinal profiles showed almost no change at SXW compared with the 2005 survey, with the slope remaining at 3 percent. The DFC site also maintained a similar 0.9 percent slope between years, but the thalweg location and meander geometry did change in the lower third of the study site (DFC 3 through DFC 7). The plots for the lower sites (MO and OX) show slightly different slopes between 2005 and 2006: The MO site slope dropped to 0.5 percent and the OX site slope dropped to 0.6 percent, 0.1 percent less slope than the 2005 plots (BIO-WEST 2006). Even though there is evidence of aggradation at these two sites based on the cross section plots, the differences in reach slope are most likely related to a slightly different survey distance in 2006 compared with 2005, and possibly differences in GPS and total station surveys for the OX study site. A close look at these numbers is warranted for the 2007 survey.

In 2006 the SWX study site is still a steeply sloped section with primarily riffle and small pocket-water pools. The DFC study site has a much more moderate slope and is dominated by riffles and run-type features in the channel. The upper 150 meters of the study site (between DFC 1 and DFC 3) have primarily riffle and run-type habitat features, whereas more pools, particularly along meander bends, are present in the lower portions of the study site (DFC 3 to DFC 7). The MO study site shows the most in-channel pool-riffle diversity, with oscillating pool, riffle, and run habitat types along the entire study site (from MO 1 to MO 6). The OX study site also contains several pools, riffles, and runs, but the distance between pool features is greater at OX than MO. The most notable feature on the OX longitudinal profile is the long, straight portion of the stream between OX 3 to

OX 7, constituting a long run in the middle to lower part of the study site. Additionally, the rip rap bank between OX 7 and OX 8 seems to limit pool depths along the outside of this large bend, compared with the upstream meander sequences at OX and MO (OX 1 to OX 4 and MO 1 to MO 6).

2.3.4 Discussion and Summary

The 2005 study site cross sections showed that the study sites span a range of channel types from the relatively simple (homogeneous elevations across the entire cross section), single-threaded channel in the SXW site to highly complex (heterogeneous elevations across the cross sections) channels that traverse bars and pools, side channels, backwaters, and/or islands, particularly at MO and the sinuous portions of DFC and OX. There are no defined backwaters or side channels at SXW. The MO site is the most sinuous, with oscillating pools and riffles.

The 2006 data verify these findings. Comparison of 2005 and 2006 data indicates that some change has occurred in most sites. The SXW site cross sections are essentially the same between 2005 and 2006. The lower three sites show areas of change such as bank erosion, deposition onto surfaces, or change in location or depth of the thalweg. Some channel shifting also occurred. Bar development and meander migration are more active in the sinuous portions of the three lower study sites (DFC, MO, and OX).

The 2005 and 2006 data seem to indicate that the lower three sites are active and adjusting, particularly in the meandering sections of the river. These areas show a trend toward increasing sinuosity and evidence of aggradation. Straight sections of the lower three sites, however, are relatively stable. As expected, MO and OX showed the most change at cross sections between the 2 years. However, these results are only indicative of a relatively short period (2 years) after pipeline completion. Given more time, vegetation encroachment and continuing geomorphic processes will also affect the channel. Moreover, many additional changes between cross sections are shown in the substrate maps in Chapter 3.

3.0 CHANNEL SUBSTRATE

3.0 CHANNEL SUBSTRATE

3.1 INTRODUCTION

Channel substrate provides habitat for many aquatic species and constitutes spawning areas for some fish species in Diamond Fork Creek. This chapter describes the methods and results of the first 2 years of monitoring channel substrate in the Diamond Fork study sites and its tributary, Sixth Water Creek. Monitoring the channel substrate determines what substrate is present and what changes in substrate have occurred over time, which is important relative to habitat condition and as an indication of recent geomorphic activity. Monitoring the substrate can help determine whether restoration efforts are required to maintain Diamond Fork Creek in a desired condition and the Mitigation Commission is fulfilling its commitments concerning Diamond Fork Creek. The pebble count results are also used as inputs to sediment transport equations as part of bedload modeling efforts (see Chapter 4).

3.2 METHODS

3.2.1 Substrate Mapping

Substrate classifications throughout each monitoring site were hand delineated in the field on plots generated from the topographic surveys (see Chapter 2) completed in fall 2006 (Table 3.1). To help ensure consistency in substrate size classification, a single individual conducted the mapping, which was done at low flow. This individual delineated substrate into visibly homogeneous substrate types based on dominant and sub-dominant particle sizes. Classification was based on a modified Wentworth scale (Table 3.2).

Table 3.1. Substrate mapping dates and flows.

SITE [a]	DATE(S) OF MAPPING	AVERAGE FLOW DURING MAPPING
SXW	8/9/06	37 cfs [b]
DFC	11/15/06 11/17/06	67 cfs 66 cfs
MO	11/17/06 11/20/06 11/26/06	66 cfs 66 cfs 63 cfs
OX	11/26/06 12/13/06	63 cfs 64 cfs

[a] SXW = Sixth Water, DFC = Diamond Fork Campground, MO = Mother, OX = Oxbow.
[b] cubic feet per second.

In 2005 detailed classification of main channel substrate was not possible because of poor visibility caused by turbid water conditions (BIO-WEST 2006). In 2006 mapping was completed in the fall, when conditions were less turbid, and main channel areas were classified based on percentages of the substrate types listed in Table 3.2. At the DFC, MO, and OX sites, it was not possible to map several areas because flows were too deep or fast for wading; these areas were classified as “unknown” substrate polygons.

Table 3.2. Size classes used for substrate mapping.

SIZE CLASS (MILLIMETERS)	DESCRIPTION	ABBREVIATION
<2	sand/silt	SA/SI
2-8	fine gravel	FG
8-32	medium gravel	MG
32-64	large gravel	LG
64-256	cobble	C
>256	boulder	B

Substrate maps were digitized into a GIS layer using ArcMAP software with the 2006 National Agricultural Imagery Program (NAIP) orthophotos as base images. Within ArcMAP each substrate patch (polygon) was attributed with the percentage of the polygon in each substrate size class. These values were multiplied by the area of each polygon to determine the total area of each size class within the entire monitoring site. For mapping purposes, a simplified dominant size class was also identified for each polygon.

3.2.2 Island and Riparian Vegetation Mapping

Qualitative mapping of island and streamside riparian vegetation types was completed in conjunction with substrate mapping at the DFC, MO and OX sites. Riparian mapping was not completed at the SXW site in 2006. Mid-channel deposits containing grass were mapped as islands rather than as substrate polygons, even if they had significant portions of bare cobble, gravel, sand, or silt as well as grass. Riparian vegetation was only mapped along the immediate streamside area visible from the main channel. Riparian vegetation growing in floodplain areas beyond the streamside corridor was not mapped as part of this effort. It should also be noted that this mapping effort is not intended to be a species-specific or quantitatively accurate technique; rather, it is meant to be a simple way to collect general information on dominant vegetation categories and observe general changes through time.

A more detailed map of riparian vegetation communities along the entire Diamond Fork and Sixth Water Creeks riparian corridor was also created in 2006 as part of the Ute ladies'-tresses (ULT) monitoring (BIO-WEST 2008). Data for the more detailed map include percent coverage of dominant species within polygons, dominant species along cross-sectional transects (within each study site), ULT counts on specific occupied surfaces, ULT estimates on all surfaces along the entire Diamond Fork riparian corridor, and riparian vegetation habitat monitoring along specific transects within specified occupied, potentially occupied, and previously unoccupied surfaces.

Areas for this task were mapped according to the combination of vegetation (e.g., grass, willow, cottonwood) and ground cover (e.g., sand/silt, gravel, rock [rip-rap]) present. Some island and bar areas contained cobble-sized material in addition to gravel. In order to keep categories relatively simple, no "cobble" category was specified; rather, the "gravel" category was used more broadly to include both gravel- and cobble-sized material. The "bare" category was used for streamside areas devoid of vegetation such as tall eroding terraces, rip-rap banks, or deposits of clean cobble or gravel material.

Riparian maps were digitized into a GIS layer using ArcMAP software with the 2006 NAIP orthophotos as base images. Within ArcMAP each riparian patch (polygon) was attributed with its vegetation category as well as any additional notes (e.g., qualitative estimate of vegetation height, maturity, density).

3.2.3 Pebble Counts

In addition to the visual substrate mapping effort, quantitative pebble counts (Wolman 1954) were completed at discreet patches and at cross sections within each monitoring site. Pebble counts were located in riffles or on gravel bar deposits to facilitate sampling.

Six pebble counts were completed in each of the four monitoring sites. A single pebble count was also conducted at the downstream side of each sediment-monitoring bridge. Each pebble count consisted of 100 pebbles. Particles were grouped into 10 size classifications (upper limits of 2 mm, 4 mm, 8 mm, 16 mm, 32 mm, 64 mm, 128 mm, 256 mm, 512 mm, and 1,024 mm) and plotted to determine grain sizes of the D16, D25, D50, D75, and D84 particles. Pebble measurements for each study site are included in Appendix 3.2.

3.3 RESULTS

3.3.1 Substrate Maps

Maps of individual substrate polygons for each monitoring site are included in Appendix 3.1A. Accompanying attribute tables are provided Appendix 3.1B.

The maps of major/dominant substrate types illustrate some differences in streambed particle-size distributions among the different monitoring sites (Figure 3.1a-d). The differences observed among sites in 2006 are similar to those observed in 2005 (BIO-WEST 2006). The SXW site generally contains coarser bed material than the downstream monitoring sites (Figure 3.2, Figure 3.3) and has the smallest percentage of area in the sand/silt category. The coarseness of the site is a function of the site’s high position within the watershed, steep slope, and confined channel condition. Changes in substrate composition of the SXW site between 2005 and 2006 were minimal (Figure 3.2). The most significant change was the development of a new cobble-gravel patch on river right below transect 1, where the high, steep bank eroded and slumped into the channel (Figure 3.1a).

Based on the 2006 mapping results, the DFC, MO, and OX Sites are all dominated by gravel-sized material (Figures 3.1b-d, Figure 3.2, Figure 3.3). This result is in contrast to the 2005 mapping results, which indicated cobble was as dominant as gravel (Figure 3.2). However, the 2005 results were biased by the fact that the turbid main channel areas were estimated as containing “50% cobble and 50% gravel,” which artificially increased the cobble percentage. Because the 2006 mapping was completed under better water clarity conditions, the 2006 results more accurately reflect the true proportion of cobble at the DFC, MO, and OX Sites. In 2006 most main channel areas contained a small percentage (~10-20%) of finer-grained sand in addition to gravel. This sand was overlooked in

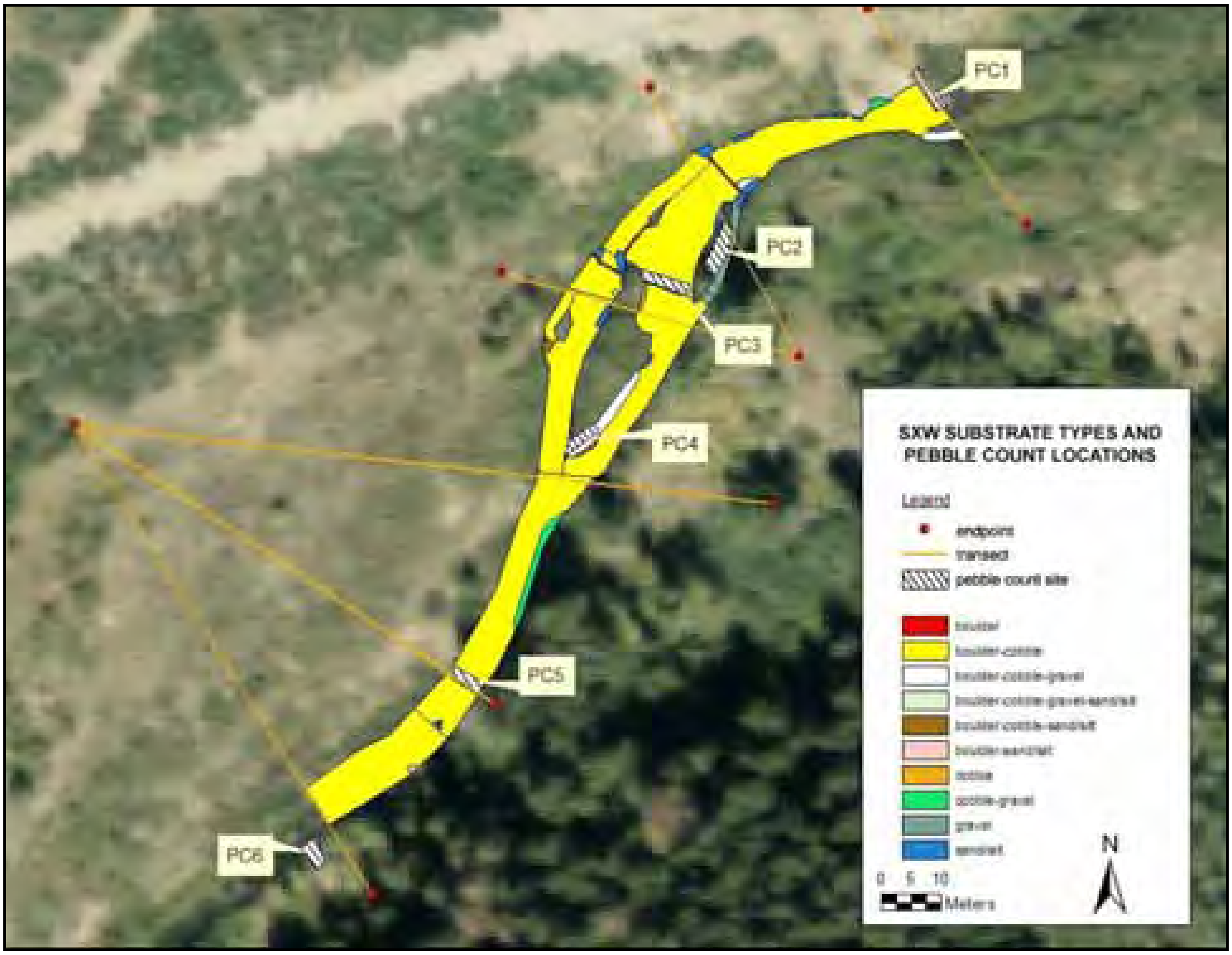


Figure 3.1a. Major substrate types and pebble count patch locations at the Sixth Water (SXW) monitoring site. Aerial photo from 2006.

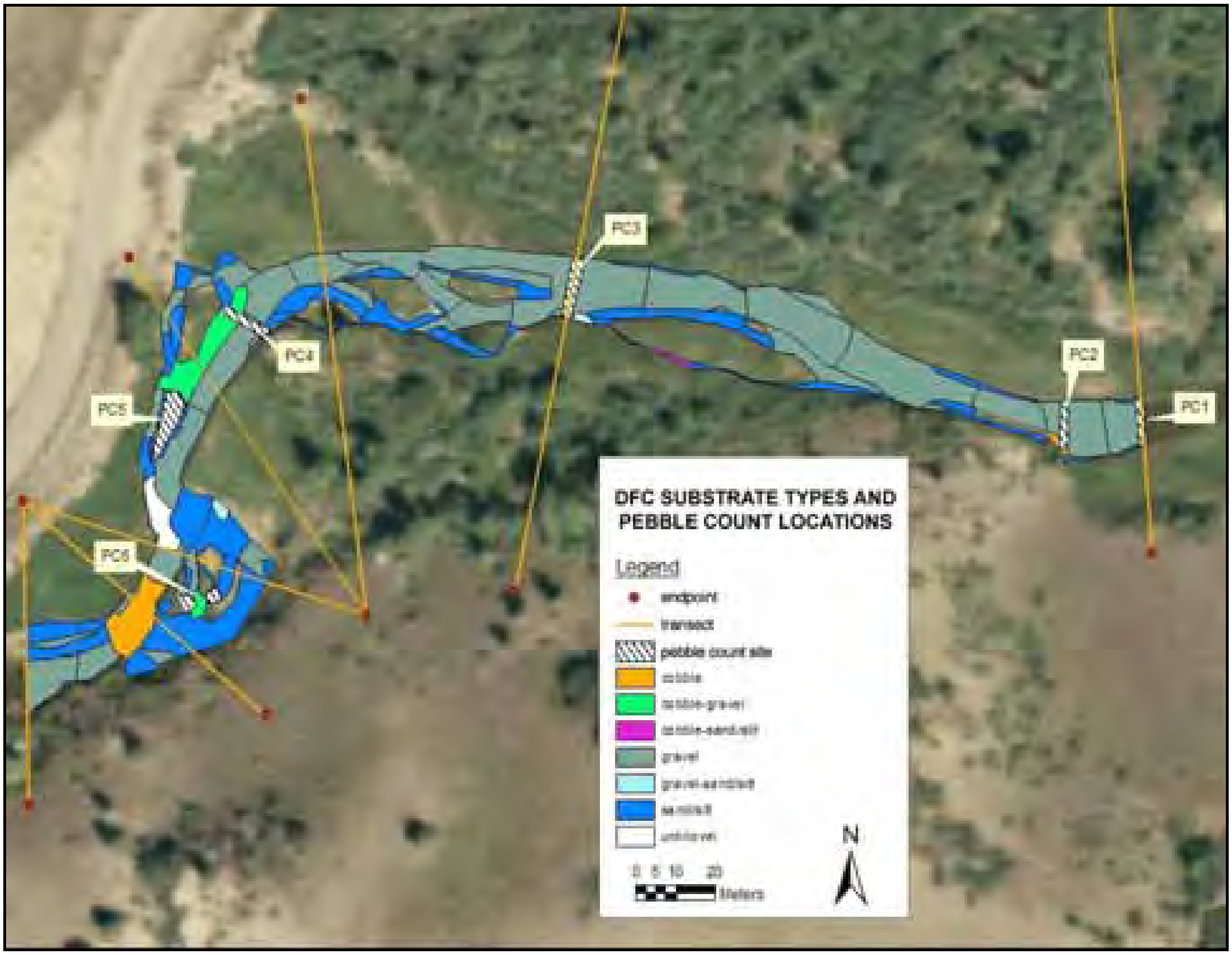


Figure 3.1b. Major substrate types and pebble count patch locations at the Diamond Fork Campground (DFC) monitoring site. Aerial photo from 2006.

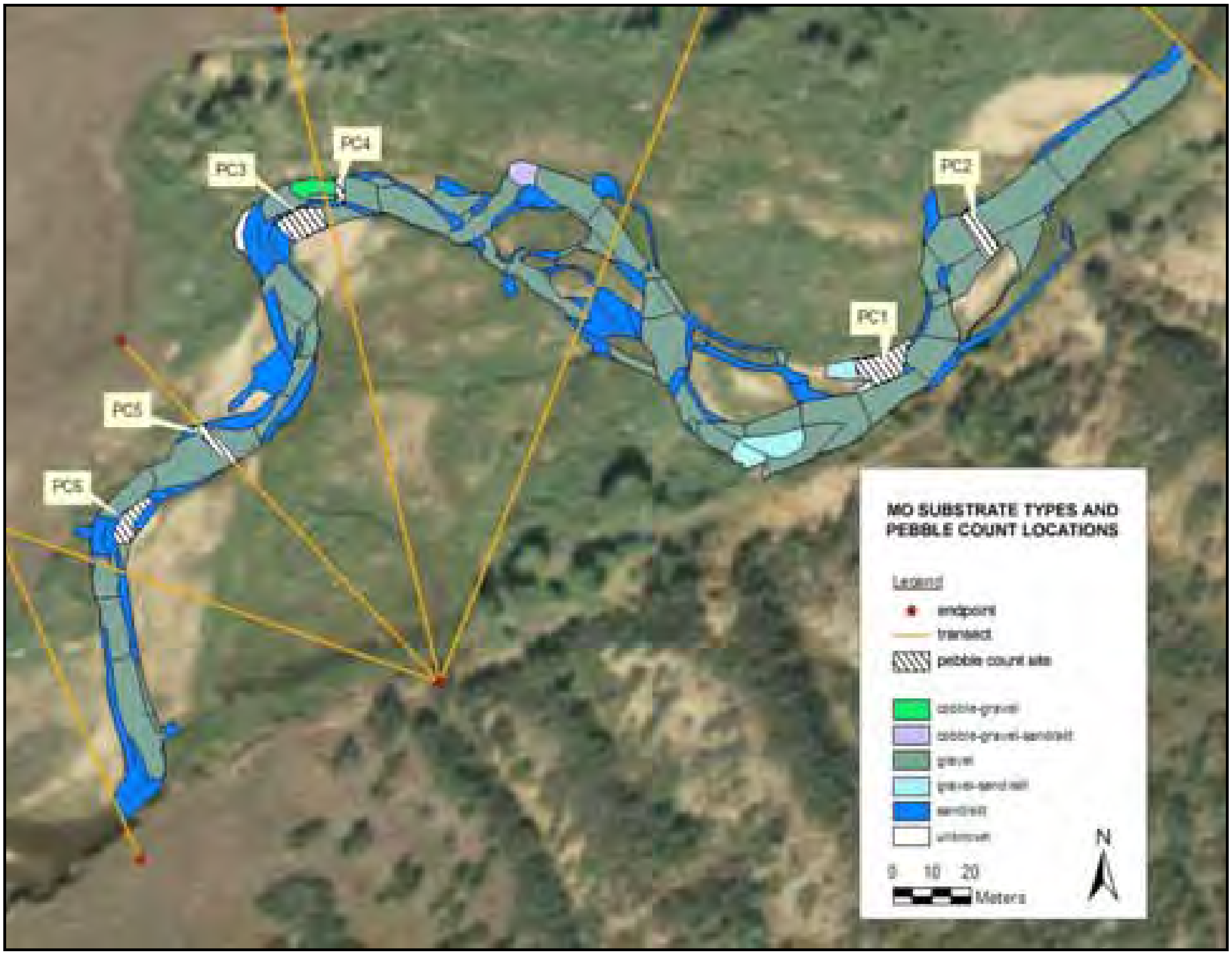


Figure 3.1c. Major substrate types and pebble count patch locations at the Mother (MO) monitoring site. Aerial photo from 2006.

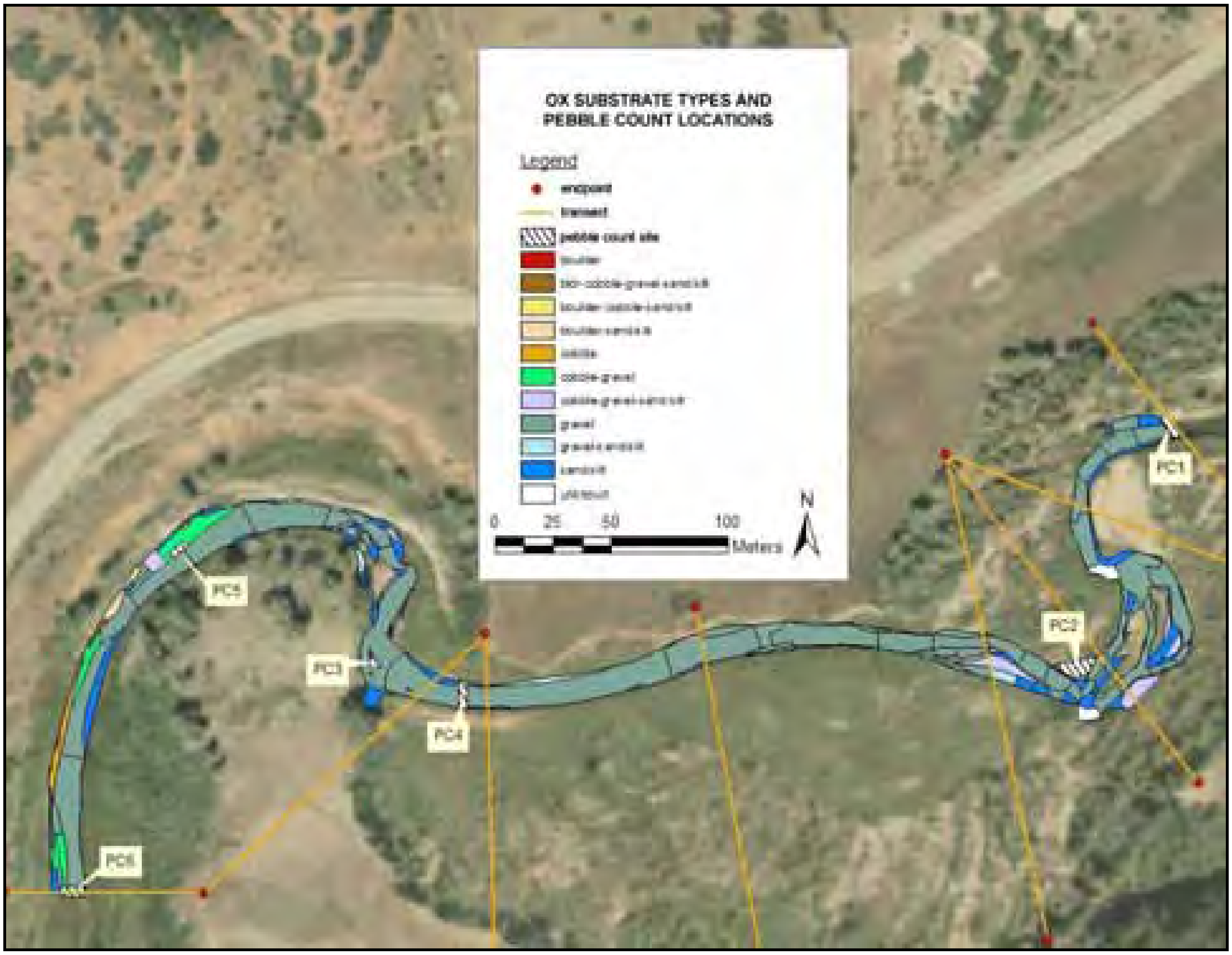
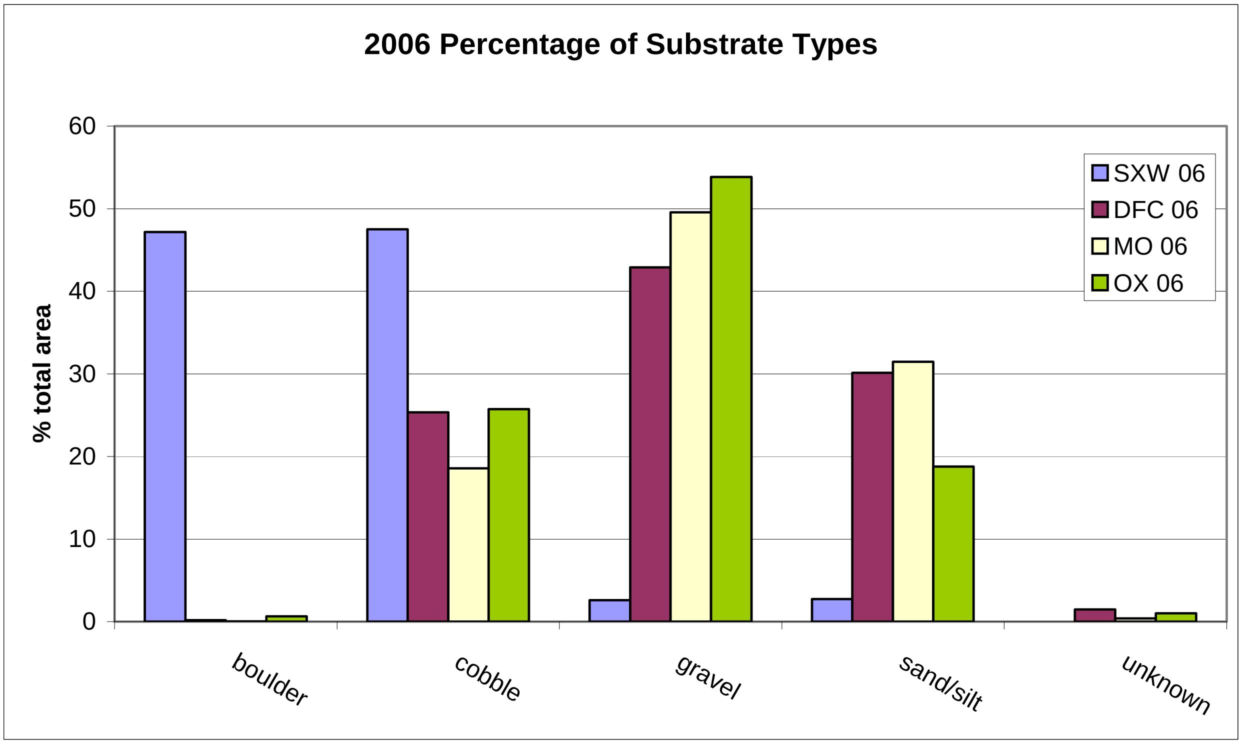


Figure 3.1d. Major substrate types and pebble count patch locations at the Oxbow (OX) monitoring site. Aerial photo from 2006.



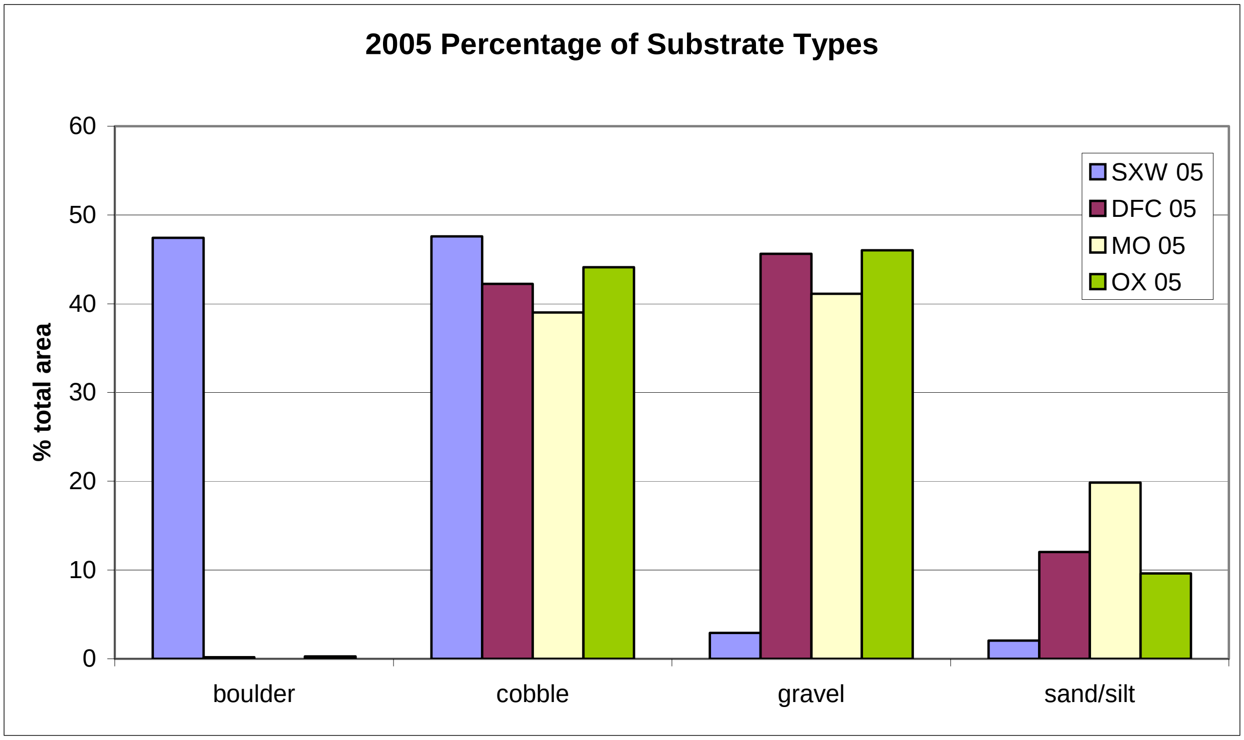


Figure 3.2. Proportion of monitoring site area occupied by various substrate size classes in 2005 and 2006.

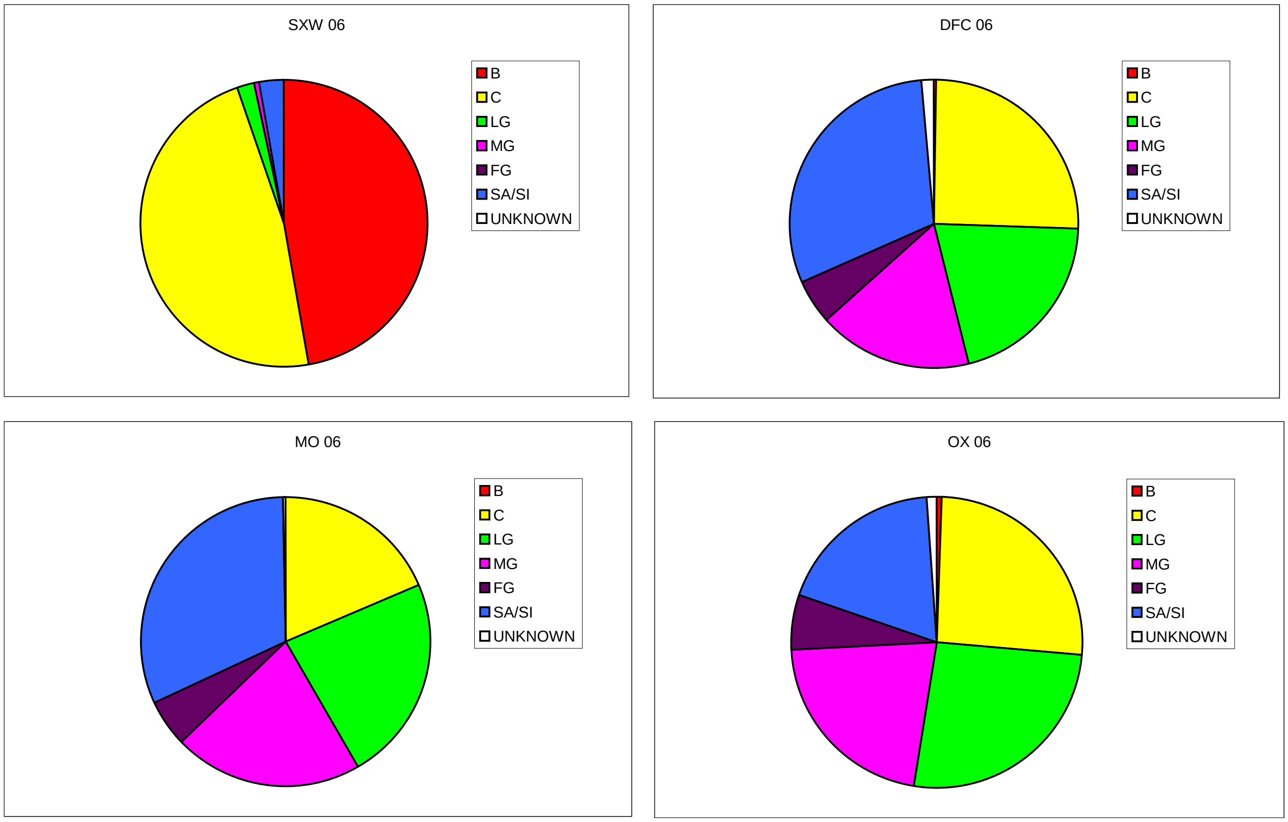


Figure 3.3. Individual plots of proportion of monitoring sites occupied by different substrate sizes, including detailed gravel sizes.

the 2005 estimates of main channel substrate types. Therefore, the apparent increase in the proportion of sand/silt between 2005 and 2006 at the three Diamond Fork sites (Figure 3.2) is largely a function of the improved mapping conditions and does not necessarily indicate that the sites are becoming more embedded with fines. Assuming that water clarity is good during the fall 2007 monitoring period, comparing the 2006 and 2007 results will provide a better indication of temporal trends in overall substrate composition.

Based on the 2006 mapping, the DFC and MO sites each contain about 30% sand/silt material, while the proportion of fines at the OX site is lower (Figure 3.3). This is likely due to the fact that sand/silt deposits typically occur in backwaters or protected channel margin areas, and these complex channel features occur with greater frequency within the DFC and MO sites. The long, straight run section of the OX site between transects 4 and 6 (Figure 3.1d) does not contain significant silt deposits, and it reduces the overall proportion of fine material at the site while increasing the overall proportion of gravel. Although the percentage of total gravel varies somewhat among the three Diamond Fork sites, the relative percentages of individual gravel sizes (fine, medium, large) are very consistent (Figure 3.3). Of the total amount of gravel at each site, about 48% is large gravel, 41% is medium gravel, and 11% is fine gravel. This contrasts with the coarser SXW Site, where 80% of the total gravel is large gravel, 19% is medium gravel, and only 1% is fine gravel.

3.3.2 Island and Riparian Vegetation Mapping

Maps of riparian and island vegetation polygons for each Diamond Fork Creek monitoring site are shown in Figure 3.4a-c. Although riparian vegetation was not specifically mapped at the SXW site in 2006, general observations made during substrate mapping indicate that riparian conditions remain similar to those observed in 2005 when willows dominated the vegetation distribution.

As in 2005 the three Diamond Fork sites showed greater variety and complexity in vegetation types than the SXW site. Although willows occupy much of the streamside area at the DFC site, large areas of grass (particularly on islands) or mixed grass and willow are also present (Figure 3.4a). Stands of mixed grass and willow are dominant along the streamside areas of the MO site, while various combinations of grass, gravel, and sand occupy island areas (Figure 3.4b). The OX site contains the greatest area of streamside cottonwoods of the four monitoring sites, and it also contains areas of willow, mixed grass and willow, and grass (Figure 3.4c). As with the other Diamond Fork sites, islands within the OX site contain combinations of grass, gravel, and sand.

Two consistent temporal trends in riparian vegetation were observed at all three of the Diamond Fork sites. These trends are illustrated using the 2005 versus 2006 maps of the MO site as an example (Figure 3.5). One trend was that many areas mapped as grass in 2005 were mapped as grass-willow in 2006. At the DFC site some areas mapped as grass-willow in 2005 were mapped as willow in 2006. This trend toward increased area of streamside willows with reduced grass dominance is what would be expected given the change in hydrology associated with pipeline completion. Now that floodplain-inundating flows are less frequent, willows are able to colonize areas that used to only be suitable for herbaceous vegetation.

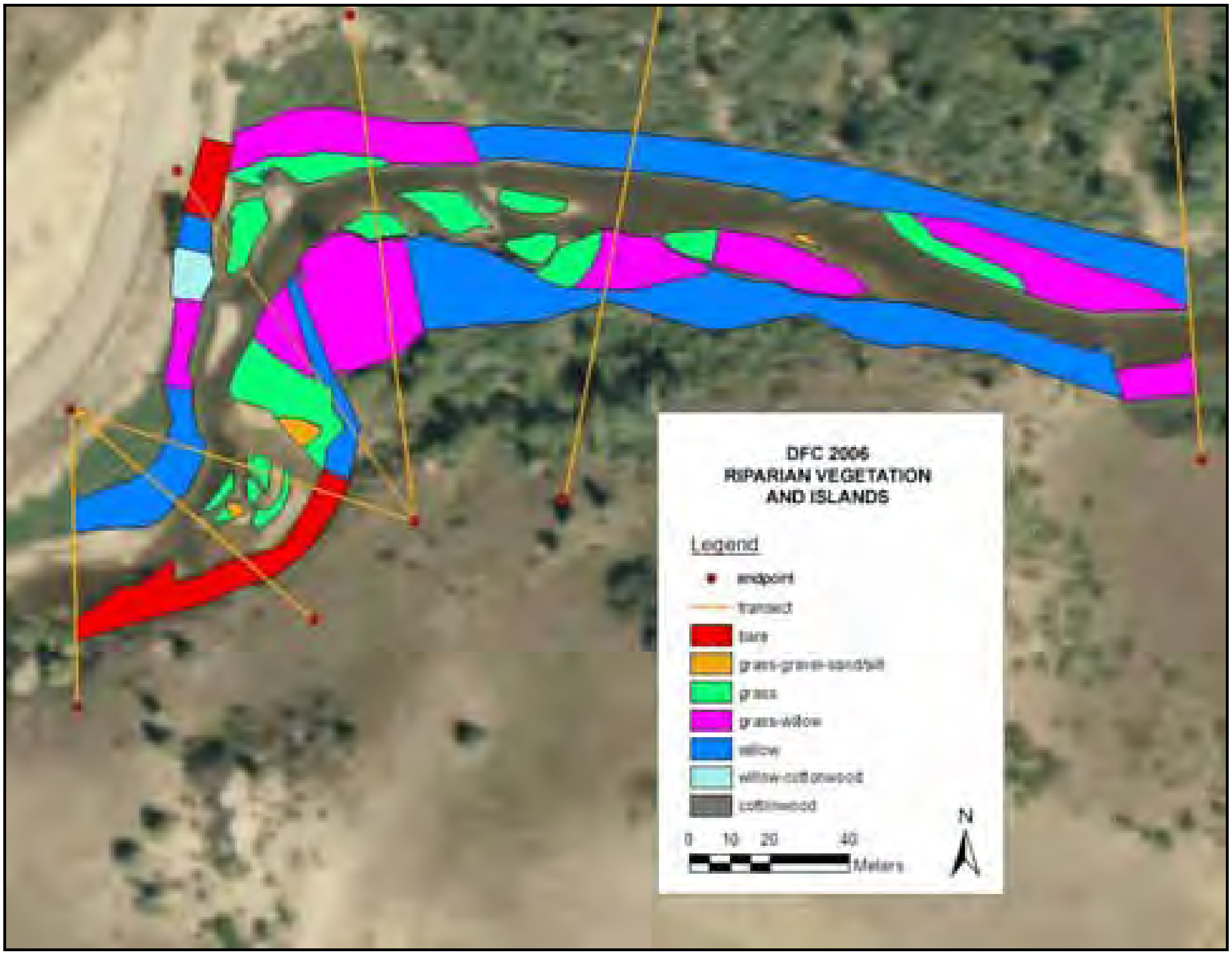


Figure 3.4a. Island and riparian vegetation types at the Diamond Fork Campground (DFC) monitoring site. Aerial photo from 2006.

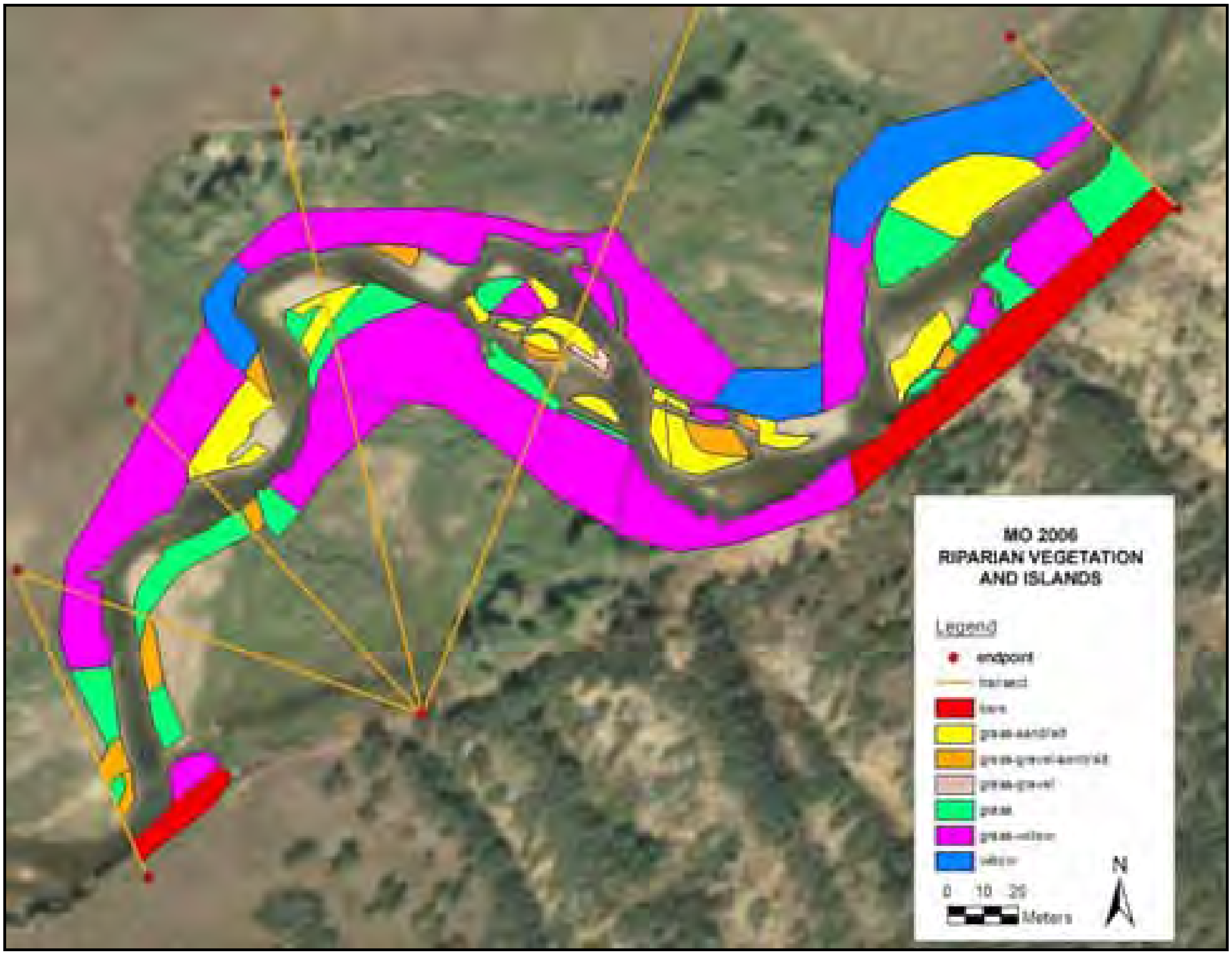


Figure 3.4b. Island and riparian vegetation types at the Mother (MO) monitoring site. Aerial photo from 2006.

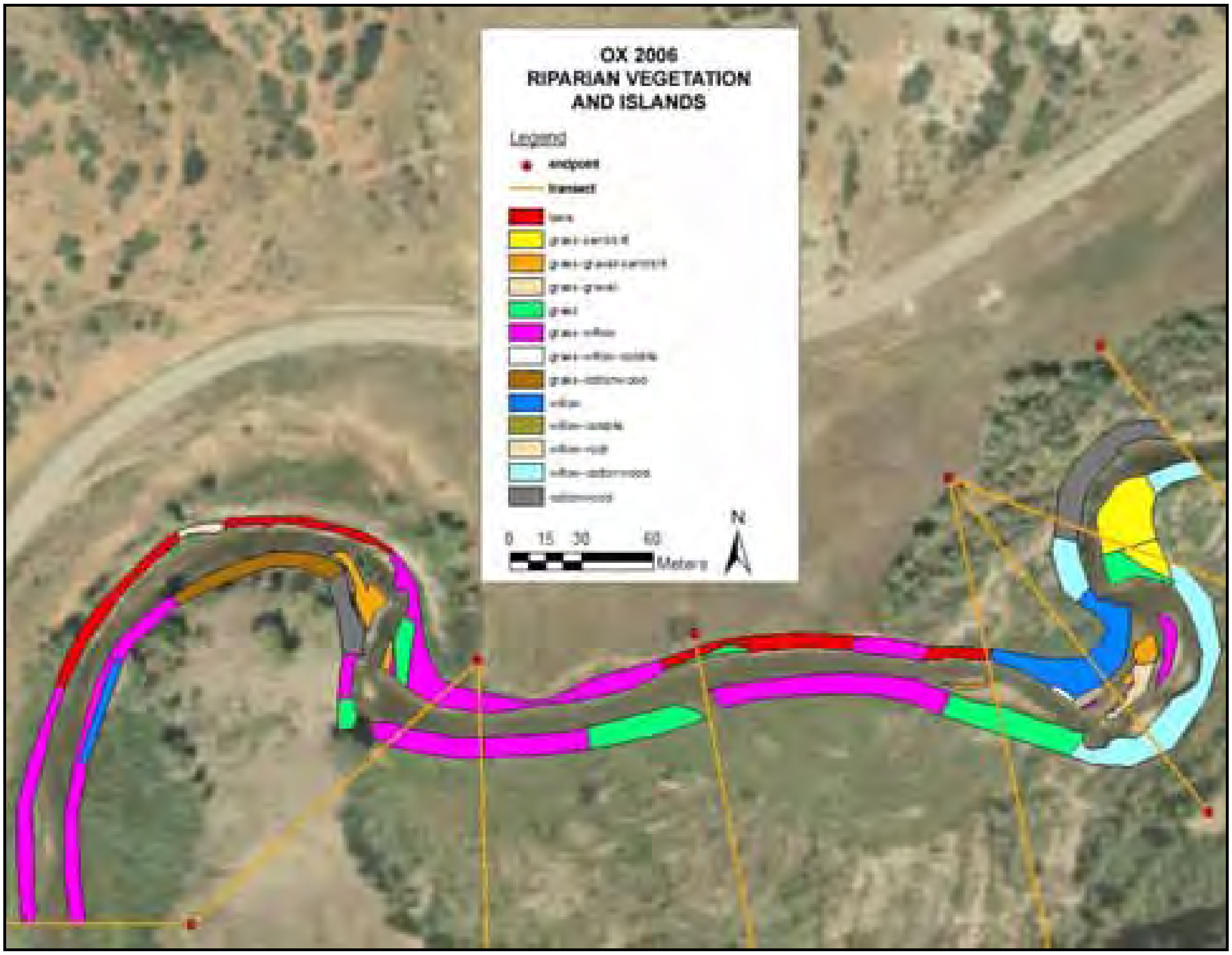


Figure 3.4c. Island and riparian vegetation types at the Oxbow (OX) monitoring site. Aerial photo from 2006.

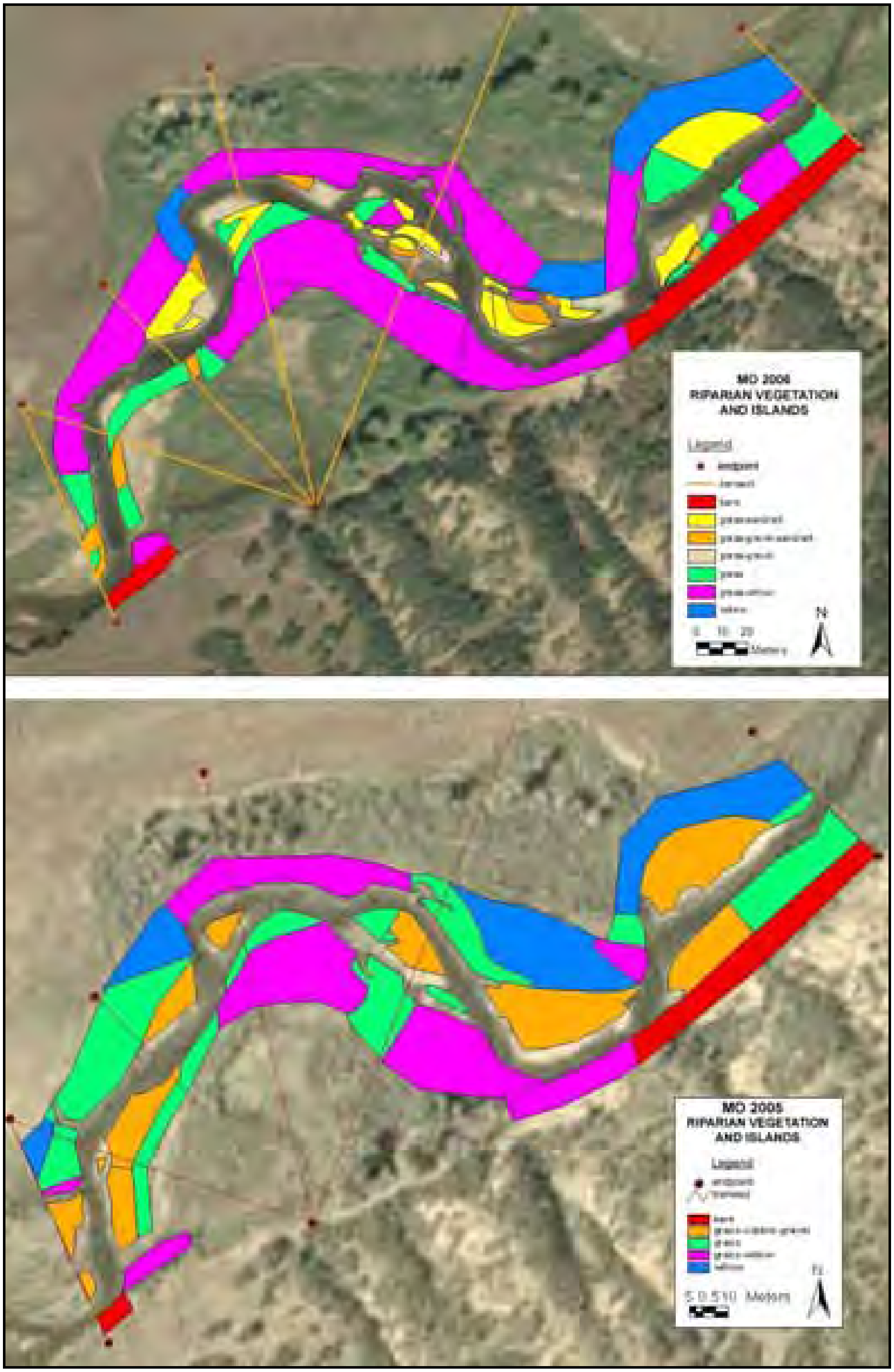


Figure 3.5 Comparison of 2005 and 2006 maps of riparian vegetation at the Mother (MO) monitoring site.

The second trend observed at all three Diamond Fork sites was an increase in the amount of sand and silt material observed on islands and channel margin deposits. In 2005 most of these areas were mapped as grass-cobble-gravel, with only minor amounts of finer material present (BIO-WEST 2006). This trend is readily illustrated by the maps of the MO site, where most islands were mapped as grass-sand/silt in 2006 (Figure 3.5). In addition, several areas mapped as combinations of grass, gravel, and cobble in 2005 were mapped as fully vegetated grass areas in 2006. The conversion of coarser gravel-cobble deposits to areas of grass or grass-sand/silt necessitated shifts in at least one pebble count sampling location at each of the Diamond Fork monitoring sites (see Section 3.3.3 below).

3.3.3 Pebble Counts

The D16, D25, D50, D75, and D84 values for 2005 and 2006 are listed for each pebble count at the study sites in Table 3.3. Results for pebble counts conducted at the bedload sampling sites (bridges) are listed in Table 3.4a (by size fraction and year for each repeat sample), and 3.4 b (by size fraction and year averaged amongst all repeat samples for each study site). Pebble count plots are shown in Appendix 3.2.

Table 3.5 summarizes the 2006 pebble count data. It lists all pebble count locations, type (riffle, bar, etc.), D50 (2005 and 2006), and relative changes between 2005 and 2006 pebble counts.

An alternative way to analyze the pebble count data is to analyze the in-channel riffle pebble counts separately from the counts completed in depositional bar (“patch”) areas. The average (mean) D16, D25, D50, D75, and D84, as well as the maximum D84 and minimum D16 from the in-channel riffle pebble counts are shown in Table 3.6., bar/patch pebble counts are shown in Table 3.7, and combined (all pebble counts for each site) are shown in Table 3.8.

Several general trends are apparent from the pebble count results. As in 2005 the SXW site had the coarsest main channel substrate material (average riffle D50 of 115 mm), the DFC site had the next coarsest material (average riffle D50 of 56 mm), and the MO and OX sites had the finest main channel material (average riffle D50s of 38 and 34 mm, respectively). These findings are expected, given the fact that the SXW site is the steepest monitoring site (3% slope), DFC is the second steepest site (0.9% slope), and the MO and OX sites are the flattest gradient sites (0.5% and 0.6% slope, respectively).

At the SXW site little change is evident between 2005 and 2006 in the pebble count results for in-channel riffle locations (Table 3.6). However, the patch count results suggest a slight trend toward fining: the D126, D25, and D50 all became smaller at these sites between 2005 and 2006 (Table 3.7). This trend is partly the result of an increase in the amount of sand- and silt-sized particles (2 mm and smaller) at all sites except PC5 (Appendix 3.2).

Table 3.3. Pebble count results for channel monitoring sites.

SIXTH WATER (SXW)	SXW1		SXW2		SXW3		SXW4		SXW5		SXW6	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
D_{16}	22	18	25	6	25	10	12	3	10	60	62	38
D_{25}	46	27	32	12	43	20	29	13	50	112	75	60
D_{50}	110	74	67	41	82	81	92	92	145	190	97	103
D_{75}	181	140	120	102	125	163	152	159	221	270	134	142
D_{84}	260	190	160	140	152	190	185	200	265	312	153	160
Class of D_{50} [a]	C	C	C	LG	C	C	C	C	C	C	C	C
DIAMOND FORK CAMPGROUND (DFC)	DFC1		DFC2		DFC3		DFC4		DFC5		DFC6	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
D_{16}	28	17	32	21	38	15	20	16	41	5	15	3
D_{25}	34	26	44	29	43	21	33	27	46	11	21	6
D_{50}	68	64	72	53	60	48	75	58	60	55	34	24
D_{75}	99	112	112	85	105	84	117	93	83	80	56	44
D_{84}	116	142	125	103	113	110	140	111	92	86	64	51
Class of D_{50} [a]	C	C	C	LG	LG	LG	C	LG	LG	LG	LG	MG
MOTHER (MO)	MO1		MO2		MO3		MO4		MO5		MO6	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
D_{16}	11	2	25	20	14	3	23	15	19	21	5	5
D_{25}	15	12	31	24	20	6	31	21	29	29	7	12
D_{50}	22	36	47	42	29	23	41	31	47	41	31	33
D_{75}	31	51	71	67	38	36	56	55	73	55	49	62
D_{84}	35	61	90	74	45	41	64	68	82	59	59	74
Class of D_{50} [a]	MG	LG	LG	LG	MG	MG	LG	MG	LG	LG	MG	LG
OXBOW (OX)	OX1		OX2		OX3		OX4		OX5		OX6	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
D_{16}	26	19	12	10	7	13	16	9	17	51	21	16
D_{25}	31	22	15	12	16	22	25	12	59	61	26	20
D_{50}	47	44	21	21	25	38	35	23	75	73	45	36
D_{75}	65	82	29	30	45	51	69	45	90	94	66	50
D_{84}	80	92	33	33	51	60	85	67	100	102	79	60
Class of D_{50} [a]	LG	LG	MG	MG	MG	LG	LG	MG	C	C	LG	LG

[a] C = cobble, MG = medium gravel, LG = large gravel.

Table 3.4. Pebble count results for bedload sampling sites[a].

CLASS	SXW-U BRIDGE		SXW-L BRIDGE		DI BRIDGE		MK BRIDGE		BR BRIDGE		CH BRIDGE	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
D_{16}	22	28	74	15	20	7	71	5	26	3	21	7
D_{25}	39	40	100	38	32	10	88	10	35	11	25	14
D_{50}	87	120	143	130	75	33	130	28	55	34	34	32
D_{75}	190	206	223	177	118	71	180	117	86	95	51	52
D_{16}	244	260	263	210	141	89	220	160	112	115	58	70
D_{25}	Cobble	Cobble	Cobble	Cobble	Cobble	Large Gravel	Cobble	Medium Gravel	Large Gravel	Large Gravel	Large Gravel	Large Gravel

[a] SXW-U = Upper Sixth Water, SXW-L = Lower Sixth Water, DI = Diamond Fork at Three Forks, MK = Monks, BR = Brimhall, CH = Childs.

TION			SUMMARY
	2005	2006	
near cross section 1.	110	74	Small increase in fine material. The D50 is smaller size but remains classified as cobble. Largest increase in i
hannel on the left side of the island near cross section 2.	67	41	Biggest change at this site. The D50 changed from Cobble to Large Gravel. Reduction in Cobble sized part gravel.
oinvertebrate sampling site located upstream of cross section 3 and oove the mid-channel island.	82	81	Increase in cobbles as well as in medium gravel and sand silt. This balances out to make the D50 nearly the
ated area at the downstream tip of the mid-channel island near cross n 4.	92	92	Little change. Increase in sand/silt.
channel riffle at cross section 5.	145	190	Increase in boulders (phi class 512) measured and decrease in medium gravel causes coarsening of this patc
ar near cross section 6 near the left edge of water.	97	103	Little change.
ID			
near transect 1.	68	64	Little change.
eters (m) downstream from pebble count DFC1.	72	53	Small increase in fine material measured as medium gravel (phi class 16 and 32). The D50 classification cha
es the main channel at transect DFC3.	60	48	Increase in medium gravel with a decrease in large gravel. D50 remains classified as large gravel.
oinvertebrate sampling site located between river left and the upper tip island downstream from transect DFC3.	75	58	Increase in fine material (large and medium gravel) with a decrease in cobble. The D50 classification chang
mpled in 2005 eroded; in 2006 sampled new mid-channel bar ~25 m stream, below transect 4.	60	55	Large increase in sand/silt with a decrease in large gravel. The D16 (5mm) changed from large gravel to fin large gravel to medium gravel. Little changed occurred with the D50 and larger sizes.
mpled in 2005 became vegetated; in 2006 sampled new gravel its adjacent to 2005 sample location.	34	24	Large increase in sand/silt and fine gravel with a decrease in large and medium gravel and cobble. The D50 medium gravel. The D25 and D16 changed from medium gravel to fine gravel.
ampled in 2005 became silted/vegetated; in 2006 sampled gravel it ~60m downstream.	22	36	Increase in fine material and larger material. Increase in sand/silt, large gravel, and cobble. Largest decreas overall increase in the D50 from medium gravel size to large gravel.
oinvertebrate sampling site located between transects 1 and 2.	47	42	Little change.
and sampled in 2005 became larger; in 2006 sampled area just slightly of 2005 location.	29	23	Large increase in sand/silt with a decrease in large and medium gravel. The D50 is smaller in 2006, but rem
hannel sampled in 2005 became silted/filled in; in 2006 sampled main nel at transect 3, just north of 2005 location.	41	31	Increase in fine material. The increase in medium gravel and decrease in large gravel changes the D50 from
at cross section 4.	47	41	Little overall change. Decrease in cobble and an increase in large gravel. The D50 remains classified as larg
mpled in 2005 became larger; in 2006 sampled area ~6 m west of location.	31	33	Increase in large gravel and cobble. The D50 classification changes from medium gravel to large gravel.
oinvertebrate sampling site located near a riffle near transect 1.	47	44	Little change.
oar deposit between transects 2 and 3.	21	21	Little change.
ampled in 2005 became vegetated; in 2006 sampled new mid nel bar ~50 m downstream.	25	38	Increase in large gravel and cobble. The D50 changes from medium gravel to large gravel.
between transects 6 and 7.	35	23	Increase in fine material (fine gravel and medium gravel) and decrease in cobble. The D50 classification cha
w mid channel bar between cross sections 7 and 8.	75	73	Little change.
at transect 8.	45	36	Small increase in fine material with a marked decrease in cobble. The D50 decrease from 45 mm to 36 mm

Table 3.6. Mean, minimum, and maximum diameters of particles counted in riffles at the four study sites.

STUDY SITE [a]	DIAMETER CLASSES															
	NUMBER OF RIFFLES		MEAN D16 (MM)		MEAN D25 (MM)		MEAN D50 (MM)		MEAN D75 (MM)		MEAN D84 (MM)		MINIMUM D16 (MM)		MAXIMUM D84 (MM)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
SXW	3	3	19	29	46	53	112	115	176	191	226	231	10	10	265	312
DFC	3	4	33	17	40	26	67	56	105	94	118	117	28	15	125	142
MO	2	3	22	19	30	25	47	38	72	59	86	67	19	15	90	74
OX	3	3	21	15	27	18	42	34	67	59	81	73	16	9	85	92

[a] Site abbreviations: SXW = Sixth Water, DFC = Diamond Fork Campground, MO = Mother, OX = Oxbow.

Table 3.7. Mean, minimum, and maximum diameters of particles counted in depositional bar/patch counts at the four study sites.

STUDY SITE [a]	DIAMETER CLASSES															
	NUMBER OF PATCHES		MEAN D16 (MM)		MEAN D25 (MM)		MEAN D50 (MM)		MEAN D75 (MM)		MEAN D84 (MM)		MINIMUM D16 (MM)		MAXIMUM D84 (MM)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
SXW	3	3	33	16	45	28	85	79	135	134	166	167	12	3	185	200
DFC	3	2	25	4	33	9	56	40	85	62	99	69	15	3	140	86
MO	4	3	13	3	18	10	31	31	44	50	51	59	5	2	64	74
OX	3	3	12	25	30	32	40	44	55	58	61	65	7	13	100	102

[a] Site abbreviations: SXW = Sixth Water, DFC = Diamond Fork Campground, MO = Mother, OX = Oxbow.

Table 3.8. Mean diameter of particles for each size fraction counted at the four study sites in 2005 and 2006.

STUDY SITE [a]	MEAN D16 (MM)		MEAN D25 (MM)		MEAN D50 (MM)		MEAN D75 (MM)		MEAN D84 (MM)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
SXW	26	23	46	41	99	97	156	163	196	170
DFC	29	13	37	20	62	50	95	83	108	101
MO	16	11	22	22	36	34	53	54	63	63
OX	17	20	29	25	41	39	61	59	71	69
ALL	22	17	33	27	59	55	91	90	110	101

[a] Site abbreviations: SXW = Sixth Water, DFC = Diamond Fork Campground, MO = Mother, OX = Oxbow.

The pebble count results at the DFC site also show an increase in fines within depositional areas (Table 3.5, Table 3.7, Appendix 3.2). This result matches substrate mapping observations, which noted that the high spring flows in 2006 deposited a layer of sand/silt material across many of the low bar/floodplain surfaces at the Diamond Fork sites. The in-channel riffle pebble counts at DFC also show a fining trend, due to an increase in sand/silt material as well as an increase in medium gravel (Table 3.5, Table 3.6, Appendix 3.2).

Pebble count results at the MO site exhibit tendencies similar to the DFC site, although the changes are generally not as consistent or visually evident. The 2006 in-channel riffle results are slightly finer than in 2005 (Table 3.6); however, most of this change is the result of including the PC4 sample in the 2006 riffle analysis. The PC4 location shifted between 2005 and 2006. The locations of the PC2 and PC5 riffle samples did not shift, and their results exhibited little change between 2005 and 2006 (Table 3.3, Table 3.5, Appendix 3.2). The pebble count results for depositional bar areas at the MO site are mixed (Table 3.5). An increase in sand/silt material was observed at the PC 1 and PC3 bars, while a decrease was observed at PC6 (Appendix 3.2).

As with the other Diamond Fork sites, the OX in-channel riffle results show a trend towards fining (Table 3.6). At the OX site this appears to be the result of increased amounts of medium gravel rather than increased amounts of sand or silt (Appendix 3.2). Pebble count results for depositional bar areas show a slight coarsening trend at OX (Table 3.7). This is due to an increase in large gravel at PC3; the results for the other bar counts (PC 2 and PC5) show little change. The change at PC3 is most likely the result of the shift in its sampling location from a channel margin area to a mid-channel deposit (Table 3.5). Although the OX pebble count results do not demonstrate a fining trend in depositional areas, substrate and riparian mapping results do indicate that several low floodplain areas within the OX site were silted in and/or vegetated following the 2006 spring flood.

Statistical analysis in the form of a 2-way ANOVA was applied to the combined data for each size fraction at each site (Table 3.8). The mean value for each site individually, and for all sites combined, show that the finer size fractions (D16 and D25) are becoming significantly more fine. The median grain size (D50) is getting smaller between years, but not changing as dramatically as the fine grain size fractions. The coarse fractions are not changing with any strong pattern. These results support the hypothesis that Sixth Water and Diamond Fork are accumulating fine sediment.

3.4 DISCUSSION AND SUMMARY

Because it was not possible to map main channel substrate areas in detail in 2005, the ability to compare 2006 and 2005 substrate mapping results is limited. The more detailed 2006 main channel maps demonstrate that gravel is the dominant substrate type within the three Diamond Fork sites, while cobble material is less dominant than was estimated during the turbid 2005 mapping effort. The dominance of gravel matches the pebble count results, which show that most D50 sizes are either large or medium gravel.

Pebble counts completed in riffle areas show a trend toward fining at the three Diamond Fork sites, while riffle results at the SXW site show little change. Counts completed in depositional bar patches at the SXW and DFC sites show an increase in fine material, while this trend is less apparent at the MO and OX sites. It is difficult to know exactly what is responsible for these changes. Several significant rainstorm events occurred during summer and fall 2006, and these storms contributed turbid, silty water to Diamond Fork Creek. The finer size distribution in riffle areas may also be part of the ongoing adjustment of the stream system to a reduced flood regime that is less able to transport large particle sizes and to the unnaturally high base flows and associated sediment transport. A trend toward increased embeddedness could be cause for concern because fine sediments degrade the quality of spawning gravels. Monitoring activities planned for 2007 will include techniques to more specifically measure embeddedness and how it changes seasonally.

During the 2006 substrate mapping, several substrate patches at the three Diamond Fork sites were noted as appearing “cemented.” In these areas gravel- and cobble-sized particles are embedded in a matrix of fine-grained material (sand and silt) that forms a semi-cohesive”brick.” In some locations abrupt drops in bed elevation were observed where pieces of this material had eroded away and formed an underwater “cut bank.” It is unclear what chemical and physical processes are responsible for this cemented substrate. For 2007 additional monitoring techniques are planned to help better understand this phenomenon and determine how it evolves seasonally from the spring runoff period through the fall.

Results of riparian mapping at the Diamond Fork sites show trends toward increasing willow dominance and siltation and vegetation of bar/island deposits. These trends are indicative of more stable conditions that could potentially lead to channel-narrowing trend. These adjustments are expected, given the hydrologic shift toward a more natural flood regime on Diamond Fork Creek, although these changes could be cause for concern if they result in a substantial reduction in overall riparian vegetation diversity. However, channel surveys indicate that dynamic processes—such as bank erosion, gravel bar deposition, and scour—are still occurring under the new flow regime (see Chapter 2 of this report). Therefore, based on the limited monitoring results to date, loss of riparian diversity does not appear to be a problem. Additional riparian vegetation monitoring was initiated by the Mitigation Commission in 2006 to specifically quantify habitat and vegetation communities on many riparian surfaces along Diamond Fork Creek. The results of this work will help determine whether there is a loss of riparian diversity or area as a result of the Diamond Fork System.

4.0 SEDIMENT TRANSPORT

4.0 SEDIMENT TRANSPORT

4.1 INTRODUCTION

This chapter describes the methods and results of sediment transport monitoring for the first 2 years of this study (2005-2006). The sediment flux, or type and amount of sediment, moving in and out of specific reaches is highly correlated with upstream sediment supplies, and the magnitude and duration of peak flows. Annual and seasonal variations in sediment flux influences the biological health of Sixth Water Creek and Diamond Fork Creek and are vital components of the riverine ecosystem. Since the completion of the Diamond Fork System in 2004, the amount of imported water flowing in Sixth Water Creek and Diamond Fork Creek has been reduced and streamflow has been returned to a more natural flow regime (Figure 1.3), except for the relatively high, established instream flows of 25 to 32 cfs in Sixth Water Creek and 60 to 80 cfs in lower Diamond Fork Creek.

Prior to completion of the Diamond Fork System, decades of elevated peak flows caused massive amounts of streambed and streambank erosion (Mitigation Commission 2005). For example, it appears that the streambed in the upper reaches of Sixth Water Creek dropped by nearly 30 feet at some locations. Channel incision in other downstream reaches initiated near-channel slumping and accelerated mass erosion on unstable side slopes. It is likely that the channel incision process migrated headward into other tributary streams as each tributary had to adjust to a new confluence elevation. The majority of the eroded material from Sixth Water Creek and other tributaries has likely been periodically and size-selectively transported to downstream reaches over the past 8 decades. These overwhelming sediment loads, combined with elevated peak flows, resulted in extensive streambank erosion and channel braiding in the flatter reaches of lower Diamond Fork Creek. It is apparent that sedimentation problems caused by the imported water still persist in the flatter reaches of the channel network, foremost the lower reaches of Diamond Fork Creek (Photo 4.1). The current levels of substrate embeddedness, including other problems caused by sedimentation, likely continue to impair the biological integrity and productivity of the stream, especially the quality of spawning gravels. However, the abnormally high peak flows over the past several decades have resulted in a wide and diverse riparian corridor, with active cottonwood and willow recruitment.

The active channel is abnormally wide and shallow in the lower reaches of Diamond Fork Creek, with width to depth ratios (w:d) exceeding 30 (over 60 feet wide and approximately 2 feet deep at bankfull) in certain reaches. Construction of the Diamond Fork System is certainly a major step toward restoration of the impacted streams. However, there will be a lag between restoring the flow regime and regaining a more natural sediment transport regime, especially during the first decade or so as channel and floodplain dimensions are adjusting to reduced peak flows, new meander patterns develop, riparian vegetation becomes established, and established vegetation stabilizes some of the old active bars, newly inactive side channels, and dried up backwaters. It is anticipated that channel dimensions, floodplain characteristics, and aquatic habitat will eventually stabilize (i.e., not change so often) under the new flow regime. However, water imports in the form of the minimum instream flows continue to result in increased sediment yields in Sixth Water Creek and Diamond Fork Creek. Therefore, according to the data collected in 2005 (BIO-WEST 2006), the potential of the Diamond Fork System to fully restore the impacted streams (aquatic habitat and riparian ecosystem) is only

Photo 4.1. High levels of siltation embedding gravels and cobbles in the low flow channel are prevalent at all study sites in lower Diamond Fork Creek. This photo looks upstream at the OX4 cross section and was taken November 2006 at 76 cfs. Notice the silty streambed in contrast to the relatively clean gravel bar. A constant supply of silt is coming from Sixth Water Creek during low flows and additional supplies are coming from other tributaries during peak flows and storm events.

partially being realized, given the levels of sediment transport caused by the relatively high, established instream flows.

4.2 METHODS

4.2.1 Stream Discharge

Streamflows during sampling were determined primarily using hourly flow data supplied by the CUWCD. Provisional 15-minute and average daily flow data from U.S. Geological Survey (USGS) were used to supplement any missing flows in the hourly data. The four gaged flows used to calculate streamflow are the USGS gaging stations #10149400 (Sixth Water above Syar Tunnel), #10149000 (Diamond Fork above Red Hollow) and the Strawberry and Syar Tunnels. The tunnel flows release water into the study area and were used to calibrate streamflow at locations where gaged flows were not available (Figure 1.3). The 15-minute and average daily flow data were copied from the USGS web site (USGS 2006), whereas hourly flow data for all the gaged flows were supplied by the CUWCD.

Because accurate gage records were lacking for all but the SXW-U and MK sediment monitoring bridges, streamflows for the SXW-L, DI, BR, and CH sediment monitoring bridges had to be calculated to include flow received from tunnel imports and tributaries. Discharge measurements were taken at the DI and SXW-L sediment monitoring bridges, and on Cottonwood Creek, Wanrhodes Creek, and Little Diamond Creek. Three discharge measurements were taken at peak, medium, and base flow. The new discharge measurements indicate that the 2005 flows (BIO-WEST 2006) were proportionally over estimated at the Diamond Fork above Three Forks bridge and underestimated at the SXW-L, BR, and CH sediment monitoring bridges. Therefore, correction factors were applied to the gaged flows to assure that each site matched the three measured flows (Table 4.1). After the corrected flows were established for the three discharge measurements, a linear ascending or descending correction factor was applied to generate hydrographs for the ungaged tributaries (Figure 1 of Appendix 4.A).

The SXW-L calculations take into account the added discharge of Syar Tunnel and a correction factor to account for inflow from Fifth Water Creek and other tributary inputs. Estimating flow during spring runoff at Diamond Fork above Three Forks involved subtracting the SXW-L calculated flows and Cottonwood Creek measured flows from the Diamond Fork at Red Hollow Gage (USGS Station #10149400). The discharge calculation at Diamond Fork above Three Forks was accurate to with in 10 percent of the discharge measurement. During base flow the Diamond Fork above Three Forks flow was calculated to one-sixth of the Red Hollow Gage, which matched the discharge measurements taken during medium and base flow very well. The BH and CH bridges discharge calculations take into account the added flow from the Wanrhodes and Little Diamond Creeks. The MK and SXW-U bridge flow data came from the hourly USGS gage data supplied by the CUWCD. Table 4.2 shows the gaging station, correction factor, tributary, and/or pipeline calculation used at each sediment monitoring site. Figure 4.1 shows hydrographs used for each of these sites.

Table 4.1. Discharge measurement dates and correlating calculated streamflow.

DATE AND LOCATION OF DISCHARGE MEASUREMENT	MEASURED DISCHARGE	CALCULATED DISCHARGE
Diamond Fork above Three Forks - 5/5	169	189
Diamond Fork above Three Forks - 7/31	17	17
Diamond Fork above Three Forks - 10/27	11	12
Lower Sixth Water - 5/5	216	216
Lower Sixth Water - 7/31	61	61
Lower Sixth Water - 10/27	73	73
Cottonwood Creek - 5/5	29	
Cottonwood Creek - 7/31	3	
Cottonwood Creek - 10/27	1	
Wanrhodes Creek - 5/5	35	
Wanrhodes Creek - 7/31	3	
Wanrhodes Creek - 10/27	1	
Little Diamond Creek - 5/5	22	
Little Diamond Creek - 7/31	4	
Little Diamond Creek - 10/27	2	
Calculation used for the BR and CH sites to account for the added discharge of Little Diamond and Wanrhodes Creeks	Red Hollow Gaged Discharge	Brimhall and Childs Bridges Calculated Discharge
Diamond Fork at Red Hollow Gage - 5/5	434	491
Diamond Fork at Red Hollow Gage - 5/5	104	111
Diamond Fork at Red Hollow Gage - 5/5	74	77

Table 4.2. Data sources used to determine streamflow at the various monitoring sites.

SITE	DATA SOURCE/ CALCULATION TECHNIQUE
Upper Sixth Water Bridge (SXW-U)	USGS Station #10149000 (Sixth Water Above Syar Tunnel) (hourly flow data supplemented with 15-minute real-time and average daily data)
Lower Sixth Water Bridge (SXW-L)	USGS Station #10149000 (Sixth Water Above Syar Tunnel) + Syar Pipeline + Lower Sixth Water Correction Factor (hourly flow data supplemented with 15-minute real-time and average daily data)
Diamond Fork at Three Forks Bridge (DI)	USGS Station #10149400 (Diamond Fork above Red Hollow) - Lower Sixth Water Bridge - Cottonwood Creek for spring runoff flow and one sixth of USGS Station #10149400 (Diamond Fork above Red Hollow) for base flow (hourly flow data supplemented with 15-minute real-time and average daily data)
Monks Bridge (MK)	USGS Station #10149400 (Diamond Fork above Red Hollow) (hourly flow data supplemented with 15-minute real-time and average daily data)
Brimhall and Childs Bridges (BR, CH)	USGS Station #10149400 (Diamond Fork above Red Hollow) + Little Diamond and Wanrhodes Creeks (hourly flow data supplemented with 15-minute real-time and average daily data)

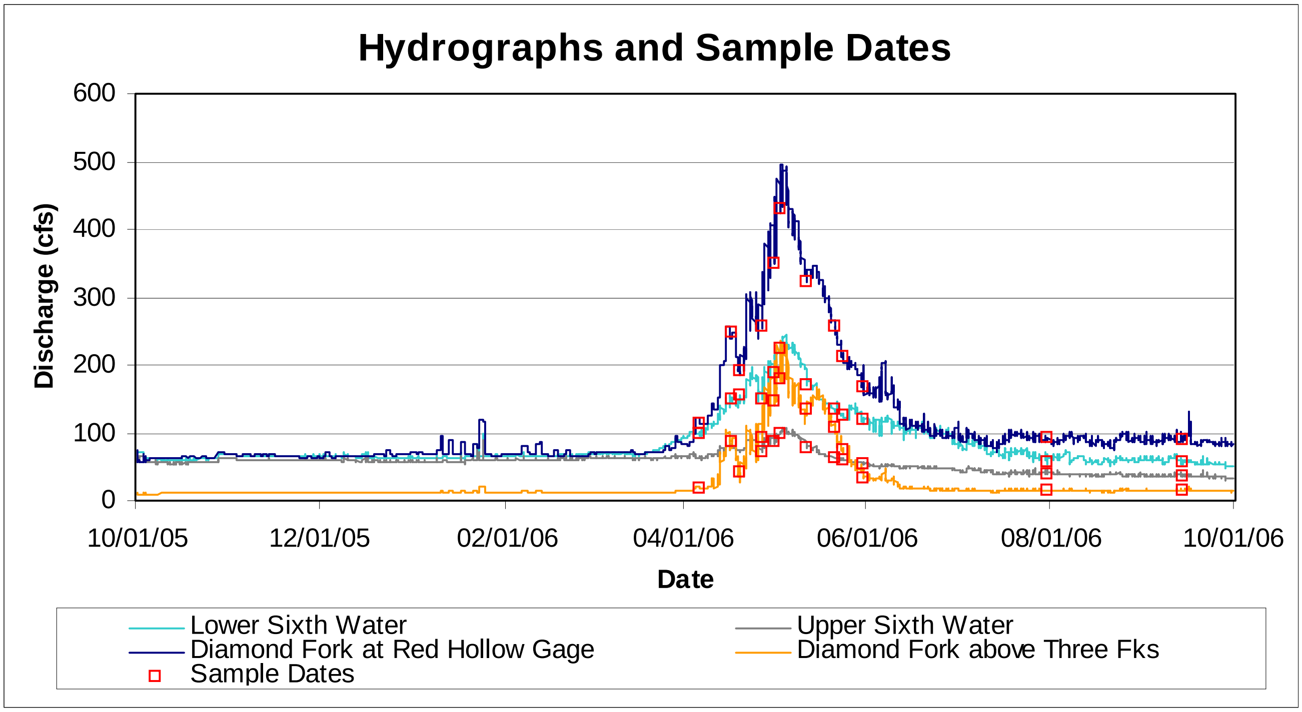


Figure 4.1. Hydrographs and sample dates for the various monitoring sites.

A problem with this method is that during the summer, erroneous spikes in the hydrograph occurred and produced negative values for some of the calculations. The spikes were said to be errors in the gaging stations (J. Croft 2006, pers. comm.). To correct for this problem, the spike errors were replaced with correlating 15-minute and average daily data or averaged hourly flow data from before and/or after the spike. These spike values apparently did not occur during natural peak flow. At the Diamond Fork above Three Forks bridge cross section, the stage/discharge measurement location was re-established after it was destroyed in 2005.

Unfortunately, the high sediment yield buried and ruined this stage/discharge measurement location again. In fall 2006 a new stage/discharge measurement location was established about 30 meters (m) upstream of the previous site; this site will be used for further studies.

4.2.2 Suspended Sediment Monitoring

Sediment samples were collected at fairly regular discharge intervals during the rising and falling limbs of the 2005 and 2006 spring runoff hydrographs and periodically during low flow (Figure 4.1). Average suspended sediment concentrations in the water column were determined by collecting samples of the flowing water at each bridge in a cross-sectional and depth-integrated manner. Techniques to achieve cross-sectional and depth-integrated samples at each bridge included the use of a Depth-Integrated Hand Line Type Model US DH-76 Suspended Sediment Sampler (Photo 4.2), which was dipped from the surface to the bottom of the water column at a minimum of ten equal intervals across the channel. Sample bottles were labeled in the field, stored until the end of the sampling season, and analyzed for total suspended sediments concentrations at the Utah State University (USU) Soils Lab using standard filter and oven-drying methods.

For each sample suspended sediment concentrations and stream flow values were converted to daily suspended sediment loads by multiplying the suspended sediment concentration (milligrams per liter) by the flow (cfs) and applying a conversion factor (0.002697) to make the units consistent and provide a suspended transport rate in tons per day. These values were used to develop an empirically derived suspended-sediment transport rating curve for each monitoring site, thereby showing the relationship between flow and suspended-sediment transport rate.

Photo 4.2. Depth-integrated hand line type model US DH-76 suspended sediment sampler.

4.2.3 Bedload Monitoring

Field samples of bedload were collected at the six sediment monitoring bridges using both 3- and 6-inch Helley-Smith type samplers (Photos 4.3 and 4.4), depending on vehicle access and wadeability of the sampling site. In 2005 all samples were collected with the 6-inch sampler, except at the Lower Sixth Water site where all samples were collected with the 3-inch sampler due to access limitations. In 2005 it was determined that the 6-inch sampler was not necessary based on the size of material in transport. Therefore, in 2006 the 6-inch sampler was only used when the sample site was not wadeable; otherwise the 3-inch sampler was preferable given the unevenness of the bed at most sites and the minimal disturbance caused by setting the sampler on the streambed (no sample contamination). Extreme care was used to avoid scooping or setting the sampler down in a way that influenced the sample.

To sample bedload the sampler was lowered onto the bottom of the channel. Ten 3-minute sub samples were taken at equally spaced locations across the active bed. The width of active bedload transport was estimated during each sample so that total transport calculations across the entire active bed could be performed.

Photo 4.3. Bedload sampling using the 3-inch hand-held sampler. Photo taken at the Diamond Fork above Three Forks monitoring site.

Photo 4.4. Bedload sampling using the 6-inch cable-operated sampler. Photo taken at the Monks Hollow monitoring site.

Each field-collected bedload sample was dried and sorted into the following size categories using standardized sieves: ≥16 millimeter (mm), >8 mm, >4 mm, >2 mm, >1 mm, and <1 mm. After sieving each size category was individually weighed using a digital scale accurate to 1 gram. When practical, organic matter present in the sample was removed before weighing. Before sorting digital photographs were taken of each sample using a penny for scale. These photographs were used to compare sample characteristics of the different sites and from different collection dates. Bedload samples (measured in grams collected with either the 3- or 6-inch sampler for 30 minutes) were converted to daily loads (in tons across the active channel width for the entire day). These values were plotted against stream flow at the time of sampling to develop an empirically derived bedload-transport rating curve for each sediment monitoring site. The rating curves show the existing (measured) relationship between flow and bedload transport rate at each sediment monitoring bridge.

4.2.4 Bedload Calculations

The Wilcock two-fraction sediment transport equation within BAGS, bedload-transport modeling software program developed by the U.S. Department of Agriculture's Forest Service Rocky Mountain Research Station, was used to model bedload transport at each bridge. The water discharge, typical cross section, reach average water surface slope, surface grain-size distribution, and total weight of each bedload sample—including gravel/sand fractions—were entered into the BAGS program. The output results were graphed and compared with the sample data collected at the sediment monitoring bridges in the study site.

The Wilcock two-fraction model did not represent the transport results well when all the bedload data were used in the calibration in the BAGS program. The BAGS program either over estimated transport at peak flow, or under estimated transport at base flow for each monitoring site. It was decided that the high-discharge bedload transport samples best represented the rate of gravel/sand transported in the incoming loads, and so the three highest values at each site were used in the Wilcock equation while the other bedload samples were marked as outliers in the BAGS program. This input adjustment to the Wilcock equation provided rating curves that represented the raw data more accurately, at least during peak discharge. The empirically derived rating curves for each site were also used to calculate the total annual bedload and compare results from the Wilcock equation.

4.2.5 Total Load Calculations

The empirically derived rating curves are assumed to best represent suspended sediment transport, whereas both empirically derived bedload rating curves and the Wilcock two-fraction sediment transport equations were used to calculate total bedload transport. The daily suspended sediment and bedload transport rates (or daily loads) were calculated by applying the rating curve (power equation derived for each monitoring site) to the discharge values as described in section 4.2 (Table 4.1). The daily transport rates were summed for total annual loads for each study site (Appendix 4A, Table 1).

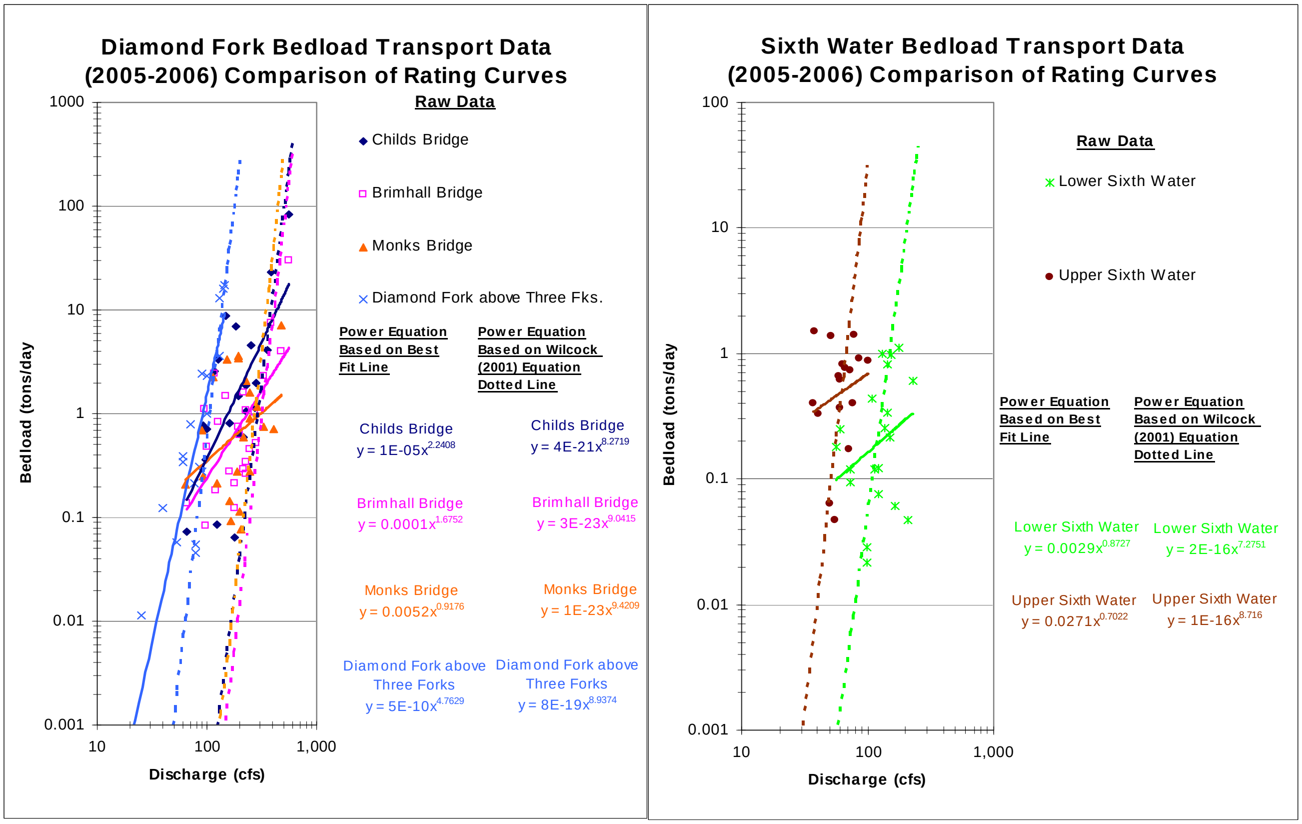


Figure 4.2. Power equations for bedload rating curves based on the Wilcock two-fraction transport equation (Wilcock 2001) (dotted lines) and a "best fit line" through empirical data (solid lines) for the Sixth Water and Diamond Fork Creek sediment monitoring bridges (2005 and 2006 data).

4.3 SEDIMENT TRANSPORT RESULTS

4.3.1 Sediment Transport / Flow Relationships

According to data collected over the past 2 years, there is almost no relationship between flow and bedload transport on Sixth Water Creek and a fairly weak relationship on Diamond Fork Creek below Three Forks (Figure 4.2). The "best fit line" could almost be drawn at any angle through the Sixth Water Creek data points (Figure 4.2). Fine- and coarse-grained sediment transport are very active in Sixth Water and Diamond Fork Creeks, particularly during summer instream flows when transport rates would, under natural flows, approach near zero in this watershed (as evident from comparing data collected in Diamond Fork above Three Forks [Tables 1 and 2 of Appendix 4A, and Appendix 4B]). The ratio of peak flow to base flow is much lower in Diamond Fork Creek (less than 10:1) and even lower in Sixth Water Creek (less than 4:1), than would naturally occur in this mountainous setting and hydrophysiographic region. The repeatedly measured high-bedload transport (both sand and gravel as seen in Appendix 4B) during summertime instream flows essentially flattens the otherwise-steep flow/transport relationship (i.e., rating curve) as shown in the comparison between observed (empirical data/best fit line) and predicted (Wilcock 2001) power equations for bedload transport at the five affected sediment monitoring bridges (Figure 4.2). The observed versus predicted relationships for bedload transport (steepness of the rating curves) are much more similar at the Diamond Fork above Three Forks monitoring site (Figure 4.2), which is the only site unaffected by imported flows.

Relatively high summertime bedload transport rates in Sixth Water Creek likely embed cobbles and other protruding particles in Diamond Fork Creek during low flow, which in turn increases in-channel supplies and transport rates in Diamond Fork Creek during high flows. An increase in cobble embeddedness alters the physical conditions of the bed during low flow to the point of enhancing bedload transport during both low- and high-flow periods (Figure 4.2). Over time, the interstitial spaces of streambed facies fill up and are covered by fine-grained material (fines), eventually reducing the effectiveness of any protruding particles on the bed for creating "hiding places" around them as normally occurs in gravel-cobble bedded streams. The particle-size distribution of the streambed seems to change (become smaller or more filled with fines) seasonally during low flow, and then is somewhat reset with clean gravel annually during peak flows. As a result, the Wilcock (2001) equation overestimates annual loads (Table 4.3), compared with the empirical data, supposedly because of seasonal variations in streambed particle-size distributions. For example, the D_{50} likely is smaller when pebble counts are performed in October than the actual D_{50} during peak flows (after many of the fine particles have been removed). This scenario could cause the Wilcock equation to overestimate transport during high flows. Furthermore, the empirical equation probably underestimates transport during high flow; however, it seems to more accurately estimate transport during low flow than the Wilcock equation (which assumes a steep relationship between flow and bedload transport).

Table 4.3 Comparison of annual loads based on the use of empirical equations and the "best fit" Wilcock (2001) bedload transport equation results.

CALCULATED ANNUAL BEDLOAD TOTALS USING DIFFERENT EQUATIONS (TONS/YEAR)						
Equation	SEDIMENT MONITORING BRIDGES					
	Upper Sixth Water	Lower Sixth Water	Diamond Fork above Three Forks	Monks	Brimhall	Childs
Empirical (Power Equation)	166	50	418	140	140	304
Wilcock (Two-fraction Model 2001)	422	312	2085	742	578	670

The expected hysteresis pattern in suspended sediment loads is evident at all six monitoring sites as seen in the suspended-sediment rating curves (Figure 4.3). Suspended sediment loads are higher at any given flow during the rising limb of the hydrograph and lower at the same flow during the falling limb. Total suspended sediment concentrations are higher for a given flow when flows increase because flood waters mobilize sediments that have been stored on channel fringes and floodplain surfaces since the last flood event. Suspended sediment concentrations are much lower during the falling limb or when flows stabilize at certain stages for long periods of time. The suspended sediment data clearly show a separation between rising and falling limb concentrations. Therefore, separate rising and falling limb power equations (Figure 4.3) for each site were used to calculate daily loads of suspended sediment.

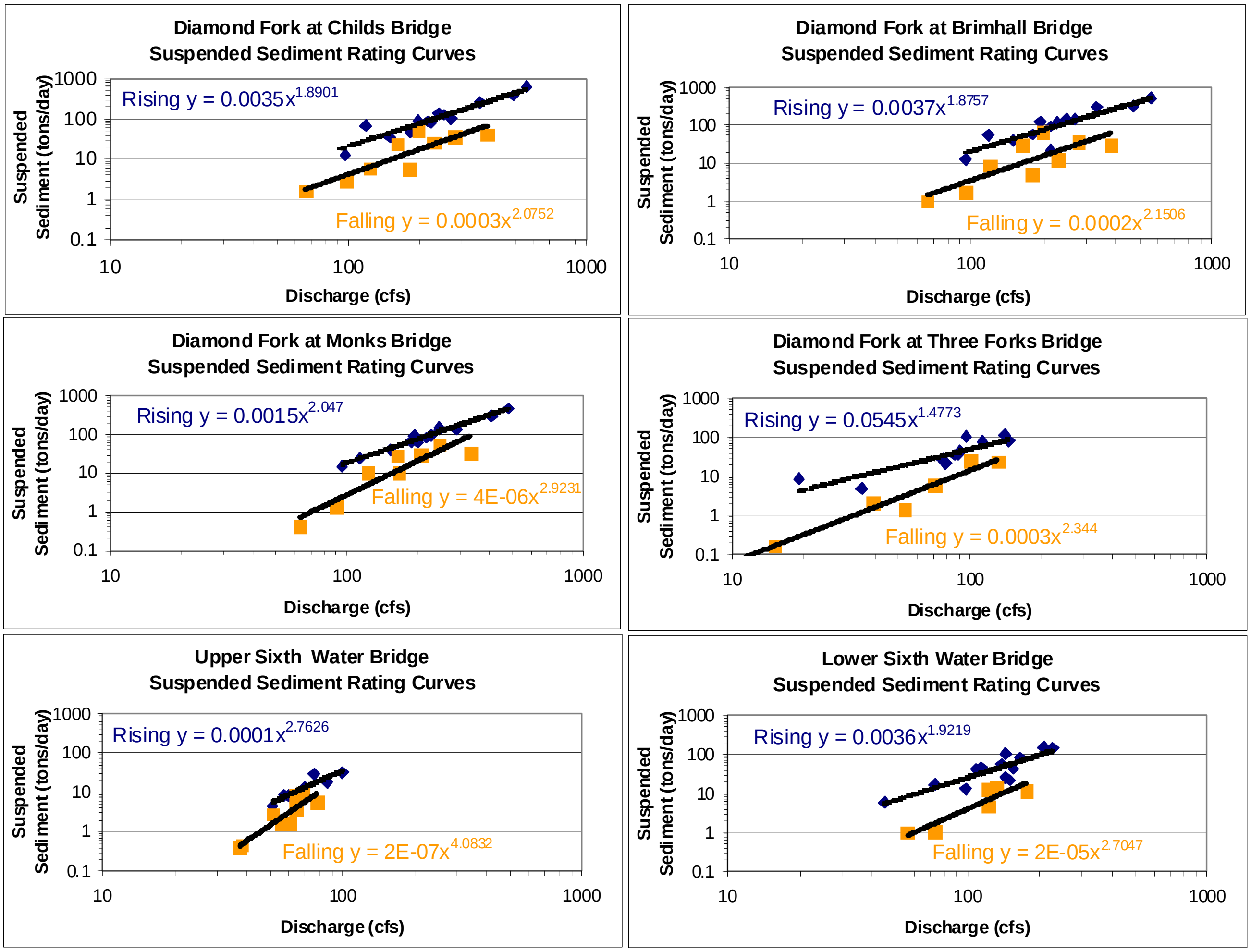


Figure 4.3. *Empirically derived suspended-sediment rating curves for the Sixth Water and Diamond Fork sediment monitoring bridges (2005 and 2006 data).*

The bedload samples did not show any distinct patterns in the rising and falling limb data except for a weak correlation between discharge and transport rates. Power equations for both suspended sediment (Figure 4.3) and bedload (Figure 4.2) rating curves were applied to hourly discharge data measured or calculated at each monitoring site to generate sedigraphs (daily transport rates plotted over an entire water year) for each site (Figure 4.4).

4.3.2 Total Sediment Yields

The results are clear that water imports in Sixth Water Creek increase daily suspended sediment yields during base flows at all impacted reaches by approximately one order of magnitude (0.1 to 1.0 ton per day). Daily suspended sediment loads during base flows are more than ten times greater in Sixth Water Creek than Diamond Fork above Three Forks (Figure 4.4). Changes in suspended sediment yields caused by the imported water during peak flows are not as apparent. Daily suspended sediment loads peak at just over 100 tons per day from Sixth Water and Diamond Fork above Three Forks, respectively. Daily loads of suspended sediment consistently peak at nearly 500 tons per day at all three lower monitoring sites in lower Diamond Fork Creek, indicating that three-fifths (or 300 tons per day) of the suspended sediment yield come from in-channel storage, tributaries, and other sediment sources downstream of Three Forks during peak flows, and only 40 percent (or 200 tons per day) of the daily suspended sediment loads during peak flows come from Sixth Water Creek. Over 90 percent of the daily suspended sediment yield during base flows come from Sixth Water Creek (Figure 4.4).

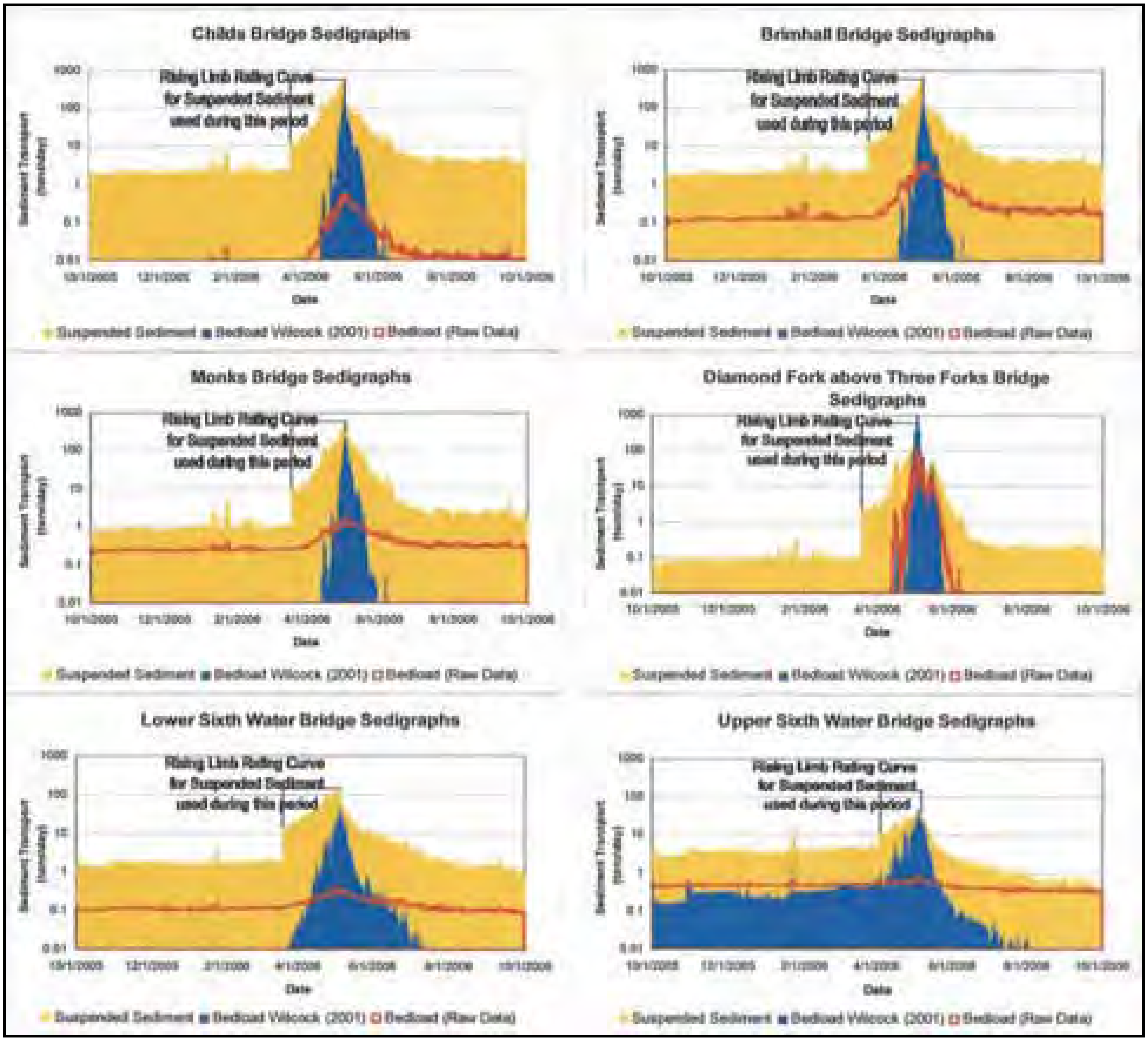


Figure 4.4 Daily sediment loads for the Diamond Fork and Sixth Water sediment monitoring bridges (2006 water year).

The results also illustrate active bedload transport during base flows (both sand and gravel) at all monitoring sites affected by water imports (Figure 4.4), with the greatest base flow transport rates in Upper Sixth Water and the lowest base flow transport rates in Lower Diamond Fork at Childs Bridge. Nearly 0.5 ton per day of bedload is exported from Upper Sixth Water Creek (Rays Crossing), with approximately 0.01 ton per day of bedload continues in transport at Childs Bridge during base flow. Most of the bedload from Upper Sixth Water (over 90 percent) presumably becomes deposited throughout the year (mostly in the lower reaches of both Sixth Water Creek and Diamond Fork Creek), and is temporarily stored in the low-velocity margins of the channel until annual spring runoff events export the stored material into downstream reaches or out of the Diamond Fork watershed altogether.

Seasonal fining of the bed impacts the pebble count results and causes the Wilcock equation to overestimate bedload transport rates during peak runoff compared with the empirical data at all monitoring sites except for Diamond Fork above Three Forks (Figure 4.4), which is the only site not affected by water and sediment imports. Approximately 32 tons per year of bedload sediments are exported from Lower Sixth Water Creek during base flows and presumably deposited in the flatter reaches of Diamond Fork Creek above Childs Bridge (Figure 4.4).

Annual loads (the sum of the daily loads computed between October 1, 2005, and September 31, 2006) were individually evaluated for each sediment monitoring site (Figure 4.5). The suspended-sediment yield dominates the sediment-transport regime in Diamond Fork Creek with an approximate export load of 7,600 tons per year of both suspended and bedload sediments in 2006, which was a relatively “wet” and high-runoff year. In total, approximately 6,900 tons of sediment were exported as suspended load and 700 tons of sediment were exported as bedload (Figure 4.5). Sixth Water Creek yields approximately 65 percent more suspended sediment than Diamond Fork Creek (above Three Forks), primarily as a result of the increased transport rates during base flows (Figure 4.5). The majority of bedload sediments are coming from Diamond Fork above Three Forks, during peak flows only. The abnormally high bedload yields coming out of Diamond Fork above Three Forks during peak runoff in 2006 were probably associated with the removal of the culvert, placement of fill across the channel, and the subsequent large bar that formed just above the confluence with Sixth Water Creek. Bedload transport rates at the Diamond Fork above Three Forks monitoring site will likely decrease dramatically when construction activities at the old culvert site are complete and the banks stabilize.

The proportion of sand to gravel (by weight) in the bedload samples is relatively even at all sites except for Brimhall Bridge (Figure 4.6). There is approximately 20 percent more sand than gravel in the bedload samples from Diamond Fork above Three Forks and Sixth Water, and approximately 5 percent more gravel than sand at two of the three monitoring sites in lower Diamond Fork. It is not apparent why the proportion of sand to gravel is so much different at Brimhall Bridge than the other sediment monitoring sites. The results for the proportion of sand and gravel are different than last year’s results because the 2005 proportions were only representative of a single sample, whereas the 2006 results were averaged from the proportions of all samples.

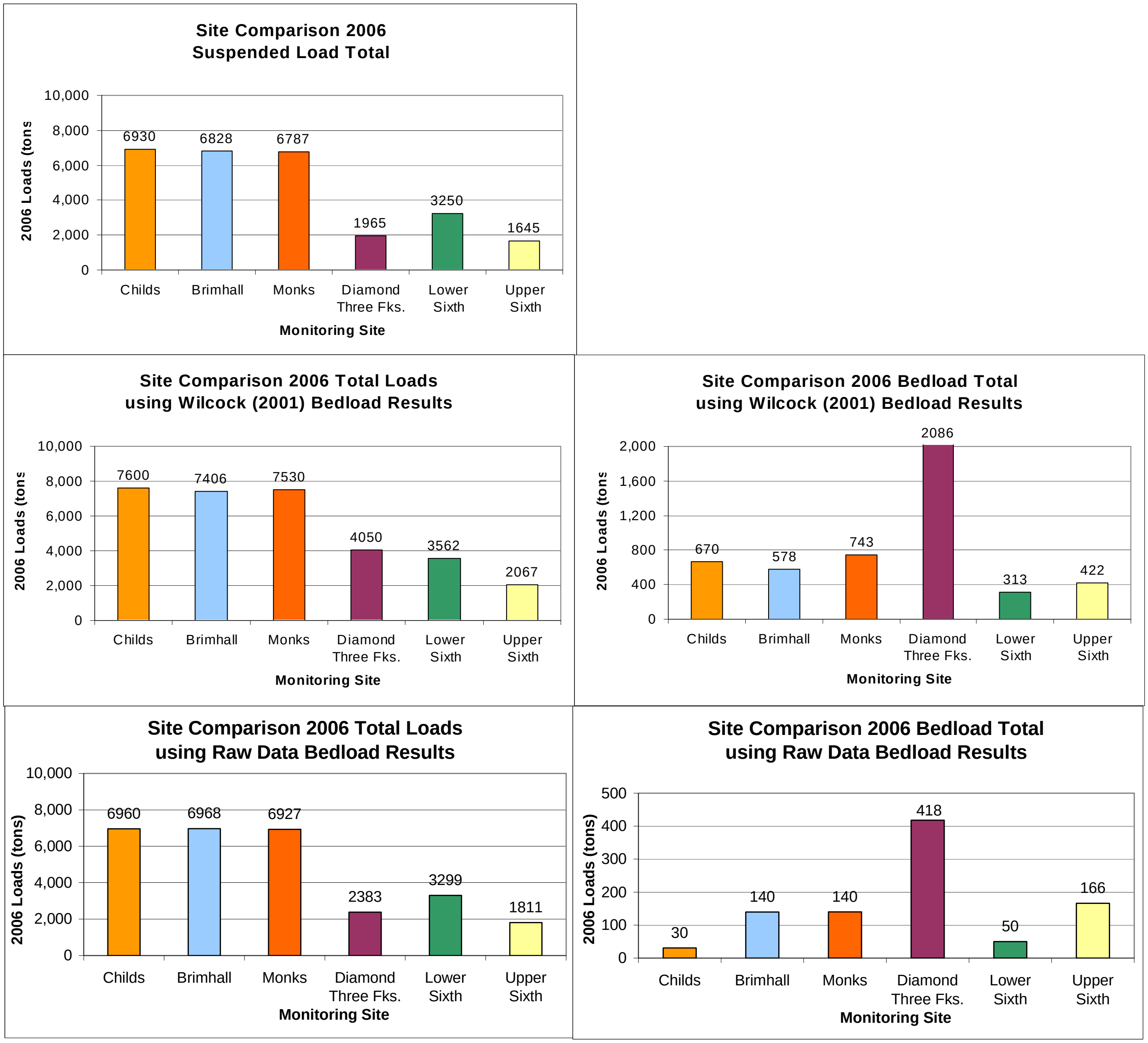


Figure 4.5 Total sediment yields for the Diamond Fork and Sixth Water monitoring bridges (2006 water year).

4.3.3 Sediment Transport During Established Instream Flows

Two years of monitoring results show that the instream flows of 25 to 32 cfs for Sixth Water Creek and 60 to 80 cfs in lower Diamond Fork Creek significantly influence suspended-sediment concentrations and loads, the duration of bedload transport, and total sediment yields in Sixth Water Creek and Diamond Fork Creek. The current instream flows exceed bedload transport thresholds in the relatively steep channels, leading to higher than “normal”or expected suspended and bedload transport rates, and sedimentation in the low-velocity margins of the channel and flatter reaches. At a minimum, this condition impairs water quality and degrades channel characteristics typically associated with clean substrates. Temporal changes in transport and streambed particle-size

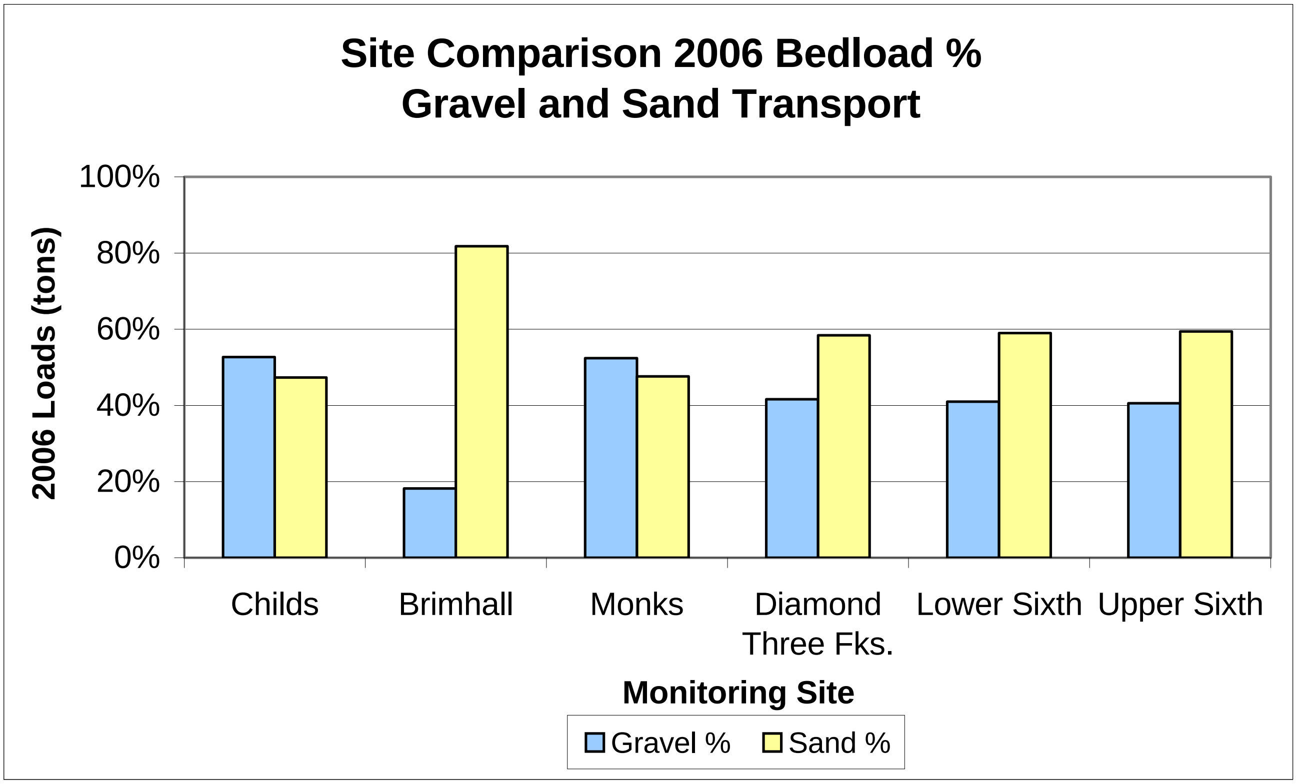


Figure 4.6. Proportion of sand and gravel in bedload samples for the Diamond Fork and Sixth Water sediment monitoring bridges.

distributions will be evaluated more carefully during the 2007 summer and fall seasons, which will help determine the role this phenomenon plays in the fluvial processes and how it may potentially affect biotic communities.

Water quality, siltation, and gravel-cobble embeddedness are influenced by suspended-sediment concentrations and sediment yields. Suspended-sediment concentrations and total sediment yield are significantly higher with the current instream flows than would occur naturally (without the imported water). The current instream flows cause year-round sand and gravel transport. No gravel and only small amounts of sand are transported at the Diamond Fork at Three Forks sediment monitoring bridge during base flow periods (Appendix 4.A), a monitoring site unaffected by imported water. The data suggest that the established instream flows cause significant amounts of sand and gravel transport at all affected monitoring bridges. Therefore, the instream flows do affect fluvial processes and channel conditions in both Sixth Water Creek and Diamond Fork Creek during summer, fall, and winter months.

4.4 SEDIMENT-TRANSPORT DISCUSSION AND RECOMMENDATIONS

The first 2 years of sediment monitoring have been insightful. The watershed experienced average runoff in 2005 and above average runoff in 2006 with flows reaching 550 cfs in the lower reaches of Diamond Fork Creek. A potentially alarming problem is the continuation of fine- and coarse-grained sediment transport after runoff subsides and the associated sedimentation and embeddedness, especially in the lower reaches of Diamond Fork Creek. The summertime and wintertime instream flows are high enough to keep sediment more mobile than would occur under a natural flow regime. We recommend the geomorphic monitoring plan be adapted in 2007 to focus on these potential concerns.

Sediment-monitoring results indicate that the established instream flows exceed thresholds for significant transport of suspended and bedload sediments. A large disparity in discharge rates between the Diamond Fork above Three Forks monitoring site and the other monitoring sites affected by water imports is seen at all times of the year, except during spring runoff (Figure 4.7). In an attempt to further illustrate the effects of imported water, natural hydrographs for 2006 (i.e., actual flows minus imported flows) were generated at specific locations within the study area (Figure 4.8). Although some differences are noticeable in the shape and duration of peak flows during spring runoff, base flows are nearly identical at the lower Sixth Water site and Diamond Fork above Three Forks site without the water imports (Figure 4.8). Additional comparisons (Figure 4.9) illustrate the fluvial geomorphic significance of the imported water where the threshold of gravel transport lies somewhere between natural base flows and the current minimum base flows. We recommend that the geomorphic monitoring plan in 2007 include test flows in the impacted reaches to specifically determine transport thresholds.

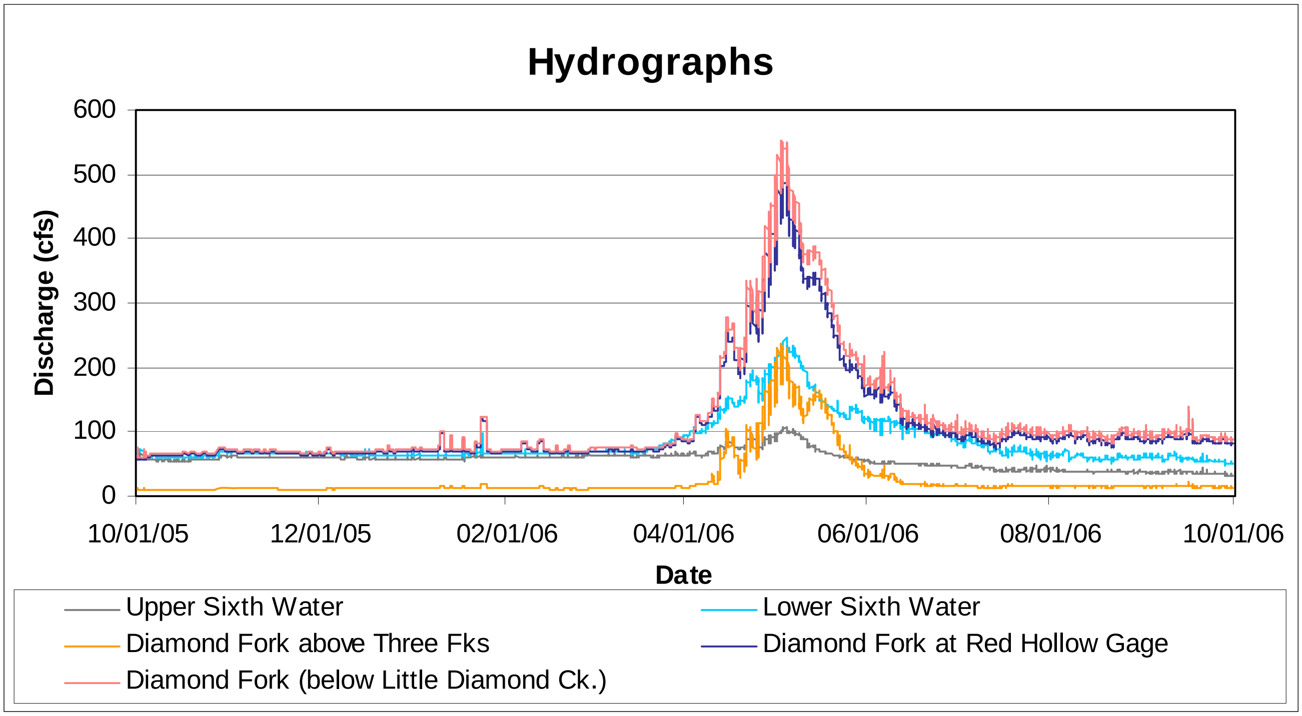


Figure 4.7. The 2006 water year hydrographs for various reaches in Sixth Water and Diamond Fork Creeks. Notice the difference in base flows between Diamond Fork above Three Forks and the other reaches affected by water imports.

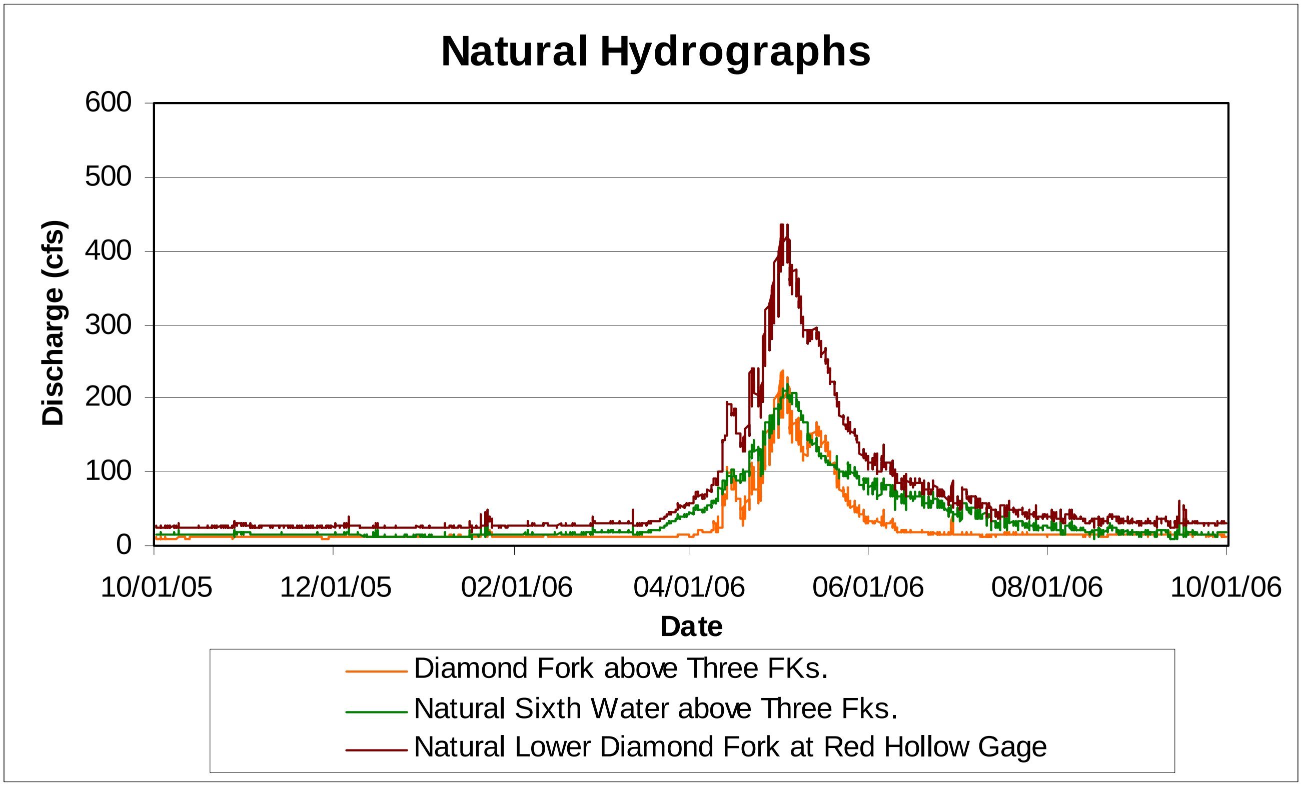


Figure 4.8 Hypothetical natural hydrographs for the 2006 water year for lower Sixth Water and lower Diamond Fork Creeks in comparison with upper Diamond Fork above Three Forks, which is not affected by water imports.

Discharge of imported water in Sixth Water Creek causes the proportion between base flow and peak flow to be approximately 1:2 in Sixth Water Creek and less than 1:10 in Diamond Fork Creek, whereas the natural proportions would be greater than 1:20 as seen at Diamond Fork above Three Forks (above the confluence with Sixth Water and Cottonwood Creeks). The proportions of base flow to peak flow at Diamond Fork above Three Forks is more typical of a natural snowmelt-dominated stream in this hydrophysiographic area. In summary, the required minimum base flows in Sixth Water Creek are elevated, unnatural, and cause abnormally high yields of both suspended and bedload sediments during all times of the year.

In general, snowmelt-dominated, gravel-bedded rivers move very little bedload sediments during base flow. All study sites with imported water exhibited elevated bedload transport during base flow. In contrast, the Diamond Fork above Three Forks site yielded small amounts of bedload sediment during base flow. Establishing more natural base flows for Sixth Water and lower Diamond Fork Creeks would reduce the elevated summertime sediment loads that are currently being deposited in lower Diamond Fork Creek.

The channel is much steeper in Sixth Water Creek than lower Diamond Fork Creek; therefore, material originating in Sixth Water Creek is transported through the canyon and steeper reaches, and it often becomes deposited in the valley and flatter reaches of Diamond Fork Creek. The longitudinal profile or energy gradient of the study area (Figure 4.10, Table 4.4), combined with channel dimensions, affects the ability of each reach to stabilize under the new flow regime on a unique

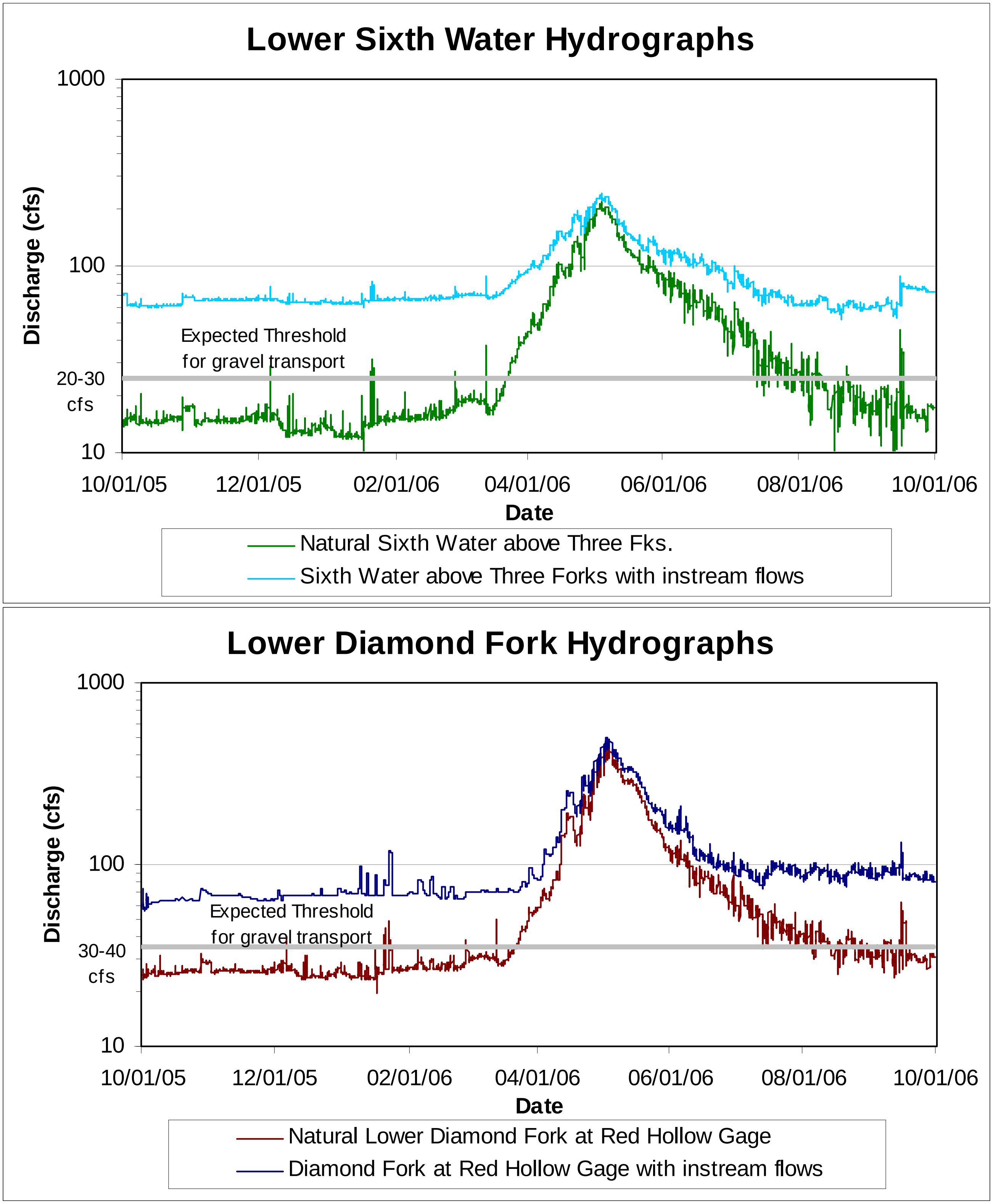


Figure 4.9 Calculated changes in the 2006 water year hydrographs in lower Sixth Water and lower Diamond Fork Creeks caused by water imports. The expected threshold for gravel transport was estimated based on existing data.

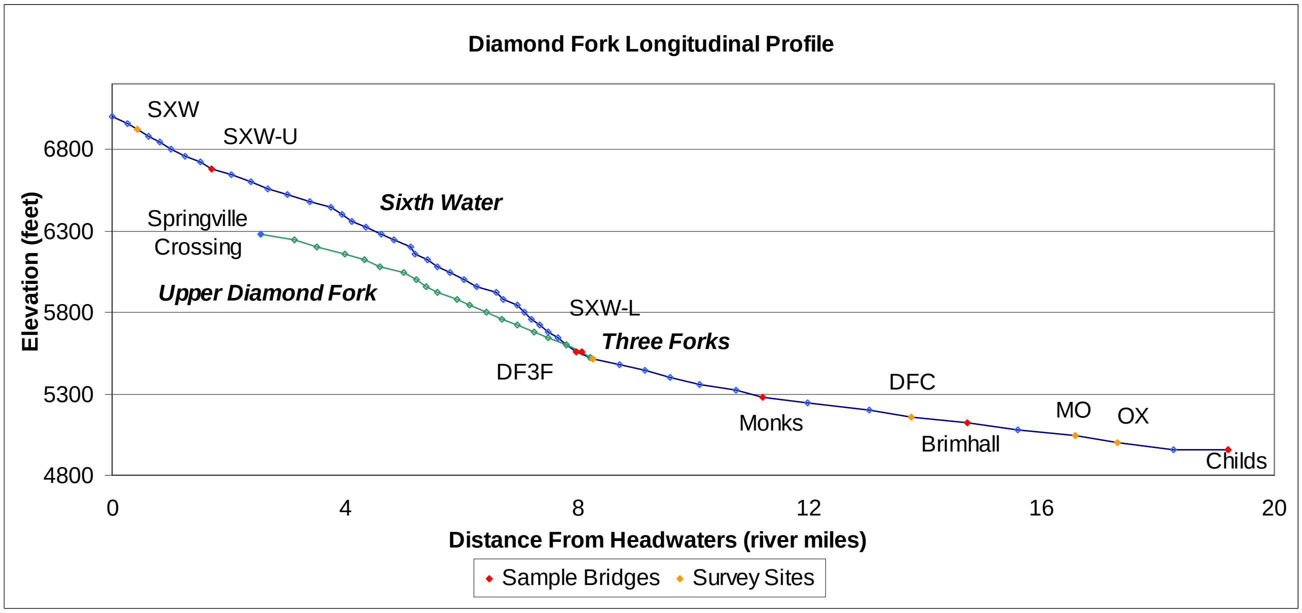


Figure 4.10. Sixth Water and Diamond Fork longitudinal profile from U.S. Geological Survey (USGS) topographical maps.

Table 4.4. Approximate channel slopes of various reaches in the Diamond Fork Watershed based on U.S. Geological Survey (USGS) topographical maps.

REACH	APPROXIMATE CHANNEL SLOPE (PERCENT)
SIXTH WATER CREEK	
Headwater to Ray's Crossing (Upper Sixth Water Bridge)	4.0
Ray's Crossing to Sixth Water Canyon	2.3
Upper Sixth Water Canyon	3.5
Lower Sixth Water Canyon to Lower Sixth Water Bridge (Three Forks)	5.3
DIAMOND FORK CREEK	
Springville Crossing to Sulfer Springs	1.7
Sulfer Springs	3.3
Diamond Fork at Three Forks	2.9
Three Forks to Monks Hollow	1.7
Monks Hollow to below Oxbow	0.9
Below Oxbow to Childs Bridge	0.1

temporal scale. For example, a flat and shallow channel (i.e., Diamond Fork below Brimhall Bridge) that cannot pass incoming sediment loads will aggrade and probably migrate laterally more significantly and more often (annually and sometimes even seasonally) than a steeper reach (i.e., Diamond Fork above Brimhall Bridge) that is more in equilibrium with its incoming and outgoing sediment loads. Geomorphic recovery to a stable pattern, dimension, and profile from the types of perturbations that occurred in Diamond Fork and Sixth Water Creeks is interconnected with equilibrated sediment loads (equal incoming and outgoing loads): It may take a decade or more to regain stable conditions once the perturbations are removed. The perturbations to the sediment-transport regime have been reduced with the Diamond Fork System, but not removed entirely.

5.0 MACROINVERTEBRATE MONITORING

5.0 MACROINVERTEBRATE MONITORING

5.1 INTRODUCTION

This section describes the results of the second year of quantitative benthic macroinvertebrate monitoring on Diamond Fork and Sixth Water Creeks following the completion of water conveyances that allow deliveries from Strawberry Reservoir, with the exception of minimum instream flows, to completely bypass the natural channels. One goal for the restoration of Sixth Water and Diamond Fork Creeks is to benefit the fishery, which appears to be negatively impacted by artificially high summer flows seen during the historical water delivery regime. Monitoring the macroinvertebrate community can provide information on changes in water quality and habitat, as well as an index for the quantity and quality of food available for the fishery. Such information can then be used to determine if and what types of adaptive maintenance activities are needed to assist in returning Diamond Fork and Sixth Water Creeks to a more desirable condition. Monitoring the health of the macroinvertebrate community will also help to ensure that the restoration is maintaining and improving biological integrity of the stream.

5.2 METHODS

In April 2006, the four long-term monitoring sites described in previous chapters (Figure 1.3 and Figures 2.1–2.4) were not sampled due to high flows. Higher-than-normal air temperatures in spring 2006 resulted in an early runoff and inability to conduct sampling during the site visit. Following these higher flows (in early June), quantitative and qualitative sampling was conducted for benthic macroinvertebrates in three sites used to evaluate the water quality impacts of hydrogen sulfide inputs resulting from conveyance tunnel construction. In 2005 two sites were selected for this purpose, one “control” (~7.25 kilometers [km] upstream of Three Forks and believed to be free of hydrogen sulfide impacts) and one “impacted” site located downstream near the highest concentration of hydrogen sulfide inputs (~2.1 km upstream of Three Forks). These sites were referred to as the Sawmill Canyon (SC) and Sulfur Impact (SI) sites, respectively. In June 2006 the physical condition of the SC site was not conducive to effective sampling, and an alternate site was selected further upstream near a guard shack (GS) to provide a control sample. In September 2006 quantitative and qualitative sampling efforts were conducted in each of the seven monitoring sites.

In each sample location, one riffle was chosen as the site for collection of three replicate benthic macroinvertebrate samples. A pre-requisite of an appropriate site was sufficient size to permit collection of three samples and physical characteristics conducive to the sampling gear. Each of the individual samples were taken using a Hess-type, cylindrical, square-foot bottom sampler with a 250-micron mesh net. The requirements for sampling with this device include substrate sizes ranging from gravel to small cobble, water depth of less than 2 feet, and water velocity that was not too great to prevent holding the sampling gear in place. Hess samplers provide a quantitative estimate of both the density (number per area) and composition of the macroinvertebrate community in riffle-type habitats within each monitoring site. Since similar habitat types were sampled in each site using the Hess sampler, estimates of richness and abundance are directly comparable among sites.

In addition to the three samples collected with the Hess-type sampler, one multi-habitat, composite, kick-net sample was collected at each site. This sample was comprised of 20 individual samples collected in various habitat types, in proportion to their estimated abundance within the site, using a D-frame kick net (Barbour et al. 1999). At the SI and SC sites, a multi-habitat sample was collected within a 200-m reach including the quantitative Hess sample sites. In each of the 20 sample sites a 0.5-m area of substrate was disturbed in front of the D-frame kick net by kicking at the substrate. In areas with moderate-to-high velocities, the current carried the invertebrates and periphyton from the disturbed area into the D-frame kick net below. Areas with low velocity or large amounts of aquatic vegetation were disturbed, and the D-frame net was passed through the water column throughout the disturbed area.

Sample processing and preservation in the field included rinsing large debris over a 250-micron mesh sieve and removing it from the sample. Samples were then rinsed, placed into a series of 1,000-milliliter (ml) and 500-ml wide-mouth Nalgene containers, preserved in 70 percent ethanol, and shipped to EcoAnalysts, Inc. (EcoAnalysts), in Moscow, Idaho, for further processing and identification.

EcoAnalysts processed and identified organisms within the benthic macroinvertebrate samples. Samples were spread over a gridded pan and sub-sampled by randomly selecting a grid and sorting and identifying all organisms within that grid. Grids were randomly selected and sorted until either 500 organisms had been picked or the entire sample had been sorted. Macroinvertebrate counts from the sorted grids were extrapolated to the remaining grids to estimate the total number (abundance) of each taxa collected in each sample. All organisms were identified to the genus/species level except for midges, which were identified to the family level, and worms, which were identified to the class level. Quality assurance and control (QA/QC) procedures included a QA sorting on all samples to ensure at least 90 percent sorting efficiency. Also, a synoptic reference collection was created, which was checked by a second taxonomist to ensure taxonomic accuracy. The number of each taxa collected was then entered into a spreadsheet, which was used to generate a list of approximately 50 metrics that can be used as an index of the quality and health of the macroinvertebrate community. EcoAnalysts provided the raw data and metrics to BIO-WEST, along with the synoptic reference collections.

5.2.1 Data Analysis

Several commonly used metrics were selected to look for differences between the sites and seasons sampled in 2006. Total abundance of organisms observed in the 2006 Hess samples was converted into density estimates for the sample site using the 0.086-square-meter area for the open bottom of the Hess sampler (WILDCO 2006) and calculating the number of organisms per square meter. A variety of data transformations was used to fit the selected metrics to the normal distribution, and an analysis of variance (ANOVA) was used to test for differences among sites. Where appropriate, Tukey’s multiple comparison test was used to compare all differences between means. Differences in the selected metrics within sites were compared between seasons using multiple paired t-tests and Bonferroni-adjusted probabilities.

5.3 RESULTS

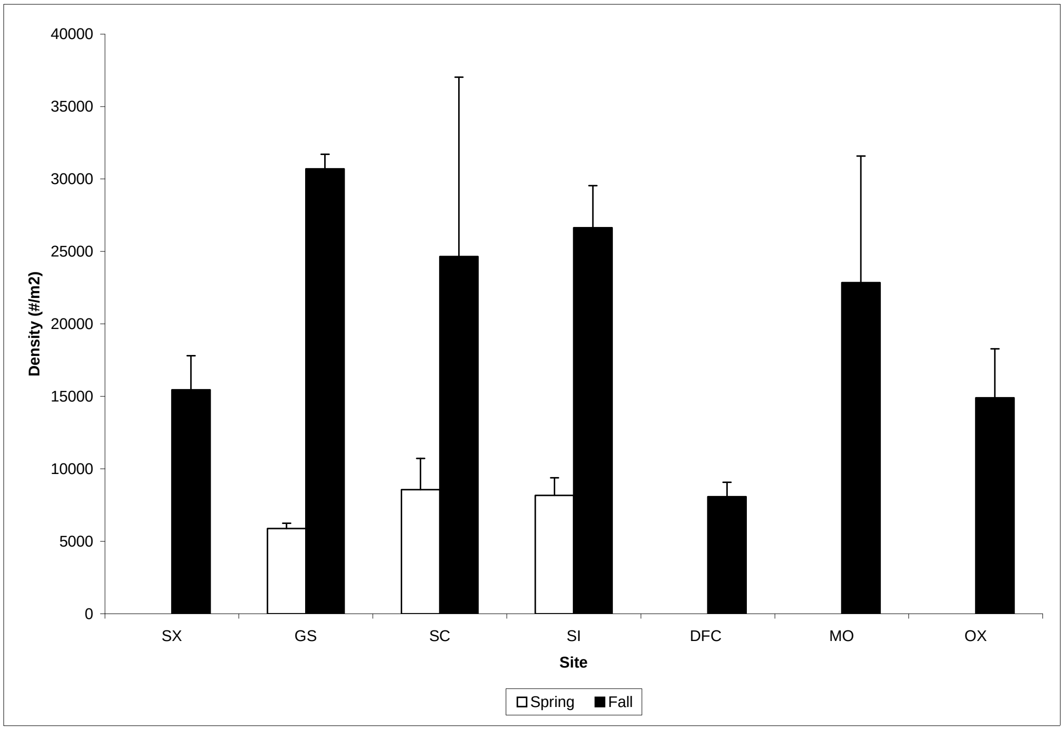
5.3.1 2006 Collections

A complete list of taxa found and metrics generated for each sample collected in 2006 can be found in Appendix 5.1. The metrics used for comparing macroinvertebrate communities among sites (within each season) and within a site (among seasons) were total density of all macroinvertebrates (total abundance for kick-net samples), density/abundance of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (collectively referred to as EPT), total taxa richness, EPT taxa richness, the Hilsenhoff Biotic Index (HBI), and the proportion of the community that is comprised of the three most-dominant taxa. The relevance of and calculated values for each of these metrics from 2006 samples are described below.

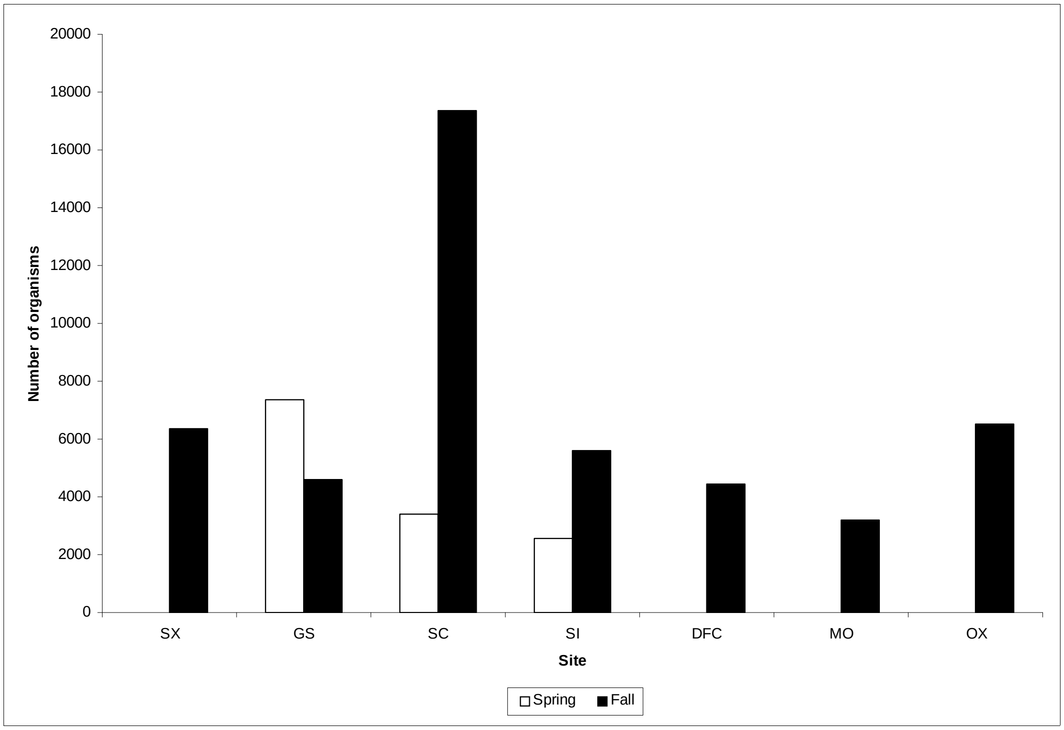
Estimates of the total density of macroinvertebrates provide a coarse method of comparing biological conditions across sites. It is “coarse” because a high overall density may not indicate a high-quality macroinvertebrate community if it results from an abundance of tolerant species. In fact, higher total density is often associated with nutrient enrichment and a degraded condition. The second “control” site selected for evaluation in 2006 (GS) had a total macroinvertebrate density similar to the original control (SC) and the impact (SI) sites, though slightly lower in spring and higher in autumn (Figure 5.1a). Despite variation in total density among the seven sample sites in September 2006, there were no significant differences among sites during either season. Comparing across seasons within a site, all three of the sites sampled during both seasons had higher total densities of all macroinvertebrates in September 2006 compared with June 2006 and significant differences between seasons for the GS and SI sites ($p < 0.002$ and $p < 0.02$, respectively).

In the qualitative kick-net samples, total abundance of macroinvertebrates was highest in the GS site among the three sites sampled in June 2006 (Figure 5.1b). Samples collected in the SC and SI in September 2006 had higher total abundance sites compared with the June 2006 samples in those same sites (there was a 5-fold increase in the SC site) while the GS site had reduced total abundance in September relative to the June sample. Among the four long-term monitoring sites, total abundance of macroinvertebrates was similar with the MO site yielding the lowest and OX the highest abundance. While the kick-net sample data indicate trends, the estimates of total abundance from these samples are less reliable than the density estimates generated from the Hess samples for two reasons. First, despite the attempts to standardize the amount of area sampled, there is no real control on how much area is sampled with the composite kick-net sampler. Second, unlike Hess samples that are all taken from similar habitats, the composite kick-net samples come from a variety of different habitat types, which may have a higher or lower macroinvertebrate density than riffles.

The EPT taxa are generally thought of as taxa sensitive to anthropogenic disturbance and provide a means of comparing macroinvertebrate community dynamics among sites at a finer scale than comparing total density of all organisms. Hess samples had low EPT density in all three sites sampled in June 2006, but EPT density estimates were higher and more variable among all sites sampled in September 2006 (Figure 5.2a). Although the average EPT density was higher in September in each of the three sites sampled during both seasons in 2006, only the GS site was significantly higher ($p < 0.02$). Among all sites the SI site had the lowest density of EPT taxa during both of the seasons sampled, but there were no significant differences. Both the SC and GS sites had

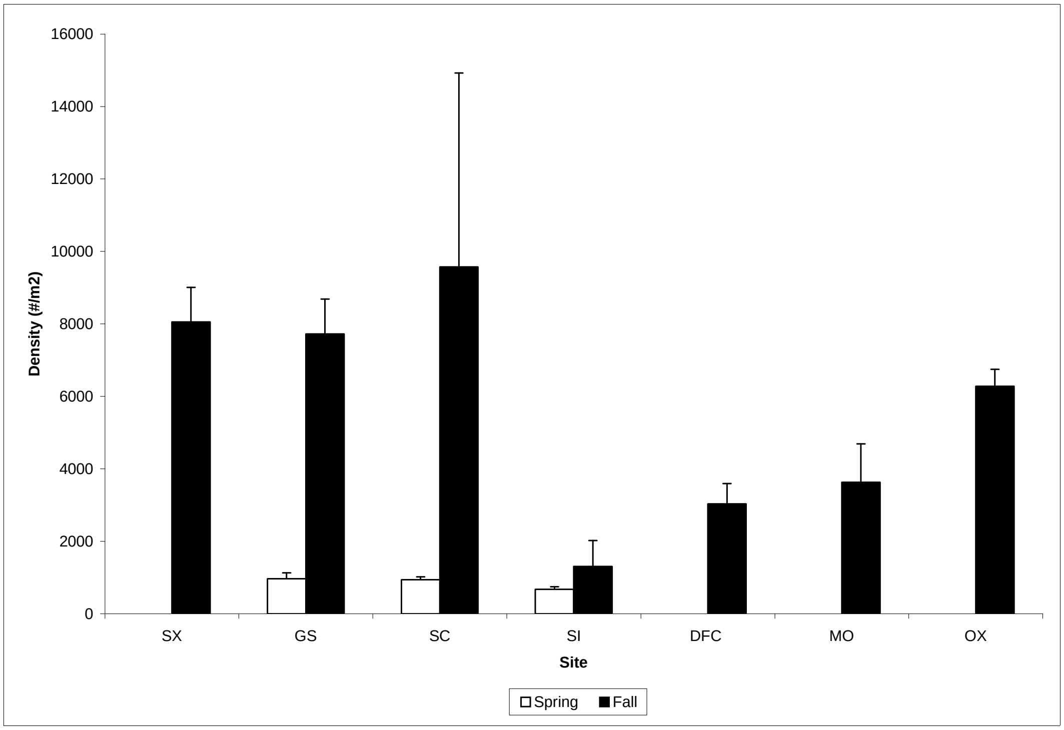


(a) Hess samples.

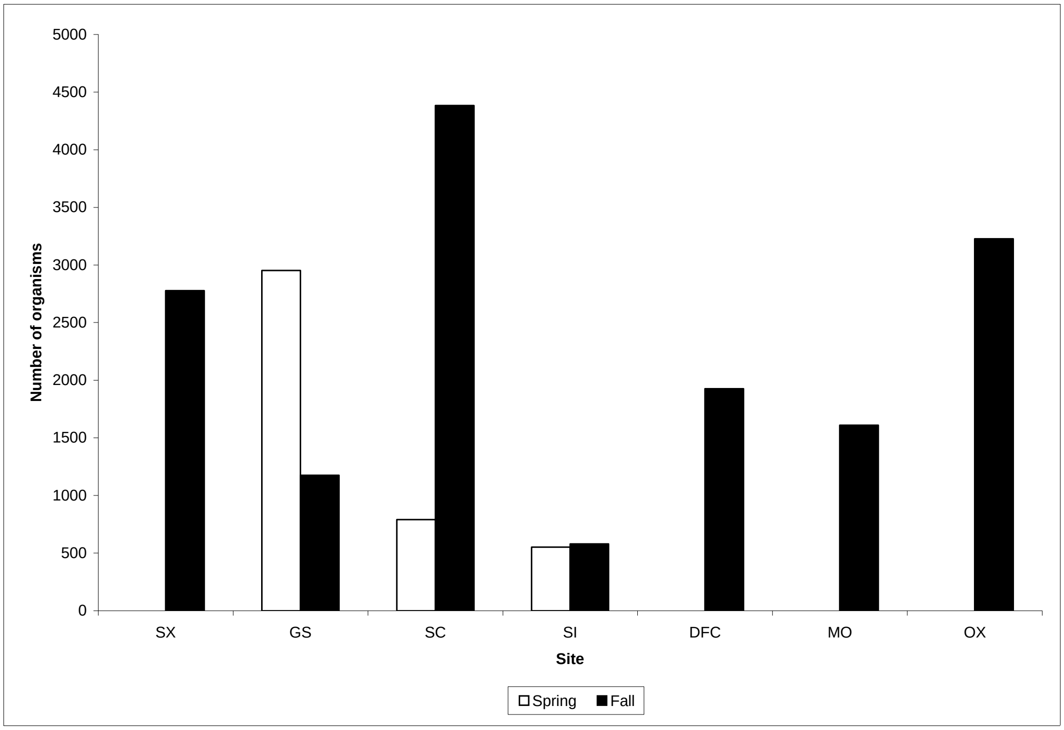


(b) Kick-net samples.

Figure 5.1. Average density of all macroinvertebrates collected in Hess samples (a), and relative abundance of all macroinvertebrates from qualitative kick-net samples (b) taken in June (spring) and September (fall) 2006.



(a) Hess samples.



(b) Kick-net samples.

Figure 5.2. Average density of EPT taxa collected in Hess samples (a), and relative abundance of all macroinvertebrates from qualitative kick-net samples (b) taken in June (spring) and September (fall) 2006.

high EPT density in the autumn, but there was high variability in density estimates among the three SC Hess samples.

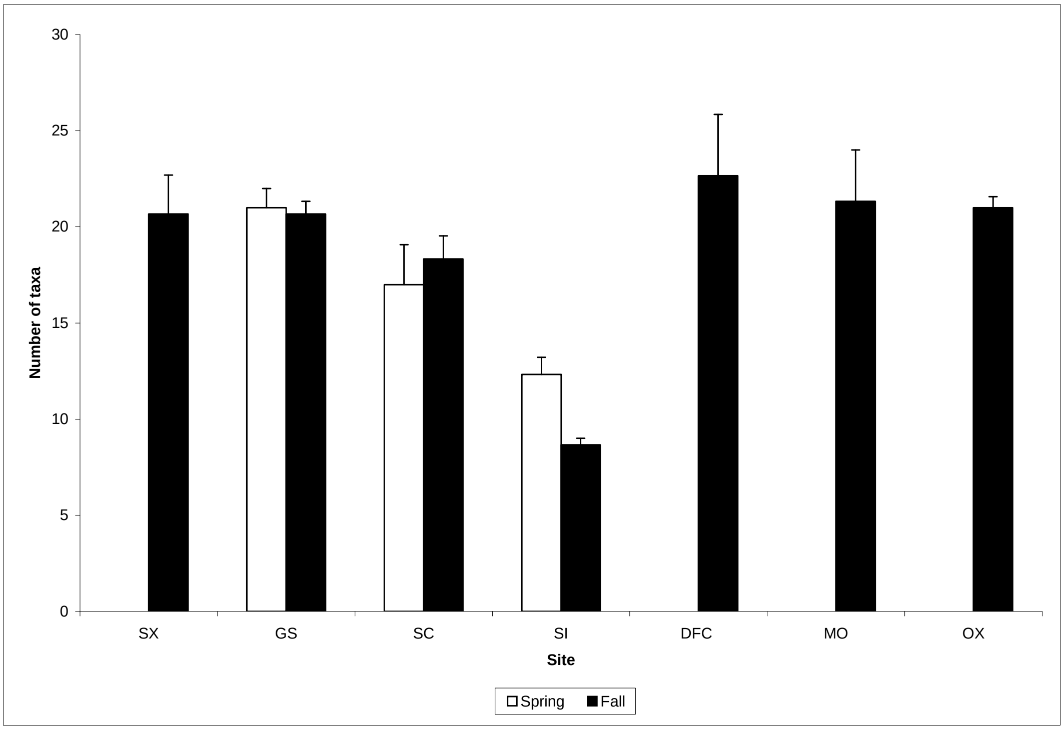
The qualitative kick-net collections (Figure 5.2b) yielded different results than the Hess samples taken in June; the GS sample had a much higher abundance of EPT taxa than either the SC or SI samples. In the samples taken during September 2006, the SC, OX, and SXW sites had a higher number of EPT taxa than the other samples. One consistent result between Hess and kick-net samples was that the SI site had the lowest EPT density/abundance among all sites.

Taxa richness provides an index for evaluating community diversity, but as with total density, it does not discriminate taxa by tolerance to altered conditions. As in 2005 taxa richness of macroinvertebrates in Hess samples (Figure 5.3a) and kick-net samples (Figure 5.3b) was lowest at the SI site in both June and September 2006. Average taxa richness in Hess samples from the SI site was significantly lower than in samples from all other sites during both collection times ($p < 0.02$). In September 2006 all sites had very similar taxa richness, with the exception of SI. Total taxa richness from qualitative kick-net samples indicated that the three sites sampled in June had similar taxa richness, which was much higher than any of the September samples. As in the Hess samples, taxa richness was lowest in the SI site during both seasons.

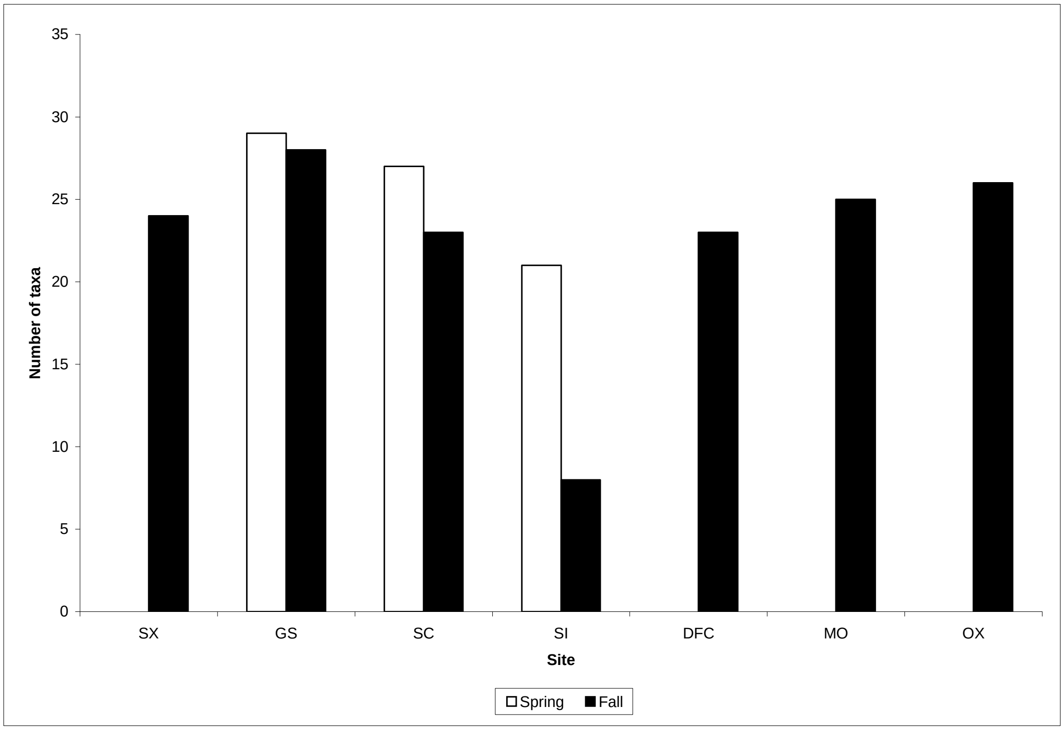
The EPT taxa richness followed a trend similar to total taxa richness (Figures 5.4a and 5.4b). The average EPT taxa richness from SI site Hess samples was the lowest value among samples in each season. The difference was not significant in June, but EPT taxa richness at the SI site was significantly lower than all sites (except SC) in September 2006 ($p < 0.02$). There was also a significant decrease in EPT richness at the SI site between June and September 2006 ($p<0.01$); while values were also lower in September in the other two sites, no significant difference was observed. Qualitative kick-net samples also yielded the lowest EPT taxa richness at the SI site in each season and showed a decline between June and September in each of the three sites sampled during both seasons.

The HBI provides an indication of the overall pollution tolerances of the macroinvertebrate community in a site from the taxa collected. This index has been used to detect nutrient enrichment, high sediment loads, low dissolved oxygen, and thermal impacts (Hilsenhoff 1988), but it was originally developed to detect organic pollution. Individual families were assigned an pollution-tolerance index value from 0 to 10. Taxa with HBI values of 0-2 are considered intolerant, clean-water taxa. Taxa with HBI values of 9-10 are considered pollution-tolerant taxa. A family level HBI was calculated for each sample. Samples with HBI values of 0-2 are considered clean, 2-4 slightly enriched, 4-7 enriched, and 7-10 polluted.

As in 2005 the SXW site had the lowest HBI value, and SI had the highest HBI value in Hess samples (Figure 5.5a) and qualitative kick-net samples (Figure 5.5b) in both June 2006 and September 2006. The average HBI value from Hess samples at the SI site was significantly higher than at the other two sites in June and all but the GS and MO sites in September 2006 ($p < 0.03$). The average HBI value at the SXW site was also significantly lower than at all sites in September 2006 ($p < 0.001$). The HBI values were similar in June and September in each of the three sites sampled during both seasons in both Hess and qualitative kick-net samples.

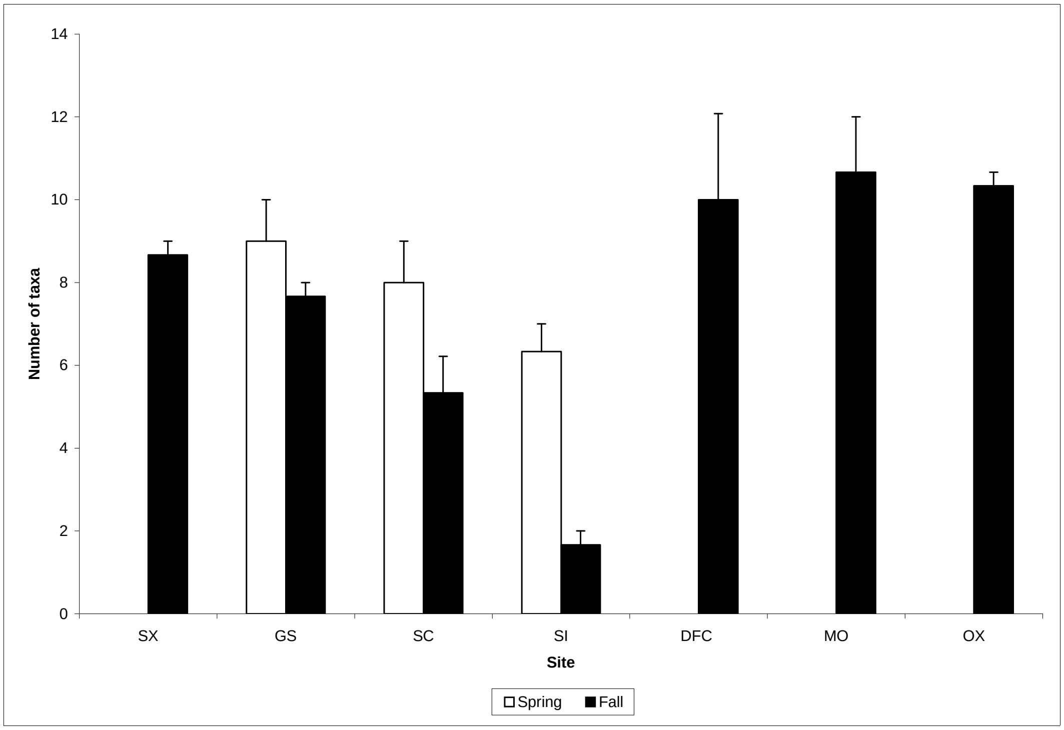


(a) Hess samples.

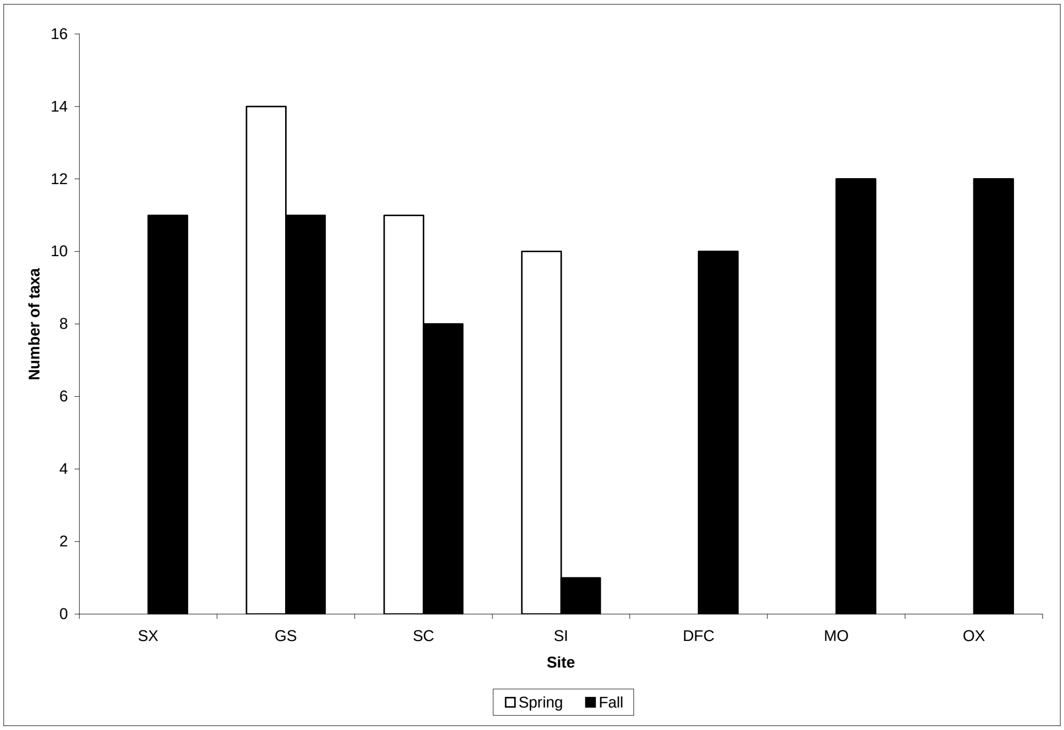


(b) Kick-net samples.

Figure 5.3. Average taxa richness in Hess samples (a), and taxa richness in qualitative kick-net-samples (b) collected in June (spring) and September (fall) 2006.

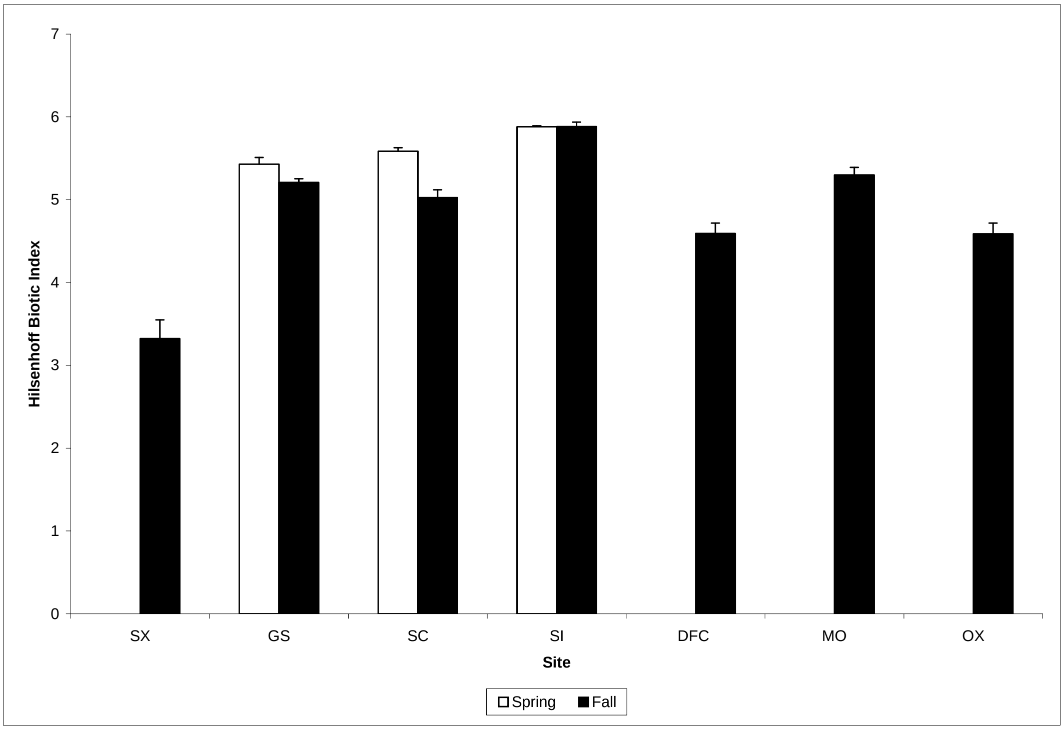


(a) Hess samples.

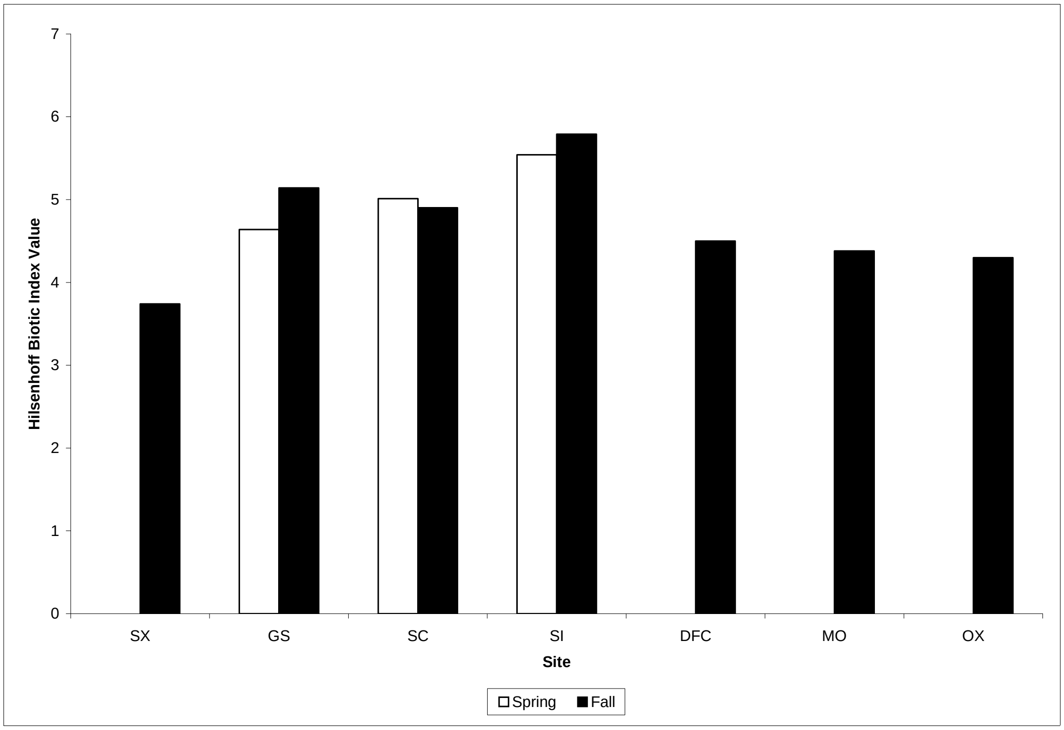


(b) Kick-net samples.

Figure 5.4. Average EPT taxa richness in Hess samples (a), and EPT taxa richness in qualitative kick-net samples (b) collected in June (spring) and September (fall) 2006.



(a) Hess samples.



(b) Kick-net samples.

Figure 5.5. Average Hilsenhoff Biotic Index (HBI) value from Hess samples (a), and HBI value from qualitative kick-net samples (b) collected in June and September 2006.

Examining the proportion of the macroinvertebrate community that is comprised of the three most dominant taxa provides an index of evenness in the community. Up to 21 percent of the total number of organisms might be found in the most dominant taxon in high-quality streams in the Wasatch and Uinta Mountains, while the three most dominant taxa might comprise up to 50 percent of the total number of organisms (Grafe 2002a, Lester 2005). Additionally, examining the three dominant taxa at a site can provide additional information about what may be impacting that site. As in 2005 the SI site had the highest percentage of its community comprised of the three most dominant taxa in each season in 2006, in both Hess (Figure 5.6a) and qualitative kick-net samples (Figure 5.6b). The higher proportion of the three dominant taxa in the SI site, compared with the other sites, was not significant in June, but it was significant compared with the DFC and OX sites in September 2006 ($p < 0.03$).

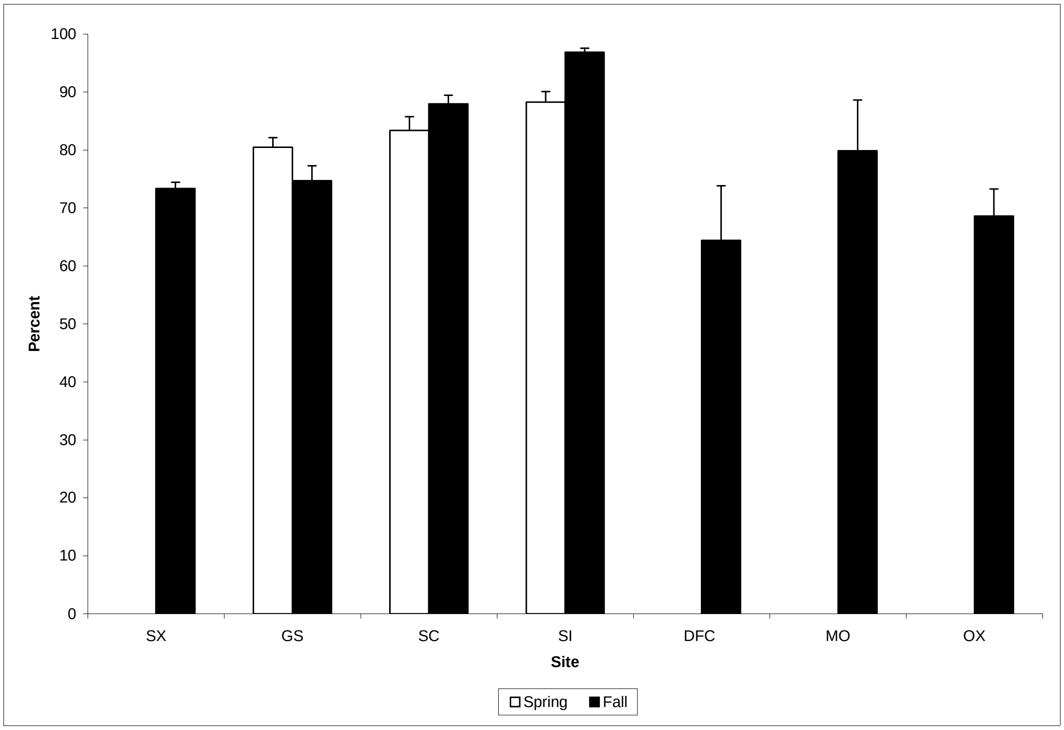
In June 2006 all three sites had only one EPT taxon among the three most dominant taxa, *Baetis tricaudatus*, which is not a pollution-sensitive species (Table 5.1). Midges (Chironomidae) were the most abundant taxa in each of the three sites sampled in June, and the other taxa was different in each site including the fast-colonizing blackfly (*Simulium* sp.), worms (Oligochaeta), and a riffle beetle (*Optioservus* sp.).

In June 2006 the SI site community was dominated by pollution-tolerant taxa in Diptera order (true flies). A few pollution-intolerant taxa were found at this site. Of the EPT species, there were between three and four mayfly taxa, two stonefly taxa, and between two and four caddisfly taxa in each of the SI site samples. In other site samples there were higher numbers of mayfly taxa (between two and seven) but similar numbers of stonefly and caddisfly taxa. Though the range of taxa richness among individual samples in the SI site was higher than observed in 2005 samples (Table 5.2), overall EPT richness for the SI site was only 11 taxa compared with 17 and 18 taxa for the GS and SC sites, respectively. In addition, the number of individuals was more evenly distributed among taxa in each of the EPT groups in the latter two sites.

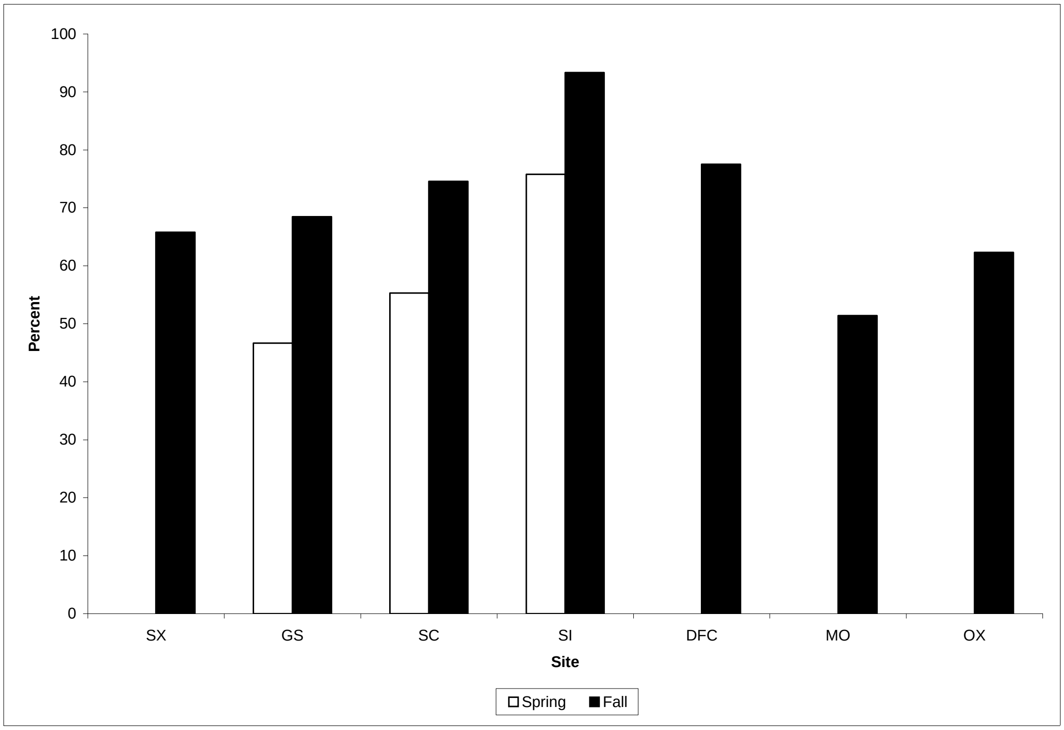
In September 2006 four taxa made up the top three most dominant taxa for six of the seven sites. These included midges, blackflies, mayfly (*Baetis tricaudatus*), and riffle beetle (*Optioservus* sp.). The only difference in the top three taxa was the most dominant taxa at the SXW site which, similar to samples from 2005, was the pollution-intolerant caddisfly (*Oligophlebodes* sp.). In this autumn sample the distinction between the SI site and other sites was more apparent than in the spring: only two mayfly, one caddisfly, and no stonefly taxa were captured in all samples. Overall EPT richness was only three taxa in the SI site, but it ranged from 14 to 18 taxa in all other sites (DFC, OX, and MO all had 18 EPT taxa). The few intolerant taxa found at the SI site were single specimens in a community dominated by relatively tolerant individuals in the order Diptera including approximately 85 percent midges among all SI site samples in September 2006.

5.3.2 Comparisons with Historical Data

During 1999-2002 the National Aquatic Monitoring Center (NAMC) collected several samples near some of the sites sampled for this study (NAMC 2006, Vinson 2006). Samples from this period would have been collected prior to the complete bypass of irrigation deliveries and the institution of the minimum-flow requirements on Sixth Water and Diamond Fork Creeks. These samples would also have been collected before the increased leaching of hydrogen sulfide into the system.



(a) Hess samples.



(b) Kick-net samples.

Figure 5.6. Average percentage of the community comprised by the three most dominant taxa from Hess samples (a), and percentage of the community comprised by the three most dominant taxa from qualitative kick-net samples (b) collected in June and September 2006.

Table 5.1. The three most dominant taxa at the six sampling sites in June and September 2006.

DOMINANCE	SIXTH WATER (SXW)	CONTROL SITE (SC)	CONTROL SITE (GS)	IMPACT SITE (SI)	DIAMOND FORK CAMPGROUND (DFC)	MOTHER (MO)	OXBOW (OX)
June 2006							
First		Chironomidae	Chironomidae	Chironomidae			
Second		*Simulium* sp.	*Baetis tricaudatus*	*Baetis tricaudatus*			
Third		*Baetis tricaudatus*	*Optioservus* sp.	Oligochaeta			
September 2006							
First	*Oligophlebodes* sp.	Chironomidae	Chironomidae	Chironomidae	*Simulium* sp.	Chironomidae	*Baetis tricaudatus*
Second	Chironomidae	*Baetis tricaudatus*	*Optioservus* sp.	*Baetis tricaudatus*	Chironomidae	*Simulium* sp.	Chironomidae
Third	*Optioservus* sp.	*Optioservus* sp.	*Baetis tricaudatus*	*Simulium* sp.	*Baetis tricaudatus*	*Baetis tricaudatus*	*Simulium* sp.

Table 5.2. The three most dominant taxa at the six sampling sites in April 2005 and September 2005.

DOMINANCE	SIXTH WATER (SXW)	CONTROL SITE (SC)	IMPACT SITE (SI)	DIAMOND FORK CAMPGROUND (DFC)	MOTHER (MO)	OXBOW (OX)
April 2005						
First	Chironomidae	Oligochaeta	Chironomidae	Chironomidae	Chironomidae	Chironomidae
Second	*Baetis tricaudatus*	Chironomidae	Oligochaeta	*Baetis tricaudatus*	Oligochaeta	Oligochaeta
Third	*Micrasema* sp.	*Optioservus* sp.	*Simulium* sp.	*Ephemerella inermis/ infrequens*	Nematoda	Nematoda
September 2005						
First	*Oligophlebodes* sp.	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Chironomidae
Second	Chironomidae	*Optioservus* sp.	*Baetis tricaudatus*	Oligochaeta	*Optioservus* sp.	Oligochaeta
Third	*Micrasema* sp.	*Hydropsche* sp.	Oligochaeta	*Optioservus* sp.	Oligochaeta	*Optioservus* sp.

Unfortunately there were no historical data from locations near each of the sites sampled for this study, and the collection methods used for it differed from those of the NAMC (Table 5.3).

There were some differences between the NAMC kick-net sample collection methods and the sample collection methods used for this study. The NAMC sample protocol was one kick in a riffle, while samples for this study were collected by performing 20 kicks throughout multiple habitats. Hence the Hess samples collected for this study may be more comparable with the kick-net samples

Table 5.3. Historical sampling near 2005-2006 sampling sites and the number and types of samples collected.

CURRENT SITE	HISTORICAL SAMPLES	1999	2000	2001	2002
Sixth Water	No	N/A	N/A	N/A	N/A
Control Site	No	N/A	N/A	N/A	N/A
Impact Site	Yes (near Three Forks confluence)	1 D-frame	N/A	3 D-frame	N/A
Diamond Fork Campground	Yes (near current site)	N/A	N/A	N/A	1 D-frame
Mother	Yes (near current site)	1 D-frame	N/A	N/A	N/A
Oxbow	Yes (near confluence with Spanish Fork River)	1 Basket sample	1 Hess sample	N/A	N/A

collected by the NAMC. Preliminary analyses showed conflicting trends when total abundance and total density from kick-net samples taken by NAMC and kick-net samples collected in 2005 for this study were compared. Additionally, since kick-net samples for this study were taken throughout multiple habitats, they should have higher taxa richness values. Preliminary analyses confirmed these expectations. Therefore, the Hess sample data collected for this study (2005 and 2006) were compared with the kick-net information and Hess sample information collected by the NAMC.

The site with the most historical information was SI, although the comparison NAMC site was 2.1 km downstream near the confluence with Three Forks. One D-frame kick-net sample was collected by NAMC in June 1999, and three replicate D-frame kick-net samples were collected in November of 2001 from the NAMC site above Three Forks. June 2006 data collected for this study were compared with NAMC's June 2005 sampling data and BIO-WEST's April 2005 data. The September 2006 data from this study were compared with NAMC's November 2001 data and BIO-WEST's September 2005 data. Total density of macroinvertebrates at the SI site in both spring (Figure 5.7a) and autumn 2006 (Figure 5.7b) was lower than in the NAMC samples in 1999 and 2001, as well as the 2005 samples taken during this study. The EPT density in the autumn 2006 sample was also lower than all previous samples. The spring 2006 density was slightly higher than in 2005, but it was still lower than in 1999 and 2001. Total taxa richness and EPT taxa richness were similar to 2005 samples taken in both spring 2006 (Figure 5.8a) and autumn 2006 (Figure 5.8b), and were substantially lower than in the samples taken in 1999 and 2001. As in 2005 there was also a higher HBI value (Figure 5.9) and percentage of the community dominated by the three most abundant taxa (Figure 5.10) at the SI site in 2006 compared with samples taken there in 1999 and 2001.

The dominant taxa (midges: *Diptera chironomidae*) were fairly similar between the 1999/2001 and 2005/2006 collections in the SI site and comparable NAMC site, although the riffle beetle (*Optioservus* sp.) was the second most abundant taxa in June 1999. The big difference in the community between the 1999/2001 and 2005/2006 collections was in the number of EPT taxa. Four stonefly taxa (*Pteronarcella badia, Pteronarcys califonica, Isoperla* sp., and Chloroperlidae), two caddisfly taxa (*Rhyacophila* sp., *Arctopsyche* sp.), and one mayfly taxa (*Tricorythodes* sp.) were found in the 1999/2001 collections but not in the 2005 or September 2006 collections.

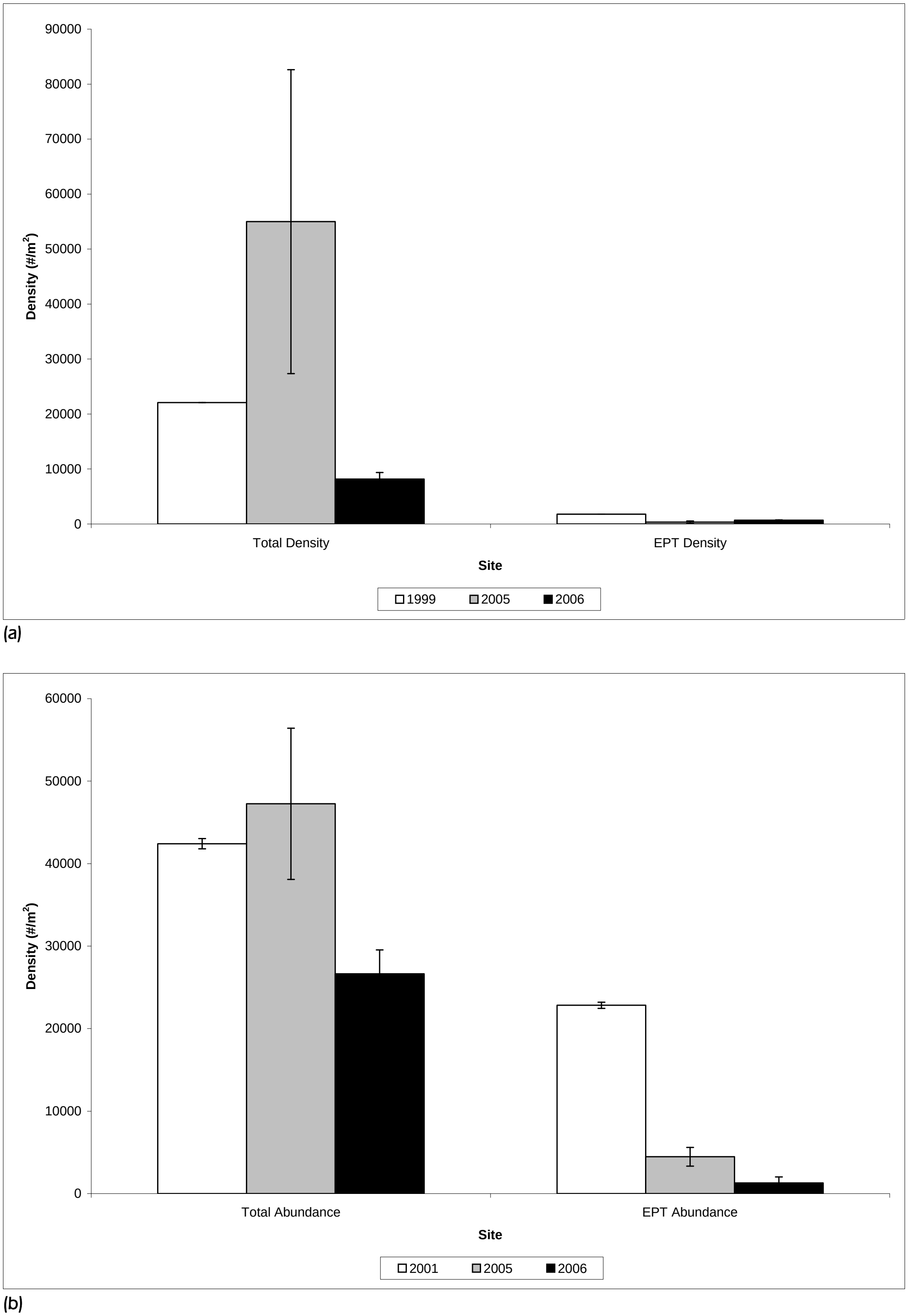


Figure 5.7. Total density and EPT taxa density from kick-net samples and Hess samples taken near the impact site (SI) in (a) spring 1999, 2005, and 2006, and (b) autumn 2001, 2005, and 2006.

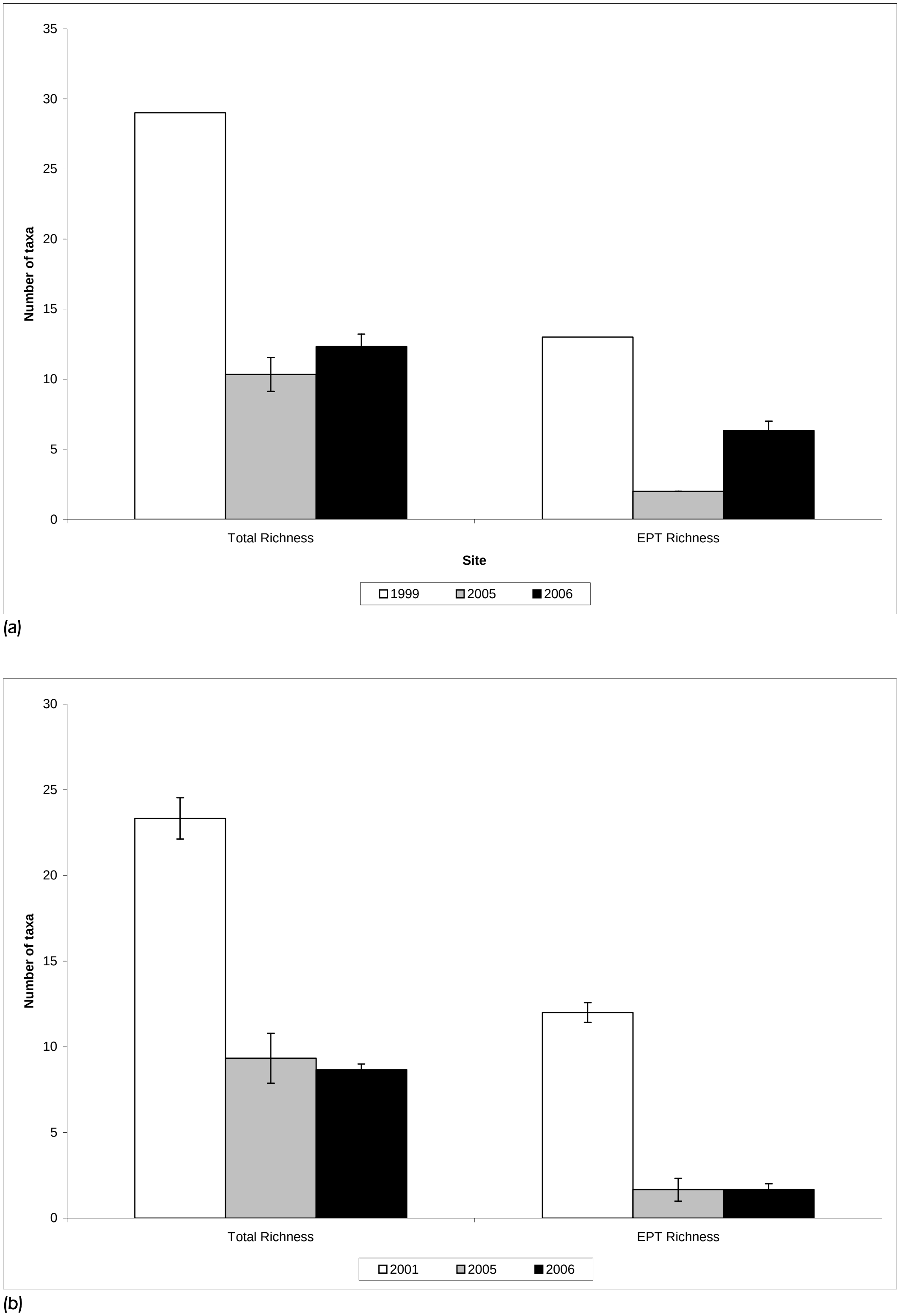


Figure 5.8. Total taxa richness and EPT taxa richness from kick-net samples and Hess samples taken near the impact site (SI) in (a) spring 1999, 2005, and 2006, and (b) autumn 2001, 2005, and 2006.

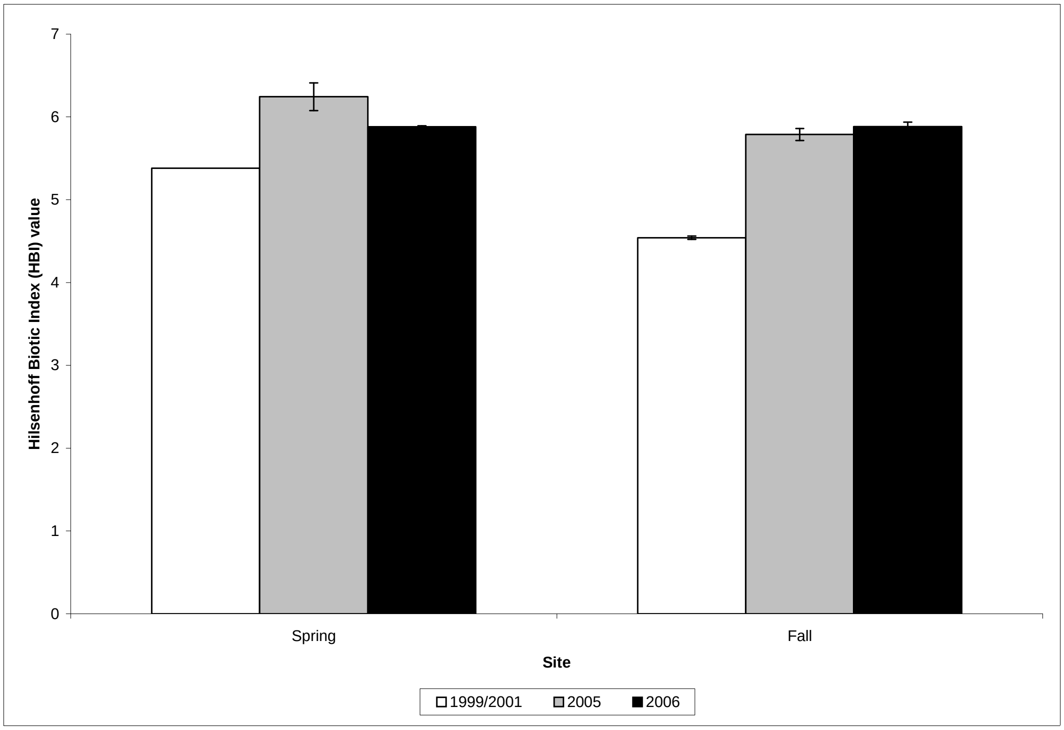


Figure 5.9. Hilsenhoff Biotic Index (HBI) values from kick-net samples and Hess samples taken near the impact site (SI) in spring 1999, 2005, and 2006, and autumn 2001, 2005, and 2006.

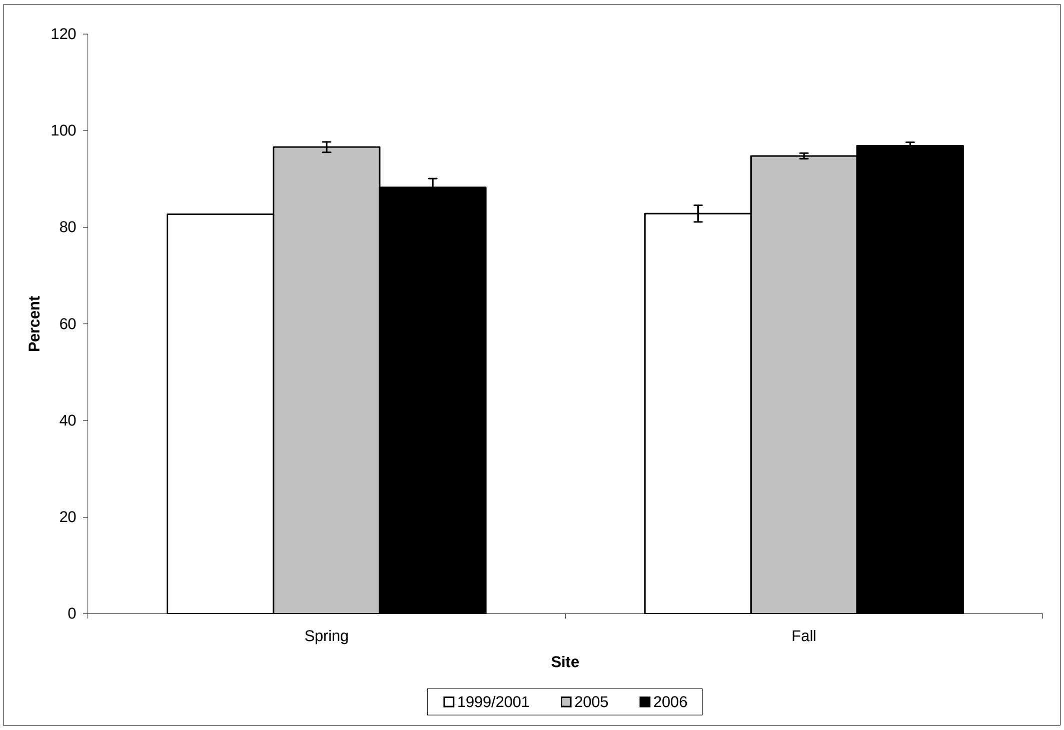


Figure 5.10. Percentage of the community comprised of the three most abundant taxa from kick-net samples and Hess samples taken near the SI site in spring 1999, 2005, and 2006, and autumn 2001, 2005, and 2006.

In the June 2006 sample, several *Pteronarcella* sp. were observed, along with one *Rhyacophila coloradensis*. In addition, those EPT taxa that were collected in the 2005/2006 samples were generally found in lower abundance than in the 1999/2001 samples.

The NAMC also collected a kick-net sample near DFC in January 2002, a kick-net sample near MO in June 1999, and a Hess sample downstream of OX (near the confluence with the Spanish Fork River) in March 2000. In the 2005 report (BIO-WEST 2006), Hess samples collected at these sites in April 2005 for this study were compared with the historical NAMC data; however, no data were collected at these sites in April 2006 due to high flows. For this report, the September 2006 data were compared with the earlier samples. Total density of macroinvertebrates in September 2006 samples was similar to the 1999–2002 samples, which were generally lower than the 2005 samples (Figure 5.11). The EPT density was similar among all collection years at MO but lower in September 2006 at DFC than in previous years. At OX the 2000 NAMC collection had a substantially higher density of EPT taxa than samples collected in April 2005 or September 2006 for this study (Figure 5.12). Total taxa richness and EPT taxa richness were similar (or within the range of variability among samples) between the NAMC collections and collections for this study (Figures 5.13 and 5.14). The HBI values of historical collections were lower than in the April 2005 and September 2006 collections, most notably at OX in 2000 (Figure 5.15). In 2005 and 2006 all sites fell into the enriched category, whereas the samples from OX in 2000 and DFC in 2002 fell into the slightly enriched category.

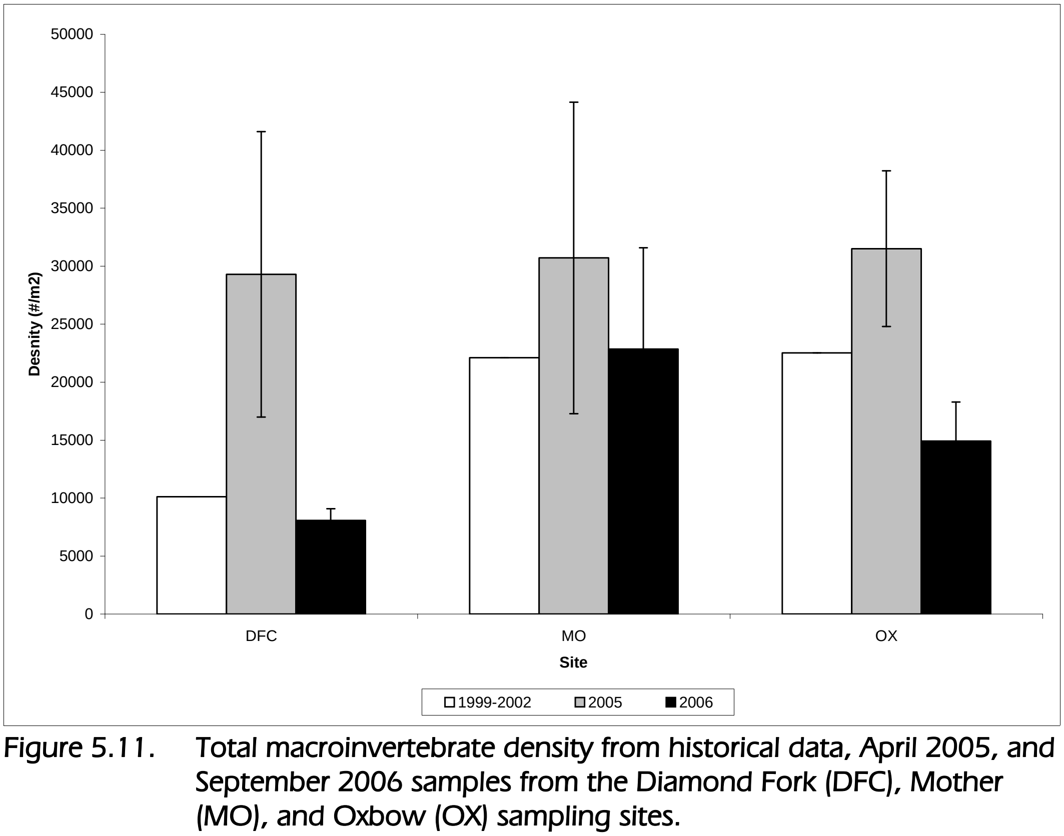


Figure 5.11. Total macroinvertebrate density from historical data, April 2005, and September 2006 samples from the Diamond Fork (DFC), Mother (MO), and Oxbow (OX) sampling sites.

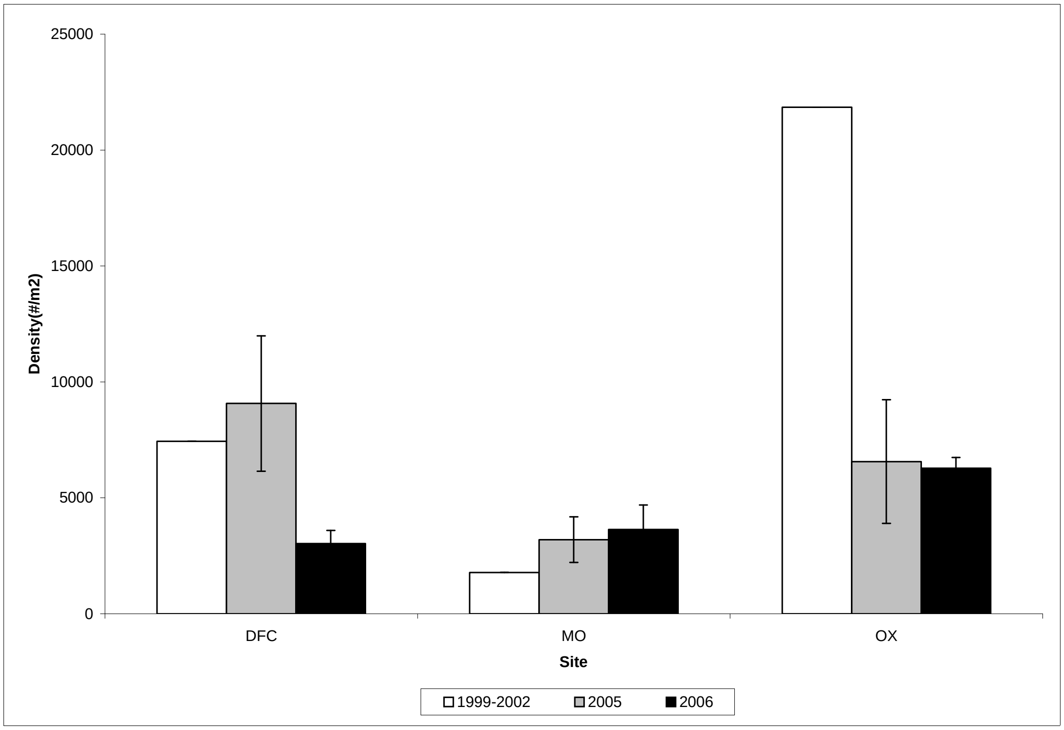


Figure 5.12. Total EPT density from historical data, April 2005 samples, and September 2006 samples from Diamond Fork (DFC), Mother (MO), and Oxbow (OX).

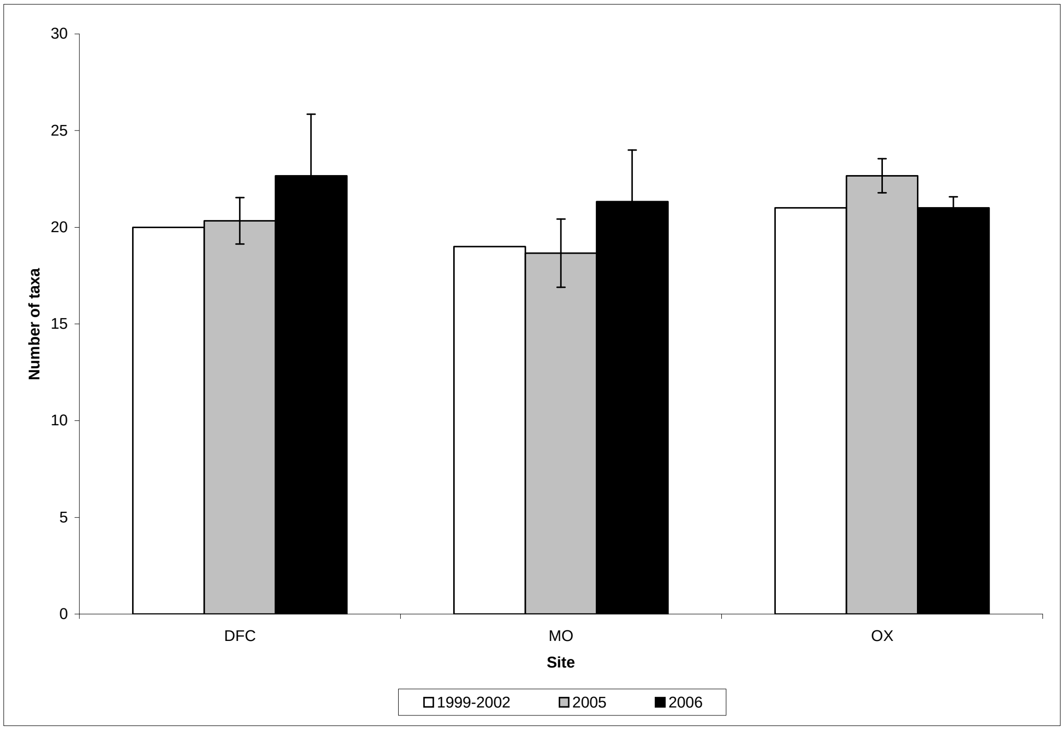


Figure 5.13. Total taxa richness from historical data, April 2005 samples, and September 2006 samples from Diamond Fork (DFC), Mother (MO), and Oxbow (OX).

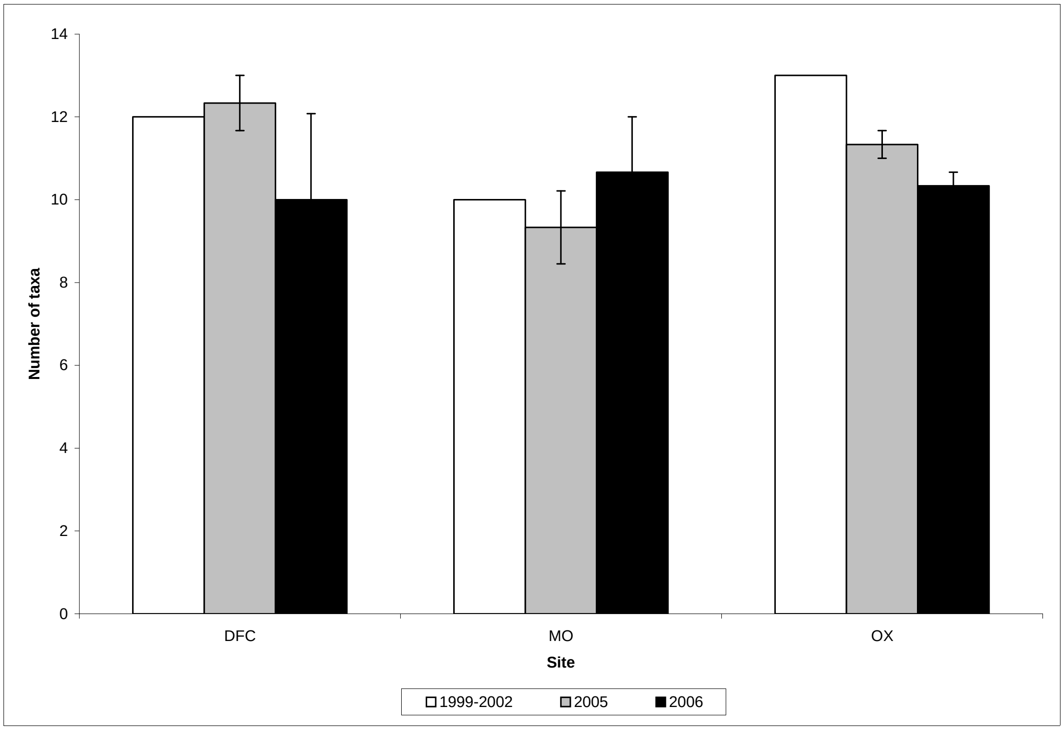


Figure 5.14. Total EPT richness from historical data, April 2005 samples, and September 2006 samples from Diamond Fork (DFC), Mother (MO), and Oxbow (OX).

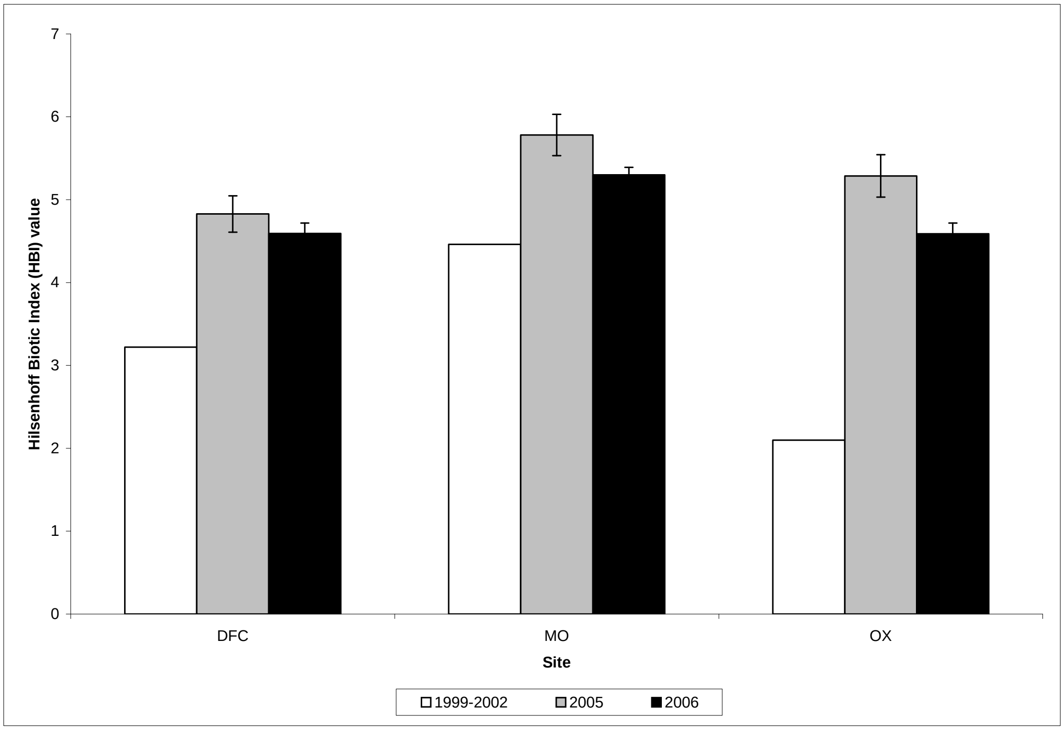


Figure 5.15. Hilsenhoff Biotic Index (HBI) values from historical data, April 2005 samples, and September 2006 samples from Diamond Fork (DFC), Mother (MO), and Oxbow (OX).

The percentage of the community comprised of the three most dominant taxa was nearly identical at OX between 2000 and 2005/2006 (Figure 5.16). Despite the fact that the same percentage of the community was comprised of three dominant taxa at OX in 2000 and 2005/2006, the three most dominant taxa in 2000 were the caddisfly taxon *Brachycentrus* sp. and the mayfly taxa Ephemerellidae and *Rhithrogena* sp., compared with the dominance of midges and worms found at OX in 2005 and 2006. In 2000 almost the entire community OX at was comprised of EPT taxa. While there were differences in the abundance of certain taxa found at OX in 2000 and 2005/2006, all the EPT taxa found in the 2000 NAMC samples were also found in the April 2005 samples, and all but one taxa (Ephemeroptera *Heptageniidae* sp.) were found in the September 2006 sample. Hence the major difference was the abundance of midges and worms in the 2005/2006 samples.

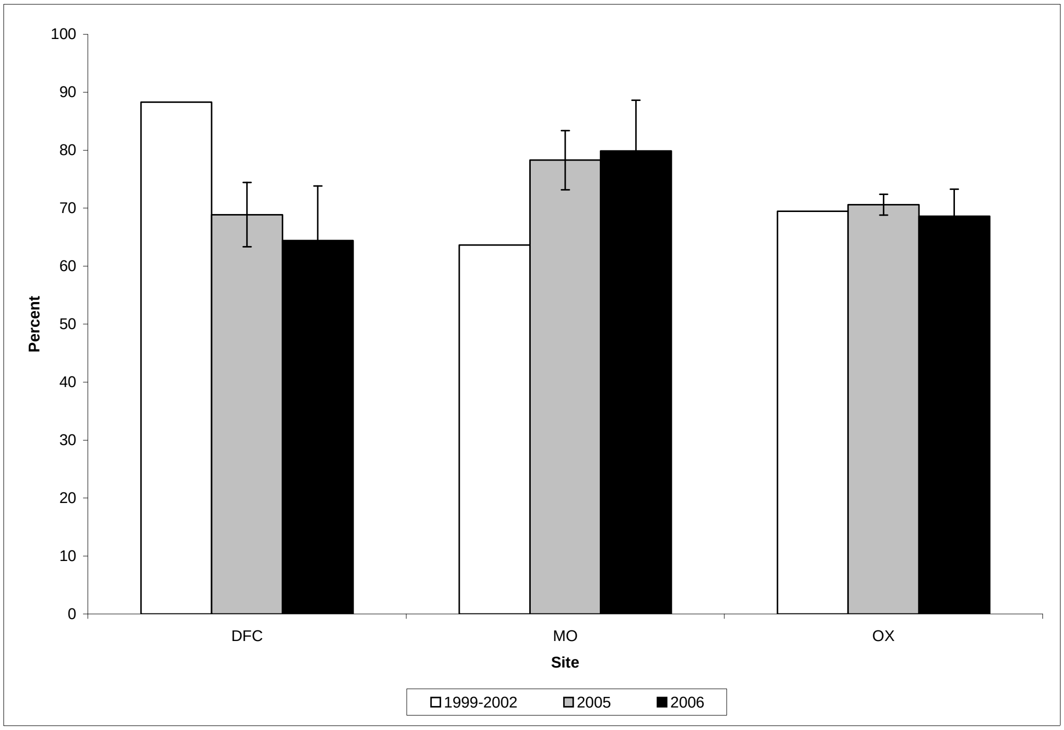


Figure 5.16. Percentage of communities comprised of the three most dominant taxa from NAMC data compared with April 2005 and September 2006 data.

In April 2005 and September 2006, approximately 15 percent more of the MO community was comprised of the three dominant species compared with the June 1999 NAMC collection. As with OX in 2000, EPT taxa were more abundant at MO in 1999 than in 2005/2006. Midges, the mayfly family Ephemerellidae, and the mayfly *Baetis tricaudatus* were the three most abundant taxa at MO in June 1999. In April 2005 midges, worms, and round worms (Nematoda) were the three most abundant taxa, while in September 2006 midges, blackflies, and the mayfly *Baetis tricaudatis* were most abundant. However, all of the EPT taxa found in the NAMC sample collected in June 1999 were found in the April 2005 sample, and all but one (Ephemeroptera *Heptageniidae* sp.) was found in the September 2006 sample. The main difference between the recent collections and those in 1999 was the abundance of midges and worms in the more recent samples.

In the DFC site approximately 20 percent less of the community was comprised of the three dominant taxa in April 2005 and September 2006, compared with the 2002 sample. The caddisfly *Brachycentrus occidentalis* dominated the community in 2002, along with the mayfly *Baetis tricaudatus* and midges. In April 2005 midges dominated the community, along with the mayflies *Baetis tricaudatus* and *Ephemerella inermis/infrequens*. In September 2006 midges, blackflies, and the mayfly *Baetis tricaudatus* were dominant.

5.4 DISCUSSION

5.4.1 Long-term Monitoring Sites

Although 2006 only provided a single monitoring effort (in the autumn) in each of the four long-term monitoring sites (SXW, DFC, MO, and OX) the numbers of macroinvertebrate and EPT taxa were very similar among sites during that sample, as observed in 2005. Also like 2005, the 2006 HBI value was similar among sites (though lowest in SXW) and percent occurrence of the three dominant species was similar among these sites. The major differences among sites in both years were total density of all macroinvertebrates, which varied widely among sites within years, and the density of EPT taxa, which was generally highest in the SXW site. These differences suggest a slightly less degraded macroinvertebrate community higher in the watershed than in the downstream sites. However, there are some differences that would be expected between the SXW site and the others based on the river continuum concept and the general pattern found in undisturbed Rocky Mountain streams (Vannote et al. 1980; Grafe 2002a, 2002b) that were not observed. The SXW site is in a second-order tributary to Diamond Fork Creek, while the remaining three long-term monitoring sites are fourth-order sites on the main stem of Diamond Fork Creek itself. According to the river continuum concept, taxa richness should increase in a downstream direction and thus be lowest in the SXW site. Instead, the total number of taxa and number of EPT taxa at the DFC, MO, and OX sites was similar to or lower than at the SXW site in both quantitative Hess samples and qualitative multi-habitat kick-net samples. This result suggests that taxa richness at the sites in the lower portion of the river are suppressed compared with expectations. Further monitoring will determine whether these sites will continue to progress toward the conditions of the SXW site and even surpass that site in terms of taxa richness and diversity. The upstream SXW site will provide a source of new macroinvertebrates for these lower sites if conditions are conducive to supporting populations of these species.

One of the most interesting observations in 2006 resulted from a comparison of EPT taxa richness among years and within sites. In all four long-term monitoring sites, the autumn samples in 2006 had lower EPT richness compared with autumn samples in 2005. With the restoration of more normal flow conditions, the richness of sensitive EPT taxa would be expected to increase, or at least remain similar, in the short term and begin to increase over a multi-year time frame. The decrease in EPT taxa richness in the second year after flows were reduced may be a result of interannual variation in the data, but it may also indicate that conditions have not been returned to a suitable condition to promote an improvement in this critical component of the macroinvertebrate community. As discussed in previous sections, the flow conditions may still be too high for the physical dimensions of this stream channel and may not permit sediment-transport conditions that support a robust macroinvertebrate community. Although there was an apparent shift toward taxa that are more intolerant of fine sediment in 2006 compared with 2005 (discussed below), unstable sediment dynamics may still affect the number of EPT taxa present.

The data from the four long-term monitoring sites were also compared with similar streams in the region. No review of macroinvertebrate data from streams in Utah was available, so a comparison was made with Idaho streams (Grafe 2002a). The average number of taxa found in Hess samples at SXW in 2005 was similar to the average found in non-impacted small streams in the mountains of Idaho, but in autumn 2006 the average had declined into the range of averages for impacted sites. In spring 2005 and autumn 2006, the average number of taxa found at the DFC, MO, and OX sampling sites was lower than within the range of averages at impacted sites (Grafe 2002a). In autumn 2005 the average taxa richness at DFC and MO were within the range of non-impacted streams. In qualitative, multi-habitat, kick-net samples, the taxa richness at all four sites was near or above the average found in non-impacted streams in both 2005 and 2006. Similarly, the average number of EPT taxa from Hess samples and the total number found in qualitative kick-net samples was near or above the average found in non-impacted small streams. These comparisons are based on Diamond Fork Creek's small-stream classification, but lower Diamond Fork Creek (MO and OX) is almost considered a large river (Grafe 2002b). If classified as such and compared with other large rivers in Idaho, the number of EPT taxa found there (MO and OX sites) in 2005-2006 would be more indicative of impacted sites.

The HBI values indicate some level of impacts at all four of these sites. The MO, OX, and DFC sites fell into the "enriched" category for HBI values during each season in 2005 and in September 2006, while the HBI value at the SXW site was in the enriched category in April 2005 and the slightly enriched category in September 2005 and September 2006. Additionally, only the HBI values at the SXW site in autumn 2005 and 2006 fell close to the average value for least-impacted small streams in Idaho (Grafe 2002a). The HBI values at the MO and OX sites were within the range of impacted small streams in both seasons and well above the median of 4.0 listed for larger rivers in Idaho (Grafe 2002a, 2002b). Some caution must be employed when interpreting taxa richness and HBI indices for these data because of the level of taxonomic resolution used in this study. Since midges were only identified to the family level and worms to class, multiple taxonomic groups likely occur within these designations. In other words, several individual taxa are combined into Chironomidae and Oligochaeta. This reduces taxa richness and also may impact HBI values. However, since Grafe (2002a, 2002b) used a similar measure of taxonomic resolution, comparisons of this study's data with that data should be valid.

The lingering effects of nearly 90 years of altered flows are probably responsible for the depressed taxa richness and elevated HBI values seen in the macroinvertebrate community in 2005 and 2006. Changes in the seasonal timing of flow and temperature regimes of a system can impact the life-history characteristics of individual species (Stanford and Ward 1979, Vannote and Sweeney 1980, Power et al. 1996). These changes can often result in reductions in species diversity like those in Diamond Fork Creek (Ward 1974, Stanford and Ward 1979). Snaddon and Davies (1998) showed that elevated summer flows from an interbasin transfer in South Africa resulted in a decrease in taxa richness in the receiving river. One of the more common community changes from elevated flows and cooler temperatures below large dams is an increase in dipteran and worm populations, while mayfly, stonefly, and other benthic orders are generally significantly reduced. Changes in water velocity can impact the channel-forming flows that structure the bedform and substrate composition of a stream. Reducing spring peak flows can alter the maintenance of certain habitat types. More constant, higher flows can lead to the development of uniform substrates, which reduces the number of niches available. All of these factors may have worked to limit the diversity of habitat available for macroinvertebrates during the past century of water deliveries through Sixth Water and Diamond Fork Creeks.

A potential reason for the reduced number of macroinvertebrate taxa in Diamond Fork Creek compared with other streams is the high level of sediment, as noted in Chapter 4. Fine sediment transport and deposition negatively impact aquatic invertebrates (Waters 1995, Relyea et al. 2000). The higher-than-average transport of gravel and fine sediments could be impacting the diversity of macroinvertebrates found at these four sites. With the exception of the SXW site, the average-weighted Fine Sediment Biotic Index (FSBI) scores for each site suggest that the macroinvertebrate communities at these sites are predominantly comprised of organisms at least moderately tolerant to fine sediments (Appendix 5.1). However, the caddisfly *Arctopsyche grandis*, which is classified as intolerant to fine sediment (Relyea et al. 2000), was present at all four of these sites. The average-weighted FSBI score at the SXW site indicated a community predominantly comprised of individuals moderately tolerant to sediment in April 2005 and September 2006, but in September 2005 it indicated individuals moderately intolerant to sediment. In addition to *Arctopsyche grandis*, another caddisfly that is intolerant of fine sediment, *Oligophlebodes* sp., was abundant at the SXW site. In general, weighted FSBI scores were lower in autumn 2006 than in 2005 (except at SXW), which suggests a macroinvertebrate shift toward a higher number of individuals intolerant or moderately intolerant to accumulations of fine sediment, but this factor still clearly impacts the community. There continues to be some variability in the FSBI score among samples, and the presence of taxa intolerant or moderately intolerant of sediment at all four sites makes an evaluation of the impact of sedimentation on the macroinvertebrate communities unclear. Hopefully, continued data collection will allow a more detailed analysis of how elevated levels of sediment may be impacting the biological communities on Diamond Fork Creek.

Although there may have been a shift toward larger numbers of taxa that are more intolerant to fine sediments, the higher transported quantity of these sediments may still influence macroinvertebrate densities. In 2005 there was a large decrease in macroinvertebrate densities between April and September that may have been influenced by high volumes of suspended sediment. It is also possible that sediment deposition in these areas could have been responsible for the reduction in invertebrate density directly, through mortality and transport, or indirectly, through decreasing primary productivity (Waters 1995). The high spring flows in 2005 could also have caused the decrease in macroinvertebrate density at the MO and OX sites in September 2005. Since only one sample was taken from the four long-term monitoring sites in spring 2006 seasonal shifts could not be evaluated, but additional monitoring may further clarify whether this is an isolated event or a long-term trend.

In addition to comparisons among sites and years, and with data from impacted and non-impacted streams in Idaho, the data collected in recent samples (2005-2006) were also compared with historical information. There were three sites for which historical samples exist (DFC, MO, and OX), and comparisons revealed similarities to the samples taken 3 to 7 years ago, although midges and worms were more abundant in the 2005-2006 samples. One possible explanation for the higher number of midges and worms is the difference in laboratories conducting the sorting; it is possible that EcoAnalysts' sorting and identification methods may have been different enough from other laboratory methods to affect the observed results. EcoAnalysts has found that when they process samples during other monitoring programs the number of organisms, particularly small organisms like midges and worms, increases substantially (Lester 2005).

Despite the multiple impacts that may have affected invertebrate diversity at SXW, DFC, MO, and OX, these sites still maintain fairly large numbers of long-lived taxa and taxa that are intolerant of disturbance. The presence of these sensitive taxa indicates that, while some impacts have occurred, the benthic community has still managed to maintain much of its integrity. In addition, the density of macroinvertebrates are such that no food limitation exists for sport fishes in the river. In instances where a food limitation for trout has been documented in other rivers, the invertebrate densities were orders of magnitude lower than those observed in Diamond Fork Creek (Cada et al. 1987, Newcomb et al. 2001). According to fisheries surveys conducted in Diamond Fork Creek in 2005, mean length and weight of brown trout (*Salmo trutta*) were greater than measurements obtained during surveys in 2003 in two of the three monitoring sites; however, condition factor of the fish was lower in 2005 and the number of trout per mile had decreased substantially in all sites (Hepworth and Wiley 2006). Bonneville cutthroat trout (*Oncorhynchus clarki utah*) were also caught, but their numbers were too low to make any meaningful comparisons with previous data. One hypothesis for the recent decline in fish numbers is that there was a very productive year class in 2001, but subsequent spawning runs were not as successful (R. Hepworth, UDWR aquatic biologist, pers. comm.). The increase in size accompanying the decrease in abundance may appeal to anglers and be natural variation in the fish population. Additional monitoring will help identify any trends in these data. A response in the fish community to altered streamflow may not be apparent as quickly as changes in the macroinvertebrate community (the fisheries survey occurred within 1 year of the changes in flow), but there is no indication that there is a limitation in the density of food items for the trout. The types of potential prey organisms also do not appear to be limiting. Midges are common in the drift and frequently consumed by trout in large numbers. The common mayfly *Baetis tricaudatus* is a species that tends to enter the drift to move among feeding locations. If the increase in fine-sediment transport is affecting macroinvertebrates as suspected, this condition may also impact success of fish spawning.

The greatest continued impacts to the macroinvertebrate community in Diamond Fork Creek are believed to be associated with sediment dynamics, and it appears that the macroinvertebrate communities have not changed/improved drastically as a result of the changes in discharge. Additional monitoring in 2007 will provide the opportunity to evaluate whether the modifications to discharge in Diamond Fork Creek have been sufficient to promote recovery of benthic macroinvertebrate communities beyond previous conditions. If all or most of the metrics used to evaluate community dynamics remain within the same range of variability in 2007, there will be enough data to suggest that the community remains in a stable condition and will not change substantively without additional modifications to sediment transport.

5.4.2 Sulfur-Impact Evaluation Sites

Although the four long-term monitoring sites have maintained much of their integrity, the sites representing areas impacted by increased hydrogen sulfide inputs above the Three Forks area following the January 2002 pipeline incident contained severely impacted benthic communities. Similarly, the fish community appears to be influenced by this condition, particularly in the autumn when discharge is low and inputs are concentrated. The Utah Division of Wildlife Resources

(UDWR) found that fish held in cages downstream of the hydrogen sulfide inputs during the autumn only survived for about an hour (R. Hepworth, UDWR aquatic biologist, pers. comm.). In general, the macroinvertebrate communities at the control sites (SC in 2005, SC and GS in 2006) were more diverse and comprised of more intolerant species than the community in the impact site. This suggests that there are impacts directly associated with the hydrogen sulfide inputs beyond any effects of the historical water flow conditions observed in the "control" sites. The use of a second control site in 2006 stemmed from the lack of suitable habitat for sampling with the Hess device in the SC site. The SC site was chosen originally as the best habitat that was within a short distance of the impact site (between Sawmill Canyon and Springville Crossing [Hepworth 2005]), but poor habitat conditions led the field crew to find an alternate control site just upstream of Springville Crossing in 2006.

Comparisons of the various metrics between the SI and SC/GS sites revealed some important differences in 2005 and 2006 that indicate the level of impact from the hydrogen sulfide inputs. Higher macroinvertebrate density in the SI site compared with the control sites during both years seems to contradict the hypothesis that the hydrogen sulfide is negatively impacting the macroinvertebrate community in the immediate vicinity, but this higher density is a result of high densities of midges and blackflies, which are generally very tolerant of degraded conditions. Similarly, the EPT density suggests no dramatic impact in the SI site relative to the control sites, which had very similar numbers among sites in each season, but the total EPT density in the SI site is dominated by a relatively tolerant colonizing mayfly, *Baetis tricaudatus*. The HBI value was slightly higher in the SI site but not high enough to result in a different category rating for the SI site compared with the other sites. Taxa richness, EPT taxa richness, and the proportion of the community comprised of the three most dominant taxa had more distinct differences between the SI and control sites. Similar to results in 2005, the SI site had significantly lower overall taxa richness compared with all other sites during each season, substantially lower EPT taxa richness than all other sites in June (not significant), and significantly lower EPT taxa richness than all of the other sites sampled in September 2006. Additionally, the SI site had a higher proportion of the macroinvertebrate community comprised of the three dominant taxa and the highest average HBI value from Hess samples in both seasons during 2005 and 2006. However, unlike in 2005, the 2006 data were not all significant (only OX and MO were significantly lower in September 2006). This low taxa richness and the dominance of only a few taxa indicates poor diversity at the SI site and a considerably higher level of disturbance than at the control sites (Barbour et al. 1999).

One promising observation from these comparisons was the relatively high value of EPT taxa richness in the June 2006 sample (which was conducted immediately after runoff rather than prior to runoff as in 2005) compared with the two control sites. The April 2005 sample from this site had very low EPT taxa richness and, if this was similar in 2006 prior to runoff, it suggests that during runoff the sulfur inputs to the stream are diluted and the macroinvertebrate community is capable of becoming much more diverse (with a relatively diverse group of EPT species) as a result of downstream dispersal during higher flows. With the reduced impact from diluted hydrogen sulfide inputs during that time, many of the organisms settle into the SI site area. By September, however, we saw a reduction in EPT taxa richness. Overall, this is a good indicator that if/when hydrogen sulfide inputs are diminished, the macroinvertebrate community will be able to recover to some degree in a short time period. Similarly, there was a higher taxa richness in the three sites sampled in June 2006 compared with September 2006 samples, whereas the April 2005 samples had lower taxa richness than the subsequent September sample. Again, assuming that April 2006 data would have been similar to 2005, this observation indicates that runoff results in a temporary reduction in taxa richness and returns to the higher value by autumn. Taxa richness then appears to increase until runoff conditions the following year, which again reduce the number of taxa. However, it is also possible that some taxa had low numbers during early June as a result of emergence and those taxa were not collected in the samples, which therefore yielded the lower richness values.

One of the critical determinations for the 2006 study is whether the SC site was an adequate control site and whether a more suitable site could be found. In June 2006 a site (GS) that appeared to be more suitable from a physical habitat perspective was identified, but this site was further upstream than the SC site. Both sites were sampled in 2006, but to minimize repetitive collection efforts only one site should be maintained as the control site in 2007 and beyond. Moving the control site too far upstream presents problems with comparable stream type, but using a site with very different habitat conditions also complicates the comparison. With only two seasonal samples collected at each control site in 2006 it is difficult to identify which site most accurately represents a true control site for the area, so we evaluated both sites and anticipated switching from the SC to GS site unless there was something unusual in the data to suggest that the GS site would not be an appropriate control site. In general, the data collected from the second control site (GS) sampled in 2006 compared very well with data collected from the SC site in 2006. Though there were some differences in absolute value of some of the metrics, the range of variation among individual Hess samples indicated that the data were similar for most comparisons. In addition, the change in each individual metric between June and September 2006 followed a similar trend between sites for nearly every parameter. Because of the similarity of results between the two sites, we believe that the GS site is an adequate replacement for the SC site as a control site with habitat characteristics similar to the SI site.

During most samples at the SI site, there was a clearly diminished quality in the macroinvertebrate community compared with other sites in Diamond Fork Creek. Several sensitive species of mayfly (e.g., *Ephemerella inermis/infrequens*), stonefly (e.g., *Pteronarcella badia*, *Pteronarcys californica*, *Isogenoides* sp.), and caddisfly (e.g., *Arctopsyche grandis*, *Glossosoma* sp., *Lepidostoma* sp.) that were common at most of the other Diamond Fork sites, including SC, were absent from SI site in both 2005 and September 2006 samples (Olsen 2006, Appendix 5.1). However, in June 2006, when samples were conducted immediately after runoff, several of the taxa listed above were found in the SI site, including each of the mayflies and stoneflies and one of the three caddisflies identified as common in other sites (*Lepidostoma* sp.). This observation gives further credence to the concept that when the sulfur inputs to the stream are diluted, the macroinvertebrate community is capable of becoming much more diverse (with a relatively diverse group of EPT species) as a result of downstream dispersal during higher flows. As described in Olsen (2006), comparisons with historical samples above the Three Forks confluence prior to the hydrogen sulfide incident (1999, 2001) show a community much more similar to the other sites sampled on Diamond Fork Creek in 2005-2006. When compared with all SI site samples in 2005-2006 (except the June 2006 sample), the historical samples, taken less than 2.1 km downstream, show a substantially higher density and diversity of EPT taxa and a substantially lower HBI value. The only known major impact to the system above Three Forks between 2001and 2005 was the increased input of hydrogen sulfide that began in 2002. Therefore, the assumption is that the increased hydrogen sulfide is responsible for the impacts seen in the invertebrate community at the SI site. Water quality samples taken with a HydroLab during September 2005 (Table 5.4) and 2006 (Table 5.5) sampling show elevated levels of conductivity and dissolved solids at the SI site compared with the SC site, which are probably the result of the increased hydrogen sulfide.

Table 5.4. HYDROLAB readings taken at the control site (SC) and the impact site (SI) on September 28, 2005.

WATER QUALITY CONSTITUENT	SC SITE	SI SITE
Temperature (Celsius)	8.84	10.54
Specific conductivity (umohs)	336.0	551.8
pH	7.95	7.91
Dissolved oxygen (mg/L)	9.16	8.35
Total dissolved solids (mg/L)	0.2153	0.3525
Turbidity (NTUs)	101.6	696.9

Table 5.5. HYDROLAB readings taken at the control site (SC) and the impact site (SI) on September 19, 2006.

WATER QUALITY CONSTITUENT	GS SITE	SC SITE	SI SITE
Temperature (Celsius)	11.02	5.32	9.47
Specific conductivity (umohs)	327.0	392.0	645.0
pH	8.46	8.40	8.23
Dissolved oxygen (mg/L)	10.59	12.24	11.05

The data collected in the SI, SC, and GS sites were also compared with the data collected in each of the long-term monitoring sites. Although the SC site appeared to be substantially different than the four long-term monitoring sites sampled on Sixth Water and Diamond Fork Creeks in overall macroinvertebrate and EPT density in 2005, no substantial difference was observed in overall macroinvertebrate density between any of the sulfur-impacted sites and the long-term monitoring sites in 2006. The only difference in EPT density was a much lower value in the SI site compared with all other sites in September 2006 (the EPT density was similar among the three sulfur-impacted sites in June). As discussed above, overall taxa richness was lower in SI than all other sites in 2005 and 2006, but the two control sites were similar to the four long-term monitoring sites. The EPT taxa richness was lowest in SI among all sites, but the SC site was similar to the four long-term monitoring sites in 2005. In 2006 the SI site was again the lowest among all sites sampled, but the two control sites were both lower than the four long-term monitoring sites. In general, EPT taxa richness was much lower overall in 2006 compared with 2005. It is not clear whether the lower values in 2006, particularly the low numbers in SC and GS, were a result of flow conditions that did not promote an increase in the EPT component of the macroinvertebrate community or an indicator of natural inter-annual variability. Additional monitoring will help identify whether this is a trend in the data or natural variability.

Historical data from samples taken by the CUWCD and available on STORET (http://www.epa.gov/storet/dbtop.html) were also analyzed to determine any changes in water quality between 2004-2006 (Figure 5.17). Although sulfur levels have declined progressively toward a level that is below detection limits for the most recent data point (collected in September 2005), sulfur-level data have been high since 2004 in the SI site. Although there are still hydrogen sulfide inputs, above the SC site, all measurements near that site were below detection limits. Other water quality parameters that were higher in the SI site than the SC site were specific conductance and total dissolved solids.

5.5 SUMMARY

Benthic macroinvertebrate samples collected in 2005-2006 indicated that the benthic communities at the four long-term monitoring sites were fairly similar, but that the most upstream site (in the Sixth Water Creek tributary), had the highest density of EPT taxa. Additionally, the scant historical information seemed to indicate that these communities had changed very little in the past 6 years, including the most recent 2 years in which the water conveyance system has been in place. With the exception of the Sixth Water site, macroinvertebrate communities appeared to be degraded, compared with “least-impacted sites” from a similar ecoregion in Idaho. The persistence of artificially high flows over the last century may be responsible for this erosion from optimum conditions. However, current flows and sediment loads may still be too high to promote recovery of the macroinvertebrate community. The hydrogen sulfide inputs have impacted the portion of the river immediately downstream and may be contributing to the impaired state in the more distant downstream sites, but if that were the case one would expect a trend of diminishing effects downstream. Because the three long-term monitoring sites downstream of the sulfur inputs have similar macroinvertebrate community dynamics, it appears that the majority of the impact is localized. The SI site has significantly lower diversity and much lower abundance of taxa sensitive to disturbance when compared with both the upstream control site and all the other sites sampled throughout the system. Sporadic historical information indicated that in 1999 and 2001 the community at this site was probably very similar to the remainder of the system. Since hydrogen sulfide leaching began in 2002, it is a likely suspect in the degradation of the macroinvertebrate community above Three Forks. Finally, benthic communities can exhibit a large degree of variability from year to year. Unfortunately, no records of long-term trends in the macroinvertebrate community leading up to 1999 were available, and only sporadic information from between 1999 and 2002 was available. Based on this paucity of data, it is recommended that a solid baseline dataset be developed for this monitoring program with at least one more year of pre- and post-runoff data. Annual sampling should be considered for several years thereafter. In addition to developing this valuable baseline data, continued macroinvertebrate monitoring should help further clarify how the new conveyance of irrigation water and minimum flow requirements on Sixth Water and Diamond Fork Creeks will influence the biological community.

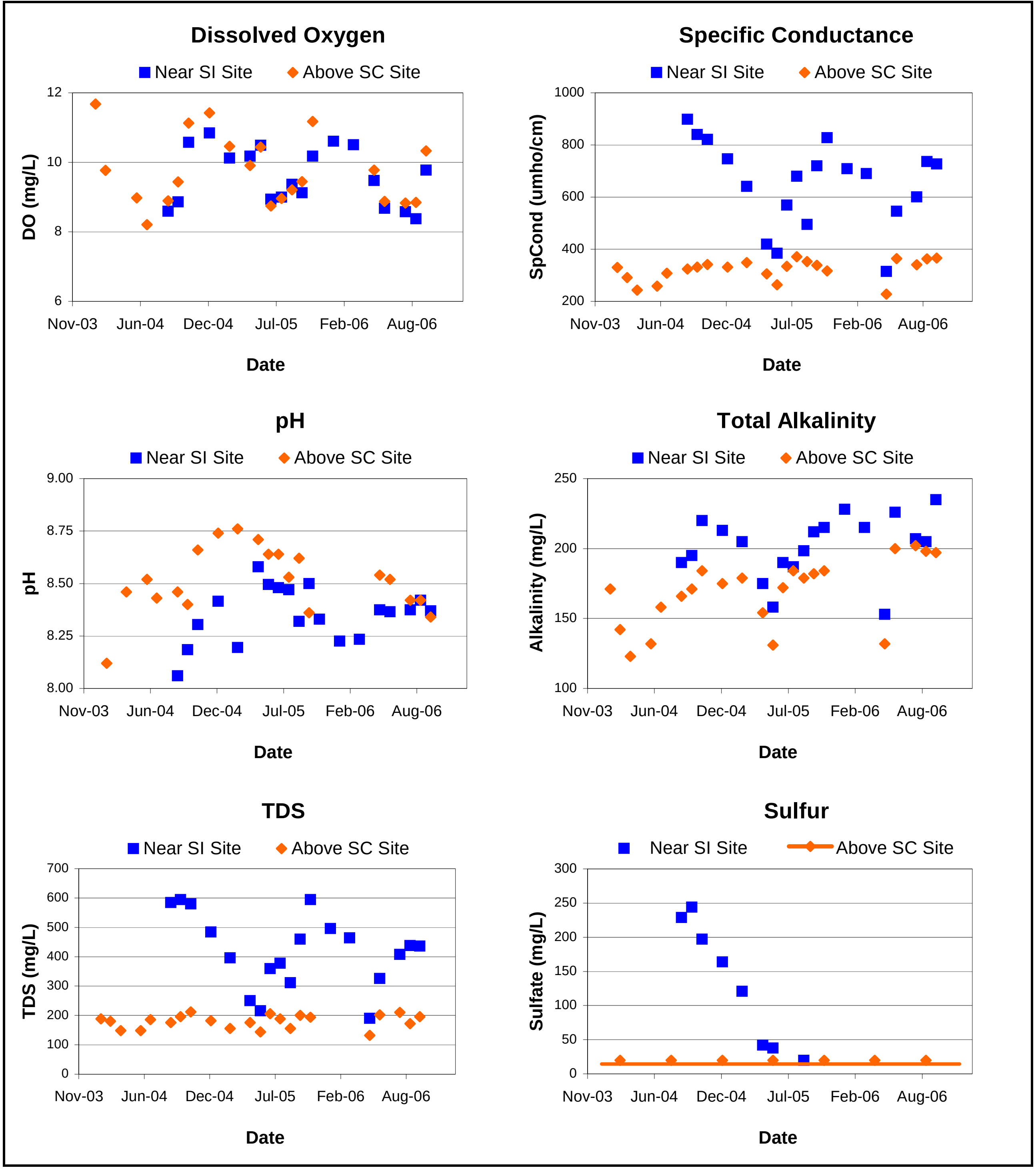


Figure 5.17. Water quality data from STORET. The Above SC site data are from STORET site number 4995710, Diamond Fork Creek above Sixth Water Creek. The Near SI site data are from STORET site number 4995760, Diamond Fork Creek at Ray's Valley Crossing.

6.0 SUMMARY AND DISCUSSION

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For many years, Diamond Fork Creek and its tributary Sixth Water Creek conveyed water imports from Strawberry Reservoir to the Wasatch Front as an important component of the Strawberry Valley Project. Such flows ceased with the completion of the Diamond Fork System, which is part of the Bonneville unit in the CUP. Today, the Diamond Fork System transports imported water through a series of tunnels and pipes to lower Diamond Fork Creek, with the capability of bypassing the natural channels to a large degree. The only flows sent through Sixth Water and Diamond Fork Creeks are water imports used to satisfy the minimum flow requirements and water deliveries when the pipe is at capacity.

Mitigation of impacts that were caused by the Diamond Fork System is required under CUPCA (1992). In order to fulfill these commitments, the Mitigation Commission established a long-term monitoring program to evaluate the geomorphic and ecological changes related to the new flow regime set by the minimum flow requirements. Long-term monitoring will allow analysis of change over time in order to set and prioritize restoration efforts and adaptively maintain the riverine and riparian ecosystem in a desirable and functional condition. The main study objectives include channel transect and inundated areas mapping, substrate monitoring, sediment transport monitoring, and macroinvertebrate monitoring. This report documents the findings of the 2005 and 2006 monitoring efforts.

The first 2 years of monitoring have been enlightening. The watershed experienced average runoff in 2005 and high runoff in 2006, with flows reaching 550 cfs in May 2006 in the lower reaches of Diamond Fork Creek. The anticipated response and recovery of aquatic and riparian habitat to the previously altered Diamond Fork System is still pending. Channel dimensions and meander patterns, although still dynamic, have not changed significantly with two years of “natural” flows. Sixth Water Creek is essentially the same, and even though the meanders of Diamond Fork Creek continue to migrate it shows few signs of stabilizing or narrowing except for increased vegetation of bars that were bare in 2005. The bugs (i.e., benthic macroinvertebrate data) indicate that the conditions have become more degraded in the lower portions of Diamond Fork Creek instead of improving as we had hoped.

A potentially alarming problem is the continuation of fine- and coarse-grained sediment transport and the associated sedimentation and embeddedness in the lower reaches of Diamond Fork Creek. The summertime and wintertime instream flows are high enough to keep sediment more mobile than would occur under a natural flow regime. We recommend that the geomorphic monitoring plan be adapted in 2007 to focus on these potential concerns.

7.0 REFERENCES

7.0 REFERENCES

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: Periphyton, benthic macroinvertebrates and fish, second edition. EPA 841-B-99-002. Washington (D.C.): U.S. Environmental Protection Agency, Office of Water.

[BIO-WEST] BIO-WEST, Inc. 2006. Sixth Water and Diamond Fork Creeks 2005 monitoring report. Salt Lake City: Utah Reclamation Mitigation and Conservation Commission.

[BIO-WEST] BIO-WEST, Inc. 2008. Diamond Fork and Sixth Water Creeks riparian vegetation and Ute ladies'-tresses 2007 final monitoring report. Salt Lake City: Utah Reclamation Mitigation and Conservation Commission.

Croft, J. 2006. Central Utah Water Conservancy District employee. Personal communication with BIO-WEST, Inc., regarding possible gaging station errors. 9/28/2006.

[CUWCD] Central Utah Water Conservancy District. 2003. Upper Diamond Fork brochure. Salt Lake City: CUWCD. Location: http://www.mitigationcommission.gov/watershed/diamondfork/watershed_diamond.html.

Grafe, C.S. (ed.). 2002a. Idaho small stream ecological assessment framework: an integrated approach. Boise: Idaho Department of Environmental Quality. 74 p.

Grafe, C.S. (ed.). 2002b. Idaho river ecological assessment framework: an integrated approach. Boise: Idaho Department of Environmental Quality. 222 p.

Hardy, T. Panja, P., Mathias, D. 2004. WinXSPRO, a channel cross section analyzer, user's manual, version 3.0 general technical report RMRS-GTR-147. Fort Collins (CO): U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 95 p.

Hepworth, R. 2005. Biologist, Utah Division of Wildlife Resources. Personal communication with Mike Golden of BIO-WEST regarding potential sulfur impacts near Sawmill Canyon. 12/9/2005.

Lester, G. 2005. Biologist, EcoAnalysts, Inc. Personal communication with Mike Golden regarding percentages of communities made up of three most dominant taxa. 1/19/2005.

[Mitigation Commission] Utah Reclamation Mitigation Conservation Commission. 2000. Diamond Fork area assessment: a cooperative project between the mitigation commission and U.S. Forest Service. 2000. Salt Lake City: Mitigation Commission. 146 p. plus appendices.

[Mitigation Commission] Utah Reclamation Mitigation Conservation Commission. 2005. More about Diamond Fork home page. Location: http://www.mitigationcommission.gov/watershed/diamondfork/watershed_diamond.html. 10/19/2005.

[NAMC] National Aquatic Monitoring Center. 2006. Buglab interactive sample mapping routine. Location: http://129.123.16.30/buglabdotnet2/mapmain.aspx. 2/3/06.

Orbendorfer, R. 2005. Water quality specialist, Central Utah Water Conservancy District. Personal communication with Darren Olsen of BIO-WEST regarding Diamond Fork Creek flow and drainages. 5/06.

Parker G. 1990. Surface-based bedload transport relation for gravel rivers. Journal of Hydraulic Research 28(4):417- 436.

Poff, N.L., J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks, and J.C. Stromberg. 1997. The natural flow regime: a paradigm for river conservation and restoration. Bioscience 47:769-784.

Power, M.E., W.E. Dietrich, and J.G. Finlay. 1996. Dams and aquatic diversity: potential food web consequences of hydrologic and geomorphic change. Environmental Management 20: 887-895.

Relyea, C.D., Minshall, G.W., and Danehy, R.J. 2000. Stream insects as bioindicators of fine sediment: Proceedings of watershed 2000, water environment specialty conference, Vancouver, B.C. 19 p. plus appendices.

Snaddon, C.D. and B.R. Davies. 1998. A preliminary assessment of the effects of a small South African inter-basin water transfer on discharge and invertebrate community structure. Regulated Rivers: Research and Management 14(5):421-441.

Stanford, J.A. and J.V. Ward. 1979. Stream regulation in North America. In: Ward, JV, Stanford, J.A., editors. The ecology of regulated streams. New York (NY): Plenum Press. pp. 215-236.

[USBOR] U.S. Bureau of Reclamation. 2005. CUP-Bonneville Unit, Utah. Location: http://www.usbr.gov/dataweb/html/bonneville.html. 10/19/2005.

[USGS] U.S. Geological Survey. 2005. Gage data from U.S. Geological Survey. Location: http://waterdata.usgs.gov/nwis/rt. 2005.

Vannote, R.L., G.W. Minshall, K.W. Cummings, J.R. Sedell, and C.E. Cushing. 1980. The river continuum concept. Canadian Journal of Fisheries and Aquatic Sciences. 37:130-137.

Vannote, R.L. and B.W. Sweeney. 1980. Geographic analysis of thermal equilibria: a conceptual model for evaluating the effect of natural and modified thermal regimes on aquatic insect communities. The American Midland Naturalist 115:666-695.

Vinson, M.R. 2006. Biologist, National Aquatic Monitoring Center. Personal communication with Michael Golden of BIO-WEST, Inc., Logan, Utah, regarding macroinvertebrate communities in Diamond Fork Creek. 2/3/2006.

Ward, J.V. 1974. A temperature -stressed stream ecosystem below a hypolimnetic release mountain reservoir. Archiv für Hydrobiologie 74:247-275.

Waters, T.F. 1995. Sediment in streams: sources, biological effects, and control. Bethesda (MD): American Fisheries Society Monograph 7. 251 p.

Wilcock P.R. 2001. Toward a practical method for estimating sediment transport rates in gravel-bed rivers. Pages 1395-1408 *In*: Earth surface processes and landforms. Vol. 26.

WILDCO. 2006. WILDCO Hess sampler. Location: http://www.wildco.com/ vw_prdct_mdl.asp? prdct_mdl_ cd=16. 2/15/06.

Wolman, M.G. 1954. A method of sampling coarse river-bed material. Transactions of the American Geophysics Union 35(6):951-956.

APPENDIX 2.1.A: CROSS-SECTION PHOTOS

(Photos are labeled by date [year/month/day], site, cross-section number, direction.)

Photo 1. 20060809SXW1US.JPG

Photo 2. 20060809SXW1RB.JPG

Photo 3. 20060809SXW1LB.JPG

Photo 4. 20060809SXW1DS.JPG

Photo 5. 20060809SXW2USBW.JPG

Photo 6. 20060809SXW2RB.JPG

Photo 7. 20060809SXW2LB.JPG

Photo 8. 20060809SXW2DS.JPG

Photo 9. 20060809SXW3USRIGHT.JPG

Photo 10. 20060809SXW3USLEFT.JPG

Photo 11. 20060809SXW3RB.JPG

Photo 12. 20060809SXW3LB.JPG

Photo 13. 20060809SXW3DSRIGHT.JPG

Photo 14. 20060809SXW3DSLEFT.JPG

Photo 15. 20060809SXW3&4ISLAND.JPG

Photo 16. 20060809SXW4USRIGHT.JPG

Photo 17. 20060809SXW4USLEFT.JPG

Photo 18. 20060809SXW4RB.JPG

Photo 19. 20060809SXW4LB.JPG

Photo 20. 20060809SXW4DSRIGHT.JPG

Photo 21. 20060809SXW5USBW.JPG

Photo 22. 20060809SXW5RB.JPG

Photo 23. 20060809SXW5LB.JPG

Photo 24. 20060809SXW5DSLEFT.JPG

Photo 25. 20060809SXW5DS.JPG

Photo 26. 20060809SXW6US.JPG

Photo 27. 20060809SXW6RB.JPG

Photo 28. 20060809SXW6LB.JPG

Photo 29. 20060809SXW6DSBW.JPG

Photo 30. 20061108DFC1US.JPG

Photo 31. 20061108DFC1RB.JPG

Photo 32. 20061108DFC1LB.JPG

Photo 33. 20061108DFC1DS.JPG

Photo 34. 20061108DFC2US.JPG

Photo 35. 20061108DFC2RB.JPG

Photo 36. 20061108DFC2LB.JPG

Photo 37. 20061108DFC2DS.JPG

Photo 38. 20061108DFC3US.JPG

Photo 39. 20061108DFC3RB.JPG

Photo 40. 20061108DFC3LB.JPG

Photo 41. 20061108DFC3DS.JPG

Photo 42. 20061108DFC4US.JPG


Photo 43. 20061108DFC4RBa.JPG


Photo 44. 20061108DFC4RBb.JPG

Photo 45. 20061108DFC4LB.JPG

Photo 46. 20061108DFC4DS.JPG

Photo 47. 20061108DFC5US.JPG

Photo 48. 20061108DFC5RB.JPG

Photo 49. 20061108DFC5LB.JPG

Photo 50. 20061108DFC5DS.JPG

Photo 51. 20061108DFC6US.JPG

Photo 52. 20061108DFC6RB.JPG

Photo 53. 20061108DFC6LB.JPG

Photo 54. 20061108DFC6DS.JPG

Photo 55. 20061108DFC7US.JPG

Photo 56. 20061108DFC7RB.JPG

Photo 57. 20061108DFC7LB.JPG

Photo 58. 20061108DFC7DS.JPG

Photo 59. 20061109MO1US.JPG

Photo 60. 20061109MO1RB.JPG

Photo 61. 20061109MO1LB.JPG

Photo 62. 20061109MO1DS.JPG

Photo 63. 20061109MO2US.JPG

Photo 64. 20061109MO2RB.JPG

Photo 65. 20061109MO2LB.JPG

Photo 66. 20061109MO2DS.JPG

Photo 67. 20061109MO3US.JPG

Photo 68. 20061109MO3RB.JPG

Photo 69. 20061109MO3LB.JPG

Photo 70. 20061109MO3DS.JPG

Photo 71. 20061109MO4US.JPG

Photo 72. 20061109MO4RB.JPG

Photo 73. 20061109MO4LB.JPG

Photo 74. 20061109MO4DS.JPG

Photo 75. 20061109MO5US.JPG

Photo 76. 20061109MO5RB.JPG

Photo 77. 20061109MO5LB.JPG

Photo 78. 20061109MO5DS.JPG

Photo 79. 20061109MO6US.JPG

Photo 80. 20061109MO6RB.JPG

Photo 81. 20061109MO6LB.JPG

Photo 82. 20061109MO6DS.JPG

Photo 83. 20061110OX1US.JPG

Photo 84. 20061110OX1RB.JPG

Photo 85. 20061110OX1LB.JPG

Photo 86. 20061110OX1DS.JPG

Photo 87. 20061110OX2US.JPG

Photo 88. 20061110OX2RB.JPG

Photo 89. 20061110OX2LB.JPG

Photo 90. 20061110OX2DS.JPG

Photo 91. 20061110OX3US.JPG

Photo 92. 20061110OX3RB.JPG

Photo 93. 20061110OX3LB.JPG

Photo 94. 20061110OX3DS.JPG

Photo 95. 20061110OX4US.JPG

Photo 96. 20061110OX4RB.JPG

Photo 97. 20061110OX4LB.JPG

Photo 98. 20061110OX4DS.JPG

Photo 99. 20061110OX5US.JPG

Photo 100. 20061110OX5RB.JPG

Photo 101. 20061110OX5LB.JPG

Photo 102. 20061110OX5DS.JPG

Photo 103. 20061110OX6US.JPG

Photo 104. 20061110OX6RB.JPG

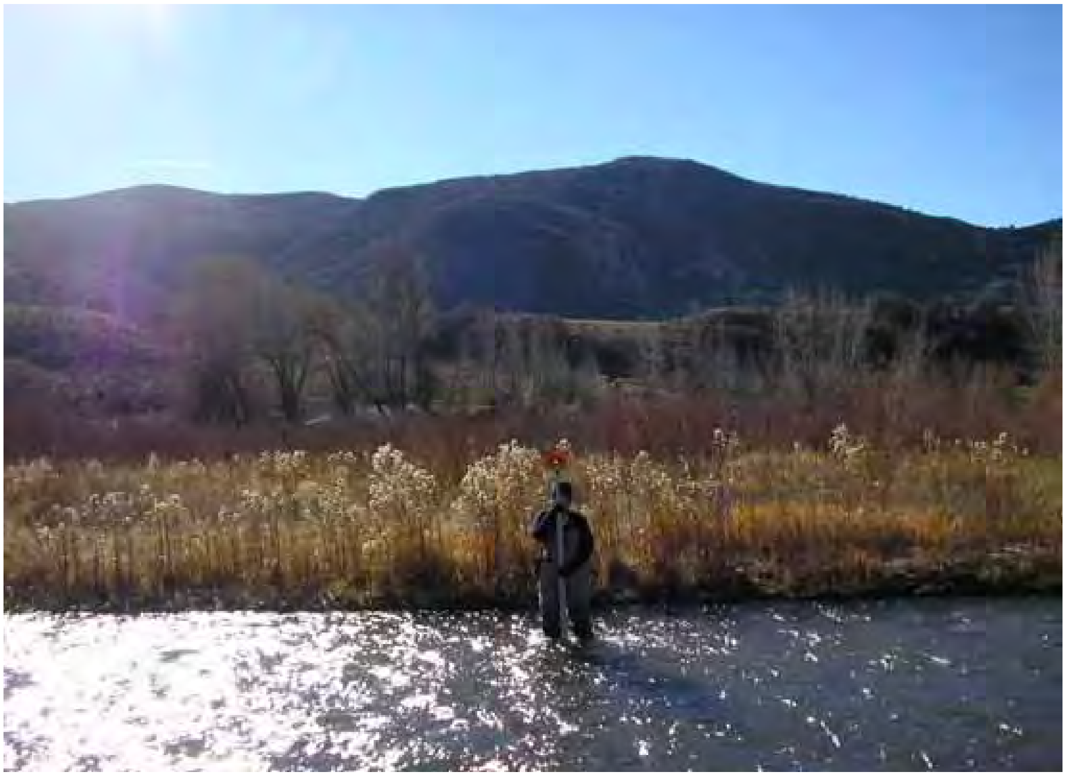


Photo 105. 20061110OX6LB.JPG

Photo 106. 20061110OX6DS.JPG

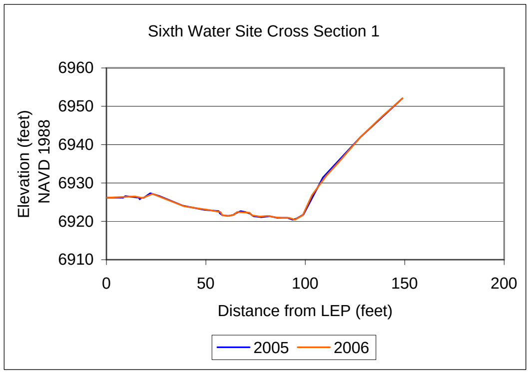
Photo 107. 20061110OX7US.JPG

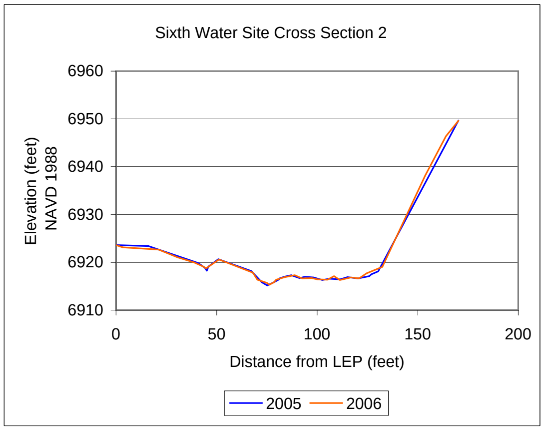
Photo 108. 20061110OX7RB.JPG

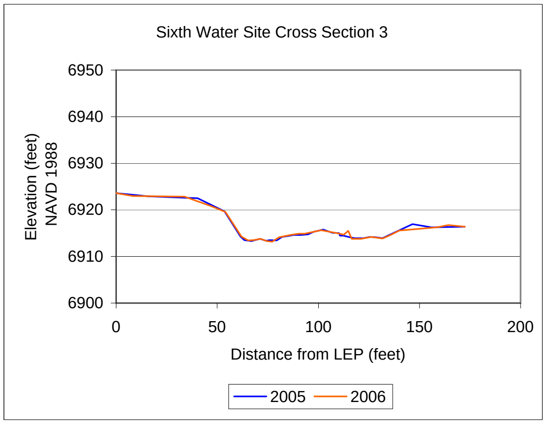
Photo 109. 20061110OX7LB.JPG

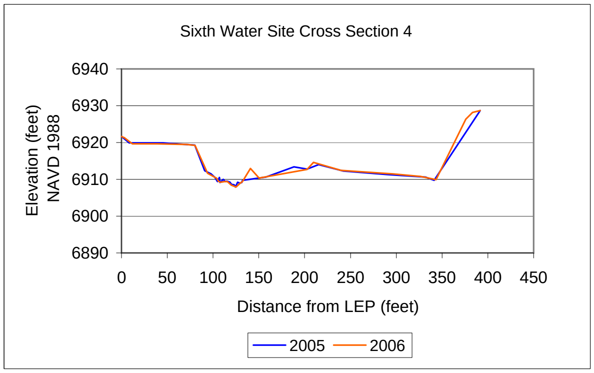
Photo 110. 20061110OX7DS.JPG

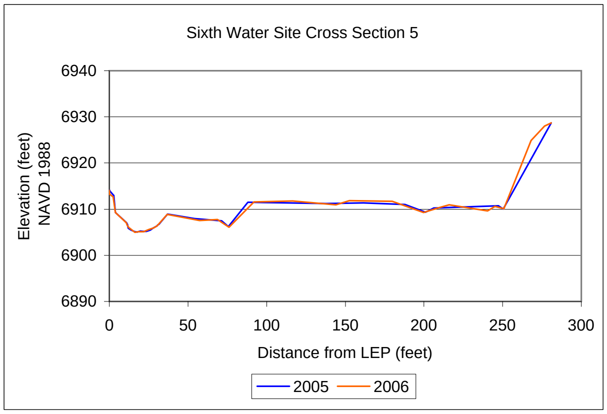
APPENDIX 2.2.A: CROSS-SECTION PLOTS

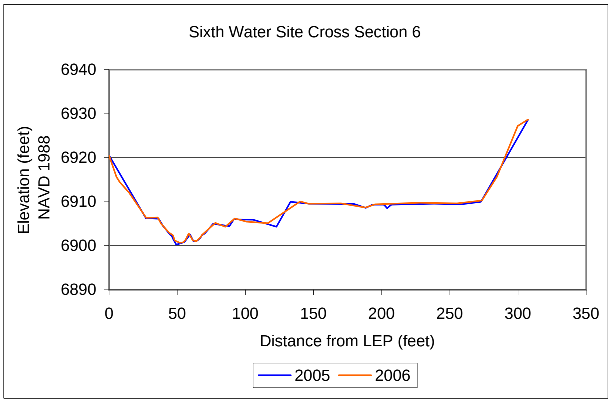

Sixth Water Site Cross Section 1
Elevation (feet) NAVD 1988
6960
6950
6940
6930
6920
6910
0
50
100
150
200
Distance from LEP (feet)
2005
2006

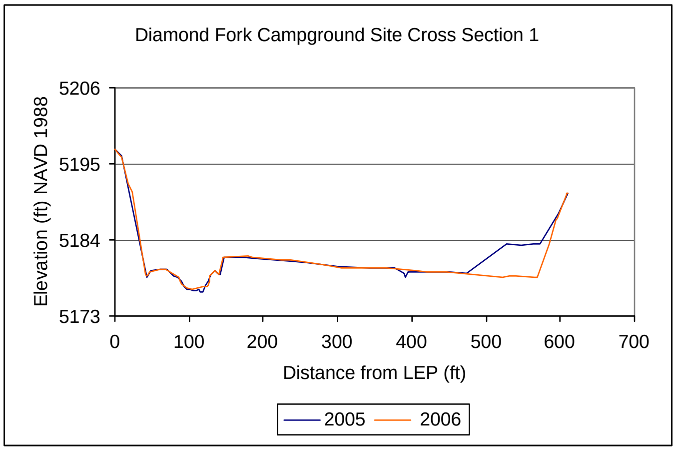

Sixth Water Site Cross Section 2
Elevation (feet) NAVD 1988
6960
6950
6940
6930
6920
6910
0
50
100
150
200
Distance from LEP (feet)
2005
2006

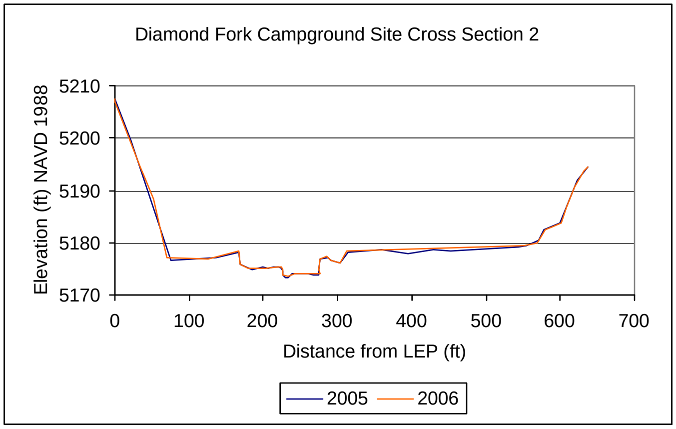

Sixth Water Site Cross Section 3
Elevation (feet) NAVD 1988
6950
6940
6930
6920
6910
6900
0
50
100
150
200
Distance from LEP (feet)
2005
2006

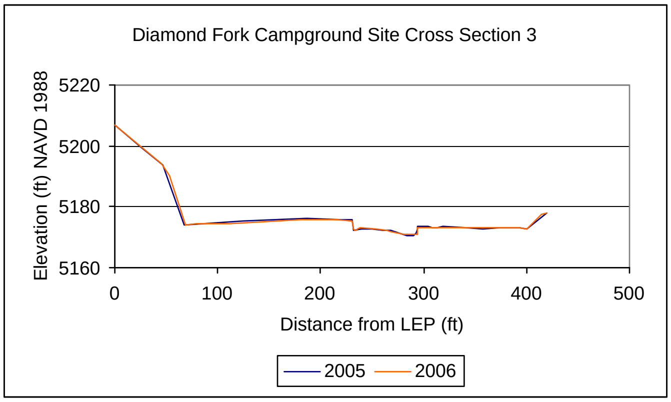

Sixth Water Site Cross Section 4
Elevation (feet) NAVD 1988
6940
6930
6920
6910
6900
6890
0
50
100
150
200
250
300
350
400
450
Distance from LEP (feet)
2005
2006

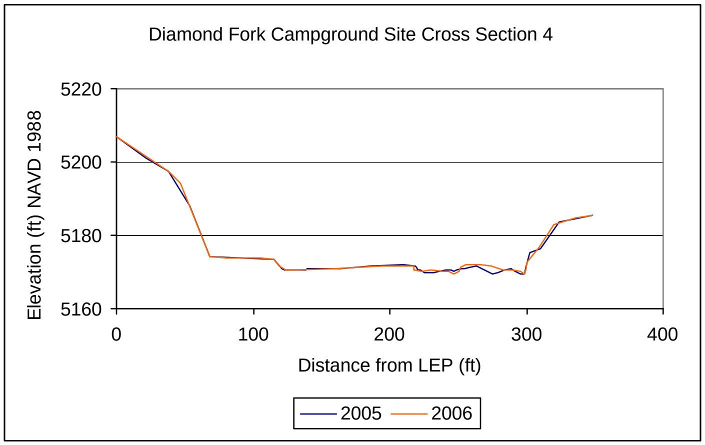

Sixth Water Site Cross Section 5
Elevation (feet) NAVD 1988
6940
6930
6920
6910
6900
6890
0
50
100
150
200
250
300
Distance from LEP (feet)
2005
2006

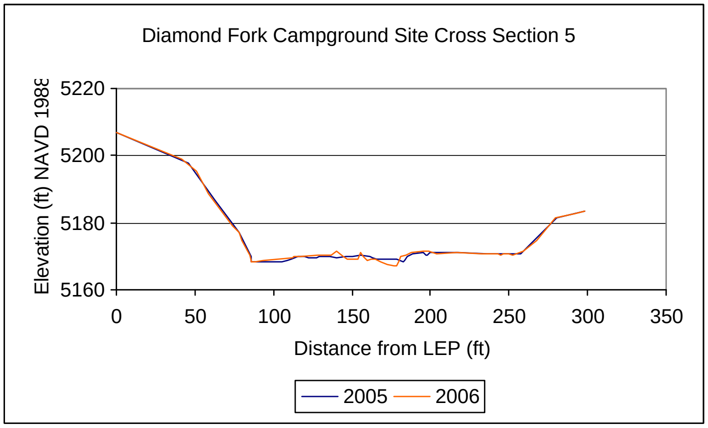

Sixth Water Site Cross Section 6
Elevation (feet) NAVD 1988
6940
6930
6920
6910
6900
6890
0
50
100
150
200
250
300
350
Distance from LEP (feet)
2005
2006

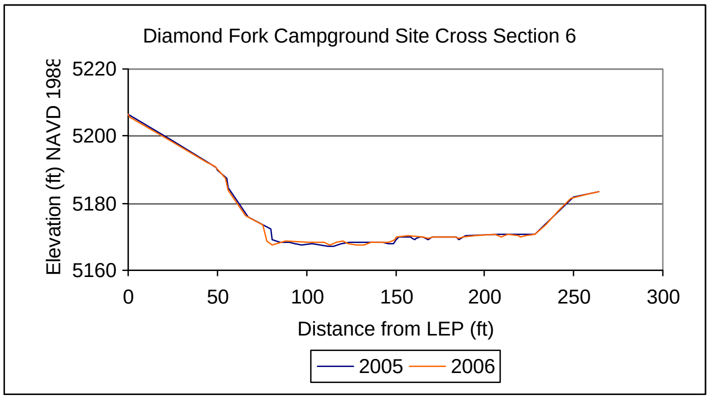

Diamond Fork Campground Site Cross Section 1

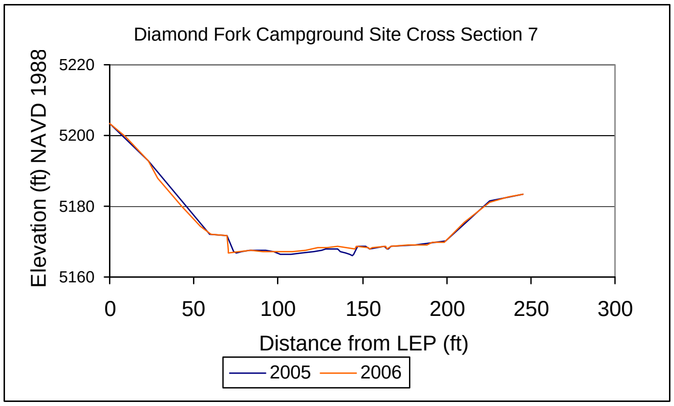

Diamond Fork Campground Site Cross Section 2

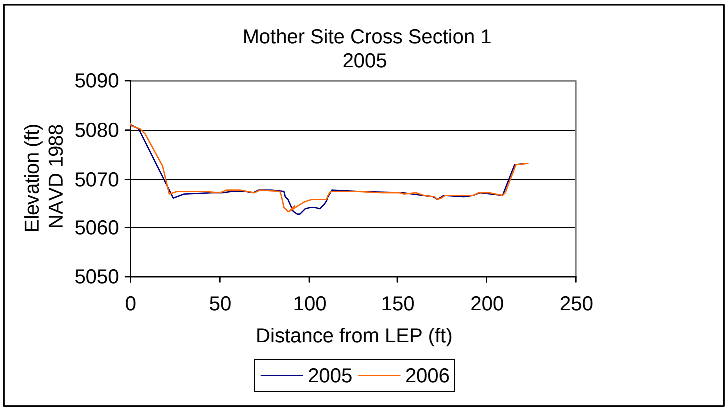

Diamond Fork Campground Site Cross Section 3

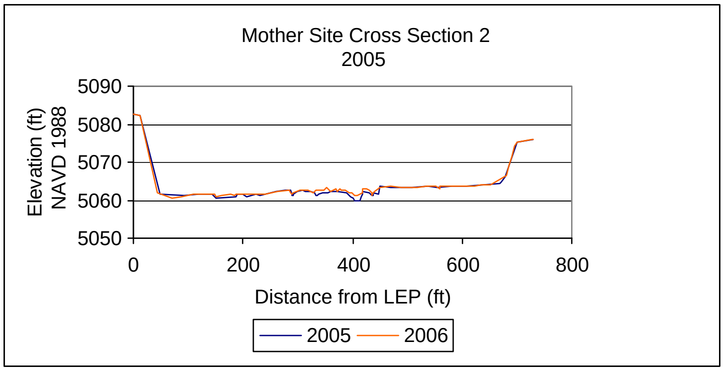

Diamond Fork Campground Site Cross Section 4

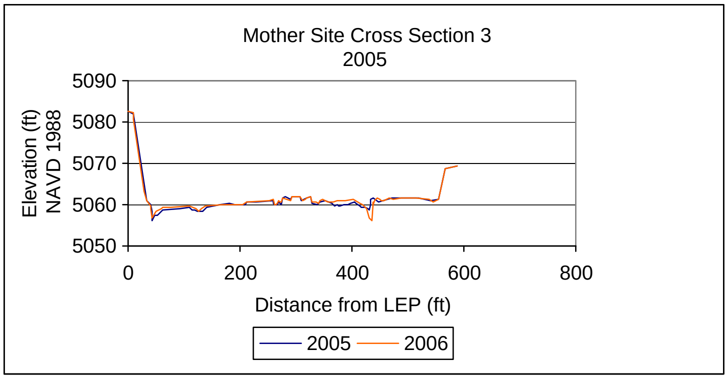

Diamond Fork Campground Site Cross Section 5

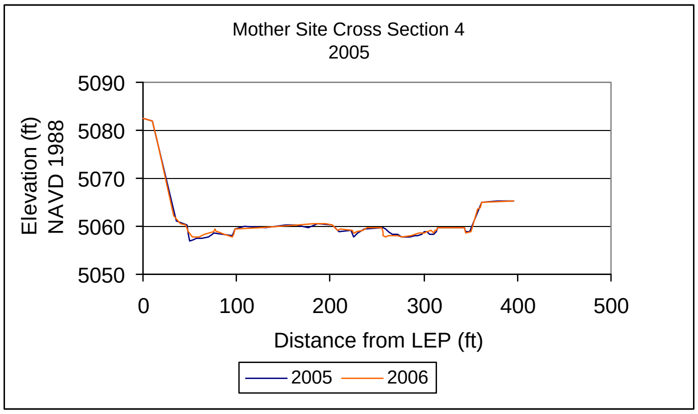

Diamond Fork Campground Site Cross Section 6

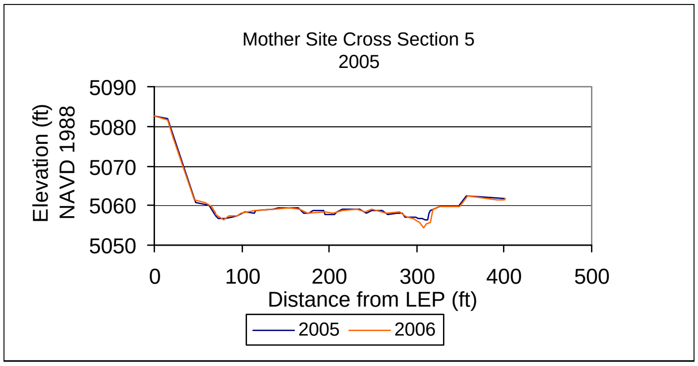

Diamond Fork Campground Site Cross Section 7

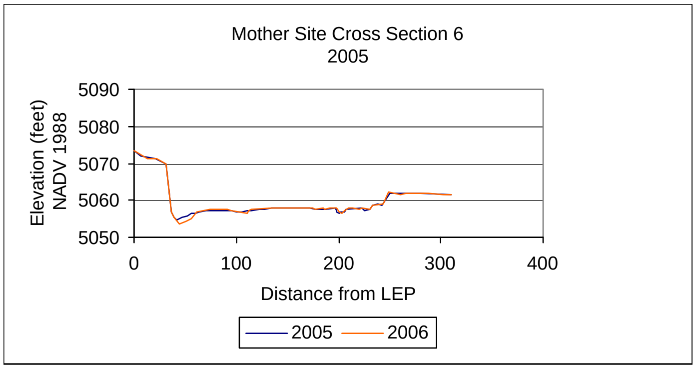

Mother Site Cross Section 1
2005
Elevation (ft)
NAVD 1988
5090
5080
5070
5060
5050
0
50
100
150
200
250
Distance from LEP (ft)
2005
2006

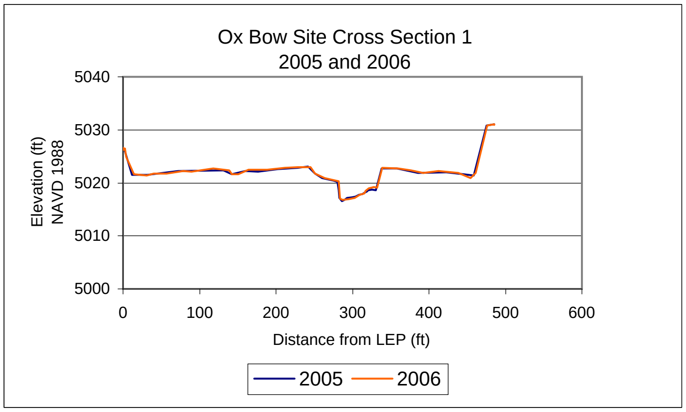

Mother Site Cross Section 2
2005
Elevation (ft)
NAVD 1988
5090
5080
5070
5060
5050
0
200
400
600
800
Distance from LEP (ft)
2005
2006

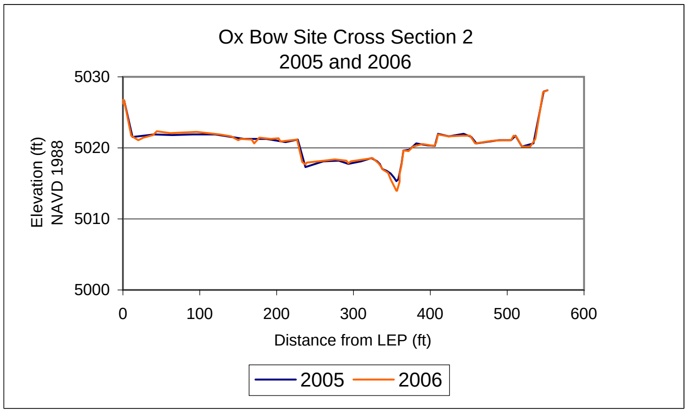

Mother Site Cross Section 3
2005
Elevation (ft)
NAVD 1988
5090
5080
5070
5060
5050
0
200
400
600
800
Distance from LEP (ft)
2005
2006

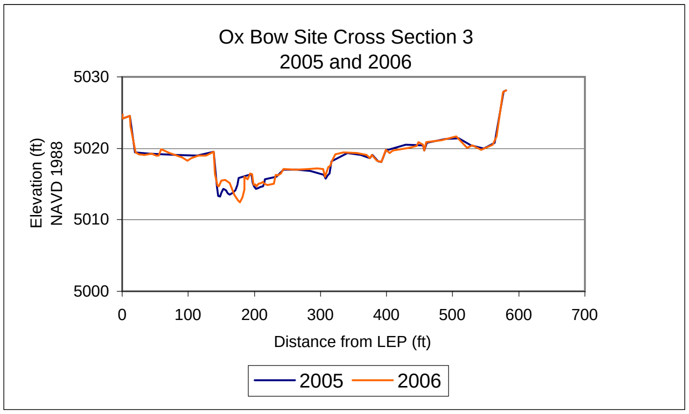

Mother Site Cross Section 4
2005
Elevation (ft)
NAVD 1988
5090
5080
5070
5060
5050
0
100
200
300
400
500
Distance from LEP (ft)
2005
2006

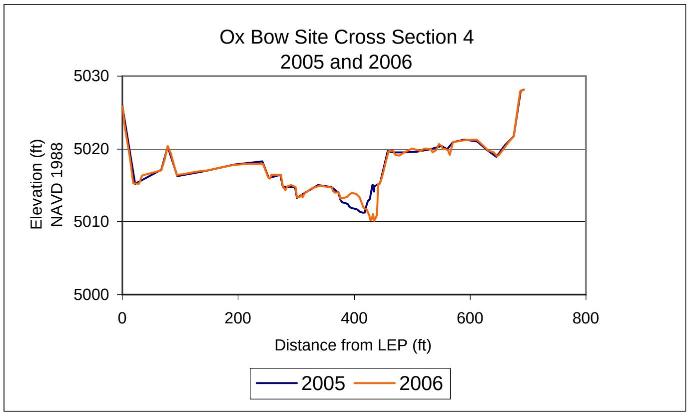

Mother Site Cross Section 5
2005
Elevation (ft)
NAVD 1988
5090
5080
5070
5060
5050
0
100
200
300
400
500
Distance from LEP (ft)
2005
2006

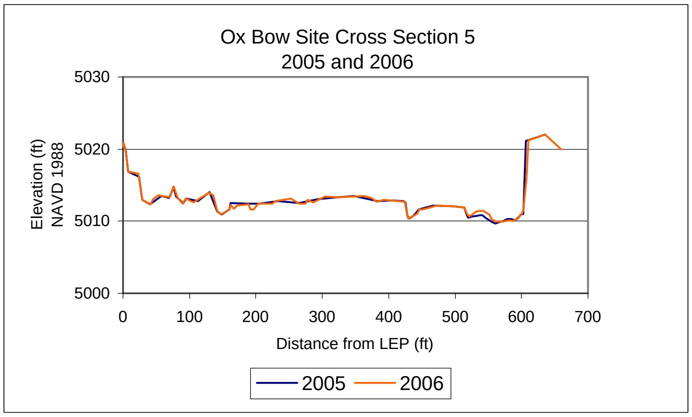

Mother Site Cross Section 6
2005
Elevation (feet)
NADV 1988
5090
5080
5070
5060
5050
0
100
200
300
400
Distance from LEP
2005
2006

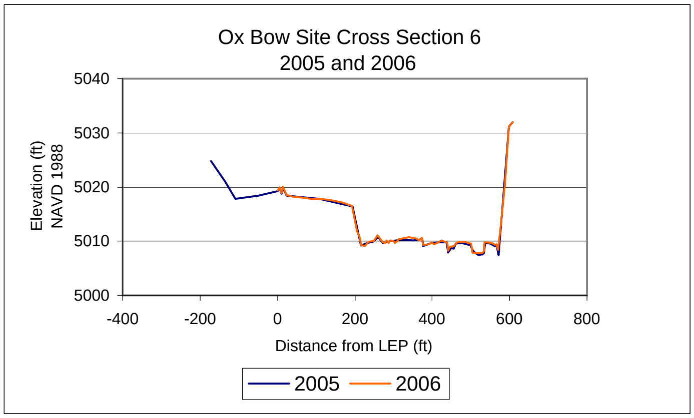

Ox Bow Site Cross Section 1
2005 and 2006
Elevation (ft) NAVD 1988
5040
5030
5020
5010
5000
0
100
200
300
400
500
600
Distance from LEP (ft)
2005
2006

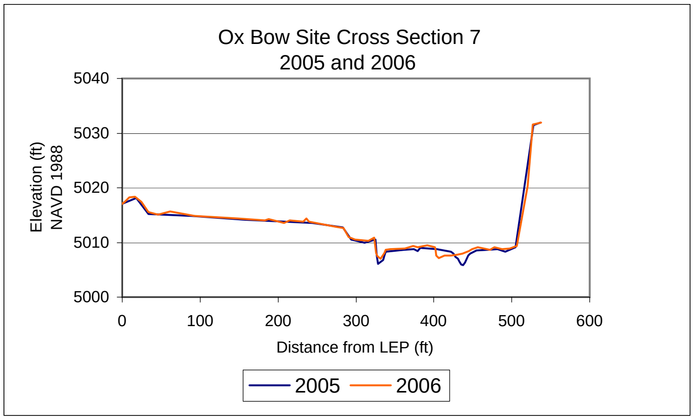

Ox Bow Site Cross Section 2
2005 and 2006
Elevation (ft) NAVD 1988
5030
5020
5010
5000
0
100
200
300
400
500
600
Distance from LEP (ft)
2005
2006

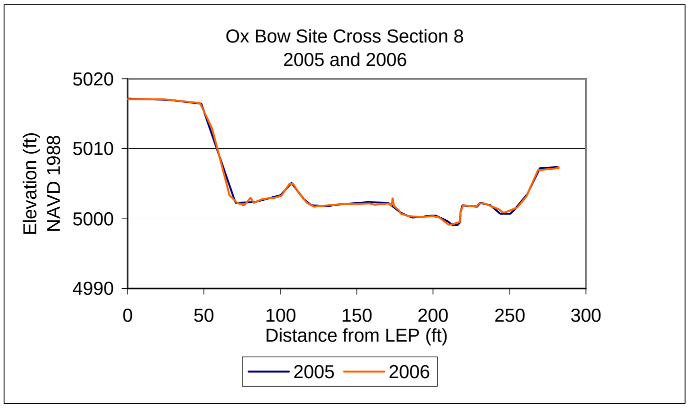

Ox Bow Site Cross Section 3
2005 and 2006
Elevation (ft) NAVD 1988
5030
5020
5010
5000
0
100
200
300
400
500
600
700
Distance from LEP (ft)
2005
2006


Ox Bow Site Cross Section 4
2005 and 2006
Elevation (ft) NAVD 1988
5030
5020
5010
5000
0
200
400
600
800
Distance from LEP (ft)
2005
2006


Ox Bow Site Cross Section 5
2005 and 2006
Elevation (ft) NAVD 1988
5030
5020
5010
5000
0
100
200
300
400
500
600
700
Distance from LEP (ft)
2005
2006


Ox Bow Site Cross Section 6
2005 and 2006
Elevation (ft) NAVD 1988
5040
5030
5020
5010
5000
-400
-200
0
200
400
600
800
Distance from LEP (ft)
2005
2006


Ox Bow Site Cross Section 7
2005 and 2006
Elevation (ft) NAVD 1988
5040
5030
5020
5010
5000
0
100
200
300
400
500
600
Distance from LEP (ft)
2005
2006


Ox Bow Site Cross Section 8
2005 and 2006
Elevation (ft) NAVD 1988
5020
5010
5000
4990
0
50
100
150
200
250
300
Distance from LEP (ft)
2005
2006

APPENDIX 2.2.B: CROSS-SECTION DATA

SIXTH WATER SITE CROSS SECTION 1 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
1	0.00	6926.19	lep1
2	3.80	6926.24	veg
3	14.30	6926.47	veg
4	18.13	6926.09	veg
5	23.14	6927.16	veg
6	39.03	6923.88	veg
7	51.03	6922.98	veg
8	57.32	6922.39	lbank
9	57.82	6921.95	lew
10	58.29	6921.57	ic
11	61.34	6921.44	ic
12	64.29	6921.72	ic
13	64.58	6921.94	ws
14	65.62	6922.38	is
15	72.03	6922.21	is
16	72.31	6922.01	ws
17	73.06	6921.59	ic
18	77.19	6921.25	ic
19	81.06	6921.42	ic
20	85.65	6920.97	ic
21	88.22	6920.88	ic
22	91.78	6920.88	ic
23	94.74	6920.40	ic
24	98.76	6921.58	rew
25	103.38	6926.81	rbank
26	110.53	6931.81	veg
27	117.01	6935.56	veg
28	127.47	6941.80	veg
29	138.45	6947.28	veg
30	148.83	6952.06	rep1

SIXTH WATER SITE CROSS SECTION 2 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
1	0.00	6923.60	lep2-3
2	3.30	6923.12	veg
3	21.07	6922.68	veg
4	30.50	6921.04	veg
5	38.80	6919.97	veg
6	43.47	6919.11	sch ws
7	44.81	6918.73	sch ic
8	45.66	6918.97	sch ws
9	51.20	6920.56	veg
10	68.08	6917.83	veg
11	70.25	6916.35	veg
12	75.02	6915.72	lew
13	76.13	6915.29	ic
14	78.57	6915.80	ic
15	79.70	6916.36	ws
16	83.90	6916.89	is
17	88.80	6917.30	ws
18	92.57	6916.65	ic
19	97.35	6916.69	ic
20	100.23	6916.47	ic
21	105.10	6916.34	ic
22	108.50	6917.09	ic
23	111.25	6916.27	ic
24	116.78	6916.85	ic
25	120.78	6916.65	ic
26	124.63	6917.69	rew
27	132.38	6919.03	rb
28	153.68	6938.12	veg
29	164.00	6946.41	veg
30	170.30	6949.60	rep2

SIXTH WATER SITE CROSS SECTION 3 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
29	0.00	6923.61	lep2-3
1	0.03	6923.58	lep2-3
2	8.24	6922.94	veg
3	33.81	6922.82	veg
4	47.09	6920.78	veg
5	54.01	6919.55	top lb
6	62.05	6914.25	lew
7	65.26	6913.47	ic
8	67.99	6913.53	ic
9	71.44	6913.80	ic
10	74.50	6913.31	ic
11	77.21	6913.20	ic
12	80.70	6914.10	ic
13	87.00	6914.71	ic
14	90.39	6914.87	ws
15	93.18	6914.86	is
16	101.41	6915.63	is
17	109.87	6914.96	ws
18	112.63	6914.69	ic
19	114.71	6915.50	lwd
20	116.56	6913.78	ic
21	121.11	6913.82	ic
22	126.23	6914.17	ic
23	131.69	6913.85	ic
24	135.26	6914.55	rew
25	140.14	6915.57	rb
26	158.56	6916.25	veg
27	164.32	6916.70	veg
30	172.47	6916.37	rep3

SIXTH WATER SITE CROSS SECTION 4 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
1	0.00	6921.68	lep4
2	3.10	6921.31	veg
3	11.92	6919.63	veg
4	38.81	6919.62	veg
5	71.42	6919.44	veg
6	80.26	6919.19	veg
7	94.06	6911.64	lb
8	104.00	6910.25	lew
9	105.78	6909.50	ic
10	108.37	6909.23	ic
11	112.49	6909.38	ic
12	115.62	6909.39	ic
13	119.78	6908.47	ic
14	125.06	6907.95	ic
15	129.64	6908.94	ic
16	132.15	6909.36	rew
17	140.65	6912.98	top rb
18	150.27	6910.31	veg
19	202.62	6912.68	veg
20	209.76	6914.62	veg
21	239.75	6912.40	veg
22	296.25	6911.46	veg
23	326.50	6910.81	veg
24	343.47	6909.92	veg
25	375.96	6926.38	veg
26	383.42	6928.17	veg
28	391.73	6928.66	rep456

SIXTH WATER SITE CROSS SECTION 5 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
1	0.00	6914.03	lep5
2	0.26	6913.27	veg
3	2.47	6912.64	veg
4	3.90	6909.27	lb
5	7.11	6908.25	lb
6	10.72	6907.04	lb
7	11.34	6906.51	lew
8	12.39	6906.03	ic
9	16.34	6904.97	ic
10	18.22	6905.09	ic
11	21.82	6905.09	ic
12	25.24	6905.62	ic
13	28.31	6905.93	ic
14	30.46	6906.42	rew
15	36.78	6908.86	top rb
16	57.36	6907.57	veg
17	68.81	6907.75	veg
18	75.99	6906.07	veg
19	91.95	6911.58	veg
20	116.47	6911.79	veg
21	143.90	6910.96	veg
22	152.46	6911.83	veg
23	179.84	6911.68	veg
24	199.75	6909.26	veg
25	209.42	6910.34	veg
26	216.07	6910.97	veg
27	240.41	6909.60	veg
28	245.01	6910.62	veg
29	250.81	6910.08	veg
30	267.99	6924.87	veg
31	276.61	6928.01	veg
32	280.97	6928.66	rep456

SIXTH WATER SITE CROSS SECTION 6 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
1	0.00	6920.55	lep6check
2	0.92	6919.65	xs6veg
3	5.43	6915.63	veg
4	5.34	6915.63	veg
5	7.86	6914.46	veg
6	14.73	6911.99	veg
7	27.33	6906.35	veg
8	35.69	6906.42	veg
9	38.35	6904.99	veg
10	43.86	6903.01	top lb
11	47.05	6902.35	lew
12	48.10	6901.16	ic
13	51.82	6900.72	ic
14	54.23	6900.72	ic
15	56.08	6901.37	ic
16	58.42	6902.80	ic bldr
17	61.47	6901.19	ic
18	64.13	6901.08	ic
19	66.90	6901.86	ic
20	68.16	6902.41	rew
21	70.50	6903.06	rb
22	78.03	6905.17	veg
23	85.24	6904.35	veg
24	92.18	6906.22	veg
25	100.72	6905.51	veg
26	116.54	6905.14	veg
27	140.05	6910.08	veg
28	146.24	6909.53	veg
29	170.23	6909.59	veg
30	188.02	6908.66	veg
31	195.00	6909.37	veg
32	227.75	6909.80	veg
33	255.12	6909.62	veg
34	273.36	6910.26	veg
35	284.58	6915.62	veg
36	299.78	6927.19	veg
37	307.18	6928.66	rep456

DIAMOND FORK CAMPGROUND SITE CROSS SECTION 1 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
3	0.00	5197.23	DFCLEP1
42	7.55	5196.35	veg
66	9.32	5196.05	nnveg
41	18.14	5192.25	veg
40	22.65	5191.21	veg
65	23.03	5191.10	nnveg
39	41.98	5179.25	veg
64	42.56	5179.11	nnveg
38	45.77	5179.18	veg
37	47.16	5179.69	veg
36	60.35	5179.99	veg
35	68.43	5180.09	veg
34	85.54	5178.98	veg
63	85.66	5178.98	nnveg
33	87.76	5178.30	lew
32	89.40	5177.91	ic
31	96.20	5177.39	ic
30	104.21	5177.20	ic
29	112.14	5177.27	ic
28	118.59	5177.46	ic
27	123.73	5177.59	ic
26	126.39	5177.78	ic
25	127.17	5178.34	rew
61	128.00	5178.92	nnveg
24	128.33	5179.14	bank
23	134.21	5179.93	veg
22	137.08	5179.62	veg bank
21	140.03	5179.25	veg bank
60	144.54	5181.57	nnveg
20	145.25	5181.66	veg
59	178.68	5181.88	nnveg
19	184.36	5181.67	veg
18	223.65	5181.41	veg
58	237.78	5181.29	nnveg
17	261.37	5181.03	veg
16	284.58	5180.69	veg
57	305.62	5180.32	nnveg
15	322.34	5180.18	veg
56	340.26	5180.24	nnveg
14	366.84	5180.14	veg
13	405.06	5179.81	veg
55	420.72	5179.64	nnveg
12	447.25	5179.57	veg
11	521.42	5178.98	veg
54	530.40	5179.04	nnveg
53	540.91	5178.99	nnveg
52	564.90	5178.88	nnveg
10	569.87	5178.81	veg
9	585.91	5183.75	veg
8	594.37	5187.08	veg
51	595.04	5187.36	nnveg
7	608.89	5190.82	veg
2	609.31	5190.97	DFCREP1
5	609.55	5190.92	rep1
4	609.57	5190.91	rep1

DIAMOND FORK CAMPGROUND SITE CROSS SECTION 2 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
4	0.00	5207.53	lep2
3	0.30	5207.53	DFCLEP2
6	0.67	5207.07	veg
7	34.48	5194.51	veg
8	40.38	5192.62	veg
9	51.49	5188.33	veg
10	70.41	5177.15	veg
11	124.87	5176.86	veg
12	166.50	5178.37	veg
13	168.83	5175.84	veg
14	179.26	5175.12	veg
15	202.30	5175.19	veg
16	219.66	5175.44	veg
17	223.75	5175.39	tbank
18	225.51	5174.80	bank
19	225.86	5174.60	lew
20	226.60	5173.92	ic
21	233.46	5173.65	ic
22	241.48	5174.13	ic
23	248.86	5174.20	ic
24	257.29	5174.19	ic
25	265.03	5174.00	ic
26	272.25	5174.02	ic
27	275.56	5174.06	ic
28	275.42	5174.81	rew
29	276.62	5176.93	tbank
30	284.85	5177.40	veg
31	291.50	5176.63	veg
32	303.86	5176.17	veg
33	313.08	5178.42	veg
34	431.01	5178.93	veg
36	551.67	5179.52	veg
37	569.21	5179.89	veg
38	578.98	5182.54	veg
39	588.77	5183.03	veg
40	601.12	5183.85	veg
41	609.13	5186.77	veg
42	619.36	5190.74	veg
43	631.79	5193.77	veg
2	638.04	5194.35	DFCREP2

230	670.6133564	5196.889
271	670.6274589	5196.899

DIAMOND FORK CAMPGROUND SITE CROSS SECTION 3 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
4	0.00	5206.85	DFCLEP345
6	45.41	5193.97	veg
7	52.72	5190.09	veg
8	68.42	5174.15	veg
9	78.48	5174.24	veg
10	110.78	5174.57	veg
11	180.05	5175.76	veg
12	216.29	5175.61	veg
13	230.41	5175.48	veg
14	231.63	5172.68	veg
15	233.16	5172.39	lew
16	234.10	5172.44	ic
17	235.71	5172.49	ws
18	238.35	5172.99	is
19	254.36	5172.90	is
20	264.02	5172.23	ws
21	267.77	5171.68	ic
22	274.21	5171.56	ic
23	280.83	5170.94	ic
24	286.49	5170.86	ic
25	291.58	5170.81	ic
26	294.22	5171.10	ic
27	294.19	5172.29	rew
28	294.47	5173.30	veg
29	308.32	5173.31	veg
30	340.53	5173.33	veg
31	374.49	5173.22	veg
32	391.89	5173.03	veg
33	399.78	5172.53	veg
34	414.90	5177.64	veg
2	419.64	5178.00	DFCREP3

DIAMOND FORK CAMPGROUND SITE CROSS SECTION 4 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
4	0.00	5206.89	DFCLEP345
6	38.12	5197.31	veg
7	46.87	5194.06	veg
8	68.09	5174.23	veg
9	81.28	5173.71	veg
10	105.71	5173.94	veg
11	115.07	5173.44	veg
12	118.79	5171.53	veg
13	124.32	5170.39	veg
14	129.95	5170.63	veg
15	159.89	5171.03	veg
16	176.76	5171.43	veg
17	194.53	5171.58	veg
18	217.11	5171.78	veg
19	217.23	5170.89	lew
20	217.60	5170.46	ic
21	223.21	5170.08	ic
22	229.85	5170.47	ic
23	238.79	5170.33	ic
24	242.55	5170.16	ic
25	246.73	5169.58	ic
26	250.69	5170.27	ic
27	252.19	5171.21	ws
28	255.37	5171.89	is
29	266.14	5171.99	is
30	273.66	5171.61	is
31	282.47	5170.71	is
32	290.22	5170.43	ws
33	295.36	5170.00	ic
34	298.83	5169.34	ic
35	299.11	5170.43	rew
36	300.07	5172.66	veg
37	309.03	5176.73	veg
38	320.33	5182.75	veg
39	335.83	5184.67	veg
2	348.30	5185.31	DFCREP4

DIAMOND FORK CAMPGROUND SITE CROSS SECTION 5 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
4	0.00	5206.92	DFCLEP345
6	0.33	5206.80	veg
7	41.69	5198.80	veg
8	50.80	5195.28	veg
9	58.27	5188.58	veg
10	73.92	5179.07	veg
11	78.20	5177.01	veg slump
12	79.68	5174.52	veg slump
13	85.10	5170.22	tbank
14	85.79	5168.78	lew bw
15	86.06	5168.15	ic
16	88.28	5168.38	ic
17	93.44	5168.78	lew bw
18	111.77	5169.61	cob sand
19	112.65	5170.09	veg
20	117.54	5170.06	veg
21	128.24	5170.48	veg
22	136.58	5170.38	veg
23	140.12	5171.72	lwd top
24	144.43	5169.94	lew
25	147.20	5169.29	ic
26	148.73	5169.09	ic
27	154.09	5169.26	ic
28	155.58	5171.32	ic lwd pile
29	157.37	5169.95	ws
30	159.52	5168.79	ic
31	162.11	5169.15	ic
32	165.02	5168.97	ic
33	168.09	5168.21	ic
34	172.32	5167.55	ic
35	176.48	5167.03	ic
36	178.35	5167.21	ic
37	180.48	5168.57	ic
38	181.36	5169.94	rew
39	184.76	5170.36	veg
40	188.15	5171.00	veg
41	195.78	5171.69	veg
42	198.68	5171.62	veg
43	203.74	5170.84	veg
44	216.20	5170.99	veg
45	232.48	5170.70	veg
46	243.00	5170.86	veg
47	244.42	5170.33	veg
48	246.70	5170.75	veg
49	249.77	5170.79	veg
50	252.28	5170.27	veg
51	259.21	5171.44	veg
52	267.2593246	5174.859689	veg
53	279.0779279	5181.409327	veg
54	291.2706847	5182.713531	veg
2	297.8106651	5183.52066	DFCREP567

DIAMOND FORK CAMPGROUND SITE CROSS SECTION 6 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
4	0.00	5206.35	lep6
6	1.12	5205.81	veg
7	24.13	5198.62	veg
8	43.82	5192.31	veg
9	48.70	5190.87	veg
10	54.98	5187.29	veg
11	56.01	5183.97	veg
12	66.10	5176.42	veg
13	75.87	5173.63	tbank
14	77.59	5168.78	lew
15	80.43	5167.62	ic
16	87.95	5168.56	ic
17	101.66	5168.43	ic
18	109.84	5168.47	ic
19	112.91	5167.56	ic
20	115.14	5167.78	ic
21	116.76	5168.46	ic
22	120.72	5168.70	ic
23	123.72	5168.05	ic
24	127.86	5167.59	ic
25	132.21	5167.58	ic
26	136.06	5168.30	ic
27	141.72	5168.27	ic
28	146.06	5168.43	ic
29	148.23	5168.66	ic
30	149.29	5169.18	rew
31	150.68	5169.95	tbank
32	157.41	5170.18	veg
33	165.01	5170.06	veg
34	168.09	5169.64	veg
35	171.19	5170.10	veg
36	183.52	5169.99	veg
37	185.54	5169.36	veg
38	187.55	5170.01	veg
39	194.58	5170.34	veg
40	205.54	5170.54	veg
41	209.47	5170.13	veg
42	211.14	5170.18	veg
43	213.16	5170.63	veg
44	218.92	5170.51	veg
45	220.27	5169.96	veg
46	222.85	5170.49	veg
47	228.43	5170.64	veg
48	233.98	5173.58	veg
49	241.92	5178.01	veg
50	248.54	5181.46	veg
51	257.72	5182.62	veg
2	264.34	5183.52	DFCREP567

DIAMOND FORK CAMPGROUND SITE CROSS SECTION 7 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
3	0.00	5203.44	DFCLEP7
4	0.01	5203.39	lep7
6	9.56	5199.69	veg
7	23.17	5193.00	veg
8	28.69	5188.02	veg
9	42.45	5179.85	veg
10	54.20	5174.27	veg
11	60.17	5172.08	veg
12	69.71	5171.60	tbank
13	70.20	5167.70	lew
14	70.48	5166.95	ic
15	77.17	5167.26	ic
16	83.74	5167.60	ic
17	91.00	5167.32	ic
18	98.77	5167.06	ic
19	108.70	5167.31	ic
20	116.25	5167.45	ic
21	123.51	5168.18	rew
22	129.00	5168.29	veg
23	135.55	5168.68	veg
24	145.33	5168.03	veg
25	145.34	5168.02	veg
26	146.82	5168.83	tbank
27	153.20	5168.48	veg
28	154.20	5167.98	veg
29	155.91	5168.35	veg
30	163.63	5168.52	veg
31	164.76	5167.98	veg
32	166.82	5168.62	veg
33	177.07	5169.01	veg
34	188.14	5169.11	veg
35	191.38	5169.84	veg
36	199.06	5169.91	veg
37	210.64	5175.52	veg
38	225.23	5181.28	veg
39	236.52	5182.57	veg
2	245.22	5183.52	DFCREP567

MOTHER SITE CROSS SECTION 1 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
3	0.00	0.00	MOLEP1
4	13.12	43.06	lep1
7	22.97	75.35	veg
8	26.25	86.12	veg
9	29.53	96.88	veg
10	32.81	107.65	veg
55	180.46	592.07	tw
11	36.09	118.41	veg
12	39.37	129.18	veg
13	42.65	139.94	veg
54	177.17	581.31	tw
14	45.93	150.71	veg
15	49.22	161.47	veg
16	52.50	172.24	veg
53	173.89	570.54	tw
17	55.78	183.00	veg
18	59.06	193.77	veg
19	62.34	204.53	veg
52	170.61	559.78	tw
20	65.62	215.30	tbank
21	68.90	226.06	lew
22	72.18	236.83	ic
23	75.46	247.59	ic
24	78.74	258.36	ic
25	82.03	269.12	ic
51	167.33	549.01	tw
26	85.31	279.89	ic
27	88.59	290.65	ic
28	91.87	301.42	ic
29	95.15	312.18	ic
30	98.43	322.95	ic
31	101.71	333.71	ic
32	104.99	344.48	rew
33	108.27	355.24	tbank
34	111.55	366.01	veg
35	114.84	376.77	veg
36	118.12	387.54	veg
37	121.40	398.30	veg
38	124.68	409.07	veg
39	127.96	419.83	veg
40	131.24	430.60	veg
41	134.52	441.36	veg
42	137.80	452.13	veg
43	141.08	462.89	veg
44	144.36	473.66	veg
45	147.65	484.42	veg
46	150.93	495.19	veg
47	154.21	505.95	veg
48	157.49	516.72	veg
49	160.77	527.48	veg
2	6.56	21.53	MOREP1

MOTHER SITE CROSS SECTION 2 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
3	0.00	5082.53	MOLEP2345
75	13.06	5082.17	veg
74	44.44	5062.06	veg
73	69.90	5060.61	veg
72	87.80	5060.84	veg
71	110.00	5061.66	veg
70	147.68	5061.66	veg
69	150.60	5060.91	veg
68	160.42	5061.27	veg
67	177.31	5061.50	veg
66	185.35	5061.27	veg
65	188.40	5061.43	veg
64	220.75	5061.70	veg
63	239.83	5061.73	veg
62	263.14	5062.32	veg
61	285.46	5062.78	veg
60	288.04	5061.76	ws
59	290.43	5061.50	sc
58	291.83	5061.80	ws
57	292.07	5062.06	veg
56	303.79	5062.68	veg
55	317.38	5062.58	lew
54	322.54	5062.35	ic
53	328.45	5062.09	ic
52	332.53	5062.52	ic
51	339.24	5062.52	ic
50	345.24	5062.58	ic
49	347.95	5062.71	ws
48	352.80	5063.50	lwd
47	356.76	5062.68	ws
46	360.59	5062.42	ic
45	363.62	5062.52	ws
44	368.65	5062.85	is
43	372.24	5062.39	is
42	376.73	5062.88	is
41	380.21	5062.68	is
40	385.89	5062.65	ws
39	393.06	5062.06	ic
38	397.75	5061.80	ic
37	403.43	5061.17	ic
36	409.03	5061.37	ic
35	418.02	5061.76	ic
34	418.32	5062.52	rew
33	419.13	5062.88	veg
32	424.76	5062.98	veg
31	430.54	5062.58	veg

30	434.07	5061.93	ws bkwtr
29	435.70	5061.27	ic bkwtr
28	437.40	5061.96	ws bkwtr
27	439.16	5062.39	veg
26	449.62	5063.17	veg
25	468.25	5063.70	veg
24	489.13	5063.37	veg
22	516.80	5063.34	veg
23	535.50	5063.76	veg
21	552.36	5063.60	veg
20	558.74	5062.91	veg
19	559.65	5063.70	veg
18	569.82	5063.67	veg
17	578.35	5063.63	veg
16	604.17	5063.73	veg
15	622.43	5063.80	veg
14	634.64	5063.93	veg
13	651.20	5064.19	veg
12	681.13	5066.49	veg
11	686.7441487	5069.37467	veg
10	690.3321936	5071.47451	veg
9	695.9682247	5074.23055	veg
8	699.0882391	5075.18204	veg
7	727.767852	5075.87105	veg
5	728.4968415	5075.90386	MOREP2
4	728.5232235	5075.90386	MOREP2

MOTHER SITE CROSS SECTION 3 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
3	0.00	5082.52	MOLEP2345
76	9.35	5082.10	veg
75	10.68	5080.55	veg
74	29.10	5063.36	veg
73	33.09	5061.02	veg
72	39.65	5059.75	veg
71	41.15	5059.16	ws sc
70	44.02	5056.79	ic sc
69	50.79	5058.39	ic sc
68	59.21	5059.04	ws sc
67	61.54	5059.28	veg
66	76.89	5059.23	veg
65	110.33	5059.57	veg
64	122.18	5058.99	ws sc
63	125.65	5058.27	ic sc
62	130.52	5059.05	ws sc
61	139.03	5059.63	veg
60	169.83	5059.96	veg
59	204.88	5060.03	veg
58	211.09	5060.51	veg
57	252.37	5061.12	veg
56	258.88	5061.27	veg
55	261.19	5060.16	ws
54	262.22	5059.95	ic sc
53	263.97	5060.13	ws
52	266.03	5060.24	veg
51	268.84	5060.94	veg
50	271.58	5060.53	veg
49	274.46	5060.60	veg
48	275.76	5061.72	veg
47	289.71	5061.12	veg
46	292.93	5061.85	veg
45	306.86	5061.87	veg
44	310.98	5060.94	veg
43	316.61	5061.25	veg
42	319.43	5061.74	veg
41	325.69	5061.86	veg
40	329.54	5060.54	veg
39	336.54	5060.69	veg
38	339.33	5060.42	veg
37	341.91	5060.84	veg
36	348.39	5061.21	veg
35	357.52	5060.63	veg

34	365.29	5060.74	veg
33	367.70	5060.49	veg
32	374.99	5060.86	gravel veg
31	388.67	5061.05	gravel veg
30	402.05	5061.23	gravel veg
29	413.62	5060.26	gravel veg
28	420.06	5059.99	lew
27	423.77	5059.44	ic
26	427.27	5059.12	ic
25	431.86	5056.64	ic
24	436.02	5056.00	ic
23	438.23	5060.76	ic
22	439.13	5059.87	rew
21	439.97	5061.13	tbank
20	445.72	5061.47	veg
19	450.89	5061.36	veg
18	453.31	5060.92	veg
17	456.56	5061.12	veg
16	463.02	5061.23	veg
15	466.57	5061.75	veg
14	473.41	5061.33	veg
13	488.47	5061.60	veg
12	514.86	5061.60	veg
11	538.59	5061.28	veg
10	545.28	5060.74	veg
9	554.49	5061.33	veg
8	560.25	5064.21	veg
7	566.90	5068.70	veg
6	587.64	5069.22	veg
2	588.4675064	5069.282802	MOREP3
4	588.7460305	5069.271401	MOREP3

MOTHER SITE CROSS SECTION 4 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
3	0.00	0.00	MOLEP2345
63	10.39	5082.00	veg
62	14.38	5078.55	veg
61	32.92	5062.14	veg
60	39.67	5060.44	veg
54	42.37	5068.29	bw
59	45.74	5060.34	veg
58	48.49	5059.00	ws
57	53.10	5057.80	bw
56	59.98	5057.78	bw
55	66.06	5058.21	bw
53	75.77	5059.01	ws dam
52	77.18	5059.52	damtop
51	78.81	5058.94	ws dam
50	79.92	5058.78	bw
49	86.93	5058.39	bw
48	91.80	5058.17	bw
47	95.85	5057.88	bw
46	96.98	5058.33	ws bw
45	98.46	5059.50	veg
44	126.01	5059.66	veg
43	164.86	5060.34	veg
42	182.23	5060.50	veg
41	194.73	5060.58	veg
40	202.52	5060.36	veg
39	208.18	5059.05	veg
38	210.93	5059.31	veg
37	224.06	5059.22	veg
36	225.06	5058.62	veg
35	227.15	5058.63	veg
34	228.20	5058.91	veg
33	235.73	5059.23	veg
32	239.65	5059.61	veg
31	249.49	5059.81	veg
30	255.25	5059.76	bank
29	255.89	5058.86	lew
28	256.72	5057.96	ic
27	258.88	5057.84	ic
26	262.55	5058.12	ic
25	272.63	5058.18	ic
24	276.90	5057.81	ic
23	286.10	5058.08	ic
22	294.95	5058.51	ic
21	300.53	5058.66	rew
20	303.91	5059.01	veg
19	307.08	5059.05	veg
18	309.86	5058.50	veg
17	311.32	5059.05	veg

16	313.95	5059.21	veg
15	315.00	5059.70	veg
14	333.92	5059.63	veg
13	337.1466603	5059.588855	veg
12	343.370891	5059.591932	veg
11	345.3173432	5058.73693	veg
10	350.2237561	5058.946143	veg
9	357.6481588	5063.620413	veg
8	359.7572559	5063.818054	veg
7	362.0116183	5065.076347	veg
6	395.9402209	5065.153289	veg
2	396.5207569	5065.260296	MOREP4
4	396.6918024	5065.222066	MOREP4

MOTHER SITE CROSS SECTION 5 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
3	0.00	5082.53	MOLEP2345
48	15.38	5081.71	veg
47	21.38	5077.09	veg
46	45.77	5061.43	veg
45	57.97	5060.61	veg
44	66.20	5059.60	veg
43	69.36	5058.09	ewtr bvrdm
42	69.72	5057.76	ic bvrdm
41	74.15	5057.07	ic bvrdm
40	78.85	5056.55	ic bvrdm
39	85.54	5057.40	ic bvrdm
38	94.34	5057.53	ic bvrdm
37	99.73	5057.96	ewtr bvrdm
36	114.91	5058.61	veg
35	136.63	5059.04	veg
34	154.20	5059.30	veg
33	165.41	5059.17	veg
32	175.81	5058.09	veg
31	195.15	5058.32	veg
30	204.55	5058.09	veg
29	214.21	5058.84	veg
27	232.44	5058.94	veg
26	241.54	5058.28	veg
25	248.95	5058.91	veg
24	264.58	5058.19	veg
23	280.94	5058.35	veg
22	286.68	5057.46	lew
21	289.96	5056.97	ic
20	296.41	5056.74	ic
19	302.95	5055.82	ic
18	307.66	5054.51	ic
17	311.32	5055.36	ic
16	314.87	5055.76	ic
15	316.97	5057.46	rew
14	317.94	5059.14	tbnk
13	326.31	5059.70	veg
12	330.78	5059.76	veg
11	341.76	5059.86	veg
10	346.96	5059.73	veg
9	348.87	5059.83	veg
8	357.68	5062.45	veg
7	391.14	5061.57	veg
6	400.10	5061.50	veg
2	400.30	5061.63	MOREP56
4	400.58	5061.57	MOREP56

MOTHER SITE CROSS SECTION 6 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
5	0.00	5073.48	MOLEP6
3	0.25	5073.54	MOLEP6
7	0.59	5073.31	veg
8	12.60	5071.29	veg
9	21.93	5071.21	veg
10	31.46	5069.76	tbank
11	36.51	5056.72	lew
12	38.96	5055.47	ic
13	44.95	5053.64	ic
14	51.44	5054.25	ic
15	56.48	5055.11	ic
16	61.29	5056.68	rew
17	61.63	5056.98	gravel veg
18	73.74	5057.40	veg
19	77.64	5057.65	veg
20	90.74	5057.47	veg
21	95.70	5057.33	gravel veg
22	102.71	5056.70	gravel veg
23	110.17	5056.46	gravel veg
24	112.04	5057.16	veg
25	115.02	5057.71	veg
26	135.90	5057.81	veg
27	166.07	5057.78	veg
28	174.55	5058.08	veg
29	177.49	5057.73	veg
30	185.27	5057.84	veg
31	186.80	5057.56	veg
32	191.69	5057.92	veg
33	197.82	5057.98	veg
34	200.64	5056.76	veg
35	202.91	5056.63	veg
36	204.12	5056.99	veg
37	206.08	5057.10	veg
38	209.25	5058.00	veg
39	213.58	5057.91	veg
40	220.35	5057.74	veg
41	222.82	5057.91	veg
42	230.44	5057.52	veg
43	233.30	5058.82	veg
44	243.09	5058.90	veg
45	249.48	5062.08	veg
46	260.69	5061.54	veg
47	266.19	5061.87	veg
48	287.30	5061.89	veg
49	301.74	5061.50	veg
2	310.03	5061.64	MOREP56

OXBOW SITE CROSS SECTION 1 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
4	0.00	5026.59	OXLEP12
5	0.04	5026.59	OXLEP12
3	0.85	5026.20	OXLEP12
8	2.31	5026.43	veg
9	4.05	5024.85	veg
10	13.84	5021.60	veg
11	30.60	5021.44	veg
12	40.52	5021.70	veg
13	57.24	5021.70	veg
14	78.43	5022.29	veg
15	89.27	5022.06	veg
16	117.65	5022.72	veg
17	139.15	5022.33	veg
18	142.46	5021.64	veg
19	150.83	5021.64	veg
20	164.01	5022.46	veg
21	188.26	5022.49	veg
22	211.59	5022.78	veg
23	228.86	5023.01	veg
24	245.37	5023.01	veg
25	250.87	5021.77	veg
26	263.19	5020.88	veg
27	274.45	5020.55	veg
28	281.89	5020.29	t bnk
29	283.05	5018.58	lew
30	283.66	5017.01	ic
31	287.25	5016.85	ic
32	294.55	5016.91	ic
33	302.74	5017.21	ic
34	309.98	5017.80	ic
35	315.16	5018.03	ic
36	316.84	5018.45	rew
38	321.59	5018.91	veg
39	328.13	5019.18	veg
40	332.54	5019.14	veg
41	338.74	5022.88	veg
42	359.97	5022.69	veg
43	376.20	5022.36	veg
44	392.22	5021.83	veg
45	412.80	5022.19	veg
46	438.79	5021.93	veg
47	454.59	5020.88	veg
48	460.81	5021.93	veg
49	475.83	5030.79	veg
2	485.42	5031.05	OXREP1
52	485.43	5030.99	rep1

OXBOW SITE CROSS SECTION 2 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
4	0.00	5026.73	OXLEP12
5	0.05	5026.72	OXLEP12
3	0.80	5026.19	OXLEP12
7	1.47	5026.63	veg
8	10.60	5021.71	veg
9	13.21	5021.55	veg
10	20.18	5021.05	veg
11	26.54	5021.47	veg
12	38.76	5021.76	veg
13	44.34	5022.30	veg
14	61.91	5022.10	veg
15	95.85	5022.28	veg
16	125.97	5021.89	veg
17	141.24	5021.66	veg
18	150.32	5021.04	veg
19	153.54	5021.24	veg
20	167.91	5021.15	veg
21	171.14	5020.66	veg
22	177.30	5021.45	veg
23	192.81	5021.26	veg
24	202.69	5021.33	veg
25	204.89	5020.89	veg
26	226.40	5021.21	veg
27	233.45	5018.03	veg
28	237.90	5017.62	veg
29	239.23	5017.90	veg
30	261.70	5018.21	veg
31	275.66	5018.41	veg
32	290.90	5018.21	veg
33	293.50	5017.87	veg
34	296.48	5018.10	veg
35	325.37	5018.59	veg
36	332.69	5017.87	veg
37	335.02	5017.44	lew
38	337.98	5016.93	ic
39	344.89	5016.47	ic
40	348.61	5015.61	ic
41	353.83	5014.28	ic
42	355.87	5013.96	ic
43	356.80	5013.95	ic
44	360.02	5015.21	ic
45	360.30	5016.31	ic
46	362.29	5017.55	rew
47	364.82	5019.61	tbank
48	372.06	5019.54	veg
49	377.17	5020.21	veg
50	389.84	5020.50	veg
51	404.64	5020.30	veg

52	407.09	5020.70	veg
53	409.81	5021.94	veg
54	423.72	5021.61	veg
55	440.73	5021.69	veg
56	451.55	5021.73	veg
57	458.54	5020.67	veg
58	480.28	5021.02	veg
59	495.02	5021.10	veg
60	505.22	5021.12	veg
61	508.46	5021.72	veg
62	511.39	5021.62	veg
63	519.38	5020.15	veg
64	530.39	5020.20	veg
65	536.69	5021.31	veg
66	546.99	5027.82	veg
2	552.35	5028.13	OXREP234

OXBOW SITE CROSS SECTION 3 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
6	0.00	5024.68	lep3
4	0.06	5024.67	OXLEP3
3	0.80	5024.20	OXLEP3
7	11.43	5024.56	veg
8	11.33	5024.55	veg
9	12.68	5023.14	veg
10	19.95	5019.41	veg
11	25.27	5019.20	veg
12	33.57	5019.09	veg
13	44.93	5019.28	veg
14	51.03	5019.00	veg
15	54.79	5018.98	veg
16	58.69	5019.87	veg
17	71.57	5019.31	veg
18	90.93	5018.72	veg
19	98.88	5018.31	veg
20	104.16	5018.59	veg
21	114.89	5019.01	veg
22	127.08	5018.98	veg
23	138.83	5019.50	veg
24	140.46	5016.42	veg
25	143.93	5014.74	veg
26	146.27	5014.65	veg
27	150.27	5015.46	veg
28	156.10	5015.57	veg
29	162.48	5015.17	veg
30	166.24	5014.24	lew
31	169.28	5013.53	ic
32	175.35	5012.68	ic
33	177.91	5012.49	ic
34	182.17	5013.17	ic
35	184.54	5014.25	ws
36	185.31	5016.01	is
37	190.11	5015.69	is
38	193.71	5016.52	is
39	196.07	5016.36	is
40	198.12	5015.04	ws
41	199.35	5014.85	ic
42	201.01	5014.92	ic
44	203.29	5014.69	ic?
43	203.71	5014.69	ic
45	205.91	5015.03	wetbar
46	210.00	5015.13	wetbar

47	212.57	5015.29	wetbarlwd
48	214.66	5015.01	ic
49	219.77	5014.90	ic
50	229.09	5015.02	ic
51	230.85	5015.51	rew
52	232.11	5016.26	bank
53	235.19	5016.19	veg
54	239.78	5016.46	veg
55	243.62	5017.10	veg
56	263.03	5017.00	veg
57	281.85	5017.08	veg
58	295.48	5017.24	veg
59	304.26	5017.10	veg
60	307.20	5016.06	veg
61	311.38	5017.40	veg
62	315.0599149	5017.560862	veg
63	317.7484477	5018.295189	veg
64	322.7056473	5019.163092	veg
65	335.1300677	5019.459078	veg
66	355.1438693	5019.337192	veg
67	369.8750862	5019.039336	veg
68	374.5440412	5018.656749	veg
69	377.1949481	5019.075674	veg
70	385.7182685	5018.285661	veg
71	392.5772126	5018.128475	veg
72	398.4841801	5019.758722	veg
73	404.6359858	5019.376804	veg
74	409.3228552	5019.729469	veg
75	433.7190699	5020.066526	veg
76	445.766544	5020.292738	veg
77	448.6798552	5020.852273	veg
78	454.604567	5020.53165	veg
79	456.7321155	5019.711456	veg
80	460.228775	5020.8562	veg
81	483.3020114	5021.098732	veg
82	505.6591655	5021.653982	veg
83	522.2254871	5020.0853	veg
84	529.5760981	5020.459547	veg
85	542.7401781	5019.812573	veg
86	560.6818972	5020.482563	veg
87	566.4247036	5021.71241	veg
88	576.5058909	5027.848198	veg
2	581.3888937	5028.1325	OXREP234

OXBOW SITE CROSS SECTION 4 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
5	0.00	5025.85	OXLEP4
4	0.02	5025.86	OXLEP4
7	0.08	5025.85	veg
8	0.74	5025.65	veg
3	0.73	5025.39	OXLEP4
9	4.78	5022.98	veg
10	13.08	5018.76	veg
11	19.13	5015.31	veg
12	28.86	5015.25	veg
13	33.70	5016.37	veg
14	67.42	5017.10	veg
15	72.47	5018.51	veg
16	78.53	5020.38	veg
17	84.33	5019.32	veg
18	93.85	5016.49	veg
19	104.96	5016.53	veg
20	127.65	5016.85	veg
21	148.61	5017.06	veg
22	162.17	5017.36	veg
23	189.93	5017.81	veg
24	212.53	5017.92	veg
25	243.08	5017.93	veg
26	251.09	5016.07	veg
27	254.76	5015.96	veg
28	257.63	5016.43	veg
29	273.49	5016.43	veg
30	276.90	5014.89	veg
31	281.54	5014.37	veg
32	285.16	5014.90	veg
33	291.23	5015.08	veg
34	298.77	5014.78	veg
35	301.44	5013.34	veg
36	305.82	5013.36	veg
37	308.85	5013.70	veg
38	311.67	5013.37	veg
39	314.96	5013.92	veg
40	326.22	5014.57	veg
41	340.66	5014.94	veg
42	362.10	5014.74	veg
43	363.13	5014.29	veg
44	367.09	5013.95	veg
45	372.79	5014.12	veg
46	375.33	5013.66	lew
47	376.20	5013.18	ic
48	382.51	5013.29	ic

49	388.19	5013.46	ic
50	391.29	5013.69	ws
51	395.68	5013.95	bar
52	403.41	5013.79	bar
53	409.77	5013.33	bar
54	412.15	5012.64	ws
55	415.80	5011.98	ic
56	421.40	5011.74	ic
57	425.65	5010.89	ic
58	428.3330021	5010.21845	ic
59	429.8392405	5010.394604	ic
60	432.9257884	5011.075431	ic debrispile
61	435.1665325	5010.110751	ic
62	439.252512	5010.893663	ic
63	440.4051287	5012.634585	rew
64	441.3465254	5015.246556	tbank
65	443.9483356	5015.172855	veg
66	447.79612	5016.092874	veg
67	458.6641325	5019.654235	veg
68	466.310629	5019.82258	veg
69	470.9764625	5019.194488	veg
70	477.9526864	5019.110531	veg
71	487.1315812	5019.496288	veg
72	499.9905994	5020.07359	veg
73	515.6612688	5019.743055	veg
74	521.3357658	5020.061565	veg
75	532.7194884	5019.936385	veg
76	534.8857731	5019.529324	veg
77	542.1431717	5019.914717	veg
78	545.7238515	5020.634247	veg
79	550.9978016	5020.420952	veg
80	552.3123883	5020.05601	veg
81	561.6737497	5019.894352	veg
82	564.9783008	5019.16824	veg
83	570.9356764	5020.907305	veg
84	589.8688455	5021.236629	veg
85	611.4805073	5021.264888	veg
86	623.694118	5020.42801	veg
87	631.7214269	5019.780137	veg
88	641.0064455	5019.497482	veg
89	646.2267294	5018.975222	veg
90	649.862985	5019.204502	veg
91	666.6517715	5020.918765	veg
92	675.6706264	5021.723132	veg
93	686.8335699	5027.844838	veg
2	693.3696302	5028.1325	OXREP234

OXBOW SITE CROSS SECTION 5 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
5	0.00	5020.84	OXLEP5
4	0.05	5020.83	OXLEP5
6	0.08	5020.83	OXLEP5
3	0.78	5020.37	OXLEP5
8	1.32	5020.79	veg
9	4.10	5019.93	veg
10	7.48	5016.88	veg
11	22.85	5016.57	veg
12	29.14	5013.00	veg
13	41.32	5012.33	veg
14	45.13	5013.05	veg
15	53.40	5013.60	veg
16	70.02	5013.29	veg
17	76.60	5014.81	veg
18	81.85	5013.33	veg
19	89.78	5012.45	veg
20	94.73	5013.14	veg
21	106.06	5012.63	veg
22	129.05	5013.92	veg
23	136.21	5013.56	veg
24	141.82	5011.44	veg
25	147.20	5010.91	veg
26	159.84	5011.66	veg
27	162.17	5012.28	veg
28	166.54	5011.70	veg
29	171.39	5012.12	veg
30	188.81	5012.32	veg
31	191.71	5011.62	veg
32	196.43	5011.65	veg
33	203.00	5012.41	veg
34	224.50	5012.45	veg
35	229.57	5012.80	veg
36	252.46	5013.12	veg
37	265.45	5012.45	veg
39	274.82	5012.40	veg
40	278.14	5012.95	veg
41	286.33	5012.63	veg
42	303.92	5013.38	veg
43	324.19	5013.33	veg
44	362.49	5013.45	veg
45	374.55	5013.23	veg
46	382.26	5012.71	veg
47	392.53	5012.92	veg

48	424.12	5012.69	veg
49	429.25	5010.42	veg
50	434.23	5010.58	veg
51	442.56	5010.98	veg
52	446.03	5011.62	veg
54	451.30	5011.59	veg
55	472.23	5012.18	veg
56	496.19	5012.07	veg
57	513.84	5011.93	veg
58	517.56	5010.96	veg
59	522.01	5010.67	veg
60	532.37	5011.34	veg
61	542.20	5011.48	veg
62	551.33	5010.89	lew
63	553.5900655	5010.596605	ic
64	555.4034201	5010.20404	ic
65	561.9720912	5009.901082	ic
66	571.8014075	5009.965472	ic
67	581.0674545	5010.081898	ic
68	586.886931	5010.042848	ic
69	594.7411989	5010.415894	ic
70	597.0389994	5010.780971	ic
71	600.0896744	5010.888995	rew
72	602.5238289	5011.478236	veg
73	604.8183632	5013.319963	veg
74	607.6648131	5015.956269	veg
75	609.8694667	5021.211385	veg
2	635.4771999	5021.987187	OXREP5
38	659.1770391	5019.995315	veg

OXBOW SITE CROSS SECTION 6 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
4	0.00	5019.30	OXLEP6
3	0.27	5019.39	OXLEP6
6	5.23	5019.99	veg
7	10.67	5018.92	veg
8	14.30	5020.00	veg
9	23.95	5018.48	veg
10	42.35	5018.21	veg
11	63.17	5018.02	veg
12	86.67	5017.85	veg
13	111.92	5017.83	veg
14	138.58	5017.56	veg
15	168.64	5017.12	veg
16	193.16	5016.55	veg
17	205.37	5011.80	veg
18	212.01	5010.77	veg
19	216.25	5009.35	veg
20	225.32	5009.05	veg
21	226.12	5009.14	veg
22	235.36	5009.90	veg
23	248.33	5009.98	veg
24	259.29	5011.06	veg
25	271.27	5009.82	veg
26	278.49	5009.66	veg
27	282.50	5010.17	veg
28	286.48	5009.65	veg
29	292.15	5010.20	veg
30	299.97	5010.03	veg
31	303.43	5009.70	veg
32	310.33	5010.05	veg
33	313.34	5010.43	veg
34	331.77	5010.60	veg
35	339.31	5010.73	veg
36	358.07	5010.50	veg
37	366.74	5010.17	veg
38	372.91	5010.63	veg
39	376.70	5009.30	veg
40	392.19	5009.43	veg
41	397.74	5009.82	veg
42	403.86	5009.43	veg
43	413.21	5009.71	veg
44	424.07	5010.20	veg
45	438.54	5009.72	veg
46	440.49	5008.24	veg
47	445.08	5008.96	veg
48	455.78	5009.07	veg
49	461.68	5009.71	veg

52	469.63	5009.87	veg
50	471.88	5009.82	veg
51	485.96	5009.95	veg
53	491.95	5009.71	veg
54	500.15	5009.61	veg
55	502.86	5008.91	lew
56	503.39	5007.95	ic
57	508.78	5007.75	ic
58	514.32	5007.83	ic
59	520.53	5007.81	ic
60	528.48	5007.81	ic
61	534.14	5008.10	ic
62	534.31	5008.91	rew
63	535.91	5009.81	t bnk
64	539.68	5009.82	veg
65	552.95	5009.65	veg
66	563.19	5009.30	veg
67	567.06	5009.42	veg
68	570.49	5008.41	veg
69	576.79	5012.47	veg
70	588.18	5020.61	veg
71	597.28	5031.17	veg
2	607.37	5031.94	OXREP67

OXBOW SITE CROSS SECTION 7 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
4	0.00	5017.22	OXLEP78
5	0.00	5017.21	OXLEP78
3	0.39	5017.11	OXLEP78
7	3.44	5017.42	veg
8	8.82	5018.30	veg
9	16.72	5018.40	veg
10	24.72	5017.44	veg
11	33.73	5015.55	veg
12	45.79	5015.09	veg
13	61.96	5015.63	veg
14	92.91	5014.87	veg
15	148.96	5014.38	veg
16	182.75	5014.08	veg
17	188.15	5014.26	veg
18	207.91	5013.58	veg
19	215.37	5014.08	veg
20	232.28	5013.84	veg
21	236.33	5014.34	veg
22	239.98	5013.82	veg
23	274.20	5012.90	veg
24	283.67	5012.59	veg
25	290.86	5010.97	veg
26	299.02	5010.54	veg
27	316.05	5010.29	veg
28	323.35	5010.90	t bnk
29	326.22	5008.04	ws
30	327.29	5007.48	bw
31	331.21	5007.08	bw
32	336.55	5008.08	ws
33	338.00	5008.68	veg
34	344.14	5008.79	veg
35	362.94	5008.85	veg
36	373.31	5009.34	veg
37	379.14	5009.08	veg
39	391.77	5009.48	veg
40	401.70	5009.07	veg
41	402.26	5008.70	lew
42.00	403.31	5007.59	ic
43.00	406.05	5007.19	ic
44.00	413.38	5007.63	ic
45.00	421.49	5007.60	ic
46.00	428.33	5007.74	ic
47.00	436.75	5007.99	ic

48.00	445.19	5008.45	ic
49.00	449.32	5008.72	rew
50.00	456.19	5009.13	veg
51.00	471.95	5008.65	veg
52.00	477.54	5009.09	veg
53.00	481.14	5009.05	veg
54.00	487.62	5008.82	veg
55.00	497.21	5008.92	veg
56.00	506.04	5009.36	veg
57.00	520.39	5020.33	veg
58.00	527.30	5031.60	veg
2.00	537.22	5031.94	OXREP67

OXBOW SITE CROSS SECTION 8 DATA

POINT	DISTANCE FROM LEP (FT)	ELEVATION (NAVD 1988 FT)	DESCRIPTION
3	0.00	5017.11	OXLEP78
54	23.01	5017.03	veg
53	47.49	5016.56	veg
52	55.36	5012.85	veg
51	66.68	5003.37	veg
50	71.69	5002.26	veg
49	76.07	5001.87	veg
48	80.54	5003.01	beavrdam
47	82.44	5002.25	veg
46	88.46	5002.82	veg
45	96.52	5002.97	veg
44	100.58	5003.30	veg
43	106.17	5005.00	veg
42	108.54	5004.91	veg
41	111.86	5003.69	veg
40	117.16	5002.27	veg
39	121.86	5001.69	veg
38	135.43	5001.99	veg
37	142.13	5002.04	veg
36	146.67	5002.04	veg
35	158.31	5002.15	veg
34	161.55	5001.99	veg
33	171.03	5002.21	veg
32	172.71	5001.81	veg
31	173.64	5002.86	log
30	174.43	5001.78	veg
29	177.76	5001.20	veg
28	178.64	5000.82	lew
27	179.03	5000.72	ic
26	184.13	5000.34	ic
25	191.70	5000.28	ic
24	200.00	5000.34	ic
23	204.11	5000.13	ic
22	209.93	4999.17	ic
21	212.07	4999.13	ic
20	217.38	4999.55	ic
19	217.98	5000.91	rew
18	219.35	5001.85	tbank
17	225.25	5001.81	veg
16	228.55	5001.69	veg
15	230.17	5002.21	veg
14	233.56	5002.20	veg
13	242.84	5001.34	veg

12	245.52	5000.88	veg
11	247.41	5000.88	veg
10	252.11	5001.30	veg
9	255.15	5001.63	veg
8	261.20	5003.20	veg
7	268.60	5006.94	veg
6	281.05	5007.17	veg
2	281.84	5007.35	OXREP8
4	282.00	5007.21	rep8

APPENDIX 2.2.C: SIXTH WATER ADJUSTED CROSS-SECTION DATA

Sixth Water Cross Section 1 2005 data
Elevations adjusted to resurveyed endpoints in 2006

point	north	east	dist	elev adj to 2006 survey	desc
2	7227793.00	1701668.34	0.00	6926.19	lep1
32	7227786.39	1701673.33	8.29	6926.20	slope
31	7227800.49	1701662.59	9.45	6926.56	slope
35	7227788.39	1701683.99	16.32	6926.13	wssc
34	7227787.26	1701684.04	16.72	6925.77	sc
33	7227786.07	1701684.48	17.57	6926.10	wssc
30	7227807.91	1701656.90	18.79	6926.13	slope
29	7227810.45	1701654.93	22.00	6927.29	tbank
28	7227814.18	1701652.11	26.68	6926.62	willowstbank
27	7227823.51	1701644.96	38.43	6924.07	botbankwills
26	7227832.06	1701638.43	49.20	6922.99	willows
25	7227837.71	1701633.97	56.40	6922.66	willows
24	7227838.34	1701633.54	57.15	6922.07	wssc
23	7227839.38	1701632.85	58.40	6921.62	sc
22	7227841.51	1701631.07	61.17	6921.44	sc
21	7227843.60	1701629.52	63.78	6921.67	sc
20	7227844.27	1701629.01	64.62	6921.97	wssc
19	7227846.59	1701627.23	67.54	6922.67	cobbgrasswill
18	7227848.46	1701625.80	69.89	6922.43	cobbgrasswill
17	7227850.29	1701624.48	72.16	6922.00	lew
16	7227851.68	1701623.27	73.99	6921.36	ic
15	7227854.80	1701621.01	77.84	6921.10	ic
14	7227858.28	1701618.35	82.22	6921.31	ic
13	7227861.04	1701616.10	85.78	6920.88	tw
12	7227862.95	1701614.56	88.23	6920.92	ic
11	7227865.27	1701612.93	91.07	6920.92	ic
10	7227867.41	1701611.29	93.77	6920.45	ic
9	7227868.95	1701610.11	95.70	6920.72	ic
8	7227870.71	1701607.05	98.97	6921.74	rew
7	7227879.32	1701601.98	108.88	6931.41	slope
6	7227894.36	1701590.67	127.69	6941.95	slope
60	7227911.09	1701577.71	148.86	6952.10	rep
5	7227911.09	1701577.70	148.86	6952.10	rep1

Sixth Water Cross section 2 2005 data
Elevations adjusted to resurveyed endpoints in 2006

point	north	east	dist	elev adj to	desc
2	7227718	1701543	0	6923.601	lep2
29	7227732	1701535	16.04737	6923.382	slope
28	7227753	1701522	40.78704	6919.844	wssc
27	7227756	1701521	44.17277	6918.869	wssc
26	7227757	1701520	45.22497	6918.272	sc
25	7227758	1701520	45.87353	6919.121	wssc
24	7227762	1701517	50.81672	6920.654	willow
23	7227776	1701509	67.31029	6918.168	tbank
22	7227781	1701506	72.48443	6915.851	lew
21	7227783	1701505	75.20278	6915.154	ic
20	7227786	1701503	78.55001	6915.818	ic
19	7227788	1701502	81.09981	6916.429	ws
18	7227789	1701502	81.52247	6916.698	iscobwil
17	7227791	1701500	84.30446	6917.016	iscobwil
16	7227794	1701499	87.08514	6917.286	ws
15	7227797	1701497	91.2879	6916.715	ic
14	7227800	1701496	93.90929	6916.95	ic
13	7227803	1701494	98.1888	6916.836	ic
12	7227807	1701491	102.5999	6916.32	ic
11	7227810	1701490	106.2624	6916.589	ic
54	7227815	1701487	111.7614	6916.439	tw
10	7227815	1701487	111.897	6916.509	tw
9	7227818	1701485	115.0542	6916.878	ic
8	7227823	1701483	120.3879	6916.611	ic
7	7227827	1701480	125.935	6917.132	ic
6	7227828	1701479	127.0602	6917.521	rew
5	7227831	1701478	130.3181	6918.112	botslopwill
30	7227866	1701458	170.2582	6949.711	rep

Sixth Water Cross section 3 2005 data
Elevations adjusted to resurveyed endpoints in 2006

point	north	east	dist	elev adj to 2006 survey	desc
2	7227718.07	1701542.53	0.00	6923.58	lep3
36	7227722.08	1701527.01	16.03	6922.94	slope
35	7227728.20	1701503.47	40.35	6922.51	slope
34	7227731.53	1701490.71	53.54	6919.65	tbank
33	7227733.49	1701482.94	61.56	6914.24	lew
32	7227733.96	1701481.14	63.41	6913.54	ic
31	7227734.93	1701477.82	66.87	6913.29	ic
30	7227735.92	1701473.66	71.15	6913.79	ic
29	7227736.67	1701470.77	74.13	6913.38	ic
28	7227737.17	1701468.87	76.10	6913.54	ic
27	7227737.98	1701465.74	79.33	6913.47	ic
26	7227738.65	1701463.13	82.02	6914.17	ic
25	7227739.44	1701460.10	85.16	6914.41	ic
24	7227740.06	1701457.72	87.62	6914.58	ic
23	7227740.95	1701454.29	91.16	6914.61	ic
22	7227741.89	1701450.65	94.92	6914.78	wsis
21	7227742.58	1701447.87	97.78	6915.29	is
20	7227743.73	1701443.42	102.37	6915.75	is
19	7227744.97	1701439.16	106.81	6915.10	is
18	7227745.75	1701435.83	110.23	6915.04	wsis
17	7227745.84	1701435.47	110.61	6914.45	ic
16	7227746.30	1701433.71	112.42	6914.48	iclog
15	7227747.10	1701430.61	115.62	6914.13	iclog
14	7227747.67	1701428.35	117.96	6913.91	ic
13	7227748.67	1701424.23	122.19	6913.94	tw
12	7227749.43	1701421.01	125.50	6914.22	ic
11	7227750.24	1701418.28	128.34	6914.14	ic
10	7227751.13	1701414.98	131.76	6913.95	ic
9	7227751.87	1701412.12	134.72	6914.57	rew
8	7227754.80	1701400.62	146.59	6916.93	willow
7	7227757.12	1701391.65	155.85	6916.23	willow
37	7227761.25	1701375.61	172.41	6916.40	rep

Sixth Water Cross section 4 2005 data
Elevations adjusted to resurveyed endpoints in 2006

point	north	east	dist	elev adj to 2006 survey	desc
3	7227636.79	1701531.21	0.00	6921.68	lep4
4	7227637.56	1701522.95	8.30	6919.91	slope
5	7227641.04	1701486.03	45.39	6919.89	slope
6	7227644.28	1701451.45	80.12	6919.31	top bnk
7	7227645.87	1701440.78	90.89	6912.32	bnk
8	7227645.96	1701433.94	97.71	6911.45	bot bnk
9	7227648.09	1701429.88	101.96	6910.55	lew
10	7227647.77	1701427.02	104.77	6909.42	ic
11	7227648.54	1701424.34	107.52	6909.17	ic
12	7227648.05	1701420.74	111.04	6909.99	ic
13	7227648.31	1701418.84	112.96	6909.45	ic
14	7227647.77	1701416.20	115.54	6909.50	ic
15	7227648.06	1701413.45	118.30	6909.18	ic
16	7227648.33	1701411.62	120.14	6908.57	ic
17	7227648.29	1701408.72	123.03	6908.54	ic
18	7227648.11	1701407.31	124.42	6907.95	thalwag
19	7227648.33	1701405.04	126.70	6909.18	ic
20	7227648.37	1701402.92	128.81	6908.96	ic
21	7227649.13	1701400.59	131.20	6909.09	ic
22	7227649.68	1701400.09	131.76	6909.54	rew
23	7227649.68	1701399.38	132.46	6909.76	bot bnk willows
25	7227651.52	1701374.43	157.48	6910.58	willows
26	7227654.40	1701343.78	188.26	6913.42	willows
27	7227655.74	1701329.52	202.58	6912.74	willows
28	7227656.92	1701316.87	215.29	6914.00	willows
29	7227659.44	1701290.03	242.25	6912.28	willows grass
30	7227664.02	1701242.68	289.81	6911.33	willows grass
31	7227668.06	1701200.75	331.94	6910.59	willows grass
32	7227668.71	1701191.42	341.29	6909.72	bot slope
1	7227673.42	1701141.19	391.75	6928.67	rep4

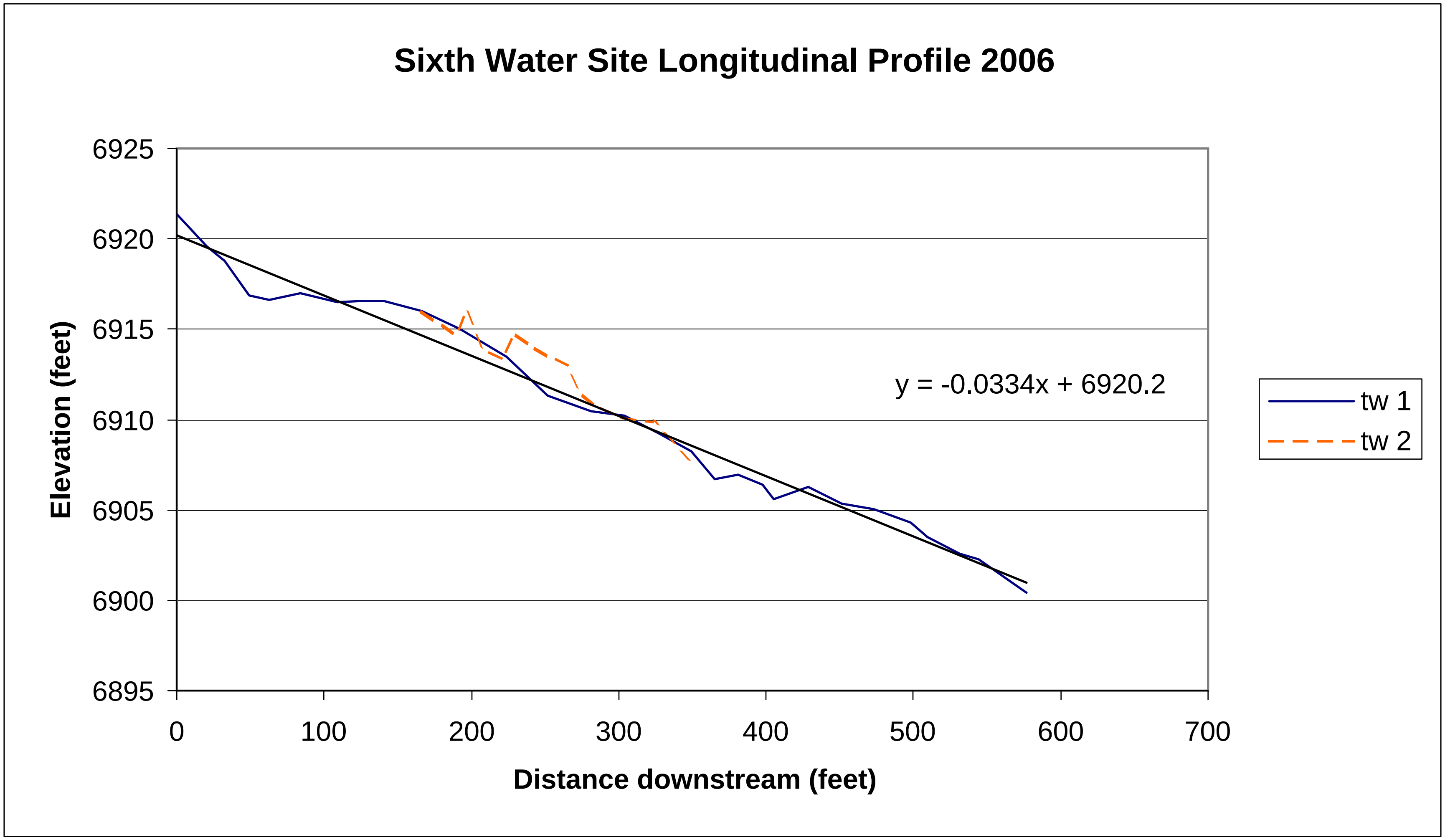
Sixth Water Cross section 5 2005 data
Elevations adjusted to resurveyed endpoints in 2006

point	north	east	dist	elev adj to 2006 survey	desc
4	7227522.65	1701378.19	0.00	6914.03	lep5
5	7227524.20	1701375.77	2.88	6912.96	top bnk
6	7227524.71	1701374.97	3.82	6909.28	bnk
7	7227528.55	1701368.93	10.98	6907.08	bot bnk
8	7227528.90	1701368.38	11.63	6906.62	lew
9	7227529.06	1701368.13	11.93	6905.88	ic
10	7227530.05	1701366.57	13.77	6905.45	ic
11	7227531.36	1701364.51	16.22	6905.15	ic
12	7227532.49	1701363.23	17.91	6905.04	ic
13	7227533.24	1701361.60	19.69	6905.23	ic
14	7227534.27	1701359.99	21.59	6905.17	ic
15	7227535.39	1701358.23	23.68	6905.20	tw
16	7227536.60	1701356.32	25.94	6905.43	ic
17	7227537.80	1701354.44	28.17	6905.98	ic
18	7227538.90	1701352.71	30.23	6906.38	ic
19	7227539.15	1701352.31	30.69	6906.59	rew
20	7227539.55	1701351.69	31.44	6906.74	bot bnk bouldr
21	7227542.58	1701346.93	37.07	6908.92	top bnk
22	7227551.66	1701332.59	54.05	6907.98	old willow
23	7227561.15	1701318.17	71.31	6907.47	boldr willow
24	7227563.41	1701314.36	75.73	6906.20	edg willows
25	7227569.90	1701303.91	88.04	6911.49	wlllow
26	7227596.66	1701261.83	137.90	6911.19	wlllow
27	7227609.48	1701242.09	161.44	6911.33	boldr willow
28	7227623.59	1701219.71	187.89	6911.00	boldr willow
29	7227630.57	1701208.71	200.93	6909.34	edge willow
30	7227633.48	1701204.19	206.30	6910.27	gr
31	7227655.42	1701169.54	247.31	6910.73	gr
32	7227657.02	1701166.87	250.42	6910.05	bot slope
1	7227673.42	1701141.19	280.90	6928.67	rep5

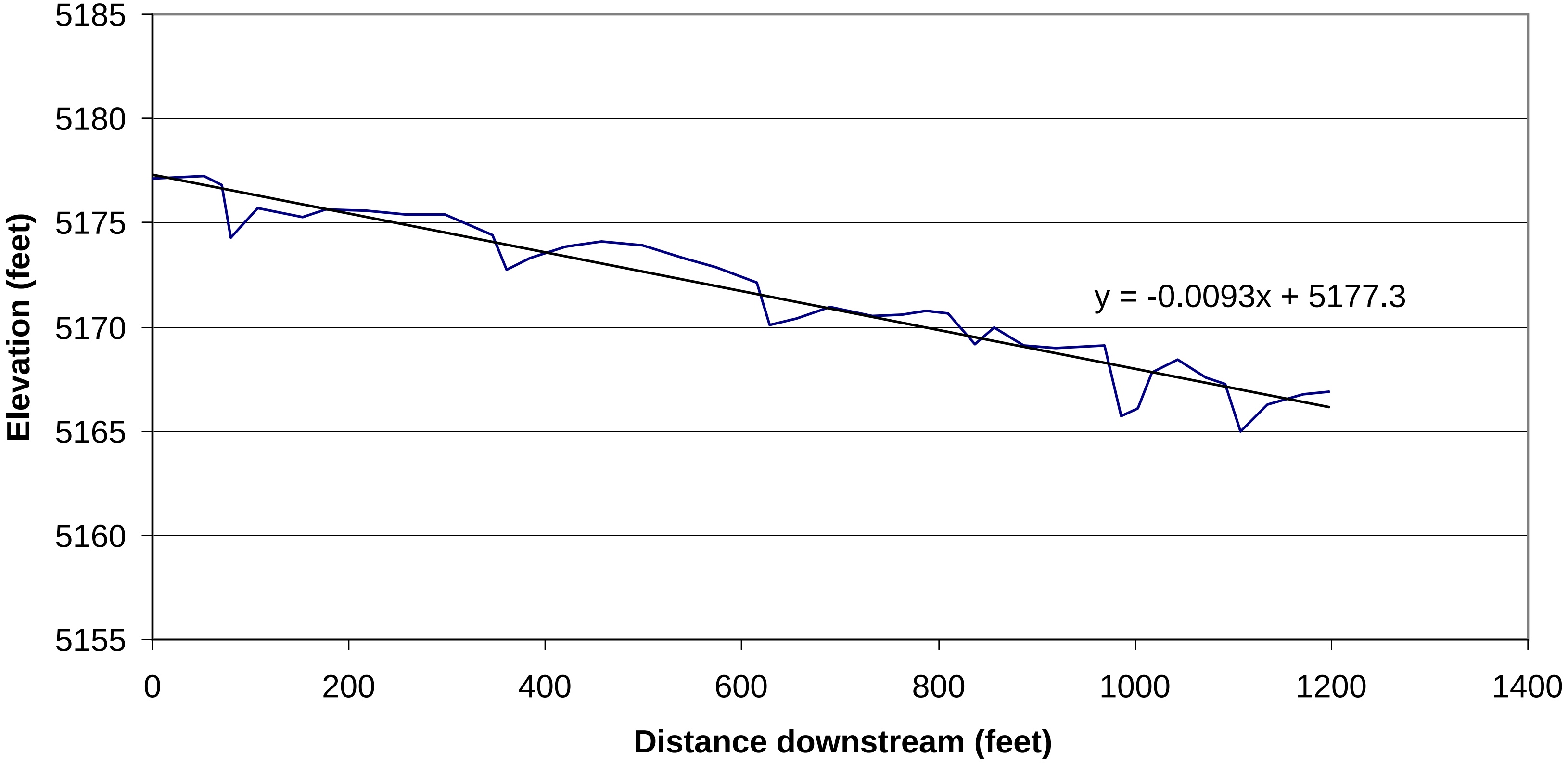
Sixth Water Cross section 6 2005 data
Elevations adjusted to resurveyed endpoints in 2006

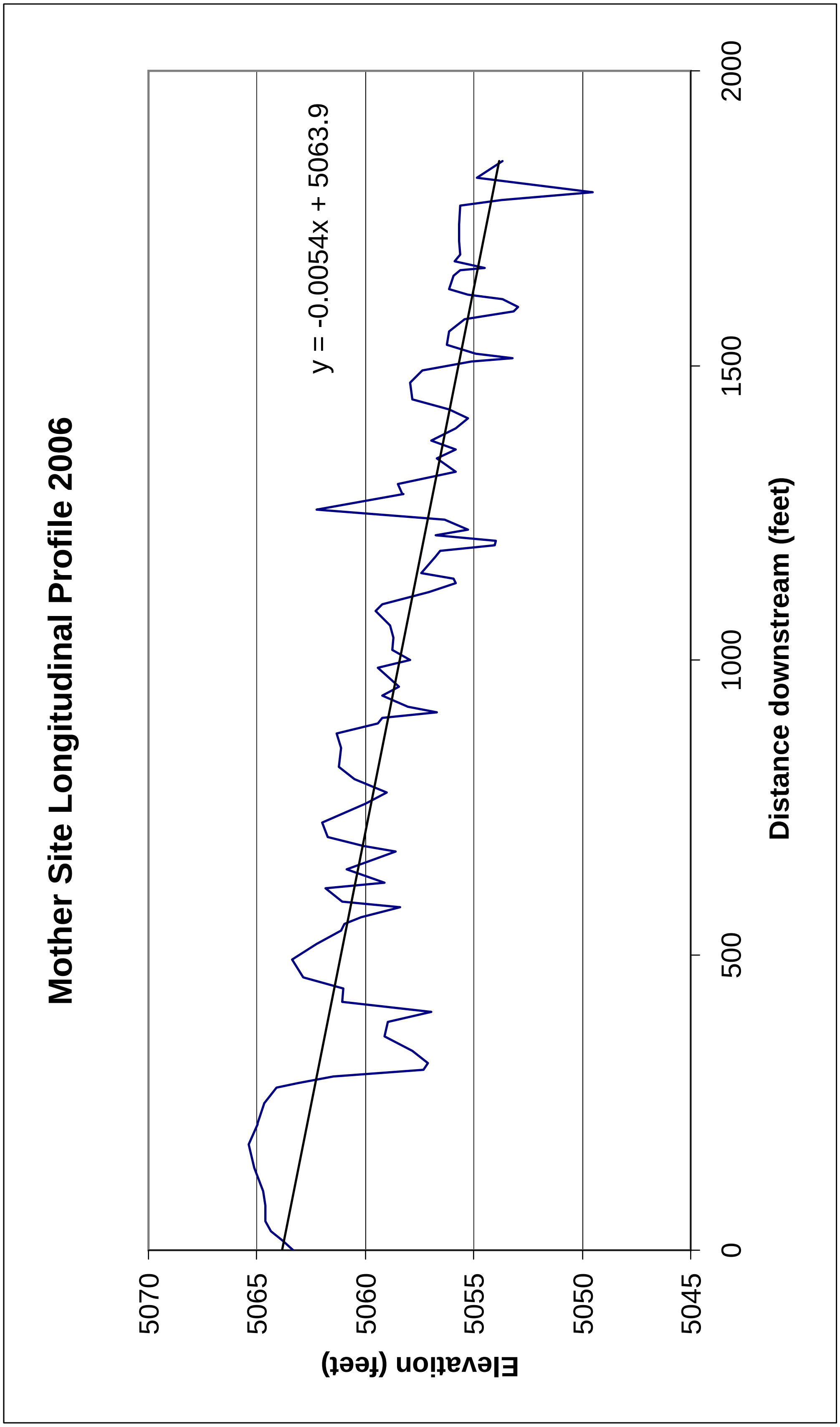
point	north	east	dist	elev adj to 2006 survey	desc
35	7227415.96	1701308.91	0.00	6920.55	lep6
4	7227438.69	1701294.13	27.11	6906.31	bot slope
5	7227446.49	1701289.05	36.41	6906.12	top bnk
6	7227448.81	1701286.83	39.57	6904.49	bnk
7	7227452.53	1701282.99	44.82	6902.49	bot bnk
8	7227454.24	1701283.50	45.94	6902.30	lew
9	7227455.16	1701283.41	46.76	6901.71	ic
10	7227457.33	1701282.01	49.34	6900.27	ic
11	7227460.39	1701279.71	53.16	6900.60	ic
12	7227462.57	1701279.16	55.29	6900.87	ic tw
13	7227465.57	1701276.32	59.35	6902.58	rock
14	7227468.08	1701275.16	62.08	6900.94	ic
15	7227470.25	1701273.69	64.71	6901.17	ic
16	7227472.12	1701272.37	66.99	6901.80	ic
17	7227473.01	1701271.80	68.05	6902.34	rew
18	7227474.75	1701270.64	70.14	6902.78	bnk
19	7227479.85	1701267.32	76.23	6904.98	top bnk
20	7227489.98	1701260.71	88.32	6904.45	willow
21	7227492.93	1701259.32	91.56	6906.00	willow
22	7227504.75	1701251.77	105.58	6905.92	willow
23	7227518.90	1701241.86	122.85	6904.35	bldr willow
24	7227526.14	1701234.40	133.00	6910.01	willow
25	7227539.01	1701228.74	146.86	6909.53	willow
26	7227566.67	1701210.86	179.79	6909.47	willow gr
27	7227573.69	1701206.26	188.18	6908.60	willow gr
28	7227577.95	1701203.48	193.27	6909.37	willow gr
29	7227585.01	1701199.18	201.54	6909.34	willow gr
30	7227586.99	1701197.57	204.07	6908.51	willow gr
31	7227589.44	1701195.71	207.14	6909.34	willow gr
32	7227615.97	1701178.83	238.58	6909.56	willow gr
33	7227632.00	1701168.09	257.87	6909.41	willow gr
34	7227644.59	1701160.19	272.74	6910.00	bot slope
1	7227673.42	1701141.19	307.27	6928.59	rep6

APPENDIX 2.3.A: LONGITUDINAL PROFILES

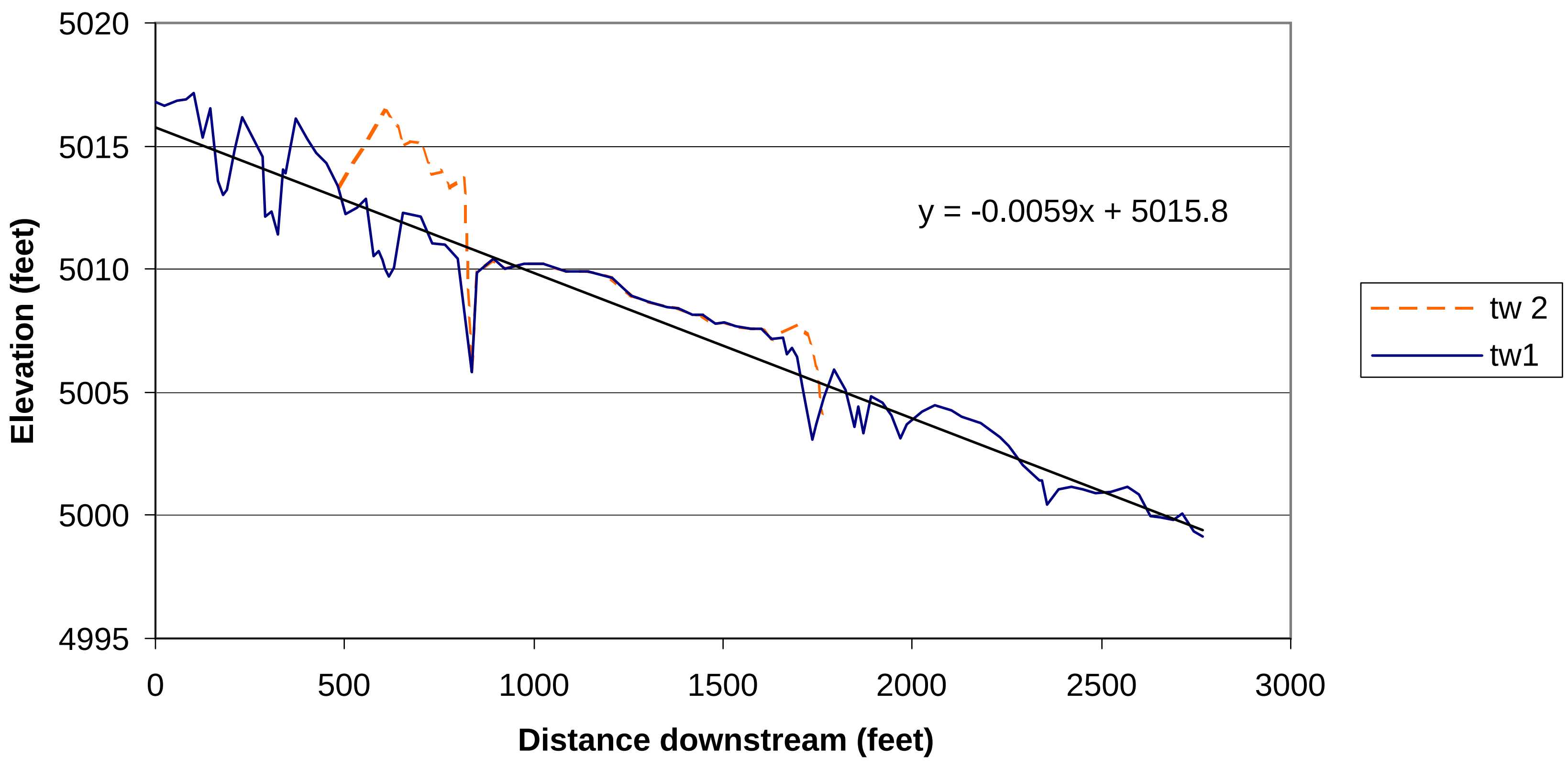

Sixth Water Site Longitudinal Profile 2006

Diamond Fork Camground Site Longitudinal Profile 2006



Mother Site Longitudinal Profile 2006
y = -0.0054x + 5063.9
Elevation (feet)
5070
5065
5060
5055
5050
5045
Distance downstream (feet)
0
500
1000
1500
2000

Oxbow Site Longitudinal Profile 2006



APPENDIX 2.3.B: LONGITUDINAL PROFILE DATA

Sixth Water Site Longitudinal Profile Data 2006

thalweg 1

number	northing	easting	elevation (m)	distance (m)	distance feet	cumu dist feet	distance from xs 1=0	elevation feet	Description
364	4445785.99	476070.86	2109.54	0.00	0.00	0.00	-3.44	6921.39	tw
365	4445783.97	476065.05	2108.99	6.15	20.19	20.19	16.75	6919.59	tw
366	4445783.00	476061.36	2108.74	3.81	12.49	32.68	29.24	6918.77	tw
367	4445781.36	476056.71	2108.17	4.94	16.20	48.87	45.43	6916.90	tw
368	4445780.79	476052.58	2108.08	4.17	13.68	62.55	59.11	6916.61	tw
369	4445779.34	476046.12	2108.20	6.62	21.72	84.27	80.83	6917.01	tw
370	4445776.71	476039.00	2108.04	7.59	24.90	109.17	105.73	6916.47	tw
371	4445774.68	476034.44	2108.06	4.99	16.37	125.55	122.11	6916.56	tw
372	4445771.19	476031.33	2108.07	4.67	15.34	140.88	137.44	6916.58	tw
373	4445764.45	476027.46	2107.90	7.78	25.52	166.40	162.96	6916.03	tw
374	4445756.59	476026.55	2107.60	7.91	25.94	192.34	188.90	6915.04	tw
375	4445747.01	476025.19	2107.12	9.68	31.75	224.10	220.66	6913.48	tw
376	4445739.44	476021.24	2106.48	8.54	28.01	252.10	248.66	6911.35	tw
377	4445732.09	476016.39	2106.20	8.81	28.91	281.01	277.57	6910.45	tw
378	4445726.26	476012.71	2106.13	6.89	22.62	303.63	300.19	6910.21	tw
379	4445720.86	476007.95	2105.83	7.20	23.63	327.26	323.82	6909.24	tw
380	4445716.04	476003.33	2105.53	6.68	21.90	349.16	345.72	6908.25	tw
381	4445712.80	475999.81	2105.06	4.78	15.68	364.85	361.41	6906.70	tw
382	4445708.22	475998.08	2105.13	4.90	16.08	380.92	377.48	6906.94	tw
383	4445703.38	475996.49	2104.97	5.09	16.68	397.61	394.17	6906.41	tw
384	4445701.14	475995.75	2104.73	2.36	7.76	405.36	401.92	6905.61	tw
385	4445694.65	475993.03	2104.92	7.04	23.09	428.45	425.01	6906.25	tw
386	4445688.72	475989.58	2104.65	6.86	22.52	450.97	447.53	6905.37	tw
387	4445682.87	475985.96	2104.56	6.87	22.55	473.52	470.08	6905.06	tw
388	4445678.13	475980.00	2104.33	7.62	24.99	498.52	495.08	6904.29	tw
389	4445676.15	475977.17	2104.09	3.45	11.33	509.85	506.41	6903.53	tw
390	4445672.76	475971.44	2103.80	6.66	21.84	531.69	528.25	6902.56	tw
391	4445670.45	475968.24	2103.70	3.95	12.95	544.64	541.20	6902.25	tw
392	4445664.95	475960.19	2103.15	9.75	31.99	576.63	573.19	6900.43	tw

Sixth Water Site Longitudinal Profile Data 2006

thalweg 2

number	northing	easting	elevation (m)	distance (m)	distance feet	cumu dist feet	distance from xs 1=0	elevation feet	Description
393	4445766.79	476026.15	2107.90	0.00	0.00	166.40	162.96	6916.01	tw r
394	4445761.85	476021.03	2107.47	7.11	23.34	189.74	186.30	6914.62	tw r
395	4445761.64	476018.76	2107.90	2.28	7.48	197.23	193.79	6916.03	tw r
396	4445761.78	476015.59	2107.24	3.18	10.42	207.65	204.21	6913.86	tw r
397	4445758.48	476013.55	2107.09	3.88	12.74	220.39	216.95	6913.36	tw r
398	4445756.22	476011.75	2107.53	2.88	9.46	229.85	226.41	6914.80	tw r
399	4445753.53	476010.71	2107.31	2.88	9.47	239.32	235.88	6914.08	tw r
400	4445746.06	476007.93	2106.97	7.98	26.18	265.49	262.05	6912.97	tw r
401	4445743.93	476006.98	2106.55	2.32	7.63	273.12	269.68	6911.58	tw r
402	4445741.13	476006.04	2106.31	2.96	9.71	282.83	279.39	6910.80	tw r
403	4445735.29	476005.75	2106.09	5.85	19.18	302.01	298.57	6910.07	tw r
404	4445728.84	476004.93	2106.02	6.50	21.32	323.33	319.89	6909.85	tw r
405	4445721.65	476003.55	2105.40	7.33	24.04	347.37	343.93	6907.81	tw r

Diamond Fork Campground Site Longitudinal Profile Data 2006

number	northing	easting	elevation (m)	distance (m)	distance feet	cumu dist feet	distance from xs 1=0	elevation feet
163	4435404.25	462868.96	1577.91	0.00	0.00	0.00	0.00	5177.12
164	4435401.71	462853.42	1577.94	15.74	51.65	51.65	51.65	5177.22
165	4435402.69	462847.79	1577.81	5.71	18.74	70.39	70.39	5176.79
166	4435402.75	462844.84	1577.04	2.95	9.68	80.07	80.07	5174.27
167	4435403.69	462836.78	1577.47	8.12	26.65	106.72	106.72	5175.68
168	4435408.54	462823.50	1577.35	14.13	46.37	153.09	153.09	5175.29
169	4435412.24	462817.46	1577.46	7.09	23.26	176.35	176.35	5175.65
170	4435417.79	462806.16	1577.43	12.59	41.29	217.65	217.65	5175.55
171	4435423.42	462795.05	1577.38	12.46	40.87	258.51	258.51	5175.38
172	4435429.67	462785.04	1577.38	11.80	38.71	297.22	297.22	5175.38
173	4435435.69	462771.56	1577.08	14.76	48.43	345.65	345.65	5174.40
174	4435436.78	462767.02	1576.57	4.68	15.34	360.99	360.99	5172.73
175	4435437.91	462760.07	1576.74	7.04	23.10	384.09	384.09	5173.28
176	4435437.90	462748.92	1576.91	11.15	36.59	420.68	420.68	5173.84
177	4435439.91	462738.07	1576.99	11.03	36.18	456.86	456.86	5174.10
178	4435441.81	462725.55	1576.94	12.67	41.58	498.44	498.44	5173.94
179	4435444.67	462713.02	1576.75	12.85	42.17	540.60	540.60	5173.32
180	4435446.23	462703.18	1576.61	9.96	32.68	573.28	573.28	5172.86
181	4435446.13	462690.56	1576.38	12.62	41.39	614.67	614.67	5172.10
182	4435445.91	462686.32	1575.77	4.25	13.95	628.62	628.62	5170.10
183	4435446.15	462678.12	1575.86	8.20	26.91	655.52	655.52	5170.40
184	4435445.71	462667.71	1576.03	10.42	34.20	689.72	689.72	5170.95
185	4435443.57	462654.75	1575.90	13.13	43.09	732.81	732.81	5170.53
186	4435440.29	462646.35	1575.91	9.02	29.59	762.40	762.40	5170.56
187	4435434.02	462642.09	1575.97	7.58	24.86	787.27	787.27	5170.76
188	4435429.84	462636.91	1575.94	6.66	21.84	809.11	809.11	5170.66
189	4435422.72	462631.97	1575.49	8.66	28.42	837.53	837.53	5169.18
190	4435417.50	462629.37	1575.73	5.83	19.12	856.66	856.66	5169.97
191	4435408.28	462630.99	1575.47	9.37	30.74	887.40	887.40	5169.12
192	4435399.14	462627.18	1575.43	9.91	32.50	919.90	919.90	5168.99

Diamond Fork Campground Site Longitudinal Profile Data 2006

number	northing	easting	elevation (m)	distance (m)	distance feet	cumu dist feet	distance from xs 1=0	elevation feet
193	4435385.91	462619.95	1575.46	15.07	49.44	969.34	969.34	5169.08
194	4435380.81	462619.28	1574.43	5.15	16.88	986.22	986.22	5165.70
195	4435376.22	462621.35	1574.55	5.04	16.54	1002.75	1002.75	5166.10
196	4435371.65	462621.41	1575.07	4.56	14.97	1017.73	1017.73	5167.80
197	4435364.24	462619.15	1575.26	7.75	25.43	1043.15	1043.15	5168.43
198	4435356.07	462615.55	1574.99	8.93	29.28	1072.44	1072.44	5167.54
199	4435350.94	462612.94	1574.91	5.76	18.90	1091.33	1091.33	5167.28
200	4435347.61	462609.48	1574.20	4.80	15.74	1107.08	1107.08	5164.95
201	4435343.38	462602.18	1574.61	8.44	27.70	1134.78	1134.78	5166.30
202	4435340.94	462591.37	1574.76	11.08	36.36	1171.13	1171.13	5166.79
203	4435338.79	462583.74	1574.79	7.93	26.01	1197.14	1197.14	5166.89

Mother Site Longitudinal Profile Data 2006

number	northing	easting	elevation (m)	distance	distance ft	cum dis ft	distance from xs 1=0	elev ft	name
51	4432969.79	460130.76	1543.22	0.00	0.00	0.00	0.00	5063.30	tw
52	4432965.64	460127.61	1543.39	5.21	17.10	17.10	17.10	5063.86	tw
53	4432961.70	460125.17	1543.54	4.63	15.19	32.30	32.30	5064.35	tw
54	4432958.25	460121.73	1543.62	4.87	15.98	48.28	48.28	5064.62	tw
55	4432953.75	460114.67	1543.61	8.37	27.45	75.73	75.73	5064.58	tw
56	4432949.72	460108.27	1543.65	7.57	24.83	100.55	100.55	5064.72	tw
57	4432942.53	460098.71	1543.78	11.96	39.24	139.79	139.79	5065.14	tw
58	4432934.78	460089.18	1543.85	12.29	40.31	180.10	180.10	5065.37	tw
59	4432930.95	460079.48	1543.72	10.43	34.23	214.33	214.33	5064.95	tw
60	4432930.95	460079.46	1543.72	0.02	0.05	214.38	214.38	5064.95	tw
61	4432925.89	460070.38	1543.63	10.40	34.13	248.51	248.51	5064.65	tw
62	4432922.01	460063.20	1543.46	8.16	26.77	275.28	275.28	5064.09	tw
63	4432919.96	460061.85	1543.16	2.46	8.07	283.35	283.35	5063.11	tw
64	4432916.88	460059.77	1542.67	3.71	12.17	295.52	295.52	5061.50	tw
65	4432913.72	460059.64	1541.39	3.16	10.37	305.89	305.89	5057.30	tw
66	4432911.11	460061.71	1541.34	3.33	10.93	316.82	316.82	5057.14	tw
67	4432904.58	460062.78	1541.56	6.62	21.71	338.53	338.53	5057.86	tw
68	4432897.23	460063.98	1541.95	7.44	24.42	362.95	362.95	5059.14	tw
69	4432890.22	460062.83	1541.89	7.11	23.33	386.28	386.28	5058.94	tw
70	4432885.27	460060.49	1541.29	5.47	17.95	404.24	404.24	5056.97	tw
71	4432883.14	460056.09	1542.54	4.88	16.02	420.26	420.26	5061.07	tw
72	4432879.23	460049.81	1542.53	7.40	24.29	444.55	444.55	5061.04	tw
73	4432875.48	460045.36	1543.08	5.81	19.08	463.62	463.62	5062.85	tw
74	4432870.91	460037.87	1543.24	8.78	28.81	492.43	492.43	5063.37	tw
75	4432867.60	460030.32	1542.90	8.24	27.04	519.47	519.47	5062.25	tw
76	4432864.71	460024.10	1542.56	6.86	22.49	541.97	541.97	5061.14	tw
77	4432864.14	460020.96	1542.51	3.19	10.47	552.43	552.43	5060.98	tw
78	4432866.62	460018.47	1542.27	3.52	11.56	563.99	563.99	5060.19	tw
79	4432867.98	460013.00	1541.72	5.63	18.48	582.47	582.47	5058.38	tw
80	4432868.55	460010.32	1542.54	2.74	8.98	591.45	591.45	5061.07	tw

Mother Site Longitudinal Profile Data 2006

number	northing	easting	elevation (m)	distance	distance ft	cum dis ft	distance from xs 1=0	elev ft	name
81	4432872.89	460005.26	1542.78	6.67	21.87	613.33	613.33	5061.86	tw
82	4432874.25	460002.62	1541.94	2.98	9.76	623.09	623.09	5059.11	tw
83	4432878.82	459997.56	1542.48	6.82	22.37	645.46	645.46	5060.88	tw
84	4432882.85	459994.60	1542.13	5.00	16.40	661.86	661.86	5059.73	tw
85	4432886.96	459994.68	1541.79	4.11	13.48	675.34	675.34	5058.61	tw
412	4432889.73	459993.02	1542.24	3.23	10.61	685.95	685.95	5060.09	tw
413	4432894.46	459993.02	1542.74	4.73	15.52	701.47	701.47	5061.73	tw
414	4432901.44	459993.18	1542.82	6.98	22.91	724.37	724.37	5061.99	tw
415	4432911.55	459992.21	1542.21	10.16	33.32	757.69	757.69	5059.99	tw
416	4432915.00	459987.84	1541.91	5.57	18.29	775.98	775.98	5059.01	tw
417	4432919.77	459982.80	1542.37	6.93	22.75	798.73	798.73	5060.52	tw
418	4432923.51	459977.98	1542.59	6.10	20.02	818.75	818.75	5061.24	tw
419	4432931.27	459971.94	1542.55	9.84	32.27	851.02	851.02	5061.11	tw
420	4432936.07	459965.94	1542.61	7.68	25.20	876.22	876.22	5061.30	tw
421	4432939.57	459962.14	1542.04	5.17	16.96	893.18	893.18	5059.43	tw
422	4432940.45	459959.48	1541.97	2.80	9.18	902.37	902.37	5059.20	tw
423	4432941.25	459956.79	1541.21	2.81	9.23	911.60	911.60	5056.71	tw
424	4432940.24	459954.16	1541.61	2.82	9.24	920.84	920.84	5058.02	tw
425	4432935.65	459950.50	1541.97	5.87	19.25	940.09	940.09	5059.20	tw
426	4432931.41	459948.49	1541.74	4.69	15.40	955.49	955.49	5058.45	tw
427	4432924.53	459941.30	1542.03	9.95	32.64	988.13	988.13	5059.40	tw
428	4432922.97	459937.97	1541.58	3.68	12.08	1000.21	1000.21	5057.92	tw
429	4432925.10	459932.82	1541.84	5.57	18.28	1018.50	1018.50	5058.78	tw
430	4432927.19	459926.83	1541.82	6.34	20.80	1039.30	1039.30	5058.71	tw
431	4432929.86	459921.36	1541.86	6.09	19.98	1059.28	1059.28	5058.84	tw
432	4432935.01	459916.03	1542.07	7.41	24.32	1083.60	1083.60	5059.53	tw
433	4432936.50	459912.99	1541.98	3.38	11.10	1094.70	1094.70	5059.24	tw
434	4432937.14	459906.76	1541.31	6.26	20.53	1115.23	1115.23	5057.04	tw
435	4432935.70	459902.34	1540.95	4.65	15.26	1130.49	1130.49	5055.86	tw

Mother Site Longitudinal Profile Data 2006

number	northing	easting	elevation (m)	distance	distance ft	cum dis ft	distance from xs 1=0	elev ft	name
436	4432936.28	459899.92	1540.98	2.49	8.16	1138.65	1138.65	5055.96	tw
437	4432935.82	459896.99	1541.42	2.96	9.71	1148.36	1148.36	5057.40	tw
438	4432932.67	459889.15	1541.22	8.45	27.73	1176.09	1176.09	5056.74	tw
439	4432930.65	459887.12	1541.16	2.86	9.38	1185.47	1185.47	5056.55	tw
440	4432928.11	459885.78	1540.40	2.87	9.43	1194.90	1194.90	5054.05	tw
441	4432926.68	459884.09	1540.38	2.22	7.28	1202.18	1202.18	5053.99	tw
442	4432924.31	459881.70	1541.23	3.36	11.03	1213.21	1213.21	5056.78	tw
443	4432921.95	459881.96	1540.77	2.38	7.80	1221.01	1221.01	5055.27	tw
444	4432917.79	459885.67	1541.10	5.57	18.28	1239.29	1239.29	5056.35	tw
445	4432914.45	459889.19	1542.90	4.85	15.93	1255.22	1255.22	5062.25	tw
446	4432908.28	459894.62	1541.68	8.22	26.98	1282.19	1282.19	5058.25	tw
447	4432908.23	459894.67	1541.69	0.07	0.24	1282.43	1282.43	5058.28	tw
448	4432904.93	459898.25	1541.76	4.87	15.99	1298.42	1298.42	5058.51	tw
449	4432899.30	459901.44	1540.94	6.47	21.21	1319.63	1319.63	5055.82	tw
450	4432892.46	459899.66	1541.21	7.07	23.20	1342.83	1342.83	5056.71	tw
451	4432888.26	459897.95	1540.95	4.53	14.87	1357.70	1357.70	5055.86	tw
452	4432883.70	459896.24	1541.28	4.88	16.00	1373.69	1373.69	5056.94	tw
453	4432878.40	459893.02	1540.94	6.19	20.31	1394.01	1394.01	5055.82	tw
454	4432874.78	459889.03	1540.77	5.39	17.70	1411.71	1411.71	5055.27	tw
455	4432871.70	459885.75	1541.03	4.50	14.75	1426.46	1426.46	5056.12	tw
456	4432870.52	459880.86	1541.55	5.03	16.50	1442.95	1442.95	5057.83	tw
457	4432868.44	459872.52	1541.59	8.60	28.21	1471.16	1471.16	5057.96	tw
458	4432866.51	459866.54	1541.41	6.29	20.64	1491.80	1491.80	5057.37	tw
459	4432864.18	459862.59	1540.73	4.58	15.03	1506.83	1506.83	5055.14	tw
460	4432863.46	459860.63	1540.14	2.09	6.86	1513.69	1513.69	5053.20	tw
461	4432862.69	459858.59	1540.66	2.18	7.15	1520.84	1520.84	5054.91	tw
462	4432859.80	459854.95	1541.07	4.64	15.23	1536.07	1536.07	5056.25	tw
463	4432854.70	459850.49	1541.03	6.78	22.23	1558.30	1558.30	5056.12	tw
464	4432850.25	459846.26	1540.82	6.15	20.17	1578.47	1578.47	5055.43	tw

Mother Site Longitudinal Profile Data 2006

number	northing	easting	elevation (m)	distance	distance ft	cum dis ft	distance from xs 1=0	elev ft	name
465	4432846.53	459844.97	1540.13	3.94	12.92	1591.38	1591.38	5053.17	tw
466	4432844.23	459843.73	1540.07	2.61	8.56	1599.95	1599.95	5052.97	tw
467	4432840.55	459844.66	1540.28	3.80	12.46	1612.41	1612.41	5053.66	tw
468	4432838.13	459845.09	1540.77	2.46	8.07	1620.47	1620.47	5055.27	tw
469	4432835.01	459845.21	1541.04	3.13	10.25	1630.73	1630.73	5056.15	tw
470	4432828.19	459845.50	1540.98	6.82	22.39	1653.12	1653.12	5055.96	tw
471	4432826.64	459847.36	1540.88	2.42	7.95	1661.06	1661.06	5055.63	tw
472	4432825.05	459847.47	1540.54	1.59	5.22	1666.29	1666.29	5054.51	tw
473	4432822.35	459848.85	1540.96	3.03	9.93	1676.22	1676.22	5055.89	tw
474	4432818.70	459850.30	1540.88	3.93	12.90	1689.12	1689.12	5055.63	tw
475	4432812.13	459851.42	1540.89	6.66	21.86	1710.98	1710.98	5055.66	tw
476	4432803.70	459853.24	1540.89	8.62	28.29	1739.27	1739.27	5055.66	tw
477	4432795.15	459858.18	1540.88	9.88	32.40	1771.67	1771.67	5055.63	tw
478	4432792.42	459859.35	1540.30	2.97	9.75	1781.43	1781.43	5053.72	tw
479	4432788.55	459860.11	1539.01	3.94	12.93	1794.35	1794.35	5049.49	tw
480	4432781.45	459858.75	1540.65	7.23	23.73	1818.08	1818.08	5054.87	tw
481	4432776.08	459851.99	1540.28	8.63	28.32	1846.39	1846.39	5053.66	tw

Oxbow Site Longitudinal Profile Data 2006

Name	Northing	Easting	Elevation	distance	distance ft	cumu dist ft	distance from xs 1=0	elev ft	Description
54	4432319.25	458793.68	1529.05	0.00	0.00	0.00	0.00	5016.81	tw
55	4432318.02	458786.66	1529.00	7.12	23.37	23.37	23.37	5016.65	tw
56	4432316.80	458776.46	1529.06	10.27	33.70	57.08	57.08	5016.85	tw
57	4432315.15	458769.71	1529.07	6.95	22.79	79.87	79.87	5016.88	tw
58	4432312.94	458763.36	1529.16	6.73	22.07	101.94	101.94	5017.17	tw
59	4432309.55	458757.74	1528.60	6.56	21.54	123.47	123.47	5015.34	tw
60	4432304.91	458753.82	1528.97	6.08	19.94	143.41	143.41	5016.55	tw
61	4432299.27	458751.31	1528.06	6.17	20.26	163.67	163.67	5013.56	tw
62	4432295.06	458750.99	1527.89	4.22	13.85	177.52	177.52	5013.01	tw
63	4432291.46	458750.73	1527.96	3.60	11.83	189.35	189.35	5013.24	tw
64	4432285.42	458748.99	1528.44	6.29	20.65	209.99	209.99	5014.81	tw
65	4432279.36	458749.31	1528.86	6.07	19.91	229.90	229.90	5016.19	tw
66	4432263.97	458753.81	1528.36	16.03	52.60	282.50	282.50	5014.55	tw
67	4432262.46	458755.37	1527.63	2.17	7.12	289.63	289.63	5012.15	tw
68	4432259.46	458759.17	1527.69	4.84	15.88	305.51	305.51	5012.35	tw
69	4432258.68	458764.58	1527.40	5.47	17.95	323.46	323.46	5011.40	tw
70	4432257.15	458768.00	1528.20	3.74	12.26	335.72	335.72	5014.02	tw
71	4432257.32	458770.20	1528.16	2.21	7.27	342.99	342.99	5013.89	tw
72	4432252.47	458777.25	1528.84	8.56	28.07	371.06	371.06	5016.12	tw1
73	4432244.58	458781.57	1528.58	9.00	29.51	400.57	400.57	5015.27	tw1
74	4432237.36	458782.55	1528.42	7.28	23.88	424.46	424.46	5014.75	tw1
75	4432228.99	458780.51	1528.29	8.62	28.29	452.75	452.75	5014.32	tw1
76	4432220.60	458778.11	1528.00	8.72	28.62	481.36	481.36	5013.37	tw1
87	4432216.00	458774.25	1527.66	6.01	19.70	501.07	501.07	5012.25	tw
88	4432209.66	458767.32	1527.74	9.39	30.82	531.89	531.89	5012.51	tw
89	4432203.35	458764.14	1527.85	7.07	23.19	555.08	555.08	5012.88	tw
90	4432200.21	458759.04	1527.14	5.99	19.65	574.73	574.73	5010.55	tw
91	4432198.46	458755.30	1527.19	4.13	13.54	588.27	588.27	5010.71	tw
92	4432198.99	458751.87	1527.09	3.47	11.39	599.66	599.66	5010.38	tw
93	4432201.19	458752.49	1526.98	2.29	7.52	607.18	607.18	5010.02	tw
94	4432204.43	458751.57	1526.88	3.36	11.03	618.21	618.21	5009.69	tw
95	4432206.81	458749.33	1527.00	3.27	10.72	628.94	628.94	5010.09	tw
96	4432210.77	458742.59	1527.67	7.82	25.67	654.60	654.60	5012.29	tw
97	4432219.31	458731.60	1527.62	13.92	45.67	700.27	700.27	5012.12	tw

Oxbow Site Longitudinal Profile Data 2006

Name	Northing	Easting	Elevation	distance	distance ft	cumu dist ft	distance from xs 1=0	elev ft	Description
98	4432224.59	458723.68	1527.30	9.52	31.23	731.49	731.49	5011.07	tw
99	4432228.89	458714.28	1527.28	10.33	33.90	765.40	765.40	5011.01	tw
100	4432230.95	458704.79	1527.11	9.71	31.87	797.27	797.27	5010.45	tw
101	4432232.71	458693.38	1525.70	11.54	37.87	835.13	835.13	5005.82	tw
102	4432231.80	458688.94	1526.93	4.53	14.86	850.00	850.00	5009.86	tw
103	4432229.56	458676.47	1527.10	12.68	41.59	891.59	891.59	5010.42	tw
104	4432228.23	458666.38	1526.98	10.17	33.37	924.96	924.96	5010.02	tw
105	4432231.92	458651.56	1527.04	15.28	50.14	975.10	975.10	5010.22	tw
106	4432232.39	458636.05	1527.04	15.51	50.89	1025.99	1025.99	5010.22	tw
107	4432233.02	458618.22	1526.95	17.84	58.55	1084.54	1084.54	5009.92	tw
108	4432229.99	458600.74	1526.94	17.74	58.20	1142.74	1142.74	5009.89	tw
109	4432225.22	458581.45	1526.87	19.87	65.20	1207.94	1207.94	5009.66	tw
110	4432220.80	458566.63	1526.64	15.46	50.73	1258.67	1258.67	5008.91	tw
111	4432216.59	458553.09	1526.56	14.19	46.55	1305.21	1305.21	5008.64	tw
112	4432211.90	458539.48	1526.50	14.39	47.21	1352.42	1352.42	5008.45	tw
113	4432210.23	458530.46	1526.48	9.17	30.10	1382.53	1382.53	5008.38	tw
114	4432206.16	458519.74	1526.41	11.46	37.61	1420.14	1420.14	5008.15	tw
74	4432203.29	458512.72	1526.41	7.59	24.89	1445.03	1445.03	5008.16	thal
75	4432203.94	458502.15	1526.30	10.59	34.76	1479.79	1479.79	5007.80	thal
76	4432204.03	458494.57	1526.32	7.57	24.85	1504.64	1504.64	5007.85	thal
77	4432204.33	458485.48	1526.27	9.10	29.85	1534.48	1534.48	5007.71	thal
78	4432206.57	458473.56	1526.24	12.13	39.80	1574.29	1574.29	5007.58	thal
79	4432207.50	458465.52	1526.24	8.09	26.55	1600.84	1600.84	5007.60	thal
80	4432209.07	458457.53	1526.12	8.14	26.69	1627.53	1627.53	5007.19	thal
81	4432211.91	458448.92	1526.12	9.06	29.74	1657.27	1657.27	5007.19	thal
86	4432212.29	458445.39	1525.91	3.55	11.66	1668.94	1668.94	5006.53	thal
87	4432215.57	458443.63	1526.00	3.73	12.22	1681.16	1681.16	5006.80	thal
88	4432219.46	458443.59	1525.89	3.88	12.74	1693.90	1693.90	5006.45	thal
89	4432225.04	458442.37	1525.45	5.72	18.75	1712.65	1712.65	5005.00	thal
90	4432231.45	458444.96	1524.86	6.91	22.68	1735.33	1735.33	5003.07	thal
91	4432234.08	458447.61	1525.05	3.73	12.23	1747.56	1747.56	5003.69	thal
92	4432238.69	458451.55	1525.39	6.07	19.92	1767.48	1767.48	5004.81	thal
93	4432246.10	458454.56	1525.73	8.00	26.24	1793.72	1793.72	5005.93	thal

Oxbow Site Longitudinal Profile Data 2006

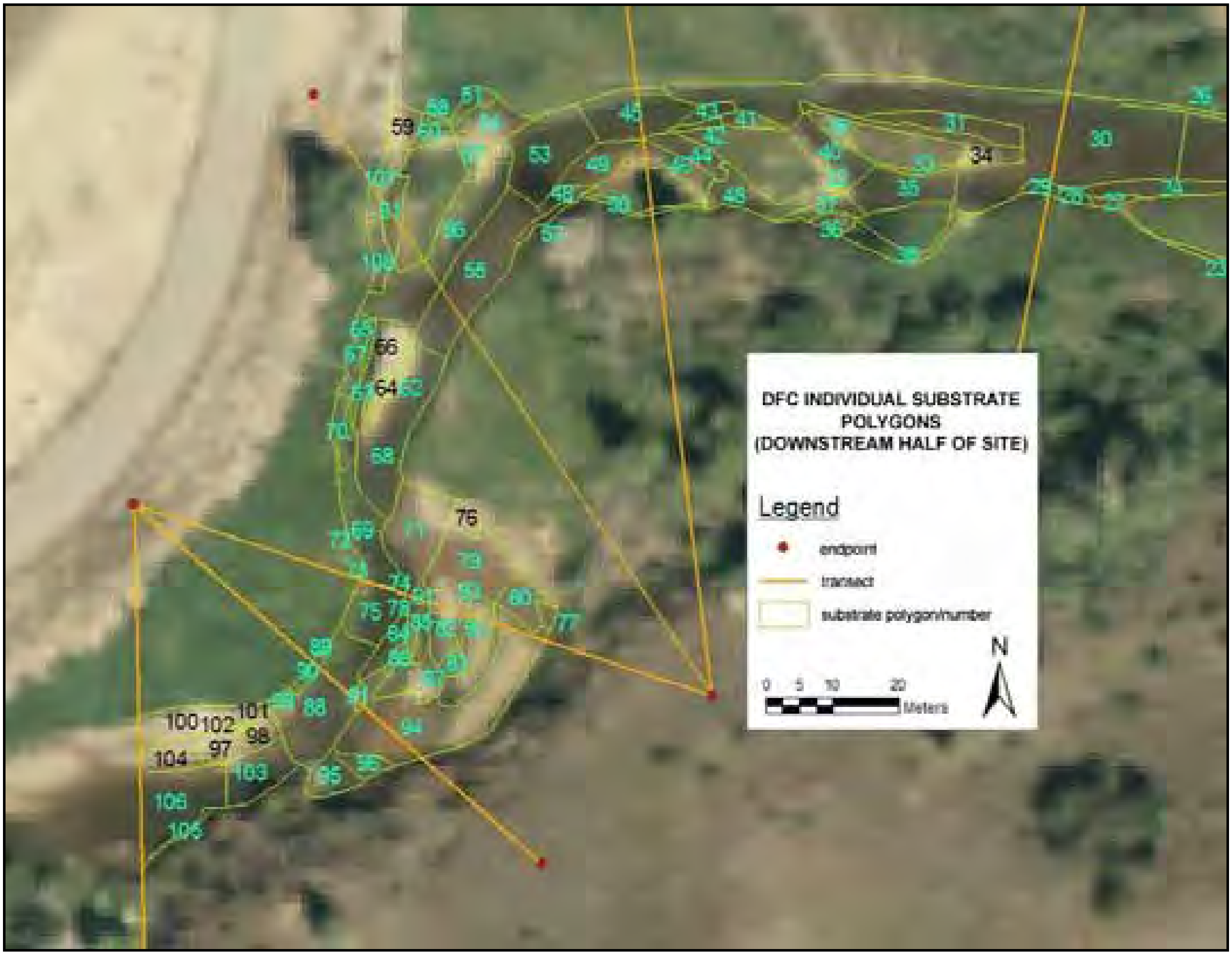
Name	Northing	Easting	Elevation	distance	distance ft	cumu dist ft	distance from xs 1=0	elev ft	Description
94	4432253.13	458460.80	1525.48	9.40	30.85	1824.58	1824.58	5005.09	thal
95	4432258.31	458465.38	1525.02	6.91	22.67	1847.25	1847.25	5003.59	thal
96	4432261.11	458463.62	1525.27	3.31	10.84	1858.10	1858.10	5004.41	thal
97	4432261.17	458459.68	1524.93	3.94	12.92	1871.01	1871.01	5003.31	thal
98	4432265.88	458455.45	1525.40	6.33	20.77	1891.79	1891.79	5004.83	thal
99	4432273.24	458450.25	1525.32	9.02	29.59	1921.37	1921.37	5004.57	thal
100	4432278.50	458444.95	1525.16	7.46	24.48	1945.85	1945.85	5004.05	thal
101	4432282.30	458438.97	1524.88	7.08	23.23	1969.09	1969.09	5003.12	thal
102	4432284.08	458433.83	1525.05	5.44	17.86	1986.95	1986.95	5003.69	thal
103	4432284.66	458421.74	1525.21	12.10	39.70	2026.65	2026.65	5004.20	thal
104	4432284.12	458411.58	1525.29	10.18	33.39	2060.04	2060.04	5004.49	thal
105	4432283.80	458398.86	1525.22	12.73	41.76	2101.80	2101.80	5004.24	thal
106	4432280.06	458390.50	1525.14	9.15	30.03	2131.82	2131.82	5003.99	thal
107	4432273.79	458376.99	1525.07	14.90	48.89	2180.71	2180.71	5003.76	thal
108	4432264.73	458364.75	1524.89	15.22	49.94	2230.66	2230.66	5003.17	thal
109	4432260.08	458358.78	1524.78	7.57	24.85	2255.50	2255.50	5002.79	thal
110	4432251.74	458350.81	1524.54	11.53	37.84	2293.35	2293.35	5002.02	thal
56	4432246.74	458338.96	1524.35	12.86	42.19	2335.53	2335.53	5001.39	tw
111	4432244.30	458338.08	1524.35	2.60	8.52	2344.05	2344.05	5001.40	thal
57	4432241.75	458335.45	1524.06	3.66	12.00	2356.05	2356.05	5000.44	tw
58	4432234.09	458329.89	1524.25	9.47	31.06	2387.11	2387.11	5001.07	tw
59	4432224.58	458326.16	1524.27	10.22	33.53	2420.64	2420.64	5001.14	tw
60	4432216.09	458321.71	1524.24	9.59	31.45	2452.09	2452.09	5001.03	tw
61	4432206.71	458319.08	1524.20	9.74	31.96	2484.05	2484.05	5000.90	tw
62	4432194.90	458315.80	1524.22	12.26	40.22	2524.26	2524.26	5000.95	tw
63	4432181.93	458316.75	1524.28	13.00	42.67	2566.93	2566.93	5001.17	tw
64	4432172.69	458318.16	1524.19	9.34	30.66	2597.59	2597.59	5000.86	tw
65	4432162.86	458319.54	1523.91	9.93	32.57	2630.16	2630.16	4999.95	tw
66	4432155.48	458318.62	1523.91	7.43	24.39	2654.55	2654.55	4999.94	tw
67	4432145.17	458317.89	1523.87	10.34	33.92	2688.47	2688.47	4999.81	tw
68	4432138.04	458316.16	1523.94	7.33	24.06	2712.53	2712.53	5000.05	tw
69	4432129.59	458310.81	1523.73	10.01	32.84	2745.37	2745.37	4999.34	tw
70	4432122.68	458309.77	1523.67	6.98	22.90	2768.27	2768.27	4999.16	tw

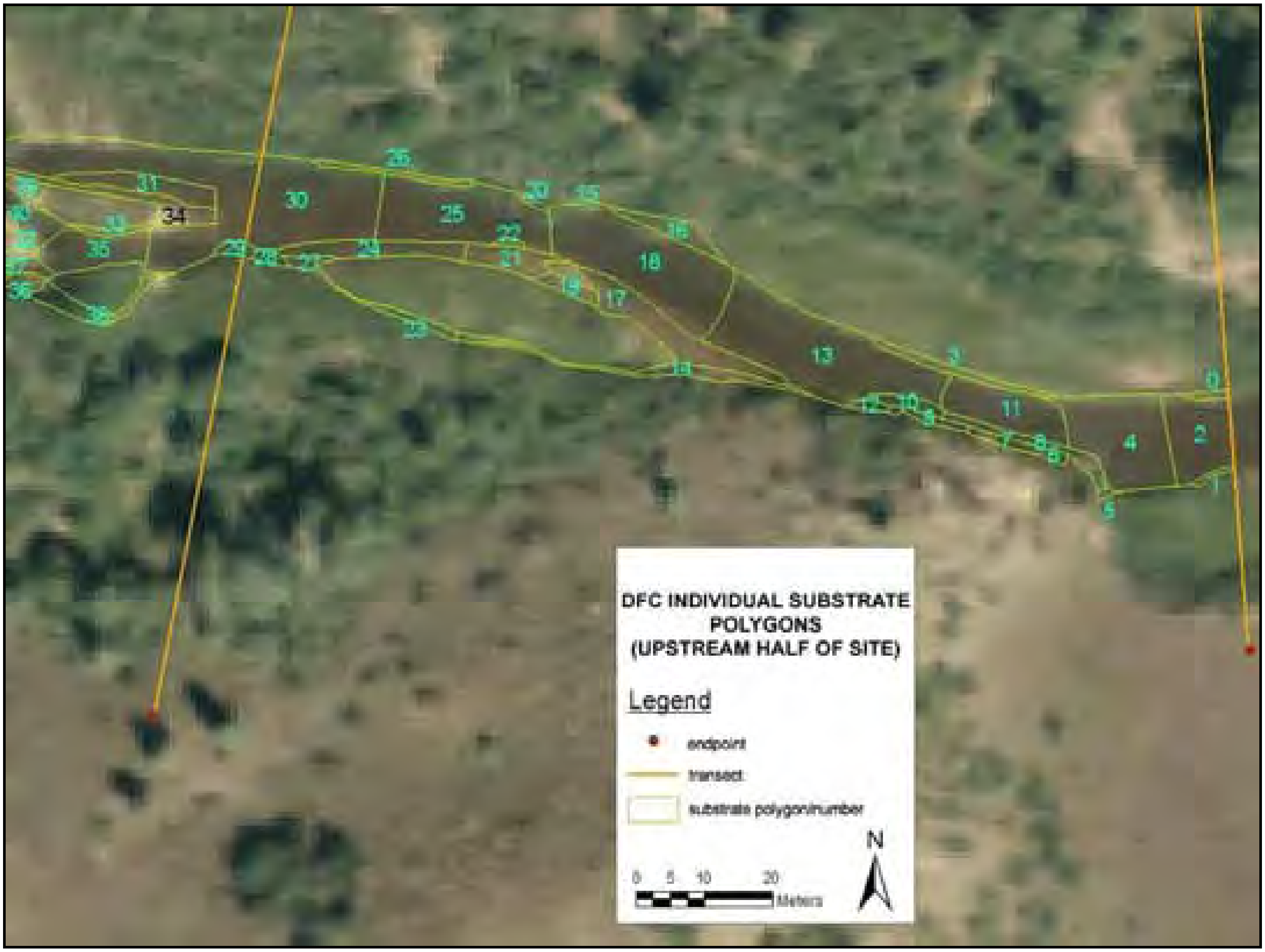
Oxbow Site Longitudinal Profile Data 2006

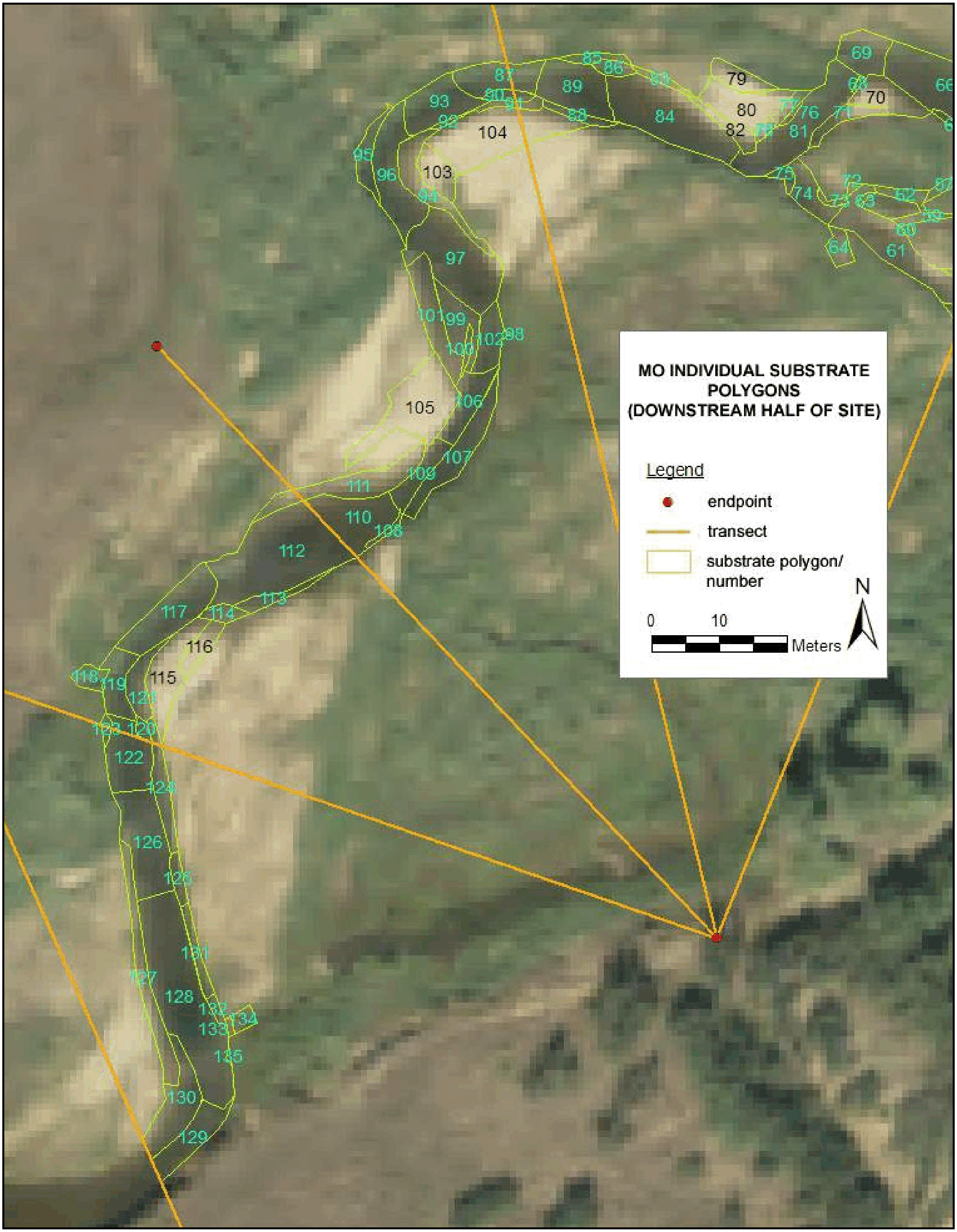
Name	Northing	Easting	Elevation	distance	distance ft	cumu dist ft	distance from xs 1=0	elev ft	Description
77	4432259.02	458777.10	1528.91	38.44	126.11	607.47	607.47	5016.35	tw2
78	4432258.94	458787.40	1528.75	10.30	33.78	641.25	641.25	5015.83	tw2
79	4432256.52	458790.63	1528.49	4.04	13.25	654.50	654.50	5014.98	tw2
80	4432250.42	458792.45	1528.55	6.36	20.86	675.36	675.36	5015.17	tw2
81	4432241.89	458793.87	1528.54	8.65	28.38	703.74	703.74	5015.14	tw2
82	4432237.26	458796.84	1528.29	5.50	18.04	721.78	721.78	5014.32	tw2
83	4432234.63	458797.88	1528.14	2.83	9.28	731.07	731.07	5013.83	tw2
84	4432227.02	458797.05	1528.17	7.66	25.13	756.20	756.20	5013.93	tw2
85	4432221.80	458792.84	1527.99	6.71	22.01	778.21	778.21	5013.34	tw2
86	4432217.83	458782.20	1528.12	11.36	37.26	815.47	815.47	5013.76	tw2
82	4432213.85	458460.56	1526.29	11.80	38.71	1695.99	1695.99	38.71	thal2
83	4432218.92	458454.55	1526.17	7.87	25.82	1721.81	1721.81	25.82	thal2
84	4432224.29	458449.38	1525.76	7.45	24.46	1746.27	1746.27	24.46	thal2
85	4432227.69	458446.10	1525.17	4.71	15.47	1761.74	1761.74	15.47	thal2

APPENDIX 3.1A. MAPS OF INDIVIDUAL SUBSTRATE POLYGONS


SXW INDIVIDUAL SUBSTRATE POLYGONS
Legend
● endpoint
transect
substrate polygon/number
0 5 10
Meters
N


DFC INDIVIDUAL SUBSTRATE POLYGONS (DOWNSTREAM HALF OF SITE)
Legend
endpoint
transect
substrate polygon/number
0 5 10 20
Meters
N


DFC INDIVIDUAL SUBSTRATE POLYGONS
(UPSTREAM HALF OF SITE)
Legend
endpoint
transect
substrate polygon/number
N
0 5 10 20
Meters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Legend
endpoint
transect
substrate polygon/ number
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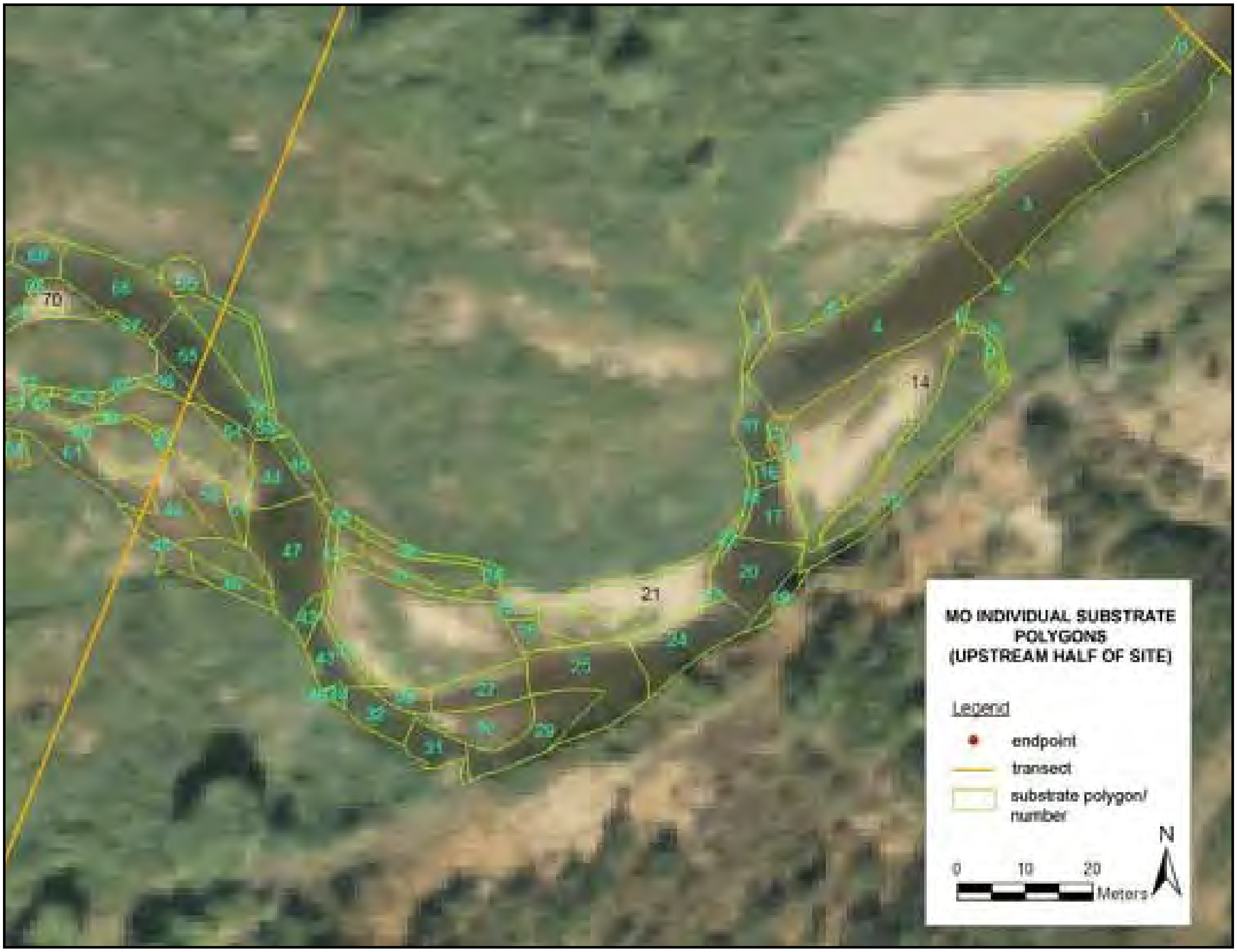
MO INDIVIDUAL SUBSTRATE
POLYGONS
(UPSTREAM HALF OF SITE)
Legend
● endpoint
transect
substrate polygon/
number
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10
20
Meters
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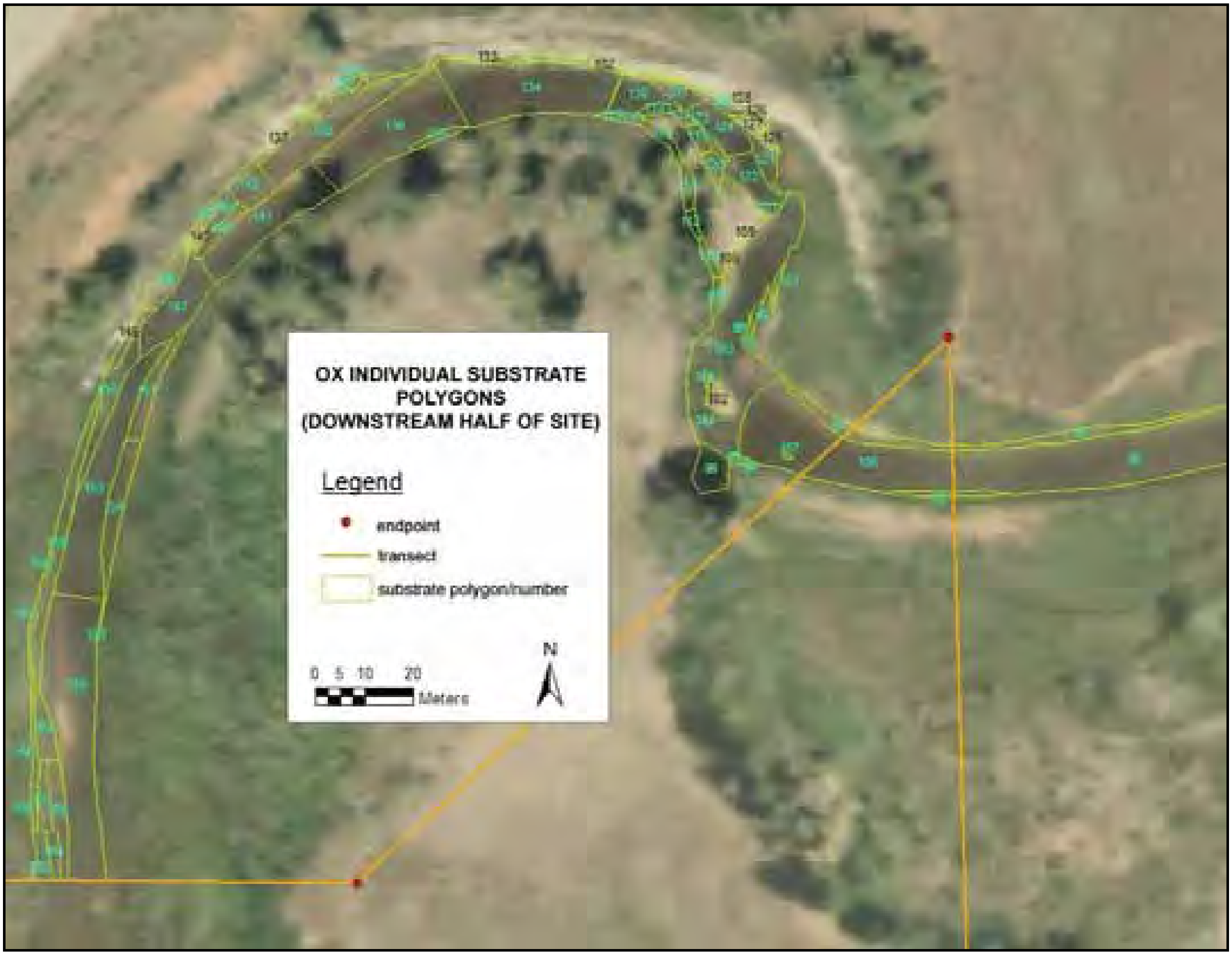
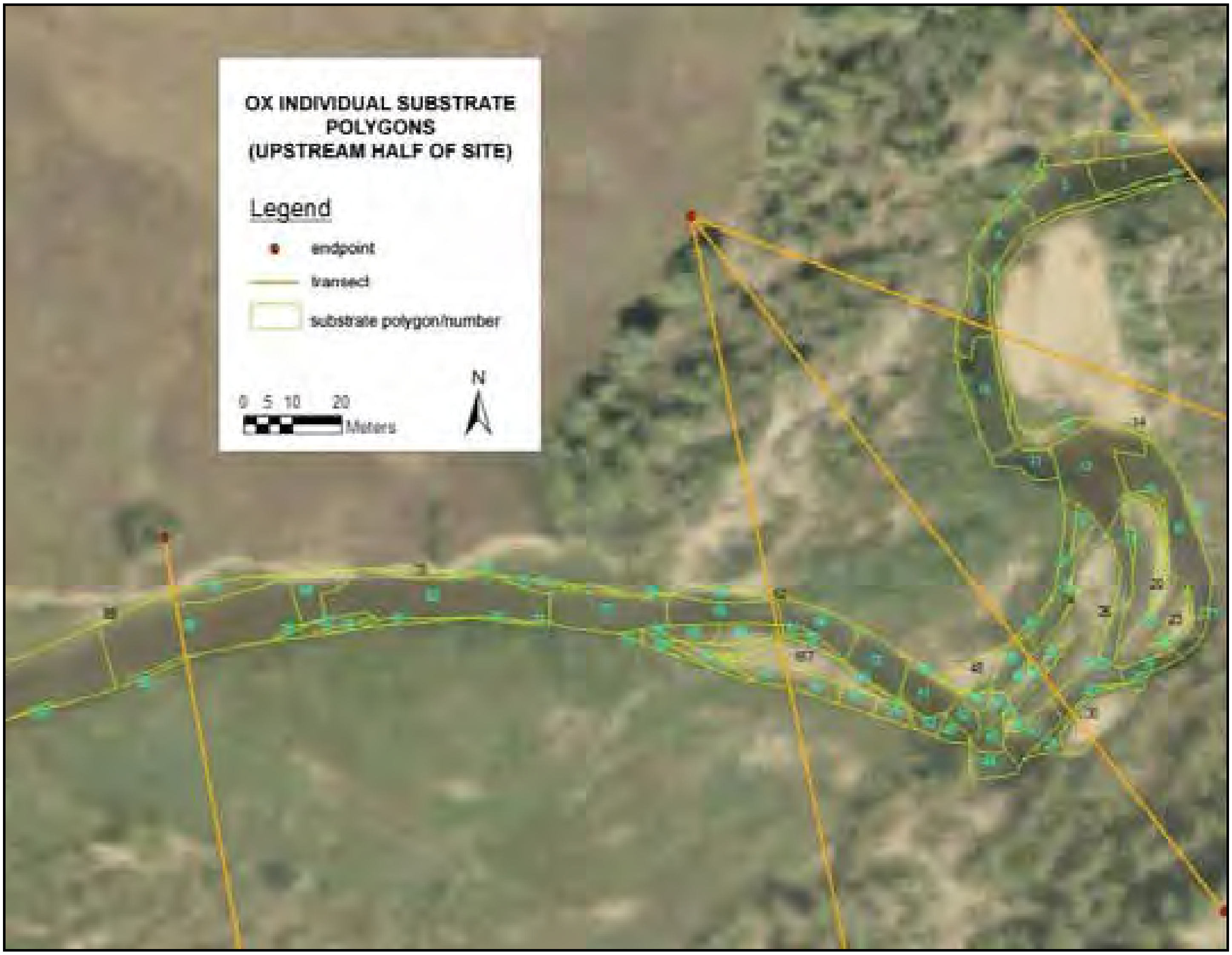
47


OX INDIVIDUAL SUBSTRATE POLYGONS (DOWNSTREAM HALF OF SITE)
Legend
endpoint
transect
substrate polygon/number
0 5 10 20
Meters
N


OX INDIVIDUAL SUBSTRATE POLYGONS (UPSTREAM HALF OF SITE)
Legend
endpoint
transect
substrate polygon/number
0 5 10 20
Meters
N
14

APPENDIX 3.1B. SUBSTRATE POLYGON ATTRIBUTE TABLES

SXW 2006										
POLYGON					PERCENTAGES					
NUMBER	Area m2	Substype	Notes	MajorType	%B	%C	%LG	%MG	%FG	%SA/SI
0	1.60	5B 5SI		boulder-sand/silt	50					50
1	0.62	10B		boulder	100					
2	1.10	10S	behind lg boulder	sand/silt						100
3	182.17	5B 5C		boulder-cobble	50	50				
4	284.57	5B 5C		boulder-cobble	50	50				
5	185.02	5B 5C		boulder-cobble	50	50				
6	1.74	10SI		sand/silt						100
7	2.76	3.3B 3.3C 3.3S	and grass	boulder-cobble-sand/silt	33	33				33
8	32.67	3.3B 3.3C 3.3LG	some minor MG SI	boulder-cobble-gravel	33	33	33			
9	22.35	1B 4C 4LG 1SI		cobble-gravel	10	40	40			10
10	3.61	10SI		sand/silt						100
11	151.95	5B 5C		boulder-cobble	50	50				
12	0.00	5B 5C		boulder-cobble	50	50				
13	17.13	5B 5C		boulder-cobble	50	50				
14	0.44	10SI		sand/silt						100
15	2.89	3.3B 3.3C 3.3SA		boulder-cobble-sand/silt	33	33				33
16	3.34	1.5B 1.5C 7S		sand/silt	15	15				70
17	0.66	4B 4C 2SI	behind log	boulder-cobble	40	40				20
18	37.63	5B 5C		boulder-cobble	50	50				
19	2.47	7B 3C	step	boulder	70	30				
20	6.17	5B 5C		boulder-cobble	50	50				
21	2.03	10SI		sand/silt						100
22	3.74	2C 8SI		sand/silt		20				80
23	0.80	10SI		sand/silt						100
24	3.16	7C 3SI		cobble		70				30
25	3.74	7B 3C	step	boulder	70	30				
26	196.37	5B 5C		boulder-cobble	50	50				
27	3.65	10SI		sand/silt						100
28	3.35	2.5B 2.5C 2.5LG 2.5MG		gravel	25	25	25	25		
29	3.91	1.9B 1.9C 1.8LG 1.9MG 2.5S		gravel	19	19	18	19		25
30	21.17	2.5B 2.5C 2.5LG 2.5MG		gravel	25	25	25	25		
31	3.86	7B 3C		boulder	70	30				
32	2.83	2.5B 2.5C 5SI		sand/silt	25	25				50
33	3.94	2.5B 2.5C 5SI		sand/silt	25	25				50
34	72.45	5B 5C		boulder-cobble	50	50				
35	3.82	1B 9S		sand/silt	10					90
36	217.51	5B5C		boulder-cobble	50	50				
37	3.65	2.5B 2.5C 2.5G 2.5SA	pool	boulder-cobble-gravel-sand/silt	25	25	25			25
38	2.78	10SI		sand/silt						100
39	3.41	10SI		sand/silt						100
40	3.93	1B 3.5C 1.16LG 1.17MG 1.17FG 2S	bank blew out here btw 05 and 06	cobble-gravel	10	35	11.6	11.7	11.7	20
41	1.08	1B 2LG 7S	assumed G was LG	sand/silt	10		20			70
42	10.39	3.3B 3.3C 3.3LG		boulder-cobble-gravel	33	33	33			
43	0.38	5B 5SI		boulder-sand/silt	50					50

6.197	2C 2LG 2MG 2FG 2S		gravel		20	20	20	20	20
317.074	2.5C 2.5LG 2.5MG 1.25FG 1.25S		gravel		25	25	25	12.5	12.5
49.033	10SI		sand/silt						100
1.746	10SI		sand/silt						100
34.201	2.33C 2.33LG 2.33MG 3S		gravel		23.4	23.3	23.3		30
104.380	3C 3LG 1MG 3S		gravel		30	30	10		30
269.370	4C 2.5LG 2.5MG 0.5FG 0.5S		gravel		40	25	25	5	5
18.926	3C 1LG 1MG 5S		sand/silt		30	10	10		50
2.943	10SI		sand/silt						100
44.045	1C 1LG 8SI		sand/silt		10	10			80
4.111	1.5MG 7FG 1.5S		gravel				15	70	15
14.827	5C 5S		cobble-sand/silt		50				50
61.045	2.5C 2.5LG 1MG 4S		sand/silt		25	25	10		40
207.411	3.5C 2.5LG 2.5MG 0.75FG 0.75S		gravel		35	25	25	7.5	7.5
17.483	1C 1LG 1MG 7S		sand/silt		10	10	10		70
10.268	10S		sand/silt						100
9.056	2C 2LG 2MG 4S		gravel-sand/silt		20	20	20		40
9.686	2.5C 2.5LG 2.5MG 1.25FG 1.25S		gravel		25	25	25	12.5	12.5
603.784	4C 2.5LG 2.5MG 0.5FG 0.5S		gravel		40	25	25	5	5
55.034	2.33C 2.33LG 2.33MG 1FG 2S		gravel		23.3	23.4	23.3	10	20
3.953	10S		sand/silt						100
9.787	1.67C 1.67LG 1.66MG 2.5FG 2.5S		gravel		16.7	16.7	16.6	25	25
53.298	1.66C 1.66LG 1.67MG 5S		sand/silt		16.7	16.6	16.7		50
77.379	2.33C 2.33LG 2.33MG 1.5FG 1.5S		gravel		23.3	23.3	23.4	15	15
13.456	1.5C 8.5SI		sand/silt		15				85
22.016	3C 3LG 3MG 1S		gravel		30	30	30		10
38.030	10SI		sand/silt						100
17.848	1.66C 1.67LG 1.66MG 2.5FG 2.5S		gravel		16.6	16.7	16.7	25	25
56.153	3.3C 3.3LG 3.3MG		gravel		33.3	33.3	33.3		
15.458	0.5C 0.5LG 9S		sand/silt		5	5			90
7.396	2.5C 2.5LG 5S		sand/silt		25	25			50
15.013	1C 2.66LG 2.67MG 2.66FG 1S		gravel		10	26.6	26.7	26.7	10
33.136	3C 3LG 3MG 1FG		gravel		30	30	30	10	
97.479	2.83C2.83LG2.83MG0.75FG0.75S		gravel		28.3	28.4	28.3	7.5	7.5
40.684	1.66C 1.67LG 1.67MG 5SI		sand/silt		16.6	16.7	16.7		50
15.354	1.5C 1.5LG 1.5MG 0.5FG 5S		sand/silt		15	15	15	5	50
60.404	10SI		sand/silt						100
47.244	10SI		sand/silt						100
13.236	0.5C 0.5LG 9SI		sand/silt		5	5			90
15.695	10SI		sand/silt						100
9.476	2LG 2MG 2FG 4S		gravel			20	20	20	40
120.270	2.16C 2.16LG 2.16MG1.75FG1.75S		gravel		21.6	21.7	21.7	17.5	17.5
46.395	2C 2LG 2MG 1FG 3S		gravel		20	20	20	10	30
165.432	2.67C 2.66LG 2.66MG 1FG 1S		gravel		26.7	26.6	26.7	10	10
172.297	5C 3.5LG 1.5MG		cobble-gravel		50	35	15		
20.985	10S		sand/silt						100
2.861	10SI		sand/silt						100
25.336	10SI		sand/silt						100
17.882	2.83C 2.83LG 2.83MG 1.5S		gravel		28.3	28.4	28.3		15
31.118	10SI	silt with some grass	sand/silt						100
2.562	3.3LG 3.3MG 3.3FG		gravel			33.3	33.3	33.3	
7.512	1C 9SI	bar	sand/silt		10				90
15.792	2C 8S		sand/silt		20				80
6.242	1.5C 1.5LG 7S		sand/silt		15	15			70
58.144	3.5C 3.5LG 1.5MG 1.5S	bar	gravel		35	35	15		15
28.039	2.83C 2.83LG 2.83MG 1.5S		gravel		28.3	28.3	28.4		15
142.983	2.83C2.83LG2.83MG .75FG .75S		gravel		28.3	28.3	28.4	7.5	7.5
78.705	unknown	too deep - guess 2C 2.5LG 2.5MG 3S	unknown						
29.334	10SI	silt with sticks	sand/silt						100
103.320	10SI	half dry	sand/silt						100
0.836	10SI		sand/silt						100
1.129	10SI		sand/silt						100
3.780	2.5C 2.5LG 2.5MG 1FG 1.5S		gravel		25	25	25	10	15
60.063	2.83C 2.83LG 2.83MG .75FG.75S		gravel		28.4	28.3	28.3	7.5	7.5
13.980	2.5LG 2.5MG 5S	dry	gravel-sand/silt			25	25		50
7.748	2.5C 2.5LG 5S		sand/silt		25	25			50
2.277	10S	behind stump	sand/silt						100
98.722	2C 2LG 6S	side ch w stagnant water	sand/silt		20	20			60
38.131	2.33C 2.33LG 2.33MG 3S	side ch w stagnant water	gravel		23.4	23.3	23.3		30
1.404	10S		sand/silt						100
6.941	3C 2LG 1MG 4S		sand/silt		30	20	10		40
11.351	2.5LG 2.5MG 2FG 3S	PC6 patch - dry	gravel			25	25	20	30
8.013	10S		sand/silt						100
23.550	3C 3LG 1MG 3S		gravel		30	30	10		30
8.608	3C 3LG 3MG 1S		gravel		30	30	30		10
19.479	5C 4LG 1MG		cobble-gravel		50	40	10		
154.736	6C 3LG 1MG		cobble		60	30	10		
0.617	10SI		sand/silt						100
10.649	1C 4LG 4MG1FG		gravel		10	40	40	10	
4.482	2.5C 2.5LG 5S		sand/silt		25	25			50
35.170	10SI	dry	sand/silt						100
0.001	10SI		sand/silt						100
255.829	10SI	half backwater/half dry	sand/silt						100
35.612	2.5C 2.5LG 5S	deep pool mapped by feel	sand/silt		25	25			50
18.716	2.66C 2.67LG 2.66MG 2S		gravel		26.6	26.7	26.7		20
19.826	0.5C 0.83LG 0.83MG 0.83FG 7S	dry	sand/silt		5	8.3	8.3	8.4	70

19	22.43	1.5B 2.75C 2.75LG 3S		sand/silt	15.0	27.5	27.5			30
20	101.91	2C 3.25LG 3.25MG 0.75FG 0.75S		gravel		20	32.5	32.5	7.5	7.5
21	138.62	2C 2LG 2MG 4S		gravel-sand/silt		20	20	20		40
22	6.76	1.5C 1.5LG 7S		sand/silt		15	15			70
23	4.79	10SI		sand/silt						100
24	117.16	1.66C 1.67LG 1.67MG 2.5FG 2.5S		gravel		16.6	16.7	16.7	25	25
25	160.85	2.5C 2.5LG 2.5MG 1.25FG 1.25S		gravel		25	25	25	12.5	12.5
26	30.07	1C 1LG 8SI		sand/silt		10	10			80
27	73.64	2.67C 2.67LG 2.66MG 1FG 1S		gravel		26.6	26.7	26.6	10	10
28	25.31	3.3C 3.3LG 3.3MG		gravel		33	33	33		
29	93.91	3.3C 3.3LG 3.3MG		gravel		33	33	33		
30	81.40	2C 2LG 2MG 4S	dry bar mid polygon	gravel-sand/silt		20	20	20		40
31	44.91	5G 5S	?deep?	gravel-sand/silt			25	25		50
32	51.13	1.5C 3.5LG 3.5MG 0.75FG 0.75S		gravel		15	35	35	7.5	7.5
33	22.99	10SI		sand/silt						100
34	10.43	1.75C 1.75LG 1.75MG 1.75FG 3SI		gravel		17.5	17.5	17.5	17.5	30
35	24.99	2LG 2MG 6SI		sand/silt			20	20		60
36	20.96	0.5LG 0.5MG 9SI		sand/silt			5	5		90
37	33.54	0.5LG 0.5MG 9SI		sand/silt			5	5		90
38	13.46	10SI		sand/silt						100
39	5.86	2.33C 2.33LG 2.33MG 1.5FG 1.5S		gravel		23.3	23.3	23.3	15	15
40	2.01	10SI		sand/silt						100
41	14.32	1.5LG 1.5MG 7S		sand/silt			15	15		70
42	18.13	4G 6SI	deep, mapped by feel	sand/silt			20	20		60
43	47.18	2.5LG 2.5MG 2.5FG 2.5S		gravel			25	25	25	25
44	60.35	2C 4LG 4MG		gravel		20	40	40		
45	25.97	3LG 3MG 2FG 2S	cemented feel	gravel			30	30	20	20
46	31.47	4LG 4MG 2FG		gravel			40	40	20	
47	160.41	1C 3.25LG 3.25MG 1.25FG 1.25S		gravel		10	32.5	32.5	12.5	12.5
48	31.79	0.5C 0.5LG 9SI		sand/silt		5	5			90
49	73.30	1.66C 1.67LG 1.66MG 5SI		sand/silt		16.6	16.7	16.6		50
50	66.04	1C 9SI		sand/silt		10				90
51	16.53	2.5C 2.5LG 5SI		sand/silt		25	25			50
52	1.32	10S	behind lwd	sand/silt						100
53	14.16	3LG 3MG 4S	deep - est type	gravel			30	30		40
54	25.96	10SI		sand/silt						100
55	113.16	2.66C 2.67LG 2.67MG 1FG 1S		gravel		26.6	26.7	26.7	10	10
56	29.10	3LG 3MG 1FG 3S		gravel			30	30	10	30
57	8.35	3.5LG 3.5MG 1.5FG 1.5S		gravel			35	35	15	15
58	6.61	1.66C 1.67LG 1.66MG 5SI		sand/silt		16.6	16.7	16.6		50
59	8.04	10SI		sand/silt						100
60	2.40	10SI		sand/silt						100
61	105.14	2.83C 2.83LG 2.83MG 1.5S		gravel		28.3	28.3	28.3		15
62	19.31	1.66C 1.67LG 1.66MG 5SI		sand/silt		16.6	16.7	16.6		50
63	1.98	10SI		sand/silt						100
64	16.27	10SI		sand/silt						100
65	51.74	10SI		sand/silt						100
66	130.03	3.3C 3.3LG 3.3MG		gravel		33	33	33		
67	6.65	2.5C 2.5LG 2.5FG 2.5S		gravel		25	25		25	25
68	2.19	2C 3LG 3MG 1FG 1S		gravel		20	30	30	10	10
69	41.55	3.3C 3.3G 3.3SI	mapped by feel	cobble-gravel-sand/silt		33	16.5	16.5		33
70	40.68	1.67C 1.67LG 1.67MG 5S		sand/silt		16.7	16.7	16.7		50
71	20.44	10SI		sand/silt						100
72	2.46	10SI		sand/silt						100
73	4.52	10SI		sand/silt						100
74	30.54	3.75LG 3.75MG 1.25FG 1.25S		gravel			37.5	37.5	12.5	12.5
75	7.64	10SI		sand/silt						100
76	2.88	7MG 3FG		gravel				70	30	
77	10.83	10SI		sand/silt						100
78	6.19	3C 3LG 1MG 3SI		gravel		30	30	10		30
79	24.51	10SI		sand/silt						100
80	57.63	1.75C 1.75LG 1.75MG 1.75FG 3S		gravel		17.5	17.5	17.5	17.5	30
81	105.06	2C 4LG 4MG		gravel		20	40	40		
82	19.62	0.67C 0.67LG 0.66MG 8S		sand/silt		6.7	6.7	6.6		80
83	8.73	1.5LG 1.5MG 7SI		sand/silt			15	15		70
84	131.78	1.5C 3.5LG 3.5MG 0.75FG 0.75S		gravel		15	35	35	7.5	7.5
85	12.35	10SI	LWD along bk	sand/silt						100
86	11.86	4.25LG 4.25MG 1.5FG		gravel			42.5	42.5	15	
87	52.18	5C 2.5LG 2.5MG	deep feels embedded/hard map by feel	cobble-gravel		50	25	25		
88	12.62	3C 3LG 4S		sand/silt		30	30			40
89	70.95	2.83C 2.83LG 2.83MG 0.75FG 0.75S		gravel		28.3	28.3	28.3	7.5	7.5
90	10.12	2.83C 2.83LG 2.83MG 0.75FG 0.75S		gravel		28.3	28.3	28.3	7.5	7.5
91	11.30	10SI		sand/silt						100
92	3.20	1.67C 1.66LG 1.66MG 5S		sand/silt		16.7	16.6	16.6		50
93	59.96	2.83LG 2.83MG 2.83FG 1.5S		gravel			28.3	28.3	28.3	15
94	47.36	10SI		sand/silt						100
95	25.18	unknown	deep	unknown						
96	80.20	1LG 1MG 1FG 7S		sand/silt			10	10	10	70
97	123.01	1.5C 3.5LG 3.5MG 0.75FG 0.75S		gravel		15	35	35	7.5	7.5
98	0.75	10SI		sand/silt						100
99	40.77	2.66C 2.67LG 2.66MG 2SI		gravel		26.6	26.7	26.6		20
100	5.51	10S	shallow bar	sand/silt						100
101	55.47	1C 1LG 8S		sand/silt		10	10			80
102	33.06	2C 4LG 4MG		gravel		20	40	40		
103	30.92	10SI	with some grass	sand/silt						100
104	123.51	1.75C 1.75LG 1.75MG 1.75FG 3S		gravel		17.5	17.5	17.5	17.5	30
105	105.72	1.67C 1.66LG 1.66MG 5SI	dry bar	sand/silt		16.7	16.6	16.6		50
106	40.63	2C 2.5LG 2.5MG 1.5FG 1.5S		gravel		20	25	25	15	15
107	57.63	1C 9SI	willow stumps bk erosion	sand/silt		10				90
108	5.33	5LG 5SI		gravel-sand/silt			50			50
109	30.82	2C 2.5LG 2.5MG 1.5FG 1.5S	v deep est substype	gravel		20	25	25	15	15
110	72.86	2C 2.5LG 2.5MG 1.5FG 1.5S		gravel		20	25	25	15	15
111	70.94	10SI		sand/silt						100
112	187.42	3.3C 3.3LG 3.3MG		gravel		33	33	33		
113	17.22	2.5C 2.5LG 5S		sand/silt		25	25			50
114	13.09	1.5C 1.5LG 7S		sand/silt		15	15			70
115	63.69	2.33C 2.33LG 2.33MG 3S	PC 6 here	gravel		23.3	23.3	23.3		30
116	22.51	1.5C 1.5LG 7S		sand/silt		15	15			70
117	81.35	2C 4LG 4MG		gravel		20	40	40		

22	159.81	3.33C 3.33LG 3.33MG		gravel		33.30	33.30	33.30			
23	29.58	3.33C 3.33G 3.33S	dry bar snow covered - guess substype	cobble-gravel-sand/silt		33.30	11.10	11.10	11.10	33.30	
24	27.62	1.33C 1.33LG 1.33MG 6S		sand/silt		13.30	13.30	13.30		60.00	
25	95.72	1.33C 1.33LG 1.33MG 6S	small dry bar in center	sand/silt		13.30	13.30	13.30		60.00	
26	2.46	10S		sand/silt						100.00	
27	0.94	2C 8S		sand/silt		20.00				80.00	
28	7.91	2C 8S		sand/silt		20.00				80.00	
29	27.79	10S		sand/silt						100.00	
30	106.01	3.33C 3.33G 3.33S	guess substype -dry bar under snow	cobble-gravel-sand/silt		33.30	11.10	11.10	11.10	33.30	
31	3.72	2.33C 2.34LG 2.33MG 3S		gravel		23.30	23.40	23.30		30.00	
32	24.49	1.66C 1.67LG 1.67MG 5S	part dry bar	sand/silt		16.60	16.70	16.70		50.00	
33	1.89	3C 3LG 4S		sand/silt		30.00	30.00			40.00	
34	4.47	10S		sand/silt						100.00	
35	11.23	1C 3.5LG 3.5MG 2S		gravel		10.00	35.00	35.00		20.00	
36	39.84	3C 3LG 4S		sand/silt		30.00	30.00			40.00	
37	105.16	2C 4LG 4MG		gravel		20.00	40.00	40.00			
38	50.46	3.33C 3.33LG 3.33MG		gravel		33.30	33.30	33.30			
39	11.69	10S		sand/silt						100.00	
40	12.07	2.5C 2.5LG 2.5MG 2.5S	dry bar	gravel		25.00	25.00	25.00		25.00	
41	6.72	1.67C 1.67LG 1.66MG 5S	dry bar	sand/silt		16.70	16.70	16.60		50.00	
42	9.82	1.5LG 1.5MG 3.5FG 3.5S		gravel			15.00	15.00	35.00	35.00	
43	66.23	2.83C 2.83LG 2.83MG 0.75FG 0.75S		gravel		28.30	28.30	28.30	7.50	7.50	
44	47.59	unknown	deep	unknown							100.00
45	31.84	10S		sand/silt						100.00	
46	17.47	10S		sand/silt						100.00	
47	30.47	3LG 3MG 2FG 2S		gravel			30.00	30.00	20.00	20.00	
48	52.68	5LG 5MG	high dry bar	gravel			50.00	50.00			
49	21.02	10S		sand/silt						100.00	
50	10.37	1.5C 1.5LG 7S		sand/silt		15.00	15.00			70.00	
51	77.52	2.33C 2.33LG 2.33MG 1.5FG 1.5S		gravel		23.30	23.30	23.30	15.00	15.00	
52	30.59	2C 2LG 3FG 3S	deep - map by feel	gravel		20.00	20.00		30.00	30.00	
53	21.58	2.33C 2.33LG 2.33MG 3S		gravel		23.30	23.30	23.30		30.00	
54	28.60	10S		sand/silt						100.00	
55	30.80	3C 7S		sand/silt		30.00				70.00	
56	6.32	3.5C 3.5LG 3S		cobble-gravel		35.00	35.00			30.00	
57	98.89	4C 4LG 2MG		gravel		40.00	40.00	20.00			
58	17.41	2C 8S		sand/silt		20.00				80.00	
59	43.94	2C 2LG 2MG 4S		gravel-sand/silt		20.00	20.00	20.00		40.00	
60	92.17	3.33C 3.33LG 3.33MG		gravel		33.30	33.30	33.30			
61	8.57	1C 1LG 1MG 3.5FG 3.5S		gravel		10.00	10.00	10.00	35.00	35.00	
62	2.75	10S	sticks and eroding bank	sand/silt						100.00	
63	44.73	2.33C 2.33LG 2.34MG 1.5FG 1.5S	LWD on bank	gravel		23.30	23.30	23.40	15.00	15.00	
64	47.57	3LG 5MG 2S	part dry bar	gravel			30.00	50.00		20.00	
65	111.08	2.66C 2.67LG 2.67MG 1FG 1S		gravel		26.60	26.70	26.70	10.00	10.00	
66	35.82	2.5LG 2.5MG 2FG 3S	part dry bar	gravel			25.00	25.00	20.00	30.00	
67	43.94	2.5C 2.5LG 2.5MG 2.5S		gravel		25.00	25.00	25.00		25.00	
68	10.02	2C 3.5LG 3.5MG 1FG		gravel		20.00	35.00	35.00	10.00		
69	19.97	2.17C 2.17LG 2.16MG 3.5S		gravel		21.70	21.70	21.60		35.00	
70	29.62	3.33C 3.33LG 3.33MG		gravel		33.30	33.30	33.30			
71	5.43	10SI		sand/silt						100.00	
72	4.40	2C 2LG 2MG 2FG 2S		gravel		20.00	20.00	20.00	20.00	20.00	
73	170.06	3.33C 3.33LG 3.33MG		gravel		33.30	33.30	33.30			
74	6.66	10S		sand/silt						100.00	
75	29.52	3C 3LG 3MG 1S		gravel		30.00	30.00	30.00		10.00	
76	3.12	10S		sand/silt						100.00	
77	3.10	5FG 5S		gravel-sand/silt					50.00	50.00	
78	29.29	3.17C 3.17LG 3.16MG 0.25FG 0.25S		gravel		31.70	31.70	31.60	2.50	2.50	
79	7.70	0.5C 2.38LG 2.37MG 2.38FG 2.37S		gravel		5.00	23.80	23.70	23.80	23.70	
80	14.97	2.33C 2.34LG 2.33MG 1.5FG 1.5S		gravel		23.30	23.40	23.30	15.00	15.00	
81	12.80	3C 3LG 3MG 0.5FG 0.5S		gravel		30.00	30.00	30.00	5.00	5.00	
82	34.01	2C 2LG 2MG 2FG 2S	LWD at us end	gravel		20.00	20.00	20.00	20.00	20.00	
83	361.17	2.83C 2.83LG 2.84MG 0.75FG 0.75S		gravel		28.30	28.30	28.40	7.50	7.50	
84	77.89	3.33C 3.33LG 3.33MG		gravel		33.30	33.30	33.30			
85	5.44	1C 4.5LG 4.5MG		gravel		10.00	45.00	45.00			
86	453.39	3C 3LG 3MG 0.5FG 0.5S		gravel		30.00	30.00	30.00	5.00	5.00	
87	62.85	3C 3LG 2FG 2S		gravel		30.00	30.00		20.00	20.00	
88	13.14	10S		sand/silt						100.00	
89	3.03	1.33C 1.33LG 1.33MG 6S		sand/silt		13.30	13.30	13.30		60.00	
90	17.96	3C 3LG 4S		sand/silt		30.00	30.00			40.00	
91	71.78	2C 2LG 2MG 4S		gravel-sand/silt		20.00	20.00	20.00		40.00	
92	831.76	2.83C 2.84LG 2.83MG 0.75FG 0.75S		gravel		28.30	28.40	28.30	7.50	7.50	
93	73.56	3C 3LG 4S		sand/silt		30.00	30.00			40.00	
94	2.55	10S		sand/silt						100.00	
95	6.53	2.67C 2.66LG 2.67MG 1FG 1S	part dry bar	gravel		26.70	26.60	26.70	10.00	10.00	
96	56.66	10S	backwater	sand/silt						100.00	
97	2.18	5MG 5FG		gravel				50.00	50.00		
98	3.06	10S		sand/silt						100.00	
99	8.73	2C 2LG 2MG 4S		gravel-sand/silt		20.00	20.00	20.00		40.00	
100	19.39	10SI	log across	sand/silt						100.00	
101	5.24	10S		sand/silt						100.00	
102	19.65	1C 5LG 3MG 1S	dry bar PC3 - got substype fr PC	gravel		10.00	50.00	30.00		10.00	
103	511.73	3.33C 3.33LG 3.33MG		gravel		33.30	33.30	33.30			
104	1.35	4LG 4MG 1FG 1S		gravel			40.00	40.00	10.00	10.00	
105	2.27	10S		sand/silt						100.00	
106	491.26	2.84C 2.83LG 2.83MG 0.75FG 0.75S		gravel		28.40	28.30	28.30	7.50	7.50	
107	1.27	10S		sand/silt						100.00	
108	3.97	10S		sand/silt						100.00	
109	14.72	2.33C 2.33LG 2.33MG 3S		gravel		23.30	23.30	23.30		30.00	
110	14.55	1.67C 1.67LG 1.66MG 2.5FG 2.5SI		gravel		16.70	16.70	16.60	25.00	25.00	
111	10.45	10S		sand/silt						100.00	
112	9.05	10SI	logs across	sand/silt						100.00	
113	22.04	2C 2LG 2MG 4S	dry bar in middle	gravel-sand/silt		20.00	20.00	20.00		40.00	
114	22.33	10SI		sand/silt						100.00	
115	5.98	2LG 8S		sand/silt			20.00			80.00	
116	6.13	2.33C 2.33LG 2.34MG 3S		gravel		23.30	23.30	23.40		30.00	
117	10.88	10SI		sand/silt						100.00	
118	11.37	1LG 3MG 3FG 3S		gravel			10.00	30.00	30.00	30.00	
119	17.75	2.67C 2.66LG 2.67MG 2S		gravel		26.70	26.60	26.70		20.00	
120	21.47	10S		sand/silt						100.00	
121	32.67	10SI		sand/silt						100.00	
122	69.12	1C 3.25LG 3.25MG 1.25FG 1.25S		gravel		10.00	32.50	32.50	12.50	12.50	
123	0.24	3C 3LG 3MG 0.5FG 0.5S		gravel		30.00	30.00	30.00	5.00	5.00	
124	76.20	3C 3LG 3MG 0.5FG 0.5S		gravel		30.00	30.00	30.00	5.00	5.00	
125	6.54	1.66C 1.67LG 1.67MG 2.5FG 2.5S		gravel		16.60	16.70	16.70	25.00	25.00	
126	11.42	1C 3.5LG 3.5MG 1FG 1S		gravel		10.00	35.00	35.00	10.00	10.00	
127	15.08	3.33C 3.33G 3.33S	dry bar	cobble-gravel-sand/silt		33.30	11.10	11.10	11.10	33.30	
128	2.96	5B 5SI		boulder-sand/silt	50.00					50.00	
129	23.78	10S		sand/silt						100.00	
130	67.30	2C 3.5LG 3.5MG 1FG		gravel		20.00	35.00	35.00	10.00		
131	32.86	2B 2.67C 2.66LG 2.67MG		gravel	20.00	26.70	26.60	26.70			
132	41.25	5B 5SI		boulder-sand/silt	50.00					50.00	
133	11.96	10S		sand/silt						100.00	
134	367.04	2.66C 2.67LG 2.67MG 1FG 1S		gravel		26.60	26.70	26.70	10.00	10.00	
135	14.09	1C 1LG 8S		sand/silt		10.00	10.00			80.00	
136	327.38	2.83C 2.84LG 2.83MG 0.75FG 0.75S		gravel		28.30	28.40	28.30	7.50	7.50	
137	22.63	1B 1C 8S		sand/silt	10.00	10.00				80.00	
138	202.82	3.75C 3.75LG 2.5S	dry bar in middle PC5	cobble-gravel		37.50	37.50			25.00	
139	0.57	10B		boulder	100.00						
140	26.74	0.5C 0.5LG 9S	beaver felled tree at ds end	sand/silt		5.00	5.00			90.00	
141	207.91	4C 4LG 1MG 1FG	many logs fr left bk	gravel		40.00	40.00	10.00	10.00		
142	56.96	3.33C 3.33LG 3.33SI		cobble-gravel-sand/silt		33.30	33.30			33.30	
143	7.28	10SI		sand/silt						100.00	

APPENDIX 3.2. PEBBLE COUNT DATA AND PLOTS FOR STUDY SITES

14	460	14	19	13.86139			13	9	13	14	12.87129		16
15	170	14	19	13.86139			14	120	14	16	13.86139		32
16	330	16	22	15.84158			15	105	15	17	14.85149		32
17	137	16	22	15.84158	D16	22	16	72	16	18	15.84158	D16	32
18	350	18	29	17.82178			17	21	17	19	16.83168		32
19	200	19	35	18.81188			18	55	17	19	16.83168		32
20	260	20	39	19.80198			19	18	17	19	16.83168		32
21 <2		21	40	20.79208			20	14	20	20	19.80198		32
22	22	21	40	20.79208			21	4	20	20	19.80198		32
23	64	23	44	22.77228			22	19	22	21	21.78218		32
24	110	23	44	22.77228			23	90	22	21	21.78218		32
25	110	25	46	24.75248	D25	46	24	37	24	25	23.76238		32
26	300	26	50	25.74257			25	54	25	27	24.75248		32
27	115	27	54	26.73267			26	43	25	27	24.75248	D25	32
28	4	28	55	27.72277			27	105	27	30	26.73267		32
29	210	28	55	27.72277			28	270	28	33	27.72277		64
30	170	30	60	29.70297			29	170	29	34	28.71287		64
31	130	30	60	29.70297			30	105	30	35	29.70297		64
32	115	32	63	31.68317			31	140	31	37	30.69307		64
33	39	33	64	32.67327			32	125	32	38	31.68317		64
34	19	34	65	33.66337			33	85	33	39	32.67327		64
35	12	35	69	34.65347			34	27	33	39	32.67327		64
36	170	36	72	35.64356			35	120	35	41	34.65347		64
37	8	37	75	36.63366			36	41	35	41	34.65347		64
38	100	37	75	36.63366			37	135	37	43	36.63366		64
39	160	39	77	38.61386			38 <2		38	45	37.62376		64
40	134	40	80	39.60396			39	25	39	48	38.61386		64
41	50	40	80	39.60396			40	230	39	48	38.61386		64
42	110	42	86	41.58416			41	16	39	48	38.61386		64
43	22	43	88	42.57426			42	95	39	48	38.61386		64
44	60	44	89	43.56436			43	45	39	48	38.61386	D50=	64
45	103	45	90	44.55446			44	103	44	54	43.56436		64
46	44	46	100	45.54455			45	48	45	55	44.55446		64
47	65	46	100	45.54455			46	48	46	64	45.54455		128
48	110	48	103	47.52475			47	110	46	64	45.54455		128
49	360	49	108	48.51485			48	135	48	69	47.52475		128
50	150	50	110	49.50495			49	115	49	70	48.51485		128
51	230	50	110	49.50495			50	200	50	72	49.50495	D50=74	128
52	55	50	110	49.50495			51	100	51	75	50.49505		128
53	29	50	110	49.50495	D50	110	52	400	52	79	51.48515		128
54	54	54	113	53.46535			53	10	53	85	52.47525		128
55	88	55	115	54.45545			54	600	54	88	53.46535		128
56	35	55	115	54.45545			55	200	55	90	54.45545		128
57	40	57	120	56.43564			56 <2		56	94	55.44554		128
58	113	57	120	56.43564			57 <2		57	95	56.43564		128
59	205	57	120	56.43564			58	48	58	100	57.42574		128
60	19	60	125	59.40594			59	21	59	103	58.41584		128
61	10	61	130	60.39604			60	20	60	105	59.40594		128
62	120	61	130	60.39604			61	35	60	105	59.40594		128
63	180	63	134	62.37624			62	64	60	105	59.40594		128
64	250	64	137	63.36634			63	70	60	105	59.40594		128
65	330	65	150	64.35644			64	210	60	105	59.40594		128
66	310	65	150	64.35644			65	39	65	110	64.35644		128
67	4	65	150	64.35644			66	140	65	110	64.35644		128
68	180	68	156	67.32673			67	19	65	110	64.35644		128
69	175	69	160	68.31683			68	140	68	115	67.32673		128
70	75	69	160	68.31683			69 <2		69	120	68.31683		128
71	300	71	170	70.29703			70	140	69	120	68.31683		128
72	150	71	170	70.29703			71	64	69	120	68.31683		128
73	150	71	170	70.29703			72	6	69	120	68.31683		128
74	72	74	175	73.26733			73	105	73	125	72.27723		128
75	160	75	180	74.25743			74	33	74	135	73.26733		256
76	330	75	180	74.25743			75	4	74	135	73.26733		256
77	15	75	180	74.25743	D75	181	76 <2		76	140	75.24752	D75	256
78	17	78	190	77.22772			77	17	76	140	75.24752		256
79	120	79	200	78.21782			78	105	76	140	75.24752		256
80	156	80	205	79.20792			79	75	76	140	75.24752		256
81	44	81	210	80.19802			80	41	76	140	75.24752		256
82	86	82	230	81.18812			81	88	81	165	80.19802		256
83	80	83	240	82.17822			82	94	82	170	81.18812		256
84	8	84	250	83.16832			83	69	83	180	82.17822		256

14	92	14	22	13.86139		
15	115	15	22	14.85149		
16	158	16	25	15.84158	D16	25
17	195	17	26	16.83168		
18	30	18	28	17.82178		
19	32	19	28	18.81188		
20	40	20	30	19.80198		
21	45	21	30	20.79208		
22	102	22	30	21.78218		
23	20	23	30	22.77228		
24	8	24	32	23.76238		
25	110	25	32	24.75248	D25	32
26	10	26	35	25.74257		
27	67	27	35	26.73267		
28	20	28	36	27.72277		
29	123	29	38	28.71287		
30	28	30	38	29.70297		
31	120	31	40	30.69307		
32	177	32	40	31.68317		
33	55	33	40	32.67327		
34	65	34	40	33.66337		
35	50	35	45	34.65347		
36	<2	36	45	35.64356		
37	10	37	45	36.63366		
38	32	38	46	37.62376		
39	81	39	46	38.61386		
40	98	40	46	39.60396		
41	38	41	50	40.59406		
42	95	42	52	41.58416		
43	35	43	53	42.57426		
44	135	44	55	43.56436		
45	40	45	55	44.55446		
46	4	46	55	45.54455		
47	18	47	55	46.53465		
48	46	48	65	47.52475		
49	9	49	65	48.51485		
50	74	50	65	49.50495		
51	92	51	67	50.49505	D50	67
52	200	52	68	51.48515		
53	26	53	68	52.47525		
54	175	54	74	53.46535		
55	182	55	75	54.45545		
56	55	56	81	55.44554		
57	22	57	85	56.43564		
58	8	58	90	57.42574		
59	<2	59	92	58.41584		
60	14	60	92	59.40594		
61	140	61	95	60.39604		
62	35	62	95	61.38614		
63	45	63	98	62.37624		
64	110	64	98	63.36634		
65	65	65	100	64.35644		
66	22	66	100	65.34653		
67	182	67	102	66.33663		
68	235	68	110	67.32673		
69	30	69	110	68.31683		
70	46	70	110	69.30693		
71	53	71	115	70.29703		
72	98	72	115	71.28713		
73	15	73	115	72.27723		
74	30	74	115	73.26733		
75	38	75	115	74.25743		
76	28	76	120	75.24752	D75	120
77	205	77	123	76.23762		
78	30	78	135	77.22772		
79	46	79	135	78.21782		
80	115	80	140	79.20792		
81	115	81	140	80.19802		
82	45	82	150	81.18812		
83	55	83	150	82.17822		
84	150	84	158	83.16832		

13	4	1	1	0.990099		2
14	10	1	1	0.990099		2
15	125	15	4	14.85149		8
16	72	16	6	15.84158	D16	8
17	<2	17	8	16.83168		16
18	125	17	8	16.83168		16
19	41	17	8	16.83168		16
20	91	17	8	16.83168		16
21	100	21	9	20.79208		16
22	8	22	10	21.78218		16
23	<2	22	10	21.78218		16
24	<2	22	10	21.78218		16
25	140	25	12	24.75248	D25	16
26	19	26	13	25.74257		16
27	380	27	15	26.73267		16
28	<2	27	15	26.73267		16
29	22	29	16	28.71287		32
30	<2	30	18	29.70297		32
31	80	30	18	29.70297		32
32	135	30	18	29.70297		32
33	90	30	18	29.70297		32
34	38	30	18	29.70297		32
35	18	35	19	34.65347		32
36	<2	35	19	34.65347		32
37	9	37	21	36.63366		32
38	34	38	22	37.62376		32
39	60	39	24	38.61386		32
40	50	40	25	39.60396		32
41	200	40	25	39.60396		32
42	15	42	26	41.58416		32
43	160	43	32	42.57426		64
44	38	44	34	43.56436		64
45	190	44	34	43.56436		64
46	300	46	35	45.54455		64
47	36	47	36	46.53465		64
48	140	48	38	47.52475		64
49	105	48	38	47.52475		64
50	100	48	38	47.52475		64
51	<2	51	41	50.49505	D50	64
52	73	52	43	51.48515		64
53	85	53	48	52.47525		64
54	100	54	50	53.46535		64
55	35	55	51	54.45545		64
56	63	56	54	55.44554		64
57	21	57	56	56.43564		64
58	<2	58	58	57.42574		64
59	250	59	60	58.41584		64
60	640	59	60	58.41584		64
61	210	61	62	60.39604		64
62	6	62	63	61.38614		64
63	62	63	64	62.37624		64
64	180	64	70	63.36634		128
65	75	65	72	64.35644		128
66	43	66	73	65.34653		128
67	160	67	75	66.33663		128
68	54	67	75	66.33663		128
69	180	69	80	68.31683		128
70	18	70	85	69.30693		128
71	34	71	86	70.29703		128
72	12	72	90	71.28713		128
73	13	73	91	72.27723		128
74	24	74	100	73.26733		128
75	16	74	100	73.26733		128
76	26	74	100	73.26733	D75=102	128
77	64	77	104	76.23762		128
78	120	78	105	77.22772		128
79	15	78	105	77.22772		128
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81	104	81	120	80.19802		128
82	86	82	125	81.18812		128
83	<2	82	125	81.18812		128

15	230	15	25	14.85149		
16	<2	15	25	14.85149		
17	20	15	25	14.85149	D16	25
18	300	18	26	17.82178		
19	5	19	28	18.81188		
20	33	20	29	19.80198		
21	110	21	30	20.79208		
22	70	22	33	21.78218		
23	100	23	39	22.77228		
24	39	24	41	23.76238		
25	65	25	43	24.75248	D25	43
26	65	26	45	25.74257		
27	24	26	45	25.74257		
28	85	28	46	27.72277		
29	230	29	48	28.71287		
30	95	29	48	28.71287		
31	16	31	50	30.69307		
32	90	31	50	30.69307		
33	275	33	52	32.67327		
34	105	34	56	33.66337		
35	110	35	58	34.65347		
36	155	35	58	34.65347		
37	240	37	63	36.63366		
38	7	38	64	37.62376		
39	190	38	64	37.62376		
40	140	40	65	39.60396		
41	25	40	65	39.60396		
42	100	40	65	39.60396		
43	45	40	65	39.60396		
44	83	40	65	39.60396		
45	130	45	68	44.55446		
46	50	45	68	44.55446		
47	130	47	70	46.53465		
48	160	48	71	47.52475		
49	64	49	72	48.51485		
50	100	50	82	49.50495		
51	65	50	82	49.50495	D50	82
52	26	52	83	51.48515		
53	58	53	85	52.47525		
54	190	54	88	53.46535		
55	88	55	90	54.45545		
56	63	56	91	55.44554		
57	152	57	95	56.43564		
58	68	57	95	56.43564		
59	48	57	95	56.43564		
60	100	60	100	59.40594		
61	95	60	100	59.40594		
62	28	60	100	59.40594		
63	245	60	100	59.40594		
64	5	60	100	59.40594		
65	110	65	105	64.35644		
66	145	65	105	64.35644		
67	150	67	110	66.33663		
68	130	67	110	66.33663		
69	46	67	110	66.33663		
70	91	67	110	66.33663		
71	65	67	110	66.33663		
72	100	67	110	66.33663		
73	48	73	120	72.27723		
74	52	73	120	72.27723		
75	71	75	124	74.25743		
76	124	76	125	75.24752	D75	125
77	50	77	130	76.23762		
78	150	77	130	76.23762		
79	65	77	130	76.23762		
80	110	80	140	79.20792		
81	82	81	145	80.19802		
82	25	82	150	81.18812		
83	<2	82	150	81.18812		
84	19	82	150	81.18812		
85	110	85	152	84.15842	D84	152

14	300	12	8	11.88119	
15	84	15	9	14.85149	
16	76	16	10	15.84158	
17	115	16	10	15.84158	D16
18	29	18	11	17.82178	
19	250	19	12	18.81188	
20	130	19	12	18.81188	
21	80	21	16	20.79208	
22	54	21	16	20.79208	
23	45	21	16	20.79208	
24	20	21	16	20.79208	
25	160	25	20	24.75248	D25
26	16	26	22	25.74257	
27	<2	26	22	25.74257	
28	160	28	23	27.72277	
29	8	29	25	28.71287	
30	60	30	26	29.70297	
31	270	31	28	30.69307	
32	<2	31	28	30.69307	
33	83	31	28	30.69307	
34	47	34	29	33.66337	
35	230	35	30	34.65347	
36	22	36	33	35.64356	
37	<2	37	37	36.63366	
38	260	38	45	37.62376	
39	160	39	47	38.61386	
40	205	40	54	39.60396	
41	10	40	54	39.60396	
42	<2	42	55	41.58416	
43	<2	43	60	42.57426	
44	33	43	60	42.57426	
45	155	45	70	44.55446	
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50	180	49	80	48.51485	
51	<2	49	80	48.51485	
52	16	52	81	51.48515	D50
53	150	53	83	52.47525	
54	170	54	84	53.46535	
55	12	55	100	54.45545	
56	26	56	105	55.44554	
57	54	56	105	55.44554	
58	60	56	105	55.44554	
59	80	59	107	58.41584	
60	160	60	115	59.40594	
61	105	61	120	60.39604	
62	28	61	120	60.39604	
63	80	61	120	60.39604	
64	<2	64	126	63.36634	
65	55	65	130	64.35644	
66	120	65	130	64.35644	
67	190	65	130	64.35644	
68	28	65	130	64.35644	
69	260	69	150	68.31683	
70	10	69	150	68.31683	
71	23	69	150	68.31683	
72	130	72	155	71.28713	
73	230	73	160	72.27723	
74	11	73	160	72.27723	
75	30	73	160	72.27723	
76	12	73	160	72.27723	D75=163
77	25	77	165	76.23762	
78	4	78	170	77.22772	
79	81	78	170	77.22772	
80	9	80	175	79.20792	
81	120	81	180	80.19802	
82	200	81	180	80.19802	
83	105	81	180	80.19802	
84	220	81	180	80.19802	

14	91	14	10	13.86139		
15	195	14	10	13.86139		
16	<2	16	12	15.84158	D16	12
17	29	17	15	16.83168		
18	55	18	16	17.82178		
19	300	19	19	18.81188		
20	105	20	20	19.80198		
21	110	20	20	19.80198		
22	130	22	21	21.78218		
23	100	23	22	22.77228		
24	72	24	23	23.76238		
25	120	25	29	24.75248	D25	29
26	220	26	33	25.74257		
27	10	27	34	26.73267		
28	100	28	35	27.72277		
29	180	29	44	28.71287		
30	300	29	44	28.71287		
31	175	31	50	30.69307		
32	270	32	53	31.68317		
33	90	33	54	32.67327		
34	90	34	55	33.66337		
35	155	35	58	34.65347		
36	20	36	64	35.64356		
37	<2	37	67	36.63366		
38	167	38	71	37.62376		
39	5	39	72	38.61386		
40	110	39	72	38.61386		
41	35	41	75	40.59406		
42	92	42	77	41.58416		
43	72	43	79	42.57426		
44	170	44	80	43.56436		
45	160	44	80	43.56436		
46	130	46	84	45.54455		
47	71	47	90	46.53465		
48	75	47	90	46.53465		
49	117	49	91	48.51485		
50	180	50	92	49.50495		
51	50	50	92	49.50495	D50	92
52	44	52	94	51.48515		
53	140	53	95	52.47525		
54	54	54	100	53.46535		
55	185	54	100	53.46535		
56	77	56	103	55.44554		
57	22	57	105	56.43564		
58	3	57	105	56.43564		
59	290	59	110	58.41584		
60	130	59	110	58.41584		
61	15	59	110	58.41584		
62	240	62	115	61.38614		
63	<2	62	115	61.38614		
64	33	62	115	61.38614		
65	9	65	117	64.35644		
66	23	66	120	65.34653		
67	<2	67	121	66.33663		
68	94	68	127	67.32673		
69	<2	69	130	68.31683		
70	145	69	130	68.31683		
71	127	69	130	68.31683		
72	64	72	139	71.28713		
73	115	73	140	72.27723		
74	34	74	145	73.26733		
75	110	75	150	74.25743		
76	200	75	150	74.25743	D75	152
77	150	77	155	76.23762		
78	139	78	160	77.22772		
79	58	79	167	78.21782		
80	16	80	170	79.20792		
81	19	81	175	80.19802		
82	190	82	180	81.18812		
83	20	82	180	81.18812		

13	65	1	1	0.990099		
14	190	1	1	0.990099		
15	95	1	1	0.990099		
16	250	1	1	0.990099		
17	17	1	1	0.990099		
18	255	18	3	17.82178	D16=3	[illegible]
19	14	18	3	17.82178		[illegible]
20	<2	20	6	19.80198		
21	<2	21	7	20.79208		
22	245	22	10	21.78218		1
23	<2	22	10	21.78218		1
24	90	24	11	23.76238		1
25	<2	25	13	24.75248	D25	1
26	<2	26	14	25.74257		1
27	150	27	17	26.73267		3
28	135	28	22	27.72277		3
29	34	29	26	28.71287		3
30	93	30	34	29.70297		6
31	88	31	35	30.69307		6
32	60	31	35	30.69307		6
33	260	33	40	32.67327		6
34	120	34	42	33.66337		6
35	<2	35	44	34.65347		6
36	125	36	45	35.64356		6
37	75	37	60	36.63366		6
38	200	38	63	37.62376		6
39	105	39	65	38.61386		12
40	136	40	70	39.60396		12
41	83	40	70	39.60396		12
42	250	42	75	41.58416		12
43	40	42	75	41.58416		12
44	150	44	80	43.56436		12
45	<2	45	83	44.55446		12
46	<2	46	85	45.54455		12
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48	220	47	88	46.53465		12
49	195	49	90	48.51485		12
50	200	49	90	48.51485		12
51	<2	49	90	48.51485	D50=92	12
52	22	52	93	51.48515		12
53	290	53	95	52.47525		12
54	185	53	95	52.47525		12
55	85	55	97	54.45545		12
56	90	56	100	55.44554		12
57	150	56	100	55.44554		12
58	3	56	100	55.44554		12
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63	3	62	110	61.38614		12
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66	97	64	120	63.36634		12
67	<2	67	125	66.33663		12
68	220	68	130	67.32673		25
69	<2	69	135	68.31683		25
70	102	69	135	68.31683		25
71	240	71	136	70.29703		25
72	75	72	140	71.28713		25
73	310	72	140	71.28713		25
74	140	74	150	73.26733		25
75	100	74	150	73.26733		25
76	90	74	150	73.26733		25
77	35	74	150	73.26733	D75=159	25
78	<2	78	170	77.22772		25
79	120	79	185	78.21782		25
80	95	79	185	78.21782		25
81	7	81	190	80.19802		25
82	6	81	190	80.19802		25

14	310	14	10	13.86139			13	7	13	25	12.87129		32
15	78	15	10	14.85149			14	140	14	50	13.86139		64
16	135	16	10	15.84158	D16	10	15	285	15	55	14.85149		64
17	65	17	16	16.83168			16	110	16	60	15.84158	D16	64
18	220	18	18	17.82178			17	110	17	65	16.83168		128
19	221	19	20	18.81188			18	312	18	69	17.82178		128
20	<2	20	23	19.80198			19	405	19	75	18.81188		128
21	<2	21	30	20.79208			20	185	20	85	19.80198		128
22	220	22	38	21.78218			21	22	20	85	19.80198		128
23	290	23	40	22.77228			22	200	22	92	21.78218		128
24	45	24	45	23.76238			23	190	23	100	22.77228		128
25	113	25	50	24.75248	D25	50	24	210	24	110	23.76238		128
26	165	26	65	25.74257			25	130	24	110	23.76238		128
27	38	27	78	26.73267			26	255	24	110	23.76238	D25=112	128
28	135	28	80	27.72277			27	490	27	115	26.73267		128
29	10	29	85	28.71287			28	185	28	125	27.72277		128
30	<2	30	87	29.70297			29	270	29	130	28.71287		256
31	20	31	90	30.69307			30	5	30	135	29.70297		256
32	<2	32	97	31.68317			31	400	30	135	29.70297		256
33	175	33	102	32.67327			32	160	32	140	31.68317		256
34	390	34	105	33.66337			33	220	33	147	32.67327		256
35	105	35	105	34.65347			34	135	34	150	33.66337		256
36	50	36	110	35.64356			35	60	34	150	33.66337		256
37	210	37	110	36.63366			36	210	36	155	35.64356		256
38	85	38	110	37.62376			37	430	37	158	36.63366		256
39	185	39	110	38.61386			38	17	38	160	37.62376		256
40	87	40	113	39.60396			39	160	38	160	37.62376		256
41	110	41	120	40.59406			40	<2	38	160	37.62376		256
42	270	42	123	41.58416			41	<2	38	160	37.62376		256
43	97	43	130	42.57426			42	<2	42	170	41.58416		256
44	105	44	130	43.56436			43	300	42	170	41.58416		256
45	205	45	130	44.55446			44	265	42	170	41.58416		256
46	185	46	135	45.54455			45	245	42	170	41.58416		256
47	190	47	135	46.53465			46	390	46	180	45.54455		256
48	260	48	135	47.52475			47	350	46	180	45.54455		256
49	205	49	135	48.51485			48	160	48	185	47.52475		256
50	265	50	135	49.50495			49	495	48	185	47.52475		256
51	350	51	145	50.49505	D50	145	50	150	48	185	47.52475		256
52	195	52	145	51.48515			51	495	51	190	50.49505	D50	256
53	<2	53	145	52.47525			52	310	52	200	51.48515		256
54	150	54	150	53.46535			53	180	52	200	51.48515		256
55	8	55	160	54.45545			54	100	52	200	51.48515		256
56	135	56	160	55.44554			55	235	55	210	54.45545		256
57	6	57	160	56.43564			56	170	55	210	54.45545		256
58	160	58	165	57.42574			57	<2	55	210	54.45545		256
59	180	59	165	58.41584			58	92	55	210	54.45545		256
60	165	60	165	59.40594			59	85	59	215	58.41584		256
61	250	61	170	60.39604			60	50	60	220	59.40594		256
62	120	62	170	61.38614			61	170	60	220	59.40594		256
63	160	63	175	62.37624			62	55	62	225	61.38614		256
64	214	64	180	63.36634			63	200	63	235	62.37624		256
65	6	65	185	64.35644			64	110	63	235	62.37624		256
66	<2	66	185	65.34653			65	240	63	235	62.37624		256
67	110	67	190	66.33663			66	210	66	240	65.34653		256
68	<2	68	195	67.32673			67	210	66	240	65.34653		256
69	135	69	195	68.31683			68	150	68	245	67.32673		256
70	285	70	205	69.30693			69	5	68	245	67.32673		256
71	255	71	205	70.29703			70	180	70	255	69.30693		512
72	380	72	210	71.28713			71	270	71	260	70.29703		512
73	350	73	214	72.27723			72	155	72	265	71.28713		512
74	145	74	220	73.26733			73	125	72	265	71.28713		512
75	30	75	220	74.25743			74	245	72	265	71.28713		512
76	250	76	221	75.24752	D75	221	75	135	75	270	74.25743		512
77	130	77	225	76.23762			76	170	75	270	74.25743	D75	512
78	250	78	230	77.22772			77	303	77	285	76.23762		512
79	230	79	250	78.21782			78	147	77	285	76.23762		512
80	300	80	250	79.20792			79	<2	79	295	78.21782		512
81	8	81	250	80.19802			80	265	80	300	79.20792		512
82	165	82	255	81.18812			81	265	80	300	79.20792		512
83	90	83	260	82.17822			82	<2	82	303	81.18812		512

14	105	14	60	13.86139		
15	160	14	60	13.86139		
16	165	14	60	13.86139		
17	87	17	62	16.83168	D16	62
18	95	18	65	17.82178		
19	112	18	65	17.82178		
20	18	18	65	17.82178		
21	95	21	70	20.79208		
22	175	21	70	20.79208		
23	70	21	70	20.79208		
24	95	21	70	20.79208		
25	62	25	75	24.75248		
26	110	25	75	24.75248		
27	115	25	75	24.75248	D25	75
28	100	28	80	27.72277		
29	92	28	80	27.72277		
30	100	28	80	27.72277		
31	80	28	80	27.72277		
32	155	28	80	27.72277		
33	80	28	80	27.72277		
34	125	28	80	27.72277		
35	75	35	85	34.65347		
36	45	35	85	34.65347		
37	90	37	87	36.63366		
38	130	38	90	37.62376		
39	60	38	90	37.62376		
40	95	38	90	37.62376		
41	65	38	90	37.62376		
42	60	38	90	37.62376		
43	90	38	90	37.62376		
44	105	38	90	37.62376		
45	43	45	92	44.55446		
46	150	46	95	45.54455		
47	45	46	95	45.54455		
48	140	46	95	45.54455		
49	190	46	95	45.54455		
50	150	46	95	45.54455		
51	220	46	95	45.54455		
52	70	46	95	45.54455		
53	115	53	98	52.47525	D50	97
54	220	54	100	53.46535		
55	75	54	100	53.46535		
56	140	54	100	53.46535		
57	95	54	100	53.46535		
58	125	58	105	57.42574		
59	200	58	105	57.42574		
60	110	58	105	57.42574		
61	110	61	110	60.39604		
62	80	61	110	60.39604		
63	65	61	110	60.39604		
64	100	61	110	60.39604		
65	70	61	110	60.39604		
66	90	66	112	65.34653		
67	120	67	115	66.33663		
68	34	67	115	66.33663		
69	90	67	115	66.33663		
70	130	70	120	69.30693		
71	150	70	120	69.30693		
72	220	72	125	71.28713		
73	30	72	125	71.28713		
74	85	74	130	73.26733		
75	90	74	130	73.26733		
76	70	74	130	73.26733		
77	90	77	135	76.23762	D75	134
78	45	77	135	76.23762		
79	80	79	140	78.21782		
80	135	79	140	78.21782		
81	260	79	140	78.21782		
82	200	79	140	78.21782		
83	140	83	150	82.17822		

13	85	12	34	11.88119		64
14	20	14	35	13.86139		64
15	49	15	36	14.85149		64
16	140	16	38	15.84158	D16	64
17	20	17	40	16.83168		64
18	150	18	45	17.82178		64
19	9	19	47	18.81188		64
20	150	20	49	19.80198		64
21	56	21	52	20.79208		64
22	155	22	56	21.78218		64
23	140	23	59	22.77228		64
24	225	24	60	23.76238		64
25	155	24	60	23.76238		64
26	120	26	61	25.74257	D25	64
27	115	27	65	26.73267		128
28	66	27	65	26.73267		128
29	34	27	65	26.73267		128
30	35	30	66	29.70297		128
31	77	30	66	29.70297		128
32	170	32	68	31.68317		128
33	24	33	70	32.67327		128
34	12	33	70	32.67327		128
35	65	35	71	34.65347		128
36	130	36	72	35.64356		128
37	90	37	73	36.63366		128
38	130	38	77	37.62376		128
39	160	39	78	38.61386		128
40	105	40	79	39.60396		128
41	210	41	80	40.59406		128
42	88	42	83	41.58416		128
43	120	43	85	42.57426		128
44	79	44	88	43.56436		128
45	210	45	90	44.55446		128
46	71	45	90	44.55446		128
47	73	47	92	46.53465		128
48	123	48	95	47.52475		128
49	68	49	100	48.51485		128
50	59	49	100	48.51485		128
51	65	49	100	48.51485	D50=103	128
52	122	52	105	51.48515		128
53	100	53	107	52.47525		128
54	7	54	110	53.46535		128
55	80	54	110	53.46535		128
56	45	54	110	53.46535		128
57	120	57	115	56.43564		128
58	90	57	115	56.43564		128
59	150	57	115	56.43564		128
60	147	60	116	59.40594		128
61	95	61	120	60.39604		128
62	110	61	120	60.39604		128
63	92	61	120	60.39604		128
64	78	61	120	60.39604		128
65	70	65	122	64.35644		128
66	180	66	123	65.34653		128
67	140	67	130	66.33663		256
68	52	67	130	66.33663		256
69	66	67	130	66.33663		256
70	190	70	133	69.30693		256
71	115	71	135	70.29703		256
72	34	72	140	71.28713		256
73	180	72	140	71.28713		256
74	100	72	140	71.28713		256
75	130	72	140	71.28713		256
76	47	72	140	71.28713		256
77	200	77	142	76.23762	D75	256
78	280	78	147	77.22772		256
79	115	79	150	78.21782		256
80 <2		79	150	78.21782		256
81	116	79	150	78.21782		256
82	135	82	155	81.18812		256

14	55	14	25	13.86139	
15	55	15	27	14.85149	
16	90	15	27	14.85149	D16
17	72	17	29	16.83168	
18	62	18	30	17.82178	
19	30	19	31	18.81188	
20	50	19	31	18.81188	
21	90	19	31	18.81188	
22	95	22	32	21.78218	
23	125	23	33	22.77228	
24	125	24	34	23.76238	
25	89	24	34	23.76238	
26	40	24	34	23.76238	D25
27	85	27	35	26.73267	
28	125	28	40	27.72277	
29	75	28	40	27.72277	
30	93	28	40	27.72277	
31	16	31	42	30.69307	
32	44	31	42	30.69307	
33	64	33	44	32.67327	
34	155	33	44	32.67327	
35	31	35	46	34.65347	
36	92	36	48	35.64356	
37	120	37	49	36.63366	
38	18	38	50	37.62376	
39	118	39	54	38.61386	
40	44	39	54	38.61386	
41	110	41	55	40.59406	
42	107	41	55	40.59406	
43	86	41	55	40.59406	
44	88	41	55	40.59406	
45	93	45	61	44.55446	
46	100	46	62	45.54455	
47	82	46	62	45.54455	
48	105	46	62	45.54455	
49	67	49	64	48.51485	
50	115	50	67	49.50495	
51	84	50	67	49.50495	D50
52	29	52	70	51.48515	
53	70	53	72	52.47525	
54	76	54	74	53.46535	
55	125	55	75	54.45545	
56	99	55	75	54.45545	
57	120	57	76	56.43564	
58	210	58	78	57.42574	
59	90	59	80	58.41584	
60	33	60	82	59.40594	
61	55	61	83	60.39604	
62	55	62	84	61.38614	
63	170	63	85	62.37624	
64	90	64	86	63.36634	
65	75	65	88	64.35644	
66	137	65	88	64.35644	
67	61	67	89	66.33663	
68	48	68	90	67.32673	
69	125	68	90	67.32673	
70	80	68	90	67.32673	
71	62	68	90	67.32673	
72	83	72	92	71.28713	
73	74	73	93	72.27723	
74	107	73	93	72.27723	
75	46	75	95	74.25743	
76	23	76	99	75.24752	D75
77	117	77	100	76.23762	
78	78	77	100	76.23762	
79	54	79	105	78.21782	
80	5	80	107	79.20792	
81	109	80	107	79.20792	
82	34	82	109	81.18812	
83	62	83	110	82.17822	

13	180	13	15	12.87129		16
14	140	13	15	12.87129		16
15	41	13	15	12.87129		16
16	145	13	15	12.87129		16
17	20	13	15	12.87129	D16=17	16
18	105	18	20	17.82178		32
19	35	18	20	17.82178		32
20	125	20	24	19.80198		32
21	<2	21	25	20.79208		32
22	88	21	25	20.79208		32
23	190	21	25	20.79208		32
24	92	21	25	20.79208		32
25	30	25	26	24.75248	D25	32
26	140	26	27	25.74257		32
27	160	27	28	26.73267		32
28	<2	28	30	27.72277		32
29	<2	28	30	27.72277		32
30	30	28	30	27.72277		32
31	180	28	30	27.72277		32
32	49	32	32	31.68317		64
33	28	33	35	32.67327		64
34	70	34	36	33.66337		64
35	60	35	38	34.65347		64
36	100	36	40	35.64356		64
37	15	37	41	36.63366		64
38	10	38	48	37.62376		64
39	110	38	48	37.62376		64
40	90	40	49	39.60396		64
41	51	41	50	40.59406		64
42	48	42	51	41.58416		64
43	103	43	53	42.57426		64
44	32	43	53	42.57426		64
45	25	45	56	44.55446		64
46	59	45	56	44.55446		64
47	63	47	59	46.53465		64
48	140	48	60	47.52475		64
49	25	49	63	48.51485		64
50	110	49	63	48.51485		64
51	135	51	64	50.49505	D50	128
52	82	52	70	51.48515		128
53	153	53	72	52.47525		128
54	15	54	75	53.46535		128
55	36	54	75	53.46535		128
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57	63	56	82	55.44554		128
58	110	56	82	55.44554		128
59	<2	59	84	58.41584		128
60	56	59	84	58.41584		128
61	165	61	85	60.39604		128
62	110	62	88	61.38614		128
63	53	63	89	62.37624		128
64	75	64	90	63.36634		128
65	11	64	90	63.36634		128
66	84	66	92	65.34653		128
67	25	66	92	65.34653		128
68	72	68	100	67.32673		128
69	15	68	100	67.32673		128
70	12	70	103	69.30693		128
71	113	71	105	70.29703		128
72	10	72	110	71.28713		128
73	130	72	110	71.28713		128
74	48	72	110	71.28713		128
75	164	72	110	71.28713		128
76	20	72	110	71.28713	D75=112	128
77	25	77	113	76.23762		128
78	82	78	120	77.22772		128
79	15	79	125	78.21782		128
80	89	80	130	79.20792		256
81	140	80	130	79.20792		256
82	27	82	135	81.18812		256

14	62	13	30	12.87129	
15	135	13	30	12.87129	
16	90	16	32	15.84158	D16
17	65	17	37	16.83168	
18	95	17	37	16.83168	
19	130	19	39	18.81188	
20	75	20	40	19.80198	
21	130	21	42	20.79208	
22	32	21	42	20.79208	
23	120	23	43	22.77228	
24	90	23	43	22.77228	
25	40	25	44	24.75248	
26	109	25	44	24.75248	D25
27	130	27	45	26.73267	
28	125	28	47	27.72277	
29	115	29	48	28.71287	
30	37	30	50	29.70297	
31	54	31	54	30.69307	
32	120	31	54	30.69307	
33	61	33	55	32.67327	
34	59	33	55	32.67327	
35	155	33	55	32.67327	
36	75	36	56	35.64356	
37	65	37	58	36.63366	
38	100	38	59	37.62376	
39	86	39	60	38.61386	
40	72	39	60	38.61386	
41	68	39	60	38.61386	
42	310	42	61	41.58416	
43	44	43	62	42.57426	
44	56	44	63	43.56436	
45	42	45	64	44.55446	
46	<2	46	65	45.54455	
47	140	46	65	45.54455	
48	64	48	68	47.52475	
49	130	49	69	48.51485	
50	125	50	72	49.50495	D50
51	135	51	73	50.49505	
52	76	52	74	51.48515	
53	55	53	75	52.47525	
54	105	53	75	52.47525	
55	140	53	75	52.47525	
56	48	56	76	55.44554	
57	44	57	77	56.43564	
58	45	58	80	57.42574	
59	110	58	80	57.42574	
60	77	60	84	59.40594	
61	110	61	85	60.39604	
62	115	62	86	61.38614	
63	60	63	90	62.37624	
64	135	63	90	62.37624	
65	54	63	90	62.37624	
66	69	66	95	65.34653	
67	80	66	95	65.34653	
68	14	68	100	67.32673	
69	84	69	105	68.31683	
70	125	69	105	68.31683	
71	110	69	105	68.31683	
72	74	69	105	68.31683	
73	105	73	109	72.27723	
74	105	74	110	73.26733	
75	110	74	110	73.26733	
76	90	74	110	73.26733	
77	55	74	110	73.26733	
78	80	74	110	73.26733	
79	58	74	110	73.26733	D75
80	39	80	115	79.20792	
81	85	80	115	79.20792	
82	73	82	120	81.18812	
83	105	82	120	81.18812	
84	25	82	120	81.18812	

13	68		9	18	8.910891		32
14	33		9	18	8.910891		32
15	48		15	20	14.85149		32
16	68		16	21	15.84158	D16	32
17	110		17	24	16.83168		32
18	25		17	24	16.83168		32
19	6		19	25	18.81188		32
20	38		19	25	18.81188		32
21	99		21	26	20.79208		32
22	61		21	26	20.79208		32
23	46		23	28	22.77228		32
24	20		23	28	22.77228		32
25	26		25	29	24.75248	D25	32
26	135		25	29	24.75248		32
27	18		27	30	26.73267		32
28	10		28	31	27.72277		32
29	30		29	33	28.71287		64
30	25		29	33	28.71287		64
31	115		29	33	28.71287		64
32	82		32	35	31.68317		64
33	38		33	36	32.67327		64
34	120		34	37	33.66337		64
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41	210		41	45	40.59406		64
42	63		41	45	40.59406		64
43	45		43	46	42.57426		64
44	15		44	48	43.56436		64
45	24		44	48	43.56436		64
46	88		44	48	43.56436		64
47	45		44	48	43.56436		64
48	85		48	50	47.52475		64
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50	78		50	52	49.50495	D50=53	64
51	52		51	55	50.49505		64
52	21		52	55	51.48515		64
53	90		53	56	52.47525		64
54	38		54	58	53.46535		64
55	44		55	60	54.45545		64
56	50		55	60	54.45545		64
57	86		57	61	56.43564		64
58	82		58	63	57.42574		64
59	180		59	68	58.41584		128
60	95		59	68	58.41584		128
61	48		61	70	60.39604		128
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66	10		65	78	64.35644		128
67	58		67	80	66.33663		128
68	18		67	80	66.33663		128
69	8		67	80	66.33663		128
70	160		67	80	66.33663		128
71	18		67	80	66.33663		128
72	83		72	82	71.28713		128
73	55		72	82	71.28713		128
74	89		74	83	73.26733		128
75	130		75	84	74.25743		128
76	28		76	85	75.24752	D75	128
77	80		77	86	76.23762		128
78	72		78	88	77.22772		128
79	55		79	89	78.21782		128
80	84		80	90	79.20792		128
81	33		80	90	79.20792		128
82	80		82	95	81.18812		128
83	15		83	99	82.17822		128

14	69	13	37	12.87129	
15	57	13	37	12.87129	
16	30	16	38	15.84158	D16
17	32	17	39	16.83168	
18	40	17	39	16.83168	
19	160	17	39	16.83168	
20	80	17	39	16.83168	
21	120	17	39	16.83168	
22	95	22	40	21.78218	
23	36	22	40	21.78218	
24	105	22	40	21.78218	
25	150	22	40	21.78218	
26	39	26	43	25.74257	D25
27	48	26	43	25.74257	
28	39	28	44	27.72277	
29	52	28	44	27.72277	
30	110	28	44	27.72277	
31	135	31	45	30.69307	
32	40	31	45	30.69307	
33	130	31	45	30.69307	
34	52	31	45	30.69307	
35	49	35	46	34.65347	
36	45	35	46	34.65347	
37	61	37	48	36.63366	
38	46	37	48	36.63366	
39	120	39	49	38.61386	
40	55	40	50	39.60396	
41	62	41	51	40.59406	
42	57	42	52	41.58416	
43	43	42	52	41.58416	
44	39	42	52	41.58416	
45	44	42	52	41.58416	
46	45	46	55	45.54455	
47	34	47	57	46.53465	
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49	69	49	59	48.51485	
50	6	49	59	48.51485	
51	11	51	60	50.49505	D50
52	51	52	61	51.48515	
53	37	53	62	52.47525	
54	115	53	62	52.47525	
55	75	55	68	54.45545	
56	52	56	69	55.44554	
57	82	56	69	55.44554	
58	60	58	70	57.42574	
59	62	58	70	57.42574	
60	35	60	71	59.40594	
61	45	61	72	60.39604	
62	110	62	75	61.38614	
63	105	62	75	61.38614	
64	75	62	75	61.38614	
65	84	62	75	61.38614	
66	46	66	80	65.34653	
67	45	67	82	66.33663	
68	83	68	83	67.32673	
69	37	69	84	68.31683	
70	52	69	84	68.31683	
71	70	71	85	70.29703	
72	130	72	92	71.28713	
73	59	73	95	72.27723	
74	105	73	95	72.27723	
75	110	75	99	74.25743	
76	40	76	105	75.24752	D75
77	30	76	105	75.24752	
78	110	76	105	75.24752	
79	105	76	105	75.24752	
80	10	76	105	75.24752	
81	44	81	110	80.19802	
82	40	81	110	80.19802	
83	37	81	110	80.19802	
84	39	81	110	80.19802	

13	86	13	12	12.87129		16
14	25	13	12	12.87129		16
15	18	15	14	14.85149		16
16	105	16	15	15.84158	D16	16
17	54	17	16	16.83168		32
18	19	17	16	16.83168		32
19	38	19	18	18.81188		32
20	53	19	18	18.81188		32
21	<2	19	18	18.81188		32
22	140	22	19	21.78218		32
23	80	23	20	22.77228		32
24	115	23	20	22.77228		32
25	84	25	21	24.75248	D25	32
26	110	26	22	25.74257		32
27	73	27	24	26.73267		32
28	46	28	25	27.72277		32
29	90	28	25	27.72277		32
30	140	28	25	27.72277		32
31	145	31	26	30.69307		32
32	80	32	28	31.68317		32
33	10	33	29	32.67327		32
34	110	34	30	33.66337		32
35	140	35	33	34.65347		64
36	190	35	33	34.65347		64
37	56	37	36	36.63366		64
38	84	38	37	37.62376		64
39	110	38	37	37.62376		64
40	18	40	38	39.60396		64
41	4	40	38	39.60396		64
42	48	40	38	39.60396		64
43	94	43	40	42.57426		64
44	110	43	40	42.57426		64
45	<2	45	41	44.55446		64
46	25	46	42	45.54455		64
47	16	47	45	46.53465		64
48	20	48	46	47.52475		64
49	5	49	47	48.51485		64
50	16	50	48	49.50495		64
51	37	50	48	49.50495	D50	64
52	115	52	50	51.48515		64
53	210	53	53	52.47525		64
54	38	54	54	53.46535		64
55	130	55	55	54.45545		64
56	<2	55	55	54.45545		64
57	30	57	56	56.43564		64
58	50	58	60	57.42574		64
59	33	58	60	57.42574		64
60	11	60	61	59.40594		64
61	160	61	64	60.39604		128
62	42	62	65	61.38614		128
63	64	63	72	62.37624		128
64	48	63	72	62.37624		128
65	12	65	73	64.35644		128
66	22	66	74	65.34653		128
67	125	67	75	66.33663		128
68	33	68	78	67.32673		128
69	83	68	78	67.32673		128
70	74	70	80	69.30693		128
71	10	70	80	69.30693		128
72	55	70	80	69.30693		128
73	37	73	81	72.27723		128
74	61	73	81	72.27723		128
75	60	75	83	74.25743		128
76	41	76	84	75.24752	D75	128
77	40	76	84	75.24752		128
78	80	78	86	77.22772		128
79	20	79	88	78.21782		128
80	72	80	90	79.20792		128
81	72	81	94	80.19802		128
82	29	82	98	81.18812		128
83	78	83	105	82.17822		128

14	110	14	17	13.86139			13	120	11	15	10.89109		
15	20	15	19	14.85149			14	56	11	15	10.89109		
16	56	15	19	14.85149			15	28	15	16	14.85149		
17	19	17	20	16.83168	D16	20	16	140	16	18	15.84158	D16	
18	13	17	20	16.83168			17 <2		16	18	15.84158		
19	140	17	20	16.83168			18	7	18	20	17.82178		
20	105	20	22	19.80198			19	15	18	20	17.82178		
21	120	21	24	20.79208			20	16	20	21	19.80198		
22	115	21	24	20.79208			21	18	21	24	20.79208		
23	185	23	26	22.77228			22	82	22	25	21.78218		
24	65	24	30	23.76238			23	140	22	25	21.78218		
25	88	24	30	23.76238	D25	33	24	60	22	25	21.78218		
26	9	26	35	25.74257			25	75	22	25	21.78218		
27	110	26	35	25.74257			26	85	22	25	21.78218		
28	35	26	35	25.74257			27	90	22	25	21.78218	D25=27	
29	74	26	35	25.74257			28	60	28	28	27.72277		
30	90	30	39	29.70297			29	100	28	28	27.72277		
31	100	31	40	30.69307			30	95	30	30	29.70297		
32	95	32	41	31.68317			31	46	31	31	30.69307		
33	220	33	44	32.67327			32	200	32	32	31.68317		
34	154	34	45	33.66337			33	41	32	32	31.68317		
35	75	35	48	34.65347			34	20	32	32	31.68317		
36	95	35	48	34.65347			35	70	35	35	34.65347		
37	68	37	49	36.63366			36	25	36	38	35.64356		
38	145	38	53	37.62376			37	65	37	41	36.63366		
39	19	39	54	38.61386			38	11	37	41	36.63366		
40	190	40	56	39.60396			39	44	39	44	38.61386		
41 <2		40	56	39.60396			40	12	39	44	38.61386		
42 <2		42	58	41.58416			41	55	41	45	40.59406		
43 <2		43	59	42.57426			42	20	41	45	40.59406		
44	59	44	65	43.56436			43	25	43	46	42.57426		
45	140	44	65	43.56436			44	90	44	51	43.56436		
46	170	46	68	45.54455			45 <2		45	52	44.55446		
47	115	47	74	46.53465			46	44	46	54	45.54455		
48	35	47	74	46.53465			47	25	47	55	46.53465		
49	3	47	74	46.53465			48	90	47	55	46.53465		
50	10	50	75	49.50495			49	18	47	55	46.53465		
51	115	50	75	49.50495	D50	75	50	35	50	56	49.50495	D50=58	
52	115	52	80	51.48515			51	111	51	60	50.49505		
53	74	53	86	52.47525			52	90	51	60	50.49505		
54	75	54	88	53.46535			53	25	51	60	50.49505		
55	56	55	90	54.45545			54 <2		51	60	50.49505		
56	49	56	93	55.44554			55	200	51	60	50.49505		
57	26	57	94	56.43564			56	60	56	65	55.44554		1
58	24	57	94	56.43564			57	71	56	65	55.44554		1
59	24	59	95	58.41584			58	80	58	69	57.42574		1
60	100	59	95	58.41584			59	65	59	70	58.41584		1
61	6	61	100	60.39604			60	100	60	71	59.40594		1
62	105	61	100	60.39604			61	51	61	72	60.39604		1
63	110	61	100	60.39604			62	110	61	72	60.39604		1
64	53	64	105	63.36634			63	160	63	75	62.37624		1
65	160	64	105	63.36634			64	32	63	75	62.37624		1
66	160	64	105	63.36634			65	25	65	78	64.35644		1
67	94	64	105	63.36634			66 <2		66	80	65.34653		1
68	20	64	105	63.36634			67	24	67	81	66.33663		1
69	130	69	110	68.31683			68	94	67	81	66.33663		1
70	105	69	110	68.31683			69	25	69	82	68.31683		1
71	135	69	110	68.31683			70	100	69	82	68.31683		1
72	48	69	110	68.31683			71	15	71	85	70.29703		1
73	155	69	110	68.31683			72	60	72	90	71.28713		1
74	170	74	115	73.26733			73	45	72	90	71.28713		1
75	80	74	115	73.26733			74	15	72	90	71.28713		1
76	17	74	115	73.26733			75	8	72	90	71.28713		1
77	140	74	115	73.26733	D75	117	76	180	72	90	71.28713	D75=93	1
78	39	78	120	77.22772			77	135	77	94	76.23762		1
79 <2		79	125	78.21782			78	72	78	95	77.22772		1
80 <2		80	130	79.20792			79	15	79	100	78.21782		1
81	110	80	130	79.20792			80	115	79	100	78.21782		1
82	22	82	135	81.18812			81	28	79	100	78.21782		1
83	30	82	135	81.18812			82	81	79	100	78.21782		1
84	40	84	140	83.16832			83	110	83	110	82.17822		1

14	54	14	40	13.86139		
15	70	14	40	13.86139		
16	105	14	40	13.86139		
17	80	14	40	13.86139		
18	53	18	42	17.82178	D16	41
19	65	19	43	18.81188		
20	56	20	44	19.80198		
21	95	21	45	20.79208		
22	45	21	45	20.79208		
23	57	21	45	20.79208		
24	65	21	45	20.79208		
25	85	21	45	20.79208		
26	<2	21	45	20.79208		
27	40	21	45	20.79208	D25	46
28	62	28	46	27.72277		
29	74	29	50	28.71287		
30	57	29	50	28.71287		
31	32	29	50	28.71287		
32	70	29	50	28.71287		
33	45	29	50	28.71287		
34	35	34	52	33.66337		
35	60	34	52	33.66337		
36	22	34	52	33.66337		
37	125	37	53	36.63366		
38	78	38	54	37.62376		
39	37	39	55	38.61386		
40	40	39	55	38.61386		
41	92	39	55	38.61386		
42	55	39	55	38.61386		
43	70	39	55	38.61386		
44	83	44	56	43.56436		
45	80	44	56	43.56436		
46	50	46	57	45.54455		
47	72	46	57	45.54455		
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49	55	46	57	45.54455		
50	55	50	60	49.50495		
51	60	50	60	49.50495	D50	60
52	57	52	62	51.48515		
53	95	53	63	52.47525		
54	55	54	64	53.46535		
55	56	55	65	54.45545		
56	42	55	65	54.45545		
57	73	55	65	54.45545		
58	45	55	65	54.45545		
59	50	59	67	58.41584		
60	55	59	67	58.41584		
61	92	61	68	60.39604		
62	20	62	70	61.38614		
63	75	62	70	61.38614		
64	67	62	70	61.38614		
65	29	62	70	61.38614		
66	92	62	70	61.38614		
67	105	67	72	66.33663		
68	115	67	72	66.33663		
69	40	69	73	68.31683		
70	105	70	74	69.30693		
71	52	71	75	70.29703		
72	45	72	78	71.28713		
73	95	72	78	71.28713		
74	150	74	80	73.26733		
75	90	74	80	73.26733		
76	70	76	83	75.24752		
77	105	76	83	75.24752	D75	83
78	90	78	84	77.22772		
79	100	79	85	78.21782		
80	85	79	85	78.21782		
81	43	79	85	78.21782		
82	31	82	90	81.18812		
83	50	82	90	81.18812		
84	44	84	92	83.16832		
85	45	84	92	83.16832		
86	63	84	92	83.16832	D84	92
87	65	87	93	86.13861		
88	70	88	95	87.12871		
89	45	88	95	87.12871		
90	50	88	95	87.12871		
91	30	88	95	87.12871		
92	95	92	100	91.08911		
93	67	93	105	92.07921		
94	85	93	105	92.07921		
95	40	93	105	92.07921		
96	50	93	105	92.07921		
97	21	97	115	96.0396		
98	37	98	125	97.0297		
99	68	99	130	98.0198		

13	125	1	1	0.833333	2
14	31	1	1	0.833333	2
15	66	1	1	0.833333	2
16	85	1	1	0.833333	2
17	35	1	1	0.833333	2
18	85	1	1	0.833333	2
19	98	1	1	0.833333	2
20	77	1	1	0.833333	2
21	44	1	1	0.833333	2
22	65	1	1	0.833333	2
23	39	1	1	0.833333	2
24	83	1	1	0.833333	2
25	>2	1	1	0.833333	2
26	28	1	1	0.833333	2
27	90	27	6	22.5	8
28	61	28	9	23.33333	16
29	74	29	10	24.16667	16
30	98	30	11	25	16
31	70	31	20	25.83333	32
32	64	31	20	25.83333	32
33	45	33	24	27.5	32
34	71	34	25	28.33333	32
35	71	35	28	29.16667	32
36	85	35	28	29.16667	32
37	<2	35	28	29.16667	32
38	<2	38	30	31.66667	32
39	139	38	30	31.66667	32
40	<2	40	31	33.33333	32
41	<2	41	33	34.16667	64
42	85	42	35	35	64
43	<2	42	35	35	64
44	24	44	36	36.66667	64
45	43	45	39	37.5	64
46	68	46	40	38.33333	64
47	51	46	40	38.33333	64
48	<2	48	41	40	64
49	<2	48	41	40	64
50	20	48	41	40	64
51	86	51	43	42.5	64
52	100	51	43	42.5	64
53	81	53	44	44.16667	64
54	80	54	45	45	64
55	<2	55	46	45.83333	64
56	<2	55	46	45.83333	64
57	10	57	50	47.5	64
58	65	58	51	48.33333	64
59	35	59	54	49.16667	64
60	41	60	55	50	64
61	<2	60	55	50	64
62	28	62	58	51.66667	64
63	63	63	60	52.5	64
64	<2	63	60	52.5	64
65	<2	65	61	54.16667	64
66	77	66	62	55	64
67	<2	66	62	55	64
68	28	68	63	56.66667	64
69	73	69	64	57.5	128
70	<2	70	65	58.33333	128
71	<2	70	65	58.33333	128
72	<2	70	65	58.33333	128
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85	40	84	75	70	128
86	<2	86	76	71.66667	128
87	36	86	76	71.66667	128
88	<2	88	77	73.33333	128
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90	<2	90	80	75	128
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92	30	90	80	75	128
93	75	93	81	77.5	128
94	58	94	83	78.33333	128
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97	33	97	85	80.83333	128
98	<2	97	85	80.83333	128

15	14	14	13.86139			14	34	1	1	0.990099		2
25	14	14	13.86139			15	49	1	1	0.990099		2
60	17	15	16.83168	D16	15	16	<2	1	1	0.990099		2
23	17	15	16.83168			17	8	1	1	0.990099		2
30	19	16	18.81188			18	<2	1	1	0.990099		2
41	19	16	18.81188			19	<2	1	1	0.990099		2
20	19	16	18.81188			20	21	1	1	0.990099		2
33	22	20	21.78218			21	<2	1	1	0.990099		2
21	22	20	21.78218			22	44	1	1	0.990099		2
56	22	20	21.78218			23	38	1	1	0.990099		2
62	25	21	24.75248			24	76	1	1	0.990099	D16=3	2
13	25	21	24.75248			25	130	25	6	24.75248		8
21	25	21	24.75248			26	<2	25	6	24.75248	D25	8
32	25	21	24.75248			27	<2	27	7	26.73267		8
80	25	21	24.75248	D25	21	28	19	28	8	27.72277		16
22	30	22	29.70297			29	52	28	8	27.72277		16
55	31	23	30.69307			30	80	30	9	29.70297		16
16	31	23	30.69307			31	<2	30	9	29.70297		16
	31	23	30.69307			32	44	32	10	31.68317		16
45	31	23	30.69307			33	48	33	11	32.67327		16
30	31	23	30.69307			34	<2	33	11	32.67327		16
25	36	25	35.64356			35	115	33	11	32.67327		16
27	36	25	35.64356			36	121	36	14	35.64356		16
40	36	25	35.64356			37	25	37	15	36.63366		16
75	36	25	35.64356			38	<2	38	16	37.62376		32
45	40	26	39.60396			39	81	38	16	37.62376		32
43	40	26	39.60396			40	75	38	16	37.62376		32
67	42	27	41.58416			41	<2	38	16	37.62376		32
60	43	30	42.57426			42	60	42	19	41.58416		32
34	43	30	42.57426			43	<2	42	19	41.58416		32
15	43	30	42.57426			44	<2	44	21	43.56436		32
70	43	30	42.57426			45	61	44	21	43.56436		32
20	47	32	46.53465			46	95	44	21	43.56436		32
21	47	32	46.53465			47	80	44	21	43.56436		32
	49	33	48.51485			48	56	48	22	47.52475		32
80	50	34	49.50495			49	25	48	22	47.52475		32
	50	34	49.50495	D50	34	50	31	48	22	47.52475		32
36	52	35	51.48515			51	<2	51	24	50.49505	D50	32
21	53	36	52.47525			52	15	51	24	50.49505		32
26	53	36	52.47525			53	36	53	25	52.47525		32
38	55	37	54.45545			54	6	53	25	52.47525		32
50	56	38	55.44554			55	49	53	25	52.47525		32
78	56	38	55.44554			56	26	56	26	55.44554		32
64	58	40	57.42574			57	14	56	26	55.44554		32
42	58	40	57.42574			58	<2	56	26	55.44554		32
23	60	41	59.40594			59	42	59	30	58.41584		32
34	61	42	60.39604			60	6	60	31	59.40594		32
51	61	42	60.39604			61	34	60	31	59.40594		32
57	63	43	62.37624			62	16	62	32	61.38614		64
64	64	44	63.36634			63	25	63	34	62.37624		64
	65	45	64.35644			64	24	63	34	62.37624		64
49	65	45	64.35644			65	<2	65	35	64.35644		64
65	65	45	64.35644			66	19	66	36	65.34653		64
45	65	45	64.35644			67	35	66	36	65.34653		64
13	69	49	68.31683			68	11	66	36	65.34653		64
23	70	50	69.30693			69	21	69	37	68.31683		64
100	71	51	70.29703			70	21	70	38	69.30693		64
58	72	54	71.28713			71	22	70	38	69.30693		64
26	72	54	71.28713			72	26	72	40	71.28713		64
25	74	55	73.26733			73	16	73	41	72.27723		64
40	75	56	74.25743			74	10	74	42	73.26733		64
23	75	56	74.25743	D75	56	75	45	75	44	74.25743		64
70	77	57	76.23762			76	16	75	44	74.25743	D75	64
30	78	58	77.22772			77	11	77	45	76.23762		64
14	78	58	77.22772			78	<2	77	45	76.23762		64
36	80	60	79.20792			79	<2	79	46	78.21782		64
37	80	60	79.20792			80	9	80	48	79.20792		64
	80	60	79.20792			81	38	80	48	79.20792		64
	80	60	79.20792			82	22	82	49	81.18812		64
85	84	62	83.16832			83	<2	82	49	81.18812		64

15	20	12	10	11.88119			14		62	1	1	0.990099	
16	30	12	10	11.88119			15		65	1	1	0.990099	
17	14	17	11	16.83168	D16	11	16		35	1	1	0.990099	
18	10	17	11	16.83168			17	<2		1	1	0.990099	
19	30	17	11	16.83168			18		120	1	1	0.990099	
20	16	20	12	19.80198			19		54	1	1	0.990099	
21	28	21	13	20.79208			20		30	1	1	0.990099	
22	73	22	14	21.78218			21	<2		1	1	0.990099	
23	30	22	14	21.78218			22		45	1	1	0.990099	d16=2
24	34	22	14	21.78218			23		34	23	2	22.77228	
25	45	25	15	24.75248			24		46	24	4	23.76238	
26	30	25	15	24.75248			25		34	25	12	24.75248	
27	20	25	15	24.75248	D25	15	26	<2		25	12	24.75248	D25
28	40	28	16	27.72277			27		68	27	13	26.73267	
29	20	28	16	27.72277			28		24	28	16	27.72277	
30	10	28	16	27.72277			29		13	28	16	27.72277	
31	9	28	16	27.72277			30		51	28	16	27.72277	
32	20	28	16	27.72277			31	<2		31	18	30.69307	
33	14	33	17	32.67327			32		49	32	22	31.68317	
34	17	33	17	32.67327			33		31	33	23	32.67327	
35	5	35	18	34.65347			34		18	34	24	33.66337	
36	11	35	18	34.65347			35	<2		34	24	33.66337	
37	23	35	18	34.65347			36		87	36	25	35.64356	
38	42	38	19	37.62376			37		50	36	25	35.64356	
39	12	39	19	38.61386			38		24	38	26	37.62376	
40	10	40	20	39.60396			39		38	38	26	37.62376	
41	20	40	20	39.60396			40		52	40	29	39.60396	
42	26	40	20	39.60396			41	<2		41	30	40.59406	
43	23	40	20	39.60396			42		29	41	30	40.59406	
44	10	40	20	39.60396			43	<2		41	30	40.59406	
45	22	40	20	39.60396			44		49	41	30	40.59406	
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47	32	40	20	39.60396			46		26	46	34	45.54455	
48	30	48	21	47.52475			47		12	46	34	45.54455	
49	23	49	22	48.51485			48		35	46	34	45.54455	
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51	22	49	22	48.51485			50	<2		49	35	48.51485	
52	16	49	22	48.51485	D50	22	51	<2		49	35	48.51485	D50=36
53	19	53	23	52.47525			52		80	52	37	51.48515	
54	18	53	23	52.47525			53		70	53	38	52.47525	
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56	25	53	23	52.47525			55		76	55	39	54.45545	
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60	16	60	25	59.40594			59		51	59	41	58.41584	
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66	25	65	26	64.35644			65		49	65	45	64.35644	
67	23	65	26	64.35644			66		43	65	45	64.35644	
68	20	68	27	67.32673			67		50	67	46	66.33663	
69	15	69	28	68.31683			68		16	67	46	66.33663	
70	25	69	28	68.31683			69		2	69	49	68.31683	
71	18	69	28	68.31683			70		4	69	49	68.31683	
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73	35	73	30	72.27723			72		44	72	50	71.28713	
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75	33	73	30	72.27723			74	<2		72	50	71.28713	
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77	18	73	30	72.27723			76		44	76	51	75.24752	D75
78	34	73	30	72.27723			77		50	76	51	75.24752	
79	22	73	30	72.27723	D75	31	78		30	78	52	77.22772	
80	27	80	32	79.20792			79		85	79	54	78.21782	
81	40	81	33	80.19802			80		34	79	54	78.21782	
82	28	82	34	81.18812			81	<2		81	55	80.19802	
83	36	82	34	81.18812			82		50	81	55	80.19802	
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14	16	14	24	13.86139		
15	70	14	24	13.86139		
16	76	16	25	15.84158		
17	90	16	25	15.84158	D16	25
18	56	18	26	17.82178		
19	21	18	26	17.82178		
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26	75	26	31	25.74257	D25	31
27	92	27	32	26.73267		
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41	40	41	42	40.59406		
42	13	42	43	41.58416		
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47	17	46	45	45.54455		
48	24	48	46	47.52475		
49	38	48	46	47.52475		
50	30	50	47	49.50495		
51	15	50	47	49.50495	D50	47
52	44	52	48	51.48515		
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57	61	56	52	55.44554		
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68	140	68	61	67.32673		
69	48	69	64	68.31683		
70	130	70	65	69.30693		
71	30	70	65	69.30693		
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75	23	75	70	74.25743		
76	81	75	70	74.25743	D75	71
77	47	77	73	76.23762		
78	94	78	75	77.22772		
79	120	79	76	78.21782		
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81	82	81	79	80.19802		
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16	31	16	20	15.84158	D16	3
17	80	16	20	15.84158		3
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75	20	75	66	74.25743		12
76	36	76	67	75.24752	D75	12
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81	33	80	70	79.20792		12
82	9	82	71	81.18812		12

14	19	13	12	12.87129		
15	55	15	13	14.85149		
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17	21	17	14	16.83168	D16	14
18	11	18	15	17.82178		
19	21	18	15	17.82178		
20	33	18	15	17.82178		
21	16	18	15	17.82178		
22	12	22	16	21.78218		
23	10	23	17	22.77228		
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26	35	26	20	25.74257	D25	20
27	30	26	20	25.74257		
28	<2	26	20	25.74257		
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53	14	51	30	50.49505		
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74	33	74	37	73.26733		
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77	22	77	38	76.23762	D75	38
78	30	78	40	77.22772		
79	23	78	40	77.22772		
80	8	78	40	77.22772		
81	20	78	40	77.22772		
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83	25	78	40	77.22772		
84	37	84	42	83.16832		
85	25	85	45	84.15842		

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14	67	1	1	0.990099		2
15	40	1	1	0.990099		2
16	19	1	1	0.990099		2
17	25	1	1	0.990099		2
18	35	1	1	0.990099		2
19	<2	1	1	0.990099		2
20	<2	1	1	0.990099		2
21	21	1	1	0.990099		2
22	67	1	1	0.990099		2
23	31	1	1	0.990099		2
24	<2	1	1	0.990099		2
25	24	1	1	0.990099		2
26	50	1	1	0.990099		2
27	<2	1	1	0.990099		2
28	12	1	1	0.990099	D16=3	2
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42	37	42	15	41.58416		16
43	24	43	16	42.57426		32
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46	<2	46	18	45.54455		32
47	<2	47	19	46.53465		32
48	<2	48	21	47.52475		32
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51	60	51	23	50.49505	D50	32
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81	<2	81	40	80.19802		64
82	11	81	40	80.19802		64
83	40	81	40	80.19802		64
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16	54	16	19	15.84158	D16	19	15	55	11	20	10.89109	
17	28	17	20	16.83168			16	49	16	21	15.84158	D16
18	60	18	25	17.82178			17	32	17	22	16.83168	
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24	72	23	28	22.77228			23	42	23	27	22.77228	
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26	29	26	29	25.74257			25	25	25	29	24.75248	D25
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51	30	51	47	50.49505	D50	47	50	50	50	41	49.50495	
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76	20	74	28	73.26733		
77	37	74	28	73.26733		
78	25	74	28	73.26733	D75	29
79	28	79	30	78.21782		
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81	20	79	30	78.21782		
82	30	79	30	78.21782		
83	10	83	32	82.17822		

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14	15	14	9	13.86139	
15	25	14	9	13.86139	
16	15	14	9	13.86139	
17	6	14	9	13.86139	
18	10	18	10	17.82178	D16
19	30	18	10	17.82178	
20	30	18	10	17.82178	
21	7	18	10	17.82178	
22	16	18	10	17.82178	
23	26	23	11	22.77228	
24	13	23	11	22.77228	
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27	20	25	12	24.75248	
28	9	25	12	24.75248	
29	16	25	12	24.75248	D25
30	21	30	13	29.70297	
31	15	30	13	29.70297	
32	10	32	14	31.68317	
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34	4	34	15	33.66337	
35	7	34	15	33.66337	
36	23	34	15	33.66337	
37	30	34	15	33.66337	
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39	21	34	15	33.66337	
40	14	34	15	33.66337	
41	26	41	16	40.59406	
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49	9	47	20	46.53465	
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51	6	51	21	50.49505	D50
52	35	51	21	50.49505	
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66	33	64	25	63.36634	
67	12	67	26	66.33663	
68	20	67	26	66.33663	
69	32	67	26	66.33663	
70	29	70	27	69.30693	
71	12	71	28	70.29703	
72	36	72	29	71.28713	
73	22	72	29	71.28713	
74	11	74	30	73.26733	
75	23	74	30	73.26733	
76	30	74	30	73.26733	
77	53	74	30	73.26733	
78	21	74	30	73.26733	D75
79	33	79	31	78.21782	
80	14	79	31	78.21782	
81	31	79	31	78.21782	
82	25	82	32	81.18812	

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15	26	1	1	0.990099			14	49	14	10	13.86139	
16	20	1	1	0.990099			15	<2	15	12	14.85149	
17	<2	1	1	0.990099			16	<2	15	12	14.85149	
18	30	18	8	17.82178	D16	7	17	41	17	13	16.83168	D16
19	<2	19	9	18.81188			18	65	17	13	16.83168	
20	24	20	11	19.80198			19	26	19	14	18.81188	
21	<2	21	12	20.79208			20	70	20	18	19.80198	
22	<2	21	12	20.79208			21	12	21	19	20.79208	
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24	<2	23	15	22.77228			23	69	22	20	21.78218	
25	50	23	15	22.77228			24	42	24	21	23.76238	
26	41	26	16	25.74257			25	23	25	22	24.75248	D25
27	40	26	16	25.74257			26	50	26	23	25.74257	
28	50	26	16	25.74257	D25	16	27	30	26	23	25.74257	
29	50	29	18	28.71287			28	53	28	24	27.72277	
30	12	29	18	28.71287			29	<2	29	25	28.71287	
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33	15	33	19	32.67327			32	<2	32	27	31.68317	
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35	45	34	20	33.66337			34	<2	32	27	31.68317	
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37	50	37	21	36.63366			36	<2	36	29	35.64356	
38	35	38	22	37.62376			37	25	37	30	36.63366	
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40	32	38	22	37.62376			39	42	39	31	38.61386	
41	22	41	23	40.59406			40	36	39	31	38.61386	
42	30	42	23	41.58416			41	27	41	32	40.59406	
43	<2	42	23	41.58416			42	18	41	32	40.59406	
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45	41	44	24	43.56436			44	44	44	35	43.56436	
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47	47	44	24	43.56436			46	38	46	36	45.54455	
48	16	44	24	43.56436			47	45	46	36	45.54455	
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50	27	50	25	49.50495			49	<2	49	37	48.51485	
51	45	50	25	49.50495	D50	25	50	85	49	37	48.51485	
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53	35	52	26	51.48515			52	24	51	38	50.49505	
54	37	54	27	53.46535			53	60	53	39	52.47525	
55	22	55	29	54.45545			54	10	53	39	52.47525	
56	46	56	30	55.44554			55	7	55	40	54.45545	
57	40	56	30	55.44554			56	45	55	40	54.45545	
58	50	56	30	55.44554			57	13	57	41	56.43564	
59	18	59	31	58.41584			58	31	57	41	56.43564	
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62	8	62	35	61.38614			61	20	59	42	58.41584	
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65	<2	64	36	63.36634			64	42	64	45	63.36634	
66	<2	66	37	65.34653			65	48	64	45	63.36634	
67	24	67	39	66.33663			66	23	64	45	63.36634	
68	23	67	39	66.33663			67	13	67	46	66.33663	
69	50	69	40	68.31683			68	27	67	46	66.33663	
70	49	69	40	68.31683			69	49	69	47	68.31683	
71	39	71	41	70.29703			70	50	69	47	68.31683	
72	22	71	41	70.29703			71	50	71	48	70.29703	
73	20	73	42	72.27723			72	32	72	49	71.28713	
74	19	74	43	73.26733			73	50	72	49	71.28713	
75	25	75	45	74.25743			74	46	74	50	73.26733	
76	9	75	45	74.25743			75	34	74	50	73.26733	
77	31	75	45	74.25743			76	12	74	50	73.26733	
78	23	75	45	74.25743	D75	45	77	52	74	50	73.26733	
79	<2	79	46	78.21782			78	21	74	50	73.26733	D75=51
80	<2	80	47	79.20792			79	<2	79	52	78.21782	
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82	24	82	49	81.18812			81	54	81	54	80.19802	
83	18	83	50	82.17822			82	31	82	55	81.18812	

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16	140	16	16	15.84158	D16	16
17	53	16	16	15.84158		
18	135	16	16	15.84158		
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22	20	19	20	18.81188		
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24	<2	24	23	23.76238		
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26	50	25	25	24.75248		
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28	28	25	25	24.75248		
29	15	25	25	24.75248	D25	25
30	31	30	26	29.70297		
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39	25	39	30	38.61386		
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42	125	39	30	38.61386		
43	63	39	30	38.61386		
44	125	39	30	38.61386		
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46	65	46	32	45.54455		
47	40	46	32	45.54455		
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54	90	52	40	51.48515		
55	27	55	41	54.45545		
56	40	56	43	55.44554		
57	110	57	45	56.43564		
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62	25	62	50	61.38614		
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65	33	65	53	64.35644		
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67	20	67	55	66.33663		
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76	75	76	69	75.24752	D75	69
77	46	77	70	76.23762		
78	25	77	70	76.23762		
79	15	79	75	78.21782		
80	9	80	76	79.20792		
81	28	81	79	80.19802		
82	16	82	80	81.18812		
83	29	83	82	82.17822		

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15	40	15	8	14.85149	
16	90	15	8	14.85149	
17	25	17	9	16.83168	D16
18	11	17	9	16.83168	
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49	9	43	20	42.57426	
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55	76	55	26	54.45545	
56	32	56	27	55.44554	
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58	20	58	29	57.42574	
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72	19	72	37	71.28713	
73	20	73	39	72.27723	
74	75	74	40	73.26733	
75	20	75	41	74.25743	
76	27	76	45	75.24752	D75
77	22	77	49	76.23762	
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80	20	80	51	79.20792	
81	36	81	54	80.19802	
82	36	82	55	81.18812	

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18	86	18	54	17.82178		
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22	84	20	55	19.80198		
23	70	23	57	22.77228		
24	50	23	57	22.77228		
25	60	25	59	24.75248	D25	59
26	90	26	60	25.74257		
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30	82	30	62	29.70297		
31	62	30	62	29.70297		
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46	72	46	72	45.54455		
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50	80	50	74	49.50495		
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54	90	54	76	53.46535		
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56	115	56	78	55.44554		
57	70	57	80	56.43564		
58	90	57	80	56.43564		
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67	85	65	84	64.35644		
68	59	68	85	67.32673		
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70	140	70	86	69.30693		
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72	78	72	88	71.28713		
73	76	73	89	72.27723		
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75	83	75	90	74.25743		
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79	72	75	90	74.25743		
80	75	75	90	74.25743	D75	90
81	143	81	92	80.19802		
82	90	82	95	81.18812		
83	213	82	95	81.18812		
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13	140	13	46	12.87129		
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15	60	15	50	14.85149		
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17	88	17	51	16.83168	D16	
18	93	18	52	17.82178		
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27	82	27	61	26.73267	D25	
28	84	27	61	26.73267		
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74	97	74	93	73.26733		1
75	96	75	94	74.25743		1
76	77	75	94	74.25743	D75	1
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82	76	82	100	81.18812		1
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19	33	18	22	17.82178			18	20	18	17	17.82178	
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21	25	21	23	20.79208			20	54	19	18	18.81188	
22	18	22	25	21.78218			21	12	19	18	18.81188	
23	45	22	25	21.78218			22	80	22	19	21.78218	
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25	54	25	26	24.75248	D25	26	24	60	24	20	23.76238	
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27	90	27	28	26.73267			26	47	24	20	23.76238	
28	20	28	30	27.72277			27	35	24	20	23.76238	D25
29	20	29	31	28.71287			28	33	28	21	27.72277	
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32	36	31	32	30.69307			31	22	28	21	27.72277	
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34	62	33	33	32.67327			33	19	32	22	31.68317	
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36	78	36	34	35.64356			35	35	35	23	34.65347	
37	95	37	35	36.63366			36	31	36	24	35.64356	
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39	22	37	35	36.63366			38	18	38	25	37.62376	
40	60	40	36	39.60396			39	37	38	25	37.62376	
41	57	41	38	40.59406			40	31	40	26	39.60396	
42	18	41	38	40.59406			41	4	41	27	40.59406	
43	74	41	38	40.59406			42	22	41	27	40.59406	
44	82	44	39	43.56436			43	11	41	27	40.59406	
45	30	45	40	44.55446			44	20	44	31	43.56436	
46	33	45	40	44.55446			45	38	44	31	43.56436	
47	50	45	40	44.55446			46	25	44	31	43.56436	
48	40	48	42	47.52475			47	60	47	33	46.53465	
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51	82	50	45	49.50495	D50	45	50	52	48	35	47.52475	
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53	60	53	50	52.47525			52	26	48	35	47.52475	
54	32	53	50	52.47525			53	7	53	36	52.47525	D50
55	39	53	50	52.47525			54	31	53	36	52.47525	
56	45	53	50	52.47525			55	69	55	37	54.45545	
57	42	53	50	52.47525			56	54	56	38	55.44554	
58	35	58	52	57.42574			57	93	56	38	55.44554	
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65	71	65	58	64.35644			64	88	62	42	61.38614	
66	20	66	60	65.34653			65	104	62	42	61.38614	
67	40	66	60	65.34653			66	42	62	42	61.38614	
68	25	66	60	65.34653			67	<2	67	44	66.33663	
69	54	66	60	65.34653			68	<2	68	45	67.32673	
70	64	66	60	65.34653			69	<2	69	46	68.31683	
71	38	71	62	70.29703			70	18	70	47	69.30693	
72	23	71	62	70.29703			71	19	70	47	69.30693	
73	32	73	64	72.27723			72	60	72	48	71.28713	
74	16	74	65	73.26733			73	33	73	49	72.27723	
75	32	75	66	74.25743			74	50	73	49	72.27723	
76	28	75	66	74.25743	D75	66	75	80	75	50	74.25743	
77	35	77	67	76.23762			76	<2	75	50	74.25743	D75
78	26	78	70	77.22772			77	27	77	51	76.23762	
79	38	79	71	78.21782			78	24	78	52	77.22772	
80	90	80	73	79.20792			79	21	78	52	77.22772	
81	85	81	74	80.19802			80	16	80	54	79.20792	
82	50	82	75	81.18812			81	18	80	54	79.20792	
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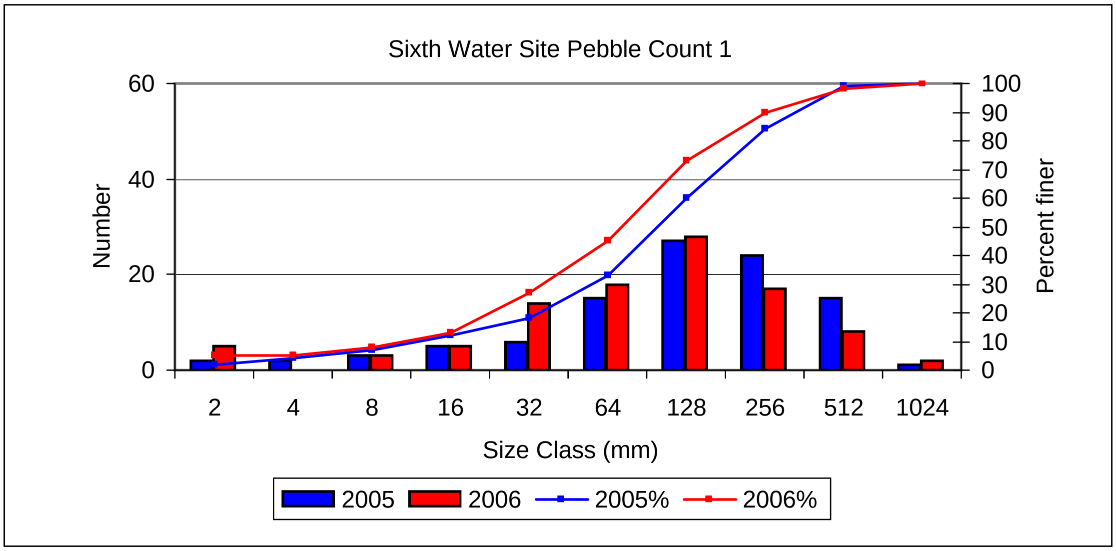
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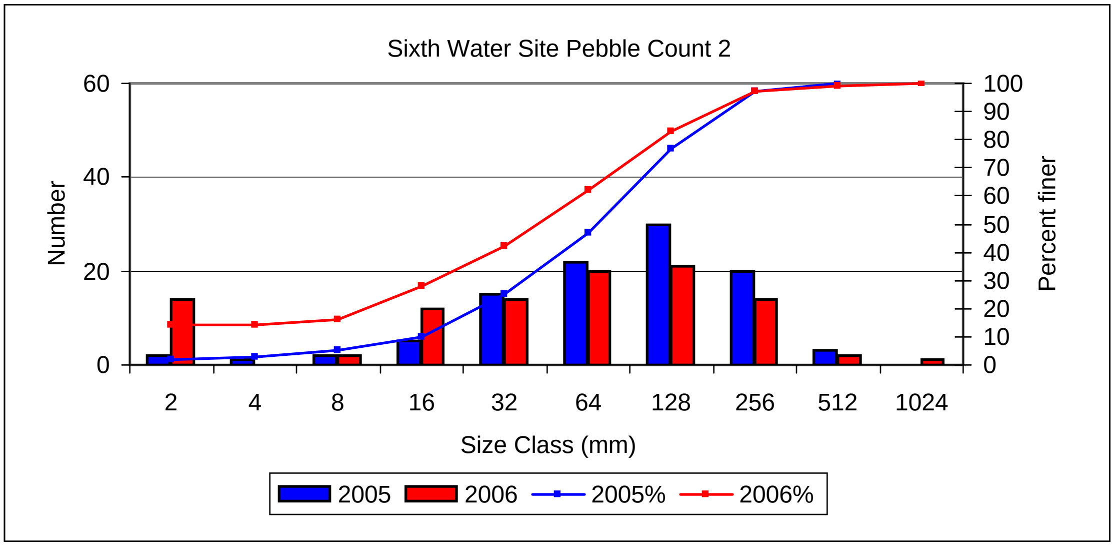
Number
60
40
20
0
100
90
80
70
60
50
40
30
20
10
0
Percent finer
2
4
8
16
32
64
128
256
512
1024
Size Class (mm)
2005
2006
2005%
2006%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Number
60
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20
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100
90
80
70
60
50
40
30
20
10
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Percent finer
2
4
8
16
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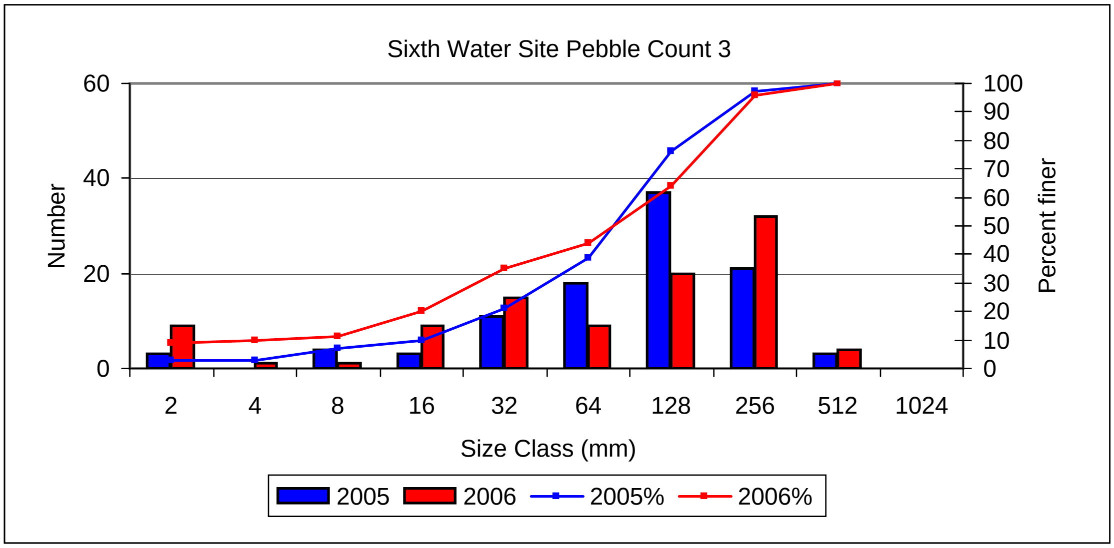
1024
Size Class (mm)
2005
2006
2005%
2006%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Number
60
40
20
0
100
90
80
70
60
50
40
30
20
10
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Percent finer
2
4
8
16
32
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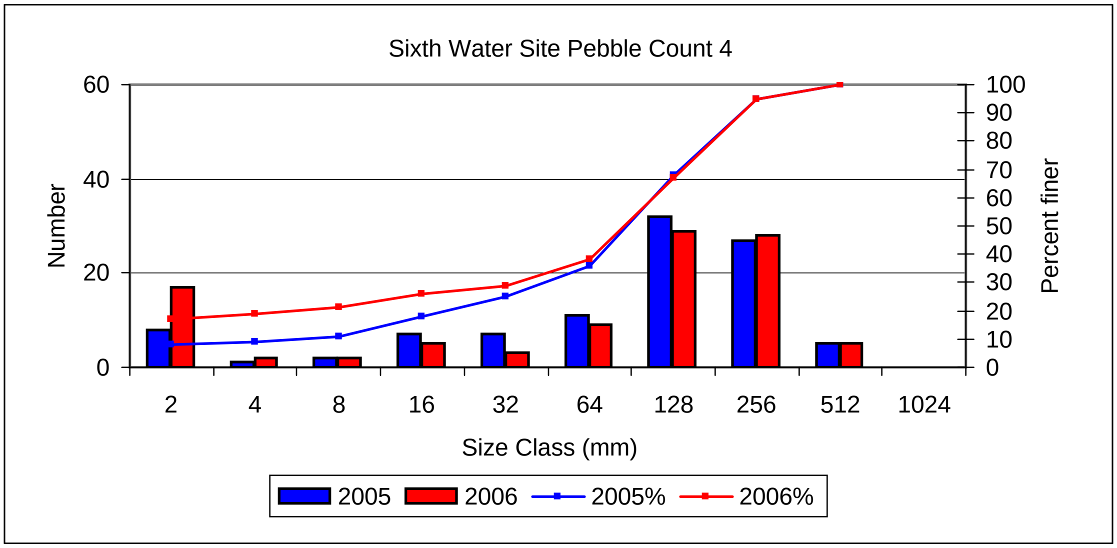
128
256
512
1024
Size Class (mm)
2005
2006
2005%
2006%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Number
Percent finer
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40
60
0
10
20
30
40
50
60
70
80
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100
2
4
8
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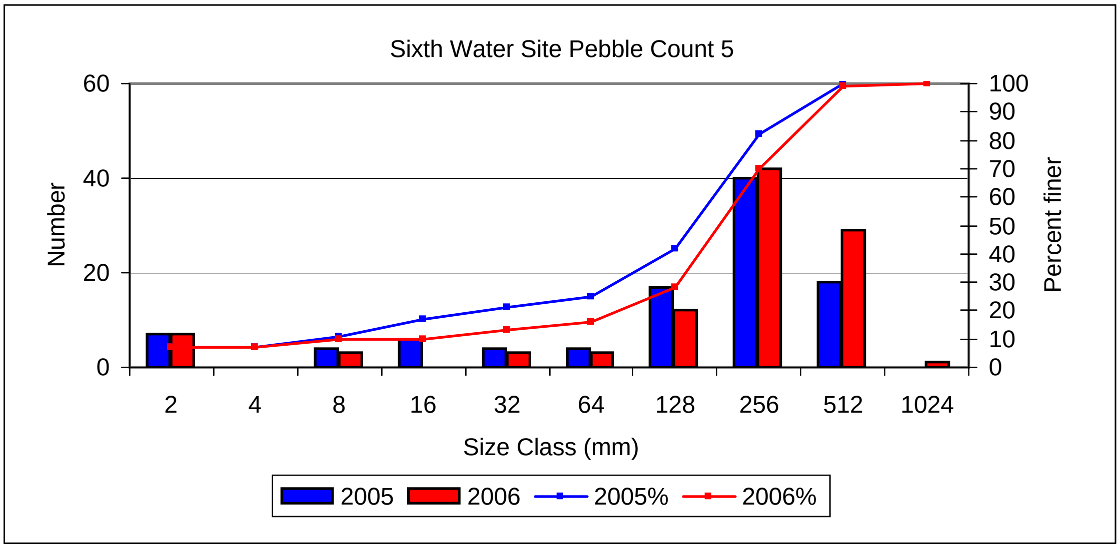
512
1024
Size Class (mm)
2005
2006
2005%
2006%


Sixth Water Site Pebble Count 5
Number
Percent finer
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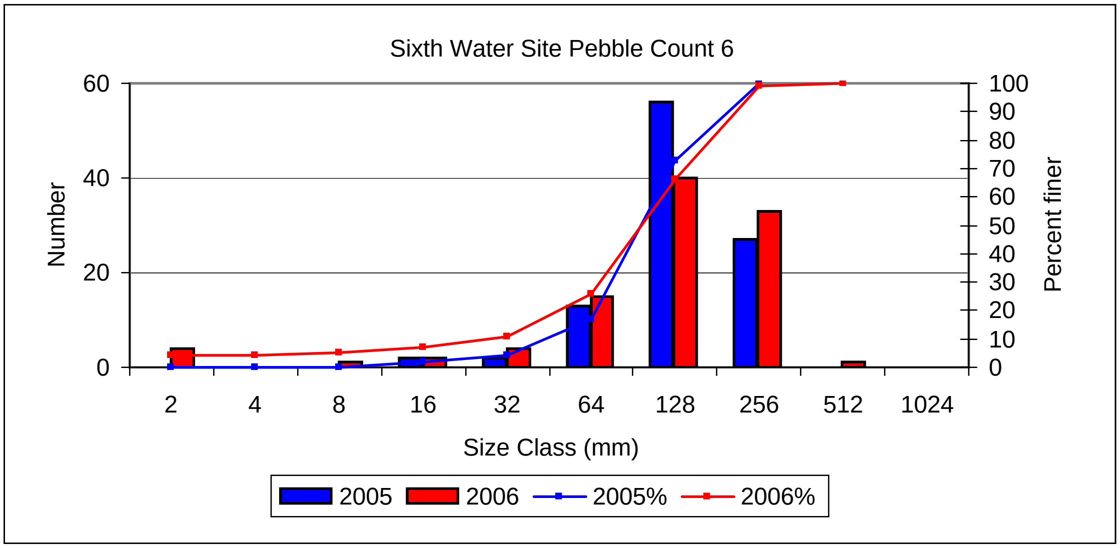
20
40
60
0
10
20
30
40
50
60
70
80
90
100
2
4
8
16
32
64
128
256
512
1024
Size Class (mm)
2005
2006
2005%
2006%


Sixth Water Site Pebble Count 6
Number
Percent finer
0
20
40
60
0
10
20
30
40
50
60
70
80
90
100
2
4
8
16
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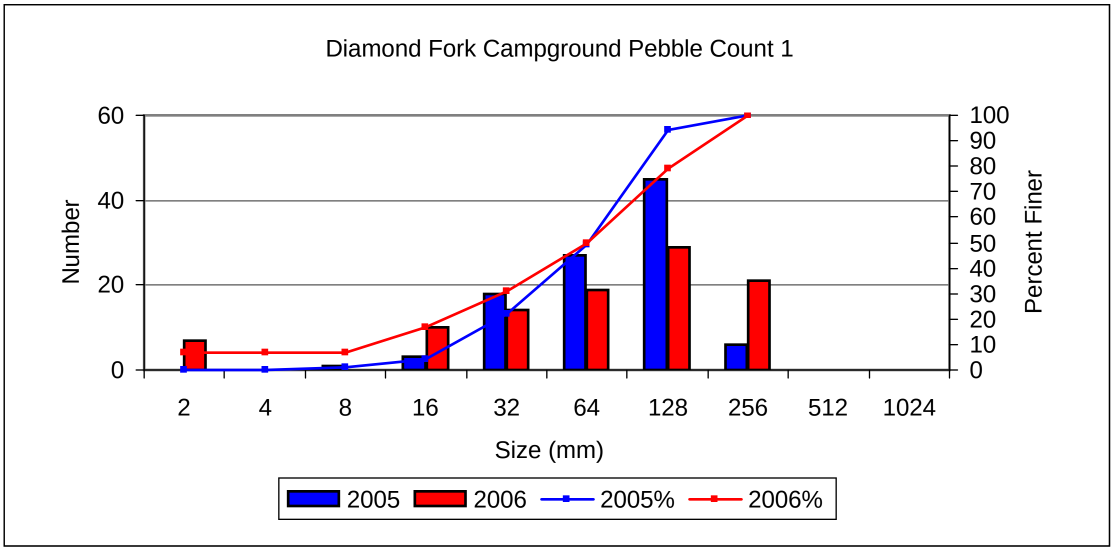
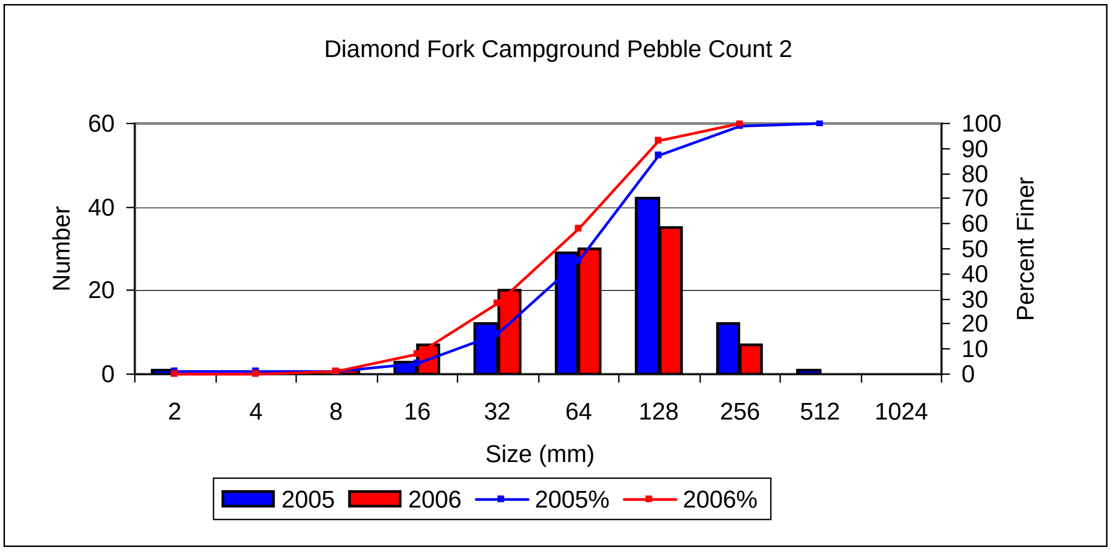
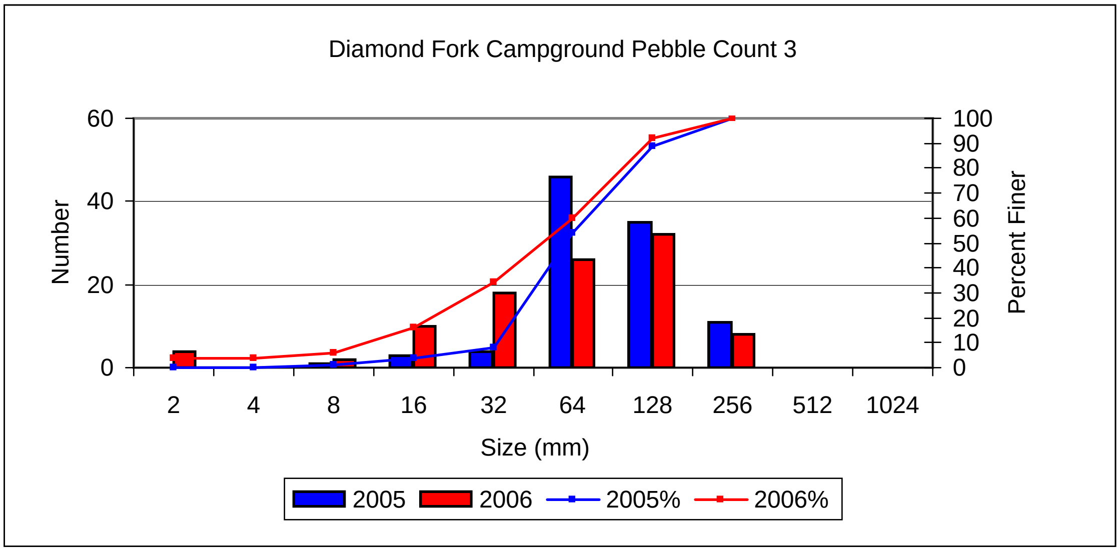
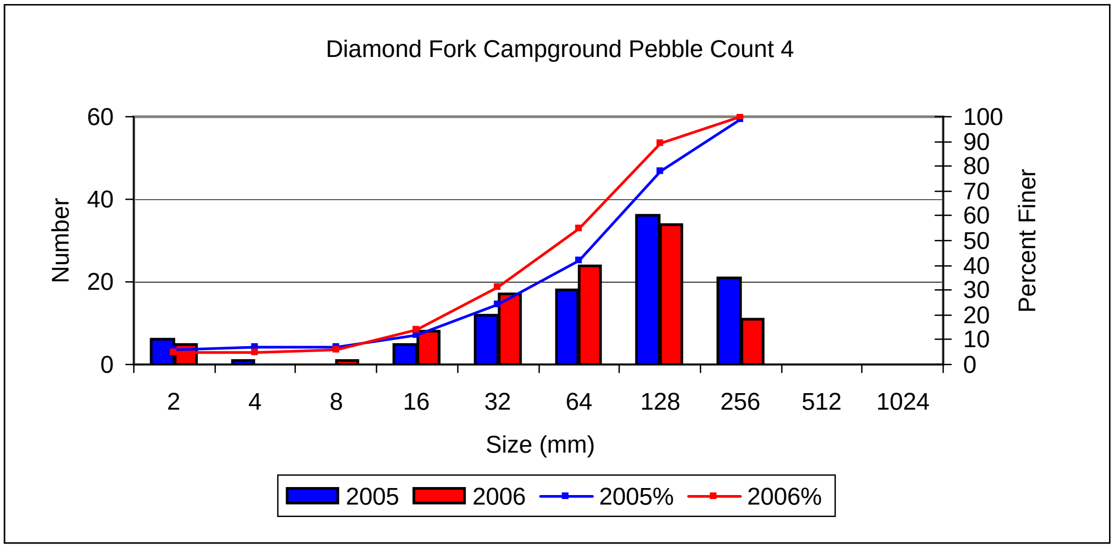
1024
Size Class (mm)
2005
2006
2005%
2006%


Diamond Fork Campground Pebble Count 1


Diamond Fork Campground Pebble Count 2


Diamond Fork Campground Pebble Count 3


Diamond Fork Campground Pebble Count 4
Number
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20
40
60
Percent Finer
0
10
20
30
40
50
60
70
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90
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2
4
8
16
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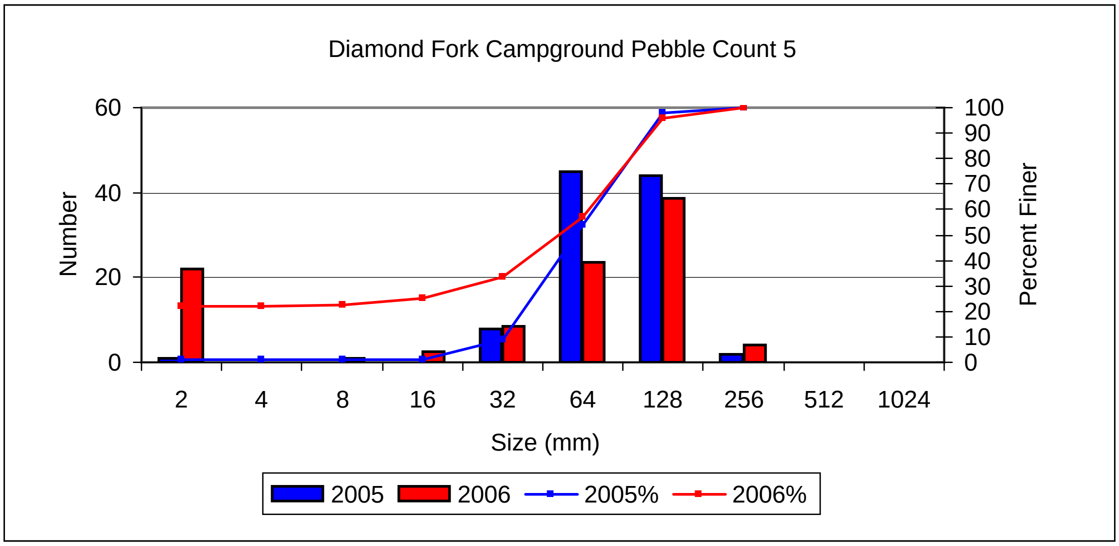
256
512
1024
Size (mm)
2005
2006
2005%
2006%


Diamond Fork Campground Pebble Count 5
Number
0
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60
Percent Finer
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10
20
30
40
50
60
70
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90
100
2
4
8
16
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128
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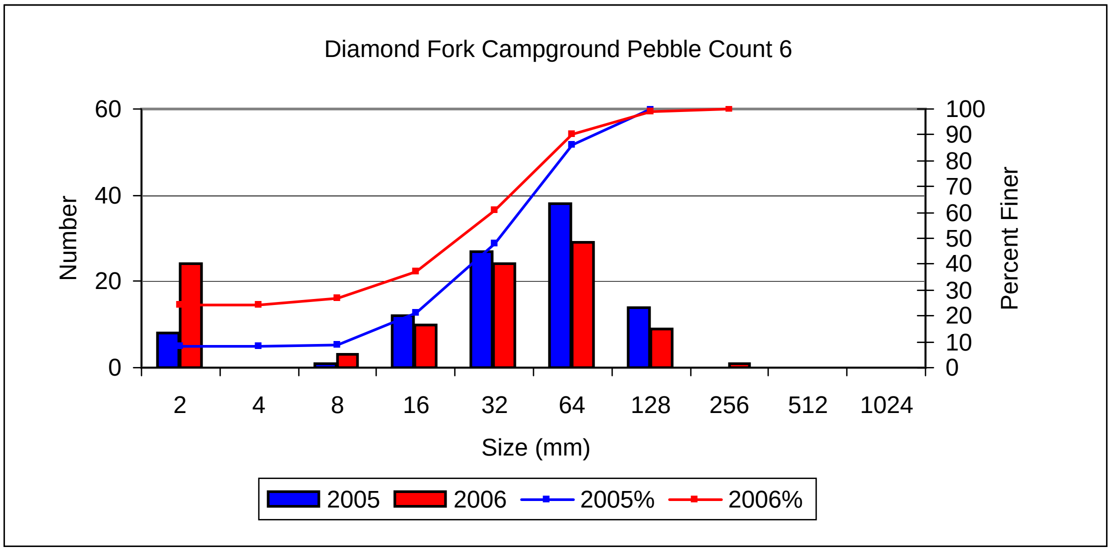
512
1024
Size (mm)
2005
2006
2005%
2006%


Diamond Fork Campground Pebble Count 6
Number
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40
60
Percent Finer
0
10
20
30
40
50
60
70
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90
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2
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8
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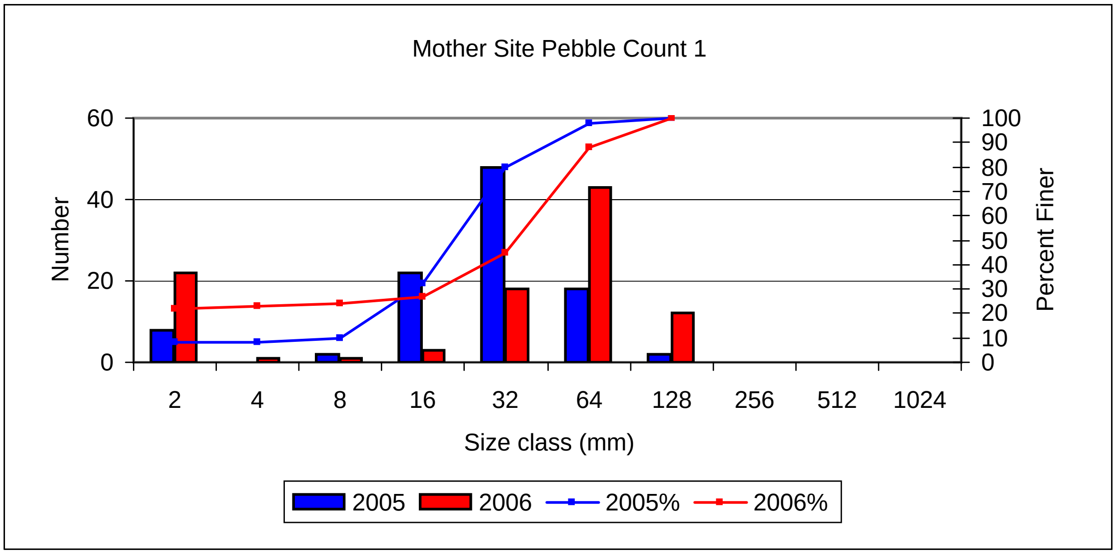
Size (mm)
2005
2006
2005%
2006%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Number
100
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80
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60
50
40
30
20
10
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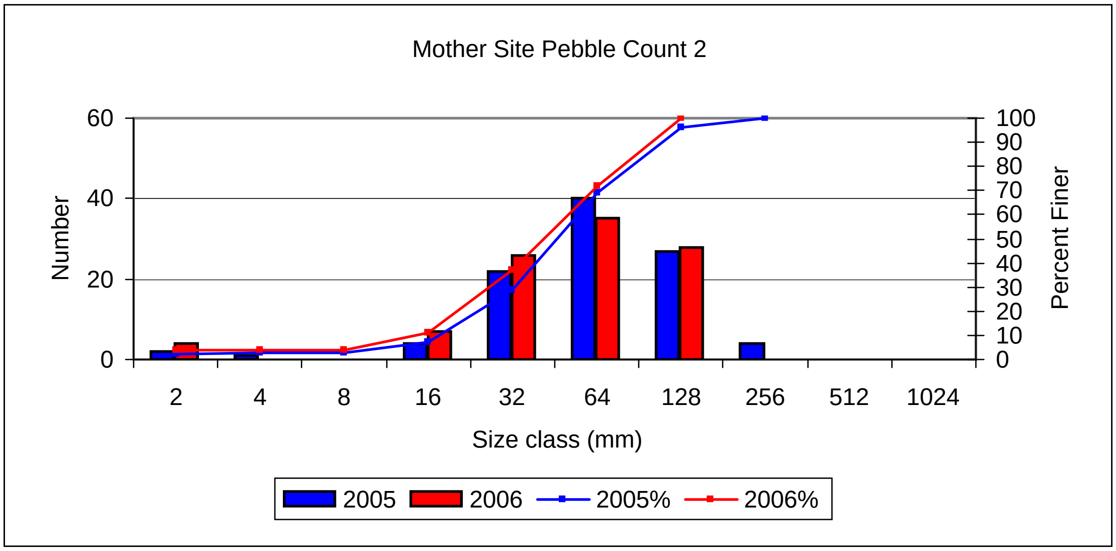
Percent Finer
2
4
8
16
32
64
128
256
512
1024
Size class (mm)
2005
2006
2005%
2006%


Mother Site Pebble Count 2
60
40
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0
Number
100
90
80
70
60
50
40
30
20
10
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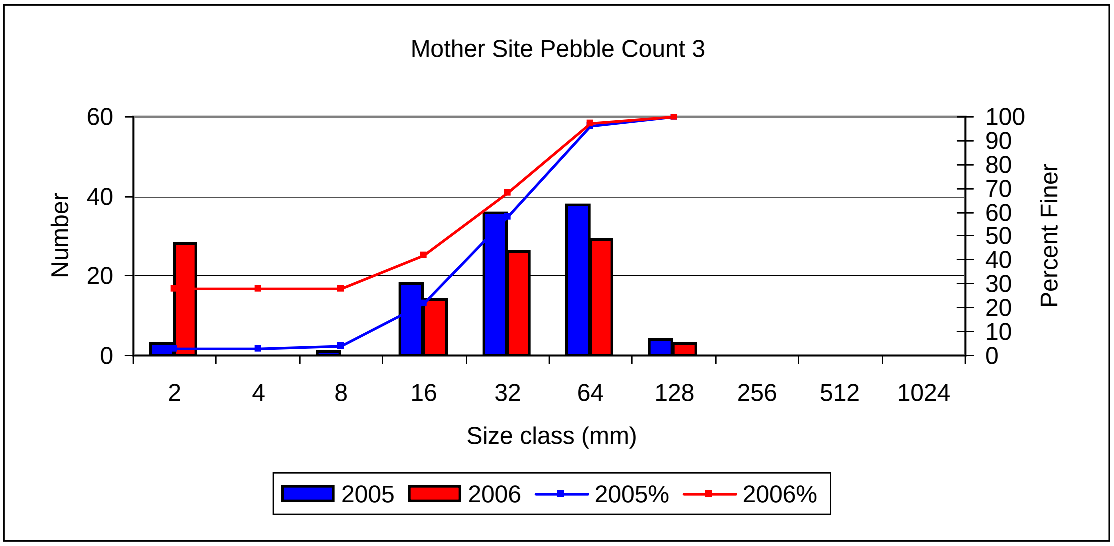
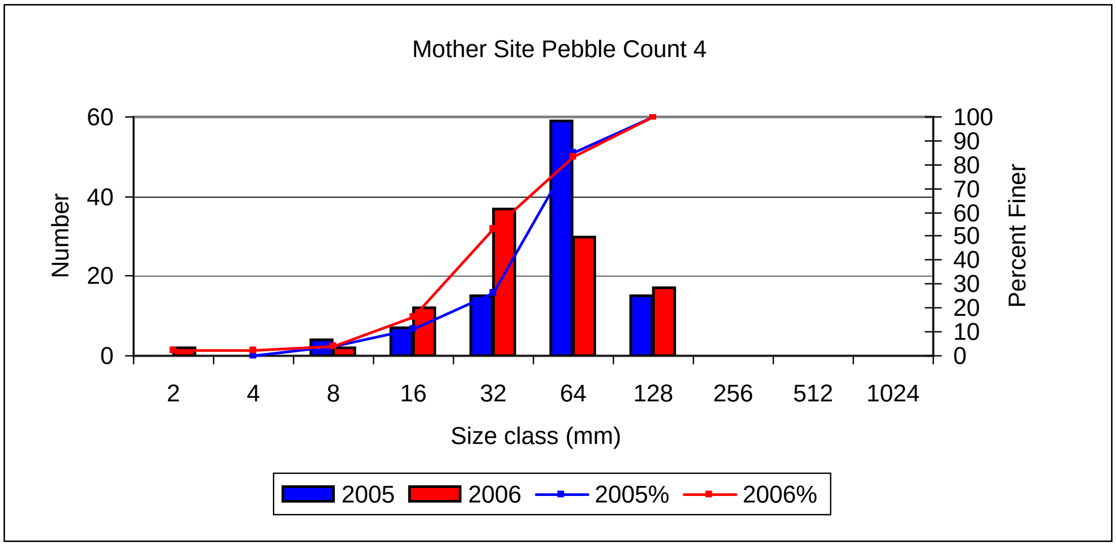
Percent Finer
2
4
8
16
32
64
128
256
512
1024
Size class (mm)
2005
2006
2005%
2006%


Mother Site Pebble Count 3
60
40
20
0
Number
100
90
80
70
60
50
40
30
20
10
0
Percent Finer
2
4
8
16
32
64
128
256
512
1024
Size class (mm)
2005
2006
2005%
2006%


Mother Site Pebble Count 4
Number
60
40
20
0
Percent Finer
100
90
80
70
60
50
40
30
20
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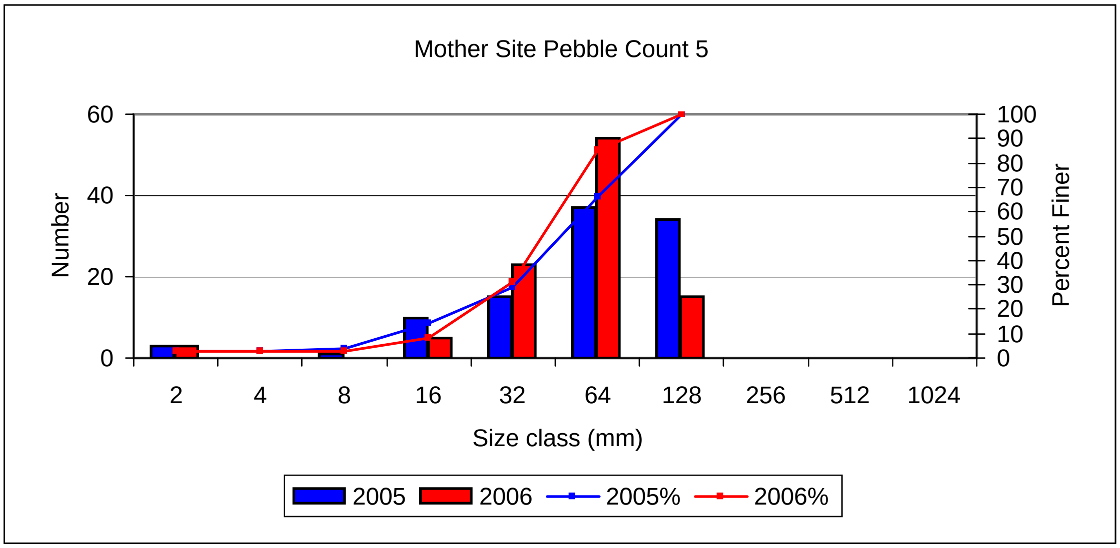
16
32
64
128
256
512
1024
Size class (mm)
2005
2006
2005%
2006%


Mother Site Pebble Count 5
Number
60
40
20
0
Percent Finer
100
90
80
70
60
50
40
30
20
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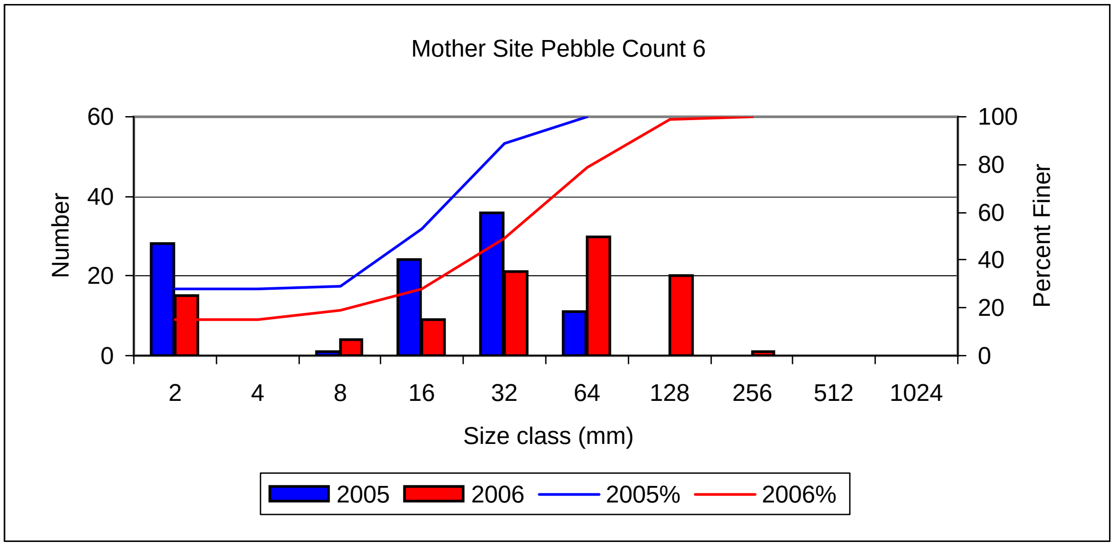
1024
Size class (mm)
2005
2006
2005%
2006%


Mother Site Pebble Count 6
Number
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20
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Percent Finer
100
80
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2
4
8
16
32
64
128
256
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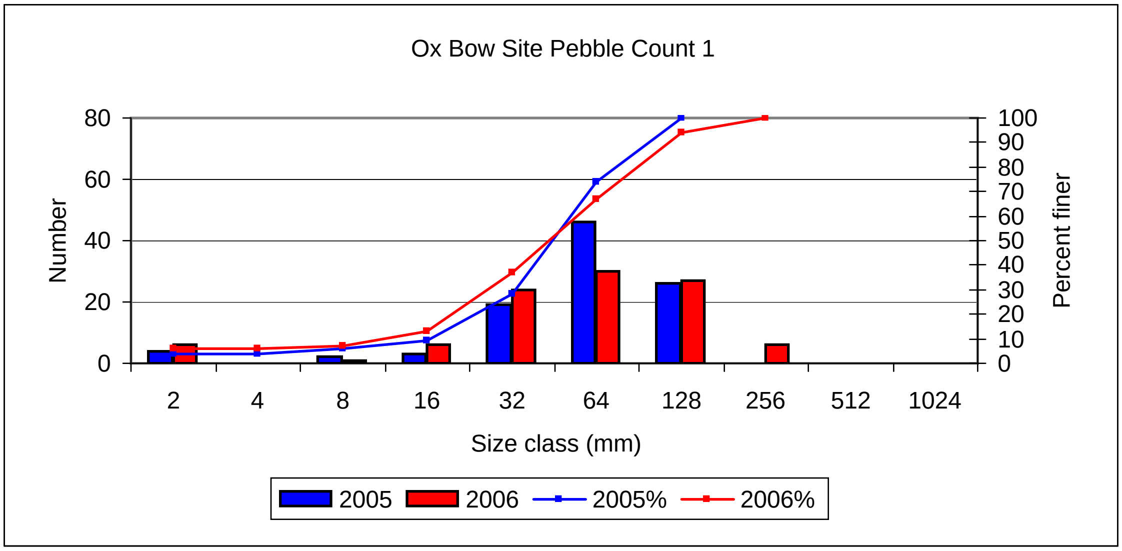
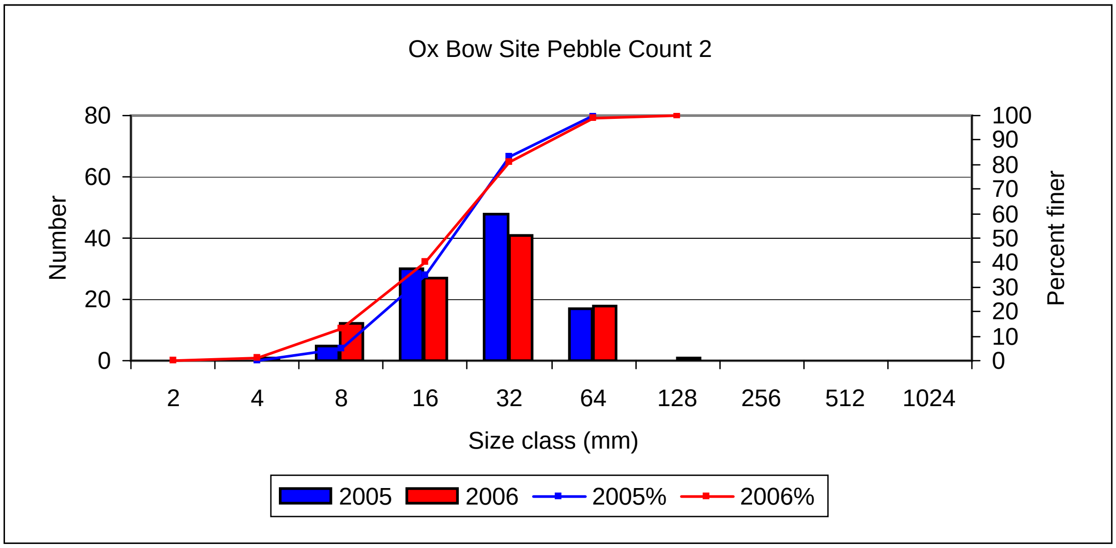
1024
Size class (mm)
2005
2006
2005%
2006%


Ox Bow Site Pebble Count 1
Number
0
20
40
60
80
Percent finer
0
10
20
30
40
50
60
70
80
90
100
2
4
8
16
32
64
128
256
512
1024
Size class (mm)
2005
2006
2005%
2006%


Ox Bow Site Pebble Count 2
Number
0
20
40
60
80
Percent finer
0
10
20
30
40
50
60
70
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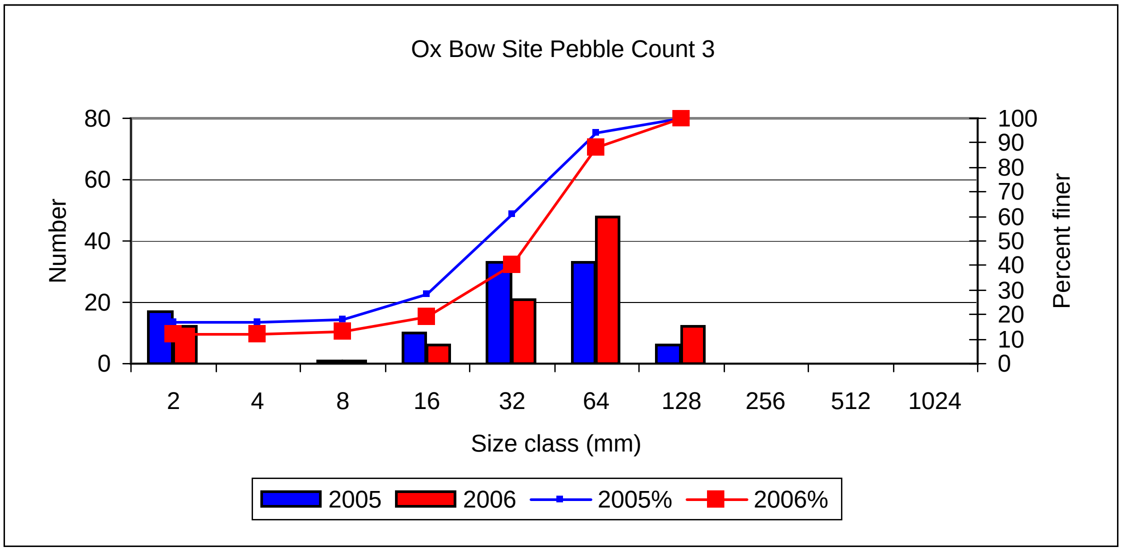
100
2
4
8
16
32
64
128
256
512
1024
Size class (mm)
2005
2006
2005%
2006%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Number
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40
60
80
Percent finer
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10
20
30
40
50
60
70
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1024
Size class (mm)
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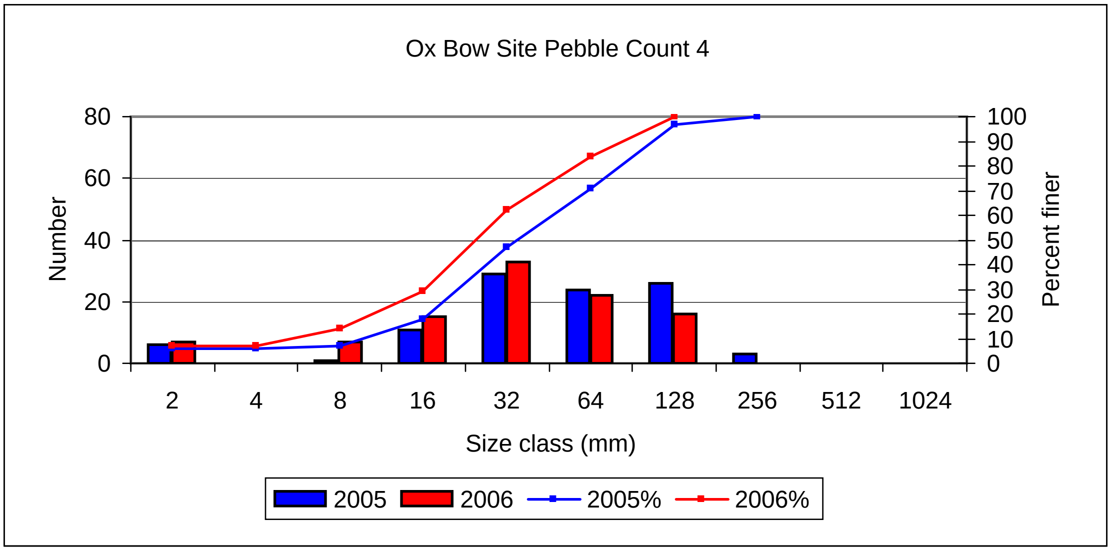
2006
2005%
2006%


Ox Bow Site Pebble Count 4
Number
Percent finer
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40
20
0
100
90
80
70
60
50
40
30
20
10
0
2
4
8
16
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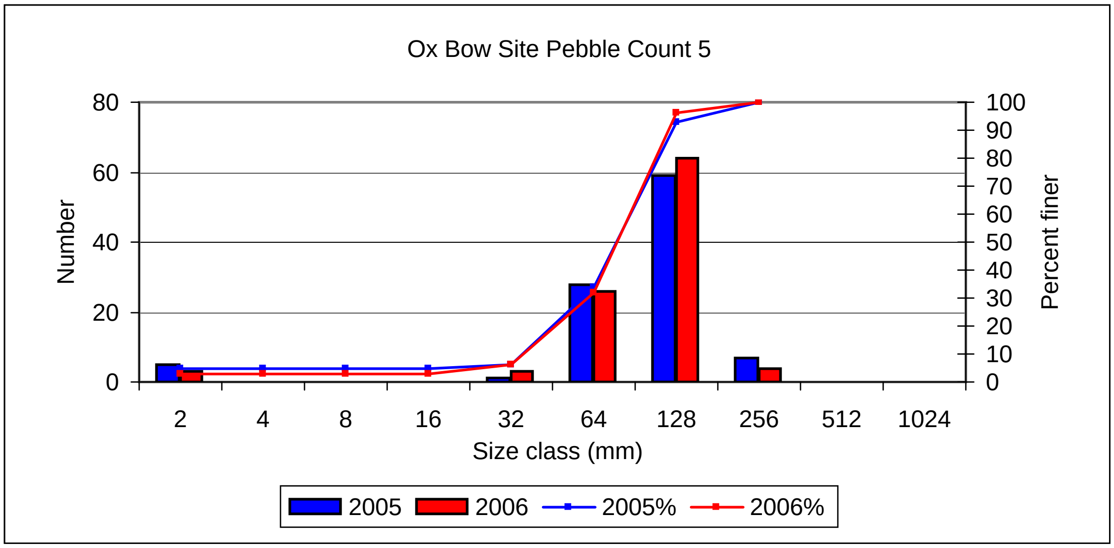
64
128
256
512
1024
Size class (mm)
2005
2006
2005%
2006%


Ox Bow Site Pebble Count 5
Number
Percent finer
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60
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20
0
100
90
80
70
60
50
40
30
20
10
0
2
4
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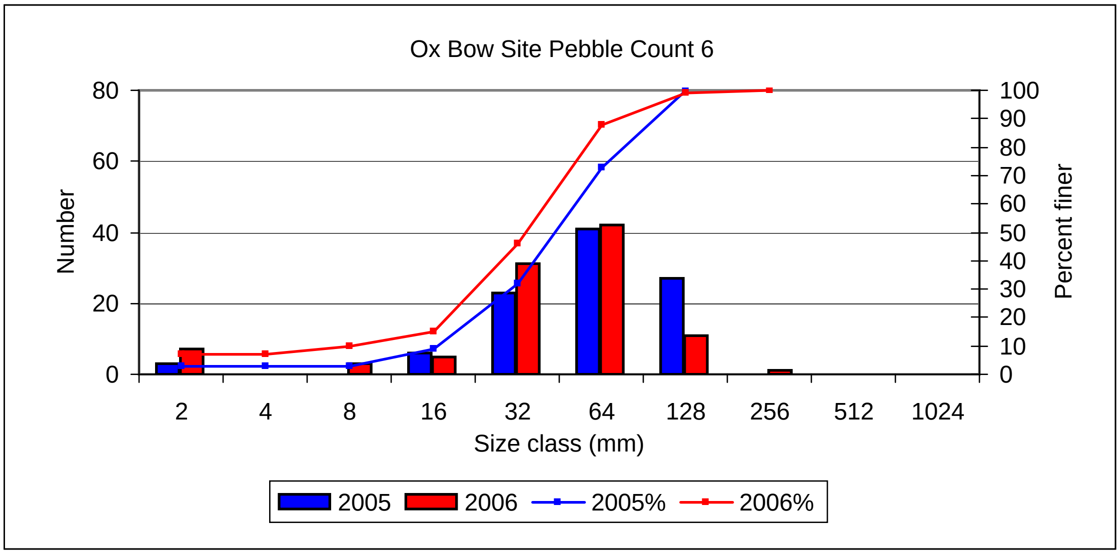
1024
Size class (mm)
2005
2006
2005%
2006%


Ox Bow Site Pebble Count 6
Number
Percent finer
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20
0
100
90
80
70
60
50
40
30
20
10
0
2
4
8
16
32
64
128
256
512
1024
Size class (mm)
2005
2006
2005%
2006%

APPENDIX 3.3. PEBBLE COUNT DATA AND PLOTS FOR BEDLOAD MONITORING BRIDGES

14	25	14	20	13.8613861	
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17	55	16	21	15.8415842	D16
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19	62	18	22	17.8217822	
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22	65	18	22	17.8217822	
23	42	18	22	17.8217822	
24	33	24	24	23.7623762	
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27	33	25	25	24.7524752	
28	32	25	25	24.7524752	
29	25	25	25	24.7524752	
30	39	25	25	24.7524752	D25
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32	58	31	26	30.6930693	
33	65	33	27	32.6732673	
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36	42	33	27	32.6732673	
37	25	37	28	36.6336634	
38	45	38	30	37.6237624	
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41	<2	38	30	37.6237624	
42	<2	42	31	41.5841584	
43	<2	42	31	41.5841584	
44	25	42	31	41.5841584	
45	32	42	31	41.5841584	
46	15	46	32	45.5445545	
47	41	46	32	45.5445545	
48	15	46	32	45.5445545	
49	22	49	33	48.5148515	
50	31	49	33	48.5148515	
51	30	49	33	48.5148515	D50 averag
52	22	52	35	51.4851485	
53	21	52	35	51.4851485	
54	71	54	36	53.4653465	
55	120	55	37	54.4554455	
56	43	55	37	54.4554455	
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68	33	67	43	66.3366337	
69	27	69	44	68.3168317	
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71	27	70	45	69.3069307	
72	30	70	45	69.3069307	
73	37	70	45	69.3069307	
74	51	70	45	69.3069307	
75	76	75	50	74.2574257	
76	17	76	51	75.2475248	D75
77	22	77	54	76.2376238	
78	37	77	54	76.2376238	
79	15	77	54	76.2376238	
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81	<2	80	55	79.2079208	
82	22	80	55	79.2079208	
83	17	83	56	82.1782178	
84	31	83	56	82.1782178	

14	79	14	3	13.861386	4
15	22	15	5	14.851485	8
16	110	16	7	15.841584	8
17	37	16	7	15.841584 d16	8
18	55	18	8	17.821782	16
19	42	19	9	18.811881	16
20	81	19	9	18.811881	16
21	7	21	10	20.792079	16
22	46	21	10	20.792079	16
23	58	23	11	22.772277	16
24	76	24	13	23.762376	16
25	54	25	14	24.752475	16
26	65	25	14	24.752475	16
27 <2		25	14	24.752475 d25	16
28 <2		28	15	27.722772	16
29	55	28	15	27.722772	16
30	40	30	17	29.70297	32
31	14	31	18	30.693069	32
32	38	31	18	30.693069	32
33	52	33	20	32.673267	32
34	33	33	20	32.673267	32
35 <2		33	20	32.673267	32
36	46	33	20	32.673267	32
37	79	37	21	36.633663	32
38	13	37	21	36.633663	32
39 <2		37	21	36.633663	32
40	17	40	22	39.60396	32
41	47	40	22	39.60396	32
42 <2		42	23	41.584158	32
43	45	43	25	42.574257	32
44 <2		43	25	42.574257	32
45	47	45	26	44.554455	32
46	30	45	26	44.554455	32
47	9	47	29	46.534653	32
48	75	48	30	47.524752	32
49	66	49	32	48.514851	64
50 <2		49	32	48.514851	64
51	11	49	32	48.514851	64
52	18	49	32	48.514851 d50	64
53	14	53	33	52.475248	64
54	32	54	35	53.465347	64
55	25	55	36	54.455446	64
56	74	56	37	55.445545	64
57	45	56	37	55.445545	64
58	10	56	37	55.445545	64
59	107	59	38	58.415842	64
60	32	60	40	59.405941	64
61	3	60	40	59.405941	64
62	52	62	41	61.386139	64
63	20	63	42	62.376238	64
64	15	63	42	62.376238	64
65	21	65	44	64.356436	64
66 <2		66	45	65.346535	64
67	40	66	45	65.346535	64
68 <2		68	46	67.326733	64
69	62	68	46	67.326733	64
70 <2		70	47	69.306931	64
71	90	70	47	69.306931	64
72	115	72	48	71.287129	64
73	37	73	50	72.277228	64
74	10	74	51	73.267327	64
75	21	75	52	74.257426	64
76	9	75	52	74.257426	64
77	20	75	52	74.257426 d75	64
78	50	78	54	77.227723	64
79	32	79	55	78.217822	64
80	84	79	55	78.217822	64
81	51	81	58	80.19802	64
82	32	82	62	81.188119	64
83	76	83	65	82.178218	128
84 <2		84	66	83.168317	128

15	42	15	25	14.85149	
16	12	15	25	14.85149	D16
17 <2		17	28	16.83168	
18	47	17	28	16.83168	
19	110	19	30	18.81188	
20	19	19	30	18.81188	
21 <2		19	30	18.81188	
22	79	22	32	21.78218	
23	30	23	34	22.77228	
24	81	23	34	22.77228	
25	115	25	35	24.75248	D25
26	62	26	37	25.74257	
27	41	26	37	25.74257	
28	78	28	38	27.72277	
29	100	28	38	27.72277	
30	120	28	38	27.72277	
31	62	31	39	30.69307	
32	76	31	39	30.69307	
33	115	31	39	30.69307	
34	49	34	40	33.66337	
35	38	34	40	33.66337	
36	39	34	40	33.66337	
37	70	37	41	36.63366	
38	90	37	41	36.63366	
39	140	39	42	38.61386	
40	34	40	43	39.60396	
41	39	41	44	40.59406	
42	56	42	47	41.58416	
43	21	43	48	42.57426	
44	140	44	49	43.56436	
45	22	45	50	44.55446	
46	18	46	52	45.54455	
47	41	47	53	46.53465	
48	37	47	53	46.53465	
49	64	47	53	46.53465	
50	55	50	55	49.50495	
51	110	50	55	49.50495	
52	68	50	55	49.50495	D 50
53	86	53	56	52.47525	
54	130	54	60	53.46535	
55	19	55	62	54.45545	
56	95	55	62	54.45545	
57	53	57	64	56.43564	
58	80	57	64	56.43564	
59	23	59	65	58.41584	
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62	50	62	69	61.38614	
63	114	63	70	62.37624	
64	72	64	72	63.36634	
65	65	65	74	64.35644	
66	69	66	75	65.34653	
67	53	67	76	66.33663	
68	74	68	78	67.32673	
69	38	69	79	68.31683	
70	25	69	79	68.31683	
71	136	69	79	68.31683	
72	75	72	80	71.28713	
73	52	72	80	71.28713	
74	94	72	80	71.28713	
75	190	75	81	74.25743	
76	64	76	86	75.24752	D75
77	79	77	90	76.23762	
78	110	78	94	77.22772	
79	30	79	95	78.21782	
80	28	79	95	78.21782	
81	38	79	95	78.21782	
82	40	82	100	81.18812	
83	60	83	110	82.17822	
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85	120	83	110	82.17822	
86	80	83	110	82.17822	D84

15	150	1	1	0.990099		2
16	125	1	1	0.990099		2
17	20	1	1	0.990099		2
18	29	1	1	0.990099		2
19	110	1	1	0.990099		2
20	65	1	1	0.990099	d16=3	2
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22	30	22	5	21.78218		8
23	120	23	6	22.77228		8
24	32	24	8	23.76238		16
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26	156	25	11	24.75248	d25	16
27	135	27	12	26.73267		16
28	125	28	13	27.72277		16
29	25	29	20	28.71287		32
30	26	30	22	29.70297		32
31	115	31	23	30.69307		32
32	30	32	24	31.68317		32
33	145	33	25	32.67327		32
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36	60	33	25	32.67327		32
37	85	37	26	36.63366		32
38	109	38	28	37.62376		32
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41	170	39	29	38.61386		32
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48	110	47	31	46.53465		32
49 <2		49	32	48.51485		64
50	5	50	34	49.50495		64
51 <2		50	34	49.50495	d50	64
52 <2		52	35	51.48515		64
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54 <2		54	36	53.46535		64
55	29	55	41	54.45545		64
56	68	56	49	55.44554		64
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62	111	62	60	61.38614		64
63	130	63	64	62.37624		128
64	120	64	65	63.36634		128
65	93	65	68	64.35644		128
66	75	66	69	65.34653		128
67	13	67	70	66.33663		128
68	12	68	74	67.32673		128
69	150	69	75	68.31683		128
70	106	69	75	68.31683		128
71	70	71	78	70.29703		128
72	115	72	85	71.28713		128
73	49	72	85	71.28713		128
74	31	74	86	73.26733		128
75	25	75	93	74.25743		128
76	85	76	95	75.24752	d75	128
77	30	77	100	76.23762		128
78	35	78	106	77.22772		128
79	36	78	106	77.22772		128
80	58	80	109	79.20792		128
81	23	81	110	80.19802		128
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83	35	83	111	82.17822		128
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14	100	12	70	11.88119	
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16	180	16	71	15.84158	D16
17	85	17	75	16.83168	
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20	55	20	80	19.80198	
21	115	20	80	19.80198	
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24	215	24	85	23.76238	
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26	170	24	85	23.76238	D25
27	60	27	90	26.73267	
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30	140	30	95	29.70297	
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32	130	30	95	29.70297	
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39	240	34	100	33.66337	
40	130	34	100	33.66337	
41	85	41	105	40.59406	
42	340	42	110	41.58416	
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45	145	42	110	41.58416	
46	110	46	115	45.54455	
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51	65	51	130	50.49505	D50
52	70	51	130	50.49505	
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70	40	70	165	69.30693	
71	145	71	170	70.29703	
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74	130	71	170	70.29703	
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76	120	76	180	75.24752	D75
77	135	76	180	75.24752	
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79	90	79	190	78.21782	
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82	170	82	200	81.18812	
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21	28	21	9	20.79208		16
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23	133	21	9	20.79208		16
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34	114	34	15	33.66337		16
35	155	34	15	33.66337		16
36	<2	36	17	35.64356		32
37	65	37	18	36.63366		32
38	<2	37	18	36.63366		32
39	<2	37	18	36.63366		32
40	<2	37	18	36.63366		32
41	20	41	20	40.59406		32
42	600	41	20	40.59406		32
43	30	41	20	40.59406		32
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45	9	45	21	44.55446		32
46	45	46	23	45.54455		32
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48	17	48	26	47.52475		32
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50	10	50	28	49.50495		32
51	210	50	28	49.50495		32
52	50	50	28	49.50495	d50	32
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56	10	56	35	55.44554		64
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59	110	59	38	58.41584		64
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62	38	62	45	61.38614		64
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67	115	65	50	64.35644		64
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71	6	71	110	70.29703		128
72	<2	72	114	71.28713		128
73	<2	72	114	71.28713		128
74	23	74	115	73.26733		128
75	<2	74	115	73.26733		128
76	125	74	115	73.26733	d75=117	128
77	35	77	120	76.23762		128
78	100	78	125	77.22772		128
79	12	78	125	77.22772		128
80	44	80	133	79.20792		256
81	10	80	133	79.20792		256
82	15	82	145	81.18812		256
83	145	83	151	82.17822		256

14	110	14	17	13.86139	
15	20	15	19	14.85149	
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17	19	17	20	16.83168	D16
18	13	17	20	16.83168	
19	140	17	20	16.83168	
20	105	20	22	19.80198	
21	120	21	24	20.79208	
22	115	21	24	20.79208	
23	185	23	26	22.77228	
24	65	24	30	23.76238	
25	88	24	30	23.76238	
26	9	26	35	25.74257	D25
27	110	26	35	25.74257	
28	35	26	35	25.74257	
29	74	26	35	25.74257	
30	90	30	39	29.70297	
31	100	31	40	30.69307	
32	95	32	41	31.68317	
33	220	33	44	32.67327	
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35	75	35	48	34.65347	
36	95	35	48	34.65347	
37	68	37	49	36.63366	
38	145	38	53	37.62376	
39	19	39	54	38.61386	
40	190	40	56	39.60396	
41	<2	40	56	39.60396	
42	<2	42	58	41.58416	
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44	59	44	65	43.56436	
45	140	44	65	43.56436	
46	170	46	68	45.54455	
47	115	47	74	46.53465	
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49	3	47	74	46.53465	
50	10	50	75	49.50495	
51	115	50	75	49.50495	D50
52	115	52	80	51.48515	
53	74	53	86	52.47525	
54	75	54	88	53.46535	
55	56	55	90	54.45545	
56	49	56	93	55.44554	
57	26	57	94	56.43564	
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73	155	69	110	68.31683	
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75	80	74	115	73.26733	
76	17	74	115	73.26733	
77	140	74	115	73.26733	D75
78	39	78	120	77.22772	
79	<2	79	125	78.21782	
80	<2	80	130	79.20792	
81	110	80	130	79.20792	
82	22	82	135	81.18812	
83	30	82	135	81.18812	
84	40	84	140	83.16832	

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16	18	14	5	13.86139		8
17	89	17	7	16.83168	D16	8
18	30	17	7	16.83168		8
19	65	19	8	18.81188		16
20	150	19	8	18.81188		16
21	55	19	8	18.81188		16
22	56	19	8	18.81188		16
23	80	23	9	22.77228		16
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27	45	27	11	26.73267		16
28	<2	28	12	27.72277		16
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30	10	28	12	27.72277		16
31	50	28	12	27.72277		16
32	39	32	14	31.68317		16
33	127	33	15	32.67327		16
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36	46	36	18	35.64356		32
37	70	36	18	35.64356		32
38	50	36	18	35.64356		32
39	68	36	18	35.64356		32
40	130	36	18	35.64356		32
41	120	41	24	40.59406		32
42	18	42	25	41.58416		32
43	85	42	25	41.58416		32
44	<2	42	25	41.58416		32
45	<2	42	25	41.58416		32
46	15	46	26	45.54455		32
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50	8	48	30	47.52475	d50=33	32
51	4	51	35	50.49505		64
52	125	52	36	51.48515		64
53	25	53	37	52.47525		64
54	35	54	38	53.46535		64
55	85	55	39	54.45545		64
56	46	55	39	54.45545		64
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67	18	67	55	66.33663		64
68	40	68	56	67.32673		64
69	25	68	56	67.32673		64
70	140	70	60	69.30693		64
71	65	70	60	69.30693		64
72	150	72	65	71.28713		128
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76	15	75	70	74.25743	d75=71	128
77	<2	77	74	76.23762		128
78	<2	78	76	77.22772		128
79	12	78	76	77.22772		128
80	15	80	80	79.20792		128
81	7	80	80	79.20792		128
82	12	82	85	81.18812		128
83	18	82	85	81.18812		128
84	9	82	85	81.18812		128

15	210	13	70	12.87129	
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17	60	17	75	16.83168	D16
18	210	18	80	17.82178	
19	130	19	90	18.81188	
20	105	19	90	18.81188	
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22	140	19	90	18.81188	
23	120	23	92	22.77228	
24	110	24	95	23.76238	
25	155	25	100	24.75248	
26	60	25	100	24.75248	
27	150	25	100	24.75248	D25
28	140	28	102	27.72277	
29	70	29	105	28.71287	
30	290	29	105	28.71287	
31	110	29	105	28.71287	
32	90	29	105	28.71287	
33	70	33	110	32.67327	
34	620	33	110	32.67327	
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36	105	36	120	35.64356	
37	120	36	120	35.64356	
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39	45	36	120	35.64356	
40	165	36	120	35.64356	
41	100	36	120	35.64356	
42	320	36	120	35.64356	
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47	230	46	140	45.54455	
48	271	46	140	45.54455	
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50	280	46	140	45.54455	
51	165	46	140	45.54455	
52	235	46	140	45.54455	D50
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54	250	53	150	52.47525	
55	30	55	155	54.45545	
56	380	56	160	55.44554	
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58	100	56	160	55.44554	
59	125	59	165	58.41584	
60	35	59	165	58.41584	
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62	140	61	170	60.39604	
63	330	61	170	60.39604	
64	270	61	170	60.39604	
65	75	65	180	64.35644	
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67	90	67	200	66.33663	
68	120	68	205	67.32673	
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71	70	69	210	68.31683	
72	280	69	210	68.31683	
73	65	69	210	68.31683	
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75	210	74	220	73.26733	
76	170	74	220	73.26733	
77	220	74	220	73.26733	D75
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79	170	79	230	78.21782	
80	110	80	235	79.20792	
81	100	81	240	80.19802	
82	270	82	245	81.18812	
83	160	83	250	82.17822	
84	210	84	260	83.16832	

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16	12	16	15	15.84158		16
17	190	16	15	15.84158		16
18	183	16	15	15.84158		16
19	130	16	15	15.84158	d16	16
20	45	20	17	19.80198		32
21	170	21	20	20.79208		32
22	125	21	20	20.79208		32
23	83	21	20	20.79208		32
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25	20	24	25	23.76238		32
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28	110	27	45	26.73267		64
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83	142	82	200	81.18812		256
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74	125	74	180	73.26733	
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76	73	76	190	75.24752	D75
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81	<2	81	220	80.19802	
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16	300	15	28	14.85149		32
17	180	15	28	14.85149	d16	32
18	210	18	29	17.82178		32
19	78	19	30	18.81188		32
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23	90	23	35	22.77228		64
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33	32	33	65	32.67327		128
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69	115	68	190	67.32673		256
70	155	68	190	67.32673		256
71	240	68	190	67.32673		256
72	210	68	190	67.32673		256
73	200	68	190	67.32673		256
74	300	74	200	73.26733		256
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76	48	74	200	73.26733	d75=206	256
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79	68	79	220	78.21782		256
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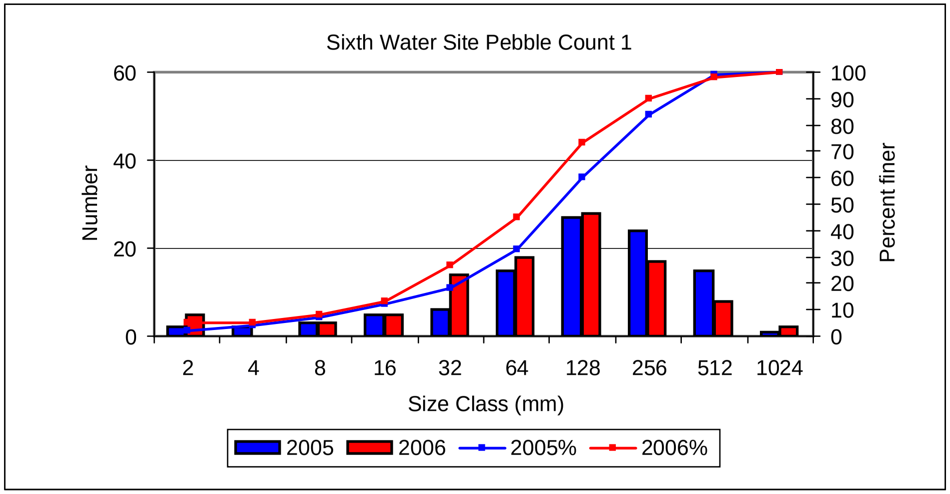
Sixth Water Site Pebble Count 1
Number
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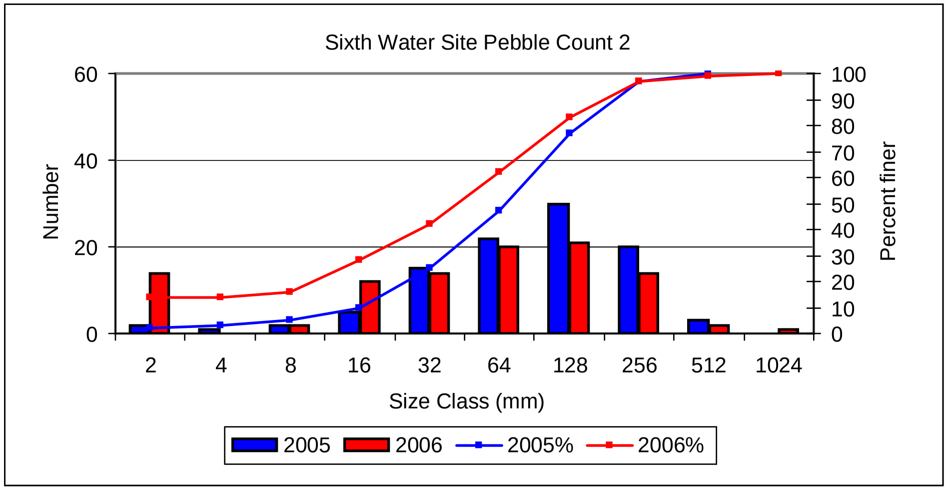
20
40
60
Percent finer
0
10
20
30
40
50
60
70
80
90
100
2
4
8
16
32
64
128
256
512
1024
Size Class (mm)
2005
2006
2005%
2006%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Number
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40
60
Percent finer
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20
30
40
50
60
70
80
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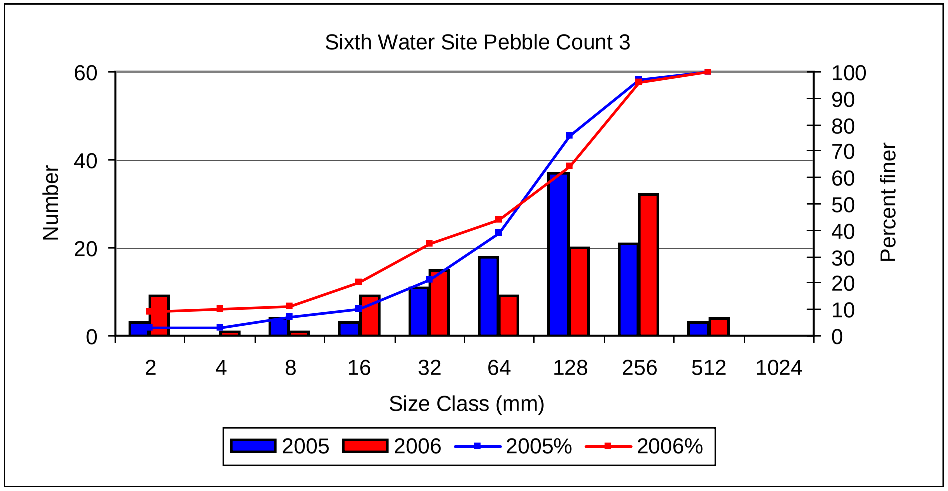
100
2
4
8
16
32
64
128
256
512
1024
Size Class (mm)
2005
2006
2005%
2006%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Number
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40
60
Percent finer
0
10
20
30
40
50
60
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100
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4
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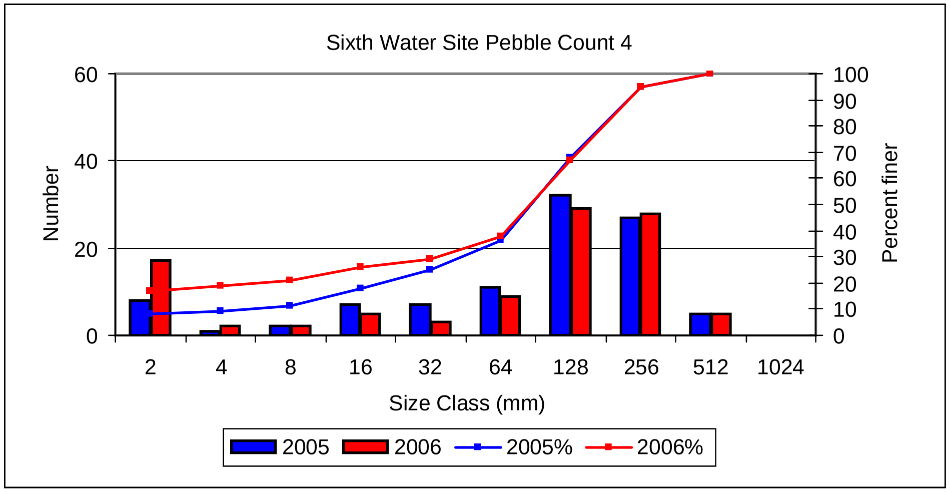
Size Class (mm)
2005
2006
2005%
2006%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60
Percent finer
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10
20
30
40
50
60
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100
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16
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512
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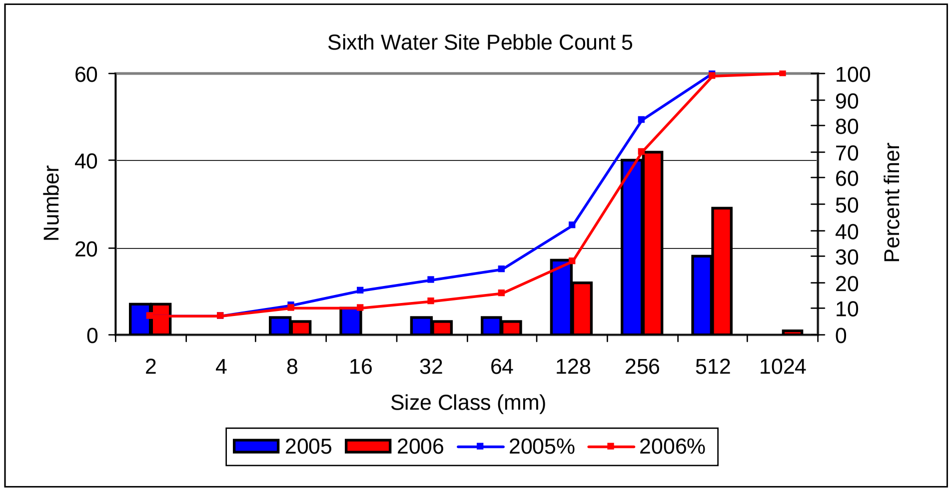
Size Class (mm)
2005
2006
2005%
2006%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Number
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60
Percent finer
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10
20
30
40
50
60
70
80
90
100
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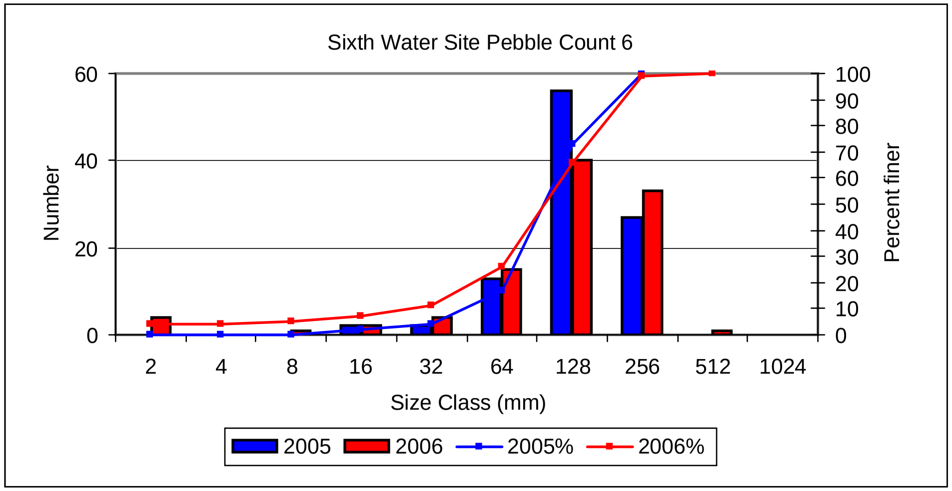
4
8
16
32
64
128
256
512
1024
Size Class (mm)
2005
2006
2005%
2006%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Number
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60
Percent finer
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10
20
30
40
50
60
70
80
90
100
2
4
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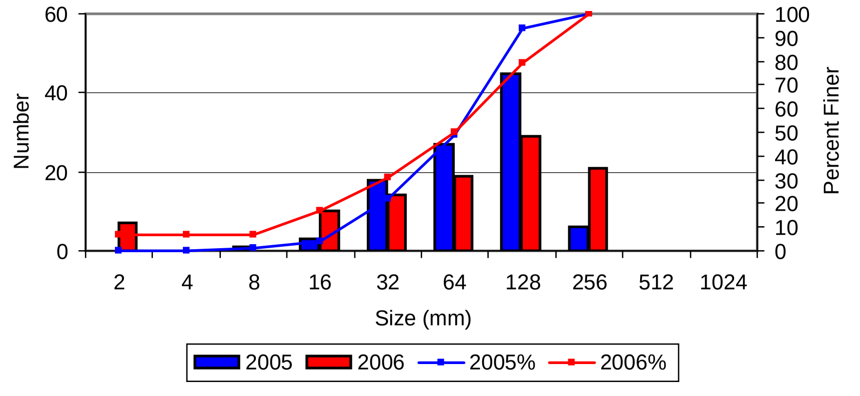
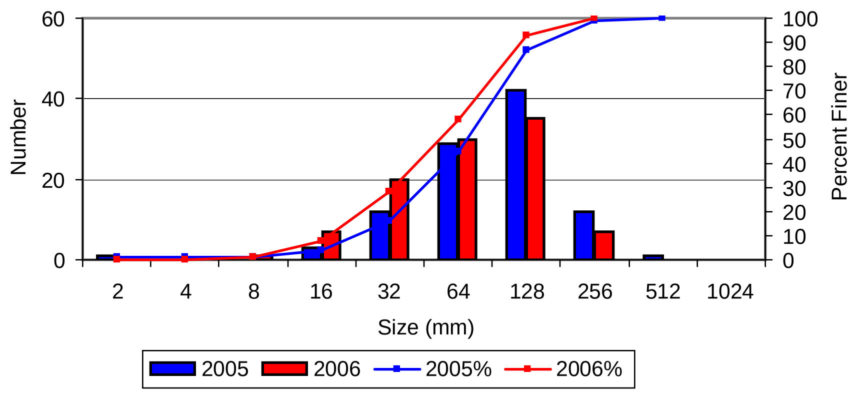
16
32
64
128
256
512
1024
Size Class (mm)
2005
2006
2005%
2006%

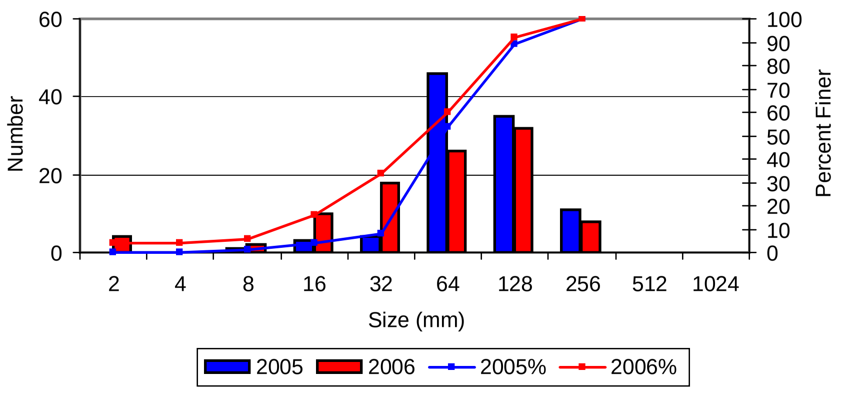
Diamond Fork Campground Pebble Count 1



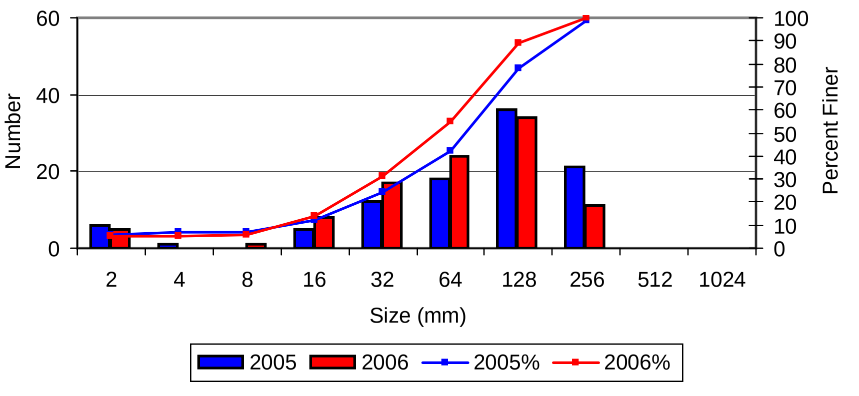
Diamond Fork Campground Pebble Count 2



Diamond Fork Campground Pebble Count 3



Diamond Fork Campground Pebble Count 4



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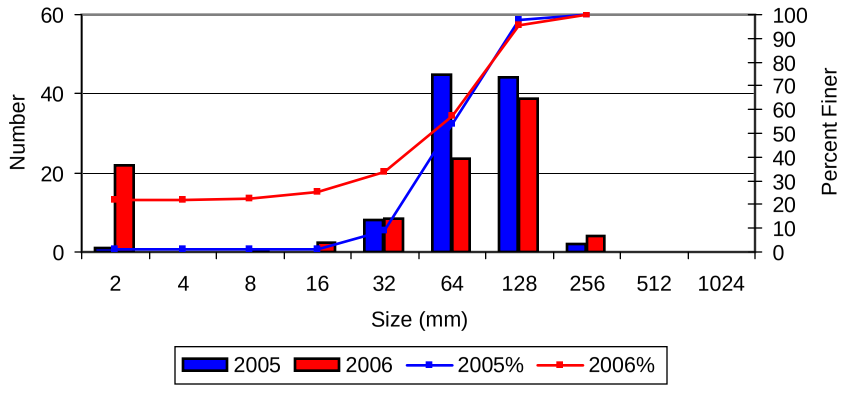
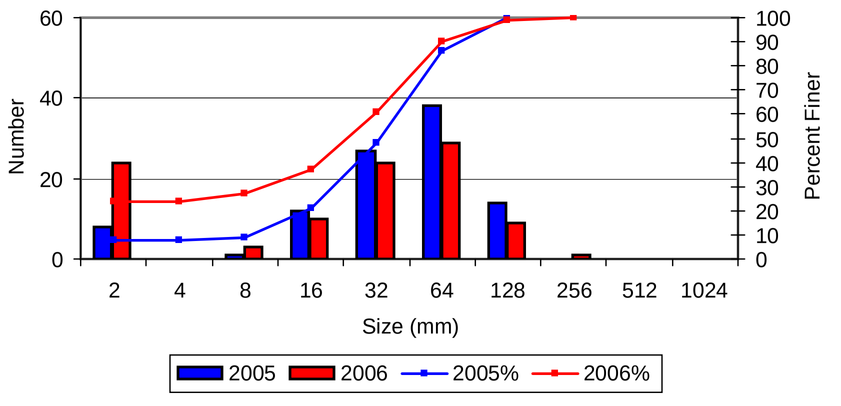
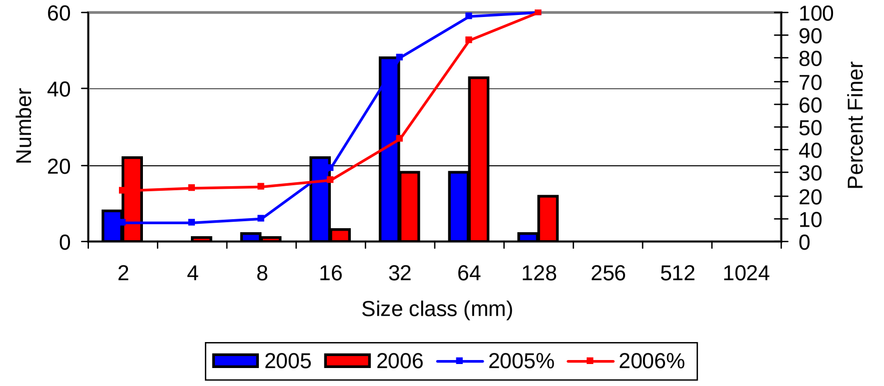


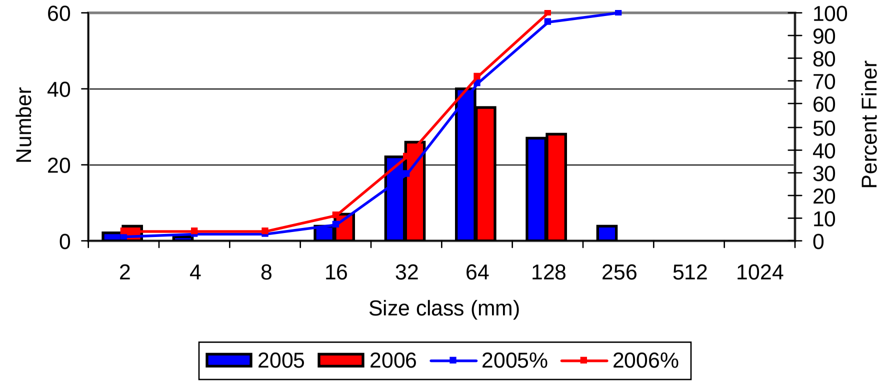
Diamond Fork Campground Pebble Count 6



Mother Site Pebble Count 1



Mother Site Pebble Count 2



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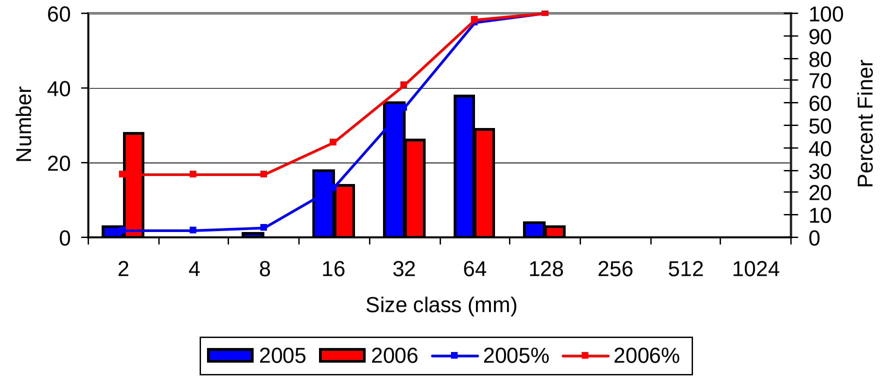

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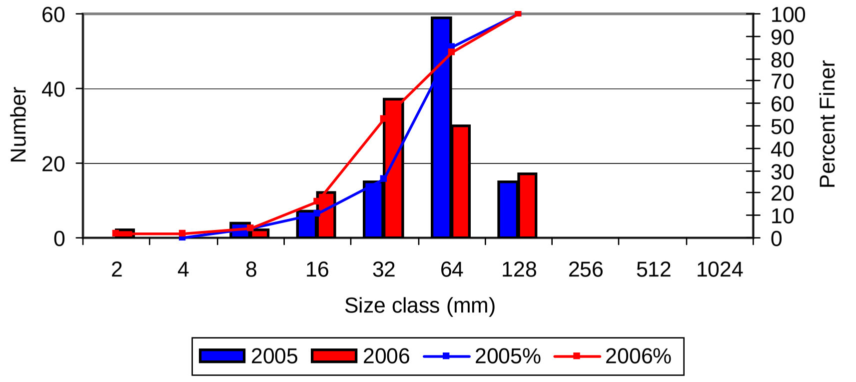
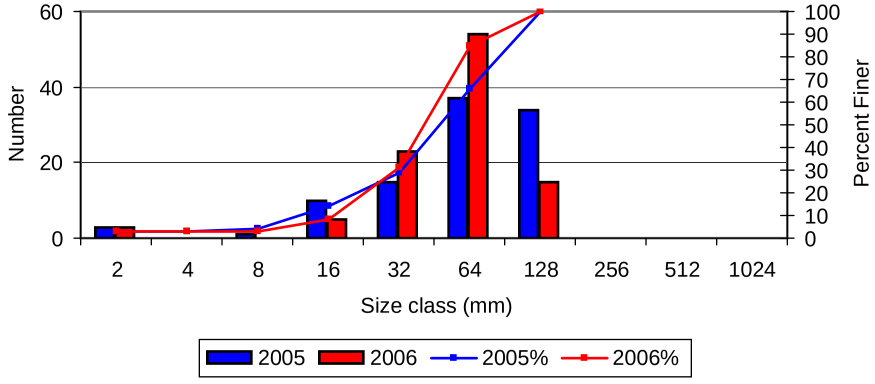


Mother Site Pebble Count 5



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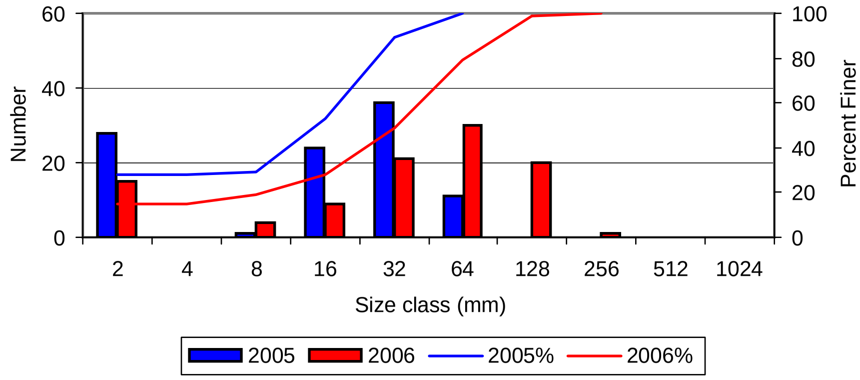
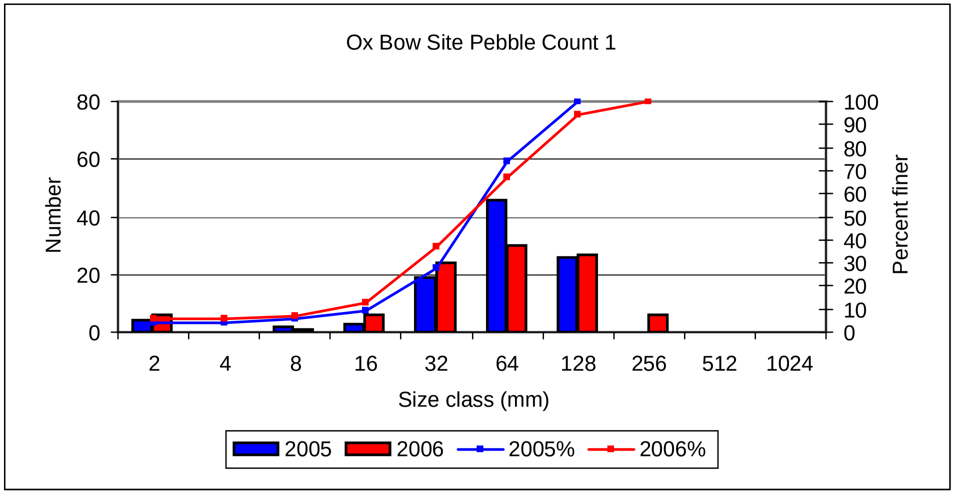
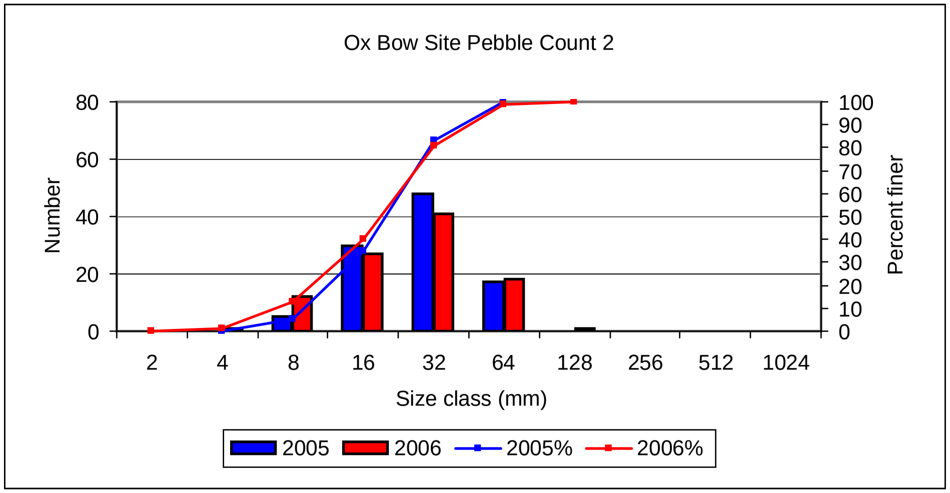



Ox Bow Site Pebble Count 1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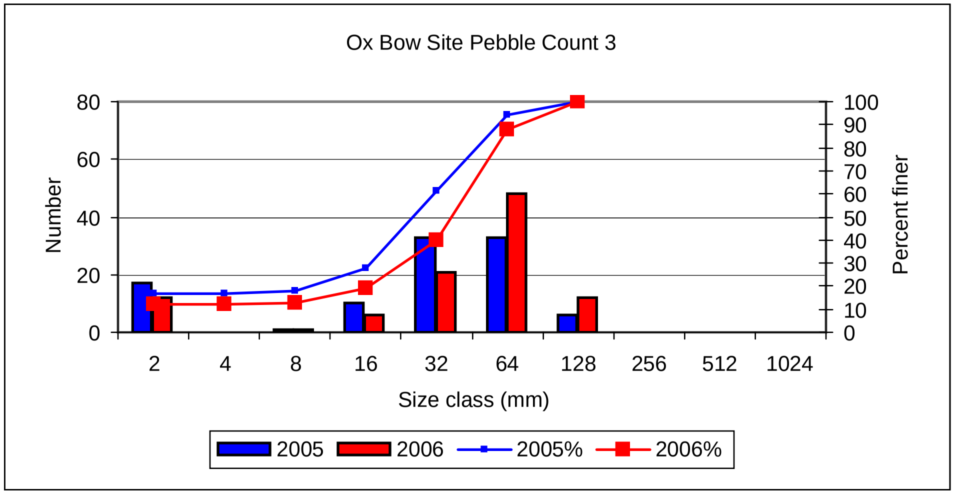
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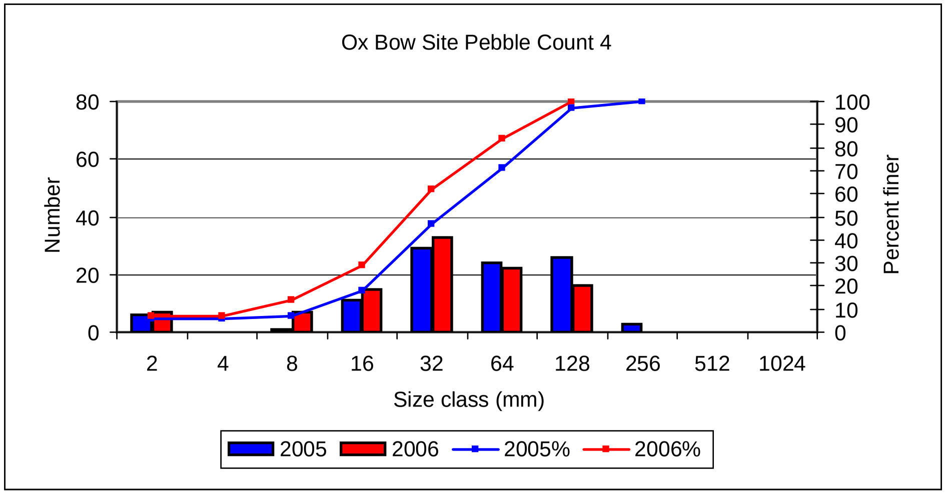
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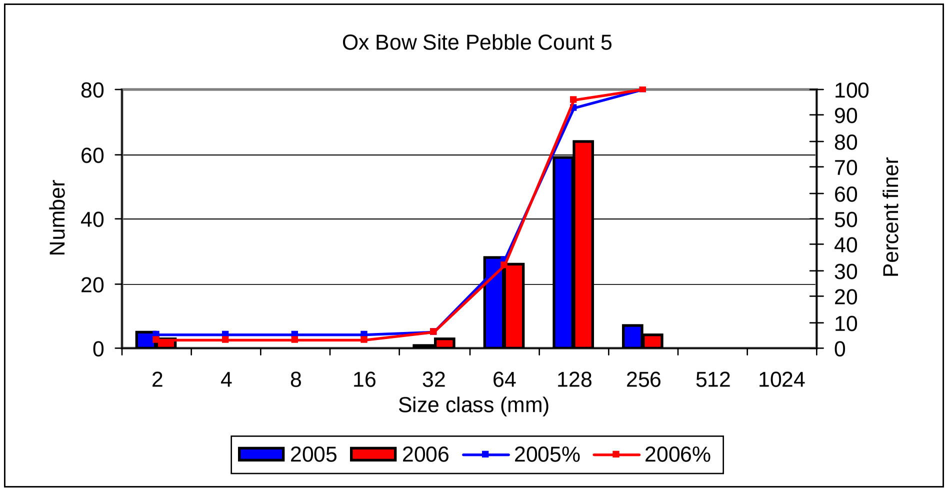
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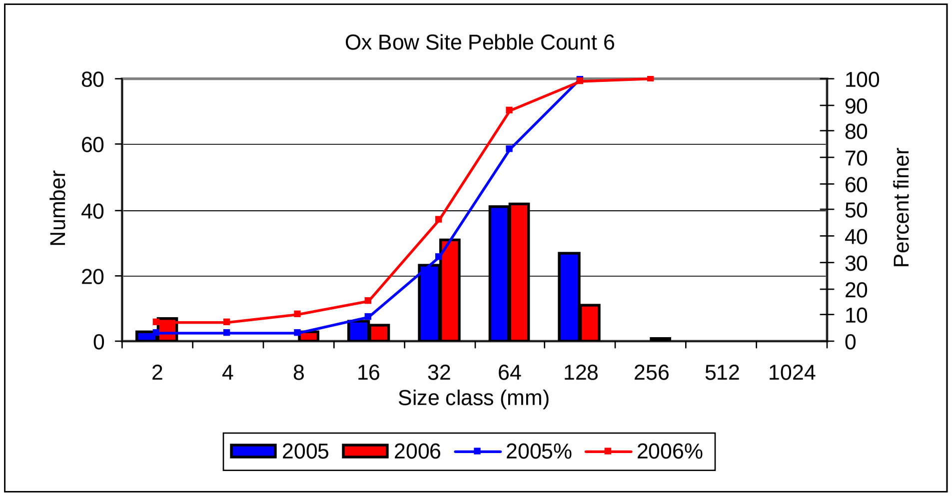
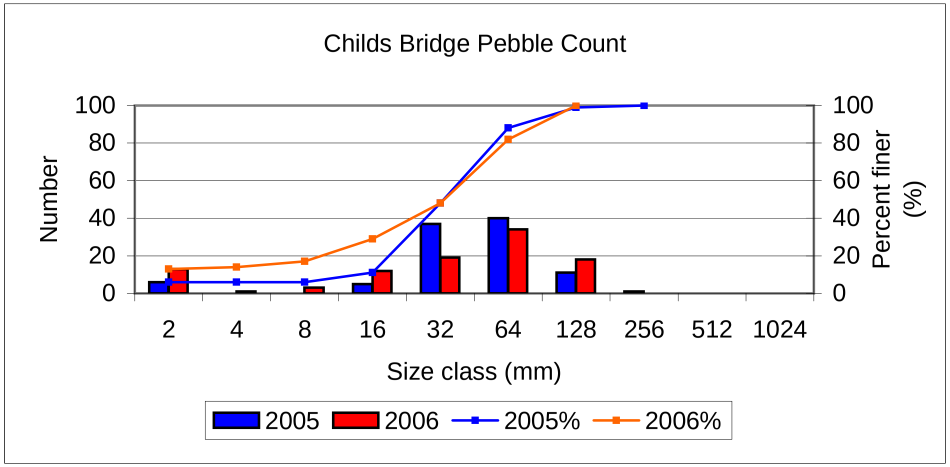
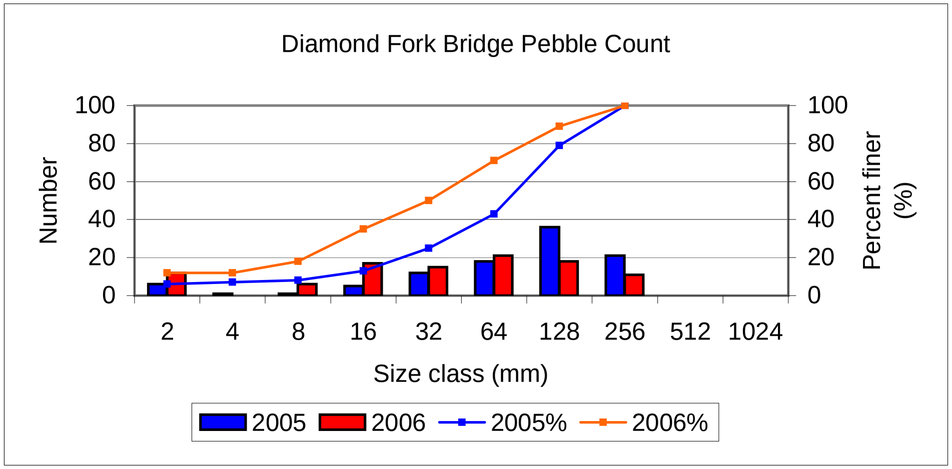
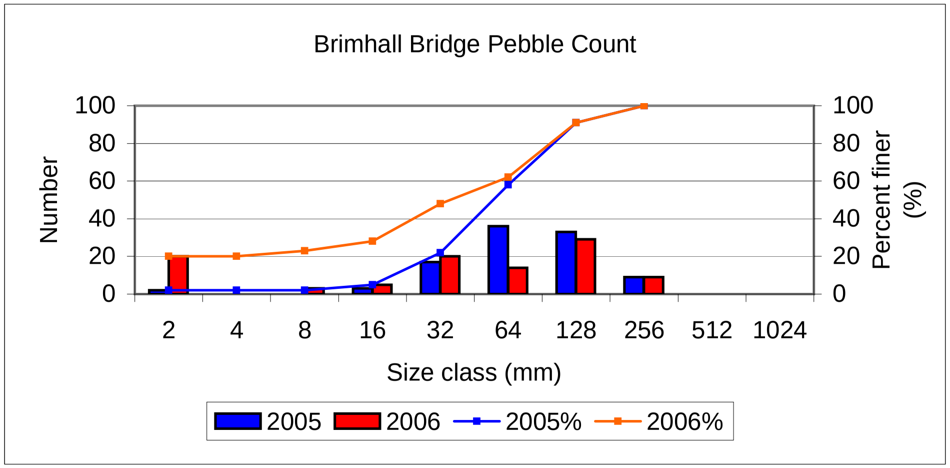
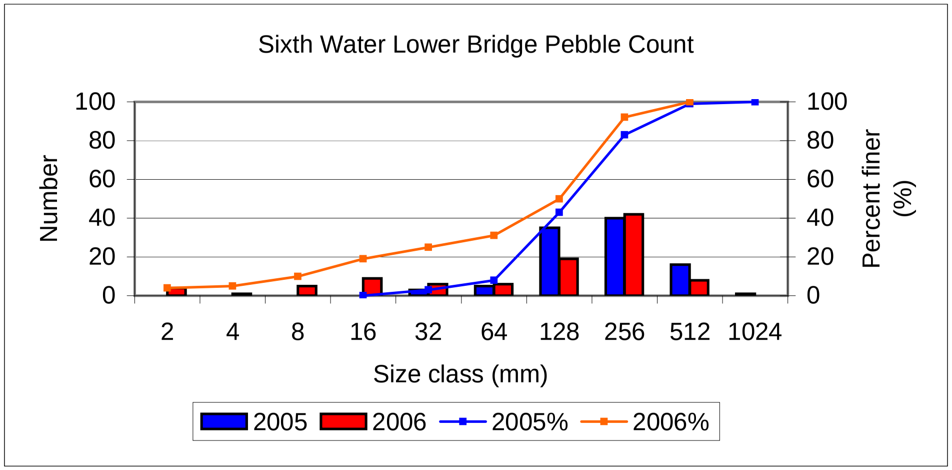
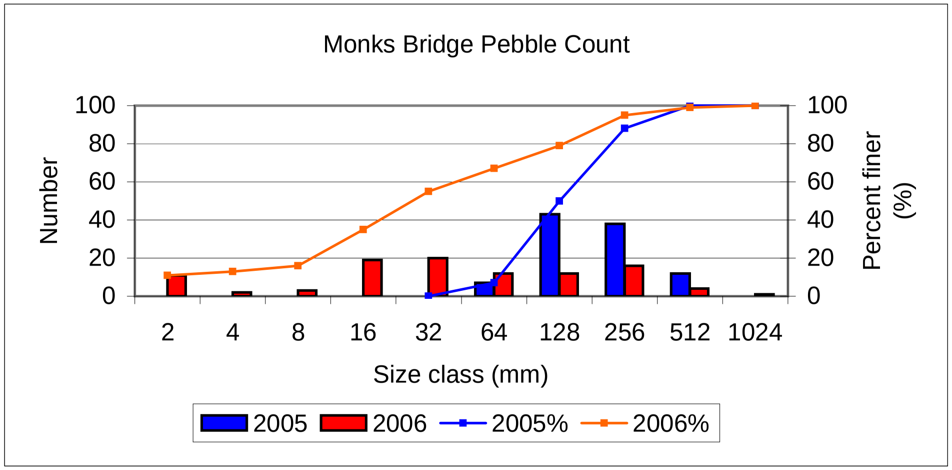

Ox Bow Site Pebble Count 6

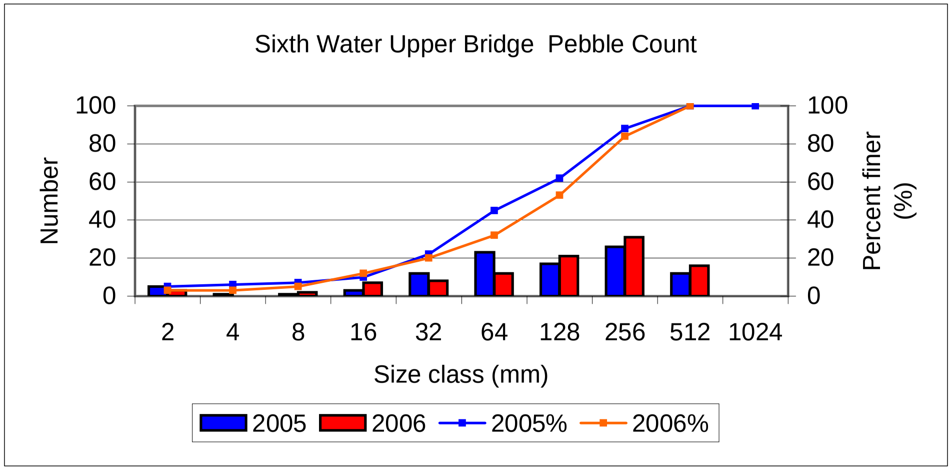

Childs Bridge Pebble Count


Diamond Fork Bridge Pebble Count

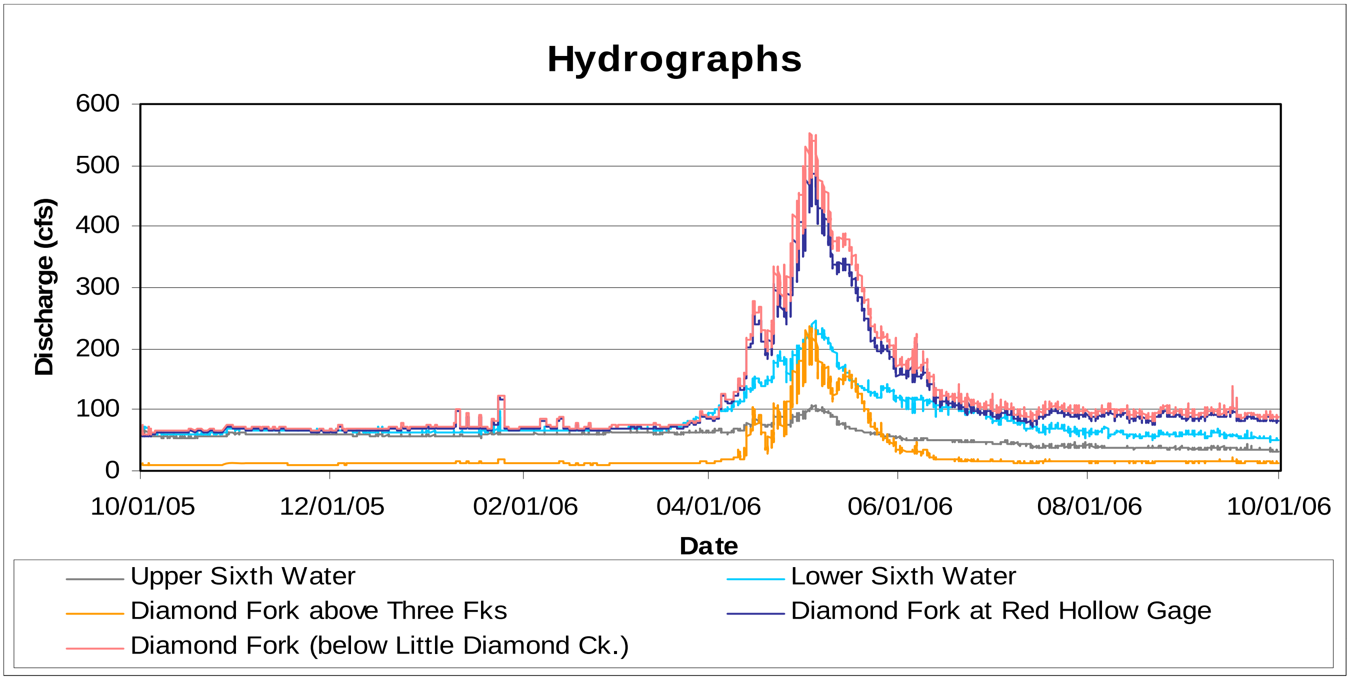

Brimhall Bridge Pebble Count

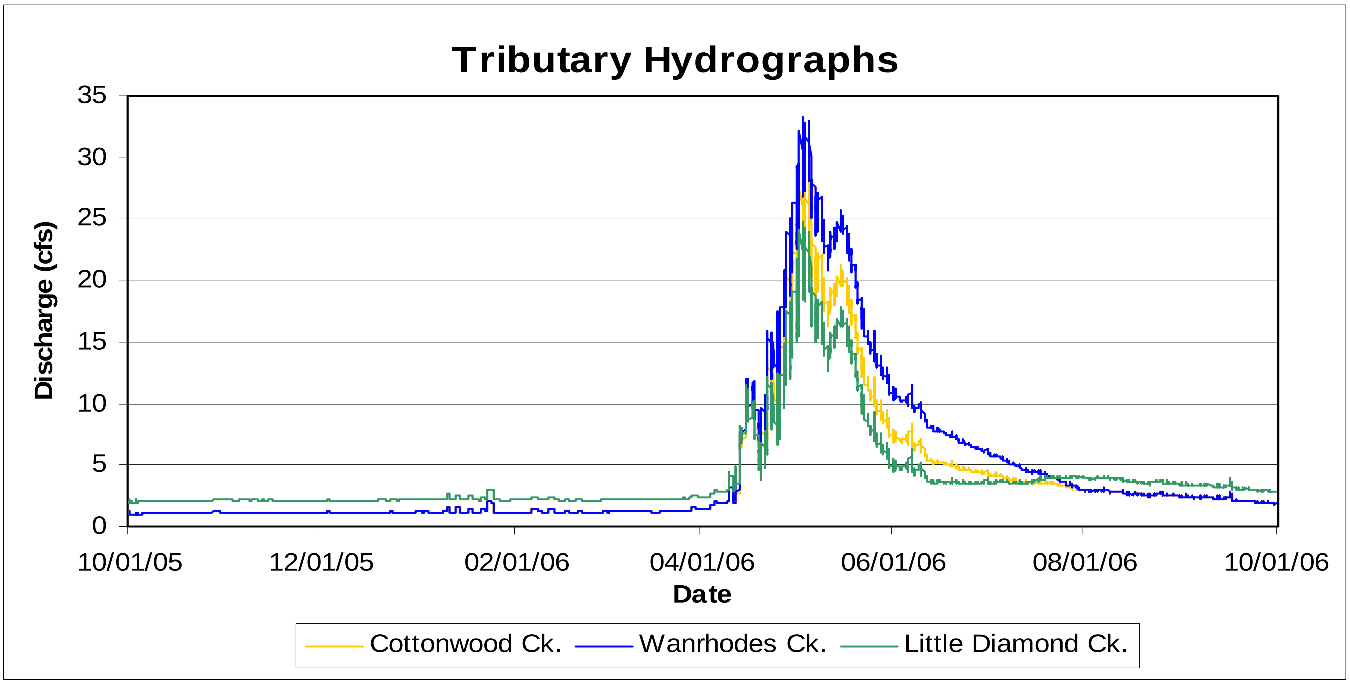

Sixth Water Lower Bridge Pebble Count


Monks Bridge Pebble Count


Sixth Water Upper Bridge Pebble Count

APPENDIX 4.A: SUSPENDED SEDIMENT AND BEDLOAD SAMPLING RESULTS


Hydrographs
Discharge (cfs)
600
500
400
300
200
100
0
10/01/05
12/01/05
02/01/06
04/01/06
06/01/06
08/01/06
10/01/06
Date
Upper Sixth Water
Lower Sixth Water
Diamond Fork above Three Fks
Diamond Fork at Red Hollow Gage
Diamond Fork (below Little Diamond Ck.)


Tributary Hydrographs
Discharge (cfs)
35
30
25
20
15
10
5
0
10/01/05
12/01/05
02/01/06
04/01/06
06/01/06
08/01/06
10/01/06
Date
Cottonwood Ck.
Wanrhodes Ck.
Little Diamond Ck.

	5/21/2006	64	3.9
	5/24/2006	60	1.6
	5/31/2006	55	1.6
	9/14/2006	38	0.5
	10/27/2006	37	0.4
Lower Sixth Water	4/6/2006	98	13.1
	4/17/2006	144	25.6
	4/20/2006	150	21.6
	4/27/2006	166	83.8
	5/1/2006	207	150.7
	5/3/2006	227	141.4
	5/12/2006	176	11.9
	5/21/2006	132	15.0
	5/24/2006	122	12.5
	5/31/2006	122	4.8
	9/14/2006	56	1.0
	10/27/2006	73	1.1
Diamond Fork	4/6/2006	19	8.8
	4/17/2006	91	43.9
	4/20/2006	35	4.8
	4/27/2006	113	77.4
	5/1/2006	146	81.1
	5/3/2006	140	114.8
	5/12/2006	131	23.7
	5/21/2006	100	25.2
	5/24/2006	71	5.8
	5/31/2006	39	2.1
	9/14/2006	15	0.2
	10/27/2006	11	0.1
Monks	4/6/2006	113	24.7
	4/17/2006	247	133.6
	4/20/2006	194	38.7
	4/27/2006	290	133.5
	5/1/2006	409	300.0
	5/3/2006	480	470.4
	5/12/2006	333	32.3
	5/21/2006	246	54.4
	5/24/2006	204	29.2
	5/31/2006	165	10.5
	9/14/2006	90	1.3
	10/27/2006	63	0.4
Brimhall	4/6/2006	118	56.5
	4/17/2006	270	143.2
	4/20/2006	214	21.8
	4/27/2006	333	301.8
	5/1/2006	473	311.3
	5/3/2006	558	514.7
	5/12/2006	381	30.3
	5/21/2006	280	36.7
	5/24/2006	229	12.0
	5/31/2006	180	5.1
	9/14/2006	95	1.7
	10/27/2006	66	1.0
Childs	4/6/2006	118	69.5
	4/17/2006	270	103.7
	4/20/2006	221	80.5
	4/27/2006	358	259.7
	5/1/2006	492	384.8
	5/3/2006	560	629.3
	5/12/2006	383	42.4
	5/21/2006	280	36.2
	5/24/2006	229	26.6
	5/31/2006	180	5.6
	9/14/2006	98	3.0

	7/31/2006	41.0	0.3
	9/14/2006	38.0	1.5
	10/27/2006	37.0	0.4
Lower Sixth Water	4/6/2006	99.0	0.0
	4/6/2006	98.0	0.0
	4/17/2006	144.0	0.3
	4/20/2006	150.0	0.2
	4/27/2006	166.0	0.1
	5/1/2006	207.0	0.0
	5/3/2006	227.0	0.6
	5/12/2006	176.0	1.1
	5/21/2006	132.0	1.0
	5/24/2006	122.0	0.1
	5/31/2006	122.0	0.1
	7/31/2006	60.0	0.3
	9/14/2006	56.0	0.2
	10/27/2006	73.0	0.1
Diamond Fork	4/6/2006	19.0	0.2
	4/6/2006	19.0	0.3
	4/17/2006	91.0	2.4
	4/20/2006	35.0	1.0
	4/27/2006	113.0	13.0
	5/1/2006	146.0	17.2
	5/3/2006	140.0	16.0
	5/12/2006	131.0	3.6
	5/21/2006	100.0	2.3
	5/24/2006	71.0	0.8
	5/31/2006	39.0	0.4
	7/31/2006	15.0	0.0
	9/14/2006	15.0	0.0
	10/27/2006	11.0	0.0
Monks	4/6/2006	113.0	6.1
	4/6/2006	113.0	2.3
	4/17/2006	247.0	1.6
	4/20/2006	194.0	3.4
	4/27/2006	290.0	1.2
	5/1/2006	409.0	0.7
	5/3/2006	480.0	7.1
	5/12/2006	333.0	0.8
	5/21/2006	246.0	0.3
	5/24/2006	204.0	0.1
	5/31/2006	165.0	0.1
	7/31/2006	92.0	0.3
	9/14/2006	90.0	0.7
	10/27/2006	63.0	0.2
Brimhall	4/5/2006	127.0	0.8
	4/6/2006	118.0	2.4
	4/17/2006	270.0	1.0
	4/20/2006	214.0	1.6
	4/27/2006	333.0	2.3
	5/1/2006	473.0	4.0
	5/3/2006	558.0	29.7
	5/12/2006	381.0	7.5
	5/21/2006	280.0	0.5
	5/24/2006	229.0	1.1
	5/31/2006	180.0	0.1
	7/31/2006	100.0	0.5
	9/14/2006	95.0	1.1
	10/27/2006	66.0	0.1
Childs	4/5/2006	127.0	3.3
	4/6/2006	118.0	2.6
	4/17/2006	270.0	1.2
	4/20/2006	221.0	1.9
	4/27/2006	358.0	4.2

APPENDIX 4.B: BEDLOAD PHOTOS

127 cubic feet per second

118 cubic feet per second

270 cubic feet per second

214 cubic feet per second

333 cubic feet per second

473 cubic feet per second

554 cubic feet per second (bag ripped during sampling)

558 cubic feet per second

381 cubic feet per second

280 cubic feet per second

229 cubic feet per second

180 cubic feet per second

100 cubic feet per second

95 cubic feet per second

66 cubic feet per second

127 cubic feet per second

118 cubic feet per second

270 cubic feet per second

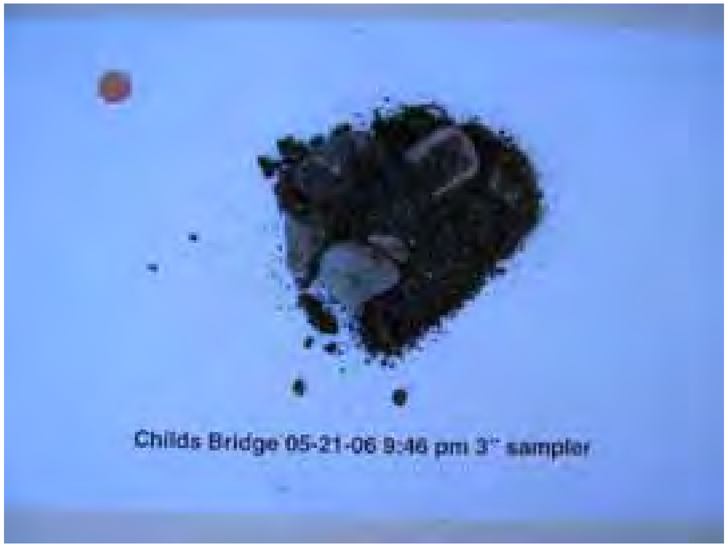
221 cubic feet per second

358 cubic feet per second

492 cubic feet per second (sample lost)

560 cubic feet per second

383 cubic feet per second



280 cubic feet per second

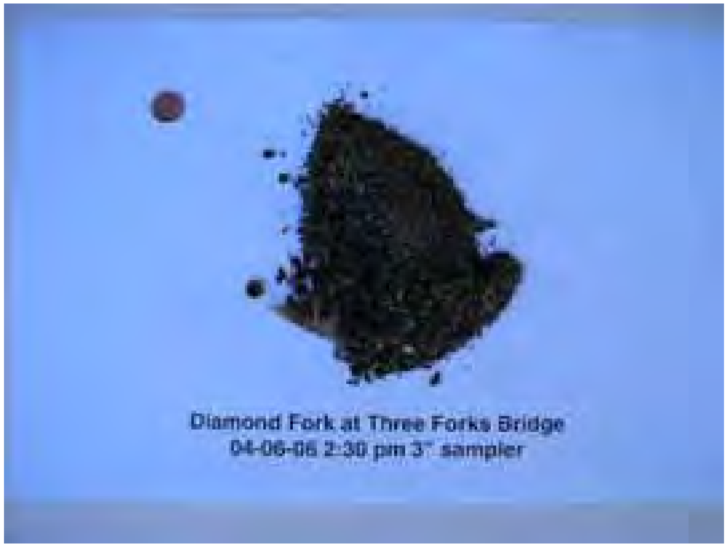
229 cubic feet per second

180 cubic feet per second

101 cubic feet per second

98 cubic feet per second

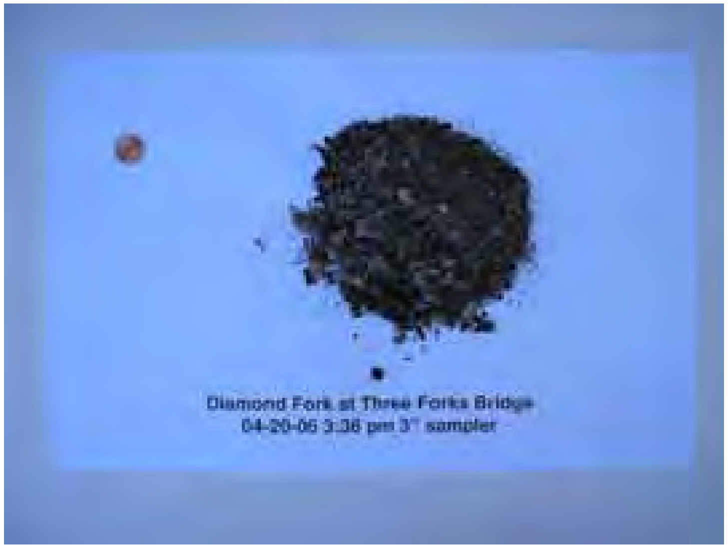
66 cubic feet per second



19 cubic feet per second

19 cubic feet per second

91 cubic feet per second



35 cubic feet per second

113 cubic feet per second

146 cubic feet per second

140 cubic feet per second

131 cubic feet per second

100 cubic feet per second

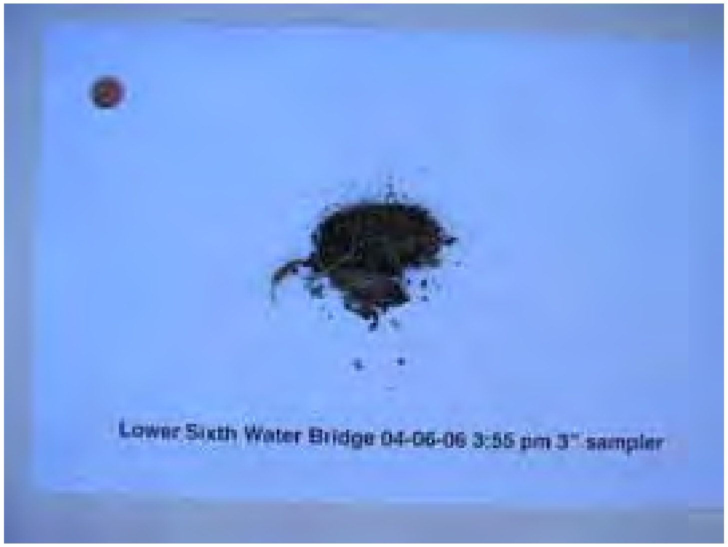
71 cubic feet per second

39 cubic feet per second

15 cubic feet per second

15 cubic feet per second

11 cubic feet per second

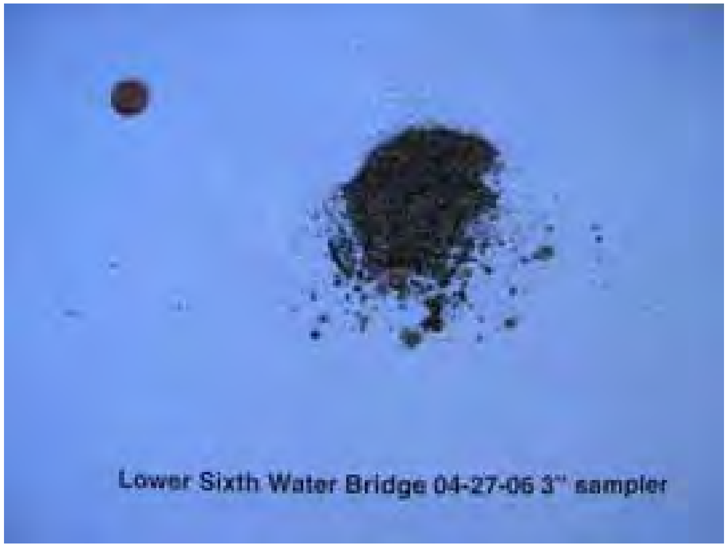


99 cubic feet per second

98 cubic feet per second

144 cubic feet per second

150 cubic feet per second



166 cubic feet per second

207 cubic feet per second

227 cubic feet per second

176 cubic feet per second

132 cubic feet per second

122 cubic feet per second

122 cubic feet per second

60 cubic feet per second

56 cubic feet per second

73 cubic feet per second

113 cubic feet per second

113 cubic feet per second

247 cubic feet per second

194 cubic feet per second

290 cubic feet per second

409 cubic feet per second

480 cubic feet per second

333 cubic feet per second

246 cubic feet per second

204 cubic feet per second

165 cubic feet per second

92 cubic feet per second

90 cubic feet per second

63 cubic feet per second

76 cubic feet per second

86 cubic feet per second

100 cubic feet per second

78 cubic feet per second

64 cubic feet per second

60 cubic feet per second

55 cubic feet per second

41cubic feet per second

38 cubic feet per second

37 cubic feet per second

APPENDIX 5.1: MACROINVERTEBRATE TAXA AND MATRIX RESULTS

Percent Subsampled	**100.00**	**100.00**	**100.00**	**8.33**	**75.19**
Device	**Hess**	**Hess**	**Hess**	**D-Frame**	**Hess**
Habitat	**blank**	**blank**	**blank**	**blank**	**12T,4443115N,471103E**
EcoAnalysts Sample ID	**1**	**2**	**3**	**4**	**5**
icaudatus	32	67	71	127	50
ula sp.	0	1	1	4	0
hageni	0	0	0	1	0
grandis	7	2	4	10	3
longimanus	0	3	0	2	1
sp.	0	0	0	0	0
rella inermis/infrequens	1	10	5	30	1
ophlebia sp.	0	0	0	6	0
ena sp.	0	0	0	0	1
erlidae	0	0	0	0	1
des sp.	0	0	0	0	0
sp.	0	0	3	2	0
ae	0	0	0	0	1
rcella sp.	2	0	4	36	0
sp.	0	1	0	0	0
his addenda		0	0	0	3
vus sp.	61	27	49	99	28
a sp.	5	2	0	12	13
midae	394	299	327	159	380
sp.	6	1	2	3	2
sp.	0	0	0	0	0
Palpomyia sp.	2	0	0	1	1
a sp.	0	0	0	0	1
na sp.	2	5	7	2	0
ta sp.	4	1	4	1	0
n sp.	2	3	0	34	42
p.	0	0	1	0	0
yche grandis	1	0	0	0	0
entrus americanus	5	2	3	6	0
entrus occidentalis	0	0	0	0	0
syche sp.	4	2	5	2	1
yche sp.	4	0	7	14	2
oma sp.	0	0	1	2	0
ia sp.	0	0	0	0	1
disjuncta	0	0	1	0	0
phila coloradensis gr.	0	0	0	4	0
dae	0	0	0	0	1
p.	0	0	0	0	0
dae	0	1	2	1	0
aeta	9	1	1	12	0
es sp.	0	0	0	0	0
sp.	0	0	0	0	0
n sp.	0	6	3	4	1

16.67	**100.00**	**58.48**	**81.30**	**20.83**
D-Frame	**Hess**	**Hess**	**Hess**	**D-Frame**
12T,4443115N,471103E	**12T,4439015N,470806E**	**12T,4439015N,470806E**	**12T,4439015N,470806E**	**12T,4439015N,470806E**
8	**9**	**10**	**11**	**12**
74	35	21	22	77
0	0	0	0	0
0	0	0	0	0
4	5	4	4	12
0	0	0	0	0
0	0	0	0	0
5	1	1	3	1
4	0	0	0	0
0	0	0	0	1
0	0	0	0	0
0	0	0	0	3
2	0	0	0	0
0	3	4	2	0
19	8	11	7	13
0	0	0	0	0
5	0	0	0	0
76	24	6	9	30
4	0	0	0	0
152	425	447	455	330
0	0	0	0	0
0	0	1	1	3
0	0	0	1	1
0	0	0	0	0
0	0	0	0	0
4	7	1	4	7
161	0	1	0	2
1	0	0	0	0
0	0	0	0	0
0	0	0	0	0
1	0	0	0	0
8	0	0	1	3
8	1	0	2	3
6	1	0	0	1
1	0	0	0	0
0	0	0	0	0
0	0	0	0	1
0	0	0	0	0
1	0	0	0	0
12	0	0	0	4
3	44	29	18	32
1	0	0	0	0
2	0	0	0	0
1	0	0	0	4

mond Fork, Utah Co., UT	**Diamond Fork, Utah Co., UT**	**Diamond Fork, Utah Co., UT**	**Diamond Fork, Utah Co., UT**	**Diamond Fork, Utah Co., UT**	**Diamond Fork, Utah Co., UT**	**Diamond Fork, Utah Co., UT**	**Diamond Fork, Utah Co., UT**	**Diamond Fork, Utah Co., UT**	**Diamond Fork, Utah Co., UT**	**Di**
d Station (GS)	**Guard Station (GS)**	**Guard Station (GS)**	**Guard Station (GS)**	**Sawmill Canyon (SC)**	**Sawmill Canyon (SC)**	**Sawmill Canyon (SC)**	**Sawmill Canyon (SC)**	**Sulfur Impact (SI)**	**Sulfur Impact (SI)**	**Su**
1	**GS-02**	**GS-03**	**GS-04**	**SC-01**	**SC-02**	**SC-03**	**SC-04**	**SI-01**	**SI-02**	**SI**
6-2006	**06-06-2006**	**06-06-2006**	**06-06-2006**	**06-06-2006**	**06-06-2006**	**06-06-2006**	**06-06-2006**	**06-06-2006**	**06-06-2006**	**06**
00	**100.00**	**100.00**	**8.33**	**75.19**	**100.00**	**50.00**	**16.67**	**100.00**	**58.48**	**81**
	Hess	**Hess**	**D-Frame**	**Hess**	**Hess**	**Hess**	**D-Frame**	**Hess**	**Hess**	**He**
k	**blank**	**blank**	**blank**	**12T,4443115N,471103E**	**12T,4443115N,471103E**	**12T,4443115N,471103E**	**12T,4443115N,471103E**	**12T,4439015N,470806E**	**12T,4439015N,470806E**	**12**
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
00	444.00	516.00	7356.00	714.21	428.00	1068.00	3396.00	554.00	902.88	65
0	88.00	105.00	2952.00	82.46	69.00	92.00	792.00	54.00	70.11	50
nomidae	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Simulium sp.	Chironomidae	Chironomidae	Ch
00	299.00	327.00	1908.00	505.40	299.00	812.00	966.00	425.00	764.37	55
servus sp.	Baetis tricaudatus	Baetis tricaudatus	Baetis tricaudatus	Baetis tricaudatus	Baetis tricaudatus	Simulium sp.	Chironomidae	Oligochaeta	Oligochaeta	Ba
0	67.00	71.00	1524.00	66.50	52.00	128.00	912.00	44.00	49.59	27
s tricaudatus	Optioservus sp.	Optioservus sp.	Optioservus sp.	Simulium sp.	Simulium sp.	Baetis tricaudatus	Optioservus sp.	Baetis tricaudatus	Baetis tricaudatus	Ol
0	27.00	49.00	1188.00	55.86	36.00	74.00	456.00	35.00	35.91	22
6	67.34	63.37	25.94	70.76	69.86	76.03	28.45	76.71	84.66	85
3	82.43	77.13	46.66	80.07	82.01	88.01	55.30	84.66	90.15	90
9	88.51	86.63	62.81	87.90	90.42	94.94	68.73	90.97	94.13	93
0	20.00	23.00	29.00	21.00	16.00	14.00	27.00	11.00	12.00	14
	8.00	11.00	14.00	10.00	7.00	7.00	11.00	7.00	5.00	7.0
	5.00	4.00	7.00	5.00	3.00	2.00	4.00	3.00	3.00	3.0
	1.00	2.00	2.00	2.00	1.00	1.00	2.00	2.00	2.00	2.0
	2.00	5.00	5.00	3.00	3.00	4.00	5.00	2.00	0.00	2.0
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.0
0	18.00	21.00	27.00	20.00	14.00	12.00	25.00	9.00	10.00	12
	0.00	0.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00	0.0
	18.69	15.70	29.36	10.43	13.32	7.12	15.37	7.40	4.92	5.4
	0.23	1.36	6.20	0.37	0.23	0.19	3.71	1.99	2.84	1.7
	0.90	3.29	4.57	0.74	2.57	1.31	4.24	0.36	0.00	0.5
7	19.82	20.35	40.13	11.55	16.12	8.61	23.32	9.75	7.77	7.7
7	6.53	9.50	18.11	8.19	3.74	2.25	15.02	4.33	1.14	1.7
4	69.59	66.09	32.63	79.33	78.50	88.20	56.18	77.98	85.23	86
	0.23	0.19	1.96	0.00	0.23	0.75	0.53	7.94	5.49	3.4
	15.09	13.76	20.88	9.31	12.15	6.93	13.07	6.32	3.98	4.1
	0.45	0.58	0.98	0.00	0.00	0.00	0.18	0.00	0.00	0.0
6	67.34	63.37	25.94	70.76	69.86	76.03	26.86	76.71	84.66	85
	2.70	1.74	6.53	0.74	0.93	0.00	1.59	1.08	0.95	1.3
	0.00	1.36	2.28	0.37	1.40	0.75	1.41	0.18	0.00	0.3
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	0.00	0.78	5.87	0.00	0.00	0.00	3.36	1.44	2.08	1.3
	0.68	0.00	5.55	7.82	8.41	11.99	28.45	0.00	0.19	0.0

ond Fork, Utah Co., U	Diamond Fork, Utah Co., U	Diamond Fork, Utah Co., U	Diamond Fork, Utah Co., U	Diamond Fork, Utah Co., U	Diamond Fork, Utah Co., U	Diamond Fork, Utah Co., U	Diamond Fork, Utah Co., U	Diamond Fork, Utah Co., U	Diamond Fork, Utah Co., U	Di
d Station (GS)	Guard Station (GS)	Guard Station (GS)	Guard Station (GS)	Sawmill Canyon (SC)	Sawmill Canyon (SC)	Sawmill Canyon (SC)	Sawmill Canyon (SC)	Sulfur Impact (SI)	Sulfur Impact (SI)	Su
1	GS-02	GS-03	GS-04	SC-01	SC-02	SC-03	SC-04	SI-01	SI-02	SI
6-2006	06-06-2006	06-06-2006	06-06-2006	06-06-2006	06-06-2006	06-06-2006	06-06-2006	06-06-2006	06-06-2006	06
00	100.00	100.00	8.33	75.19	100.00	50.00	16.67	100.00	58.48	81
	Hess	Hess	D-Frame	Hess	Hess	Hess	D-Frame	Hess	Hess	He
k	blank	blank	blank	12T,4443115N,471103E	12T,4443115N,471103E	12T,4443115N,471103E	12T,4443115N,471103E	12T,4439015N,470806E	12T,4439015N,470806E	12
	2	3	4	5	6	7	8	9	10	11
	1.35	2.33	8.97	8.19	10.51	12.92	32.16	0.18	0.19	0.3
0	83.33	77.71	52.53	83.43	82.71	84.64	42.93	90.97	94.13	93
	4.95	6.20	8.32	1.49	1.40	0.56	3.53	1.81	1.52	1.7
5	7.88	11.43	19.09	6.52	5.37	1.69	15.72	5.23	1.89	2.0
	2.25	2.13	11.09	0.19	0.00	0.00	5.48	1.81	2.27	1.8
	0.00	0.00	0.00	0.19	0.00	0.19	0.18	0.00	0.00	0.0
	0.23	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	3.00	3.00	4.00	2.00	3.00	4.00	4.00	1.00	1.00	1.0
	5.00	4.00	8.00	5.00	5.00	5.00	7.00	3.00	3.00	3.0
	5.00	7.00	9.00	6.00	4.00	2.00	7.00	2.00	4.00	5.0
	5.00	4.00	5.00	6.00	4.00	2.00	4.00	2.00	2.00	3.0
	1.00	4.00	3.00	1.00	0.00	0.00	4.00	3.00	2.00	2.0
	0.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	0.00	0.0
	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	0.55	0.62	1.02	0.51	0.50	0.39	0.89	0.41	0.31	0.3
	1.82	2.05	3.39	1.68	1.65	1.31	2.97	1.35	1.01	1.0
	1.26	1.42	2.35	1.17	1.14	0.91	2.06	0.94	0.70	0.7
	3.12	3.52	3.14	3.04	2.48	1.86	3.20	1.58	1.62	2.0
	0.42	0.45	0.70	0.38	0.41	0.34	0.62	0.39	0.28	0.2
	0.52	0.57	0.85	0.48	0.49	0.40	0.81	0.40	0.28	0.2
2	97.75	98.06	96.57	99.63	99.30	100.00	97.00	98.74	99.81	99
	5.35	5.35	4.64	5.54	5.55	5.67	5.01	5.88	5.90	5.8
6	29.73	34.50	65.42	25.51	28.50	22.28	66.96	13.54	8.90	9.4
	4.45	4.51	4.44	4.75	4.66	4.81	4.69	4.55	4.38	4.3
6	27.70	29.65	58.08	27.37	27.34	22.66	60.95	11.91	6.44	7.7
0	55.00	51.00	72.00	54.00	38.00	45.00	47.00	24.00	28.00	30
	2.75	2.22	2.48	2.57	2.38	3.21	1.74	2.18	2.33	2.
	4.46	4.27	4.19	4.03	4.19	3.86	3.54	4.41	4.82	4.7
3	95.05	93.22	88.91	98.32	97.20	98.69	90.99	90.79	93.94	95
	3.00	2.52	2.86	3.43	2.75	3.43	1.93	4.00	3.67	2.9
	4.90	4.77	4.61	4.85	4.90	4.96	4.66	4.92	5.00	4.9
	3.00	4.00	4.00	3.00	3.00	4.00	6.00	2.00	3.00	3.0
0	10.00	11.00	15.00	15.00	10.00	11.00	13.00	6.00	6.00	7.0
0	24.77	29.07	58.08	27.93	28.27	23.03	64.31	13.72	8.90	8.8
	5.00	6.00	9.00	7.00	4.00	5.00	7.00	4.00	3.00	3.0
	0.23	0.20	0.20	0.00	0.47	0.37	0.15	8.04	3.22	2.7
0	5.00	4.35	6.90	0.00	12.50	7.14	11.11	9.09	8.33	7.
	2.00	1.00	2.00	3.00	2.00	2.00	3.00	1.00	1.00	1.0
1	775-2	775-3	775-4	775-5	775-6	775-7	775-8	775-9	775-10	77

	Site	Guard Station (GS)	Sawmill Canyon (SC)	Sulfur Impact (SI)
	Rep	Pooled	Pooled	Pooled
	Percent Subsampled	100.00	100.00	100.00
	EcoAnalysts Sample ID	13	14	15
tera	Baetis tricaudatus	297	213	155
	Cinygmula sp.	6	0	0
	Diphetor hageni	1	0	0
	Drunella grandis	23	11	25
	Epeorus longimanus	5	1	0
	Epeorus sp.	0	2	0
	Ephemerella inermis/infrequens	46	6	6
	Paraleptophlebia sp.	6	4	0
	Rhithrogena sp.	0	1	1
tera	Chloroperlidae	0	1	0
	Isogenoides sp.	0	0	3
	Isoperla sp.	5	2	0
	Perlodidae	0	3	9
	Pteronarcella sp.	42	19	39
	Triznaka sp.	1	0	0
tera	Cleptelmis addenda	0	8	0
	Optioservus sp.	236	127	69
	Zaitzevia sp.	19	22	0
ae	Chironomidae	1,179	1,237	1,657
tera	Antocha sp.	12	3	0
	Atherix sp.	0	0	5
	Bezzia/Palpomyia sp.	3	1	2
	Dicranota sp.	0	1	0
	Hexatoma sp.	16	0	0
	Neoplasta sp.	10	5	19
	Simulium sp.	39	303	3
	Tipula sp.	1	1	0
tera	Arctopsyche grandis	1	2	0
	Brachycentrus americanus	16	0	0
	Brachycentrus occidentalis	0	1	0
	Helicopsyche sp.	13	12	4
	Hydropsyche sp.	25	18	6
	Lepidostoma sp.	3	6	2
	Neotrichia sp.	0	3	0
	Oecetis disjuncta	1	0	0
	Rhyacophila coloradensis gr.	4	4	1
oda	Lymnaeidae	0	1	0
	Physa sp.	0	1	0
lvia	Sphaeriidae	4	16	4
lida	Oligochaeta	23	8	123
Acari	Atractides sp.	0	1	0
	Protzia sp.	0	2	0
	Sperchon sp.	13	4	4

Dominance Measures			
Dominant Taxon	Chironomidae	Chironomidae	Chironomidae
Dominant Abundance	1179.00	1237.00	1657.00
2nd Dominant Taxon	Baetis tricaudatus	Simulium sp.	Baetis tricaudatus
2nd Dominant Abundance	297.00	303.00	155.00
3rd Dominant Taxon	Optioservus sp.	Baetis tricaudatus	Oligochaeta
3rd Dominant Abundance	236.00	213.00	123.00
% Dominant Taxon	55.38	59.90	77.11
% 2 Dominant Taxa	69.33	74.58	84.32
% 3 Dominant Taxa	80.41	84.89	90.04
Richness Measures			
Species Richness	33.00	38.00	22.00
EPT Richness	17.00	18.00	11.00
Ephemeroptera Richness	7.00	7.00	4.00
Plecoptera Richness	3.00	4.00	3.00
Trichoptera Richness	7.00	7.00	4.00
Chironomidae Richness	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	1.00
Non-Chiro. Non-Olig. Richness	31.00	36.00	20.00
Rhyacophila Richness	1.00	1.00	1.00
Community Composition			
% Ephemeroptera	18.04	11.53	8.70
% Plecoptera	2.25	1.21	2.37
% Trichoptera	2.96	2.23	0.60
% EPT	23.25	14.96	11.68
% Coleoptera	11.98	7.60	3.21
% Diptera	59.18	75.11	78.46
% Oligochaeta	1.08	0.39	5.72
% Baetidae	14.00	10.31	7.21
% Brachycentridae	0.75	0.05	0.00
% Chironomidae	55.38	59.90	77.11
% Ephemerellidae	3.24	0.82	1.44
% Hydropsychidae	1.22	0.97	0.28
% Odonata	0.00	0.00	0.00
% Perlidae	0.00	0.00	0.00
% Pteronarcyidae	1.97	0.92	1.81
% Simuliidae	1.83	14.67	0.14
Functional Group Composition			
% Filterers	3.99	16.46	0.60
% Gatherers	72.33	72.49	90.04
% Predators	5.97	1.79	2.56
% Scrapers	13.29	7.55	4.61
% Shredders	4.32	1.55	2.19
% Piercer-Herbivores	0.00	0.15	0.00
% Unclassified	0.09	0.00	0.00
Filterer Richness	5.00	5.00	3.00
Gatherer Richness	8.00	8.00	3.00
Predator Richness	9.00	12.00	9.00
Scraper Richness	5.00	8.00	4.00
Shredder Richness	4.00	4.00	3.00
Piercer-Herbivore Richness	0.00	1.00	0.00
Unclassified	2.00	0.00	0.00
Diversity/Evenness Measures			
Shannon-Weaver H' (log 10)	0.76	0.65	0.44
Shannon-Weaver H' (log 2)	2.51	2.14	1.45
Shannon-Weaver H' (log e)	1.74	1.49	1.01
Margalef's Richness	4.18	4.85	2.74
Pielou's J'	0.50	0.41	0.33
Simpson's Heterogeneity	0.66	0.61	0.40
Biotic Indices			
% Indiv. w/ HBI Value	97.79	98.93	98.74
Hilsenhoff Biotic Index	5.21	5.43	5.80
% Indiv. w/ MTI Value	40.02	36.66	15.50
Metals Tolerance Index	4.48	4.71	4.43
% Indiv. w/ FSBI Value	35.60	35.35	12.61
Fine Sediment Biotic Index	83.00	85.00	43.00

Ephemeroptera	Baetis tricaudatus	62	86
	Drunella grandis	0	0
	Ephemerella sp.	0	0
	Ephemerellidae	6	0
	Leptophlebiidae	10	0
	Paraleptophlebia sp.	0	0
	Rhithrogena sp.	51	8
Plecoptera	Capniidae	0	0
	Chloroperlidae	2	3
	Claassenia sabulosa	0	0
	Isogenoides sp.	14	15
	Isoperla sp.	14	12
	Perlodidae	0	0
	Pteronarcella sp.	45	13
	Skwala sp.	1	0
	Zapada cinctipes	3	0
Coleoptera	Cleptelmis addenda	0	0
	Optioservus sp.	27	28
	Zaitzevia parvula	0	0
	Zaitzevia sp.	0	0
tera-Chironomidae	Chironomidae	150	121
Diptera	Antocha sp.	0	0
	Atherix sp.	2	7
	Bezzia/Palpomyia sp.	2	0
	Ceratopogoninae	0	0
	Chelifera/Metachela sp.	0	0
	Clinocera sp.	0	0
	Dasyhelea sp.	0	0
	Dicranota sp.	0	0
	Hemerodromia sp.	0	0
	Hexatoma sp.	0	0
	Muscidae	0	0
	Neoplasta sp.	1	0
	Pericoma/Telmatoscopus sp.	0	0
	Simulium sp.	52	271
	Tipula sp.	0	0
	Tipulidae	2	0
Trichoptera	Arctopsyche grandis	0	0
	Brachycentrus americanus	0	0
	Brachycentrus occidentalis	18	9
	Glossosoma sp.	0	0
	Glossosomatidae	0	0
	Helicopsyche sp.	0	0
	Hydropsyche sp.	47	16
	Hydroptila sp.	0	0
	Hydroptilidae	7	0
	Lepidostoma sp.	4	2
	Micrasema sp.	0	0
	Neotrichia sp.	0	0
	Ochrotrichia sp.	0	0
	Oligophlebodes sp.	0	0
	Rhyacophila brunnea gr.	0	0
	Rhyacophila coloradensis gr.	0	0
Gastropoda	Gastropoda	0	0
	Lymnaeidae	0	0
	Physa sp.	1	1
Bivalvia	Pisidium sp.	0	0
	Sphaeriidae	5	2
Annelida	Erpobdellidae	6	2
	Oligochaeta	26	5
Acari	Atractides sp.	1	0

183	60	89	88
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0	2	8	11
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91	226	244	204
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0	7	5	6
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3	11	0	3

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45	17	61	129
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177	152	52	164
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31	12	5	6
0	2	0	0

PT Abundance	309.56	164.00	308.80	1926.18
ominance Measures				
ominant Taxon	Chironomidae	Simulium sp.	Chironomidae	Simulium sp.
ominant Abundance	163.50	271.00	248.00	1416.96
nd Dominant Taxon	Baetis tricaudatus	Chironomidae	Simulium sp.	Baetis tricaudatus
nd Dominant Abundance	67.58	121.00	188.80	1350.54
rd Dominant Taxon	Simulium sp.	Baetis tricaudatus	Baetis tricaudatus	Chironomidae
rd Dominant Abundance	56.68	86.00	145.60	671.58
o Dominant Taxon	26.69	44.87	28.60	31.95
o 2 Dominant Taxa	37.72	64.90	50.37	62.40
o 3 Dominant Taxa	46.98	79.14	67.16	77.54
ichness Measures				
pecies Richness	29.00	19.00	20.00	23.00
PT Richness	14.00	9.00	7.00	10.00
phemeroptera Richness	4.00	2.00	1.00	2.00
lecoptera Richness	6.00	4.00	2.00	4.00
richoptera Richness	4.00	3.00	4.00	4.00
hironomidae Richness	1.00	1.00	1.00	1.00
ligochaeta Richness	1.00	1.00	1.00	1.00
on-Chiro. Non-Olig. Richness	27.00	17.00	18.00	21.00
hyacophila Richness	0.00	0.00	0.00	0.00
ommunity Composition				
o Ephemeroptera	22.95	15.56	16.79	32.78
o Plecoptera	14.06	7.12	0.37	2.00
o Trichoptera	13.52	4.47	18.45	8.65
o EPT	50.53	27.15	35.61	43.43
o Coleoptera	4.80	4.64	2.03	4.66
o Diptera	37.19	66.06	59.59	48.42
o Oligochaeta	4.63	0.83	1.11	2.16
o Baetidae	11.03	14.24	16.79	30.45
o Brachycentridae	3.20	1.49	14.58	7.49
o Chironomidae	26.69	20.03	28.60	15.14
o Ephemerellidae	1.07	0.00	0.00	0.00
o Hydropsychidae	8.36	2.65	2.77	1.00
o Odonata	0.00	0.00	0.00	0.00
o Perlidae	0.00	0.00	0.00	0.00
o Pteronarcyidae	8.01	2.15	0.18	0.67
o Simuliidae	9.25	44.87	21.77	31.95
unctional Group Composition				
o Filterers	21.71	49.34	39.30	40.43
o Gatherers	45.37	35.10	51.66	48.42
o Predators	8.01	6.95	5.35	2.66
o Scrapers	14.06	6.13	3.14	7.32
o Shredders	9.61	2.48	0.18	0.67
o Piercer-Herbivores	1.25	0.00	0.00	0.00
o Unclassified	0.00	0.00	0.37	0.50
ilterer Richness	4.00	4.00	5.00	4.00
atherer Richness	6.00	3.00	4.00	4.00
redator Richness	11.00	7.00	7.00	8.00
craper Richness	3.00	3.00	2.00	4.00
hredder Richness	4.00	2.00	1.00	1.00
iercer-Herbivore Richness	1.00	0.00	0.00	0.00
nclassified	0.00	0.00	1.00	2.00
iversity/Evenness Measures				
hannon-Weaver H' (log 10)	1.09	0.78	0.87	0.80
hannon-Weaver H' (log 2)	3.63	2.57	2.89	2.64
hannon-Weaver H' (log e)	2.51	1.78	2.01	1.83
largalef's Richness	4.36	2.81	2.81	2.62
ielou's J'	0.75	0.61	0.67	0.58
impson's Heterogeneity	0.88	0.73	0.82	0.77
iotic Indices				
o Indiv. w/ HBI Value	99.11	99.67	98.15	99.00
ilsenhoff Biotic Index	4.41	4.83	4.54	4.50
o Indiv. w/ MTI Value	62.63	78.15	68.27	80.37
letals Tolerance Index	4.02	4.71	4.44	4.70
o Indiv. w/ FSBI Value	49.29	72.35	66.61	79.20
ine Sediment Biotic Index	44.00	36.00	58.00	53.00

56.80	610.40	826.15	1176.00	148.20	462.00
hironomidae	Chironomidae	Chironomidae	Optioservus sp.	Chironomidae	Chironomidae
084.80	1063.84	1087.32	1296.00	253.08	2016.00
ptioservus sp.	Baetis tricaudatus	Optioservus sp.	Chironomidae	Baetis tricaudatus	Simulium sp.
33.60	388.04	623.61	1080.00	75.24	348.00
aetis tricaudatus	Simulium sp.	Baetis tricaudatus	Baetis tricaudatus	Oligochaeta	Baetis tricaudatus
38.00	292.12	469.04	768.00	63.84	222.00
1.39	42.51	38.86	28.22	41.50	62.92
5.57	58.01	61.14	51.74	53.83	73.78
6.56	69.69	77.90	68.47	64.30	80.71
2.00	20.00	20.00	28.00	24.00	24.00
00	7.00	8.00	11.00	12.00	12.00
00	4.00	4.00	4.00	3.00	4.00
00	1.00	1.00	0.00	6.00	4.00
00	2.00	3.00	7.00	3.00	4.00
00	1.00	1.00	1.00	1.00	1.00
00	1.00	1.00	1.00	1.00	1.00
0.00	18.00	18.00	26.00	22.00	22.00
00	1.00	1.00	1.00	0.00	0.00
1.54	17.42	19.81	18.12	13.83	8.99
00	0.17	0.19	0.00	5.98	2.62
71	6.79	9.52	7.49	4.49	2.81
1.25	24.39	29.52	25.61	24.30	14.42
6.74	9.76	24.38	31.36	9.72	6.37
0.00	60.45	43.43	34.15	52.52	74.34
83	3.83	1.90	6.97	10.47	0.75
0.99	15.51	16.76	16.72	12.34	6.93
18	0.00	0.57	0.17	0.56	0.56
1.39	42.51	38.86	23.52	41.50	62.92
18	0.52	0.95	0.87	0.75	1.69
14	5.92	8.76	5.23	2.24	1.31
00	0.00	0.00	0.00	0.00	0.00
00	0.00	0.00	0.00	0.19	0.19
00	0.00	0.00	0.00	1.68	1.87
11	11.67	1.71	6.97	6.54	10.86
0.44	17.60	11.05	12.72	9.35	12.73
9.71	65.68	63.81	51.92	65.61	72.47
58	6.62	2.67	4.88	10.65	4.87
4.54	9.76	22.48	29.44	10.65	6.74
37	0.17	0.00	1.05	3.74	2.62
18	0.00	0.00	0.00	0.00	0.19
18	0.17	0.00	0.00	0.00	0.37
00	2.00	3.00	4.00	3.00	3.00
00	9.00	9.00	9.00	5.00	5.00
00	4.00	6.00	9.00	10.00	9.00
00	3.00	2.00	5.00	3.00	3.00
00	1.00	0.00	1.00	3.00	2.00
00	0.00	0.00	0.00	0.00	1.00
00	1.00	0.00	0.00	0.00	1.00
80	0.83	0.79	0.92	0.91	0.65
65	2.77	2.62	3.06	3.01	2.16
83	1.92	1.81	2.12	2.08	1.49
67	2.43	2.39	3.20	3.59	2.85
59	0.64	0.61	0.64	0.66	0.47
75	0.77	0.76	0.82	0.79	0.58
7.62	95.30	98.29	97.56	96.07	95.69
20	5.29	5.13	5.14	5.33	5.44
1.47	46.34	52.38	62.89	42.99	29.78
72	4.84	4.92	4.80	4.50	4.74
3.85	45.82	54.67	64.63	37.20	28.65

27.12	1610.25	460.32	576.24	584.00	3228.00
imulium sp.	Brachycentrus occidentalis	Baetis tricaudatus	Chironomidae	Baetis tricaudatus	Baetis tricaudatus
071.60	757.10	223.44	607.11	380.00	1800.00
hironomidae	Chironomidae	Optioservus sp.	Simulium sp.	Chironomidae	Simulium sp.
46.72	446.35	157.92	428.75	304.00	1536.00
aetis tricaudatus	Oligochaeta	Chironomidae	Baetis tricaudatus	Brachycentrus occidentalis	Optioservus sp.
51.92	440.70	154.56	329.28	110.00	732.00
1.44	23.67	24.72	32.78	34.86	27.57
2.49	37.63	42.19	55.93	62.75	51.10
4.58	51.41	59.29	73.70	72.84	62.32
6.00	25.00	22.00	20.00	21.00	26.00
00	12.00	11.00	10.00	10.00	12.00
00	3.00	3.00	3.00	3.00	3.00
00	3.00	5.00	2.00	3.00	4.00
00	6.00	3.00	5.00	4.00	5.00
00	1.00	1.00	1.00	1.00	1.00
00	1.00	0.00	0.00	1.00	1.00
4.00	23.00	21.00	19.00	19.00	24.00
00	1.00	0.00	0.00	0.00	0.00
2.27	14.49	25.28	18.15	35.23	28.86
44	7.77	5.95	2.04	1.10	4.41
99	28.09	19.70	10.93	17.25	16.18
5.70	50.35	50.93	31.11	53.58	49.45
72	9.89	17.47	8.33	3.12	11.21
2.85	22.08	28.62	56.85	39.82	33.46
36	13.78	0.00	0.00	1.28	1.29
2.09	13.25	24.72	17.78	34.86	27.57
08	23.67	13.94	7.78	10.09	10.85
1.05	13.96	17.10	32.78	27.89	9.56
18	0.18	0.19	0.19	0.18	0.18
90	1.06	5.76	2.04	6.79	3.13
00	0.00	0.00	0.00	0.00	0.00
00	0.00	0.56	0.00	0.00	0.18
90	4.42	3.35	1.67	0.37	2.02
1.44	6.36	7.81	23.15	7.16	23.53
3.43	31.10	27.70	32.96	24.04	37.50
3.68	41.52	42.01	51.30	66.79	38.79
26	7.42	8.36	4.07	4.95	6.07
72	12.90	18.22	8.52	3.49	13.24
90	6.89	3.35	2.22	0.73	3.68
00	0.00	0.00	0.56	0.00	0.37
00	0.18	0.37	0.37	0.00	0.37
00	3.00	5.00	4.00	4.00	3.00
00	5.00	3.00	4.00	4.00	5.00
00	8.00	9.00	6.00	8.00	10.00
00	6.00	3.00	2.00	3.00	4.00
00	2.00	1.00	2.00	2.00	2.00
00	0.00	0.00	1.00	0.00	1.00
00	1.00	1.00	1.00	0.00	1.00
54	1.02	0.95	0.82	0.82	0.94
80	3.40	3.16	2.72	2.74	3.12
25	2.36	2.19	1.89	1.90	2.17
96	2.97	3.09	2.53	2.86	2.85
45	0.73	0.71	0.63	0.62	0.66
62	0.87	0.85	0.79	0.78	0.83
9.82	96.47	98.14	96.48	97.25	96.69
13	4.38	4.38	4.83	4.55	4.30
8.23	67.84	80.11	63.15	67.52	84.01
92	3.87	4.48	4.66	4.59	4.55
7.15	59.19	74.16	60.74	66.42	79.78

72.80	1744.00	353.58	4384.00	32.00	73.12
aetis tricaudatus	Baetis tricaudatus	Chironomidae	Optioservus sp.	Chironomidae	Chironomidae
39.20	1464.00	587.88	4960.00	1664.00	2216.45
hironomidae	Chironomidae	Baetis tricaudatus	Simulium sp.	Neoplasta sp.	Simulium sp.
62.40	1440.00	306.72	4864.00	28.80	114.25
ptioservus sp.	Optioservus sp.	Optioservus sp.	Baetis tricaudatus	Baetis tricaudatus	Baetis tricaudatus
06.40	712.00	193.83	3136.00	28.80	73.12
7.00	34.53	48.85	28.55	92.69	88.99
5.62	68.49	74.34	56.54	94.30	93.58
3.13	85.28	90.44	74.59	95.90	96.51
0.00	19.00	16.00	23.00	9.00	9.00
00	4.00	5.00	8.00	2.00	1.00
00	2.00	2.00	2.00	2.00	1.00
00	0.00	0.00	0.00	0.00	0.00
00	2.00	3.00	6.00	0.00	0.00
00	1.00	1.00	1.00	1.00	1.00
00	0.00	1.00	1.00	1.00	1.00
3.00	18.00	14.00	21.00	7.00	7.00
00	1.00	0.00	1.00	0.00	0.00
9.09	37.17	26.90	18.78	1.78	2.94
00	0.00	0.00	0.00	0.00	0.00
57	3.96	2.48	6.45	0.00	0.00
0.66	41.13	29.38	25.23	1.78	2.94
2.51	18.11	16.99	29.47	0.53	0.37
1.41	40.38	52.39	44.20	96.26	95.96
54	0.00	0.88	0.37	1.43	0.73
7.00	34.53	25.49	18.05	1.60	2.94
00	0.00	0.18	0.00	0.00	0.00
3.62	33.96	48.85	13.44	92.69	88.99
35	0.00	0.00	0.00	0.00	0.00
22	3.58	2.12	5.34	0.00	0.00
00	0.00	0.00	0.00	0.00	0.00
00	0.00	0.00	0.00	0.00	0.00
00	0.00	0.00	0.00	0.00	0.00
52	4.34	1.42	27.99	1.25	4.59
75	7.92	3.89	33.52	1.25	4.59
2.60	73.02	77.70	34.25	96.08	92.66
62	2.08	1.59	2.76	2.14	2.39
2.69	16.79	16.11	28.91	0.53	0.37
17	0.19	0.53	0.55	0.00	0.00
17	0.00	0.18	0.00	0.00	0.00
00	0.00	0.00	0.00	0.00	0.00
00	2.00	4.00	3.00	1.00	1.00
00	7.00	6.00	9.00	5.00	3.00
00	8.00	3.00	6.00	2.00	4.00
00	1.00	1.00	3.00	1.00	1.00
00	1.00	1.00	2.00	0.00	0.00
00	0.00	1.00	0.00	0.00	0.00
00	0.00	0.00	0.00	0.00	0.00
68	0.70	0.62	0.79	0.17	0.22
25	2.33	2.07	2.61	0.57	0.74
56	1.62	1.43	1.81	0.40	0.51
79	2.16	2.11	2.25	1.07	1.02
52	0.55	0.52	0.58	0.18	0.23
73	0.73	0.67	0.79	0.14	0.20
3.08	98.68	98.58	97.97	97.86	97.98
98	4.88	5.21	4.90	5.97	5.90
2.83	61.32	47.26	82.87	3.57	8.26
97	4.94	4.92	4.94	4.95	4.91
4.05	62.08	46.73	82.50	3.57	8.26
0.00	49.00	30.00	53.00	16.00	18.00

33.07	580.72	764.86	784.00	530.16	2777.34
hironomidae	Chironomidae	Oligophlebodes sp.	Chironomidae	Oligophlebodes sp.	Chironomidae
211.88	4046.00	602.27	649.60	406.08	2032.20
aetis tricaudatus	Simulium sp.	Chironomidae	Oligophlebodes sp.	Chironomidae	Oligophlebodes sp.
28.50	590.24	261.06	486.40	246.28	1467.70
imulium sp.	Baetis tricaudatus	Brachycentrus occidentalis	Turbellaria	Optioservus sp.	Baetis tricaudatus
00.54	580.72	80.15	92.80	95.88	688.69
5.51	72.40	48.08	37.94	39.63	31.91
4.35	82.96	68.92	66.36	63.67	54.96
3.23	93.36	75.32	71.78	73.03	65.78
00	8.00	24.00	17.00	21.00	24.00
00	1.00	9.00	8.00	9.00	11.00
00	1.00	2.00	2.00	2.00	2.00
00	0.00	1.00	0.00	1.00	2.00
00	0.00	6.00	6.00	6.00	7.00
00	1.00	1.00	1.00	1.00	1.00
00	1.00	1.00	1.00	1.00	1.00
00	6.00	22.00	15.00	19.00	22.00
00	0.00	1.00	1.00	1.00	2.00
83	10.39	3.66	9.72	6.06	12.94
00	0.00	0.18	0.00	0.18	0.53
18	0.00	57.22	36.07	45.50	30.14
01	10.39	61.06	45.79	51.74	43.62
71	0.17	6.22	4.30	9.36	6.38
9.75	83.99	23.22	41.87	26.24	36.17
35	5.28	2.19	0.93	1.10	1.06
83	10.39	1.28	4.86	3.85	10.82
00	0.00	8.04	6.92	4.77	5.50
5.51	72.40	20.84	37.94	24.04	31.91
00	0.00	2.38	4.86	2.20	2.13
18	0.00	0.18	0.00	0.37	0.35
00	0.00	0.00	0.00	0.00	0.00
00	0.00	0.00	0.00	0.00	0.00
00	0.00	0.00	0.00	0.00	0.00
89	10.56	0.00	0.00	0.00	0.00
06	10.56	7.50	5.05	3.30	1.24
4.70	88.07	25.41	47.10	30.28	47.70
53	0.85	8.04	7.85	13.03	14.36
71	0.34	56.86	37.76	51.19	31.56
00	0.17	1.65	2.06	2.20	5.14
00	0.00	0.55	0.19	0.00	0.00
00	0.00	0.00	0.00	0.00	0.00
00	1.00	3.00	2.00	4.00	4.00
00	3.00	5.00	4.00	4.00	6.00
00	1.00	10.00	5.00	8.00	9.00
00	2.00	4.00	4.00	3.00	3.00
00	1.00	1.00	1.00	2.00	2.00
00	0.00	1.00	1.00	0.00	0.00
00	0.00	0.00	0.00	0.00	0.00
25	0.41	0.79	0.80	0.83	0.92
82	1.35	2.64	2.67	2.74	3.06
57	0.94	1.83	1.85	1.90	2.12
89	0.81	3.22	2.15	2.89	2.63
27	0.45	0.58	0.65	0.62	0.67
26	0.45	0.72	0.76	0.77	0.82
9.65	99.15	97.44	97.94	98.17	92.91
78	5.79	2.90	3.67	3.40	3.74
3.78	21.29	72.21	58.88	64.22	59.22
00	4.99	1.88	2.28	2.13	2.77
3.60	21.29	67.64	53.27	62.39	53.37

	Ephemerellidae	6	0	0
	Leptophlebiidae	10	24	1
	Paraleptophlebia sp.	0	0	0
	Rhithrogena sp.	73	0	11
Plecoptera	Capniidae	0	1	0
	Chloroperlidae	6	0	2
	Claassenia sabulosa	0	0	2
	Isogenoides sp.	30	0	13
	Isoperla sp.	26	0	30
	Perlodidae	7	1	0
	Pteronarcella sp.	63	0	49
	Skwala sp.	1	0	0
	Zapada cinctipes	3	0	2
Coleoptera	Cleptelmis addenda	0	8	0
	Optioservus sp.	94	463	146
	Zaitzevia parvula	0	0	0
	Zaitzevia sp.	0	39	0
era-Chironomidae	Chironomidae	517	809	809
Diptera	Antocha sp.	32	10	5
	Atherix sp.	18	0	8
	Bezzia/Palpomyia sp.	9	23	23
	Ceratopogoninae	0	0	0
	Chelifera/Metachela sp.	2	2	0
	Clinocera sp.	6	0	0
	Dasyhelea sp.	0	0	0
	Dicranota sp.	0	0	0
	Hemerodromia sp.	2	0	2
	Hexatoma sp.	0	3	0
	Muscidae	0	0	0
	Neoplasta sp.	1	33	1
	Pericoma/Telmatoscopus sp.	0	23	0
	Simulium sp.	633	133	414
	Tipula sp.	0	8	0
	Tipulidae	2	0	0
Trichoptera	Arctopsyche grandis	3	0	2
	Brachycentrus americanus	0	0	0
	Brachycentrus occidentalis	151	5	146
	Glossosoma sp.	6	1	3
	Glossosomatidae	1	0	0
	Helicopsyche sp.	0	2	1
	Hydropsyche sp.	81	149	28
	Hydroptila sp.	0	0	1
	Hydroptilidae	7	0	0
	Lepidostoma sp.	6	0	27
	Micrasema sp.	0	0	0
	Neotrichia sp.	0	1	0
	Ochrotrichia sp.	0	1	0
	Oligophlebodes sp.	0	2	0
	Rhyacophila brunnea gr.	0	0	0
	Rhyacophila coloradensis gr.	0	24	1
Gastropoda	Gastropoda	1	0	0
	Lymnaeidae	0	0	3
	Physa sp.	3	2	6
Bivalvia	Pisidium sp.	0	0	0
	Sphaeriidae	8	2	0
Annelida	Erpobdellidae	8	0	0
	Oligochaeta	50	82	140
Acari	Atractides sp.	2	1	17
	Corticacarus	2	0	3
	Hygrobates sp.	0	0	1
	Lebertia sp.	0	0	0

2	1	0	0
0	26	0	1
0	10	0	0
10	0	0	0
0	0	0	0
6	0	1	0
4	0	0	0
6	0	0	0
14	0	1	0
3	0	1	0
40	0	0	0
0	0	0	0
0	0	2	0
0	7	0	0
217	464	144	10
0	10	0	0
0	0	0	0
473	693	628	1,914
18	4	48	0
11	5	0	0
7	18	10	4
0	1	0	0
0	0	0	0
1	0	0	0
0	2	0	0
0	1	0	1
16	1	0	1
0	0	0	0
0	0	3	0
0	11	6	26
0	1	2	1
334	186	0	116
0	7	1	1
0	0	0	0
5	0	4	0
0	0	2	0
231	1	78	0
1	1	1	0
0	0	0	0
0	1	0	0
91	67	1	1
3	1	0	0
2	0	4	0
14	1	0	0
0	0	58	0
0	1	0	0
0	2	0	0
0	0	761	0
0	0	12	0
0	4	3	0
0	0	0	0
0	0	0	0
6	0	1	1
0	0	6	0
1	2	2	0
0	0	0	0
14	33	29	45
17	2	2	0
6	0	0	0
1	0	0	0
1	0	3	0

Dominance Measures				
Dominant Taxon	Simulium sp.	Chironomidae	Chironomidae	Baetis tricaudatus
Dominant Abundance	633.00	809.00	809.00	569.00
2nd Dominant Taxon	Chironomidae	Optioservus sp.	Simulium sp.	Chironomidae
2nd Dominant Abundance	517.00	463.00	414.00	473.00
3rd Dominant Taxon	Baetis tricaudatus	Baetis tricaudatus	Baetis tricaudatus	Simulium sp.
3rd Dominant Abundance	422.00	333.00	245.00	334.00
% Dominant Taxon	27.41	36.46	36.96	26.26
% 2 Dominant Taxa	49.81	57.32	55.87	48.08
% 3 Dominant Taxa	68.08	72.33	67.06	63.50
Richness Measures				
Species Richness	39.00	34.00	35.00	36.00
EPT Richness	18.00	14.00	18.00	18.00
Ephemeroptera Richness	4.00	4.00	4.00	5.00
Plecoptera Richness	7.00	2.00	6.00	6.00
Trichoptera Richness	7.00	8.00	8.00	7.00
Chironomidae Richness	1.00	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	1.00	1.00
Non-Chiro. Non-Olig. Richness	37.00	32.00	33.00	34.00
Rhyacophila Richness	0.00	1.00	1.00	0.00
Community Composition				
% Ephemeroptera	22.13	16.72	12.43	26.90
% Plecoptera	5.89	0.09	4.48	3.37
% Trichoptera	11.04	8.34	9.55	16.01
% EPT	39.06	25.15	26.45	46.29
% Coleoptera	4.07	22.98	6.67	10.01
% Diptera	52.92	47.05	57.65	39.69
% Oligochaeta	2.17	3.70	6.40	0.65
% Baetidae	18.28	15.01	11.19	26.26
% Brachycentridae	6.54	0.23	6.67	10.66
% Chironomidae	22.39	36.46	36.96	21.83
% Ephemerellidae	0.26	0.63	0.69	0.18
% Hydropsychidae	3.64	6.71	1.37	4.43
% Odonata	0.00	0.00	0.00	0.00
% Perlidae	0.00	0.00	0.09	0.18
% Pteronarcyidae	2.73	0.00	2.24	1.85
% Simuliidae	27.41	5.99	18.91	15.41
Functional Group Composition				
% Filterers	37.94	13.02	26.95	30.55
% Gatherers	44.95	60.21	55.50	49.75
% Predators	5.72	4.73	6.03	5.86
% Scrapers	7.67	21.50	7.77	10.84
% Shredders	3.20	0.41	3.56	2.49
% Piercer-Herbivores	0.30	0.05	0.05	0.23
% Unclassified	0.22	0.09	0.14	0.28
Filterer Richness	5.00	4.00	4.00	5.00
Gatherer Richness	7.00	10.00	6.00	7.00
Predator Richness	14.00	10.00	14.00	14.00
Scraper Richness	5.00	6.00	6.00	5.00
Shredder Richness	4.00	2.00	3.00	2.00
Piercer-Herbivore Richness	1.00	1.00	1.00	2.00
Unclassified	3.00	1.00	1.00	1.00
Diversity/Evenness Measures				
Shannon-Weaver H' (log 10)	0.97	0.87	0.91	0.94
Shannon-Weaver H' (log 2)	3.22	2.89	3.03	3.12
Shannon-Weaver H' (log e)	2.23	2.00	2.10	2.16
Margalef's Richness	4.91	4.28	4.42	4.56
Pielou's J'	0.61	0.57	0.59	0.60
Simpson's Heterogeneity	0.83	0.79	0.80	0.84
Biotic Indices				
% Indiv. w/ HBI Value	99.00	97.16	97.03	97.14
Hilsenhoff Biotic Index	4.57	5.19	5.06	4.52
% Indiv. w/ MTI Value	72.63	53.31	52.58	73.70
Metals Tolerance Index	4.50	4.82	4.46	4.56
% Indiv. w/ FSBI Value	67.17	54.75	48.38	70.28
Fine Sediment Biotic Index	74.00	75.00	77.00	82.00

Chironomidae	Oligophlebodes sp.	Chironomidae
693.00	761.00	1914.00
Baetis tricaudatus	Chironomidae	Baetis tricaudatus
637.00	628.00	136.00
Optioservus sp.	Optioservus sp.	Simulium sp.
464.00	144.00	116.00
31.34	34.73	84.73
60.15	63.40	90.75
81.14	69.97	95.88
36.00	38.00	15.00
14.00	16.00	3.00
5.00	2.00	2.00
0.00	4.00	0.00
9.00	10.00	1.00
1.00	1.00	1.00
1.00	1.00	1.00
34.00	36.00	13.00
1.00	2.00	0.00
30.53	8.12	6.06
0.00	0.23	0.00
3.57	42.17	0.04
34.10	50.52	6.11
21.75	6.57	0.44
42.06	31.86	91.37
1.49	1.32	1.99
28.81	5.25	6.02
0.05	6.30	0.00
31.34	28.66	84.73
0.09	2.88	0.00
3.03	0.23	0.04
0.00	0.00	0.00
0.00	0.00	0.00
0.00	0.00	0.00
8.41	0.00	5.14
11.58	4.24	5.18
64.59	37.65	92.83
2.26	10.86	1.46
21.12	44.27	0.49
0.36	2.78	0.04
0.09	0.18	0.00
0.00	0.00	0.00
4.00	6.00	2.00
13.00	7.00	5.00
11.00	16.00	5.00
4.00	5.00	2.00
2.00	3.00	1.00
2.00	1.00	0.00
0.00	0.00	0.00
0.76	0.89	0.28
2.54	2.97	0.94
1.76	2.06	0.65
4.54	4.81	1.81
0.49	0.57	0.24
0.77	0.78	0.28
98.33	96.58	98.67
5.00	3.43	5.86
63.41	63.62	11.86
4.94	2.25	4.98
63.68	59.15	11.82
80.00	87.00	31.00