P-10855

Document # GB-0806

Upper Peninsula Power Company
(a subsidiary of WPS Resources Corporation)
700 N. Adams Street
P.O. Box 19001
Green Bay, WI 54307-9001

November 21, 2003

FERC Project No. 10855

Ms. Peggy Harding (2 copies of ltr)
Federal Energy Regulatory Commission
Chicago Regional Office
230 South Dearborn Street, Room 3130
Chicago, IL 60604

ORIGINAL

Dear Ms. Harding:

<u>Silver Lake Head-Cutting Control Structure</u>

As indicated in an August 14, 2003 letter to your office, Upper Peninsula Power Company (UPPCO) received e letter from the Michigan Department of Environmental Quality (MDEQ) on August 11, 2003. The MDEQ letter required the installation of a structure to control the perceived continued head-cutting et the current outlet of Silver Lake (See Appendix 1). The structure was to be installed by October 1, 2003.

As a result of the August 11, 2003 letter from MDEQ, UPPCO retained en expert to enalyze the potential for continued head-cutting of the stream (during the 2003/2004 winter season and spring runoff), and if warrented, recommend interim stabilization measures to reduce additional head-cutting until a permanent measure can be designed and constructed.

The enalysis was completed in late September and the report was issued on October 7, 2003. As e result of the analysis, it was determined that the existing natural structure, termed a conglomerate, is controlling the water surface elevation of Silver Lake end construction of e temporary measure is not necessary for the 2003/2004 winter season and spring runoff. A copy of the report is enclosed in Appendix 2.

As a result of the report, the MDEQ issued a letter dated October 15, 2003 withdrawing the required ection to control the head-cutting erosion at the current outlet of Silver Lake. A copy of the October 15, 2003 MDEQ letter is enclosed in Appendix 3.

Should you have any questions relative to this material, please feel free to contact Shawn Puzen et (920) 433-1094 at your earliest convenience.

Sincerely,

David W Harpole

David W. Harpole
Vice President - Energy Supply
for Wisconsin Public Service Corporation
Telephone: (920) 433-1264

Enc.

cc: Mr. Thomas LuVollo, FERC - Wash - 2 copies ltr/attach
Ms. Joan Johanek, WPSC - D2 w/Attach
Mr. Dave Harpole, WPSC - D2 w/o Attach
Mr. Tom Meinz, WPSC - A2 w/o Attach
Mr. Gil Snyder, WPSC - D2 w/o Attach
Mr. John Myers, WPSC - D2 w/o Attach
Ms. Paula Coates, WPSC - D2 w/Attach
Mr. Shawn Puzen, WPSC - A2 w/Attach
Ms. Elyse Stackhouse/Mr. Barth Wolf - G4 (3 copies) w/o Attach
Mr. Dennis Maki, WPSC - WES w/o Attach
Mr. Gery Erickson, UPPCO - UISC w/o Attach
Mr. Bob Edwards, UPPCO - UHGO w/o Attach
Mr. Bob Meyers, UPPCO - UISC w/o Attach

Appendix 1

August 11, 2003 MDEQ Letter

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
UPPER PENINSULA DISTRICT OFFICE

Document # GB-0484

JENNIFER M. GRANHOLM
GOVERNOR

STEVEN E. CHESTER
DIRECTOR

cc - J F Johanek D2 (original)
D W Harpole D2
G E Snyder D2
J W Myers D2
P A Coates D2
S C Puzen A2
D S Nalepka G4
E Stackhouse G4
D J Maki WES
G W Erickson UISC
R W Edwards UHGO
R J Meyers UISC

August 11, 2003

Mr Shawn Puzen
Environmental Consultant
Upper Peninsula Power Company
P O Box 19001
Green Bay, Wisconsin 54307-9001

Dear Shawn,

SUBJECT Required Action Under Part 31 of PA 451 of 1994 to Abate Erosion at the Site of the Silver Lake Fuse Plug

The construction of a structure to control head cutting at Silver Lake Basin has been under discussion for some time. The purpose of this letter is to communicate the Department of Environmental Quality's decision to require the installation of a head cutting control structure under Part 31 of PA 451 of 1994 In addition, this letter will clarify the issue of permits from the Geological and Land Management Division (GLMD) for future restoration work

A structure is needed to control continued head cutting (erosion) at Silver Lake Basin Additional head cutting will result in more sand and other soils entering the Dead River system In addition the basin is currently very close to its "natural" size and we desire to keep the basin intact until a long term management strategy is finalized For these reasons a modest structure to control head cutting under high flow conditions is required Once a final decision is made by UPPCo regarding the rebuilding of Silver Lake Storage Basin, MDEQ/MDNR will review the final disposition of the temporary structure. If the final restoration plan calls for utilizing the newly formed channel below the fuse plug as the river channel, the head cutting control structure must accommodate fish passage If the dam is rebuilt, it can remain in place as fish habitat Please note that a permit is required for this structure from GLMD and an application with detailed construction plans should be submitted by August 29 This structure can be considered for permitting under your currently pending application #03-52-0059-p.

Please complete installation of this structure by October 1, 2003

With rare exceptions (which must be specifically detailed in writing) UPPCo must obtain permits from GLMD for projects involving construction below the ordinary high water mark of streams or disturbance of wetlands (essentially all of the restoration work) These exceptions must be communicated in writing

Finally, we have also discussed the potential installation of a sand trap below County Road AAD. I will communicate the state's position on this issue after an August 18 inspection of the site. For your information, I've enclosed a description of the sand traps that we may be requiring.

If you would like to discuss these matters further, please feel free to call me.

Sincerely,

Steve Casey
District Supervisor
Water Division

SC:DP
Enclosures

cc: Bernie Huetter, NRCS
George Madison, DNR
Jessica Mistak, DNR
Hampton Waring, Marquette County Conservation District
Robert Schmeling, WHMD
Joan Duncan, GLMD
Mark Feldhauser, GLMD
Mitch Koetje, WD

Sand Trap Construction/Maintenance Requirements

Two in-stream sand traps, in tandem, are necessary. The second downstream trap shall be located approximately 200 feet below the first upstream trap. Two traps are necessary due to the highly mobile bedload of sediment in the upper river. The second trap will allow for successful control of sediments if the upstream trap were to overflow. It is possible for the upstream trap to overfill during mid winter periods when access is difficult or during spring runoff when water flows are high.

The following requirements are needed for each of the two traps.

- Each trap needs to be constructed in-stream, a minimum of 400 feet long by 5 feet deep and should be the width of the existing river channel.
- Each trap shall be cleaned out when they become 60% full. If the traps fill beyond 60%, they will lose their effectiveness in allowing sediments accumulate. Inspections and maintenance shall occur year-round, including the winter months.
- A log record of each trap shall be maintained and the data of this log shall be available to the MDNR or MDEQ on a monthly basis. The log shall include a linear measurement of how much of the trap has accumulated sediment and will document include clean-out events (including the volume of material removed).
- The sediment traps shall remain in place until such time that the MDEQ/MDNR determines that the river clean up efforts are completed.

Appendix 2

Silver Lake Outlet Interim Stabilization Report

Silver Lake Outlet Interim Stabilization Report

for

Upper Peninsula Power Company

by

CH2MHILL

October 7, 2003

Document #GB-0696

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Introduction

Project Description

The purpose of the Silver Lake Outlet Interim Stabilization Report is to analyze the potential of the post-event Dead River channel to headcut into the post-event Silver Lake Reservoir during the winter of 2003 and the spring of 2004, and to recommend, if necessary, the construction of revetment or grade control measures to reduce the potential for erosion. The measure, if warranted, will serve as an interim stabilization measure at the lake/river interface, and will be viewed as a temporary solution until a permanent solution is designed and implemented.

Project Goals and Objectives

The interim stabilization report is designed to meet the following goals:

- Analyze the potential for continued headcutting of the stream during the 2003/2004 winter season and spring run-off
- If warranted, recommend interim stabilization measures to reduce the potential for additional headcutting until a permanent measure is designed and constructed.

Assessment and Design Methods

Overview

Any stream channel alteration should be designed using natural channel design principles. Design of restoration/stabilization of degraded stream reaches first involves accurately diagnosing the current condition of a stream. Understanding of stream type, condition, and potential is essential to developing adequate restoration/stabilization measures. This combination of assessment and design is often referred to as natural channel design. The following natural channel design methodology was employed for the Silver Lake Interim Stabilization Report.

Natural Channel Design Methodology

Dave Rosgen developed a natural channel design methodology that is being used in conjunction with his channel classification scheme to design restoration/stabilization projects. This section outlines the methodology described by Rosgen, modified for use at the interim stabilization site.

The first step in this analysis and design was to study the stream and its watershed to understand the relationship between the stream and its drainage basin and determine the causes of stream degradation. Bankfull discharge and other flows were determined for the watershed. Once sources of stream degradation were identified and bankfull discharge was determined, a plan for interim stabilization was formulated.

The next step in this analysis was to study a reference reach and its watershed. It was necessary to find a reference reach that had the same valley type, land type, and stream type as the design reach. A reference reach should be located in the immediate area or in the closest watershed in the same hydro-physiographic province. After an acceptable reference reach is selected, morphological characterization information should be compiled for the reference reach and the design reach to determine the relationships associated with the natural stable channel and existing morphology of the design reach.

A series of iterative calculations are performed, using data from the reference reach, to determine the appropriate stable cross-sectional, profile, and plan form dimensions of the design reach. When all channel dimensions have been calculated and checked, the proposed plan view over the existing channel with the appropriate bankfull width, pool width, meander wavelength, radius, belt width, etc. is laid out. The design should mimic natural variability to avoid a totally symmetrical layout for visual/natural appearance objectives.

Since the effort for the interim stabilization is limited in scope, intended to only provide short-term stability to the degraded reach until a permanent solution can be identified and implemented, the analysis and recommendations focus mainly on studying the cross-section and profile in the degraded reach to prevent the continued headcutting of the stream in the subject reach. The plan form (alignment) will be studied in more detail later and necessary adjustments recommended at that time.

Stream Classification

In 1985, Rosgen developed a stream classification system (Catena, 1985) that categorizes essentially all types of channels based on measured morphological features, updated for broad applicability and communication among users. The Rosgen stream classification system uses bankfull stage as the basis for measuring the width/depth ratio and entrenchment ratio, two of the most important delineative criteria. Therefore, it is critical to correctly identify bankfull stage when classifying streams and designing interim stabilization measures.

The Rosgen stream classification system includes several types (A, B, C, D, DA, E, F, and G) based on a hierarchical system (Rosgen, 1994, 1996). The first level distinguishes between single and multiple thread channels. Streams are then separated based on degrees of entrenchment, width/depth ratio, and sinuosity. Slope range and channel materials are evaluated to further subdivide the streams. Even more subtypes are then classified according to average riparian vegetation, organic debris, blockages, flow regimes, stream size, depositional features, and meander pattern. Figure 1 presents Rosgen's stream classification.

Bankfull Discharge

Natural channel design principles require that the proposed stream be designed with consideration of surface hydrology and runoff processes. Restored channels should be sized (width, depth, and cross-sectional area) for the bankfull discharge. Bankfull discharge is the discharge that fills the channel to the elevation where its floodplain begins. It is a frequently occurring flow of moderate magnitude. Nationally, data collected regarding bankfull discharge indicate a recurrence interval between 1 and 2 years (NC Stream Restoration Institute, 2001).

There are several field indicators of bankfull stage, an important determination used to subsequently determine bankfull discharge. Bankfull stage is the height of water, or stage, during bankfull flow. This may or may not be the top of the stream bank. If the stream has downcut due to changes in the watershed or streamside vegetation, the bankfull indicator may be a small bench or scour line on the stream bank. The top of the bank, which was formerly the floodplain, is called a "terrace" in this case. Other bankfull indicators include the back of a point bar, the upper break in slope of the bank, and occasionally the top of the bank. Often, there is another prominent feature known as the "inner berm," also known as the "mean high water mark." This feature is usually identified as a scour line or small bench halfway between the low flow water surface and the bankfull stage.

Reference Reach

The reference reach is a channel segment that is stable—neither aggrading nor degrading—and is of the same morphological "type" as the channel under consideration for restoration. The reference reach is used to develop design criteria based on morphological relationships associated with the bankfull discharge stage. This reach should be used as the "blueprint" for the channel design (Rosgen, 1998). Data on channel characteristics in the form of dimensionless ratios are developed for each stream type. These ratios can then be applied to disturbed channel reaches for the purpose of designing restoration and stabilization projects (Rosgen, 1998).

Interim Stabilization Site – Existing Conditions

Watershed

Overview

The Silver Lake Reservoir, is located along the Dead River System in the upper peninsula of Michigan in Marquette County. The Dead River System extends approximately 32.4 miles between the post-event Silver Lake Reservoir and Lake Superior. The system includes the Silver Lake Reservoir (both pre- & post-event), the Dead River Storage Basin "the Hoist", the McClure Reservoir, the Forestville Reservoir, and the Tourist Park Reservoir (pre-event).

The watershed draining to the post-event Silver Lake outfall is predominantly timber and forested timber with few "independent" living sites. Due to the remote nature of the area the current watershed land use should remain relatively stable and development should be minimal.

Interim Stabilization Site

Overview

The location evaluated for the interim stabilization site is approximately 2500 LF downstream of the existing Silver Lake impoundment (September 18, 2003), at a point near the pre-event Silver Lake earthen dam. The post-event Site has a 23.7 square mile drainage area. Photo 1 is an overview of the project site.

On May 14, 2003, a breach of the fuse plug spillway and earthen dike on the Silver Lake Reservoir occurred. In the area of the former spillway and earthen dike, the water formed a new lake outlet/stream channel interface that connects the post-event Silver Lake reservoir with the downstream system. During the initial field visits, field team members observed a new narrow channel through old lake depositional material (peat) and unconsolidated soil with no existing vegetation. In addition, members observed several different locations that appeared to be vertically unstable and actively headcutting in an upstream direction towards the post-event reservoir. As part of the Post-Event Environmental Assessment (EA) conducted by CH2M Hill for UPPCO, the Silver Lake outlet/stream channel interface was identified as an "Area of Particular Interest".

On September 18, 2003, field team members from CH2M Hill, WPSC and Michigan Department of Natural Resources (DNR) performed a Rosgen Level II geomorphic survey of the Dead River stream channel upstream of the pre-event Silver Lake (Reference Reach Survey) and a longitudinal survey of the Silver Lake outlet and the Dead River stream channel interface (Interim Stabilization Site).

Geomorphological Survey and Stabilization Site Classification

The existing stream at the interim stabilization site was surveyed and classified using Rosgen's Stream Classification (Rosgen, 1996). The survey was conducted in two parts. First, a full topographical survey of the site was performed. Following the topographical survey, a longitudinal survey was performed following the guidelines in *Stream Channel*

Reference Sites: An Illustrated Guide to Field Technique (USFS, 1994). Figure 2 and Photo 6 depict the area of the survey.

Based on field observation the existing channel at the interim stabilization site is a Rosgen F1/F4 stream type. From Rosgen, 1996:

F1 Stream Type
The F1 stream type is an (sic) entrenched, meandering, high width/depth ratio channel that is deeply incised in valleys that are structurally controlled with bedrock. The F1 stream channels are often entrenched in highly weathered rock formations configured as low relief landforms with low valley gradients. Side slopes of the F1 stream types are often vertical and confine the river laterally for great distances. The F1 stream channels are located in Valley Type IV and VI. The F1 stream type does not lave developed floodplains, with all of the natural range of flows contained in a similar width channel. The dominant channel materials are principally bedrock, with boulders, cobble, and gravel present in fewer quantities. The F1 stream type has a relatively low to moderate sinuosity and low meander width ratios due to the degree of natural entrenchment and lateral containment. The "top of banks" of this stream type cannot be reached by floods that may be developed with the modern-day climate. The F1 stream type typically exhibits low sediment deposition, due to the low sediment supply from the relatively stable bed and banks. These systems are considered very stable stream types due to the resistant nature of their channel materials, and basically have not changed or significantly adjusted in modern times.

F4 Stream Type
The F4 stream type is a gravel dominated, entrenched, meandering channel, deeply incised in gentle terrain. The "top of banks" elevation for this stream type is much greater than the bankfull stage, which is indicative of the deep entrenchment. The F4 stream type can be incised in alluvial valleys, resulting in the abandonment of former floodplains. The F4 stream channels are found in Valley Types IV, VI, VIII, X, and XI. The F4 channels have slopes that are generally less than 2 percent, exhibit riffle/pool bed features, and have width/depth ratios that are high to very high. The dominant channel materials are gravel, with lesser accumulations of cobble and sands. Often the sand with be imbedded with the cobble and gravel. Sediment supply in the F4 stream types is moderate to high, depending on stream bank erodibility conditions. Depositional features are common in this stream type, and over time tend to promote development of a floodplain inside of the bankfull channel. Central and transverse bars are common, and related to the high sediment supply from streambanks and the high width/depth ratio. Streambank erosion rates are very high due to side slope rejuvenation and mass-wasting processes which enhance the fluvial entrainment. Riparian vegetation plays a marginal role in streambank stability due to the typically very high bank heights, which extend beyond the rooting depth of riparian plants. Exceptions to this are the F4 stream types in the Northeast, Northwest, and Southeast United States where the relatively longer growing seasons and ample precipitation results in the establishment of riparian vegetation that tends to cover the entire slope face of channel banks.

The site has a dual classification of F1/F4 because the stream bed and bank material, below bankfull and within the limits of the flood prone area (FPA), are composed of a gravel, cobble, sand and silt matrix referred to as "conglomerate" (Photos 6 and 7). Along the exposed surface of the conglomerate individual rocks (predominantly gravel and small cobble) protrude from the surface. Figure 3 presents the X-section elevations and hydraulic geometry information for the interim stabilization site.

Bankfull Discharge

In addition to describing the morphology of the existing channel at the interim stabilization site, the survey data collected was used to determine the bankfull discharge of the existing channel. The bankfull discharge was estimated based on the Q2 - provided by Michigan DEQ (Holtschlag, 1984). Table 2 presents the bankfull discharges.

TABLE 2
Interim Stabilization Site Discharges
Dead River Interim Stabilization Report

Location	Intarim Stabilization Sita
Drainage Araa (SM)	23.7
Q bkf	333 cfs
Q2 - DEQ	390 cfs

The bankfull discharge will be used to calculate the design channel parameters for any necessary interim stabilization.

Soils/Site Geology

The exposed conglomerate extends for several hundred feet downstream of the initial lake/stream interface and extends from across the entire width of the channel to a point greater than bankfull. At an elevation close to two (2) times bankfull or commonly identified as the flood prone area the banks transition to steep slopes primarily comprised of unconsolidated material silt, sand, gravel, cobble, and large boulders which have been graded and seeded as part of the bank stabilization program performed post-event (Photo 6).

The conglomerate is currently functioning similar to a Riffle /Pool or Step/Pool system with a series of short grade control features "riffle" with a base flow water depth of 0.65 feet and small plunge pools with baseflow pool depth of greater than 1.6 feet. Figure 4 presents this information.

Reference Reach

A list of possible reference reach sites for this project was identified during the review of existing and pre-event mapping of the Dead River system. During the (EA) field survey Field Team 2 was responsible for evaluating Reach "0", Dead River upstream of the pre-event Silver Lake as a possible Reference Reach Site. A reference reach survey, following the guidelines in *Stream Channel Reference Sites: An Illustrated Guide to Field Technique* (USFS, 1994), was performed and the data is summarized in Figures 5 through 10 and Photos 8 and 9.

The reference reach drains approximately 9.6 SM and is a Rosgen B4 stream type. It is moderately entrenched, with a series of steps and irregularly spaced scour pools. The stream bed is gravel dominated with large cobble and medium boulders controlling the grade. The bankfull indicator was clearly defined on both channel banks using a variety of indicators including change in bank slope, vegetation change, and discoloration lines on large boulders. The stream was a series of small riffle features with consistent baseflow depth mixed with single and double pool systems. Channel slope for the reach was calculated at 2.8 percent.

According to Rosgen:

B4 Stream Type

The B4 stream types are moderately entrenched systems on gradients of 2 - 4 percent. B4 stream types normally develop in stable alluvial fans, colluvial deposits, and structurally controlled drainage ways. Landforms are often gentle to rolling slopes in relatively narrow, colluvial or structurally controlled valleys. Valley types that contain B4 stream channel include types II, III, and VII. The channel bed morphology is dominated by gravel material and characterized as a series of rapids with irregularly spaced scour pools. The average pool to pool spacing for the B4 stream type is 3 - 4 bankfull channel widths, for the B4c (< 2 percent slope), pool to pool spacing for the B4c (< 2 percent) is generally 4 - 5 bankfull channel widths. Pool to pool spacing adjusts inversely with stream gradient. The B4 stream type has a moderate width/depth ratio and a sinuosity greater than 1.2. Many B4 stream types are associated with residual materials derived from resistant rock types or from alluvial and/or colluvial deposition. The channel materials are composed predominantly of gravel with lesser amounts of boulders, cobble, and sand. The B4 stream type is considered relatively stable and is not a high sediment supply stream channel. Large, woody debris is an important component for fisheries habitat when available.

Interim Stabilization Analysis and Recommendations

- The longitudinal profile conducted on September 18, 2003 measured that the water surface elevation (WSE) from the edge of the existing Silver Lake "pool" to the start of the conglomerate is within 2 tenths of a foot over 1600 LF (Figure 4 and Photos 2 through 5). These measurements indicate that the existing conglomerate is controlling the WSE of Silver Lake and that this point marks the transition from lake to stream system.

- The dimension, pattern, and profile of the interim stabilization should mimic the conditions at the stable reference reach as closely as possible. These dimensions were determined by developing dimensionless ratios derived from the measurements taken from the Rosgen B4 upstream of Silver Lake on the Dead River. The stable parameters at the reference reach, and the subsequent dimensions computed using the dimensionless ratios, serve as the basis for analysis of the interim stabilization site. The analysis shows that the conglomerate outcropping in the degraded stream reach mimics the conditions of the riffle cross-section at the reference reach, and thus serves as a geomorphologically-correct in-stream structure, controlling both the profile and form of the stream reach downstream of the Silver Lake Breach (Figure 3). This conglomerate formation should adequately control headcutting downstream of the breach throughout the winter of 2003 and spring of 2004, until such time in 2004 that the pattern, form, and profile can be adjusted fully.

- An initial visual evaluation of a conglomerate sample indicates that the material should be sufficient to withstand shear velocities calculated as part of the x-section analysis during an interim period (NCDEHNR-DLQ, 1988). However the exposed conglomerate may not be suitable as a long-term solution since the matrix may be susceptible to repetitive freeze-thaw cycle failure. Detailed geological/materials testing and evaluation of the conglomerate would be required to determine successfulness beyond an interim time period.

- The establishment and survey of a "permanent" x-section in the conglomerate area should be conducted if a decision regarding the future elevation of Silver Lake is not made by the summer of 2004.

References

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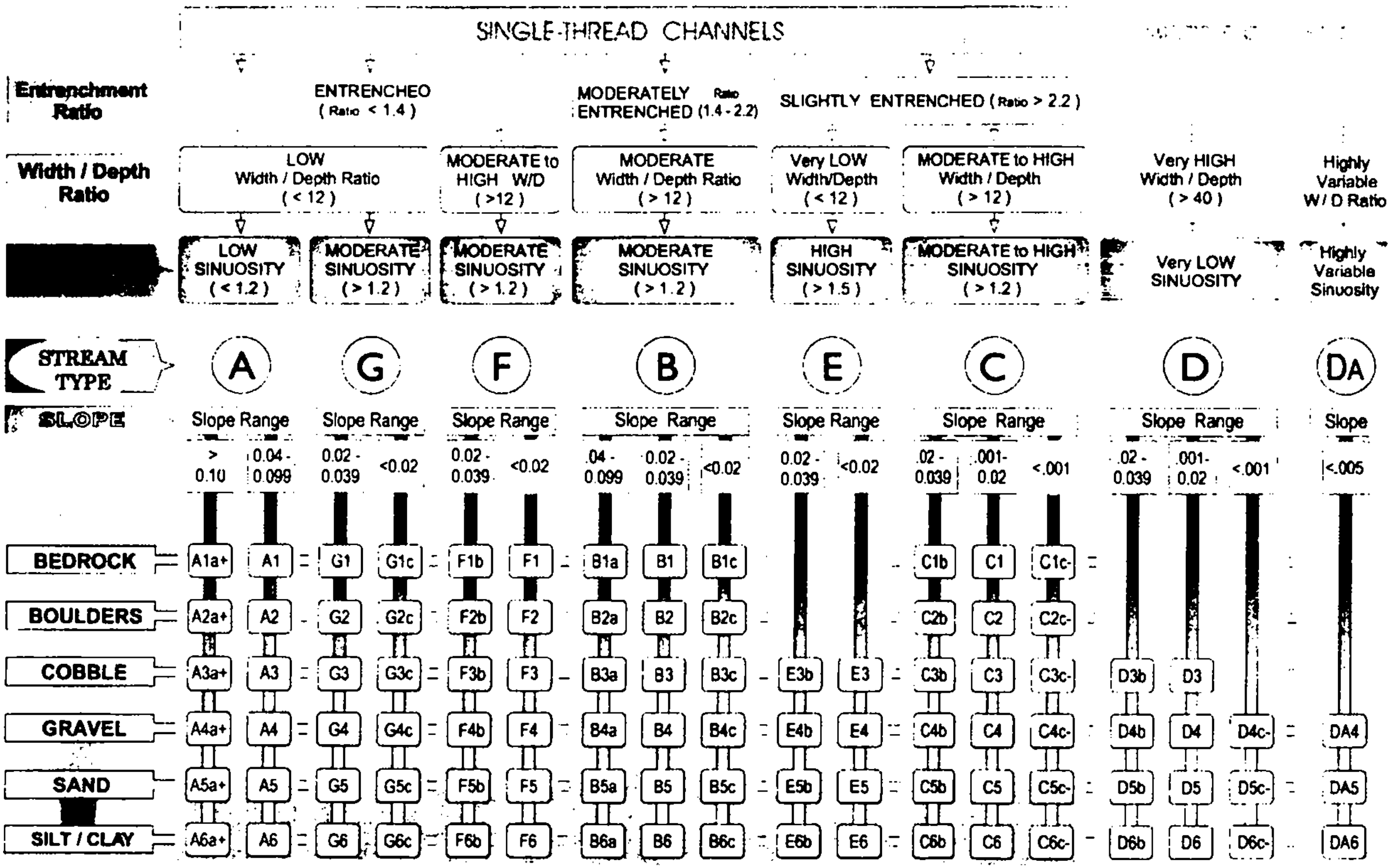
The Key to the Rosgen Classification of Natural Rivers



KEY to the ROSGEN CLASSIFICATION of NATURAL RIVERS. As a function of the *"continuum of physical variables"* within stream reaches, values of ***Entrenchment*** and ***Sinuosity*** ratios can vary by +/- 0.2 units; while values for ***Width / Depth*** ratios can vary by +/- 2.0 units.

 1481 Stevens Lake Road Pagosa Springs, CO 81147 (970) 731-6100 e-mail: wildlandhydrology@pagosa.net

Figure 1
Rosgen Stream Classification

Silver Lake Outlet

Ortho-Photo Date:May 23, 2003

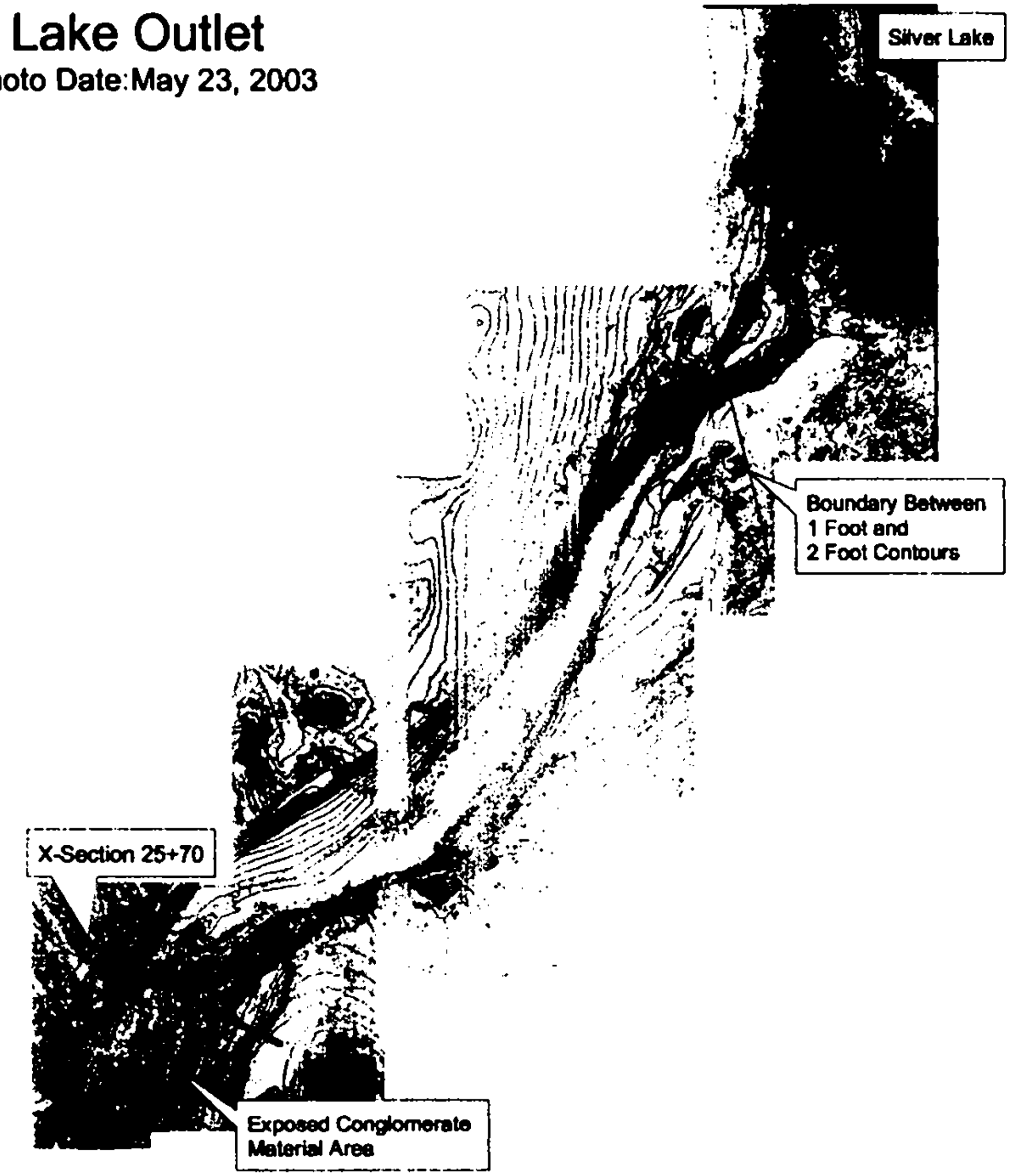
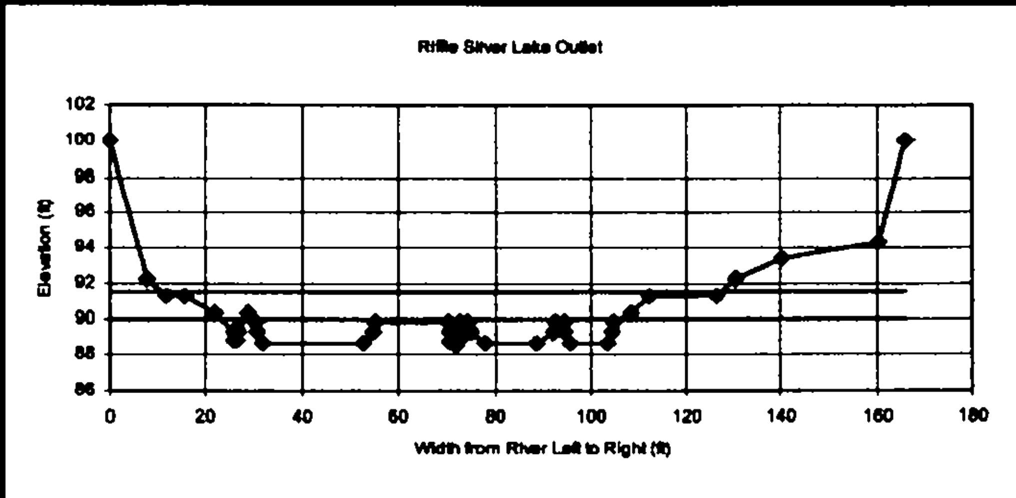


Photo1 and Figure 2 Silver Lake Post-Event Topo

Document #GB-0695

Cross Section



Riffle

section:	Riffle
stream:	Silver Lake Outlet
location:	
description:	Sta. 2+57
height of instrument (ft):	100.50

notes	omit pt.	distance (ft)	FS (ft)	elevation
	■	[illegible]		100
	■	[illegible]	[illegible]	92.3
	■	[illegible]	[illegible]	91.3
	■	[illegible]	[illegible]	91.3
	■	[illegible]	[illegible]	90.3
	■	[illegible]	[illegible]	89.3
	■	[illegible]	[illegible]	88.6
	■	[illegible]	[illegible]	88.6
	■	[illegible]	[illegible]	89.3
	■	[illegible]	[illegible]	90.3
	■	[illegible]	[illegible]	89.8
	■	[illegible]	[illegible]	89.3
	■	[illegible]	[illegible]	88.8
	■	[illegible]	[illegible]	88.8
	■	[illegible]	[illegible]	89.3
	■	[illegible]	[illegible]	89.8
	■	[illegible]	[illegible]	89.8
	■	[illegible]	[illegible]	89.3
	■	[illegible]	[illegible]	88.7
	■	[illegible]	[illegible]	88.8
	■	[illegible]	[illegible]	88.8
	■	[illegible]	[illegible]	89.3
	■	[illegible]	[illegible]	89.8
	■	[illegible]	[illegible]	89.8
	■	[illegible]	[illegible]	89.3
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	■	[illegible]	[illegible]	89.8
	■	[illegible]	[illegible]	89.8
	■	[illegible]	[illegible]	89.3
	■	[illegible]	[illegible]	88.6
	■	[illegible]	[illegible]	88.6
	■	[illegible]	[illegible]	89.3
	■	[illegible]	[illegible]	89.8
	■	[illegible]	[illegible]	90.3
	■	[illegible]	[illegible]	91.3
	■	[illegible]	[illegible]	91.3
	■	[illegible]	7.7	92.3

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
13	[illegible]	[illegible]	1.24	0.036
90	120			

dimensions			
78.0	x-section area	1.0	d mean
81.6	width	87.0	wet P
1.5	d max	0.9	hyd radi
31.5	bank ht	85.8	w/d ratio
115.0	W flood prone area	1.4	ent ratio

hydraulics	
4.3	velocity (ft/sec)
333.8	discharge rate, Q (cfs)
0.69	shear stress ((lbs/ft sq)
0.60	shear velocity (ft/sec)
3.158	unit stream power (lbs/ft/sec)
0.60	Froude number
7.1	friction factor u/u*
44.1	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

check from channel material (R/D84) - Limerinos			
#DIV/0!	R/D84 (ft/ft)	#DIV/0!	u/u*
#DIV/0!	Manning's n from channel material		

u/u* = friction factor

check from Shear Velocity	
#DIV/0!	u - velocity
#DIV/0!	Manning's n from Shear Velocity

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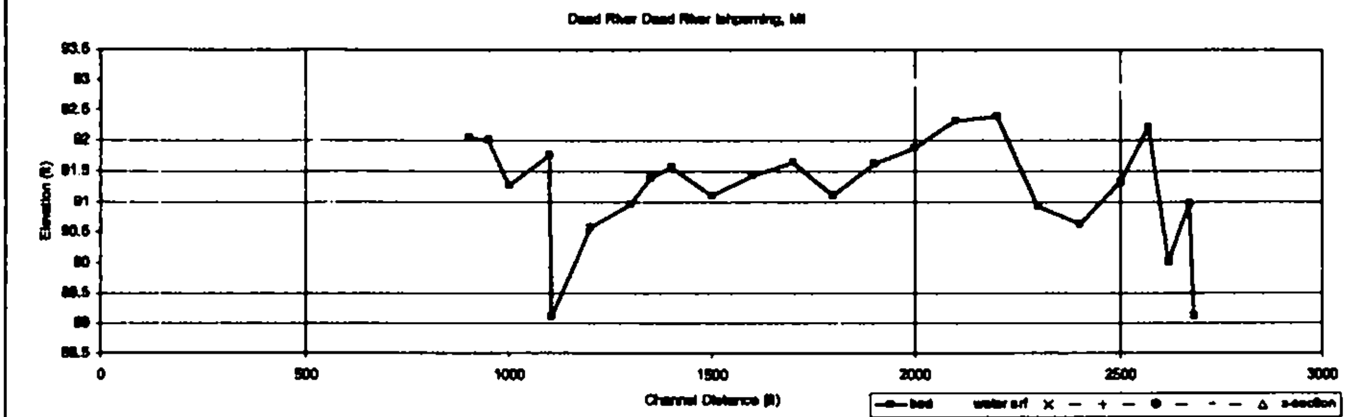
Figure 3
Draft Reach "2" Silver Lake Post-Event X-Section from Topo

Slope Profile



Incremental data | Elevation BM

notes	cross section	distance	station	BS	HI	FS TP	FS bed	depth water	FS	FS	FS	FS	AZ azimuth	ELEV bed	ELEV water srf	ELEV —	ELEV —	ELEV —	ELEV —
					100														
			0		100														
			900		100									92.05	93.05				
			950		100									92	93				
			1000		100									91.28	93.08				
			1100		100									91.76	93.08				
			1108		100									89.1	93.1				
			1200		100									90.57	93.07				
			1300		100									90.98	93.08				
			1330		100														
			1360		100									91.4	93.08				
			1400		100									91.58	93.07				
			1500		100									91.1	93.08				
			1600		100									91.44	93.09				
			0		100														
			0		99.15														
			1700		99.15									91.65	93.1				
			1800		99.15									91.11	93.08				
			1900		99.15									91.61	93.01				
			2000		99.15									91.87	92.97				
			2100		99.15									92.31	92.95				
			2200		99.15									92.38	92.92				
			2300		99.15									90.9	92.9				
			2400		99.15									90.61	92.92				
			0		99.15														
			0		97.8														
			2500		97.8									91.33	92.9				
			2570		97.8									92.2	92.86				
			2617		97.8									90	91.85				
			2670		97.8									90.98	91.81				
			2682		97.8									89.1	91.2				

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Figure 4
Draft Reach "2" Silver Lake Post-Event Outfall

Reference Reach

Stream:	Dead River
Watershed:	Dead River
Location:	Upstream of Silver Lake
Latitude:	—
Longitude:	—
County:	—
Date:	September 18, 2003
Observers:	SC, BB, SP, J
Channel Type:	B4
Drainage Area (sq mi):	9.6

Pattern

	typical	min	max
bankfull width (ft)	22.26362		
meander length (ft)	[illegible]		
belt width (ft)	[illegible]		
amplitude (ft)	[illegible]		
radius (ft)	[illegible]		
arc angle (degrees)	[illegible]		
straight length (ft)	[illegible]		
stream length	[illegible]		
valley length	[illegible]		
Sinuosity	1.13		
Meander Width Ratio	—	—	—
Amplitude Ratio	—	—	—
Meander Length Ratio	—	—	—
Straight Length Ratio	—	—	—
Radius Ratio	—	—	—

Profile

	typical	min	max
bankfull width (ft)	22.26362		
pool-pool spacing (ft)	[illegible]	[illegible]	[illegible]
riffle length (ft)	[illegible]	[illegible]	[illegible]
pool length (ft)	[illegible]	[illegible]	[illegible]
run length (ft)	[illegible]		
glide length (ft)	[illegible]		
channel slope (%)	[illegible]		
riffle slope (%)	[illegible]	[illegible]	[illegible]
pool slope (%)	[illegible]	[illegible]	[illegible]
run slope (%)	[illegible]		
glide slope (%)	[illegible]		
measured valley slope (%)	[illegible]		
valley slope (%)	3.240		
Riffle Length Ratio	1.1	0.3	2.0
Pool Length Ratio	0.6	0.4	1.3
Run Length Ratio	—	—	—
Glide Length Ratio	—	—	—
Riffle Slope Ratio	2.6	0.6	4.6
Pool Slope Ratio	0.5	0.3	0.6
Run Slope Ratio	—	—	—
Glide Slope Ratio	—	—	—
Pool Spacing Ratio	1.8	0.9	2.7

Slope Calculator

	station	elevation	% slope	note
point 1	[illegible]	[illegible]		
point 2	[illegible]	[illegible]	2.532	
point 1	[illegible]	[illegible]		
point 2	[illegible]	[illegible]	3.031	
point 1	[illegible]	[illegible]		
point 2	[illegible]	[illegible]	3.020	
point 1	[illegible]	[illegible]		
point 2	[illegible]	[illegible]	2.815	
point 1				
point 2			—	

Avg. WSE
2.861

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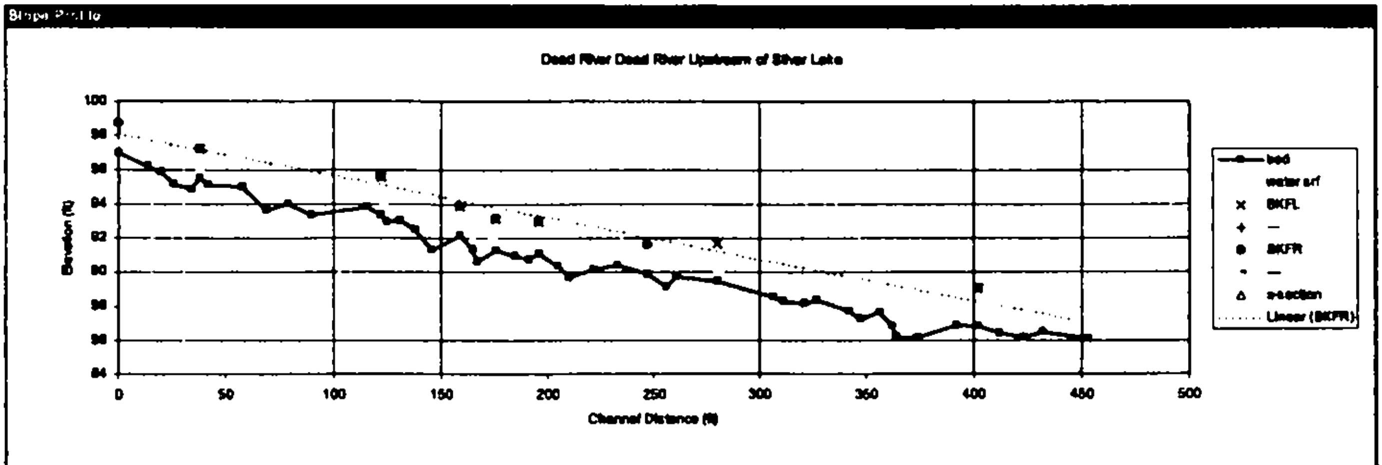
Figure 5
Reach "0" Longitudinal Profile Data



		Incremental data				Elevation BM													
notes	cross section	distance	station	BS	HI	FS TP	FS bed	depth water	FS	FS	FS	FS	AZ azimuth	ELEV bed	ELEV water srf	ELEV BKFR	ELEV BKFL	ELEV —	ELEV —
					100														
			0		100									96.97	97.57	98.76			
			8		100														
			14		100									96.16	96.74				
			20		100									95.83	96.43				
			28		100									95.2	95.4				
			34		100									94.82	95.22				
			38		100									95.46	96.06	97.22	97.22		
			42		100									95.1	95.7				
			58		100									94.95	95.55				
			69		100									93.61	95.01				
			79		100									93.98	94.78				
			90		100									93.3	94.7				
			116		100									93.78	94.38				
			122		100									93.32	93.92	95.57	95.59		
			125		100									92.92	93.67				
			131		100									92.87	93.57				
			138		100									92.46	93.06				
			146		100									91.27	92.77				
			150		100									92.16	92.75	93.85	93.85		
			0		100														
			0		98.15														
			165		98.15									91.36	92.05				
			167		98.15									90.64	92.24				
			176		98.15									91.3	91.9	93.1	93.1		
			185		98.15									90.97	91.57				
			191		98.15									90.75	91.35				
			198		98.15									91.05	91.65	92.98	92.93		
			206		98.15									90.38	91.08				
			210		98.15									89.69	91.09				
			222		98.15									90.13	91.09				
			233		98.15									90.41	91.01				
			247		98.15									89.89	90.59	91.62			
			256		98.15									89.18	90.59				
			261		98.15									89.72	90.32				
			280		98.15									89.51	90.11		91.69		
			0		98.15														
			0		93.65														
			308		93.65									88.63	89.23				
			311		93.65									88.82	89.32				
			321		93.65									88.18	89.11				
			328.5		93.65									88.39	89.09				
			342		93.65									87.69	88.29				
			347		93.65									87.21	88.31				
			356		93.65									87.63	88.23				

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Figure 6
Draft Reach "0" Longitudinal Profile Data

Reference Reach			Hints
Stream:	Dead River		
Watershed:	Dead River		
Location:	Upstream of Silver Lake		
Latitude:	—		
Longitude:	—		
County:	—		
Date:	September 18, 2003		
Observers:	SC, BB, SP, J		
Channel Type:	B4		
Drainage Area (sq mi):	9.6		
Dimension	**typical**	**min**	**max**
Riffle: x-area bankfull	[illegible]		
width bankfull	22.3		
hydraulic radius	[illegible]		
max depth	[illegible]		
bank ht	[illegible]		
width flood prone area	[illegible]		
mean depth	1.70		
Pool: x-area pool	0.0		
width pool	0.0		
hydraulic radius	0.0		
max depth pool	0.0		
bank ht	0.0		
Run: x-area run			
width run			
hydraulic radius			
max depth run	0		
bank ht			
Glide: x-area glide			
width glide			
max depth glide	0		
Dimensionless Ratios:	**typical**	**min**	**max**
Width/Depth Ratio	13.1		
Entrenchment Ratio	2.0		
Riffle Max Depth Ratio	1.5	—	—
Pool Area Ratio	—	—	—
Pool Width Ratio	—	—	—
Pool Max Depth Ratio	—	—	—
Bank Height Ratio	—		
Run Area Ratio	—	—	—
Run Width Ratio	—	—	—
Run Max Depth Ratio	—	—	—
Glide Area Ratio	—	—	—
Glide Width Ratio	—	—	—
Glide Max Depth Ratio	—	—	—
Hydraulics:	**riffle**	**pool**	**run**
channel slope (%)	[illegible]		
discharge rate, Q (cfs)	[illegible]		
velocity (ft/sec)	7.2	—	—
shear stress @ max depth (lbs/ft sq)	4.499	—	—
shear stress (lbs/ft sq)	2.900	—	—
shear velocity (ft/sec)	1.223	—	—
stream power (lbs/sec)	488.9	488.9	488.9
unit stream power (lbs/ft/sec)	21.961	21.961	21.961
relative roughness	3.4	—	—
friction factor u/u*	5.9	—	—
threshold grain size @ max depth (mm)	1361	—	—
threshold grain size (mm)	#N/A	—	—

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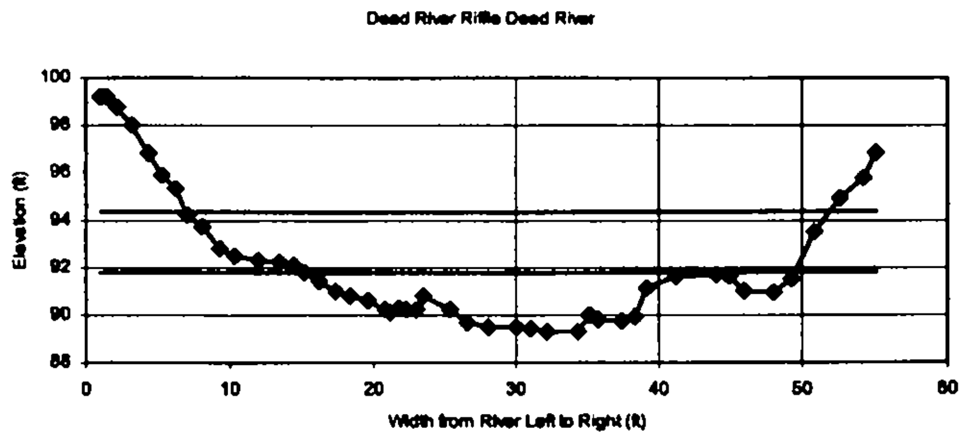
Figure 7

Draft Reach "0" X- Section Data

Cross Section



section: Dead River

Riffle
Dead River
Dead River

description:

height of instrument (ft): 99.60

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	[illegible]	0.38	99.22
	☐	1.4	0.38	99.22
	☐	2.2	0.82	98.78
	☐	3.2	1.61	97.99
	☐	4.3	2.75	96.85
	☐	5.3	3.71	95.89
	☐	6.2	4.29	95.31
	☐	[illegible]	5.41	94.19
	☐	8	5.87	93.73
	☐	9.5	6.83	92.77
	☐	10.[illegible]	7.1	92.5
	☐	12	7.3	92.3
	☐	13.4	7.36	92.24
	☐	14.4	7.48	92.12
	☐	15.2	7.79	91.81
	☐	16.2	8.15	91.45
	☐	17.3	8.64	90.96
	☐	18.3	8.82	90.78
	☐	19.6	8.96	90.64
	☐	20.5	9.35	90.25
	☐	21.1	9.49	90.11
	☐	21.8	9.27	90.33
	☐	22.3	9.34	90.26
	☐	[illegible]	9.36	90.24
	☑	23.5	8.8	90.8
	☐	25.4	9.38	90.22
	☐	26.5	9.94	89.66
	☐	28	10.09	89.51
	☐	30	10.1	89.5
	☐	31	10.2	89.4
	☐	32.2	10.31	89.29
	☐	34.3	10.29	89.31
	☐	35.2	9.6	90
	☐	35.5	9.79	89.81
	☐	37.4	9.89	89.71
	☐	38.3	9.66	89.94
	☑	39.2	8.49	91.11
	☑	41.2	8.01	91.59
	☑	44	7.91	91.69

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.79	0	45.5	2.801	0.046
91.81	99.6			

dimensions			
37.8	x-section area	1.7	d mean
22.3	width	23.3	wet P
2.5	d max	1.6	hyd radi
10.3	bank ht	13.1	w/d ratio
45.5	W flood prone area	2.0	ent ratio

hydraulics	
7.2	velocity (ft/sec)
273.9	discharge rate, Q (cfs)
2.90	shear stress ((lbs/ft sq)
1.22	shear velocity (ft/sec)
21.961	unit stream power (lbs/ft/sec)
0.98	Froude number
5.9	friction factor u/u*
579.2	threshold grain size (mm)

check from channel material			
143	measured D84 (mm) - riffle		
3.6	relative roughness	6.0	fric. factor
0.047	Manning's n from channel material		

check from channel material (R/D84) - Limerinos			
3.473006	R/D84 (ft/ft)	5.9120215	u/u*
0.046	Manning's n from channel material		

u/u* = friction factor

check from Shear Velocity	
7.229222	u - velocity
0.046	Manning's n from Shear Velocity

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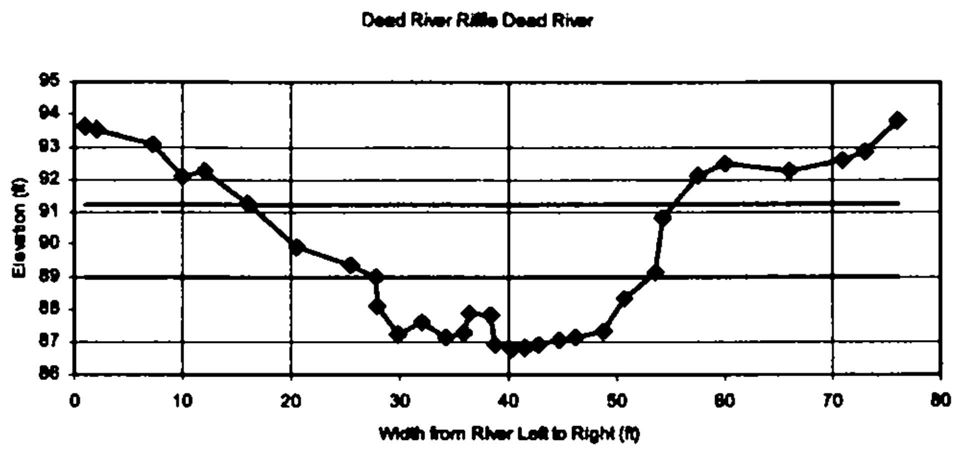
Figure 8
Draft Reach "0" Riffle X- Section Data

Cross Section



section:	Dead River
Riffle	Riffle Dead River Dead River
description:	
height of instrument (ft):	94.27

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	1	0.62	93.65
	☐	2	0.73	93.54
	☐	7.3	1.19	93.08
	☐	10	2.18	92.09
	☐	12	2	92.27
	☐	16	3.02	91.25
	☐	20.5	4.32	89.95
	☐	25.5	4.88	89.39
	☐	27.8	5.26	89.01
	☐	28	6.15	88.12
	☐	29.8	7.04	87.23
	☐	32	6.69	87.58
	☐	34.2	7.11	87.16
	☐	35.3	7	87.27
	☑	36.5	6.41	87.86
	☑	38.3	6.46	87.81
	☐	[illegible]	7.34	86.93
	☐	40.3	7.48	86.79
	☐	41.5	7.47	86.8
	☐	42.8	7.36	86.91
	☐	44.6	7.23	87.04
	☐	[illegible]	7.15	87.12
	☐	48.7	6.93	87.34
	☐	50.7	5.94	88.33
	☐	53.5	5.11	89.16
	☐	54.3	3.46	90.81
	☐	57.5	2.15	92.12
	☐	60	1.8	92.47
	☐	66	1.99	92.28
	☐	71	1.71	92.56
	☐	[illegible]	1.42	92.85
	☐	[illegible]	0.45	93.82
	☐			
	☐			
	☐			

FS bankfull	FS top of bank	W fps (ft)	channel slope (%)	Manning's "n"
5.26	0	40.0	2.561	0.049
89.01	94.27			

dimensions			
36.7	x-section area	1.6	d mean
22.3	width	23.6	wet P
2.2	d max	1.5	hyd radi
7.5	bank ht	13.9	w/d ratio
40.0	W flood prone area	1.8	ent ratio

hydraulics	
6.7	velocity (ft/sec)
240.6	discharge rate, Q (cfs)
2.69	shear stress ((lbs/ft sq)
1.18	shear velocity (ft/sec)
19.287	unit stream power (lbs/ft/sec)
0.88	Froude number
5.7	friction factor u/u*
609.9	threshold grain size (mm)

check from channel material			
143	measured D84 (mm)		
3.4	relative roughness	5.9	fric. factor
0.048	Manning's n from channel material		

check from channel material (R/D84) - Limerinos			
3.226462	R/D84 (ft/ft)	5.7297413	u/u*
0.049	Manning's n from channel material		

u/u* = friction factor

check from Shear Velocity	
6.753087	u - velocity
0.049	Manning's n from Shear Velocity

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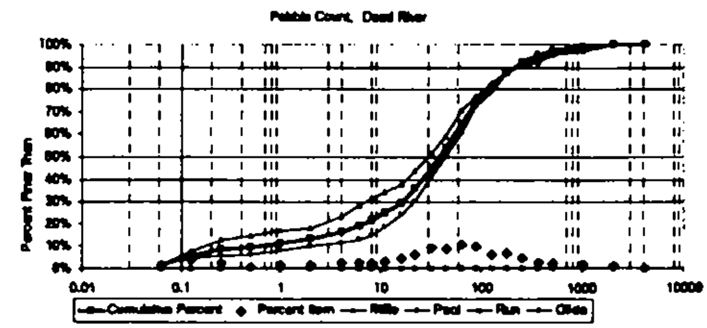
Figure 9
Draft Reach "0" Riffle X- Section Data (alt)

Percent Riffle:	[illegible]		Percent Run:	[illegible]
Percent Pool:	[illegible]		Percent Glide:	[illegible]

Dead River
Dead River
Upstream of Silver Lake
Note:

Material	Size Range (mm)		Total #
silt/clay	0	0.062	1.5
very fine sand	0.062	0.13	4.2
fine sand	0.13	0.25	2.7
medium sand	0.25	0.5	1.0
coarse sand	0.5	1	2.0
very coarse sand	1	2	1.7
very fine gravel	2	4	2.8
fine gravel	4	6	3.0
fine gravel	6	8	2.2
medium gravel	8	11	3.4
medium gravel	11	16	4.5
coarse gravel	16	22	6.3
coarse gravel	22	32	8.3
very coarse gravel	32	45	8.7
very coarse gravel	45	64	10.7
small cobble	64	90	8.5
medium cobble	90	128	8.4
large cobble	128	180	6.8
very large cobble	180	256	4.8
small boulder	256	362	2.8
small boulder	362	512	2.3
medium boulder	512	1024	1.8
large boulder	1024	2048	1.4
very large boulder	2048	4096	0.0
bedrock			0.0
Weighted Count:			100
True Total Particle Count:			444

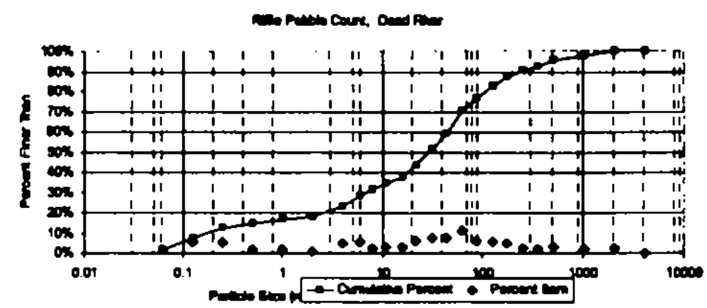


Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
3.791	21.38	38.1	154	380	2%	12%	61%	27%	8%	0%

Riffle Pebble Count

Dead River
Dead River
Upstream of Silver Lake
Note:

Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	
very coarse sand	1	2	
very fine gravel	2	4	
fine gravel	4	6	
fine gravel	6	8	
medium gravel	8	11	
medium gravel	11	16	
coarse gravel	16	22	
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			222

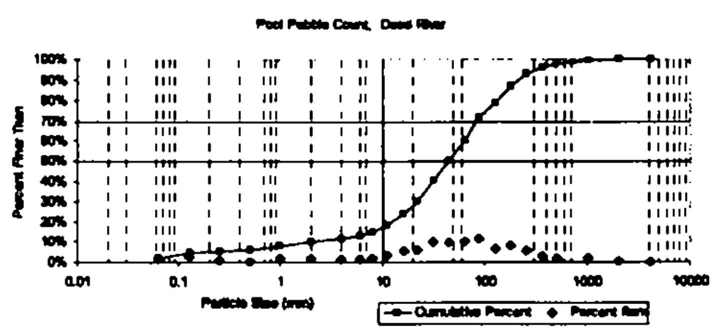


Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.709	12.05	30.0	143	465	2%	16%	52%	20%	10%	0%

Pool Pebble Count

Dead River
Dead River
Upstream of Silver Lake
Note:

Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	
very coarse sand	1	2	
very fine gravel	2	4	
fine gravel	4	6	
fine gravel	6	8	
medium gravel	8	11	
medium gravel	11	16	
coarse gravel	16	22	
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			222



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.844	26.10	46.0	169	326	2%	9%	60%	32%	7%	0%

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Figure 10
Draft Reach "0" Materials Data

Silver Lake Outlet

Ortho-Photo Date:May 23, 2003

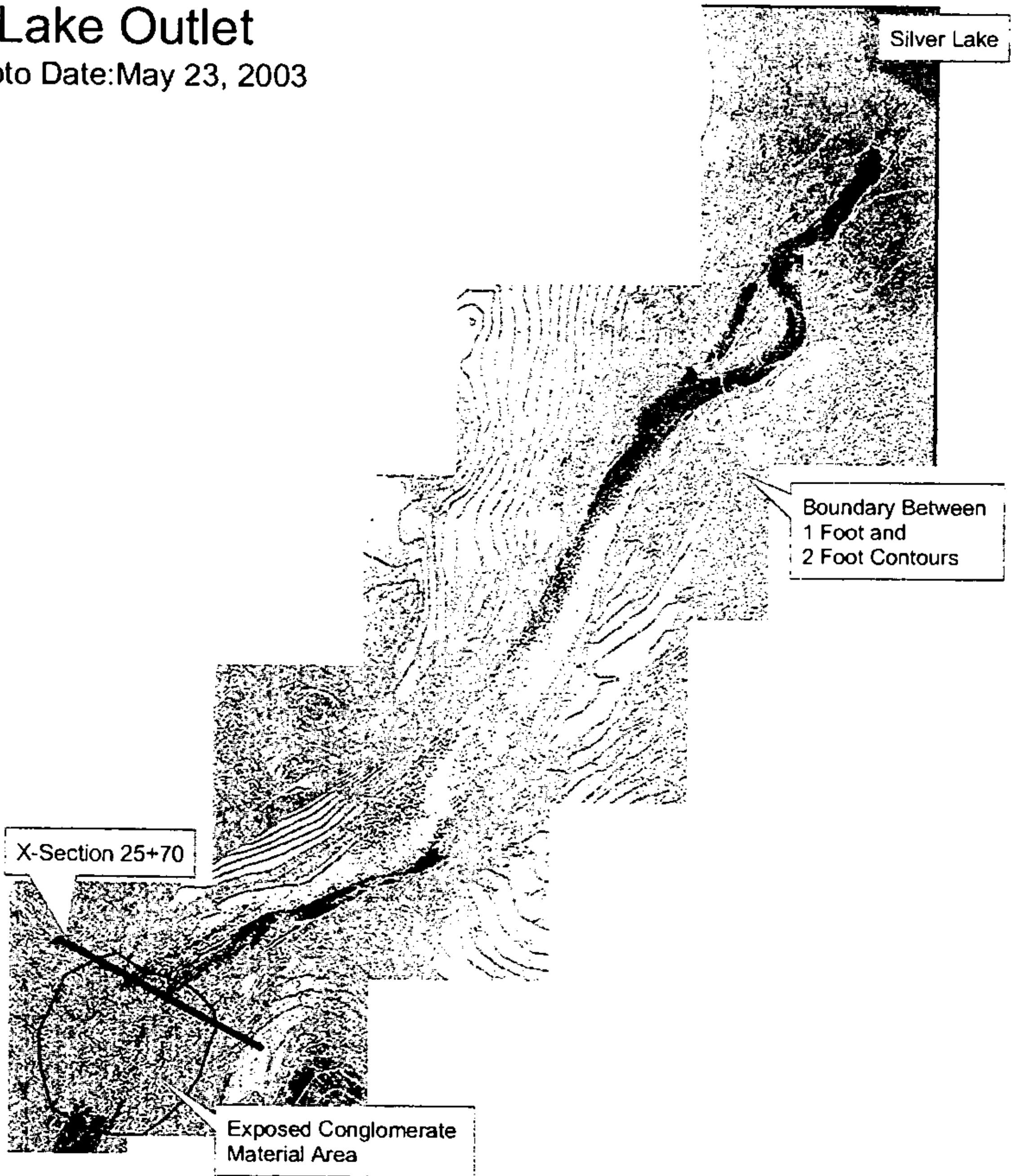

Photo1 and Figure 2 Silver Lake Post-Event Topo

Document #GB-0695

Photo 2: Silver Lake Outlet August 22, 2003 (Downstream of outlet facing Upstream)

Photo3: Silver Lake Outlet August 22, 2003 (Downstream of outlet facing Downstream)

Photo 4: Silver Lake Outlet August 22, 2003 (Upstream of "Conglomerate" facing DS)

Photo5: Silver Lake Outlet August 22, 2003 (Upstream limits of exposed "Conglomerate" Area)

Photo 6: Exposed "Conglomerate" Area

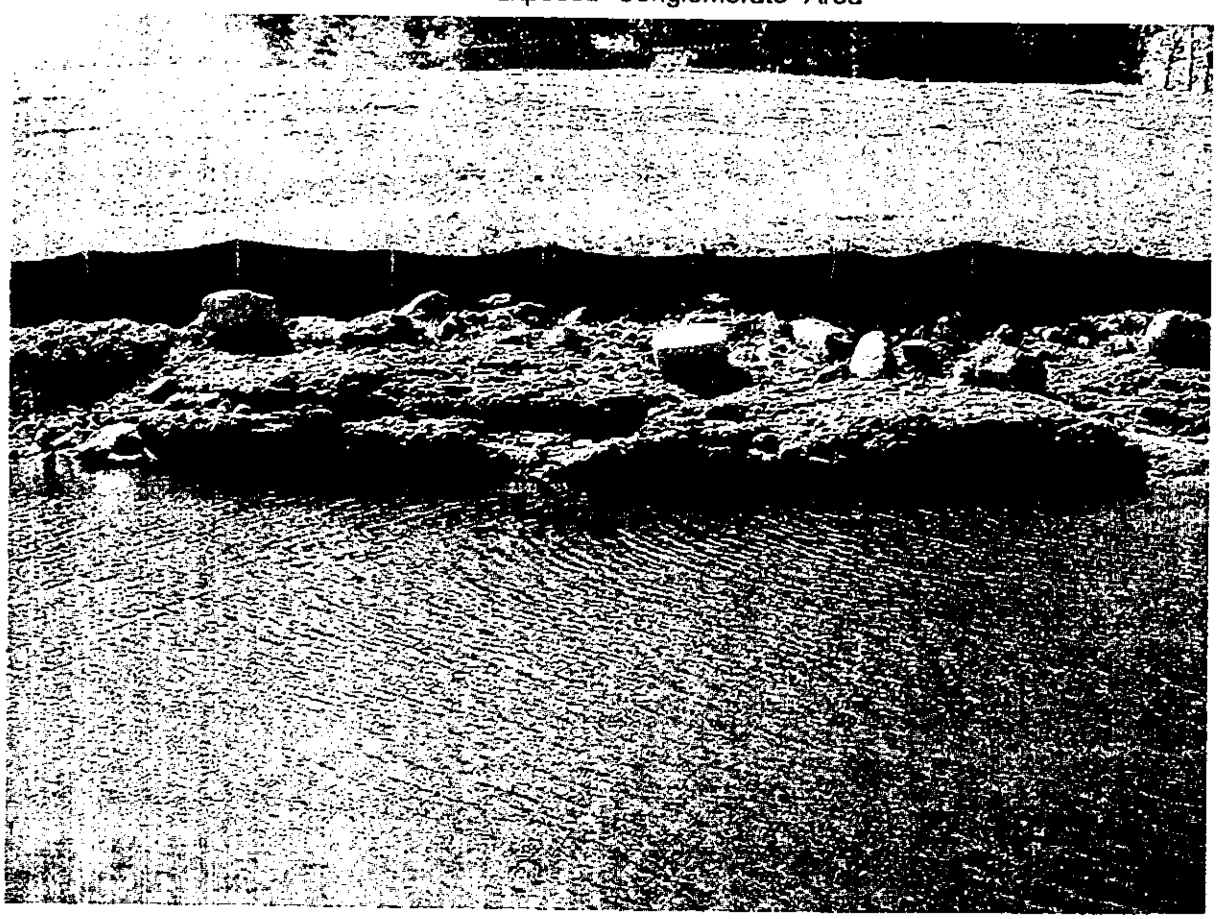

Photo 7: Close-up of "Conglomerate" Material

Photo 8. Reach "0" Bankfull Indicators

Photo 9. Dead River Reach "0" Reference Reach

Appendix 3

October 15, 2003 MDEQ Letter

Document # GB-0713

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
UPPER PENINSULA DISTRICT OFFICE

JENNIFER M. GRANHOLM
GOVERNOR

STEVEN E. CHESTER
DIRECTOR

October 15, 2003

Mr Gary Erickson, Vice President
Upper Peninsula Power Company
P.O. Box 357
Ishpeming, Michigan 49849

Dear Mr. Erickson:

SUBJECT: Withdrawal of the required action to control head cutting erosion at the outlet of the Silver Lake Basin.

The August 11, 2003, letter required the construction of a structure to control head cutting and continued channel erosion at the Silver Lake Basin. As a result of continuing discussions with the Upper Peninsula Power Company (UPPCO), the Michigan Department of Environmental Quality (MDEQ) remained receptive to the results of a detailed assessment of the issue. UPPCO and their consultants completed and then distributed the "Silver Lake Outlet Interim Stabilization Report" on October 10th to the MDEQ and other resource agencies for review.

Upon review of the report, MDEQ agrees to withdraw the requirement of constructing the Silver Lake Basin head cutting structure at this time. This decision is based on the report's recommendation that the existing "conglomerate formation should adequately control head cutting downstream of the (present post-event Silver Lake Basin) throughout the winter of 2003 and spring of 2004." The MDEQ also agrees with the reports recommendations that "the exposed conglomerate may not be suitable as a long-term solution...and a detailed geological/materials testing and evaluation of the conglomerate would be required" if this solution is to be used beyond the spring 2004.

As stated in the August 11th letter, the MDEQ maintains the desire to keep the existing size of the Silver Lake Basin intact until a long term management strategy is finalized. Therefore, if the existing conglomerate material does not prevent future head cutting and erosion in this region the MDEQ may require UPPCO to take action to stop active erosion and restore the area to the current condition. Please provide a report assessing the amount of head cutting (including the change in Silver Lake area/elevation) as a result of spring snowmelt to me by June 1, 2004. That report must include a long range plan for controlling head cutting at Silver Lake Basin.

Please call me if you would like to further discuss the contents of this letter.

Sincerely,

Steve Casey
District Supervisor
Water Division
906-346-8535

MK:SC:DN
cc: Mr. Bernie Huetter, NRCS
Mr. George Madison, MDNR
Ms. Jessica Mistak, MDNR
Mr. Shawn Puzen, UPPCO
Mr. Hampton Waring, Marquette Conservation District
Mr. Ralph Reznick, MDEQ-WD
Mr. Robert Schmeling, MDEQ-WHMD
Ms. Joan Duncan, MDEQ-GLMD
Mr. Mark Feldhauser, MDEQ-GLMD
Mr. Mitch Koetje, MDEQ-WD
File: Dead River Basin file