GENWAL™
RESOURCES, INC.

P.O. Box 1077, Price, Utah 84501 794 North "C" Canyon Rd, East Carbon, Utah 84520
Telephone (435) 888-4000 Fax (435) 888-4002

Daron Haddock
Permit Supervisor
Utah Division of Oil, Gas and Mining
P.O. Box 145801
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84114-5801

March 30, 2010

Re: Crandall Canyon Mines, C/015/032
2009 Annual Report

Dear Mr. Haddock:

Enclosed are two copies of the 2009 annual report.

If you have any questions or comments regarding this submittal please contact me at 435 888-4017.

Sincerely,

David Shaver
Resident Agent

Form DOGM - C1 (Last Revised March 30, 2010)

File Folder # 3

APPLICATION FOR PERMIT PROCESSING

Permit Change ☐	New Permit ☐	Renewal ☐	Transfer ☐	Exploration ☐	Bond Release ☐	Permit Number: 015/032

Title of Proposal: 2009 annual report

Mine: Crandall Canyon Mines

Permittee: **GENWAL Resources, Inc.**

Description, include reason for application and timing required to implement:.

Instructions: *If you answer yes to any of the first 8 questions (gray), submit the application to the Salt Lake Office. Otherwise, you may submit it to your reclamation specialist.*

☐ Yes	☐ No	1. Change in the size of the Permit Area? ________ acres Disturbed Area? _____ acres ☐ increase ☐ decrease.
☐ Yes	☐ No	2. Is the application submitted as a result of a Division Order?
☐ Yes	☐ No	3. Does application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes	☐ No	4. Does application include operations in hydrologic basins other than as currently approved?
☐ Yes	☐ No	5. Does application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes	☐ No	6. Does the application require or include public notice/publication?
☐ Yes	☐ No	7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes	☐ No	8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes	☐ No	9. Is the application submitted as a result of a Violation?
☐ Yes	☐ No	10. Is the application submitted as a result of other laws or regulations or policies? Explain:
☐ Yes	☐ No	11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes	☐ No	12. Does the application require or include underground design or mine sequence and timing?
☐ Yes	☐ No	13. Does the application require or include collection and reporting of any baseline information?
☐ Yes	☐ No	14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☐ Yes	☐ No	15. Does application require or include soil removal, storage or placement?
☐ Yes	☐ No	16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes	☐ No	17. Does the application require or include construction, modification, or removal of surface facilities?
☐ Yes	☐ No	18. Does the application require or include water monitoring, sediment or drainage control measures?
☐ Yes	☐ No	19. Does the application require or include certified designs, maps, or calculations?
☐ Yes	☐ No	20. Does the application require or include subsidence control or monitoring?
☐ Yes	☐ No	21. Have reclamation costs for bonding been provided for?
☐ Yes	☐ No	22. Does application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes	☐ No	23. Does the application affect permits issued by other agencies or permits issued to other entities?

☐ **Attach _3_ complete copies of the application.**

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein. (R645-301-123)

[signature] Agent 3/30/10

Signed - Name - Position - Date

Subscribed and sworn to before me this 30th day of March, 2010

Linda Kerns
Notary Public

My Commission Expires: 03.27.13
Attest: STATE OF Utah
COUNTY OF Carbon

Notary Public
LINDA KERNS
Commission #578211
My Commission Expires
March 27, 2013
State of Utah

Received by Oil, Gas & Mining

RECEIVED
APR 05 2010
DIV. OF OIL, GAS & MINING

ASSIGNED TRACKING NUMBER

Form DOGM - C2 (Last Revised 6/93) File Folder # 3

Application for Permit Processing
Detailed Schedule of Changes to the MRP

Title of Application: 2009 annual report	Permit Number: 015/032
	Mine: CRANDALL CANYON MINESA
	Permittee: GENWAL RESOURCES

Provide a detailed listing of all changes to the mining and reclamation plan which will be required as a result of this proposed permit application. Individually list all maps and drawings which are to be added, replaced, or removed from the plan. Include changes of the table of contents, section of the plan, pages, or other information as needed to specifically locate, identify and revise the existing mining and reclamation plan. Include page, section and drawing numbers as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIALS TO BE CHANGED
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	
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☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	

Any other specific or special instructions required for insertion of this proposal into the Mining and Reclamation Plan?

RECEIVED
APR 05 2010
DIV. OF OIL, GAS & MINING

GENWAL RESOURCES, INC.

CRANDALL CANYON MINE
C/015/032

2009 ANNUAL REPORT

This Annual Report shows information the Division has for your mine. Please review the information to see if it is current. If the information needs to be updated please do so in this document. At the end of each section the operator is asked to verify if the information is correct. Please answer these questions and make all comments on this document. Submit the completed document and any additional information identified in the Appendices to the Division by April 30, 2010. During a complete inspection an inspector will check and verify the information. To enter text, click in the cell and type your response. You can use the tab key to move from one field to the next. To enter an X in a box, click next to the box, right click, and select properties, then the checked circle, then hit enter, or hit the unchecked circle if the X is to be removed.

GENERAL INFORMATION

Permittee Name	Genwal Resources, Inc.
Mine Name	Crandall Canyon
Operator Name (If other then permittee)	
Permit Expiration Date	May 13, 2013
Permit Number	C/015/0032
Authorized Representative Title	Dave Shaver, Resident Agent
Phone Number	(435) 888-4017
Fax Number	(435) 888-4002
E-mail Address	dshaver@coalsource.com
Mailing Address	P.O. Box 910, East Carbon, Utah 84520-0910
Designated Representative	Dave Shaver
Resident Agent	Dave Shaver
Resident Agent Mailing Address	Same as above.
Number of Binders Submitted	2

Operator, please update any incorrect information.

IDENTIFICATION OF OTHER PERMITS

Identify other permits that are required in conjunction with mining and reclamation activities.

Permit Type	ID Number	Description	Expiration Date
MSHA Mine ID(s)	42-01715	Crandall Canyon Mine	N/A
		South Crandall Mine	
MSHA Impoundment(s)	N/A		
NPDES/UPDES Permit(s)	UT0024368	UPDES Permit	11/30/2010
PSD Permit(s) (Air)	DAQE-N0225003-03	Crandall Canyon	

Other

Operator, please update any incorrect information.

CERTIFIED REPORTS

List the certified inspection reports as required by the rules and under the approved plan that must be periodically submitted to the Division. Specify whether the information is included as Appendix A to this report or currently on file with the Division.

Certified Reports:	Required Yes	Required No	Included or Included	DOGM file location Vol, Chapter, Page
Excess Spoil Piles	☐	☐	☐	
Refuse Piles	☐	☐	☐	
Impoundments	☐	☐	☑	Sediment Pond certification
Other				
	☐	☐	☐	
	☐	☐	☐	

Operator Comments:

Inspector:
Has the operator complied with this section? Yes ☐ No ☐
Inspector Comments:

COMMITMENTS AND CONDITIONS

The Permittee is responsible for ensuring annual technical commitments in the MRP and conditions accepted with the permit are completed throughout the year. The Division has identified these commitments below and has provided space for you to report what you have done during the past year for each commitment. If the particular section is blank, no commitment has been identified and no response is required for this report. If additional written response is required, it should be filed under Appendix B to this report.

Admin R645-301-100
Soils R645-301-200
Biology R645-301-300

Title: Macroinvertebrate Sampling
Objective: To monitor changes in the macroinvertebrates and stream impacts in Crandall Creek from mining related disturbances .
Frequency: Annually in the spring and fall beginning fall 2009
Status: Ongoing
Reports: Annual Report
Citation: Volume A Text, Chapter 3, pg. 3-17

Operator: Has this commitment been acted on this year?
Yes ☑ No ☐ Not required this year. ☐ If yes, comment;
Operator Comments:
Report is included

Inspector:
Has the operator complied with this commitment? Yes ☐ No ☐
Inspector Comments:

Title: Raptor Surveys
Objective: To monitor raptor activity and nesting within and adjacent to the permit area.
Frequency: Every Three years, or annually if a.)UDWR recommends it, b.)it will not unduly harass raptors, and c.)if it is prudent to insure raptor safety and/ or habitat.
Status: Ongoing
Reports: In annual report
Citation: Volume A Text, Chapter 3, page 3-17

Operator: Has this commitment been acted on this year?
Yes ☐ No ☐ Not required this year. ☑ If yes, comment;
Operator Comments:
Mine idled since 2006, raptor survey completed in 2008

Inspector:
Has the operator complied with this commitment? Yes ☐ No ☐
Inspector Comments:

Land use, Cultural Resources, Air Quality R645-301- 400

Engineering R645-301-500

Title: SUBSIDENCE MONITORING
Objective: Determine subsidence effects.
Frequency: Annually.
Status: On going.
Reports: Submit surveyed monitoring data to Division by June 30, annually.
Citation: MRP.

Operator: Has this commitment been acted on this year?
Yes ☑ No ☐ Not required this year. ☐ If yes, comment;
Operator Comments:
Subsidence information provided

Inspector:
Has the operator complied with this commitment? Yes ☐ No ☐
Inspector Comments:

Geology R645-301-600

Hydrology R645-301-700

Title: Water Monitoring: North Portal Sandstone Seepage

Objective: Obtain monthly flow measurements from the sandstone seepage located directly below the north portals.

Frequency: The Permittee will submit the flow data to the Division via e-mail once a month until such time as the final reclamation plan is approved and the Division determines that the monitoring is no longer necessary.

Status: Ongoing

Reports: Monthly e-mails to the Division. Not included in Annual Report.

Citation: Page 7 of Appendix 7-65.

Operator: Has this commitment been acted on this year?
Yes ☑ No ☒ Not required this year. ☒ If yes, comment;
Operator Comments: Seep flow reading have been provided by email (monthly)
Inspector:
Has the operator complied with this commitment? Yes ☐ No ☐
Inspector Comments:

Title: Additional Ground Mine Water Discharge Samples

Objective: Determine the effectiveness of the Malestrom Oxidizer Unit in treating the total iron concentrations in the mine-water discharge.

Frequency: Permittee will collect additional water quality samples pre- and post-treatment by the Maelstrom Oxidizer Unit. Additional samples include: Iron (total, dissolved and ferrous), Manganese (total and dissolved), Aluminum (total and dissolved), Alkalinity, Sulfate, pH and Dissolved Oxygen.

Status: Ongoing

Citation: Page 8 of Appendix 7-65.

Operator: Has this commitment been acted on this year?
Yes ☑ No ☒ Not required this year. ☒ If yes, comment;
Operator Comments: Additional pre-treatment sample analysis has been provided by email (monthly)
Inspector:
Has the operator complied with this commitment? Yes ☐ No ☐
Inspector Comments:

Bonding & Insurance R645-301-800

Other Commitments

*Reminder: If equipment has been abandoned during 2009, an amendment must be submitted that includes a map showing its location, a description of what was abandoned, whether there were any hazardous or toxic materials and any revision to the PHC as necessary.

REPORTING OF OTHER TECHNICAL DATA

List other technical data and information as required under the approved plan, which must be periodically submitted to the Division. Specify whether the information is included as Appendix B to this report or currently on file with the Division.

Operator Comments:

Inspector:
Has the operator complied with this section? Yes ☐ No ☐
Inspector Comments:

LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION

Change in administration or corporate structure can often bring about necessary changes to information found in the mining and reclamation plan. The Division is Requesting that each permittee review and update the legal, financial, compliance and related information in the plan as part of the annual report. Please provide the Department of Commerce, Annual Report of Officers, or other equivalent information as necessary to ensure that the information provided in the plan is current. Provide any other change as necessary regarding land ownership, lease acquisitions, legal results from appeals of violations, or other changes as necessary to update information required in the mining and reclamation plan. Include certified financial statements, audits or worksheets, which may be required to meet bonding requirements. Specify whether the information is currently on file with the Division or included as Appendix C to the report.

Legal / Financial Update	**Required** Yes	No	**Included or** Included	**DOGM File location** Vol, Chapter, Page
Department of Commerce, Annual Report Officers	☐	☑	☐	
Other				
	☐	☐	☐	
	☐	☐	☐	
	☐	☐	☐	

Operator Comments:

Inspector:
Has the operator complied with this section? Yes ☐ No ☐
Inspector Comments:

MAPS

Copies of mine maps, current and up-to-date through at least December 31, 2009, are to be provided to the Division as Appendix D to this report in accordance with the requirements of R 645-301-525.240. The map copies shall be made in accordance with 30 CFR 75.1200 as required by MSHA. Mine maps are not considered confidential. (Please provide a CD.)

Confidential information is limited to:

R645-300-124.310. Information that pertains only to the analysis of the chemical and physical properties of the coal to be mined, except information on components of such coal which are potentially toxic in the environment.

R645-300-124.330. Information on the nature and location of archeological resources on public land and Indian land as required under the Archeological Resources Protection Act of 1979 (P. L. 96-95, 93 Stat. 721, 16 U.S.C. 470).

R645-301-322, Fish and Wildlife Information; R645-301-322.100, the scope and level of detail for such information will be determined by the Division in consultation with state and federal agencies with responsibilities for fish and wildlife and will be sufficient to design the protection and enhancement plan required under R645-301-333 and R645-301-322.230, other species or habitats identified through agency consultation as requiring special protection under state or federal law; R645-301-333.300, Include protective measures that will be used during the active mining phase of operation.

The Division will provide procedures, including notice and opportunity to be heard for persons both seeking and opposing disclosure.

Map Number(s)	Map Title/ Description	Confidential Yes	Confidential No
Annual subsidence map			
Mine map			
Other maps			
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐

Operator Comments:

Subsidence information and mine map are included

Inspector:

Has the operator complied with this section? Yes ☐ No ☐

Inspector Comments:

OTHER INFORMATION

Please provide any comments of further information to be included as part of the Annual Report. Any other attachments are to be provided as Appendix E to this report. If information is submitted as a group rather then by individual mine, please identify each of the mine's data in the list below.

Additional attachment to this report? **Yes** ☐ **No** ☐

Operator Comments:

Inspector:
Has the operator complied with this section? Yes ☐ No ☐
Inspector Comments:

O:\AnnualReport\2009 Annual Reports\Active Mines\Crandall Canyon Mine C0150032.doc

APPENDIX A

Certified Reports

Excess Spoil Piles
Refuse Piles
Impoundments

As required under R645-301-514

CONTENTS

APPENDIX B

Reporting of Technical Data

Including monitoring data, reports, maps, and other information
As required under the approved plan or as required by the Division

In accordance with the requirement of R645-310-130 and R645-301-140

CONTENTS

APPENDIX C

Legal Financial, Compliance and Related Information

Annual Report of Officers
As submitted to the Utah Department of Commerce

Other change in ownership and control information
As required under R645-301-110

CONTENTS

APPENDIX D

Mine Maps

As required under R645-302-525-270

CONTENTS

APPENDIX E

Other Information

In accordance with the requirements of R645-301 and R645-302

CONTENTS

SEDIMENT POND CERTIFICATION

UtahAmerican Energy, Inc.
2009 Crandall Canyon Mines
~~2008~~ Annual Pond Certification Report

SUPPLEMENTAL POND CERTIFICATION - POST CLEANING

POND: Sediment Pond LOCATION: Crandall Canyon Mines

IMPOUNDMENTS	
(1) Stability	Slopes Stable.
(2) Structural Weakness / Erosion	None Noted.
(3) Potential Safety Hazards	None Noted.
(4) Depth of Impounded Water	0' (pond recently cleaned)
(5) Existing Storage Capacity	3.5 ac-ft (100%)
(6) Monitoring Process	U.P.D.E.S. discharge. Quarterly Inspection.

SEDIMENT PONDS ONLY	
(7) Sediment Accumulation (Elevation)	7763.75 (lowest point)
(8) Sediment Cleanout Level (Elevation)	7769.00'
(9) Principle Spillway (Elevation)	7780.81'
(10) Emergency Spillway (Elevation)	7781.81'
(11) Existing Sediment Capacity (To Cleanout)	0.30 acre-ft based on survey of 12/16/200[illegible]

GENERAL	
(12) Comments / Recommendations	Pond cleaned December, 2009 No Discharge.

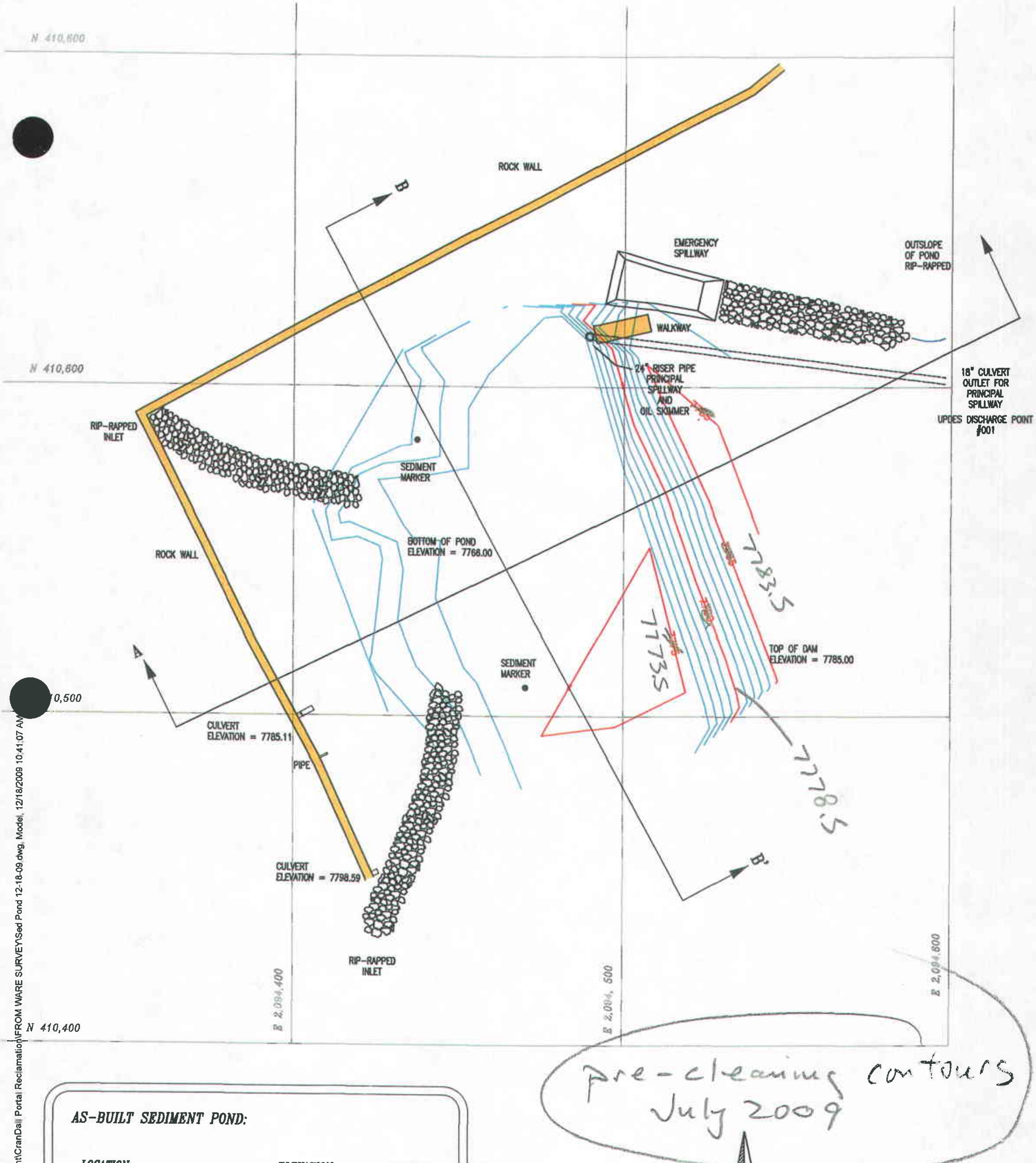
STATEMENT

I hereby certify that; I am experienced in the construction of impoundments; I am qualified and authorized in the State of Utah to inspect and certify the condition and appearance of impoundments in accordance with the certified and approved designs for this structure; that the impoundment has been maintained in accordance with approved design and meets or exceeds the minimum design requirements under all applicable federal, state and local regulations; and, that inspections and inspection reports are made by myself and include any appearance of instability, structural weakness or other hazardous conditions of the structure affecting stability.

David W. Hibbs
(Signature)

12/18/09
(Date)

REGISTERED PROFESSIONAL ENGINEER
6449561
DAVID W. HIBBS
12/18/09
STATE OF UTAH

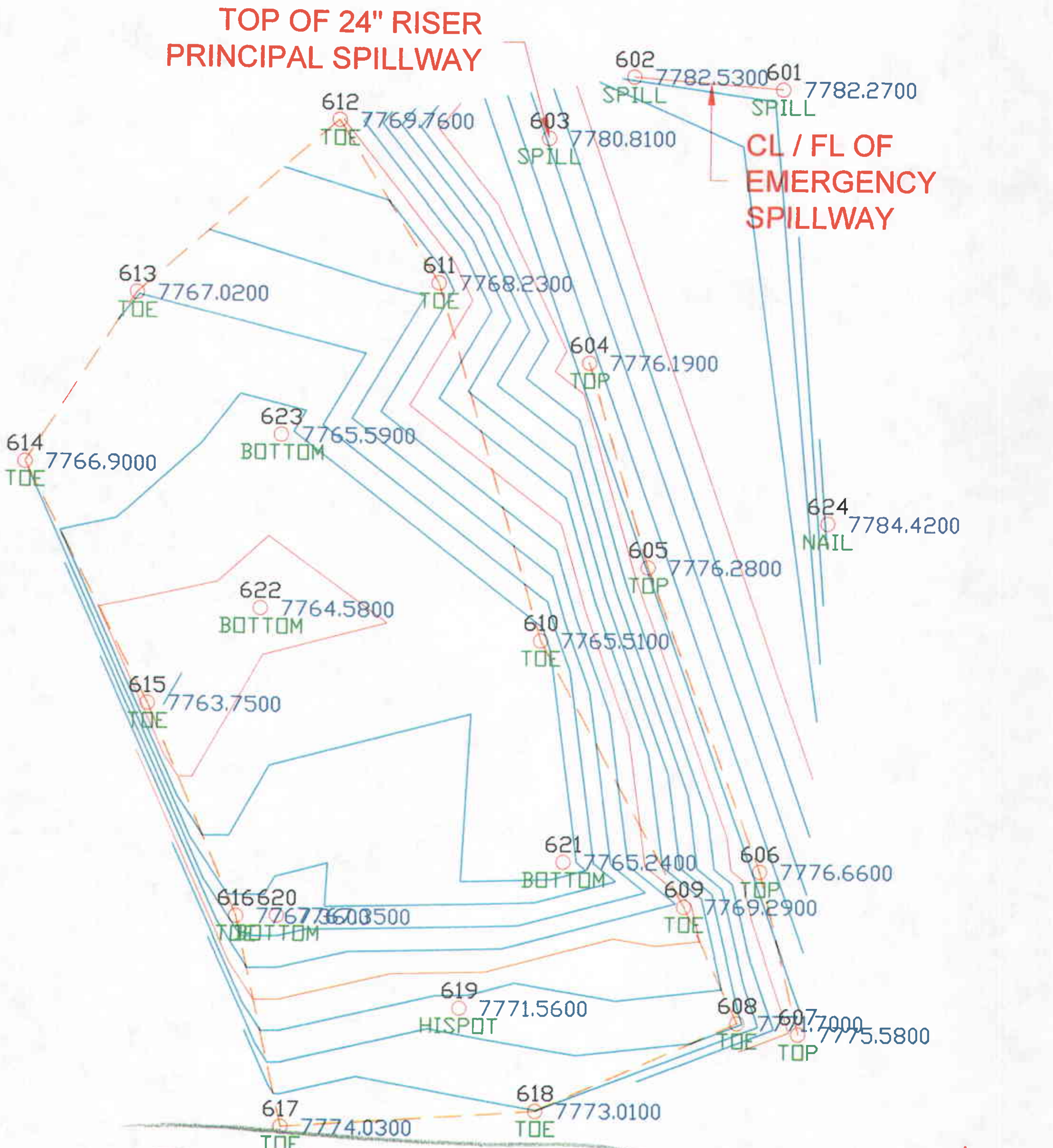


AS-BUILT SEDIMENT POND:

LOCATION:	ELEVATION:	VOLUME:	
BOTTOM OF POND:	7766.00	0.000	AC. FT.
SEDIMENT CLEANOUT LEVEL:	7769.00	0.290	AC. FT.
MAXIMUM SEDIMENT LEVEL:	7770.00	0.437	AC. FT.
PRINCIPAL SPILLWAY:	7780.81	3.513	AC. FT.
EMERGENCY SPILLWAY:	7781.81	3.936	AC. FT.

CONTOUR INTERVAL = 1'
SCALE: 1" = 40'

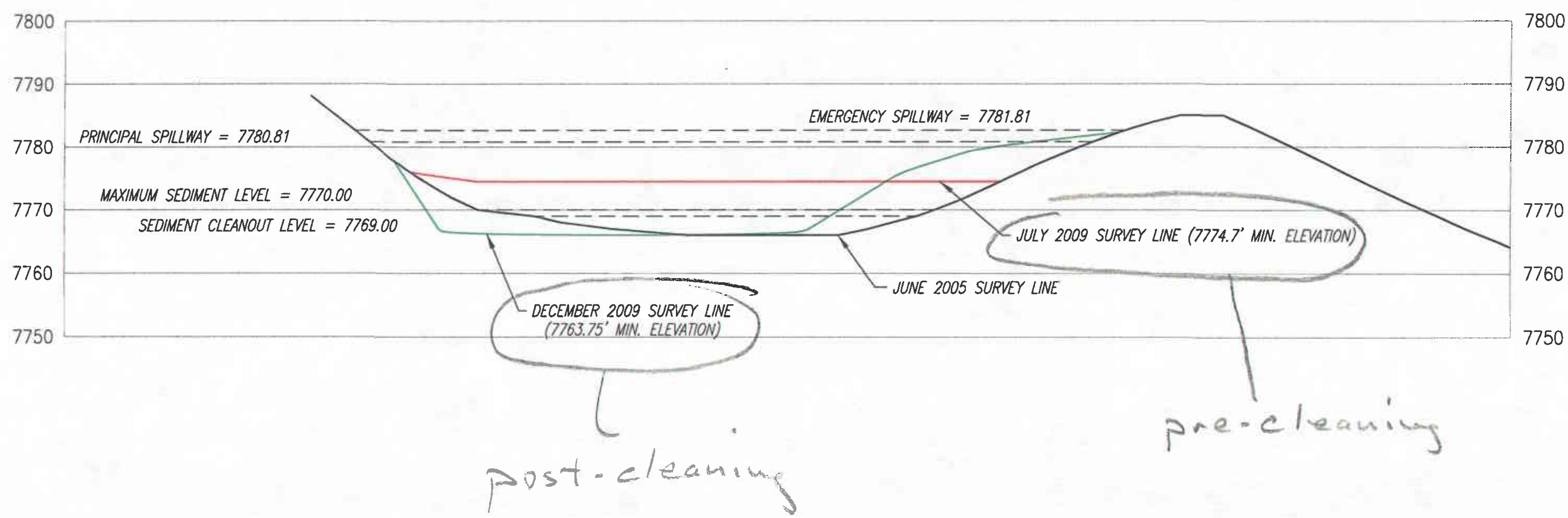
G:\Current Drawings\MRP M... dall Canyon\Current\CranDall Portal Reclamation\FROM WARE SURVEY\Sed Pond 12-18-09.dwg, Model, 12/18/2009 10:41:07 AM



Post cleaning contours
Dec 16, 2009

CRANDALL CANYON
SEDIMENT POND SURVEY
DATE: 12/17/09
SCALE: 1": 20'

G:\Current Drawings\MRP Maps\Crandall Canyon\Current\Final Reclamation\From Ware Surveying\POND with Points 12-17-09.dwg, Model, 12/18/2009 7:47:09 AM



UtahAmerican Energy, Inc.
794 NORTH "C" CANYON ROAD, EAST CARBON, UTAH 84520
P.O. BOX 1077, PRICE, UTAH 84501
PHONE: (435) 888-4000 FAX: (435) 888-4002

SEDIMENT POND CROSS SECTION

Crandall Canyon Mines
Crandall Canyon
P.O. BOX 1077
PRICE, UTAH

MSHA ID #42-01715

DRAWN BY	PJ	SCALE	NONE
APPROVED BY	DS	DATE	18 DEC. 2009
SHEET			1 of 1

Volume Report   Fri Dec 18 10:19:23

Comparing Grid: G:/Current Drawings/MRP Maps/Crandall Canyon/Current/Final Recla
and Grid: G:/Current Drawings/MRP Maps/Crandall Canyon/Current/Final Recla
Grid corner locations: 2095225.07,411260.66 to 2095399.07,411434.66
Grid resolution X: 174, Y: 174 Grid cell size X: 1.00, Y: 1.00
Area in Cut : 10,691.8 S.F., 0.25 Acres
Area in Fill: 1,554.2 S.F., 0.04 Acres
Total inclusion area: 12,246.0 S.F., 0.28 Acres
Cut to Fill ratio: 55.68
Average Cut Depth: 5.39 Average Fill Depth: 0.67
Max Cut Depth: 10.77 Max Fill Depth: 1.99
Cut (C.Y.) / Area (acres): 7592.33
Fill (C.Y.) / Area (acres): 136.35
Cut volume: 57,629.5 C.F., 2,134.43 C.Y.
Fill volume: 1,035.0 C.F., 38.33 C.Y.

computer generated volume difference (amount cleaned out) based on pre and post cleaning surveys

2,134 cubic yards material cleaned out

Comparing Grid: G:/Current Drawings/MRP Maps/Crandall Canyon/Current/Final Recla
and Grid: G:/Current Drawings/MRP Maps/Crandall Canyon/Current/Final Recla
Grid corner locations: 2095225.07,411260.66 to 2095399.07,411434.66
Grid resolution X: 174, Y: 174 Grid cell size X: 1.00, Y: 1.00
Area in Cut : 5,021.9 S.F., 0.12 Acres
Area in Fill: 335.1 S.F., 0.01 Acres
Total inclusion area: 5,357.0 S.F., 0.12 Acres
Cut to Fill ratio: 35.35
Average Cut Depth: 2.61 Average Fill Depth: 1.11
Max Cut Depth: 5.00 Max Fill Depth: 3.60
Cut (C.Y.) / Area (acres): 3944.10
Fill (C.Y.) / Area (acres): 111.56
Cut volume: 13,096.2 C.F., 485.04 C.Y. = 0.30 acre-ft
Fill volume: 370.4 C.F., 13.72 C.Y.

To 7769' cleanout level

Crandall Mine
Sediment Pond Load Count

Date	Loa	Machine	Operator	Nature of Work	Rate	Total
11/18/09				**Wednesday**		
	17	Rock Trk	Tim H	Hauled 17 loads to holding area		
11/19/09				**Thursday**		
	14	Rock Trk	Tim H	Hauled 14 loads to holding area		
11/20/09				**Friday**		
	17	Rock Trk	Tim H	Hauled 17 loads to holding area		
11/23/09				**Monday**		
	15	Rock Trk	Tim H	Hauled 15 loads		
11/24/09				**Tuesday**		
	16	Rock Trk	Tim H	Hauled 16 loads to holding area		
11/25/09				**Wednesday**		
	16	Rock Trk	Tim H	Hauled 16 loads to holding area		
11/30/09				**Monday**		
	16	Rock Trk	Tim H	Hauled 16 loads to holding area		
12/03/09				**Thursday**		
	16	Rock Trk	Tim H	Hauled 16 loads to holding area		
12/04/09				**Friday**		
	12	Rock Trk	Tim H	Hauled 12 loads of mud		
12/11/09				**Friday**		
	21	Rock Trk	Tim H	Hauled 21 loads to holding area		
12/14/09				**Monday**		
	18	Rock Trk	Tim H	Hauled 18 loaded of material		
[illegible]5/09				**Tuesday**		
	20	Rock Trk	Tim H	Hauled 20 loads from pond		
	198			**Total**		

Scamp Excavation load counts

SUBSIDENCE INFORMATION

UtahAmerican Energy, Inc.

Crandall Canyon Mine - Subsidence Survey

1/27/2010

YEAR	2004		1999	2000	2001	2002	2003	2004	2007	2008	2009	2010
STATION	NORTHING (FEET)	EASTING (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)	ELEVATION (FEET)
A	413190.85	2080628.41	10440.42	10441.40	10441.15	10440.88	10440.87	10440.47	10439.53	10439.43	10439.47	
B	413095.74	2080610.92	10426.48	10427.31	10427.07	10426.76	10426.79	10426.40	10425.43	10425.40	10425.41	
C	412995.22	2080594.07	10412.35	10413.16	10412.85	10412.55	10412.57	10412.27	10411.20	10411.23	10411.23	
D	412897.30	2080578.76	10400.56	10401.24	10400.86	10400.53	10400.60	10400.21	10399.21	10399.25	10399.18	
E	412795.72	2080563.91	10385.69	10386.22	10385.80	10385.40	10385.52	10385.11	10384.15	10384.18	10384.13	
J	412296.72	2080487.65	10327.54	10325.20	10324.12	10323.64	10323.63	10323.47	10323.29	10323.20	10323.15	
K	412196.52	2080472.68	10320.44	10317.88	10316.54	10316.05	10316.09	10316.28	10315.74	DESTROYED		
N	411898.88	2080428.44	10317.94	10315.72	10313.63	10313.15	10313.22	10313.15	10313.15	10313.13	10313.16	
O	411798.12	2080415.52	10321.44	10319.48	10317.12	10316.57	10316.59	10316.56	10316.49	10316.50	10316.56	
P	411700.03	2080403.24	10326.55	10325.12	10322.23	10321.67	10321.74	10321.64	10321.65	10321.65	10321.69	

10443.88	10443.92
10429.85	10429.86
10415.68	10415.68
10403.7	10403.63
10388.63	10388.58
10327.65	10327.6
10317.58	10317.61
10320.95	10321.01
10326.1	10326.14

WARE SURVEYING & ENGINEERING

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1344 North 1000 West
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Olympus Aerial Surveys, Inc.
Job No 209052
Photography Dated October 12, 2009
For
UTAH AMERICAN ENERGY
CRANDALL CANYON SUBSIDENCE STUDY

POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
101	2075558.238	407296.622	8876.39	-1.04	8875.35	101
102	2075571.465	408179.127	8892.40	-0.97	8891.43	102
103	2075578.997	408784.976	8888.45	-0.12	8888.33	103
104	2075579.333	407874.899	8891.78	-0.85	8890.93	104
105	2075580.158	408490.497	8886.68	-0.19	8886.49	105
106	2075584.099	407579.859	8887.79	2.71	8890.50	106
107	2075586.078	418626.301	9200.92	-1.32	9199.61	107
108	2075589.924	409081.631	8889.69	-0.59	8889.10	108
109	2075591.674	409392.750	8892.04	0.11	8892.15	109
110	2075596.374	409675.980	8896.29	0.89	8897.18	110
111	2075602.098	414772.964	9087.43	0.48	9087.91	111
112	2075602.211	411777.074	8947.64	-0.14	8947.50	112
113	2075602.655	415732.602	9182.08	-0.04	9182.04	113
114	2075603.148	410302.698	8906.97	0.01	8906.98	114
115	2075604.359	410889.582	8921.77	0.82	8922.59	115
116	2075605.536	409968.624	8900.24	0.42	8900.66	116
117	2075608.931	413586.436	9040.25	-1.00	9039.25	117
118	2075610.583	414195.043	9064.20	0.49	9064.69	118
119	2075611.545	413292.485	9018.93	-0.10	9018.83	119
120	2075611.700	415061.373	9134.73	0.23	9134.96	120
121	2075613.550	411501.717	8936.79	-0.22	8936.57	121
122	2075614.250	412976.268	8999.48	-1.14	8998.34	122
123	2075615.021	413902.429	9054.14	-1.79	9052.35	123
124	2075615.076	411181.655	8928.24	1.19	8929.43	124
125	2075617.063	414458.204	9074.59	-0.44	9074.15	125
126	2075620.148	410574.465	8914.50	0.06	8914.56	126
127	2075620.503	415393.849	9159.64	-1.06	9158.58	127
128	2075623.045	416861.260	9211.69	-2.30	9209.40	128
129	2075623.955	412393.829	8973.96	-0.47	8973.49	129
130	2075627.162	412688.260	8987.69	-1.06	8986.63	130
131	2075627.238	412092.665	8962.62	-0.69	8961.93	131
132	2075634.137	416269.565	9226.64	-22.50	9204.14	132
133	2075636.346	417167.610	9211.23	-2.66	9208.57	133
134	2075637.108	415992.834	9187.36	-0.24	9187.12	134
135	2075663.742	417472.573	9215.66	0.39	9216.05	135
136	2075677.553	417785.304	9258.87	-0.74	9258.13	136
137	2075734.834	418090.100	9276.82	-7.65	9269.17	137
138	2075857.818	407000.991	8877.38	-0.11	8877.27	138
139	2075861.849	407297.283	8898.60	-0.21	8898.40	139
140	2075869.383	407593.316	8912.78	-1.52	8911.26	140
141	2075879.730	408201.675	8907.95	1.92	8909.87	141
142	2075880.579	408499.528	8908.48	-0.64	8907.84	142
143	2075883.995	407920.020	8911.31	0.42	8911.73	143

NOTE: All (0) zero elevations and study year are in obscure areas.

POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
144	2075884.063	408798.754	8907.68	-0.83	8906.85	144
145	2075885.406	409081.868	8905.47	0.39	8905.86	145
146	2075893.830	409396.582	8907.28	-0.34	8906.94	146
147	2075896.091	410302.768	8922.96	1.15	8924.11	147
148	2075897.230	409710.735	8909.23	0.88	8910.11	148
149	2075898.176	412098.850	8977.59	0.56	8978.15	149
150	2075898.281	410002.259	8916.45	-0.50	8915.95	150
151	2075902.609	410607.540	8930.50	0.08	8930.58	151
152	2075904.932	412441.995	8992.88	-0.68	8992.20	152
153	2075906.072	410887.885	8933.91	1.01	8934.92	153
154	2075906.537	411800.967	8963.81	0.02	8963.83	154
155	2075910.837	418399.827	9247.97	-0.07	9247.90	155
156	2075911.693	411495.359	8949.50	0.12	8949.62	156
157	2075912.006	413905.206	9072.85	-1.42	9071.43	157
158	2075912.428	411193.224	8938.56	-0.16	8938.40	158
159	2075915.948	413323.991	9032.79	-0.12	9032.67	159
160	2075933.340	413606.072	9053.21	0.00	9053.21	160
161	2075938.729	414507.997	9100.73	-0.39	9100.34	161
162	2075939.680	414222.310	9089.24	-0.65	9088.60	162
163	2075942.065	415713.505	9152.47	-1.26	9151.21	163
164	2075942.534	413029.330	9019.81	0.28	9020.09	164
165	2075945.266	414807.484	9108.55	0.16	9108.71	165
166	2075947.425	415134.430	9121.01	-0.35	9120.66	166
167	2075954.765	412717.969	9008.47	0.37	9008.84	167
168	2075955.869	417208.168	9195.05	-2.12	9192.94	168
169	2075956.113	417810.485	9206.92	-2.49	9204.43	169
170	2075956.728	416910.527	9185.21	-2.03	9183.18	170
171	2075957.722	415984.402	9161.26	-1.20	9160.06	171
172	2075958.399	418668.301	9254.23	-0.27	9253.96	172
173	2075968.471	417509.313	9201.39	-2.54	9198.85	173
174	2075973.226	416323.895	9171.02	-1.37	9169.66	174
175	2075981.539	415451.954	9137.06	-1.00	9136.06	175
176	2075983.887	416621.690	9176.89	-1.51	9175.38	176
177	2076067.139	418133.417	9219.17	-2.94	9216.23	177
178	2076123.601	407301.758	8917.16	-0.84	8916.32	178
179	2076143.864	406996.867	8898.33	-1.04	8897.29	179
180	2076166.639	409403.072	8922.70	0.15	8922.85	180
181	2076171.627	408780.167	8933.11	-0.12	8932.99	181
182	2076172.344	407544.094	8940.15	-0.23	8939.92	182
183	2076174.313	409683.486	8926.20	-0.10	8926.10	183
184	2076176.336	408177.474	8934.57	0.51	8935.08	184
185	2076176.580	408478.025	8935.02	-0.97	8934.05	185
186	2076177.726	407868.195	8939.45	-0.38	8939.07	186
187	2076181.962	410281.182	8942.41	0.81	8943.22	187
188	2076185.412	412091.495	8994.20	-0.76	8993.44	188
189	2076190.457	411783.904	8980.12	-0.42	8979.70	189
190	2076194.002	409075.426	8929.39	1.59	8930.98	190
191	2076198.263	410570.224	8951.54	0.42	8951.96	191
192	2076201.427	409990.000	8937.67	0.55	8938.22	192
193	2076201.878	410885.555	8953.53	-0.36	8953.17	193

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
194	2076204.946	413244.617	9040.41	0.16	9040.57	194
195	2076205.167	411490.288	8968.24	-0.27	8967.97	195
196	2076205.965	412448.066	9012.06	-0.70	9011.36	196
197	2076206.827	411186.757	8957.52	-0.72	8956.80	197
198	2076226.082	413551.360	9061.49	-0.85	9060.64	198
199	2076228.595	412705.758	9022.65	-0.38	9022.27	199
200	2076229.897	414462.602	9117.75	-0.95	9116.80	200
201	2076235.431	414188.758	9110.15	-1.86	9108.29	201
202	2076236.310	412970.285	9031.86	-0.40	9031.46	202
203	2076237.532	414780.117	9124.09	0.23	9124.32	203
204	2076238.604	413882.576	9085.82	0.58	9086.40	204
205	2076247.454	416232.280	9187.40	-1.02	9186.38	205
206	2076249.132	416577.279	9199.99	-1.07	9198.92	206
207	2076252.094	415078.387	9136.00	-0.14	9135.86	207
208	2076252.842	417146.065	9213.97	-1.45	9212.52	208
209	2076252.914	417442.718	9221.15	-0.50	9220.65	209
210	2076253.992	416855.517	9207.89	-2.11	9205.78	210
211	2076257.427	415677.187	9167.00	-1.39	9165.61	211
212	2076259.402	418651.115	9281.93	-1.59	9280.34	212
213	2076260.496	417768.501	9223.26	-0.81	9222.45	213
214	2076260.998	415927.983	9175.92	-0.86	9175.06	214
215	2076263.282	415352.524	9150.23	-0.43	9149.81	215
216	2076272.090	418064.967	9222.04	-0.85	9221.19	216
217	2076282.160	418386.545	9232.09	-2.43	9229.67	217
218	2076463.615	407329.270	8950.17	1.23	8951.40	218
219	2076470.880	407602.300	8969.39	-0.01	8969.38	219
220	2076474.709	407901.090	8966.96	-0.10	8966.86	220
221	2076480.924	408194.773	8962.57	0.35	8962.92	221
222	2076482.280	408825.347	8960.76	1.39	8962.15	222
223	2076482.719	408480.438	8963.90	0.64	8964.54	223
224	2076483.271	409103.248	8951.63	1.59	8953.22	224
225	2076489.002	410030.646	8968.69	1.42	8970.11	225
226	2076494.160	410319.213	8978.34	1.19	8979.53	226
227	2076495.764	409760.219	8954.69	0.02	8954.71	227
228	2076498.271	410594.890	8984.15	0.98	8985.13	228
229	2076500.874	409412.088	8945.83	1.15	8946.98	229
230	2076506.936	411202.998	8984.68	0.06	8984.74	230
231	2076509.185	411805.286	9007.54	1.16	9008.70	231
232	2076509.593	412088.479	9023.98	2.73	9026.71	232
233	2076513.539	410908.687	8984.68	2.07	8986.75	233
234	2076517.462	411500.781	8991.59	3.65	8995.24	234
235	2076520.030	412410.506	9042.98	-3.35	9039.63	235
236	2076529.695	412721.677	9050.56	0.11	9050.67	236
237	2076535.592	413306.264	9063.76	1.08	9064.84	237
238	2076536.725	413611.807	9082.48	-1.17	9081.31	238
239	2076538.137	413015.348	9055.08	0.43	9055.51	239
240	2076542.870	414219.807	9139.30	0.51	9139.81	240
241	2076544.257	413921.331	9107.87	0.64	9108.51	241
242	2076545.436	414498.907	9151.12	0.73	9151.85	242
243	2076546.203	416316.603	9222.55	-0.81	9221.74	243

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
244	2076548.572	416010.171	9211.27	0.20	9211.47	244
245	2076549.921	406994.200	8930.45	0.00	8930.45	245
246	2076551.183	416619.617	9229.39	-1.29	9228.10	246
247	2076552.515	416931.417	9238.56	-1.65	9236.91	247
248	2076558.852	415721.939	9199.27	-3.61	9195.66	248
249	2076561.909	414800.217	9161.34	-1.28	9160.06	249
250	2076562.963	415424.214	9177.35	-0.01	9177.34	250
251	2076565.805	417207.541	9247.81	-1.96	9245.85	251
252	2076566.314	418682.255	9250.13	-0.85	9249.28	252
253	2076573.688	417513.288	9256.76	-1.22	9255.54	253
254	2076573.869	417827.190	9252.83	-1.53	9251.30	254
255	2076576.768	415103.258	9163.50	-0.69	9162.81	255
256	2076593.689	418139.566	9255.20	-2.39	9252.81	256
257	2076765.871	412407.014	9070.63	0.53	9071.16	257
258	2076771.863	410863.171	0.00	0.00	9031.75	258
259	2076773.378	407893.498	9009.75	-0.99	9008.76	259
260	2076775.162	407285.345	8985.03	-0.71	8984.32	260
261	2076775.449	408179.572	8992.26	0.17	8992.43	261
262	2076776.200	407575.592	9006.34	-0.48	9005.86	262
263	2076777.777	408473.482	8999.88	0.86	9000.74	263
264	2076781.101	408777.571	9001.91	0.72	9002.63	264
265	2076781.233	409079.505	8986.27	0.21	8986.48	265
266	2076781.441	406992.169	8964.30	0.81	8965.11	266
267	2076785.696	409364.225	8973.20	0.72	8973.92	267
268	2076791.695	409666.324	8981.89	1.51	8983.40	268
269	2076792.809	412095.926	9061.94	0.65	9062.59	269
270	2076795.633	409976.226	8997.35	1.08	8998.43	270
271	2076798.479	410273.776	9015.96	0.73	9016.69	271
272	2076799.839	410577.745	9031.46	0.51	9031.97	272
273	2076800.273	412651.421	9082.28	0.68	9082.96	273
274	2076803.418	411174.105	0.00	0.00	9020.89	274
275	2076806.850	411481.645	9017.77	4.16	9021.93	275
276	2076809.108	411774.505	9038.02	0.93	9038.95	276
277	2076821.416	412967.083	9078.82	0.41	9079.23	277
278	2076834.173	413256.739	9090.52	0.49	9091.01	278
279	2076837.820	414473.521	9185.42	-4.09	9181.33	279
280	2076839.313	413569.478	9109.60	-1.61	9107.99	280
281	2076840.829	414182.792	9154.23	-1.04	9153.19	281
282	2076841.418	413881.868	9128.14	-2.77	9125.38	282
283	2076842.537	414758.913	9192.64	-2.45	9190.19	283
284	2076844.513	415085.053	9192.52	-0.42	9192.11	284
285	2076852.418	415394.268	9201.34	-1.53	9199.81	285
286	2076853.449	415679.774	9224.32	-1.31	9223.01	286
287	2076854.166	416880.661	9272.51	-2.07	9270.44	287
288	2076854.226	417147.026	9282.78	-1.11	9281.67	288
289	2076858.943	416576.961	9271.33	-1.24	9270.09	289
290	2076864.493	418678.780	9287.13	-0.87	9286.26	290
291	2076865.160	418360.328	9284.68	-0.91	9283.78	291
292	2076865.909	416254.004	9266.26	-1.35	9264.91	292
293	2076866.518	415980.209	9247.85	-1.33	9246.52	293

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
294	2076868.848	417769.759	9294.94	-3.02	9291.92	294
295	2076869.605	417463.849	9294.18	-1.39	9292.79	295
296	2076875.548	418066.460	9290.68	-2.19	9288.49	296
297	2077070.936	407582.190	9049.93	2.25	9052.18	297
298	2077072.484	407898.206	9049.77	0.32	9050.09	298
299	2077075.424	408205.126	9038.11	1.31	9039.42	299
300	2077082.042	406998.004	9053.28	-2.99	9050.29	300
301	2077082.369	408795.259	9049.73	-1.12	9048.61	301
302	2077084.788	408502.932	9048.89	-0.56	9048.33	302
303	2077086.185	409110.490	9025.30	-0.01	9025.30	303
304	2077087.389	407302.913	9045.86	3.80	9049.66	304
305	2077094.475	409697.869	9039.97	-0.39	9039.58	305
306	2077096.245	409395.856	9039.08	0.22	9039.30	306
307	2077099.747	410568.705	9090.47	-1.75	9088.72	307
308	2077103.405	409991.461	9051.71	-0.51	9051.20	308
309	2077104.545	410893.804	9068.86	2.01	9070.87	309
310	2077105.104	410296.037	9064.34	1.34	9065.68	310
311	2077110.506	413616.441	9149.54	-0.56	9148.98	311
312	2077111.236	411488.520	9064.07	2.00	9066.07	312
313	2077111.711	411791.953	9077.10	0.18	9077.28	313
314	2077112.676	412069.697	9103.01	1.10	9104.11	314
315	2077113.972	411187.475	9073.77	1.70	9075.47	315
316	2077115.636	412718.694	9120.38	1.49	9121.87	316
317	2077116.398	413312.806	9133.89	-1.12	9132.77	317
318	2077118.535	412445.617	9131.19	-0.83	9130.36	318
319	2077125.387	413009.395	9115.64	0.96	9116.60	319
320	2077135.638	414778.248	9241.11	-2.96	9238.15	320
321	2077141.396	418675.217	9326.15	0.04	9326.19	321
322	2077144.869	413921.949	9166.32	-0.68	9165.64	322
323	2077145.358	414490.603	9220.28	-1.55	9218.73	323
324	2077148.953	416050.491	9284.30	0.27	9284.57	324
325	2077149.057	418104.603	9337.27	-0.86	9336.41	325
326	2077149.713	416310.230	9312.20	-1.37	9310.83	326
327	2077151.862	416617.820	9322.82	-1.89	9320.94	327
328	2077153.409	415115.610	9236.64	-0.37	9236.27	328
329	2077154.311	417495.828	9339.49	-2.39	9337.10	329
330	2077158.281	417851.766	9336.43	-0.94	9335.49	330
331	2077161.746	415737.397	9262.09	-1.49	9260.60	331
332	2077162.608	418398.411	9328.98	-2.15	9326.83	332
333	2077164.701	415408.855	9232.59	-1.64	9230.95	333
334	2077165.219	416914.972	9321.75	-2.35	9319.41	334
335	2077174.046	417227.008	9331.50	-0.63	9330.87	335
336	2077181.606	414208.077	9198.46	-1.10	9197.36	336
337	2077327.144	408584.183	9118.50	-5.05	9113.45	337
338	2077341.919	409427.893	9123.69	-1.58	9122.11	338
339	2077369.243	412440.405	9181.64	2.03	9183.67	339
340	2077372.040	407304.093	9212.03	-3.16	9208.88	340
341	2077375.260	408191.709	9231.11	-9.67	9221.44	341
342	2077377.800	407936.184	9202.25	1.14	9203.39	342
343	2077378.502	407034.029	9236.93	6.38	9243.31	343

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
344	2077380.015	413587.030	9208.46	5.25	9213.70	344
345	2077394.763	409983.859	9134.71	1.24	9135.95	345
346	2077395.978	412645.274	9172.70	0.29	9172.99	346
347	2077397.366	409679.669	9140.26	0.16	9140.42	347
348	2077399.707	411496.044	9152.86	0.25	9153.11	348
349	2077402.652	411205.346	9155.77	-1.28	9154.49	349
350	2077402.965	412950.462	9185.55	0.06	9185.61	350
351	2077405.646	410882.927	9153.38	0.86	9154.24	351
352	2077405.827	410221.835	9146.48	-2.49	9143.99	352
353	2077406.135	415651.618	9332.15	-1.99	9330.16	353
354	2077407.691	413278.777	9199.36	1.99	9201.35	354
355	2077409.167	407548.934	9190.99	1.14	9192.13	355
356	2077410.252	410542.455	9154.74	-1.83	9152.91	356
357	2077413.404	415030.801	9277.00	-1.44	9275.56	357
358	2077421.588	415362.935	9314.11	0.28	9314.39	358
359	2077424.785	414470.169	9256.17	0.69	9256.86	359
360	2077426.097	416858.967	9368.46	-1.02	9367.44	360
361	2077426.868	414154.724	9238.09	3.40	9241.49	361
362	2077428.813	414723.692	9287.51	-5.22	9282.29	362
363	2077428.858	418082.652	9390.74	-0.78	9389.96	363
364	2077431.268	417772.752	9389.25	-0.94	9388.32	364
365	2077433.431	413924.580	0.00	0.00	9236.96	365
366	2077433.603	417178.339	9378.32	-1.70	9376.62	366
367	2077433.749	408830.537	9223.80	-3.23	9220.58	367
368	2077433.974	411773.423	9178.68	2.35	9181.03	368
369	2077439.776	416550.490	9377.44	1.45	9378.89	369
370	2077441.113	412095.887	9179.68	1.93	9181.61	370
371	2077448.081	415970.215	9352.21	-3.05	9349.16	371
372	2077450.407	417472.218	9388.52	1.50	9390.02	372
373	2077459.348	418342.719	9389.59	2.27	9391.86	373
374	2077467.012	418649.456	9388.60	-0.89	9387.71	374
375	2077473.441	416249.283	0.00	0.00	9356.83	375
376	2077486.811	409078.793	9251.42	2.92	9254.34	376
377	2077617.220	416811.723	9420.82	0.97	9421.79	377
378	2077653.954	407389.895	9348.26	-0.14	9348.12	378
379	2077655.214	417753.204	9443.98	-0.67	9443.31	379
380	2077662.949	408527.324	0.00	0.00	9280.97	380
381	2077667.836	417044.337	9453.80	-3.26	9450.54	381
382	2077677.808	412398.030	9240.19	7.92	9248.11	382
384	2077705.279	409419.764	9352.05	0.85	9352.90	384
385	2077706.029	408239.791	9388.73	0.06	9388.79	385
386	2077707.058	413860.681	9389.09	0.49	9389.58	386
387	2077713.671	417429.568	9486.07	0.00	9448.84	387
388	2077714.351	409715.921	9340.91	-0.74	9340.17	388
389	2077722.152	410325.622	9359.75	1.82	9361.57	389
390	2077722.785	410015.663	9340.43	0.86	9341.29	390
391	2077722.335	412131.521	9356.95	0.23	9357.18	391
392	2077723.462	413633.072	9390.62	-0.64	9389.98	392
393	2077723.663	407928.653	9315.77	-0.12	9315.66	393
394	2077726.902	418152.914	0.00	0.00	9462.44	394

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
395	2077732.966	416598.184	9478.95	0.30	9479.25	395
396	2077733.047	413372.927	9416.26	-6.68	9409.58	396
397	2077736.450	412772.912	9392.31	-1.79	9390.52	397
398	2077736.578	410900.265	9373.43	-1.01	9372.42	398
399	2077736.685	411737.335	9374.03	0.21	9374.24	399
400	2077746.821	413109.696	9410.24	-0.13	9410.12	400
401	2077751.745	415324.085	9538.11	-1.95	9536.16	401
402	2077752.566	415932.907	9540.71	-0.93	9539.78	402
403	2077752.693	415632.986	9533.45	-0.98	9532.47	403
404	2077755.497	409050.595	9388.89	1.39	9390.28	404
405	2077758.768	408804.221	9287.39	-0.60	9286.79	405
406	2077758.773	416238.547	9546.56	1.21	9547.77	406
407	2077761.250	411521.427	0.00	0.00	9389.72	407
408	2077762.691	418677.222	9467.25	0.24	9467.49	408
409	2077763.913	418088.944	9476.19	-1.54	9474.65	409
410	2077766.600	418385.690	9471.69	0.68	9472.37	410
411	2077767.387	411199.842	9391.99	-0.95	9391.04	411
412	2077769.532	410619.303	9288.57	1.48	9290.05	412
413	2077774.996	407709.917	0.00	0.00	9210.22	413
414	2077784.328	414966.591	9438.28	0.63	9438.91	414
416	2077977.570	417956.009	0.00	0.00	9564.72	416
417	2077991.702	415647.014	0.00	0.00	9651.53	417
418	2077993.098	415373.835	9653.41	-0.87	9652.54	418
419	2078009.322	416581.861	9558.67	-1.17	9557.50	419
420	2078009.957	411739.624	9527.35	1.90	9529.25	420
421	2078014.165	412604.064	9412.59	0.18	9412.77	421
422	2078015.585	410894.682	9502.72	0.47	9503.19	422
423	2078021.702	411169.941	9524.67	0.99	9525.66	423
424	2078022.117	411423.848	0.00	0.00	9491.19	424
425	2078027.614	415977.361	0.00	0.00	9677.71	425
426	2078030.955	407686.494	0.00	0.00	9257.74	426
427	2078032.505	410611.536	9388.00	3.73	9391.73	427
428	2078034.658	408649.050	0.00	0.00	9309.12	428
429	2078038.452	409739.749	9485.93	-0.99	9484.94	429
430	2078042.377	410247.077	9492.03	10.42	9502.45	430
431	2078043.741	410015.211	0.00	0.00	9495.39	431
432	2078045.520	408922.564	9409.45	0.02	9409.47	432
433	2078054.818	413840.001	9605.95	-1.10	9604.85	433
434	2078055.142	414117.045	9624.98	-3.78	9621.20	434
435	2078057.519	408181.298	9502.93	0.12	9503.05	435
436	2078059.763	409456.376	9551.43	0.59	9552.02	436
437	2078063.062	413527.239	9566.96	-0.50	9566.46	437
438	2078065.623	413261.367	9594.05	-0.98	9593.07	438
439	2078083.292	412039.022	9560.52	0.74	9561.26	439
440	2078093.765	409201.227	9571.71	-6.90	9564.81	440
441	2078110.326	417007.273	0.00	0.00	9679.84	441
442	2078111.788	415056.226	9509.25	1.81	9511.06	442
443	2078121.857	412942.249	9596.56	-0.33	9596.23	443
444	2078133.011	414433.546	0.00	0.00	9627.51	444
445	2078247.352	417736.019	9672.14	-0.58	9671.56	445

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
447	2078257.796	413864.903	9701.26	0.68	9701.94	447
448	2078267.822	414937.082	9464.01	-0.54	9463.47	448
449	2078292.610	408799.342	9420.07	1.71	9421.78	449
450	2078301.331	416532.685	9615.91	-3.64	9612.27	450
451	2078311.547	409059.426	9554.78	0.20	9554.98	451
452	2078353.533	410857.308	9609.30	0.95	9610.25	452
453	2078354.224	411137.838	9698.83	1.84	9700.67	453
454	2078364.331	413654.280	0.00	0.00	9727.04	454
455	2078366.027	410275.851	9584.64	-0.62	9584.03	455
456	2078375.574	409395.539	9664.23	1.19	9665.42	456
457	2078383.019	410621.898	9500.49	0.14	9500.63	457
458	2078394.824	417907.170	9770.90	4.41	9775.31	458
459	2078404.264	415701.062	0.00	0.00	9837.85	459
460	2078413.346	412631.116	9543.59	-0.22	9543.38	460
461	2078423.908	408199.568	9577.25	1.22	9578.47	461
462	2078424.906	414154.702	9818.06	-0.15	9817.91	462
463	2078426.111	415432.012	9744.31	-0.63	9743.68	463
464	2078441.123	409650.144	9663.63	0.57	9664.20	464
465	2078443.435	411709.163	9745.61	-0.37	9745.24	465
466	2078456.871	417037.658	9882.24	-0.26	9881.98	466
467	2078456.885	407653.147	9384.26	-5.31	9378.95	467
468	2078457.420	413347.459	9770.04	-3.07	9766.97	468
469	2078466.935	411362.218	9709.92	0.71	9710.63	469
470	2078468.237	413127.991	9775.58	-4.78	9770.80	470
471	2078470.900	410029.721	9675.59	1.21	9676.80	471
472	2078473.904	416770.068	9770.86	0.74	9771.60	472
473	2078474.252	416091.219	0.00	0.00	9804.42	473
474	2078520.643	417321.463	0.00	0.00	9885.63	474
476	2078574.858	411906.212	9757.66	1.60	9759.26	476
477	2078583.147	412356.375	9579.76	-0.82	9578.94	477
478	2078599.885	413888.700	9853.79	-2.18	9851.61	478
479	2078617.669	415075.189	9607.31	-1.62	9605.69	479
480	2078624.884	410291.579	0.00	0.00	9670.49	480
481	2078632.011	417777.743	9840.61	-3.08	9837.53	481
482	2078654.261	408803.055	9570.71	0.85	9571.56	482
483	2078662.668	412976.862	9760.98	-1.66	9759.32	483
484	2078669.874	407939.206	9575.58	-0.93	9574.65	484
485	2078670.293	409073.205	9649.18	2.19	9651.37	485
486	2078672.957	410885.248	9712.56	1.72	9714.28	486
487	2078679.036	413604.746	9845.62	1.36	9846.98	487
488	2078683.998	410559.020	9632.29	1.29	9633.58	488
489	2078685.652	416548.919	9749.30	0.29	9749.59	489
490	2078686.464	416183.369	9830.79	-0.73	9830.06	490
491	2078693.533	415733.365	9945.82	-0.65	9945.17	491
492	2078702.149	413353.352	9849.17	-4.48	9844.69	492
493	2078703.928	411118.440	9817.22	1.43	9818.65	493
494	2078718.302	416863.261	9876.30	-2.01	9874.29	494
495	2078738.455	409903.137	9805.45	0.33	9805.78	495
496	2078791.597	417158.140	10045.50	-1.58	10043.92	496
497	2078796.984	409506.035	9870.68	0.96	9871.64	497

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
498	2078808.760	408483.181	9639.72	0.53	9640.25	498
499	2078809.579	408214.750	9723.87	0.84	9724.71	499
500	2078860.561	411458.313	9911.78	0.92	9912.70	500
501	2078862.614	412389.103	0.00	0.00	9654.45	501
502	2078864.060	414684.834	0.00	0.00	9683.21	502
503	2078875.866	410193.285	9802.20	5.72	9807.92	503
504	2078876.903	407628.913	9567.12	5.20	9572.32	504
505	2078894.259	412729.500	9718.03	0.07	9718.10	505
506	2078901.193	413948.220	10035.98	-1.69	10034.29	506
507	2078902.630	410875.949	9785.92	-0.12	9785.80	507
508	2078905.403	413666.146	9983.32	0.39	9983.71	508
509	2078906.840	411721.610	9970.37	0.20	9970.57	509
510	2078908.558	416612.253	9863.73	0.23	9863.96	510
511	2078912.617	413087.455	9834.42	-0.75	9833.67	511
512	2078928.744	417892.060	10015.04	-1.71	10013.33	512
513	2078943.842	415858.289	10065.30	0.61	10065.91	513
515	2078960.541	407880.213	9666.99	2.06	9669.05	515
516	2078962.331	415478.680	9859.72	-2.07	9857.65	516
517	2078999.972	410571.191	9788.40	-1.57	9786.84	517
518	2079007.439	416828.813	9968.72	-1.47	9967.25	518
519	2079007.633	417212.526	10139.86	-1.13	10138.73	519
520	2079008.594	409085.598	9772.56	0.75	9773.31	520
521	2079019.184	415010.411	9678.98	3.84	9682.82	521
522	2079024.978	408739.251	0.00	0.00	9712.95	522
523	2079036.729	417604.373	0.00	0.00	10023.16	523
524	2079047.226	408204.857	9833.19	-2.49	9830.70	524
525	2079050.768	413383.901	10038.70	-3.73	10034.97	525
526	2079165.119	411683.115	10089.68	-1.01	10088.68	526
527	2079170.521	407570.344	9683.23	-2.19	9681.04	527
528	2079183.351	412745.496	9808.64	-2.39	9806.25	528
529	2079197.243	410291.942	9952.22	-0.34	9951.88	529
530	2079203.057	410910.553	9976.32	-2.74	9973.59	530
532	2079211.499	415388.869	9883.57	1.46	9885.03	532
533	2079214.744	409641.740	10035.85	-0.27	10035.58	533
534	2079230.262	415688.640	10022.37	5.04	10027.41	534
535	2079231.145	416895.453	10084.98	0.19	10085.17	535
536	2079231.992	411202.534	10100.02	-0.19	10099.83	536
537	2079233.930	410018.925	10038.84	-1.93	10036.91	537
538	2079235.425	415115.330	9777.78	0.11	9777.89	538
539	2079237.432	413635.948	10142.19	-1.15	10141.04	539
540	2079242.727	417757.912	10162.03	-1.15	10160.88	540
541	2079243.157	415903.618	10131.07	-0.22	10130.85	541
542	2079245.082	413832.474	10175.17	-0.84	10174.33	542
543	2079247.960	412359.203	9874.94	-4.73	9870.21	543
544	2079249.768	414265.925	0.00	0.00	9976.66	544
545	2079258.108	417275.659	10264.87	-1.06	10263.81	545
546	2079264.704	413083.054	9992.21	3.86	9996.07	546
547	2079286.252	407859.478	9792.44	-0.92	9791.53	547
549	2079296.109	410572.769	0.00	0.00	9966.68	549
550	2079305.439	412087.051	0.00	0.00	9943.81	550

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
551	2079309.524	413404.059	10158.47	-0.39	10158.08	551
552	2079315.179	417516.922	10215.53	-0.87	10214.66	552
553	2079319.514	408782.708	0.00	0.00	9870.00	553
554	2079327.312	414853.045	0.00	0.00	9712.67	554
555	2079328.045	408262.240	9936.82	-1.18	9935.64	555
556	2079328.690	416588.351	10031.59	-1.91	10029.68	556
557	2079348.162	409093.074	9918.97	-1.93	9917.04	557
558	2079353.155	416285.939	0.00	0.00	10048.96	558
559	2079417.198	408517.305	9930.79	-3.78	9927.01	559
561	2079513.802	415354.372	9974.87	-1.00	9973.87	561
562	2079514.358	415671.206	10134.21	-2.90	10131.31	562
563	2079515.313	415000.281	0.00	0.00	9893.66	563
564	2079539.154	414604.806	0.00	0.00	9898.73	564
565	2079544.886	413267.894	10176.82	-0.94	10175.88	565
566	2079547.534	416894.454	10231.16	-1.41	10229.75	566
567	2079552.675	417277.174	10364.85	-0.87	10363.98	567
568	2079555.568	413537.332	10277.81	-0.40	10277.41	568
569	2079559.334	413812.992	0.00	0.00	10259.86	569
570	2079565.599	415950.746	10260.44	-0.58	10259.86	570
571	2079574.596	407854.713	9940.85	-0.86	9940.00	571
572	2079584.483	407612.050	9886.68	-0.33	9886.35	572
573	2079593.755	417669.223	10331.33	-0.53	10330.80	573
574	2079617.468	412775.821	10074.55	-3.02	10071.53	574
575	2079627.019	409536.688	10139.71	-0.21	10139.50	575
576	2079627.728	410672.430	10151.83	-0.65	10151.18	576
577	2079635.053	416232.892	10214.35	-0.17	10214.18	577
578	2079637.739	410090.080	10194.03	-2.26	10191.77	578
579	2079640.580	411663.374	10203.92	-0.67	10203.26	579
580	2079641.980	412229.726	10102.69	-1.21	10101.48	580
581	2079646.996	411333.375	10263.44	-0.37	10263.07	581
582	2079648.732	408911.030	10032.37	0.18	10032.55	582
583	2079655.237	409261.767	10080.63	1.15	10081.78	583
584	2079655.497	416601.362	10199.10	-2.05	10197.05	584
585	2079665.946	409842.086	10221.30	-1.26	10220.04	585
586	2079669.657	408622.731	10041.99	-1.13	10040.87	586
587	2079689.014	411996.840	10158.02	-2.06	10155.97	587
588	2079692.386	408028.867	10008.46	-0.55	10007.91	588
589	2079695.443	411068.280	10228.43	-1.22	10227.21	589
590	2079695.531	412473.143	10096.03	-5.20	10090.83	590
591	2079706.441	410446.607	10163.25	4.47	10167.72	591
592	2079754.447	408298.391	10102.23	-1.03	10101.20	592
595	2079835.076	414339.802	0.00	0.00	10136.82	595
596	2079838.583	417448.923	10442.25	-0.91	10441.34	596
597	2079839.206	415984.906	10343.45	-1.75	10341.70	597
598	2079843.279	413273.770	10288.08	-0.06	10288.02	598
599	2079845.115	417136.729	10429.02	0.82	10429.84	599
600	2079850.556	415628.098	10203.15	-0.65	10202.50	600
601	2079851.817	416833.319	10347.42	-1.57	10345.85	601
602	2079852.530	413534.749	10384.98	0.09	10385.07	602
603	2079854.253	415374.458	10132.87	0.13	10133.00	603

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
604	2079855.925	417727.546	10432.58	-0.54	10432.04	604
605	2079865.446	414735.680	0.00	0.00	9998.99	605
606	2079865.599	411663.608	10274.57	-0.56	10274.01	606
607	2079870.858	416264.634	10316.93	-0.61	10316.32	607
608	2079875.569	415049.469	10111.55	-4.64	10106.91	608
609	2079904.992	413883.352	0.00	0.00	10333.65	609
610	2079921.059	408638.789	10139.19	-0.81	10138.38	610
611	2079934.149	416600.727	10331.37	-1.10	10330.27	611
612	2079939.244	409220.153	10181.22	-0.67	10180.56	612
614	2079953.127	410434.492	10287.82	-0.17	10287.65	614
615	2079963.134	408938.296	10152.88	-1.46	10151.42	615
616	2079963.254	410132.981	10318.01	-2.74	10315.27	616
617	2079963.619	410725.586	10319.80	-1.88	10317.92	617
618	2079966.973	409534.925	10241.05	-0.05	10241.00	618
620	2079967.209	408064.802	10127.01	-0.41	10126.60	620
623	2079975.682	412788.577	10236.45	-2.03	10234.42	623
624	2079978.879	414160.443	10257.14	0.13	10257.27	624
625	2079979.879	412165.562	10241.44	-1.80	10239.64	625
626	2079980.933	411305.126	10376.80	-0.21	10376.60	626
627	2079982.695	411956.538	10268.58	-2.12	10266.46	627
628	2079985.960	412537.992	10239.45	-1.04	10238.41	628
629	2079986.217	411030.844	10344.34	-0.28	10344.07	629
630	2080015.532	409863.611	10354.85	-0.03	10354.82	630
631	2080019.402	417136.529	10506.45	-0.32	10506.13	631
632	2080019.441	413112.649	10304.51	-2.21	10302.30	632
633	2080039.931	417499.171	10506.41	-1.22	10505.19	633
634	2080092.467	415364.712	10238.81	1.65	10240.46	634
635	2080104.500	416032.369	10433.50	-0.30	10433.20	635
636	2080124.478	416853.177	10464.64	-0.75	10463.89	636
637	2080136.305	415707.277	10335.10	3.87	10338.97	637
638	2080141.550	416562.245	10432.46	0.54	10433.00	638
639	2080146.772	416256.511	10436.98	0.37	10437.35	639
640	2080161.223	415051.851	10223.18	1.45	10224.63	640
641	2080173.603	414738.443	0.00	0.00	10188.68	641
642	2080200.853	411028.016	10395.72	-0.75	10394.97	642
643	2080210.609	411334.784	10367.52	0.20	10367.72	643
644	2080213.252	414272.881	10317.44	-0.08	10317.36	644
645	2080215.586	410462.454	10409.27	-0.83	10408.44	645
646	2080219.509	408606.565	10255.18	-1.05	10254.13	646
647	2080224.983	408261.473	10292.78	-0.78	10292.00	647
648	2080225.739	409220.467	10256.11	0.01	10256.12	648
649	2080235.795	414514.522	10241.51	-0.01	10241.50	649
651	2080254.400	408917.813	10236.27	2.78	10239.05	651
653	2080255.204	411634.738	10344.57	0.55	10345.12	653
654	2080259.962	410723.491	10439.31	0.30	10439.61	654
656	2080265.171	411936.302	10336.51	-0.72	10335.79	656
657	2080265.352	410143.268	10390.21	1.57	10391.78	657
658	2080266.221	409837.923	10296.52	0.60	10297.12	658
659	2080271.569	409534.868	10273.98	-0.68	10273.30	659
660	2080281.706	414057.157	10385.84	1.09	10386.93	660

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
663	2080319.782	412220.425	10330.41	0.55	10330.96	663
664	2080322.001	412857.898	10376.13	-0.28	10375.86	664
665	2080353.923	412532.165	10357.67	-1.08	10356.59	665
666	2080367.658	413122.559	10447.92	-0.20	10447.73	666
667	2080399.856	417794.036	10607.25	0.96	10608.21	667
668	2080437.131	415032.685	10329.48	0.41	10329.89	668
669	2080439.271	417111.724	10638.00	2.45	10640.45	669
670	2080441.541	416829.196	10585.57	-0.91	10584.66	670
671	2080466.689	415906.014	10530.71	-1.40	10529.31	671
672	2080470.012	417432.992	10622.84	0.89	10623.73	672
673	2080477.355	416504.448	10581.37	1.28	10582.65	673
674	2080478.757	416249.518	10585.75	0.79	10586.54	674
675	2080491.687	415347.701	10422.60	-0.57	10422.04	675
676	2080499.109	414518.836	0.00	0.00	10352.73	676
678	2080506.543	408312.079	10281.24	-0.24	10281.00	678
679	2080521.968	414722.959	10356.46	0.36	10356.82	679
680	2080523.335	415659.194	10509.50	-0.64	10508.86	680
681	2080539.207	409837.768	10185.15	0.77	10185.92	681
682	2080550.136	408946.215	10108.68	0.30	10108.98	682
683	2080552.671	410436.037	10361.45	-0.19	10361.26	683
684	2080553.641	408633.932	10158.34	-0.03	10158.31	684
685	2080553.849	410134.667	10249.97	-0.02	10249.95	685
686	2080555.098	413443.178	10497.82	-0.81	10497.01	686
687	2080555.179	411634.695	10304.98	-0.24	10304.74	687
688	2080555.200	411334.756	10322.36	0.45	10322.81	688
689	2080555.316	409532.545	10169.50	-0.65	10168.85	689
690	2080555.328	411034.657	10340.60	-0.47	10340.13	690
691	2080555.358	412234.783	10312.51	-0.01	10312.50	691
692	2080555.420	411934.680	10294.95	0.37	10295.32	692
693	2080556.224	413138.704	10443.84	-0.72	10443.12	693
695	2080575.530	410694.975	10382.69	-0.79	10381.90	695
696	2080579.683	409239.127	10118.12	-0.58	10117.54	696
697	2080585.268	412526.293	10347.04	-0.65	10346.39	697
700	2080640.287	412848.814	10389.99	-1.09	10388.90	700
701	2080750.467	413860.350	10557.41	0.00	10115.51	701
702	2080761.872	417129.373	10652.60	1.10	10653.70	702
703	2080762.638	415343.103	10525.44	0.23	10525.67	703
704	2080770.087	417439.095	10617.93	0.65	10618.58	704
705	2080770.212	417735.270	10594.43	1.07	10595.50	705
706	2080774.145	415634.735	10582.83	1.31	10584.14	706
707	2080774.574	413577.296	10501.13	-0.65	10500.49	707
708	2080776.143	413016.266	10400.92	-0.73	10400.19	708
709	2080776.394	416284.630	10690.05	0.53	10690.58	709
710	2080781.772	416850.224	10669.26	-0.13	10669.13	710
711	2080782.507	415047.417	10484.93	1.94	10486.87	711
712	2080785.706	416532.375	10683.96	0.00	10683.96	712
714	2080801.410	414733.192	10486.93	0.52	10487.45	714
715	2080823.581	415872.922	10666.63	0.30	10666.93	715
716	2080826.735	414147.403	10540.25	3.42	10543.67	716
717	2080828.099	414449.386	10501.91	-2.07	10499.84	717

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718	2080837.384	413346.675	10446.92	-0.07	10446.85	718
719	2080841.762	409247.766	9989.15	-0.35	9988.80	719
720	2080842.646	408338.218	10095.91	-0.60	10095.31	720
721	2080843.828	408933.106	9989.37	0.76	9990.13	721
722	2080843.842	408045.594	10157.70	0.82	10158.52	722
723	2080844.969	410130.644	10146.92	1.05	10147.97	723
725	2080852.016	409830.770	10083.44	0.10	10083.54	725
726	2080852.352	411038.435	10288.28	0.42	10288.70	726
727	2080854.862	409520.568	10043.64	0.60	10044.24	727
728	2080855.119	411934.888	10232.48	0.35	10232.83	728
729	2080855.249	411334.551	10261.84	-0.07	10261.77	729
730	2080855.454	411634.600	10238.33	1.13	10239.46	730
731	2080856.082	412239.890	10254.69	-0.37	10254.32	731
732	2080856.807	410426.817	10243.79	0.33	10244.12	732
733	2080856.922	412553.103	10303.34	-0.20	10303.14	733
734	2080867.497	408545.571	10062.96	0.91	10063.87	734
735	2080872.072	410711.139	10322.62	0.07	10322.69	735
737	2081041.903	414394.005	10579.62	-0.39	10579.23	737
738	2081061.943	415670.606	10668.55	1.04	10669.59	738
739	2081061.995	417150.462	10623.48	0.01	10623.49	739
740	2081067.022	416847.819	10661.39	-0.34	10661.06	740
741	2081069.293	413867.525	10469.06	0.02	10469.08	741
742	2081069.429	417450.194	10582.76	0.77	10583.53	742
743	2081072.774	413535.131	10418.65	-0.32	10418.33	743
744	2081072.926	416227.300	10735.40	-0.92	10734.48	744
745	2081073.108	416536.563	10700.55	-0.27	10700.28	745
746	2081076.806	413247.379	10381.42	-0.60	10380.82	746
747	2081083.629	415022.303	10587.46	-0.87	10586.59	747
748	2081083.818	417748.086	10556.77	0.73	10557.50	748
749	2081086.028	412940.754	10327.53	-0.83	10326.70	749
750	2081096.222	414136.882	10500.17	-0.27	10499.90	750
753	2081123.805	408631.458	9941.93	1.00	9942.93	753
754	2081124.883	415316.386	10623.69	0.23	10623.92	754
755	2081125.104	408083.547	10028.88	0.24	10029.12	755
756	2081138.518	409283.972	9849.25	1.09	9850.34	756
757	2081138.817	411340.272	10185.75	0.52	10186.27	757
758	2081141.636	415912.080	10735.83	0.08	10735.91	758
759	2081144.995	408905.563	9867.97	1.38	9869.35	759
760	2081147.161	408361.687	9958.41	-0.12	9958.29	760
761	2081150.467	410694.870	10297.42	0.46	10297.88	761
762	2081155.398	412234.899	10186.95	-0.78	10186.17	762
763	2081155.410	412534.840	10240.35	-0.55	10239.80	763
764	2081156.998	411632.783	10150.10	-0.76	10149.34	764
765	2081161.401	411950.948	10149.50	-1.81	10147.69	765
766	2081162.144	409537.105	9879.58	1.74	9881.32	766
767	2081164.690	414688.581	10643.45	-0.11	10643.34	767
768	2081165.396	410134.993	10057.34	0.30	10057.64	768
769	2081174.914	409850.680	9973.01	0.61	9973.62	769
770	2081189.998	411052.799	10217.54	0.66	10218.20	770
771	2081192.312	410450.222	10169.91	-0.23	10169.68	771

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773	2081328.319	416261.483	10711.98	0.02	10712.00	773
774	2081341.670	408216.045	9916.65	1.14	9917.79	774
775	2081345.535	416823.136	10630.07	-0.42	10629.65	775
776	2081346.262	412960.194	10246.08	-1.41	10244.67	776
777	2081351.413	416538.985	10674.53	-1.44	10673.09	777
778	2081351.705	413550.500	10260.45	-0.11	10260.34	778
779	2081358.267	414480.299	10478.35	0.07	10478.42	779
780	2081370.683	417143.561	10580.27	-0.42	10579.85	780
781	2081371.815	417735.952	10508.89	0.62	10509.51	781
782	2081373.295	417438.175	10538.90	0.14	10539.04	782
783	2081374.156	414102.320	10343.18	-0.19	10342.99	783
784	2081396.878	418094.089	10485.18	1.58	10486.76	784
786	2081405.862	415654.987	10710.48	-0.17	10710.31	786
787	2081408.943	414744.305	10558.05	-0.47	10557.58	787
788	2081411.124	413265.974	10208.73	0.70	10209.43	788
789	2081412.484	415057.130	10661.54	-0.26	10661.28	789
790	2081428.814	408587.463	9787.91	1.65	9789.56	790
791	2081430.480	415924.433	10719.17	-0.07	10719.10	791
792	2081434.540	413837.270	10269.85	-0.55	10269.30	792
793	2081436.578	411677.059	10052.70	0.50	10053.20	793
794	2081441.803	411018.782	10176.36	-1.03	10175.33	794
795	2081444.503	410489.549	10142.83	0.51	10143.34	795
796	2081444.630	409828.096	9884.48	-3.01	9881.47	796
797	2081445.958	410759.429	10220.80	-0.41	10220.39	797
798	2081446.881	411342.259	10095.65	0.04	10095.69	798
799	2081448.253	415282.706	10706.99	0.17	10707.16	799
800	2081453.066	411929.692	10047.19	-0.62	10046.57	800
801	2081453.344	410106.467	9995.33	-0.34	9994.99	801
802	2081463.721	409178.158	9699.60	0.87	9700.47	802
803	2081464.827	412496.761	10152.68	-0.81	10151.87	803
804	2081469.440	409549.846	9757.80	1.06	9758.86	804
805	2081487.957	412214.209	10090.30	-0.63	10089.67	805
806	2081490.263	408976.881	9693.58	6.42	9700.00	806
808	2081605.976	412874.146	10100.07	-2.58	10097.49	808
809	2081616.867	412996.566	10085.91	-1.89	10084.02	809
810	2081621.850	417179.770	10539.93	0.72	10540.65	810
811	2081636.492	413599.234	10125.54	0.60	10126.14	811
812	2081646.479	413930.458	10192.36	-0.12	10192.24	812
813	2081648.975	415034.571	10606.04	0.87	10606.91	813
814	2081659.309	417729.572	10450.58	-0.91	10449.67	814
815	2081665.150	416559.845	10639.57	-1.42	10638.15	815
816	2081668.515	414445.928	10357.60	1.19	10358.79	816
817	2081669.259	418040.308	10439.26	-0.03	10439.23	817
818	2081669.337	417447.254	10486.96	0.14	10487.10	818
819	2081672.526	414777.174	10481.34	0.55	10481.89	819
820	2081680.718	415591.353	10713.22	-1.87	10711.35	820
821	2081695.052	413302.088	10036.83	0.44	10037.27	821
822	2081698.835	414171.779	10253.26	0.37	10253.63	822
823	2081702.972	416830.341	10587.21	-0.36	10586.85	823
824	2081711.113	410142.954	9966.72	0.90	9967.62	824

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825	2081712.113	408639.669	9685.11	-0.67	9684.44	825
827	2081725.866	411028.717	10117.18	0.25	10117.43	827
828	2081727.813	410455.064	10070.49	0.44	10070.93	828
829	2081729.480	411656.158	9942.04	0.13	9942.17	829
830	2081730.850	408134.356	9895.83	3.24	9899.07	830
831	2081733.724	408350.115	9807.42	1.01	9808.43	831
833	2081740.616	409560.826	9689.08	-0.02	9689.06	833
834	2081742.314	415340.075	10687.98	0.04	10688.02	834
835	2081749.172	412499.276	10050.34	0.26	10050.60	835
836	2081749.806	409848.031	9822.58	-1.04	9821.54	836
837	2081751.171	409212.244	9604.60	2.29	9606.89	837
838	2081755.377	411926.293	9924.07	-0.10	9923.97	838
840	2081767.477	410763.037	10151.78	-0.31	10151.47	840
841	2081772.641	411322.306	10027.50	0.00	10027.50	841
842	2081772.826	416221.798	10676.77	-0.66	10676.11	842
843	2081775.296	412211.296	9981.36	-0.44	9980.92	843
845	2081781.870	415904.332	10703.40	-1.23	10702.17	845
846	2081793.841	408909.224	9611.18	0.06	9611.24	846
847	2081933.795	417434.982	10442.25	-0.55	10441.70	847
848	2081943.003	414449.366	10277.65	0.25	10277.90	848
849	2081959.010	415928.614	10676.13	0.01	10676.14	849
850	2081959.192	416577.681	10603.83	-0.21	10603.62	850
851	2081971.391	413857.065	10017.11	-1.45	10015.66	851
852	2081971.581	415601.737	10686.17	0.32	10686.49	852
853	2081972.705	417767.246	10378.39	-0.37	10378.02	853
854	2081974.321	414727.363	10384.80	0.17	10384.97	854
855	2081979.883	415052.532	10535.16	0.47	10535.63	855
856	2081981.115	417143.739	10496.36	-0.22	10496.14	856
857	2081982.460	413250.561	9876.39	1.01	9877.40	857
858	2081985.967	415356.996	10645.62	-0.17	10645.45	858
859	2081989.876	413603.291	9925.16	0.62	9925.78	859
860	2081997.337	414130.780	10115.36	-3.33	10112.03	860
861	2082001.022	416156.043	10659.61	0.41	10660.02	861
862	2082004.406	418136.119	10376.08	0.27	10376.35	862
863	2082009.019	410456.252	10020.08	0.87	10020.95	863
864	2082009.314	408700.843	9635.26	2.41	9637.67	864
867	2082036.445	409818.553	9731.29	0.05	9731.34	867
868	2082036.503	411088.377	10039.82	0.76	10040.58	868
869	2082041.721	409590.867	9621.68	1.48	9623.16	869
870	2082042.295	409248.218	9535.62	-1.28	9534.34	870
872	2082045.725	412487.917	9837.86	-0.41	9837.45	872
873	2082053.260	411954.664	9763.68	1.40	9765.08	873
876	2082055.575	416883.406	10541.75	-0.59	10541.16	876
878	2082075.278	412913.598	9799.78	-2.34	9797.44	878
879	2082077.259	410745.304	10108.23	0.97	10109.20	879
880	2082081.122	412163.248	9751.21	-0.22	9750.99	880
881	2082095.387	411683.597	9816.63	0.50	9817.13	881
883	2082127.601	408010.187	9933.88	-1.11	9932.77	883
884	2082153.225	410116.121	9850.22	-1.42	9848.80	884
885	2082158.071	408385.379	9775.07	0.05	9775.12	885

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
886	2082174.483	415865.057	10647.87	0.43	10648.30	886
887	2082232.217	414137.827	10048.51	3.07	10051.58	887
888	2082239.976	417797.002	10297.12	4.71	10301.83	888
889	2082243.816	417476.075	10374.33	3.76	10378.09	889
890	2082253.573	418085.889	10317.02	-0.40	10316.62	890
892	2082256.882	413493.534	9788.93	2.35	9791.28	892
893	2082264.478	413278.644	9754.43	0.39	9754.82	893
894	2082265.691	415610.061	10628.96	1.18	10630.14	894
895	2082270.233	415346.610	10590.30	0.54	10590.84	895
896	2082282.646	416862.005	10521.71	-0.29	10521.42	896
897	2082288.585	411006.291	10022.70	1.31	10024.01	897
898	2082289.020	415081.665	10488.17	0.40	10488.57	898
899	2082297.359	414459.206	10185.51	-2.49	10183.02	899
900	2082298.474	414747.546	10321.79	1.05	10322.84	900
901	2082298.832	413908.902	9927.69	0.75	9928.44	901
902	2082298.919	411927.849	9682.15	0.43	9682.58	902
904	2082308.021	408603.390	9649.75	0.50	9650.25	904
905	2082311.682	412908.739	9727.50	-0.19	9727.31	905
906	2082319.955	416486.804	10566.20	0.30	10566.50	906
907	2082320.058	412435.034	0.00	0.00	9726.29	907
908	2082320.320	418391.415	10356.46	-0.93	10355.53	908
909	2082327.375	409603.450	9592.28	-0.48	9591.80	909
910	2082337.906	416272.090	10549.62	-0.36	10549.26	910
911	2082337.918	411723.428	9714.06	0.66	9714.72	911
912	2082345.135	411312.384	9894.71	-1.56	9893.15	912
913	2082357.145	412198.942	9729.86	0.48	9730.34	913
914	2082363.783	410775.914	10057.49	-1.36	10056.13	914
916	2082365.172	409258.721	9453.31	0.19	9453.50	916
917	2082375.501	410160.017	9820.78	-0.04	9820.74	917
918	2082383.317	410496.856	9983.91	-2.10	9981.82	918
920	2082396.724	408925.413	9498.78	0.44	9499.22	920
921	2082396.992	407968.514	9873.51	0.59	9874.10	921
923	2082413.209	417162.667	10433.25	-0.25	10433.00	923
926	2082439.619	409841.570	9637.48	0.84	9638.32	926
927	2082442.422	408338.567	9772.48	1.51	9773.99	927
928	2082492.683	417931.262	10235.46	0.41	10235.87	928
929	2082498.036	418101.110	10267.68	-0.74	10266.94	929
930	2082510.345	413899.904	9931.67	1.58	9933.25	930
932	2082548.296	417344.620	10363.05	0.78	10363.83	932
933	2082552.314	415352.745	10548.08	0.84	10548.92	933
934	2082562.451	414466.200	10200.61	1.86	10202.47	934
935	2082571.033	416817.816	10470.80	-0.16	10470.64	935
936	2082572.522	412942.159	9604.41	0.19	9604.60	936
937	2082572.757	415946.115	10389.46	0.51	10389.97	937
938	2082574.039	414724.782	10329.66	0.42	10330.08	938
939	2082577.866	415672.060	10449.44	2.60	10452.04	939
940	2082579.334	416586.674	10417.33	0.07	10417.40	940
941	2082579.357	416232.292	10383.12	0.58	10383.70	941
942	2082595.271	413169.679	9588.76	0.70	9589.46	942
943	2082604.399	408448.703	10409.61	0.00	9705.02	943

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
944	2082605.045	417149.612	10409.95	0.21	10410.16	944
945	2082616.166	413586.804	9805.17	-0.33	9804.84	945
946	2082616.914	410140.692	9742.97	-1.87	9741.10	946
947	2082617.472	414135.034	10062.39	1.73	10064.12	947
948	2082622.576	409839.400	9608.38	-0.34	9608.04	948
949	2082629.936	415059.245	10476.36	0.92	10477.28	949
950	2082631.898	407772.892	9729.92	-10.14	9719.78	950
951	2082640.394	411601.928	9817.79	0.00	9693.77	951
952	2082643.688	411316.630	9820.61	-0.83	9819.78	952
953	2082647.467	411029.440	9950.92	-1.25	9949.68	953
954	2082651.718	408006.574	9710.23	0.81	9711.04	954
955	2082654.399	412746.181	9555.72	-0.49	9555.23	955
957	2082658.481	410468.588	9890.77	-2.44	9888.33	957
958	2082659.411	408885.966	9465.11	-0.60	9464.51	958
959	2082672.454	409531.175	9478.10	1.25	9479.35	959
960	2082683.487	410761.221	9994.80	-0.64	9994.16	960
961	2082691.519	418226.750	10250.31	0.36	10250.67	961
963	2082695.565	409196.316	9345.57	-3.02	9342.55	963
966	2082713.420	412504.683	9532.78	1.33	9534.11	966
968	2082720.018	412050.577	9515.51	-1.20	9514.31	968
971	2082785.241	418027.332	10200.61	-0.23	10200.38	971
972	2082814.539	412937.111	9540.30	1.44	9541.74	972
973	2082820.349	408605.559	9548.87	1.36	9550.23	973
974	2082826.476	414975.310	10442.39	1.85	10444.24	974
975	2082833.033	416227.440	10223.04	1.47	10224.51	975
976	2082847.348	413290.620	9745.80	0.10	9745.90	976
977	2082861.898	414491.186	10272.59	1.78	10274.37	977
978	2082869.439	415324.243	10443.68	3.03	10446.71	978
979	2082876.684	413840.316	10000.66	2.55	10003.21	979
980	2082888.592	412735.856	9482.78	1.37	9484.15	980
981	2082888.772	417139.247	10364.65	0.79	10365.44	981
982	2082901.560	415921.687	10194.71	1.96	10196.67	982
983	2082904.086	417546.023	10245.22	0.03	10245.25	983
984	2082909.213	414167.222	10161.46	0.50	10161.96	984
985	2082909.566	416840.000	10327.31	0.41	10327.72	985
986	2082911.342	409264.063	9310.46	1.35	9311.81	986
987	2082923.695	408493.325	9552.69	2.07	9554.76	987
988	2082927.029	410740.147	9974.96	-0.71	9974.25	988
989	2082927.255	409497.331	9419.86	2.23	9422.09	989
990	2082927.399	410125.566	9647.85	-0.05	9647.80	990
991	2082929.582	416630.626	10244.12	0.37	10244.49	991
992	2082930.551	412591.403	9439.98	-0.65	9439.33	992
993	2082938.442	408156.655	9529.14	-0.47	9528.68	993
994	2082938.597	412126.838	9436.80	2.06	9438.86	994
995	2082944.666	410437.537	9860.52	-0.49	9860.04	995
996	2082951.618	408898.164	9406.47	2.27	9408.74	996
997	2082956.980	411596.725	10252.59	0.00	9655.11	997
998	2082959.469	415615.709	10254.86	0.72	10255.58	998
999	2082964.353	411029.795	9894.67	1.64	9896.31	999
1000	2082984.086	409809.377	9557.04	1.42	9558.46	1000

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1002	2083009.774	418249.531	10197.66	0.18	10197.84	1002
1003	2083009.806	414742.666	10332.29	-0.23	10332.06	1003
1004	2083023.143	413411.749	9847.52	-0.72	9846.80	1004
1005	2083039.326	411292.796	9761.85	-0.75	9761.10	1005
1008	2083118.855	416273.909	10077.13	1.87	10079.00	1008
1009	2083126.334	417994.830	10120.98	0.46	10121.44	1009
1011	2083134.952	409888.367	9576.31	0.02	9576.33	1011
1013	2083136.874	415028.959	10327.27	-0.68	10326.59	1013
1015	2083148.094	414158.605	10171.45	-0.15	10171.30	1015
1016	2083161.013	415965.411	10064.70	1.10	10065.80	1016
1017	2083165.544	415688.182	10131.54	0.04	10131.58	1017
1018	2083169.990	412898.372	9646.54	0.90	9647.44	1018
1019	2083175.803	417559.492	10202.50	-0.64	10201.86	1019
1022	2083191.038	417084.357	10327.59	0.08	10327.67	1022
1023	2083195.153	414499.319	10232.93	0.96	10233.89	1023
1024	2083196.633	410713.631	9956.38	2.69	9959.07	1024
1025	2083205.691	418452.023	10209.98	-0.22	10209.76	1025
1026	2083210.065	409545.190	9400.87	1.12	9401.99	1026
1027	2083211.077	412317.435	9350.89	0.23	9351.12	1027
1028	2083220.509	409259.435	9265.85	2.11	9267.96	1028
1029	2083223.566	408888.490	9331.21	2.40	9333.61	1029
1030	2083238.133	408447.397	9406.83	-0.06	9406.77	1030
1031	2083240.687	415381.134	10257.82	1.25	10259.07	1031
1032	2083267.394	411408.047	9665.78	-1.67	9664.12	1032
1033	2083290.655	411795.507	9504.96	-2.24	9502.72	1033
1034	2083298.156	412557.376	9485.95	1.56	9487.51	1034
1035	2083299.905	410202.947	9709.90	0.62	9710.52	1035
1036	2083306.370	413856.798	10114.26	0.18	10114.44	1036
1037	2083322.323	418182.473	10124.68	-0.30	10124.39	1037
1038	2083325.250	410737.225	9944.70	1.44	9946.14	1038
1039	2083346.104	411094.410	9790.56	1.81	9792.37	1039
1040	2083374.575	416695.640	10087.62	0.59	10088.21	1040
1041	2083377.450	408131.259	9371.26	1.05	9372.31	1041
1043	2083406.210	413346.636	9833.11	-0.07	9833.04	1043
1044	2083413.909	415048.975	10249.42	-0.09	10249.33	1044
1045	2083421.929	416001.105	9957.21	-0.86	9956.35	1045
1046	2083427.939	416397.639	9984.88	-0.23	9984.65	1046
1047	2083429.956	417859.630	10074.30	1.81	10076.11	1047
1048	2083434.433	417088.436	10294.13	0.33	10294.46	1048
1049	2083462.230	415685.959	10030.94	0.17	10031.11	1049
1050	2083484.647	411330.464	9629.98	-3.00	9626.98	1050
1051	2083492.930	414802.379	10179.22	-0.28	10178.94	1051
1052	2083494.395	417511.437	10174.70	0.31	10175.01	1052
1053	2083496.954	409980.006	9595.27	-3.43	9591.84	1053
1054	2083503.074	409614.121	9437.77	1.26	9439.03	1054
1056	2083504.688	408871.787	0.00	0.00	9263.32	1056
1057	2083505.053	410515.421	9762.92	0.50	9763.42	1057
1058	2083506.547	411862.204	9413.49	-0.90	9412.59	1058
1060	2083512.582	412238.427	9276.28	-0.73	9275.56	1060
1064	2083528.852	409270.939	9261.22	1.84	9263.06	1064

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1065	2083529.130	412627.586	9528.49	0.15	9528.64	1065
1066	2083531.981	414551.463	10113.66	0.81	10114.47	1066
1069	2083551.830	413917.513	10040.21	1.30	10041.51	1069
1070	2083555.674	414386.353	10073.31	1.28	10074.59	1070
1071	2083558.214	407710.410	9658.17	1.27	9659.44	1071
1072	2083573.955	410140.768	9601.32	0.94	9602.26	1072
1075	2083630.115	418459.299	10019.80	-0.74	10019.06	1075
1076	2083633.692	418187.191	9990.47	0.20	9990.67	1076
1077	2083643.536	415429.420	10098.72	0.68	10099.40	1077
1078	2083699.046	417138.428	10259.37	0.41	10259.78	1078
1079	2083700.683	415139.157	10163.05	-0.14	10162.91	1079
1080	2083708.936	416844.277	10104.78	0.18	10104.96	1080
1081	2083717.821	416277.534	9875.28	0.87	9876.15	1081
1082	2083745.390	411576.379	0.00	0.00	9426.17	1082
1083	2083751.124	417844.029	10025.07	1.15	10026.22	1083
1084	2083754.764	415971.286	9860.70	0.15	9860.85	1084
1085	2083785.542	410142.417	9548.87	2.05	9550.92	1085
1086	2083787.537	418111.713	9955.31	1.01	9956.32	1086
1087	2083788.186	415751.726	9904.06	0.99	9905.05	1087
1088	2083789.657	412164.511	9152.31	0.39	9152.70	1088
1089	2083792.086	413902.088	9911.57	-2.54	9909.03	1089
1090	2083796.592	409783.991	9449.09	-1.14	9447.95	1090
1091	2083799.915	413494.538	9877.19	3.90	9881.09	1091
1092	2083807.478	417501.199	10138.91	1.14	10140.05	1092
1093	2083831.829	409491.678	9287.69	1.10	9288.79	1093
1094	2083835.456	414167.622	9929.51	-0.97	9928.54	1094
1097	2083848.864	414811.330	10088.65	1.17	10089.82	1097
1099	2083861.769	408381.432	9324.86	-0.70	9324.16	1099
1100	2083870.199	414505.957	9980.40	1.65	9982.05	1100
1101	2083879.997	408975.239	0.00	0.00	9075.50	1101
1102	2083886.992	408070.466	0.00	0.00	9501.40	1102
1103	2083891.549	407767.406	9659.79	2.41	9662.20	1103
1105	2083900.711	416481.667	9919.48	-0.06	9919.43	1105
1106	2083911.176	408654.091	9207.27	-0.05	9207.22	1106
1107	2083912.602	410708.307	9649.62	1.28	9650.90	1107
1108	2083925.493	409250.353	9162.01	1.49	9163.50	1108
1109	2083929.727	417153.032	10231.34	0.65	10231.99	1109
1110	2083937.026	412588.622	9416.86	-1.09	9415.77	1110
1113	2083967.806	418458.663	9950.75	0.28	9951.03	1113
1114	2083996.763	413243.400	9747.90	-0.42	9747.48	1114
1115	2084009.237	413624.356	9777.09	-0.12	9776.97	1115
1116	2084012.198	415062.472	10119.29	0.38	10119.67	1116
1117	2084019.824	410968.131	0.00	0.00	9541.93	1117
1118	2084020.067	415433.249	9954.91	0.78	9955.69	1118
1119	2084029.412	413004.470	9643.09	0.73	9643.82	1119
1120	2084030.209	418057.638	9853.24	0.50	9853.74	1120
1121	2084055.731	411691.288	0.00	0.00	9185.13	1121
1122	2084061.140	417617.853	10040.05	0.97	10041.02	1122
1123	2084106.922	416894.324	10109.06	-0.35	10108.71	1123
1124	2084107.025	415797.893	9763.43	0.70	9764.13	1124

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1125	2084129.660	416102.377	9730.84	0.85	9731.69	1125
1126	2084137.169	412236.299	9237.56	0.63	9238.19	1126
1127	2084146.966	414061.314	9768.12	-0.17	9767.95	1127
1128	2084150.490	410345.623	9547.33	-0.09	9547.24	1128
1129	2084153.409	411995.563	9002.97	1.90	9004.87	1129
1130	2084155.858	410097.338	9419.38	1.24	9420.62	1130
1131	2084161.262	414307.508	9817.27	-1.64	9815.63	1131
1132	2084168.097	414720.708	9988.65	0.61	9989.26	1132
1133	2084174.150	409726.709	9219.82	0.89	9220.71	1133
1134	2084179.366	411342.879	0.00	0.00	9354.90	1134
1135	2084189.389	417193.250	10199.48	0.03	10199.51	1135
1136	2084207.279	416588.720	9927.96	0.81	9928.77	1136
1140	2084267.899	413329.465	9648.36	5.27	9653.63	1140
1141	2084277.031	410564.348	9585.97	0.58	9586.55	1141
1143	2084290.575	408538.022	0.00	0.00	9311.45	1143
1144	2084291.986	408230.380	9492.77	4.60	9497.37	1144
1145	2084295.297	412632.842	9460.86	1.57	9462.43	1145
1146	2084301.586	409479.567	9154.02	2.88	9156.90	1146
1147	2084305.008	407783.205	9719.48	-2.94	9716.54	1147
1148	2084307.367	408833.854	0.00	0.00	9129.20	1148
1149	2084310.672	415131.070	10016.31	1.12	10017.43	1149
1150	2084326.167	411140.238	9320.04	-3.82	9316.22	1150
1151	2084343.662	417888.585	9867.79	1.68	9869.47	1151
1152	2084359.420	415443.433	9837.39	-0.27	9837.12	1152
1153	2084360.343	413899.500	9670.38	-1.02	9669.36	1153
1154	2084370.300	414262.633	9792.39	0.67	9793.06	1154
1157	2084385.272	418084.074	9776.37	0.60	9776.97	1157
1158	2084387.420	418463.144	9825.93	-1.79	9824.14	1158
1159	2084390.968	417267.173	10145.97	1.11	10147.08	1159
1160	2084393.708	409214.066	8980.60	0.92	8981.52	1160
1161	2084396.693	408042.007	9558.81	0.69	9559.50	1161
1162	2084408.087	417656.246	9948.93	0.96	9949.89	1162
1163	2084409.220	414528.611	9892.45	1.47	9893.92	1163
1164	2084409.338	416002.247	9666.12	1.36	9667.48	1164
1165	2084421.149	413063.412	9585.44	2.70	9588.14	1165
1166	2084425.543	414947.276	10051.67	-0.42	10051.25	1166
1167	2084425.716	413615.470	9577.08	7.77	9584.85	1167
1169	2084474.189	415665.096	9721.85	2.89	9724.74	1169
1170	2084480.327	416685.710	9886.66	-0.31	9886.35	1170
1171	2084481.361	416245.738	0.00	0.00	9709.24	1171
1172	2084566.412	416859.644	9926.14	-0.17	9925.97	1172
1173	2084575.995	411895.477	8899.70	-6.99	8892.71	1173
1174	2084583.568	411473.208	0.00	0.00	9069.54	1174
1175	2084589.584	412293.019	9196.15	0.06	9196.21	1175
1176	2084600.723	415340.678	9812.93	-0.23	9812.71	1176
1177	2084610.238	410134.772	9407.08	1.52	9408.60	1177
1178	2084611.929	414785.520	10016.63	-0.79	10015.85	1178
1179	2084621.454	412617.179	9396.12	0.83	9396.95	1179
1180	2084630.831	414189.755	9752.88	2.20	9755.08	1180
1181	2084633.414	413277.444	9475.60	3.35	9478.95	1181

NOTE: All (0) zero elevations and study year are in obscure areas.

POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1182	2084642.730	415066.982	9955.03	0.00	9955.03	1182
1183	2084646.865	410672.962	9488.18	4.72	9492.90	1183
1184	2084647.897	410472.402	9558.08	0.30	9558.38	1184
1185	2084652.777	414497.343	9894.39	0.39	9894.78	1185
1186	2084656.939	407715.413	9512.70	-2.02	9510.68	1186
1187	2084657.242	413900.189	9601.28	1.41	9602.69	1187
1188	2084659.525	417300.769	10051.91	-0.04	10051.87	1188
1189	2084673.262	418033.371	9759.78	0.22	9760.00	1189
1190	2084675.430	418476.162	9752.88	1.16	9754.04	1190
1191	2084676.902	410940.257	9378.72	-1.79	9376.93	1191
1192	2084688.819	409568.516	9063.66	-0.47	9063.19	1192
1194	2084699.531	409247.748	8944.68	3.57	8948.25	1194
1195	2084701.183	412953.099	9433.71	3.12	9436.83	1195
1196	2084701.933	408210.023	9410.77	2.44	9413.21	1196
1197	2084704.635	417715.639	9889.08	2.02	9891.10	1197
1199	2084724.262	409854.540	9253.27	3.56	9256.83	1199
1200	2084733.242	415538.053	9701.61	0.43	9702.04	1200
1201	2084733.818	408447.372	9279.73	0.19	9279.92	1201
1202	2084745.768	415862.404	9643.88	0.93	9644.81	1202
1203	2084747.621	408976.418	8992.05	3.42	8995.47	1203
1205	2084787.612	416960.865	9899.42	0.16	9899.58	1205
1207	2084803.486	413586.068	9445.56	8.20	9453.76	1207
1208	2084807.808	416292.557	9678.30	0.14	9678.44	1208
1209	2084809.829	408002.247	0.00	0.00	9483.39	1209
1212	2084864.155	417352.952	9965.14	-0.60	9964.54	1212
1213	2084872.008	416108.752	9651.49	2.11	9653.60	1213
1214	2084888.061	414777.810	10047.31	-0.80	10046.51	1214
1215	2084898.268	414206.405	9755.94	1.18	9757.12	1215
1216	2084910.545	418445.815	9698.22	-1.12	9697.10	1216
1217	2084922.018	412394.653	9268.33	-1.80	9266.53	1217
1218	2084927.855	413283.427	9300.32	0.67	9300.99	1218
1219	2084933.245	414482.987	9905.21	-1.56	9903.65	1219
1220	2084945.040	415387.822	9705.20	0.69	9705.89	1220
1221	2084946.731	416541.110	9694.70	-0.51	9694.19	1221
1222	2084949.622	415095.256	9852.25	-1.77	9850.48	1222
1223	2084950.974	412164.329	9062.68	-0.51	9062.17	1223
1224	2084967.907	411186.482	0.00	0.00	9156.57	1224
1225	2084971.048	413916.100	9619.30	4.74	9624.04	1225
1226	2084978.256	417043.783	9860.54	1.25	9861.79	1226
1227	2084983.358	412994.074	9262.48	0.29	9262.77	1227
1228	2084984.163	418052.077	9707.34	-0.98	9706.36	1228
1229	2084988.197	409296.253	8884.19	0.76	8884.95	1229
1230	2084992.310	415606.703	9631.83	2.38	9634.21	1230
1231	2085013.226	412681.436	9205.49	-0.18	9205.32	1231
1232	2085016.434	409009.440	8955.07	4.49	8959.56	1232
1233	2085026.961	410478.571	9521.27	0.27	9521.54	1233
1234	2085042.485	407436.431	9259.72	1.67	9261.39	1234
1235	2085044.147	411840.299	8808.69	1.53	8810.22	1235
1236	2085049.623	417719.847	9809.80	0.23	9810.03	1236
1237	2085054.918	407769.943	9310.95	1.96	9312.91	1237

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1238	2085067.242	411512.583	0.00	0.00	8930.21	1238
1239	2085068.048	410136.312	9333.16	0.97	9334.13	1239
1241	2085081.727	408142.841	9382.23	-3.63	9378.60	1241
1242	2085116.823	413580.896	9464.23	-2.40	9461.83	1242
1243	2085118.866	409570.418	8977.56	4.70	8982.26	1243
1244	2085146.835	416279.746	9566.59	1.35	9567.94	1244
1245	2085149.131	417389.805	9900.29	-1.42	9898.87	1245
1246	2085150.899	408505.282	0.00	0.00	9202.67	1246
1247	2085159.278	409802.120	9163.27	-0.88	9162.39	1247
1248	2085165.741	418490.949	9698.66	-2.36	9696.31	1248
1249	2085167.926	415869.312	9575.27	1.20	9576.47	1249
1250	2085196.658	414178.183	9743.61	-1.19	9742.42	1250
1251	2085215.401	414764.044	9943.02	-0.98	9942.04	1251
1252	2085219.122	414487.673	9891.85	1.37	9893.22	1252
1253	2085222.594	409157.379	8853.02	0.31	8853.33	1253
1254	2085243.970	415105.963	9778.89	-0.38	9778.52	1254
1255	2085245.575	413316.491	9326.17	-7.79	9318.38	1255
1256	2085245.783	417107.040	0.00	0.00	9787.57	1256
1257	2085247.679	413898.190	9643.69	0.37	9644.06	1257
1258	2085247.798	416693.982	9654.03	-3.08	9650.95	1258
1259	2085252.668	415388.477	9657.79	3.33	9661.12	1259
1260	2085255.229	412989.660	9119.63	1.30	9120.93	1260
1261	2085285.425	418069.694	9637.54	-0.41	9637.13	1261
1262	2085288.420	412448.527	8996.35	-6.33	8990.02	1262
1263	2085337.511	415655.462	9517.44	1.81	9519.25	1263
1264	2085356.409	413571.013	9485.95	-4.24	9481.71	1264
1265	2085361.361	417746.588	9745.27	0.62	9745.89	1265
1266	2085362.422	412684.307	8946.34	-0.95	8945.39	1266
1267	2085401.500	412179.691	8892.80	-2.96	8889.84	1267
1268	2085421.119	409806.459	9167.41	2.77	9170.18	1268
1269	2085427.683	408906.306	8913.09	4.06	8917.15	1269
1270	2085432.155	417409.335	9875.56	-1.47	9874.09	1270
1271	2085451.462	408329.003	9231.92	-0.78	9231.14	1271
1272	2085452.450	418484.828	9652.68	-0.50	9652.18	1272
1273	2085461.917	413829.670	9638.18	-1.34	9636.84	1273
1274	2085477.156	409552.917	8940.05	0.36	8940.41	1274
1275	2085486.195	410478.830	9519.11	-6.08	9513.03	1275
1276	2085486.682	416216.955	9452.16	-1.75	9450.41	1276
1277	2085489.699	411844.079	8742.83	-9.58	8733.25	1277
1278	2085501.529	407888.781	9166.76	-2.10	9164.66	1278
1279	2085503.212	410185.261	9368.15	0.42	9368.57	1279
1280	2085509.395	415872.627	9498.25	0.65	9498.90	1280
1282	2085517.245	407498.433	8996.76	1.29	8998.05	1282
1283	2085523.931	414772.996	9810.83	0.63	9811.46	1283
1284	2085530.083	415084.342	9659.46	-1.10	9658.36	1284
1285	2085532.225	418699.932	9733.30	-1.96	9731.34	1285
1286	2085532.443	416938.862	9659.66	-1.04	9658.63	1286
1287	2085534.566	408126.472	9142.65	1.41	9144.06	1287
1288	2085550.704	415384.289	9546.85	-18.55	9528.30	1288
1289	2085551.293	416634.136	0.00	0.00	9538.34	1289

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1290	2085552.646	414210.309	9753.60	-1.40	9752.20	1290
1291	2085554.432	413294.841	9403.71	-0.48	9403.23	1291
1292	2085558.085	414565.563	9910.84	-0.03	9910.81	1292
1293	2085567.491	418077.424	9571.66	-0.30	9571.36	1293
1294	2085576.378	411100.734	9204.34	18.74	9223.08	1294
1295	2085599.529	409279.139	8800.45	2.13	8802.58	1295
1296	2085610.734	417175.191	9754.69	-2.81	9751.88	1296
1297	2085629.519	417740.436	9714.08	0.07	9714.15	1297
1298	2085674.724	412920.547	9210.08	0.42	9210.50	1298
1299	2085680.295	413590.972	9568.56	-2.46	9566.10	1299
1300	2085680.723	417447.179	9842.30	-0.87	9841.43	1300
1301	2085691.777	412632.076	8985.84	-3.65	8982.19	1301
1302	2085746.748	418442.036	9582.36	0.32	9582.68	1302
1303	2085775.259	416409.361	9341.41	1.97	9343.38	1303
1304	2085778.168	410053.619	9240.52	3.29	9243.81	1304
1305	2085779.904	416036.905	9407.13	0.49	9407.62	1305
1307	2085789.289	415666.264	9322.07	1.69	9323.76	1307
1308	2085816.041	408347.421	9031.67	-12.31	9019.36	1308
1309	2085818.378	413893.604	9696.39	-0.95	9695.44	1309
1310	2085820.483	418062.112	9544.63	0.63	9545.26	1310
1311	2085824.871	410521.382	9453.28	0.13	9453.41	1311
1312	2085829.305	414307.711	9769.27	1.17	9770.44	1312
1313	2085840.888	413295.211	9446.33	-2.94	9443.39	1313
1314	2085843.788	409708.918	9015.02	1.74	9016.76	1314
1315	2085847.377	411236.002	9078.01	-3.87	9074.14	1315
1316	2085852.218	415087.739	9633.34	-0.31	9633.03	1316
1317	2085852.818	416633.935	9436.50	7.81	9444.31	1317
1318	2085861.238	409093.047	8766.51	0.01	8766.52	1318
1319	2085872.908	416969.173	9595.17	-1.05	9594.12	1319
1320	2085877.074	407675.693	8898.85	2.25	8901.10	1320
1321	2085884.224	410839.724	9324.17	-2.22	9321.95	1321
1322	2085893.117	415383.401	9521.48	-0.46	9521.02	1322
1323	2085897.078	408024.533	8898.48	0.34	8898.82	1323
1324	2085898.364	411967.723	8664.78	1.60	8666.38	1324
1325	2085915.538	412306.330	8813.19	-0.40	8812.79	1325
1326	2085918.211	414762.976	9814.44	-0.10	9814.34	1326
1327	2085923.328	409408.426	8819.49	1.09	8820.58	1327
1328	2085940.494	408713.549	8904.98	0.79	8905.77	1328
1329	2085966.660	418324.805	9402.97	-0.44	9402.53	1329
1330	2085975.628	418624.577	9556.89	-12.63	9544.26	1330
1332	2086002.143	409878.211	9165.99	1.27	9167.26	1332
1333	2086027.832	417747.924	9676.15	-0.13	9676.03	1333
1334	2086032.733	407444.845	8933.80	-0.02	8933.78	1334
1335	2086041.053	414869.475	9751.65	-0.24	9751.41	1335
1336	2086046.761	412803.570	9091.91	-0.58	9091.33	1336
1337	2086052.894	416184.018	9284.81	0.23	9285.04	1337
1338	2086085.837	410241.843	9332.10	0.47	9332.57	1338
1339	2086088.885	415843.918	9207.95	1.83	9209.78	1339
1340	2086095.593	413498.497	9490.70	2.04	9492.74	1340
1341	2086098.857	414208.380	9702.07	-0.53	9701.54	1341

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1342	2086099.018	417220.033	9686.97	0.48	9687.45	1342
1343	2086105.800	413676.079	9567.99	5.85	9573.84	1343
1344	2086128.610	411164.224	9177.83	-3.71	9174.12	1344
1345	2086136.141	410551.745	9497.48	2.07	9499.55	1345
1346	2086156.398	415309.722	9512.17	1.50	9513.67	1346
1347	2086160.907	414443.218	9749.20	-0.61	9748.59	1347
1348	2086161.289	418046.164	9515.06	-0.21	9514.85	1348
1349	2086163.233	414648.656	9750.90	0.51	9751.41	1349
1350	2086188.262	413295.760	9387.39	-1.75	9385.64	1350
1351	2086196.405	408280.713	8784.34	3.10	8787.44	1351
1352	2086225.618	418398.784	9343.19	-0.53	9342.66	1352
1353	2086239.631	413030.627	9256.68	2.71	9259.39	1353
1354	2086241.186	416955.572	9564.13	1.51	9565.64	1354
1355	2086250.074	409441.022	8840.67	-5.34	8835.33	1355
1356	2086252.761	408019.583	8804.27	1.50	8805.77	1356
1357	2086269.848	414999.756	9621.88	-0.66	9621.22	1357
1358	2086271.777	408540.610	8754.40	2.89	8757.29	1358
1359	2086291.801	416653.226	9355.81	-5.01	9350.80	1359
1360	2086299.375	418727.723	9453.10	-0.22	9452.88	1360
1361	2086317.581	417738.590	9659.22	0.12	9659.34	1361
1362	2086328.030	417044.618	9600.53	1.66	9602.19	1362
1363	2086328.325	409143.252	8709.79	2.92	8712.71	1363
1364	2086335.333	410595.985	9416.68	-9.28	9407.40	1364
1365	2086343.236	412589.959	8896.76	0.11	8896.87	1365
1366	2086348.562	411771.337	8730.43	3.40	8733.83	1366
1367	2086349.628	414496.877	9715.57	0.41	9715.98	1367
1368	2086350.339	417457.992	9751.06	0.59	9751.65	1368
1369	2086351.580	408850.323	8715.54	5.49	8721.03	1369
1370	2086360.523	407785.671	8915.28	-4.50	8910.78	1370
1371	2086367.216	407274.805	9066.75	-1.97	9064.78	1371
1372	2086370.383	416263.066	9037.06	2.43	9039.49	1372
1373	2086378.844	410266.821	9328.51	-1.53	9326.99	1373
1374	2086382.350	416458.368	9205.57	2.70	9208.27	1374
1375	2086399.029	413710.900	9422.14	0.18	9422.32	1375
1376	2086413.631	411090.210	9162.66	-8.04	9154.62	1376
1377	2086421.258	413008.660	9226.39	-2.57	9223.82	1377
1378	2086441.732	415292.056	9464.91	-1.44	9463.47	1378
1379	2086454.266	407597.640	9033.60	-5.59	9028.00	1379
1380	2086465.783	416856.105	9475.76	-3.43	9472.33	1380
1381	2086471.540	418122.833	9437.84	4.85	9442.69	1381
1383	2086479.295	409910.633	9206.34	1.53	9207.87	1383
1384	2086496.747	414792.288	9603.06	-12.16	9590.90	1384
1385	2086503.385	414082.248	9562.91	-1.21	9561.70	1385
1386	2086520.899	412263.280	8674.20	-0.90	8673.30	1386
1387	2086530.645	418875.103	9403.74	-0.84	9402.90	1387
1388	2086541.350	413368.569	9274.77	-0.82	9273.95	1388
1389	2086554.851	410711.714	9322.43	3.62	9326.05	1389
1390	2086573.944	409143.048	8679.30	3.72	8683.02	1390
1391	2086576.603	416004.785	9031.85	1.41	9033.26	1391
1392	2086587.951	418517.599	9216.61	0.11	9216.72	1392

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1393	2086590.151	411494.115	8864.65	0.45	8865.10	1393
1394	2086594.484	409521.522	8839.07	2.63	8841.70	1394
1395	2086599.624	413551.857	9262.93	5.25	9268.18	1395
1396	2086607.136	414318.419	9674.31	0.13	9674.44	1396
1397	2086650.547	413907.010	9452.25	-1.18	9451.07	1397
1398	2086659.841	412522.355	8793.20	0.79	8793.99	1398
1399	2086662.619	415657.692	9163.87	-0.49	9163.38	1399
1400	2086663.788	410178.504	9174.17	-0.41	9173.76	1400
1401	2086668.039	417572.559	9690.95	0.46	9691.41	1401
1402	2086678.559	417731.027	9652.78	0.13	9652.91	1402
1403	2086685.426	417205.672	9630.92	0.72	9631.64	1403
1404	2086717.787	414988.379	0.00	0.00	9476.07	1404
1405	2086719.849	416248.704	0.00	0.00	9049.01	1405
1407	2086739.593	408527.792	0.00	0.00	8792.19	1407
1408	2086749.315	407579.464	0.00	0.00	9120.99	1408
1409	2086766.705	414571.508	9679.68	0.40	9680.08	1409
1410	2086782.513	407852.835	0.00	0.00	9007.47	1410
1411	2086793.307	408219.955	0.00	0.00	8915.65	1411
1412	2086806.539	415291.258	0.00	0.00	9323.96	1412
1413	2086813.620	412928.901	8906.95	1.17	8908.12	1413
1414	2086814.120	412121.240	8581.76	1.83	8583.59	1414
1415	2086828.379	410783.818	9297.23	-0.82	9296.41	1415
1416	2086846.592	417432.090	9653.40	-0.89	9652.52	1416
1417	2086857.764	418853.024	9272.73	-0.50	9272.23	1417
1418	2086869.446	418016.409	9470.85	1.84	9472.69	1418
1419	2086879.115	409035.470	8660.40	1.24	8661.64	1419
1420	2086882.224	413423.003	9181.86	1.70	9183.56	1420
1421	2086891.514	411236.878	0.00	0.00	9019.82	1421
1422	2086896.053	413733.339	9340.74	3.95	9344.69	1422
1423	2086897.215	416506.228	9173.01	0.22	9173.23	1423
1424	2086905.668	409892.692	8838.56	-1.21	8837.35	1424
1425	2086935.492	409481.380	8706.11	1.66	8707.77	1425
1426	2086959.164	416942.663	9507.74	0.42	9508.16	1426
1427	2086976.137	414088.959	9542.66	0.41	9543.07	1427
1428	2086977.232	415105.449	9435.26	2.09	9437.35	1428
1429	2086985.855	410281.528	8916.55	-3.11	8913.44	1429
1430	2087008.500	418555.015	0.00	0.00	9114.72	1430
1431	2087012.206	410550.628	9156.83	1.20	9158.03	1431
1432	2087018.457	410871.502	9238.87	4.49	9243.36	1432
1433	2087039.975	415835.532	0.00	0.00	8949.33	1433
1434	2087060.465	412619.813	8694.50	1.77	8696.27	1434
1435	2087109.563	413418.661	9220.34	-0.23	9220.11	1435
1436	2087110.310	414694.096	9556.47	-2.18	9554.29	1436
1437	2087112.368	416152.178	8950.32	2.75	8953.07	1437
1438	2087160.828	417677.457	9618.64	-0.13	9618.52	1438
1439	2087170.940	412104.695	8536.86	1.61	8538.47	1439
1440	2087181.697	418624.738	9025.07	18.55	9043.62	1440
1441	2087186.378	419081.910	9235.51	2.22	9237.73	1441
1442	2087188.691	410839.087	9208.50	-1.05	9207.45	1442
1443	2087190.374	409474.372	8593.79	3.78	8597.57	1443

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1444	2087196.488	417195.500	9401.62	4.21	9405.83	1444
1445	2087198.920	415432.261	0.00	0.00	9163.91	1445
1446	2087218.712	413068.956	8974.53	-0.20	8974.33	1446
1447	2087235.551	408153.168	9160.50	-4.94	9155.56	1447
1448	2087238.405	409832.556	8648.78	-1.16	8647.62	1448
1449	2087258.256	411142.682	0.00	0.00	8994.18	1449
1450	2087262.133	418006.967	9446.83	1.69	9448.52	1450
1451	2087279.784	409144.181	0.00	0.00	8655.79	1451
1452	2087280.622	414397.735	9656.36	-0.23	9656.13	1452
1453	2087302.909	407880.794	9253.92	-3.03	9250.89	1453
1454	2087323.178	416869.653	9225.19	1.19	9226.38	1454
1455	2087331.474	410581.760	8911.77	1.61	8913.38	1455
1456	2087335.753	412796.965	8863.44	1.01	8864.45	1456
1457	2087339.561	410185.481	8718.65	3.36	8722.01	1457
1458	2087347.036	416478.286	9037.14	3.01	9040.15	1458
1459	2087386.697	414008.244	9515.93	3.19	9519.12	1459
1460	2087391.601	411947.409	0.00	0.00	8494.55	1460
1461	2087410.177	415784.156	0.00	0.00	8936.53	1461
1462	2087437.826	411407.449	0.00	0.00	8767.75	1462
1463	2087443.087	408472.073	8881.36	-9.44	8871.92	1463
1465	2087458.956	412401.917	8644.10	2.87	8646.97	1465
1467	2087475.164	416196.980	8846.85	1.81	8848.66	1467
1468	2087482.967	410954.357	8999.83	-0.19	8999.64	1468
1469	2087489.645	413639.245	9349.32	0.30	9349.62	1469
1470	2087504.657	408778.199	8723.66	5.04	8728.70	1470
1471	2087530.851	417701.429	9589.46	-0.48	9588.98	1471
1472	2087532.234	409359.589	0.00	0.00	8595.03	1472
1473	2087534.442	414737.682	0.00	0.00	9526.79	1473
1474	2087534.447	409980.753	8566.05	1.95	8568.00	1474
1475	2087543.893	409030.638	0.00	0.00	8707.32	1475
1476	2087544.143	409632.031	8567.36	4.02	8571.38	1476
1478	2087553.765	413156.388	9219.50	-0.18	9219.33	1478
1479	2087564.268	415085.749	9408.05	-1.87	9406.18	1479
1480	2087566.355	418553.679	0.00	0.00	9092.91	1480
1481	2087569.360	414206.583	9634.50	-0.81	9633.69	1481
1482	2087571.901	415329.246	0.00	0.00	9252.89	1482
1483	2087572.908	414346.182	9669.14	0.84	9669.98	1483
1484	2087574.710	410579.301	8773.11	3.41	8776.52	1484
1485	2087581.094	417276.219	9347.04	1.18	9348.22	1485
1486	2087592.729	410306.566	8655.51	2.10	8657.61	1486
1487	2087616.632	416853.317	9049.76	0.36	9050.12	1487
1488	2087617.739	416510.372	8931.42	1.70	8933.12	1488
1489	2087638.873	419010.214	9019.45	-0.20	9019.25	1489
1490	2087667.322	412047.102	8475.29	1.00	8476.29	1490
1491	2087671.669	412644.001	8785.34	0.43	8785.77	1491
1492	2087717.836	415636.696	0.00	0.00	9016.52	1492
1493	2087747.742	411667.227	8536.56	-4.63	8531.94	1493
1494	2087750.506	419238.758	9082.48	-0.13	9082.35	1494
1496	2087768.004	415014.365	9381.26	1.56	9382.82	1496
1497	2087771.545	417416.395	9394.08	0.36	9394.44	1497

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1498	2087795.009	416823.135	9002.92	-0.64	9002.28	1498
1499	2087795.632	418554.775	0.00	0.00	9082.22	1499
1500	2087800.649	415970.703	0.00	0.00	8865.73	1500
1502	2087818.907	411251.973	8669.13	17.33	8686.46	1502
1503	2087822.240	417955.044	9463.86	0.18	9464.04	1503
1504	2087832.070	408664.412	8903.35	-1.74	8901.61	1504
1505	2087841.083	414490.402	9622.72	1.13	9623.85	1505
1506	2087852.499	412326.635	8637.84	-0.96	8636.88	1506
1507	2087853.806	409923.446	0.00	0.00	8500.29	1507
1508	2087855.130	413564.997	9417.28	3.26	9420.54	1508
1509	2087866.637	409644.703	0.00	0.00	8584.83	1509
1510	2087873.631	410913.709	8762.78	0.13	8762.91	1510
1511	2087884.694	412938.439	9031.79	-0.87	9030.92	1511
1512	2087901.227	413179.165	9209.01	-0.81	9208.20	1512
1513	2087912.594	414276.753	9678.87	-0.49	9678.38	1513
1515	2087928.479	410510.873	8583.29	1.67	8584.96	1515
1516	2087932.852	414801.461	9464.65	-3.22	9461.43	1516
1517	2087939.004	413923.144	9610.70	0.00	9610.70	1517
1518	2087946.779	412093.475	8535.93	0.26	8536.19	1518
1519	2087946.990	418759.482	0.00	0.00	8994.47	1519
1520	2087985.922	409074.223	8933.41	-6.06	8927.35	1520
1522	2088012.132	409266.595	0.00	0.00	8809.08	1522
1523	2088045.638	417122.710	9066.24	0.16	9066.40	1523
1524	2088064.228	410336.471	8462.68	-0.15	8462.53	1524
1525	2088079.605	415188.986	0.00	0.00	9368.45	1525
1526	2088101.564	414227.916	9719.22	-0.17	9719.05	1526
1527	2088110.106	419245.851	8956.30	-1.48	8954.82	1527
1528	2088119.238	417668.291	9414.90	1.45	9416.35	1528
1530	2088134.663	413541.723	9420.24	-1.81	9418.43	1530
1531	2088137.077	412603.615	8826.61	-0.67	8825.95	1531
1532	2088138.742	411681.195	8390.33	1.44	8391.77	1532
1533	2088148.054	418831.533	0.00	0.00	8933.25	1533
1534	2088167.536	412017.666	8531.78	-0.85	8530.93	1534
1535	2088173.046	417844.766	9513.77	-0.06	9513.71	1535
1536	2088174.427	409981.049	8486.29	-3.29	8483.00	1536
1537	2088175.658	410694.793	8499.05	2.02	8501.07	1537
1538	2088184.571	413999.882	9649.47	-1.60	9647.87	1538
1539	2088191.587	416200.179	0.00	0.00	8803.33	1539
1540	2088198.982	418558.991	0.00	0.00	9072.17	1540
1542	2088228.630	414939.905	9495.17	-1.27	9493.90	1542
1543	2088230.331	416531.424	8728.76	2.08	8730.84	1543
1544	2088235.429	414522.951	9635.79	1.88	9637.67	1544
1545	2088239.426	415894.522	0.00	0.00	8949.25	1545
1546	2088240.327	416870.028	8883.90	1.44	8885.34	1546
1547	2088259.512	415475.348	9289.39	0.95	9290.34	1547
1548	2088259.659	412326.419	8678.90	-1.59	8677.32	1548
1549	2088273.657	411236.206	8481.16	1.42	8482.58	1549
1551	2088305.253	418058.509	9442.83	3.66	9446.49	1551
1552	2088319.773	412725.537	8884.16	-3.51	8880.65	1552
1556	2088376.439	417412.395	9170.78	1.91	9172.69	1556

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1557	2088376.767	419224.829	8831.20	-2.31	8828.89	1557
1558	2088376.785	415161.378	9452.20	-2.87	9449.33	1558
1559	2088388.805	413412.006	9312.02	-4.12	9307.90	1559
1561	2088426.230	414236.262	9748.11	-0.34	9747.77	1561
1563	2088429.005	417628.015	9364.32	-0.91	9363.41	1563
1564	2088430.497	413046.604	9108.87	-2.02	9106.85	1564
1566	2088439.212	411473.379	8376.04	-0.08	8375.96	1566
1567	2088439.499	418859.932	0.00	0.00	8939.51	1567
1571	2088520.323	412135.186	8700.38	-0.99	8699.39	1571
1572	2088546.862	417099.006	8946.64	2.35	8948.99	1572
1574	2088588.122	415742.701	0.00	0.00	9025.91	1574
1575	2088603.701	416138.282	0.00	0.00	8807.03	1575
1576	2088612.274	416350.568	0.00	0.00	8693.60	1576
1577	2088620.282	416721.525	8739.90	1.50	8741.40	1577
1578	2088659.932	414516.565	9613.89	0.94	9614.83	1578
1579	2088662.752	414266.507	9699.61	2.11	9701.72	1579
1580	2088669.174	417601.335	9211.66	1.55	9213.21	1580
1581	2088680.060	415170.926	0.00	0.00	9393.80	1581
1582	2088700.555	417889.665	9402.66	0.03	9402.69	1582
1583	2088712.963	413999.391	9623.21	0.10	9623.31	1583
1584	2088716.869	414899.859	0.00	0.00	9471.71	1584
1585	2088722.561	419103.545	0.00	0.00	8856.66	1585
1586	2088727.307	413716.660	9517.37	-2.01	9515.36	1586
1587	2088727.433	412808.787	9191.72	1.17	9192.89	1587
1588	2088739.601	413445.462	9396.89	-2.16	9394.73	1588
1589	2088748.034	417402.152	9037.19	14.47	9051.66	1589
1590	2088749.462	412392.181	8895.79	-1.95	8893.84	1590
1591	2088761.770	418088.678	9430.22	-1.47	9428.75	1591
1592	2088764.425	413106.692	9303.18	0.10	9303.28	1592
1593	2088775.638	411154.602	8314.51	1.58	8316.09	1593
1594	2088833.931	410771.325	0.00	0.00	8424.73	1594
1595	2088836.637	416487.265	8579.27	7.96	8587.23	1595
1597	2088853.274	412110.961	8664.52	-0.77	8663.75	1597
1599	2088855.373	411489.007	8332.95	-2.22	8330.73	1599
1601	2088907.354	412487.953	8895.75	-0.78	8894.97	1601
1602	2088918.266	419263.210	0.00	0.00	8816.82	1602
1603	2088955.942	415196.139	0.00	0.00	9240.03	1603
1604	2088956.850	413137.148	9281.32	-0.55	9280.77	1604
1605	2088972.235	416369.287	0.00	0.00	8654.24	1605
1606	2088978.406	415497.136	0.00	0.00	9083.55	1606
1607	2088980.182	412919.449	9154.84	-0.91	9153.93	1607
1608	2088985.256	417332.499	8941.73	-0.03	8941.70	1608
1609	2088990.978	417859.382	9202.33	1.11	9203.44	1609
1610	2088994.210	416695.632	8647.11	2.91	8650.02	1610
1611	2088995.713	414892.649	0.00	0.00	9369.51	1611
1612	2088998.677	415796.965	8907.56	-10.34	8897.22	1612
1613	2088998.707	416091.620	0.00	0.00	8775.73	1613
1614	2089000.225	414590.398	9507.33	5.12	9512.45	1614
1615	2089004.198	414312.787	9614.19	0.14	9614.33	1615
1617	2089010.515	414052.547	9582.41	1.35	9583.76	1617

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1618	2089013.483	419371.904	0.00	0.00	8790.70	1618
1619	2089024.504	413456.562	9378.24	-0.48	9377.76	1619
1620	2089034.898	416999.055	8758.47	3.53	8762.00	1620
1621	2089043.304	418237.369	9434.59	0.42	9435.01	1621
1622	2089052.619	410689.557	0.00	0.00	8530.08	1622
1623	2089059.619	413756.709	9426.62	-1.52	9425.10	1623
1624	2089103.758	411539.667	8312.82	-2.02	8310.80	1624
1626	2089219.869	418973.487	0.00	0.00	9018.74	1626
1628	2089277.473	413989.493	9459.82	-2.17	9457.65	1628
1629	2089294.561	416369.807	0.00	0.00	8664.21	1629
1630	2089296.528	412943.995	9178.99	-1.75	9177.24	1630
1631	2089298.700	415254.106	0.00	9271.79	9271.79	1631
1632	2089299.515	412246.533	8631.13	-0.15	8630.98	1632
1633	2089301.253	413723.408	9343.40	-2.88	9340.52	1633
1634	2089302.401	413449.529	9227.28	-0.52	9226.76	1634
1635	2089304.934	413117.119	9179.07	-0.64	9178.43	1635
1636	2089305.560	414264.568	9585.97	0.50	9586.47	1636
1637	2089308.183	418229.730	9277.93	-0.34	9277.59	1637
1638	2089308.230	411933.444	8473.11	-3.48	8469.63	1638
1639	2089309.113	414544.194	9578.19	-1.79	9576.40	1639
1640	2089319.693	417516.444	8900.39	2.46	8902.85	1640
1641	2089326.455	414932.218	9411.51	-3.71	9407.80	1641
1642	2089327.813	416526.367	0.00	0.00	8599.31	1642
1643	2089339.415	412447.842	8766.24	-2.11	8764.13	1643
1644	2089346.577	414416.514	9607.62	1.03	9608.65	1644
1645	2089367.738	416855.299	8595.70	3.41	8599.11	1645
1646	2089379.271	417232.294	8733.22	2.21	8735.43	1646
1647	2089387.082	418426.036	9385.62	-0.01	9385.61	1647
1648	2089387.834	417804.111	8997.75	-4.53	8993.22	1648
1649	2089403.223	419192.477	0.00	0.00	8959.17	1649
1650	2089406.719	416021.787	0.00	0.00	8849.81	1650
1651	2089431.061	415652.290	9072.08	1.69	9073.77	1651
1652	2089436.271	411334.855	8306.69	4.63	8311.32	1652
1653	2089484.349	411060.777	0.00	0.00	8418.99	1653
1654	2089495.381	410643.491	0.00	0.00	8646.40	1654
1655	2089528.940	415012.308	9421.04	0.43	9421.47	1655
1656	2089553.297	412806.380	8883.83	-0.34	8883.49	1656
1657	2089571.815	410314.933	0.00	0.00	8859.74	1657
1658	2089572.350	417578.741	8825.03	1.83	8826.86	1658
1659	2089574.804	412108.412	8527.24	1.42	8528.66	1659
1660	2089576.654	418467.734	9333.07	-2.58	9330.49	1660
1661	2089583.559	417881.264	8962.19	-3.40	8958.79	1661
1662	2089592.312	414011.137	9447.16	-0.21	9446.95	1662
1663	2089595.198	411675.161	8307.18	0.72	8307.90	1663
1664	2089596.395	413412.705	9153.16	-0.95	9152.21	1664
1665	2089597.648	416986.888	8559.16	4.96	8564.12	1665
1666	2089598.344	414683.048	9581.80	-1.11	9580.69	1666
1667	2089600.573	413093.472	8938.40	1.44	8939.84	1667
1668	2089600.577	416089.091	0.00	0.00	8786.69	1668
1669	2089603.375	418245.340	9159.33	-0.80	9158.53	1669

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1670	2089603.824	412506.335	8724.39	0.46	8724.85	1670
1671	2089607.254	417190.321	8634.16	1.46	8635.62	1671
1672	2089609.095	413703.210	9296.99	-1.04	9295.95	1672
1673	2089610.122	414491.419	9619.02	0.99	9620.01	1673
1674	2089613.841	415806.467	0.00	0.00	8949.51	1674
1675	2089615.888	418570.328	9387.99	0.22	9388.21	1675
1676	2089617.164	416628.178	0.00	0.00	8568.94	1676
1677	2089617.362	415352.940	9235.58	-1.30	9234.28	1677
1678	2089624.560	416388.679	0.00	0.00	8654.05	1678
1679	2089630.817	414250.750	9567.50	1.21	9568.71	1679
1681	2089720.168	419221.215	0.00	0.00	9030.94	1681
1682	2089751.237	410955.796	0.00	0.00	8484.73	1682
1683	2089771.494	410617.720	0.00	0.00	8670.85	1683
1684	2089786.737	413781.544	9293.61	-1.95	9291.66	1684
1685	2089831.304	410426.959	0.00	0.00	8782.91	1685
1686	2089835.616	412012.319	8407.91	2.95	8410.86	1686
1687	2089851.473	418450.855	9143.90	-0.34	9143.56	1687
1688	2089851.930	417283.698	8620.12	1.92	8622.04	1688
1689	2089873.730	417573.935	8716.98	4.33	8721.31	1689
1690	2089882.314	411605.237	8218.54	1.88	8220.42	1690
1691	2089887.868	412900.811	8734.80	-1.33	8733.47	1691
1692	2089889.902	414004.447	9403.55	-2.29	9401.26	1692
1693	2089893.457	415499.671	0.00	0.00	9151.62	1693
1694	2089897.602	416423.349	0.00	0.00	8676.96	1694
1695	2089899.131	417909.697	8866.76	1.59	8868.35	1695
1696	2089903.384	418210.356	8982.90	-2.87	8980.03	1696
1697	2089907.523	416985.704	8476.83	3.11	8479.94	1697
1698	2089908.228	415075.939	9363.13	5.19	9368.32	1698
1699	2089914.275	412485.531	8557.52	-0.86	8556.66	1699
1700	2089918.034	414699.463	9574.12	0.40	9574.52	1700
1701	2089922.413	414521.686	9608.92	0.89	9609.81	1701
1702	2089927.811	413109.713	8853.41	1.09	8854.50	1702
1703	2089928.832	414304.255	9563.48	0.47	9563.95	1703
1704	2089930.623	415799.972	0.00	0.00	9009.20	1704
1705	2089933.532	416088.808	8867.34	1.69	8869.03	1705
1706	2089934.442	418784.879	9347.83	-0.09	9347.74	1706
1707	2089939.551	416698.987	8543.55	1.49	8545.04	1707
1708	2089951.281	412226.814	8449.23	1.18	8450.41	1708
1709	2089981.822	413510.982	9148.18	-0.26	9147.92	1709
1710	2090073.489	410345.998	8745.83	8.63	8754.46	1710
1711	2090079.115	419085.006	0.00	0.00	9201.63	1711
1712	2090106.106	418775.661	9194.66	-2.40	9192.26	1712
1713	2090112.032	410603.144	8620.77	0.47	8621.24	1713
1715	2090139.423	413165.151	8926.35	-1.50	8924.85	1715
1716	2090171.408	412895.676	8789.41	-0.57	8788.84	1716
1717	2090171.780	410883.750	8470.53	-0.64	8469.89	1717
1718	2090172.586	415391.971	9335.17	-0.39	9334.78	1718
1719	2090184.306	417890.864	8728.16	2.98	8731.14	1719
1720	2090187.703	413471.937	9160.19	-1.54	9158.65	1720
1721	2090188.382	416679.042	8543.78	17.43	8561.21	1721

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1722	2090188.543	417212.550	8482.24	0.67	8482.91	1722
1724	2090193.064	418259.300	8888.40	-0.26	8888.14	1724
1725	2090194.652	415791.333	9067.62	1.66	9069.28	1725
1726	2090198.599	419042.473	9282.67	1.75	9284.42	1726
1727	2090199.026	417592.347	8610.55	-1.38	8609.17	1727
1728	2090199.231	416392.112	8701.51	3.11	8704.62	1728
1729	2090199.436	416092.276	8864.92	-0.58	8864.34	1729
1730	2090201.884	414287.936	9556.23	-0.73	9555.50	1730
1731	2090202.037	418516.906	8989.21	1.11	8990.32	1731
1732	2090205.607	413695.624	9224.90	-0.72	9224.18	1732
1733	2090212.331	414548.476	9640.13	0.65	9640.78	1733
1734	2090212.753	414713.883	9583.69	-0.19	9583.50	1734
1735	2090220.047	416968.086	8417.35	8.71	8426.06	1735
1736	2090229.449	411917.976	8321.28	2.74	8324.02	1736
1737	2090268.628	415156.221	9420.95	0.32	9421.27	1737
1738	2090280.133	411583.081	8183.85	3.92	8187.77	1738
1739	2090344.977	412325.219	8540.80	0.89	8541.69	1739
1740	2090428.213	417305.494	8416.77	-0.02	8416.75	1740
1741	2090449.005	417922.623	8644.18	1.87	8646.05	1741
1742	2090467.746	418522.725	8887.46	1.87	8889.33	1742
1743	2090472.001	412857.642	8840.73	0.27	8841.00	1743
1744	2090472.286	410376.083	0.00	0.00	8672.91	1744
1745	2090473.345	413175.637	9154.36	0.30	9154.66	1745
1747	2090490.023	414348.257	9595.90	0.93	9596.83	1747
1748	2090493.195	416387.584	0.00	0.00	8719.08	1748
1749	2090498.523	415192.398	0.00	0.00	9387.60	1749
1750	2090499.393	413412.502	9234.68	-0.40	9234.28	1750
1751	2090500.741	416081.338	8858.84	0.28	8859.12	1751
1752	2090504.741	418789.377	8992.92	3.21	8996.13	1752
1753	2090506.489	415784.643	8997.88	-0.30	8997.58	1753
1754	2090506.884	416978.630	0.00	0.00	8474.59	1754
1755	2090508.656	414894.134	9554.71	-0.43	9554.28	1755
1756	2090508.705	413675.236	9329.50	-0.34	9329.16	1756
1757	2090509.701	411131.666	0.00	0.00	8297.25	1757
1758	2090513.302	419110.893	9184.73	-1.07	9183.67	1758
1759	2090514.320	418195.904	8718.37	2.42	8720.79	1759
1760	2090514.439	417556.887	8494.85	-0.59	8494.26	1760
1761	2090523.519	414543.419	9734.63	0.43	9735.06	1761
1762	2090534.088	415514.145	9205.17	6.67	9211.84	1762
1763	2090545.494	411867.549	8316.03	1.22	8317.25	1763
1764	2090552.499	412551.201	8658.48	1.14	8659.62	1764
1765	2090561.219	414044.673	9510.30	0.04	9510.34	1765
1766	2090577.125	416713.146	0.00	0.00	8604.62	1766
1767	2090584.528	411538.046	8194.22	3.55	8197.77	1767
1768	2090623.530	410702.921	0.00	0.00	8500.98	1768
1769	2090697.645	414253.823	9579.09	-0.38	9578.71	1769
1770	2090730.460	412096.669	8391.06	2.77	8393.83	1770
1772	2090745.939	416942.164	0.00	0.00	8519.99	1772
1773	2090771.387	416358.803	8850.30	-0.36	8849.95	1773
1774	2090771.554	412810.353	8754.90	-1.39	8753.51	1774

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1775	2090773.019	413994.264	9465.40	0.44	9465.84	1775
1776	2090784.244	414584.236	9707.53	-0.17	9707.36	1776
1777	2090793.002	417621.507	8409.48	5.36	8414.84	1777
1778	2090796.576	410186.758	0.00	0.00	8795.49	1778
1779	2090800.297	414789.689	9578.33	2.53	9580.86	1779
1780	2090800.688	418817.468	8876.37	5.04	8881.41	1780
1781	2090801.031	416692.015	0.00	0.00	8654.31	1781
1782	2090802.952	419135.049	9026.82	-2.26	9024.56	1782
1783	2090806.459	413361.232	9152.50	1.43	9153.93	1783
1784	2090806.607	417884.924	8485.95	1.05	8487.00	1784
1785	2090814.385	415200.564	9386.92	-2.16	9384.76	1785
1786	2090816.734	413667.301	9274.40	0.62	9275.02	1786
1787	2090817.683	418201.656	8596.32	-3.11	8593.21	1787
1788	2090818.794	413111.791	8918.47	-1.77	8916.70	1788
1789	2090820.330	418473.344	8708.84	2.05	8710.89	1789
1790	2090821.699	415728.398	9244.79	-5.16	9239.63	1790
1791	2090841.554	415475.986	9325.74	-1.73	9324.01	1791
1792	2090850.678	412469.928	8570.55	-5.76	8564.79	1792
1793	2090854.067	411086.020	8271.47	5.33	8276.80	1793
1794	2090896.430	417256.892	0.00	0.00	8386.41	1794
1795	2090904.035	416077.729	9055.80	6.09	9061.89	1795
1796	2090919.760	411864.674	8324.88	1.21	8326.09	1796
1797	2090952.017	411503.805	8154.72	1.31	8156.03	1797
1799	2091014.445	410549.547	8502.02	7.27	8509.29	1799
1800	2091020.248	418740.553	8730.53	0.68	8731.21	1800
1801	2091031.606	418188.821	8513.28	-1.61	8511.67	1801
1802	2091032.962	415763.586	9291.61	-10.29	9281.32	1802
1803	2091054.547	417299.861	8400.40	0.90	8401.30	1803
1804	2091064.498	413024.172	8923.45	-3.09	8920.36	1804
1805	2091077.217	415413.230	9414.73	-2.82	9411.91	1805
1806	2091087.171	414373.255	9639.24	-0.94	9638.30	1806
1807	2091087.988	416411.208	0.00	0.00	8826.44	1807
1808	2091090.607	419116.685	8882.99	0.71	8883.70	1808
1809	2091099.416	417892.457	8394.90	1.06	8395.96	1809
1810	2091099.993	416683.070	0.00	0.00	8669.29	1810
1811	2091100.416	417602.207	8255.81	3.45	8259.26	1811
1812	2091104.149	414897.265	9600.29	-3.37	9596.92	1812
1813	2091121.720	417027.999	8493.96	0.94	8494.90	1813
1814	2091128.137	409978.767	8772.55	-1.80	8770.75	1814
1815	2091134.158	418479.469	8588.68	-2.30	8586.38	1815
1816	2091134.573	413748.534	9297.84	-2.58	9295.26	1816
1817	2091137.559	413290.985	9099.17	-1.25	9097.93	1817
1818	2091143.437	416110.953	0.00	0.00	9028.61	1818
1819	2091160.022	413981.240	9437.72	-1.99	9435.73	1819
1820	2091183.955	412432.574	8682.94	-1.19	8681.75	1820
1821	2091185.019	415143.467	9567.19	-1.24	9565.95	1821
1822	2091201.334	414618.739	9768.66	-1.69	9766.97	1822
1823	2091267.541	411624.788	8211.87	2.51	8214.38	1823
1824	2091289.507	410293.151	8549.07	3.06	8552.13	1824
1825	2091333.641	413040.386	9139.06	-0.94	9138.12	1825

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1826	2091338.548	418811.829	8645.16	0.97	8646.13	1826
1827	2091341.598	410590.705	8379.23	4.58	8383.81	1827
1828	2091349.792	418492.846	8515.82	0.02	8515.84	1828
1829	2091353.447	411915.288	8362.55	-2.31	8360.24	1829
1830	2091357.140	419097.199	8763.85	0.34	8764.19	1830
1831	2091362.766	413223.613	9216.49	-2.01	9214.48	1831
1832	2091367.963	413428.212	9272.80	-1.72	9271.08	1832
1833	2091369.463	411233.192	8083.88	1.29	8085.17	1833
1834	2091379.986	415566.413	0.00	0.00	9324.94	1834
1835	2091381.711	416082.517	0.00	0.00	9057.24	1835
1836	2091389.098	418147.616	8374.37	2.44	8376.81	1836
1837	2091398.552	417897.562	8306.39	0.88	8307.27	1837
1838	2091408.418	416396.489	0.00	0.00	8855.43	1838
1839	2091416.878	416657.011	0.00	0.00	8739.90	1839
1840	2091422.202	409865.402	8675.51	-6.17	8669.34	1840
1841	2091427.910	417258.294	8501.74	-0.92	8800.82	1841
1842	2091446.109	415778.756	0.00	0.00	9284.81	1842
1843	2091483.389	417631.580	0.00	0.00	8296.15	1843
1844	2091486.220	417032.072	8607.55	2.55	8610.10	1844
1845	2091542.562	412212.780	8506.69	-1.97	8504.72	1845
1846	2091543.871	414924.686	9639.37	-2.19	9637.18	1846
1847	2091545.416	414704.487	9694.87	-0.11	9694.76	1847
1848	2091565.419	412534.900	8690.68	-2.07	8688.61	1848
1849	2091566.992	413423.295	9242.73	-2.69	9240.04	1849
1850	2091570.565	415557.123	0.00	0.00	9369.21	1850
1851	2091585.018	414492.302	9723.36	-1.65	9721.71	1851
1852	2091592.464	416154.370	0.00	0.00	9063.60	1852
1853	2091599.645	414091.091	9545.77	-0.80	9544.97	1853
1854	2091614.916	415259.168	0.00	0.00	9498.62	1854
1855	2091668.147	413847.484	9416.36	0.52	9416.88	1855
1856	2091670.419	413189.029	9095.44	-3.71	9091.73	1856
1857	2091687.240	412280.404	8555.92	-3.74	8552.18	1857
1858	2091687.754	418479.997	8383.54	-0.69	8382.85	1858
1859	2091695.055	417874.375	0.00	0.00	8199.13	1859
1860	2091695.714	418766.271	8513.81	1.50	8515.31	1860
1861	2091696.810	415821.537	0.00	0.00	9297.46	1861
1862	2091698.947	418194.120	8250.13	1.46	8251.59	1862
1863	2091700.136	417591.707	0.00	0.00	8371.87	1863
1864	2091700.287	417293.957	0.00	0.00	8529.94	1864
1865	2091716.848	410245.201	8405.51	-2.28	8403.23	1865
1866	2091740.605	411410.277	8213.12	2.18	8215.30	1866
1867	2091764.929	411755.643	8394.97	-2.23	8392.74	1867
1868	2091780.722	409969.446	8494.64	3.51	8498.15	1868
1869	2091796.875	411077.903	8076.49	2.80	8079.29	1869
1870	2091799.254	411975.840	8479.69	-3.17	8476.52	1870
1871	2091821.232	410676.845	8199.24	-0.24	8199.00	1871
1872	2091852.003	415249.143	9501.81	2.06	9503.87	1872
1873	2091857.999	413522.937	9221.07	-1.65	9219.42	1873
1874	2091858.858	416763.636	0.00	0.00	8821.39	1874
1875	2091862.400	417048.765	0.00	0.00	8665.51	1875

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1876	2091868.203	418843.725	8480.18	-0.98	8479.21	1876
1877	2091872.375	419092.807	8563.10	-0.65	8562.45	1877
1878	2091874.490	414963.523	9556.73	-0.79	9555.94	1878
1879	2091878.500	415812.579	9355.70	1.05	9356.75	1879
1881	2091885.498	412896.043	8913.85	-3.83	8910.02	1881
1882	2091889.133	415556.622	9400.42	-5.79	9394.63	1882
1883	2091897.431	417659.706	0.00	0.00	8374.26	1883
1884	2091897.486	416136.206	9269.21	0.35	9269.56	1884
1885	2091898.086	414681.578	9580.56	-1.23	9579.33	1885
1886	2091918.240	418379.225	8253.93	0.98	8254.91	1886
1887	2091919.894	413281.945	9117.36	0.33	9117.69	1887
1888	2091920.842	414100.638	9535.62	-2.25	9533.37	1888
1889	2091924.586	418601.660	8365.78	-0.55	8365.23	1889
1890	2091930.557	416508.274	9031.87	-2.93	9028.94	1890
1891	2091940.919	414406.193	9647.38	-0.52	9646.86	1891
1892	2091945.522	413841.779	9400.35	-1.39	9398.96	1892
1893	2091986.513	417900.300	0.00	0.00	8289.98	1893
1894	2092023.454	412562.598	8815.12	-0.24	8814.88	1894
1895	2092096.726	411598.650	8366.22	-0.03	8366.19	1895
1896	2092134.566	418287.790	8148.43	0.34	8148.77	1896
1897	2092151.254	414300.354	9623.18	-1.42	9621.76	1897
1898	2092152.827	416732.554	0.00	0.00	8901.95	1898
1899	2092153.060	410325.020	8253.34	-1.72	8251.62	1899
1900	2092154.147	414661.828	9544.92	-3.68	9541.25	1900
1901	2092161.489	416132.595	9301.54	-0.60	9300.94	1901
1902	2092165.792	419144.920	8516.85	0.65	8517.50	1902
1903	2092167.032	418846.667	8378.13	-0.02	8378.11	1903
1904	2092169.188	411923.535	8600.02	-2.45	8597.57	1904
1905	2092170.483	415853.677	0.00	0.00	9365.24	1905
1906	2092171.916	411242.650	8239.28	1.71	8240.99	1906
1907	2092173.902	415533.904	9354.14	3.86	9358.00	1907
1908	2092180.992	417341.561	0.00	0.00	8565.57	1908
1909	2092189.128	409962.283	8424.61	0.14	8424.75	1909
1910	2092193.149	415236.636	0.00	0.00	9390.96	1910
1911	2092193.522	412996.335	9126.70	-0.71	9125.99	1911
1912	2092194.578	413583.919	9337.37	-1.46	9335.91	1912
1913	2092197.628	416373.804	9194.30	-0.41	9193.89	1913
1914	2092197.647	413794.809	9435.08	-2.32	9432.76	1914
1915	2092211.801	414931.782	0.00	0.00	9458.03	1915
1916	2092212.296	416996.293	0.00	0.00	8752.84	1916
1917	2092212.899	413378.886	9261.59	-2.31	9259.28	1917
1918	2092219.420	418550.607	8252.49	0.20	8252.69	1918
1919	2092227.215	412237.325	8776.18	-1.47	8774.71	1919
1920	2092229.309	414069.143	9553.19	-3.22	9549.98	1920
1921	2092280.802	417930.745	0.00	0.00	8286.20	1921
1923	2092314.468	410848.433	8031.06	1.75	8032.81	1923
1924	2092324.764	417659.667	8431.16	-3.55	8427.61	1924
1925	2092407.267	417029.630	0.00	0.00	8790.53	1925
1926	2092416.179	419147.424	8506.57	-0.39	8506.18	1926
1927	2092439.825	418527.105	8195.21	0.31	8195.52	1927

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1928	2092448.361	414655.667	9474.84	-1.46	9473.38	1928
1929	2092449.926	411623.930	8517.13	-2.03	8515.10	1929
1930	2092450.981	415845.645	0.00	0.00	9286.77	1930
1931	2092456.619	413786.146	9508.58	-2.35	9506.23	1931
1932	2092458.837	412005.488	8692.92	-2.40	8690.52	1932
1933	2092463.034	418848.468	8317.89	-0.27	8317.62	1933
1934	2092466.239	417651.519	0.00	0.00	8432.59	1934
1935	2092466.265	417936.866	0.00	0.00	8287.72	1935
1936	2092467.234	418295.537	8079.84	-1.35	8078.49	1936
1937	2092468.819	413442.375	9374.19	0.00	9374.19	1937
1938	2092470.103	417346.348	0.00	0.00	8608.64	1938
1939	2092471.694	414356.063	9553.15	-0.05	9553.10	1939
1940	2092473.299	416129.922	0.00	0.00	9312.40	1940
1941	2092474.010	414975.820	0.00	0.00	9356.43	1941
1942	2092474.864	416728.358	0.00	0.00	8976.54	1942
1943	2092474.942	416457.501	9204.45	-1.30	9203.15	1943
1944	2092475.505	413191.305	9312.04	-1.63	9310.41	1944
1945	2092476.563	415529.753	0.00	0.00	9244.28	1945
1946	2092482.793	415247.356	0.00	0.00	9300.28	1946
1947	2092499.312	414107.259	9600.52	-1.62	9598.90	1947
1948	2092520.678	409938.962	8231.81	0.87	8232.68	1948
1949	2092563.564	412856.224	9254.82	0.05	9254.87	1949
1950	2092592.396	411211.919	8280.80	0.95	8281.75	1950
1951	2092665.118	410314.767	8071.73	-1.93	8069.80	1951
1952	2092699.266	410875.245	8132.75	-0.53	8132.22	1952
1953	2092721.781	417649.030	8456.57	0.44	8457.01	1953
1954	2092757.514	413146.422	9389.09	-0.34	9388.75	1954
1955	2092768.683	418554.264	8121.97	-0.44	8121.53	1955
1956	2092769.100	412328.215	9003.53	-1.23	9002.31	1956
1957	2092770.199	414330.502	9508.77	-1.72	9507.05	1957
1958	2092770.780	414053.567	9562.00	-2.04	9559.96	1958
1959	2092771.964	419159.456	8471.46	0.11	8471.57	1959
1960	2092772.067	415260.372	0.00	0.00	9184.47	1960
1961	2092772.758	415521.545	9149.86	-3.82	9146.04	1961
1962	2092774.736	414942.953	0.00	0.00	9282.64	1962
1963	2092776.811	414649.642	9383.84	-0.66	9383.18	1963
1964	2092777.189	416452.100	0.00	0.00	9222.52	1964
1965	2092779.365	416746.038	0.00	0.00	9009.65	1965
1966	2092782.520	418868.190	8293.01	-2.17	8290.84	1966
1967	2092782.799	413522.795	9516.03	2.32	9518.35	1967
1968	2092784.285	413869.573	9605.96	-0.74	9605.22	1968
1969	2092789.244	417359.489	0.00	0.00	8622.31	1969
1970	2092791.234	416255.319	9301.88	1.63	9303.51	1970
1971	2092792.475	417062.767	0.00	0.00	8800.49	1971
1972	2092800.238	412922.755	9307.81	-1.22	9306.59	1972
1973	2092801.060	418245.708	0.00	0.00	8147.04	1973
1974	2092821.927	415875.416	9185.66	4.92	9190.58	1974
1975	2092830.909	417964.133	0.00	0.00	8286.33	1975
1976	2092873.457	412024.783	8836.82	-1.34	8835.48	1976
1977	2092896.635	411642.244	8611.11	0.06	8611.17	1977

NOTE: All (0) zero elevations and study year are in obscure areas.

POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
1978	2092914.291	409944.009	8091.99	-0.32	8091.67	1978
1979	2092969.815	410837.480	8145.63	-0.20	8145.43	1979
1980	2092985.754	411235.727	8400.91	-1.45	8399.46	1980
1981	2093033.677	419153.893	8378.53	3.06	8381.59	1981
1982	2093051.079	417058.981	0.00	0.00	8840.17	1982
1983	2093067.449	413422.853	9493.13	0.12	9493.25	1983
1984	2093071.359	416174.494	9195.69	2.00	9197.69	1984
1985	2093071.823	417947.222	0.00	0.00	8318.85	1985
1986	2093072.381	416442.731	9288.38	1.10	9289.48	1986
1987	2093074.701	414953.805	9221.70	-2.71	9218.99	1987
1988	2093078.622	415170.292	9129.94	-2.53	9127.41	1988
1989	2093079.510	417355.600	0.00	0.00	8660.47	1989
1990	2093079.919	414322.268	9418.23	-4.61	9413.62	1990
1991	2093080.945	413212.808	9392.05	0.98	9393.03	1991
1992	2093081.059	414638.754	9335.57	-6.61	9328.96	1992
1993	2093081.590	417653.217	0.00	0.00	8485.68	1993
1994	2093081.702	412951.569	9283.31	0.02	9283.33	1994
1995	2093083.266	418165.592	0.00	0.00	8196.94	1995
1996	2093083.964	415844.224	9028.77	-1.72	9027.05	1996
1997	2093085.303	413729.209	9510.55	-0.67	9509.88	1997
1998	2093092.682	416741.030	0.00	0.00	9062.48	1998
1999	2093101.117	418840.160	8204.30	3.10	8207.40	1999
2000	2093103.138	418599.051	8067.89	2.61	8070.50	2000
2001	2093104.420	414079.475	9420.81	-12.92	9407.89	2001
2002	2093106.272	415467.819	0.00	0.00	8929.49	2002
2003	2093180.365	410337.189	8034.12	1.08	8035.20	2003
2004	2093280.339	409975.159	8148.73	8.10	8156.83	2004
2005	2093308.542	412067.340	8760.43	-0.49	8759.94	2005
2006	2093309.537	413561.482	9474.65	2.09	9476.74	2006
2007	2093323.856	415858.602	8893.53	2.16	8895.69	2007
2008	2093343.992	412385.467	8875.89	-3.01	8872.88	2008
2009	2093355.807	418845.288	8103.88	0.36	8104.24	2009
2010	2093357.532	416158.626	8990.63	1.96	8992.59	2010
2011	2093358.667	419142.031	8217.80	0.94	8218.74	2011
2012	2093363.569	416561.821	9245.55	-16.30	9229.25	2012
2013	2093364.913	414424.197	9322.50	-1.45	9321.05	2013
2014	2093370.246	417353.478	0.00	0.00	8686.88	2014
2015	2093370.365	416753.847	0.00	0.00	9080.33	2015
2016	2093370.673	418254.163	0.00	0.00	8195.95	2016
2017	2093370.980	417053.525	0.00	0.00	8861.40	2017
2018	2093371.073	417654.298	0.00	0.00	8509.03	2018
2019	2093372.973	411835.657	8641.39	0.75	8642.14	2019
2020	2093377.934	412891.744	9224.03	0.00	9224.03	2020
2021	2093378.110	414031.656	0.00	0.00	9297.99	2021
2022	2093386.094	417913.573	0.00	0.00	8378.70	2022
2023	2093389.707	415512.101	8793.46	-1.48	8791.98	2023
2024	2093390.717	413798.945	9341.85	12.28	9354.13	2024
2025	2093392.234	418617.603	7968.08	6.19	7974.27	2025
2026	2093409.757	410811.845	8134.30	-1.19	8133.11	2026
2027	2093418.940	415235.672	8900.19	2.48	8902.67	2027

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POINT	EASTING	NORTHING	2003/2007 ELEVATION	2009 DIFFERENCE	2009 ELEVATION	POINT
2028	2093442.274	411235.617	8355.50	-0.64	8354.86	2028
2029	2093452.755	411560.260	8517.51	-1.04	8516.47	2029
2030	2093461.917	414545.759	9297.14	-0.60	9296.54	2030
2031	2093477.252	414881.404	9139.18	-2.61	9136.57	2031
2032	2093564.743	413520.442	9388.76	1.93	9390.69	2032
2033	2093571.862	410660.243	7977.85	0.31	7978.16	2033
2034	2093591.675	410346.587	7964.34	-5.50	7958.84	2034
2035	2093595.694	410945.632	8165.47	-1.69	8163.78	2035
2036	2093601.227	412095.560	8633.30	-1.57	8631.73	2036
2037	2093613.618	413146.542	9231.08	-1.91	9229.17	2037
2038	2093630.592	416421.293	9002.86	3.30	9006.16	2038
2039	2093638.196	412846.844	9106.87	1.10	9107.97	2039
2040	2093648.007	417926.736	0.00	0.00	8348.91	2040
2041	2093649.963	418667.168	7948.63	3.28	7951.91	2041
2042	2093652.371	417645.907	0.00	0.00	8509.57	2042
2043	2093664.584	413504.188	9353.17	0.79	9353.96	2043
2044	2093665.347	418857.112	8067.33	1.87	8069.20	2044
2045	2093667.681	412523.744	8865.93	1.22	8867.15	2045
2046	2093669.057	418233.245	8213.58	1.35	8214.93	2046
2047	2093670.467	417353.186	0.00	0.00	8680.24	2047
2048	2093670.800	413717.087	9294.43	-2.04	9292.39	2048
2049	2093671.211	411765.652	8490.99	-0.88	8490.11	2049
2050	2093671.577	414054.141	0.00	0.00	9149.55	2050
2051	2093671.587	415241.263	8802.95	-5.50	8797.45	2051
2052	2093672.638	416612.828	9193.39	0.55	9193.94	2052
2053	2093677.843	415521.267	8682.52	4.70	8687.22	2053
2054	2093681.851	414921.600	8971.56	-5.05	8966.51	2054
2055	2093683.488	415909.172	8740.67	0.91	8741.58	2055
2056	2093688.168	419126.054	8156.18	3.87	8160.05	2056
2057	2093695.008	411496.007	8377.55	-1.65	8375.90	2057
2058	2093704.218	416152.733	8823.94	2.30	8826.24	2058
2059	2093754.915	414406.770	9111.90	0.29	9112.19	2059
2060	2093772.279	414622.368	9140.07	-0.27	9139.80	2060
2061	2093773.464	410489.157	7906.29	-1.88	7904.41	2061
2062	2093779.021	417137.431	0.00	0.00	8807.19	2062
2064	2093827.953	410840.081	8138.01	-2.59	8135.42	2064
2065	2093830.170	411226.468	8242.90	-1.07	8241.83	2065
2066	2093917.827	414715.361	8974.93	-0.84	8974.10	2066
2067	2093947.967	411534.948	8265.89	-2.73	8263.16	2067
2068	2093948.027	412929.324	9105.18	-0.87	9104.31	2068
2069	2093961.689	413253.878	9258.68	-4.74	9253.94	2069
2070	2093962.747	415262.484	8680.88	-1.40	8679.48	2070
2071	2093965.021	412161.109	8615.72	-3.35	8612.38	2071
2072	2093971.255	413429.424	9280.32	2.19	9282.51	2072
2073	2093972.939	414949.529	8822.77	0.13	8822.90	2073
2074	2093973.664	414000.731	0.00	0.00	9065.87	2074
2075	2093976.897	413751.430	9157.22	-9.64	9147.59	2075
2076	2093994.769	411139.435	8133.41	-2.13	8131.28	2076
2077	2094004.049	412550.060	8851.54	-3.14	8848.40	2077
2078	2094022.478	411923.000	8505.75	-1.73	8504.02	2078

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2079	2094029.398	410730.564	7940.14	0.57	7940.71	2079
2080	2094067.556	414286.497	0.00	0.00	8849.63	2080
2081	2094156.598	410390.650	7961.57	4.11	7965.68	2081
2082	2094230.098	411471.664	8290.15	0.45	8290.60	2082
2083	2094231.119	412147.536	8677.35	0.89	8678.24	2083
2084	2094245.772	413351.172	9269.77	0.97	9270.74	2084
2085	2094247.397	412793.961	9070.58	0.32	9070.90	2085
2086	2094272.376	414956.856	8688.28	-1.22	8687.06	2086
2087	2094275.835	413916.422	0.00	0.00	8954.35	2087
2088	2094284.439	415225.312	8573.61	-10.03	8563.58	2088
2089	2094290.025	413572.909	9201.41	8.01	9209.42	2089
2090	2094294.360	411815.424	8498.04	-0.89	8497.15	2090
2091	2094326.521	412437.556	8876.36	1.06	8877.42	2091
2093	2094340.846	414649.826	8688.14	-1.41	8686.73	2093
2094	2094358.830	411106.713	8123.35	-0.42	8122.93	2094
2095	2094372.052	410828.595	7939.99	-0.02	7939.97	2095
2096	2094373.487	414343.031	8689.73	0.14	8689.87	2096
2097	2094476.766	413581.295	0.00	0.00	9122.22	2097
2098	2094518.287	413321.514	9255.49	2.31	9257.80	2098
2099	2094529.387	413948.973	0.00	0.00	8880.62	2099
2100	2094540.412	411481.074	8377.97	0.66	8378.63	2100
2101	2094546.623	412151.639	8788.82	-1.34	8787.48	2101
2102	2094569.415	411876.136	8625.59	-0.72	8624.87	2102
2103	2094577.203	414960.711	8501.87	-2.22	8499.65	2103
2104	2094579.145	412499.555	9100.66	-2.85	9097.81	2104
2105	2094583.443	414370.462	0.00	0.00	8608.94	2105
2106	2094590.945	410664.194	7857.16	-1.63	7855.53	2106
2107	2094604.441	414711.967	8489.78	-0.40	8489.38	2107
2108	2094618.793	415251.548	8403.88	-3.40	8400.48	2108
2109	2094684.645	412811.619	9073.21	-0.74	9072.47	2109
2110	2094730.613	411271.643	8198.62	0.63	8199.25	2110
2112	2094802.812	413854.108	0.00	0.00	8905.98	2112
2113	2094803.733	413549.750	0.00	0.00	9147.32	2113
2114	2094811.742	413322.922	9241.09	4.16	9245.25	2114
2115	2094818.068	414489.473	0.00	0.00	8488.40	2115
2116	2094828.828	414845.361	8338.98	-1.45	8337.53	2116
2117	2094829.869	414182.916	0.00	0.00	8686.60	2117
2118	2094833.176	410800.128	7859.32	-0.51	7858.81	2118
2119	2094852.063	411120.504	8060.54	0.88	8061.42	2119
2120	2094864.480	415242.099	8286.73	-0.38	8286.35	2120
2121	2094904.138	412558.289	8805.56	-1.34	8804.22	2121
2122	2094924.796	412855.439	8929.77	-0.63	8929.14	2122
2123	2094933.029	411417.594	8263.12	0.02	8263.14	2123
2124	2094953.568	411805.084	8567.11	-0.24	8566.87	2124
2125	2094999.032	412161.184	8672.09	-0.39	8671.70	2125
2126	2095088.008	415285.972	8133.35	1.28	8134.63	2126
2127	2095098.603	413402.231	9221.49	-1.54	9219.95	2127
2128	2095127.231	413619.940	9093.38	-1.69	9091.69	2128
2129	2095138.856	413155.485	9059.39	1.78	9061.17	2129
2130	2095147.874	414321.778	0.00	0.00	8594.69	2130

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2131	2095164.424	414956.820	0.00	0.00	8203.72	2131
2132	2095167.851	411121.552	8031.25	-1.38	8029.88	2132
2133	2095177.921	414619.935	0.00	0.00	8400.74	2133
2134	2095179.007	413936.301	0.00	0.00	8842.90	2134
2135	2095195.298	410849.418	7842.82	2.54	7845.36	2135
2136	2095264.714	412050.379	8465.31	0.87	8466.18	2136
2137	2095298.662	411778.391	8368.21	2.31	8370.52	2137
2138	2095326.686	412981.314	8897.28	0.07	8897.35	2138
2139	2095343.853	412428.869	8552.92	0.40	8553.32	2139
2140	2095344.088	411437.334	8131.28	2.98	8134.26	2140
2141	2095352.526	412699.966	8709.88	-0.84	8709.04	2141
2142	2095370.566	413350.878	9224.46	0.46	9224.92	2142
2143	2095404.916	411310.346	8041.48	2.07	8043.55	2143
2144	2095424.985	413673.849	9051.75	-3.07	9048.68	2144
2145	2095465.874	413999.920	0.00	0.00	8821.85	2145
2146	2095481.194	410937.348	7801.91	2.15	7804.06	2146
2147	2095492.218	414330.742	0.00	0.00	8608.81	2147
2148	2095519.451	414798.776	8361.75	-3.63	8358.12	2148
2149	2095639.445	411842.717	8220.43	0.42	8220.85	2149
2150	2095653.860	412372.736	8460.94	1.90	8462.84	2150
2151	2095662.321	412627.305	8622.02	2.21	8624.23	2151
2152	2095671.259	411536.877	8074.19	3.19	8077.38	2152
2153	2095672.619	413259.554	9120.71	-0.25	9120.46	2153
2154	2095681.474	412112.601	8293.80	1.88	8295.68	2154
2155	2095686.852	410993.540	7779.03	1.76	7780.79	2155
2156	2095711.439	415147.588	8151.89	-1.38	8150.51	2156
2157	2095724.034	413877.129	8963.10	6.81	8969.91	2157
2158	2095727.634	412988.861	8843.52	2.39	8845.91	2158
2159	2095733.971	413546.003	9202.80	0.61	9203.41	2159
2160	2095742.560	411252.530	7890.18	1.14	7891.32	2160
2161	2095748.263	414655.791	8474.15	-2.22	8471.93	2161
2162	2095770.992	414208.573	8722.35	9.75	8732.10	2162
2163	2095909.082	412694.781	8614.08	1.55	8615.63	2163
2164	2095935.044	412359.259	8408.37	0.71	8409.08	2164
2165	2095952.431	411658.740	8025.89	2.21	8028.10	2165
2166	2095978.688	411022.869	7752.18	1.18	7753.36	2166
2167	2096022.059	412160.251	8286.16	0.80	8286.96	2167
2168	2096024.064	411277.121	7820.88	2.56	7823.44	2168
2169	2096026.896	412922.184	8726.61	-0.53	8726.09	2169
2170	2096045.919	414455.143	8528.28	1.96	8530.24	2170
2171	2096061.717	413265.525	8963.60	-0.06	8963.54	2171
2172	2096064.096	414827.650	8314.27	-1.84	8312.43	2172
2173	2096070.686	413503.450	9155.97	0.64	9156.61	2173
2174	2096078.193	414140.532	8689.61	3.66	8693.27	2174
2175	2096085.441	415130.111	8129.19	3.15	8132.34	2175
2176	2096098.389	413809.044	8905.87	-4.53	8901.34	2176
2177	2096308.832	411486.628	7889.18	2.24	7891.42	2177
2178	2096322.831	411759.199	8032.44	1.39	8033.83	2178
2179	2096346.729	414441.374	8471.33	-2.47	8468.86	2179
2180	2096363.396	413887.091	8799.67	-0.14	8799.53	2180

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2181	2096366.466	411138.813	7725.12	1.43	7726.55	2181
2182	2096388.246	412121.606	8227.08	-0.54	8226.54	2182
2183	2096396.753	413124.541	8986.03	-2.29	8983.74	2183
2184	2096427.825	414149.404	8644.73	-0.65	8644.08	2184
2185	2096428.557	415177.775	8083.06	1.10	8084.16	2185
2186	2096435.667	412444.283	8443.42	-0.09	8443.33	2186
2187	2096454.961	413499.927	8807.26	1.58	8808.84	2187
2188	2096462.188	414854.369	8270.84	0.60	8271.44	2188
2189	2096469.763	412846.823	8747.56	-0.75	8746.81	2189
2190	2096641.775	412048.681	8141.16	1.47	8142.63	2190
2191	2096661.049	411670.999	7948.80	3.36	7952.16	2191
2192	2096675.304	413136.429	8806.04	-0.73	8805.31	2192
2193	2096694.576	414343.550	8530.18	0.78	8530.96	2193
2194	2096724.413	414010.005	8559.02	1.94	8560.96	2194
2195	2096742.663	412566.370	8474.74	-0.13	8474.62	2195
2196	2096852.542	414814.317	8276.58	0.09	8276.67	2196
2197	2096860.332	413563.479	8516.98	0.71	8517.69	2197
2198	2097043.469	415225.866	8109.85	0.60	8110.45	2198
2199	2097088.508	414145.518	8330.76	-0.05	8330.71	2199
2200	2097156.112	411737.582	7888.59	-1.27	7887.32	2200
2201	2097164.378	413194.448	8571.84	0.83	8572.67	2201
2202	2097172.689	412412.597	8230.46	-1.67	8228.80	2202
2203	2097187.210	412055.173	7950.34	1.20	7951.54	2203
2204	2097208.321	412644.618	8293.40	-1.94	8291.46	2204
2205	2097217.623	413848.672	8236.95	-1.23	8235.72	2205
2206	2097222.505	412956.697	8426.64	2.29	8428.93	2206
2207	2097224.737	413572.232	8374.84	-1.82	8373.02	2207
2208	2097238.073	414420.058	8211.21	0.86	8212.07	2208
2209	2097245.433	411415.830	7663.42	-1.30	7662.12	2209
2210	2097269.419	414900.753	8021.34	0.78	8022.12	2210
2211	2097373.819	411930.186	7895.73	2.62	7898.35	2211
2212	2097426.521	412948.889	8380.22	-0.30	8379.92	2212
2213	2097457.838	413489.295	8348.25	-1.96	8346.29	2213
2214	2097462.282	412549.946	8095.69	-0.77	8094.92	2214
2215	2097473.369	412225.102	8002.26	-0.93	8001.33	2215
2216	2097480.359	413169.331	8494.35	-1.06	8493.29	2216
2217	2097488.599	414141.455	8065.12	-0.47	8064.66	2217
2218	2097495.771	413756.152	8184.22	-1.74	8182.48	2218
2219	2097552.161	414466.820	8010.44	2.51	8012.95	2219
2220	2097714.743	414905.863	7761.50	-1.67	7759.83	2220

NOTE: All (0) zero elevations and study year are in obscure areas.

MACRO-INVERTEBRATE STUDY

Crandall Canyon Mine Macroinvertebrate Study September 2009

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January 28, 2010

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Crandall Canyon Mine Macroinvertebrate Study September 2009

1.0 Introduction

On September 16, 2009, JBR Environmental Consultants, Inc. (JBR) collected benthic macroinvertebrate samples from Crandall Creek, which is located near Huntington, Utah. The samples were collected both upstream and downstream of an underground coal mine operated by Genwal Resources, Inc. (Genwal) and permitted by the Utah Division of Oil, Gas and Mining (DOGM) through its coal mining program. The mine, known as the Crandall Canyon Mine, has been idle for more than two years but intercepted groundwater continues to discharge from the sealed portals. Crandall Creek is the receiving water for the discharge. Genwal hired JBR to sample the creek's benthic macroinvertebrates and assess the resultant data to determine whether or not the mine discharge is affecting Crandall Creek's aquatic community. After giving some relevant background information, this report describes the data collection and analysis methodology, provides the laboratory data, and discusses the results of the September 2009 macroinvertebrate study. The report also provides recommendations for future macroinvertebrates studies in Crandall Creek, which are required by DOGM.

1.1 Background

The Crandall Canyon Mine began discharging groundwater in late 1995, and did so more or less continuously for 12 years. While the mine was operating, groundwater entering the underground mine had to be collected and pumped to the surface to ensure safe operating conditions. Except for some passive in-mine settling, groundwater was not treated prior to being released to Crandall Creek. Its discharge was regulated by the Utah Division of Water Quality (DWQ) through the Utah Pollutant Discharge Elimination System (UPDES) permit program, and water quality limits were imposed to ensure that Crandall Creek and downstream water resources were protected. With very few exceptions, those permit limits were met during the 12 years of near-continuous groundwater discharge.

Subsequent to mine closure in mid-2007, the pumps and other infrastructure were removed from underground and the portals were sealed. Without active pumping, groundwater discharge ceased. The UPDES permit continued to be in effect, and the "no discharge" status was reflected on the monthly discharge monitoring reports. Genwal projected that recovering groundwater levels would never reach the portal elevations and, therefore, this water would never again discharge from the mine. However, after about three months with no discharge, groundwater unexpectedly began flowing out of the mine from beneath the portal seals. It has continued without interruption since that time.

While the more recent gravity-flow rates have been similar to the flow rates that were prevalent during the operational pumping, water quality has been somewhat different since the flow resumed in early 2008. After several weeks during which samples collected from the initial gravity discharge contained elevated total dissolved solids (TDS) and certain metals (zinc, nickel, iron), concentrations of most of the measured constituents diminished and soon returned to a near-normal level. Iron concentrations were the exception – total iron increased from <0.05 mg/L, which was a typical concentration during the active mining and groundwater pumping activities, to about 1.0 to 2.0 mg/L immediately after the gravity discharge began. After several months, total iron concentrations appeared to stabilize at about 0.5 mg/L, but in September 2008, iron again began to climb to a concentration that is currently two orders of magnitude higher than it was during the active mining and pumping period. As an example, concentrations of 5.1 and 3.0 mg/L of total iron were measured in two groundwater discharge samples that were collected in the two months prior to the September macroinvertebrate sampling. Genwal's UPDES permit limit for total iron is 1.0 mg/L. The iron-laden discharge has also resulted in iron-stained streambed substrate along an approximate 3,000-foot reach of Crandall Creek immediately downstream of where the groundwater discharge enters the stream. Based upon water quality sampling, no heavy metals other than iron are present in the discharge water in any problematic concentrations. The water's pH has been near-neutral or slightly alkaline.

Crandall Creek is a small perennial stream that drains a 2,500-acre watershed located within the bounds of the Manti-La Sal National Forest and conveys flow to Huntington Creek. Genwal's intercepted groundwater enters Crandall Creek approximately 1.5 miles upstream of the confluence of those two streams. Both Crandall Creek and Huntington Creek support aquatic resources, and Huntington Creek is a noted trout fishery. These fish rely in part upon a healthy and abundant macroinvertebrate community as a food source. The Utah Division of Wildlife Resources (DWR), in a 1995 letter to Genwal, indicated that Crandall Creek had a small resident cutthroat population and was also important spawning habitat for trout in Huntington Creek (Moretti 1995).

Iron is an essential element for both fish and the macroinvertebrates upon which they rely as a food source, as well as all other terrestrial and aquatic biota. However, in the aquatic environment, iron can be harmful or toxic depending upon its chemical form and its concentration. Largely as a function of the water's pH and its dissolved oxygen content, iron is typically present in either an insoluble ferric form or a soluble ferrous form. It can also be present as an integral component of individual sediment particles whose parent rock contains iron. While the chemistry of iron in water can be complex and is not fully discussed here, it is important to note a couple of key points. Commonly, iron found in groundwater is in the ferrous form, but when exposed to the atmosphere, this dissolved iron often oxidizes to the ferric form and then precipitates (Hem 1985). These iron precipitates can physically degrade aquatic habitat by covering bed substrate and organic matter; the covering can also reduce food sources for both fish and macroinvertebrates. The particulates (either from precipitates or fine sediments) can clog an organism's gills or filtering apparatus, and thereby hinder oxygen intake. Iron can also precipitate directly onto an organism's body, physically harming its body structure and function. In its soluble (dissolved) form, iron can also be toxic when ingested by aquatic life; this is commonly the mechanism of impact in waters where acid mine drainage often elevates the dissolved concentrations of numerous heavy metals including iron. Pelow and Edmunds (1999) provide a comprehensive review of acid mine drainage and its effects on macroinvertebrates.

Taking all of these things into account, EPA has conservatively recommended (nationwide) a criterion (chronic) of 1.0 mg/L iron, as part of their published National Recommended Water Quality Criteria for the protection of aquatic life (EPA 2009). Following EPA's recommendation, Utah, in its Water Quality Standards given at U.A.C. R317-2-14, adopted a maximum dissolved iron criterion of 1.0 mg/L for all streams that are classed for aquatic wildlife beneficial uses. DWQ set the Crandall Canyon Mine's UPDES permit limit at 1.0 mg/L total iron to provide protection at an even more conservative level than the stream standard without accounting for any dilution effects. However, as noted above, this limit is currently being exceeded. Genwal is obligated to take measures to bring its groundwater discharge back into compliance with its UPDES permit. An iron treatment plant was brought online in January 2010, and will presumably significantly reduce the iron concentration in both Genwal's discharge and Crandall Creek downstream of the discharge.

1.2 Purpose of Study

Due to elevated iron concentrations associated with Genwal's permitted groundwater discharge over recent months, the relevant regulatory (DWQ, DOGM) and management (U.S. Forest Service (USFS), DWR) agencies are concerned about the potential impacts of this discharge on aquatic life. In mid-August, 2009, DOGM issued a Citation for Non-Compliance (#10044) that required Genwal to engage a qualified biologist to collect macroinvertebrate samples from Crandall Creek prior to September 30, 2009 and prepare a comprehensive report that describes and evaluates the study results.

This macroinvertebrate study is intended to meet the DOGM requirements, as well as to accommodate the USFS's requests for obtaining results that would be comparable with their routine Huntington Creek benthic studies. Its purpose is to assess both the spatial and temporal variation in the macroinvertebrate community of Crandall Creek with an eye towards determining what, if any, iron-caused impacts have occurred in that community. The spatial assessment was the primary focus of this round of study because it can be based upon the single set of data that was collected on September 16, 2009. The data set also serves the purpose of establishing the current baseline condition, with which future sampling results can be compared to assess changes in the macroinvertebrate community over time as the water quality improves with treatment.

In addition, study results can be used to assess the overall health of Crandall Creek. Because they are sensitive to water quality and respond quickly to stressors including water pollutants, and also because they are fairly stationary within a given stream feature, benthic macroinvertebrates integrate variations in water quality or other habitat components (Davis et al 2001). Numerous indices and metrics such as diversity, taxa ratios, richness, and the like can be calculated and used to assess the macroinvertebrate community at a given site in regard to its ability to tolerate environmental pollution. The presence or absence of a specific macroinvertebrate taxon can indicate a perturbation that may not have been captured by grab samples analyzed for specific water chemistry. Ideally, this study may provide insight on the general condition of Crandall Creek as well as the iron-specific impact (if any) of Genwal's discharge on the creek's aquatic community.

2.0 Previous Studies

The macroinvertebrate samples collected on September 16, 2009 were not the first such samples collected in Crandall Creek. In 1980, prior to the mine start-up, macroinvertebrate samples were collected at several locations along Crandall Creek. A follow-up macroinvertebrate study was conducted in 1994, after several years of mine operations; at the time of sampling, groundwater had not been intercepted in a quantity sufficient to require surface discharge. While these studies' methodologies and site locations appear to be somewhat different from each other and from the 2009 study, their results can perhaps provide some baseline data with which the 2009 Crandall Creek data can be compared. In addition, the USFS samples benthic macroinvertebrates in Huntington Creek every five years. Brief descriptions of each of these studies follow.

2.1 Winget Study

As part of the baseline data collection program that was implemented prior to the development of the Crandall Canyon Mine, macroinvertebrates were collected from Crandall Creek by Robert N. Winget Environmental Consultants in October, 1980. Although his original report (if one was prepared) has not been located, a report describing study results is included in Genwal's Mine and Reclamation Permit (MRP) in Appendix 3-2; the date and author of this report are unclear. Winget's samples were collected near the mouth of Crandall Creek (site CC01) and an upstream site located near the proposed mine disturbance (site CC02). They were collected with a modified Surber sampler using a stratified random criterion (EPA 1973) to determine exact sampler placement for each subsample. Mesh size of the Surber sampler and the feature(s) the stratification was based on are unknown. A limited number of metrics were calculated.

This study indicated that the downstream site had fewer organisms than the upstream site, but a similar number and diversity of taxa. The sites were rated equal in regard to their aquatic community's environmental tolerance. While there were variations in taxa, both sites had representatives of both low- and high-tolerance organisms. The report noted that, based upon the macroinvertebrate communities observed, the downstream site reflected somewhat poorer water quality than the upstream site. However, the above-noted indices indicate only slight differences. The report also described more desirable physical habitat at the upstream site, due to the presence of silts and mineral cementation at the downstream site.

2.2 EIS Study

In July 1994, Environmental Industrial Services (EIS) collected macroinvertebrate samples in Crandall Creek as part of a riparian study prior to an expansion of the Crandall Canyon Mine (EIS 1995). As noted above, intercepted groundwater was not yet being discharged. EIS used a 900-micron mesh Surber sampler to collect samples at 12 sites within different habitat features along Crandall Creek. Specific site locations are not known. In most cases, taxonomic identification was made only to the family level. Functional feeding groups were noted and formed the basis of discussion in the EIS report. Other typical macroinvertebrate indices were not derived or discussed.

The lack of knowledge about site locations limits the value of the 1994 study results. In addition, the difference in level of taxonomic identification hinders meaningful comparison with data collected in 1980. It also makes it difficult to determine tolerance because many families contain some genera with low tolerance and others with higher tolerance. In sum, this study provides a very limited means of comparison with either the 1980 study or the 2009 study.

2.3 Other Studies

In the summer of 1983, the UDWR conducted a stream survey on Crandall Creek, which included some cursory macroinvertebrate information. While no report on the survey has been located, field data sheets are included in Genwal's MRP, in Appendix 3-2. A data sheet describing conditions near the confluence of Crandall and Huntington indicates that the overall macroinvertebrate abundance was "sparse" and that the major taxa represented were of the orders Ephemeroptera (mayfly) and Tricoptera (caddisfly).

In 1984, the Manti-La Sal National Forest began monitoring macroinvertebrate communities in several locations along Huntington Creek. Samples are collected approximately every five years. In 1994 and 1995 (the last years for which published results are available), Huntington Creek's macroinvertebrate community was between 72 and 78 percent of its potential, based upon calculated Biotic Condition Indices (U.S. Forest Service 2001). Unpublished sampling results from 2002 reportedly indicated improvements; results from the 2007 surveys are not yet available (Jewkes, personal communication 2009).

3.0 Site Selection and Site Descriptions

3.1 Site Selection

As required by DOGM, macroinvertebrate sample sites were to be located both upstream and downstream of the Crandall Canyon Mine. In that way, the upstream site would be located outside of any potential influence of the mine's groundwater discharge and could serve as a reference site. DOGM also required that sites be selected with their input, as well as with input from the USFS and DWR.

On September 3, 2009, representatives from JBR, DOGM, and USFS met at the Crandall Canyon Mine to identify the broad reaches wherein macroinvertebrate collection sites would be located (DWR chose not to participate). All three representatives agreed that three reaches would be selected: the previously mentioned upstream location and two reaches downstream of Genwal's groundwater discharge. One of the downstream reaches would be located within the stream section where iron-stained substrate is visible, and the other would be located further downstream outside of the visibly impacted substrate. This selection would enable not only a comparison of results from the upstream reference site and the downstream sites, but would further delineate the receiving waters into two reaches. This would potentially allow for a determination of the spatial extent of impacts (if any) due to Genwal's discharge.

Through a field examination of the stream on September 3rd, these three broad stream reaches were further defined. The intent was to provide a general reach location from which a specific measured reach could be delineated at the time of sampling. The uppermost reach (CRANDUP-01) was defined to be upstream of, but close to, the flow measurement flume located near the upstream edge of the upper parking lot. This site is outside of any influence of the mine's groundwater discharge. The middle reach (CRANDMD-02) was selected to include the area immediately downstream of the discharge location where flow mixing, aeration, and iron precipitation are occurring. In regard to potential iron impacts, this site would presumably represent the worst water quality and stream substrate conditions. The downstream reach (CRANDLWR-03) was chosen to be immediately upstream of the mine road crossing near the confluence with Huntington Creek. This site would have the potential to reflect either continued impacts, reduced impacts, or no impacts from the mine discharge.

3.2 Site Descriptions

Sample reaches were delineated at each location identified in the previous section (CRANDUP-01, CRANDMD-02, and CRANDLWR-03) following the methods outlined in the Environmental Monitoring and Assessment Program (EMAP) Field Operations Manual for Wadeable Streams (EPA 2001). EMAP specifies that a sample reach should be 40 times the average width of the stream channel or a minimum of 150 meters if the average channel width is less than four meters. Due to the small size of Crandall Creek throughout its length (average width less than 4 meters), sample reaches of 150 meters were defined for this study. A principle feature of the EMAP sampling reach is that 11 cross-section transects are established at regular intervals, with macroinvertebrate samples taken at each transect. The start and end points of the sample reaches were flagged and labeled Transect "A" and Transect "K" respectively. Between these points an additional nine transects were identified. These transects were spaced equally, 15 meters apart, and labeled Transects "B" through "J."

3.2.1 CRANDUP-01

The downstream endpoint for the upstream site, CRANDUP-01, was established approximately 2 meters above the flow measurement flume and it extended upstream approximately 150 meters (Figure 1). All transects, including end points, were flagged with yellow construction flagging labeled with the appropriate transect letter. Crandall Creek within this reach is a relatively narrow, steep headwater stream. Stream morphology is generally riffle-pool, with several beaver ponds; there are few meanders. Channel width is generally less than 1 meter, with the exception of the beaver ponds. The reach is bordered by abundant riparian vegetation, composed primarily of willow (*Salix* spp.) and redosier dogwood (*Cornus sericea*). Substrate within the reach is primarily coarse gravel and small cobble; however, substrate within the beaver ponds is primarily silt and fine sediment. Figure 2 shows the stream at the downstream endpoint (Transect A) as seen several weeks following sampling (5 November 2009).

Figure 2. View upstream from the downstream endpoint (Transect A) of CRANDUP-01

3.2.2 CRANDMID-02

The CRANDMD-02 reach was established directly below the mine water discharge (Figure 1). The upstream endpoint (Transect K) was located approximately 5 meters downstream of the discharge point, with the reach extending downstream approximately 150 meters. All transects, including end points, were flagged with yellow construction flagging labeled with the appropriate transect. Crandall Creek within this reach is a bit wider than at CRANDUP-01, with an average width between 1 and 2 meters. Stream gradient is considerably steeper than at the other sites and stream morphology is generally step-pool, with a large cascade approximately 60 meters down from the upstream endpoint (near Transect G). There are also several large beaver ponds within the reach. Riparian vegetation is less dense than at CRANDUP-02 and includes willow, redosier dogwood, and conifers. Substrate within the reach is primarily coarse gravel and cobble, with silt and fine sediment within beaver ponds and large runs. Substrate is heavily stained throughout the reach by iron precipitates. Figure 3 shows the reach at its upstream endpoint (Transect K) as seen several weeks following sampling (5 November 2009).

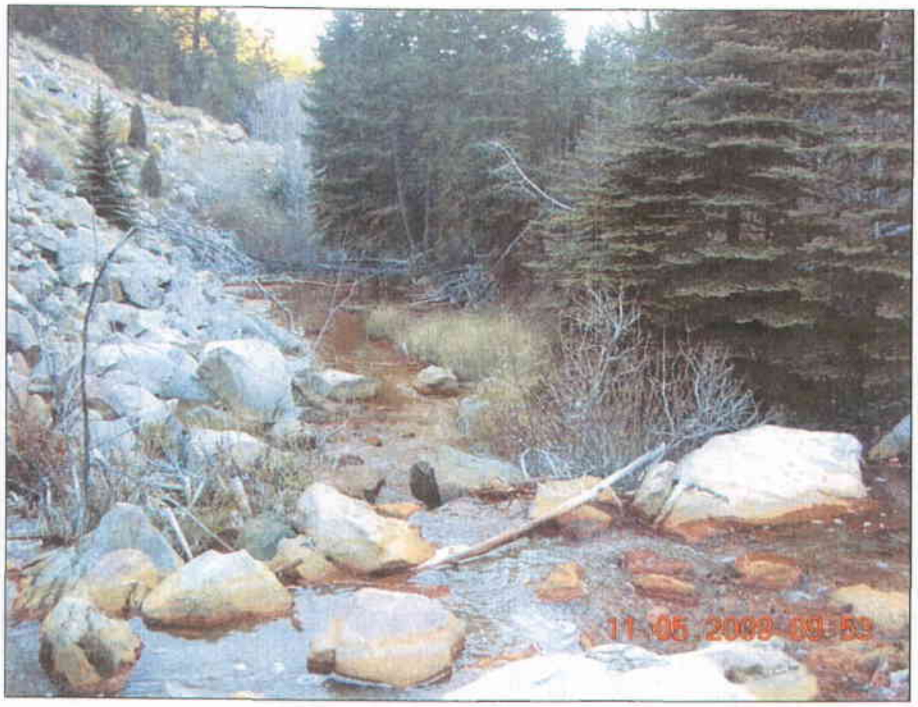

Figure 3. View downstream from the upstream endpoint (Transect K) of CRANDMID-02

3.2.3 CRANDLWR-03

The downstream endpoint for the downstream site, CRANDLWR-03, was established approximately 2 meters above where Crandall Creek passes under the mine road. It extended upstream from that point approximately 150 meters, with all transects flagged as described for the other sites. Crandall Creek within this reach remains relatively narrow and is lower gradient than the two upstream sites. Stream morphology is generally riffle-run, with several beaver ponds and several long runs. Riparian vegetation is similar in composition to CRANDMD-02, with conifers, willows, redosier dogwood, and some cottonwood (*Populus* spp.). Substrate within the reach is primarily gravel; however, substrate within beaver ponds and large runs is primarily silt and fine sediment. Figure 4 shows the stream at the downstream endpoint (Transect A) as seen several weeks following sampling (5 November 2009).

Figure 4. View upstream from the downstream endpoint (Transect A) of CRANDLWR-03

4.0 Methods

JBR collected macroinvertebrate samples from the three above-described stream reaches on Crandall Creek. Sample collection methodology was generally based upon the reach-wide sample methodology outlined in the (EMAP) Field Operations Manual for Wadeable Streams (EPA 2001). The specific application of the reach-wide sample methodology was modified as per discussions with the Manti-La Sal National Forest fisheries biologist who is responsible for USFS macroinvertebrate sampling on the Forest. Section 4.1 below describes the modified methodology. The collected and preserved samples were then delivered to the National Aquatic Monitoring Center (the BugLab) in Logan, Utah for processing and taxonomic identification. The BugLab is a cooperative venture between the U.S. Bureau of Land Management (BLM) and Utah State University. Its focuses on processing macroinvertebrate samples, and processes a large percentage of the samples collected on federal land in the western U.S. The DWQ Monitoring Manual (DWQ 2006) specifies that macroinvertebrate samples be processed by the BugLab. DWQ's methodology is described in Section 4.2., and the BubLab's complete report (Miller 2009) is attached as Appendix 1.

4.1 Sample Collection Methods

The EMAP methodology for the reach-wide sample specifies that one macroinvertebrate subsample is taken at each of the eleven transects within the delineated reach. These subsamples are then combined into a composite reach-wide sample. The sample location at the first transect is randomly selected using a six sided dice (i.e., sample is taken at a location 25, 50, or 75 percent of the distance from the channel's left edge depending upon the roll of the dice), with the sampling point at subsequent transects chosen systematically. However, the Manti-La Sal National Forest regularly collects only 4-5 macroinvertebrate subsamples within each reach, which are then combined into a single composite sample. The 4-5 subsamples are collected from as many habitat types as possible in order to sample the full range of habitat types present within the reach. In order to be more consistent with the methodology used by the Forest, the EMAP reach-wide sample methodology was modified to only include five samples. However, to keep the modified methodology as similar to EMAP procedure as possible (which improves consistency and keeps the samples as replicable as possible), the five samples were collected at every other transect starting with Transect B. The exception was at CRANDMD-02, where one of the samples was taken at an adjacent transect in order to sample a large run that was different than other habitat types within the reach. At the other sites, sampling at every other transect sufficiently captured the range of habitat types present in the reach.

As Crandall Creek is a narrow stream at all sites, and particularly CRANDUP-01, sample location at each transect was not chosen randomly or systematically, rather the site that was most suitable to sampling was chosen (i.e., the location that allowed placement of the sampler). All sampling was conducted using a 1,000-micron mesh Surber sampler. This is also a modification of the EMAP procedures, which specifies a 500-micron mesh kick net. In a couple of cases, a transect directly intersected a beaver dam and the sample was taken below the beaver dam, as sampling the lentic environment behind the dam would not have been feasible using a Surber sampler. None of the transects directly intersected a beaver pond. The samples were collected in a downstream-to-upstream order to avoid including organisms dislodged from upstream samples.

For sampling transects the following procedures were utilized.

1. The Surber sampler was quickly and securely positioned on the bottom of the channel with the opening facing upstream. Gaps between the frame and substrate were minimized.

2. The sample area was checked for heavy organisms, such as mussels and snails. Any such organisms were placed into the composite sample bucket. All substrate particles larger than golf balls and that were at least halfway into the sample area were picked up and rubbed with hands or a brush to dislodge organisms into the net. Particles that were more than halfway outside the sample area were pushed aside and not sampled. After particles were washed, they were placed outside of the sample area.

3. Starting at the upstream end of the sample area, the remaining substrate was kicked vigorously for 30 seconds. The water was allowed to clear before removing the net from the water column.

4. The net was lifted out of the water then quickly immersed several times to concentrate sample material in the end of net. Care was taken not to further disturb channel substrate with the net, or allow for organisms to escape.

5. The net was inverted into the composite bucket, which had been ¼ to ½ filled with stream water. The net was inspected for clinging organisms and forceps were used to place these organisms into the bucket.

6. The net was rinsed in the stream before moving to the next transect.

7. The dominant substrate and habitat type were recorded on the field data sheet.

After sampling was completed at the five transects, the following procedures were employed to prepare a Multi-Habitat composite index sample to be sent to the lab.

1. The contents of the sample bucket were manually swirled to separate organisms from the sample material. The sample material was poured through a 300-micron mesh sieve and the inside of the bucket was inspected for organisms. Organisms were rinsed off any large objects (rocks, organics, etc.) with a spray bottle filled with stream water before discarding the objects. Additional serial bucket rinses were employed until no remaining organisms were noted in the sample bucket.

2. Using the spray bottle, the sample material inside the sieve was rinsed to one side and transferred into the sample container using as little water as possible. The sieve was carefully examined for clinging organisms and these were placed into the sample bottle using forceps.

3. The sample container was completely filled with 95-percent ethanol so that the final concentration was between 75 and 90 percent. The container was slowly tipped horizontally and rotated to allow complete mixing of the ethanol and sample.

4. Sample containers were labeled with the information listed below. A duplicate of this label was written on ethanol-safe paper and placed inside of the container. Samples were then delivered to the BugLab for analysis.

   * Type of Sample (multi-habitat)
   * Stream Name
   * Site I.D.
   * Forest (Manti-La Sal National Forest)
   * Date and Time of Collection
   * Number of Jars

4.2 Analysis Methods

As noted above, the BugLab identified the taxa represented in the macroinvertebrate samples that JBR collected. The lab processed the samples using methods similar to those recommended by the United States Geological Survey (Cuffney et al 1993, as referenced in Miller 2009). Because the samples contained fewer than 600 organisms, 100 percent of the sample material was processed (if more than 600 organisms had been present per sample, a sub-sampling procedure would have been used). Generally, organisms were removed under a dissecting microscope at 10-30 power and separated into taxonomic orders. Organisms were then identified to a lower taxonomic level (family, genus, and/or species, as feasible). Once identified and counted, samples were placed in 20-ml glass scintillation vials with polypropylene lids in 70% ethanol, given a catalog number, and retained. The results report (Miller 2009) includes a complete list of taxa and the number of organisms by taxa (see Appendix 1).

The BugLab also provided data summaries and calculated various indices and metrics (Miller 2009), many of which will be discussed in the results discussion. These include: abundance, total taxa richness, EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa richness, Ephemeroptera taxa richness, Plecoptera taxa richness, Trichoptera taxa richness, percent EPT abundance, percent Ephemeroptera abundance, percent Chironomidae abundance, Intolerant taxa richness, percent tolerant organisms, Hilsenhoff Biotic Index, percent contribution of the dominant taxon, clinger taxa richness, percent clinger abundance, percent collector-filterer abundance, and percent scraper abundance. Definitions/descriptions of these individual metrics and their usefulness are provided below and are taken almost verbatim from the BugLab's data report (Miller 2009). More detail and references for how calculations were made are also given in their report, which can be found in Appendix 1.

Taxa richness - Richness is a component and estimate of community structure and stream health based on the number of distinct taxa. Taxa richness normally decreases with decreasing water quality. In some situations organic enrichment can cause an increase in the number of pollution tolerant taxa. Taxa richness was calculated for operational taxonomic units (OTUs) and the number of unique genera, and families. The values for operational taxonomic units may be overestimates of the true taxa richness at a site if individuals were the same taxon as those identified to lower taxonomic levels or they may be underestimates of the true taxa richness if multiple taxa were present within a larger taxonomic grouping but were not identified. All individuals within all samples were generally identified similarly, so that comparisons in operational taxonomic richness among samples within this dataset are appropriate, but comparisons to other data sets may not. Comparisons to other datasets should be made at the genera or family level.

Abundance - The abundance, density, or number of aquatic macroinvertebrates per unit area is an indicator of habitat availability and fish food abundance. Abundance may be reduced or increased depending on the type of impact or pollutant. Increased organic enrichment typically causes large increases in abundance of pollution tolerant taxa. High flows, increases in fine sediment, or the presence of toxic substances normally cause a decrease in invertebrate abundance. Invertebrate abundance is presented as the number of individuals per square meter for quantitative samples and the number of individuals collected in each sample for qualitative samples.

EPT - A summary of the taxonomic richness and abundance within the insect orders Ephemeroptera, Plecoptera, and Trichoptera (EPT). These orders are commonly considered sensitive to pollution (Karr and Chu 1998, as referenced in Miller 2009).

Percent contribution of the dominant family or taxon - An assemblage largely dominated (>50%) by a single taxon or several taxa from the same family suggests environmental stress. Habitat conditions likely limit the number of taxa that can occur at the site.

Shannon Diversity Index - Ecological diversity is a measure of community structure defined by the relationship between the number of distinct taxa and their relative abundances. The Shannon Diversity Index was calculated for each sampling location for which there were a sufficient number of individuals and taxa collected to perform the calculations.

Evenness - Evenness is a measure of the distribution of taxa within a community. Value ranges from 0-1 and approach zero as a single taxa becomes more dominant.

Clinger taxa - The number of clinger taxa have been found by Karr and Chu (1998, as referenced in Miller 2009) to respond negatively to human disturbance. These taxa typically cling to the tops of rocks and are thought to be reduced by sedimentation or abundant algal growths.

Long-live taxa - The number of long-lived taxa was calculated as the number of taxa collected that typically have 2-3 year life cycles. Disturbances and water quality and habitat impairment typically reduces the number of long-lived taxa (Karr and Chu 1998, as referenced in Miller 2009).

Biotic indices - Biotic indices use the indicator taxa concept. Taxa are assigned water quality tolerance values based on their tolerance to pollution. Scores are typically weighted by taxa relative abundance. In the USthe most commonly used biotic index is the Hilsenhoff Biotic Index (Hilsenhoff 1987, Hilsenhoff 1988, as referenced in Miller 2009). The USFS and BLM throughout the western U.S. have also frequently used the USFS Community Tolerance Quotient.

Hilsenhoff Biotic Index - The Hilsenhoff Biotic Index (HBI) summarizes the overall pollution tolerances of the taxa collected. This index has been used to detect nutrient enrichment, high sediment loads, low dissolved oxygen, and thermal impacts. It is best at detecting organic pollution. Families were assigned an index value from 0 (taxa normally found only in high quality unpolluted water) to 10 (taxa found only in severely polluted waters). Family level values were taken from Hilsenhoff (1987, 1988, as referenced in Miller 2009) and a family level HBI was calculated for each sampling location for which there were a sufficient number of individuals and taxa collected to perform the calculations. Sampling locations with HBI values of 0-2 are considered clean, 2-4 slightly enriched, 4-7 enriched, and 7-10 polluted. Rather than using mean HBI values for a sample, taxon HBI values can also be used to determine the number of pollution intolerant and tolerant taxa occurring at a site. In this report, taxa with HBI values ≤ 2 were considered intolerant clean water taxa and taxa with HBI values ≥ 8 were considered pollution tolerant taxa. The number of tolerant and intolerant taxa and the abundances of tolerant and intolerant taxa were calculated for each sampling location.

USFS community tolerant quotient - Taxa are assigned a tolerant quotient from 2 (taxa found only in high quality unpolluted water) to 108 (taxa found in severely polluted waters). The dominance weighted community tolerance quotient (CTQd) was calculated. Values can vary from about 20 to 100, in general the lower the value the better the water quality.

Functional feeding group measures - A common classification scheme for aquatic macroinvertebrates is to categorize them by feeding acquisition mechanisms. Categories are based on food particle size and food location, e.g., suspended in the water column, deposited in sediments, leaf litter, or live prey. This classification system reflects the major source of the resource, either within the stream itself or from riparian or upland areas and the primary location, either erosional or depositional habitats. The number of taxa and individuals of the following feeding groups were calculated for each sampling location.

Shredders - Shredders use both living vascular hydrophytes and decomposing vascular plant tissue - coarse particulate organic matter. Shredders are sensitive to changes in riparian vegetation. Shredders can be good indicators of toxicants that adhere to organic matter.

Scrapers - Scrapers feed on periphyton - attached algae and associated material. Scraper populations increase with increasing abundance of diatoms and can decrease as filamentous algae, mosses, and vascular plants increase, often in response to increases in nitrogen and phosphorus. Scrapers decrease in relative abundance in response to sedimentation and higher levels of organic pollution or nutrient enrichment.

Collector-filterers - Collector-filterers feed on suspended fine particulate organic matter. Collector-filterers are sensitive to toxicants in the water column and to pollutants that adhere to organic matter.

Collector-gatherers - Collector-gatherers feed on deposited fine particulate organic matter. Collector-gatherers are sensitive to deposited toxicants.

Predators - Predators feed on living animal tissue. Predators typically make up about 25% of the assemblage in stream environments and 50% of the assemblage in still-water environments.

Unknown feeding group - This category includes taxa that are highly variable, parasites, and those that for which the primary feeding mode is currently unknown.

In addition, JBR used the BugLab's data set to calculate several other metrics that various literature sources consistently indicate as being potentially useful for macroinvertebrate analysis, particularly in regard to potential metals pollution. These are described below.

Ratio of Specialist Feeders to Generalist Feeders - Specialist feeders include shredders and scrapers and generalist feeders include filterers and gatherers. Generalists are typically more tolerant to environmental stressors, so their proportion often increases in response to degraded water quality or stream habitat. This ratio has been used successfully to assess impacts from mining (Mize and Deacon 2002).

Ratio of EPT to Chironomidae - Ideally, communities have a near-even distribution among all four of these major groups. The Chironimid Family, in general, is more tolerant than most of the taxa in the Ephemeroptera, Plecoptera, and Trichoptera orders (Barbour et al 1999). Therefore, this ratio can indicate environmental stress when it shows disproportionate numbers of Chironomidae (Davis et al 2001).

Percent *Baetis*, Hydropsychidae, and Orthocladinae; Ratio of *Baetis* to all Ephemeroptera – These two similar measures express the documented higher tolerances of *Baetis*, Hydropsychidae, and Orthocladinae, than other members of their families. Mize and Deacon (2002) among others have used the presence of these taxa when assessing environmental conditions specific to mining (some studies have found the opposite conclusion with *Baetis*; however, the majority appear to consider it one of the more tolerant of the mayflies).

Percent Heptageniidae, Chloroperlidae, and *Rhyacophila*; Ratio of Heptageniidae to all Ephemeroptera – Similarly to the above-noted tolerant taxa, Heptageniidae, Chloroperlidae, and *Rhyacophila* were considered by Mize and Deacon (2002) when assessing elevated trace metals impacts. Heptageniidae, Chloroperlidae, and *Rhyacophila* were chosen due to their apparent sensitivity to such elements, thus their absence can indicate poor water quality. Many other authors have associated a lack of Heptageniidae organisms, in particular, with heavy metals pollution (i.e. Kiffney and Clements 1994).

As with analysis of any set of macroinvertebrate data, multiple metrics and their predicted response to perturbations (as given by EPA (2009a) and others in the scientific community) will be relied upon to make a finding of impact or nonimpact in regard to Genwal's groundwater discharge and Crandall Creek. Whether looking at data from an individual sample, comparing data from different sites for a spatial assessment, or examining temporal changes, no one metric can ever be presumed to tell the whole story. First, there is typically some natural variability in community makeup, so reliance on a single metric can be misleading. Further, some metrics are better at ascertaining specific conditions than others (i.e. organic pollution versus metals pollution). For these reasons, most researchers use a variety of metrics and would expect to see similar indications in several of them before making a conclusion regarding impact to a given site. In contrast, there is some redundancy among metrics because they use at least some of the same data. EPA (Barbour et al 1999) and others have developed techniques for combining various metrics into a single index, and also for ranking sites based upon individual metrics in a way that a potentially impacted site can be compared to reference sites (known to be unimpacted). In this study, the low number of sample sites, lack of replicates, and inadequate information on historical baseline make these techniques impossible or impractical to use. Further, the natural variability of any of one these metrics is not known, so it is difficult to determine whether a difference between sites as shown by one metric is due to degraded conditions or simply a reflection of natural variability. While a data set conducive to statistical handling (assigning confidence limits, assessing significance, etc.) would be ideal, and may be available as sampling continues in the future, those types of data do not currently exist.

Instead, individual metrics were calculated for each site and graphed to provide an easy visual means of comparison (Appendix 2). Although some metrics are not independent of each other, there was a specific intent to choose metrics that are of different types (i.e. tolerance as measured by CTQd, community composition as measured by EPT abundance, feeding mechanism as measured by specialist-to-generalist ratio), as recommended by EPA (Bafour et al 1999). Metrics that would be expected to decrease as site conditions worsen (i.e. richness) are shown in blue and those that would be expected to increase as site conditions worsen (i.e. HBI) are shown in green, further facilitating visual interpretation. Comparisons between CRANDUP-01 and CRANDMD-02, across matrices, allow an assessment of whether conditions are degraded below Genwal's discharge. The presumption is that if multiple matrices indicate the same trend (i.e. impact), there is a greater likelihood that (1) there is a degradation between sites; and (2) the mine discharge is responsible for the degradation. Similarly, comparisons between CRANDMD-02 and CRANDLWR-03 can be made to assess whether there is a spatial limit to the degradation (recovered conditions downstream).

5.0 Results and Discussion

The results report that was prepared by the BugLab (Miller 2009) is provided in full as Appendix 1. That report includes the raw data (taxonomic lists of organisms identified, counts, etc.) as well as numerous tables of various metrics and indices that the lab calculated based upon the data. Many of these metrics and indices were described in Section 4.2 above. The report (Miller 2009) does not discuss or interpret the study results and this section focuses on those tasks, beginning with a brief summary of the data and a general discussion of the results. An analysis of the spatial differences among the three Crandall Creek sites sampled in September 2009 provides the best indication of whether or not Genwal's groundwater discharge has impacted the reach of stream below the discharge. Only limited comparisons with the older study results are provided in this report, due to a lack of knowledge about these studies' methodology and sampling locations, and because few metrics were calculated by their authors. In the future, as additional samples are collected at CRANDUP-01, CRANDMD-02, and CRANDLWR-03, and results will be better suited to begin to address temporal trends.

A total of 57 operational taxonomic units (OTU) were identified in the 3-sample set (OTUs are used as a measure because of the variation in taxonomic levels to which identification is made). There were members of 28 families and 33 genera present within the sample set, and all of the insect orders most commonly found in macroinvertebrate communities (Coleoptera, Diptera, Ephemeroptera, Plecoptera, and Tricoptera) were represented in each of the three samples. In addition, individuals from some non-insect classes were identified in all three samples. The average abundance in the sample set was approximately 660 individual organisms per square meter, which is lower than generally expected in good quality aquatic habitat. Abundance is likely to have been higher if the mesh size of the net used for sampling had been finer, as well as if riffle areas had been the primary focus of the collection efforts. Time of year may also have affected the overall numbers. However, the fairly low abundance may also provide additional evidence in support of the following discussion on the overall health of Crandall Creek.

The 2009 results (including, but not limited to, the abundance measured mentioned above) generally indicate that none of the three Crandall Creek sites was in optimum shape at the time of sampling. As the first graph in Appendix 2 shows, all three sites were dominated by members of the order Diptera. Dominance of any single order often indicates an unbalanced system. Further, while Diptera includes some families or genera that are sensitive to pollution, many taxa in that order (including the majority of the ones found at Crandall Creek) are quite tolerant to perturbations. In addition, all three sites had relatively low proportions of the generally sensitive Ephemeroptera, Plecoptera, and Trichoptera orders. Low proportions of these orders can be indicative of a stressed system. The two tolerance indices calculated by the BugLab also indicate a less than ideal aquatic community throughout Crandall Creek. HBI results, when rated according to the scale provided in Section 4.2 under the HBI description, were at best "slightly enriched" and at worst "enriched"; none of the three sites would be categorized as "clean" by this measure. CTQd, which can range from about 20 in the best quality streams up to about 100 in the poorest, was between 71 and 79 in the Crandall Creek September 2009 samples, which also indicates a stream that is providing less than ideal aquatic habitat. It is unknown whether all of these measures reflect the inherent characteristics of Crandall Creek, or are an indication of a diminished watershed condition.

Although Crandall Creek as a whole may provide less-than-ideal habitat, all of the sites had at least a somewhat diverse assemblage of taxa, and all supported at least some taxa that are considered intolerant to pollution or other habitat alterations. All three sites had individuals from both the most tolerant taxa (HBI>=8) and the least tolerant taxa (HBI<=2). This is useful information because it indicates that, while not ideal, there is suitable aquatic habitat in Crandall Creek, including at the CRANDMD-02 location immediately below Genwal's discharge point. Whatever effects the discharge may have had, the stream at that location is not devoid of life, and in fact is still supporting some sensitive aquatic taxa, albeit taxa that may be more sensitive to organic enrichment and perhaps less sensitive to iron.

Knowing that (1) Crandall Creek overall has an aquatic community that is not optimum, and (2) in spite of Genwal's iron-laden discharge, the creek is still supporting aquatic life provides a useful context for the remainder of the results discussion. Those two things being said, by most of the metrics discussed below, there is a less healthy macroinvertebrate community at CRANDMD-02, immediately below the discharge, than at CRANDUP-01, which is upstream of the discharge. Further downstream, at CRANDLWR-03, conditions are generally (by most but not all metrics) worse or similar to those at CRANDMD-02. Although these metrics do not definitively identify iron (either in the water column or on the substrate) as the cause of the noted impairment, they consistently indicate that Genwal's mine discharge is likely to have impacted the macroinvertebrate community. And, iron is the most logical culprit. This subject is discussed in more detail below.

5.1 Spatial Variation in Macroinvertebrate Community

Numerous metrics and indices based upon the September 2009 sampling at CRANDUP-01, CRANDMD-02, and CRANDLWR-03 have been calculated and graphed. These graphs are included in Appendix 2 and provide the visual means to analyze the spatial variation in the macroinvertebrate community along Crandall Creek. CRANDUP-01 is upstream of any potential impact from Genwal's discharge, CRANDMD-02 is immediately below the discharge where impacts would presumably be the greatest, and CRANDLWR-03 is further downstream where impacts could presumably be either similar those seen at CRANDMD-02 or reduced, thus indicating a spatial limit to the impact.

Out of the 20 metrics graphed in Appendix 2, all but three indicate a decline in macroinvertebrate community health between CRANDUP-01 and CRANDMD-02. It is important to reiterate that the data for any one metric are insufficient to make a statistical significance determination of the differences between sites. Some difference would be expected simply due to natural variations in the measurements and this cannot be determined for any single metric with the available data. Further, each metric is, at best, simply a likely indicator of a condition or trend rather than definitive proof. It is also important to note that some of these metrics are not independent of each other. All that being said, however, the fact that such a high percentage of the metrics showed the same trend between these two sites substantiates a finding of difference and increases the likelihood that the difference is not simply due to natural variation.

The three metrics that did not indicate a decline in macroinvertebrate health between CRANDUP-01 and CRANDMD-02 were Number of Long-lived Taxa, HBI, and Percent Tolerant Organisms. The first of these metrics (Number of Long-lived Taxa) reflected an increase between CRANDUP-01 and CRANDMD-02. However the increase was from two taxa to three taxa, and is most likely not a real difference or indication of trend, but is simply within normal statistical variation.

HBI, as noted in Section 4.2, has been used to detect numerous types of water quality problems. But, it was developed - and is best used for - detecting organic pollution such as would be due to septic contamination, agricultural impacts, and the like. It may simply be an unsuitable indicator for this study (the other tolerance index, the CTQd, uses different tolerance values and showed an opposite trend to the HBI). Further, there is not a ready explanation for HBI at the upstream site to be worse than the middle site, or a ready explanation for HBI to be improved by the addition of Genwal's discharge. The best assumption may be that the HBI variation is simply due to natural variation and is insignificant.

The third metric (Percent Tolerant Organisms) that did not follow the dominant trend was calculated by the BugLab using the same tolerance values as the HBI, so not surprisingly it followed the same pattern as the HBI. For the same reasons as mentioned above, this may not be a good indicator for Crandall Creek (all of the other tolerance-based indices that used difference taxa for the assessment indicated that CRANDMD-02 has a more stressed aquatic community). Last, it is interesting to note that the high Percent Tolerant Organisms metric at CRANDUP-01 is due to the overwhelming presence of a single taxon within the *Pericoma* genus (in the Psychodidae family within the Diptera order). This pollutant-tolerant taxon comprised a full 25 percent of all organisms sampled at the most upstream, unaffected site. While *Pericoma* is not an uncommon organism in Utah, its presence in such a quantity appears to be unusual and is not easily explained.

The other 17 metrics pointed towards a decline in the aquatic community between sites CRANDUP-01 and CRANDMD-02. As shown in Appendix 2, they encompass a range of tolerance, community composition, diversity, and feeding group metrics. Both the CTQd Index, which is a weighted community tolerance index, and Shannon's Diversity Index, which is a measure of variety in the macroinvertebrate community, indicated poorer conditions at CRANDMD-02 than at CRANDUP-01. Taxa richness and evenness, which are different measures of community structure, also pointed towards a less healthy stream at CRANDMD-02. Several metrics assessing various taxa (Chironomids, *Baetis*, Hydropsychidae, and Orthocladiinae) that can withstand poor water quality showed a higher relative abundance of those organisms at CRANDMD-02 than at CRANDUP-01, supporting the contention of degraded conditions at the former. Also supporting that contention were several metrics assessing taxa sensitive to poor water quality (Heptageniidae, Chloroperidae, and *Rhyacophila*, specifically, and all EPT taxa generally). Last, feeding group measures also support the conclusion of these other metrics. Therefore, based upon the number and variety of metrics that indicate at least some level of decline in the macroinvertebrate community between these two sites, it appears that CRANDMD-02 has been subject to some type of perturbation.

Comparing the various metrics (Appendix 2) for CRANDMD-02 and CRANDLWR-03 does not give quite as consistent a set of results as the comparison between CRANDUP-01 and CRANDMD-02. But, out of the same 20 metrics, 16 appeared to indicate either a continuing decline in the stream health between CRANDMD-02 and CRANDLWR-03 or a similar condition between the two. Four metrics indicated improved conditions at CRANDLWR-03 and generally similar levels as those measured at CRANDUP-01. These four metrics are Evenness, Percent EPT Taxa, Percent Chironomids, and EPT:Chironomidae, which are all related to some degree. However, because *Baetis* made up the largest portion of Ephemeroptera at CRANDLWR-03 (as noted previously, *Baetis* is one of the more pollutant tolerant members of a generally sensitive order), in this case Ephemeroptera's increase at CRANDLWR-03 is not necessarily indicative of an improvement at that site. Overall, with the available data, the majority of the indicators suggest that CRANDLWR-03 has also been subject to some type of perturbation.

5.2 Temporal Variation in Macroinvertebrate Community

As previously mentioned, macroinvertebrate studies were conducted in Crandall Creek in 1980 and 1994. However, those data are of limited use due to unknowns in either sampling locations and/or collection methodology. Additionally, few if any metrics were calculated by the study authors. Results from the two sites sampled in 1980 can more easily be compared with the 2009 study because sampling locations were in close proximity: 1980's CC01 is essentially at the same location as CRANDLWR-03, and CC02's location is essentially the same as CRANDUP-01. The 1994 results are not as easily used for comparison in part because site locations are not known, so are only partially included here.

The 1980 study reported a density (equivalent to total abundance) at the downstream site (CC01) of an order of magnitude higher than the 2009 data. CC02 density was an order of magnitude higher than CC01, and thus two orders of magnitude higher than the 2009 data. In 1994, a total of only 329 individuals were collected from 12 sites with a combined area of slightly more than a square meter. Whether the much-reduced densities in 1994 and 2009 (when compared to the 1980 results) are due to seasonal flow or life-cycle differences, annual variation, sampling equipment or methodology differences, or another cause cannot be determined. While abundance alone is not considered to be a particularly useful number for assessing ecological impact, these variations may indicate that other comparisons among the data sets should be approached with caution.

Different dominant families were present in 1980 than were reported in 2009. Nemouridae (a Plecoptera), was the dominant family represented at the upstream site (CC02) in 1980. It made up approximately 26 percent of the total number of individuals sampled. In 2009, Nemouridae individuals were present, but comprised less than 6 percent of the total density. As in 2009, *Baetis* appears to have been the dominant family represented at the downstream-most site (CC01) in Crandall Creek in 1980. These small minnow mayflies made up 17 percent of the total organisms at that site (there was a larger number of Hydracarina organisms reported in the sample, but this suborder of more than 40 families was not further keyed by family). Interestingly, the only dominant family from the 1980 and 2009 surveyed sites that was identified as being present at all during the 1994 survey was Chironomidae.

In 1980, total taxa richness was reported to be 33 at the upstream site and 31 at the downstream site. Because the level of taxonomic identification may have been different in the 1980 data set than in the 2009 data set, it may not be appropriate to compare the taxa richness numbers between the two years. Instead, looking at the spatial difference in 1980 and the spatial difference in 2009, it appears that total richness was similar at the two sites in 1980, but by 2009 total richness was markedly decreased at the downstream site when compared to the upstream site. Similarly, in 1980, EPT richness showed only a slight change downstream (decreasing from 16 to 14), while in 2009, EPT richness decreased substantially from upstream to downstream.

The 1980 data also showed a very slight, almost negligible, decrease in diversity as measured by the Shannon Diversity Index from the upper site (3.46) to the lower site (3.33). Overall, this index indicates a degradation of macroinvertebrate community structure between 1980 and 2009, at both the upstream and downstream sites.

While the CTQd was not calculated in the 1980 study, the related Actual Community Tolerance Quotient (CTQa) was. It may not be appropriate to compare the 2009 CTQd at a given site with the 1980 CTQa at the same site, since the equations use to calculate these measures are different. However, both measures use the same taxa-specific tolerance quotients, so there is some validity in comparing the spatial trend in 1980 with the spatial trend in 2009. As noted above, the 2009 CTQd indicated some degradation between the upstream and downstream sites. In contrast, in 1980, both the upstream and the downstream sites had a CTQa of 60, indicating a similar condition in both locations (i.e. no degradation).

Because sampling locations for the 1994 study are not known, and because metrics were not compiled, that study is less useful for assessing temporal trends beyond what is briefly discussed above. Interestingly, several taxa that were prevalent in 2009 were not reported at all in 1994. No *Baetis* were collected in 1994, though they were found in large numbers both in 1980 and 2009. While the 1980 and 2009 data showed significant numbers of *Pericoma* at the upstream site (where it was the dominant taxa in 2009), it was not reported at all in 1994. Though a large number of *Pisidiinae Pisidium* (a mollusk) was sampled at CRANDMD-02, none were reported in either 1980 or 1994.

As noted, there are numerous limitations in assessing temporal trends between 1980 and 2009, but the 2009 data can provide the basis for comparisons with data that will be collected more regularly beginning in spring 2010.

5.3 Indication of Iron-specific Impacts

As described above, the data indicate that there is some degradation in the aquatic community between CRANDUP-01 and CRANDMD-02. That degradation also appears to continue downstream to CRANDLWR-03. Attributing the degradation directly to iron in Genwal's groundwater discharge is problematic. First, there are no specific taxa or collection of taxa that are known to be absent (or present) in iron-laden waters. Second, there are other variables besides iron that are at play between CRANDUP-01 and CRANDMD-02: most noticeably, Genwal's discharge adds considerably more flow volume and is significantly warmer during at least fall and winter months. Last, even attributing the change in macroinvertebrate community to Genwal's discharge as opposed to other factors (either anthropogenic, natural, or due to inherent variability) is based somewhat on assumptions of cause and effect. However, given that water quality sampling has verified that iron is present in Genwal's discharge in elevated concentrations and that the stream bed has been visibly altered by iron precipitates, the most reasonable assessment is that iron is, at least in large part, responsible for impacts to macroinvertebrate community downstream of the discharge. Whether these are due to iron dissolved in the water column, iron present as suspended or colloidal particles, or iron precipitated onto the streambed cannot be distinguished with the available data and the current level of analysis. However, while there are no known iron indicator taxa, the literature does provide evidence of macroinvertebrate sensitivity to water containing various heavy metals, including iron. This type of information provides the basis for much of the following discussion.

While analyzing the effects on macroinvertebrates of using wetlands to treat landfill effluent, Moolamoottil et al (1999) reviewed literature that discussed iron toxicity and macroinvertebrates. Their analysis concluded that the EPT taxa were more sensitive to iron and Diptera were more tolerant, which are similar conclusions as most of the literature that assesses poor water quality in general. Based upon these measures, as discussed more fully above, there is support for the finding that iron has affected the macroinvertebrate community in Crandall Creek. In contrast, however, their study also included Coleoptera as an iron-sensitive family and CRANDMD-02 had more organisms in this family than either CRANDUP-01 or CRANDLWR-03. Two other species of caddisfly (*Glossosoma* spp. and *Neophylax* spp.) were also indicated as sensitive to iron (at least when it results in bacterial blooms), but neither were identified at all in Crandall Creek, including at the upstream site. Another caddisfly, Hydropsychidae family, was also considered to be sensitive to iron and iron-loving bacteria by Moolamoottil et al (1999). But, coming to the opposite conclusion, Mize and Deacon (2003) found members of this family to be tolerant of trace metals in general. In any case, this family was more prevalent downstream of Genwals' discharge than upstream of it.

Much of the knowledge regarding the effects of heavy metals on macroinvertebrate communities has been derived through study of acid mine drainage (AMD). AMD is known to degrade the water quality and aquatic habitat of receiving streams by contributing significant levels of dissolved metals, including iron. Many of the metals typically found in AMD are more toxic than iron and are more likely to be elevated, so the related literature often does not specifically address iron, but instead focuses on a constellation of other more toxic heavy metals. For example, Giddings et al (2001) studied the relationship of trace metals and macroinvertebrates in several Utah streams, but focused on priority metals such as lead, mercury, and zinc.

Studies that do include iron as a constituent of concern because it is elevated, often address the elevation of numerous other metals and low pH that often go hand-in-hand. This makes it difficult to separate out the effects of iron alone. In a study comparing water quality, sediment, and macroinvertebrates in mining and nonmining sites in Colorado (Mize and Deacon 2002), the mining sites were found to have different macroinvertebrate communities than the nonmining sites. Mining sites had significantly lower total abundance, fewer taxa, and decreased EPT richness when compared to the nonmining sites. Similarly, a study of mine-affected streams in Washington found that elevated heavy metals concentrations resulted in decreased density and diversity of benthic macroinvertebrates, as compared to the non-affected upstream sites (Peplow 1999), though iron was not among the metals that were present in the study stream at high concentrations. The Crandall Creek results showed similar relationships.

The Mize and Deacon (2002) study also found larger percentages of tolerant species at the mining sites, and specifically noted that *Baetis*, Hydropsychidae, Orthocladiinae, and chironomids appeared to be tolerant of elevated trace-element concentrations. Conversely, they attributed the scarcity of Heptageniidae, Chloroperlidae, and *Rhyacophila* spp. at mining sites to their sensitivity to elevated trace-element concentrations. These six taxa were analyzed in the Crandall data set (see Appendix 2), and similar inferences can be made regarding the effect of Genwal's discharge.

In a study that attempted to differentiate macroinvertebrate tolerance among specific individual heavy metals, including iron, Beasley and Kneale (2003) sampled stream sediments subjected to runoff with varying levels of metal pollution. Among its results were rankings of the five macroinvertebrate families most sensitive to iron and the five most tolerant. The study reported some inconsistencies in results (thought in part to be due to the interaction between variations in life cycle and the seasonality of the sampling) and had a different focus than the issue being studied in Crandall Creek. Even so, the September 2009 Crandall Creek macroinvertebrate lists were compared to the two sets of families to see if there appeared to be any parallels. While three of the five most iron-sensitive families, as determined in the Beasley and Kneale (2003) study (Heptageniidae, Perlodidae, and Rhyacophilidae), were among the families reported in the September 2009 Crandall Creek survey, there were no definitive relationships. For example, two of the supposedly most iron-sensitive families were found at CRANDMD-02 (all three were found at CRANDUP-01 and one was found at CRANDWLR-03).

Heptageniidae is indicated by numerous authors and studies to be one of the best single indicators for metals pollution over other types of stream perturbations (Kiffney and Clements 1994; Clements 1994). Although the previous caveats regarding the use of a single metric still apply, it is noteworthy that this family of Ephemeroptera was found only at CRANDUP-01, where it made up about 7 percent of all Ephemeroptera individuals samples (see metrics in Appendix 2). No organisms in this family were found at either CRANDMD-02 or CRANDLWR-03. This provides another strong indication that iron has impacts these downstream receiving waters.

6.0 Recommendations for Future Study

As discussed previously, the data collected in September 2009 are primarily useful in assessing spatial variation in macroinvertebrate communities along Crandall Creek. This allows some inference into impacts from Genwal's discharge as discussed. However, future studies can provide the ability to examine temporal variation and provide some level of statistical analysis. In order to make the data comparable between years, some consistency in sampling methodology should be maintained. However, there were also several shortcomings of the September 2009 sample methodology that should be addressed. These shortcomings primarily include the type of net used for sampling and the types of habitats sampled.

The September 2009 sampling was conducted using a 1,000-micron mesh Surber sampler. Both the EMAP manual and the DWQ manual specify using a 500-micron kick net. In a comparison of sample methodologies, Lenz and Miller (1998) found that the mesh size used in sample nets affected the macroinvertebrate community structure indicated by the samples. Specifically, samples taken using nets with larger mesh sizes had fewer taxa than samples taken with smaller mesh sized nets. Species and genera richness were also lower in samples collected using nets with larger mesh sizes. The differences in community structure also led to variation in several indices, such as percentage EPT and ratio of scrapers to collectors. However, water quality indices that are based on environmental tolerance values were not affected by the differences in community structure (Lenz and Miller 1998). Although mesh size does not affect the current results pertaining to spatial variability and possible impacts (as all sites were sampled using the same equipment and methods), the reduced abundance and richness noted in the September 2009 samples may be due to the use of a larger mesh size net. As a result, it seems reasonable at this time to change to a 500-micron mesh kick net. This would allow for better assessment of overall stream health relevant to other streams, and many of the water quality indices used in this report would be comparable. In addition, use of a kick net would allow more sampling flexibility, particularly in slow water habitats.

The September 2009 samples were collected from multiple habitat types in each reach. This allows for a good general assessment of stream health relative to other streams. However, since the habitat types varied somewhat between each reach, the comparison of data between sites may not be as robust as if the same habitat types were sampled within each reach. As a result, JBR recommends that future sampling include both a composite reach-wide sample at each site (using the same methodology described here), as well as a targeted riffle sample at each site. The targeted riffle sample would be collected following EMAP methodology, which collects eight samples from four different riffles in each reach. The eight samples are then combined into a composite sample that is sent to the lab for analysis. Taking both samples at each site would allow for a better comparison among sites and a better assessment of impacts, while still allowing for an overall assessment of stream health that can be compared to other areas on the Manti-La Sal National Forest.

7.0 Summary and Conclusions

In September 2009, benthic macroinvertebrate samples were collected from three reaches of Crandall Creek. One reach was located upstream of Genwal's Crandall Canyon Mine groundwater discharge, which has become iron-laden in recent months. The other two reaches were located downstream of the discharge. One of the primary goals of the study was to determine whether the elevated iron concentrations have impacted Crandall Creek's macroinvertebrate population. Macroinvertebrate community composition at these three reaches was determined by taxonomic identification of the organisms collected during the September sampling, and numerous indices and metrics were calculated for ease in interpreting results.

Overall, the study results indicate that the Crandall Creek macroinvertebrate community downstream of the mine's discharge has been negatively impacted. Further, results indicate that the impact has not been confined to immediately downstream of the discharge; instead it has occurred as far down as the lowermost sampled site near the mouth of Crandall Creek. However, both downstream reaches of the creek are still supporting a variety of macroinvertebrates, indicating that the discharge has not rendered the stream sterile. Last, the study results indicated that even Crandall Creek upstream of the mine discharge is in less than optimum condition, based on the sampled macroinvertebrate community.

Although there are some historical data for macroinvertebrates in Crandall Creek, these data were of limited use to assess temporal changes. However, those data generally supported the conclusions derived from the analysis of the 2009 data set.

Future sampling will provide additional data, which will be used to assess continued impact or recovery as the iron-laded discharge is treated. Recommendations have been made to refine the sampling methodology so as to enhance the ability to assess both spatial and temporal trends.

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DRAFT
Huntington Creek
CRANDLWR-03
CRANDMD-02
CRANDUP-01
© 2010 Google
Image State of Utah
Image USDA Farm Service Agency
Google
39°27'43.65" N 111°09'31.00" W
elev 7650 ft
2006
Eye alt 15071 ft

APPENDIX 1
BUGLAB REPORT

Aquatic invertebrate report for samples collected by JBR Environmental Consultants

Report prepared for:
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16 October 2009

Sampling Locations

Table 1. Sampling site locations

Station	Location	Latitude	Longitude	Elevation (meters)
CRANDLWR-03	Crandall Creek, Lower, Emery County, Utah	39.464	-111.146	2363
CRANDMD-02	Crandall Creek, Middle, Emery County, Utah	39.460	-111.165	2384
CRANDUP-01	Crandall Creek, Upstream, Emery County, Utah	39.460	-111.168	2389

Methods

Field sampling

Samples were collected on September 16, 2009 (Table 2). Aquatic invertebrates were collected quantitatively from riffle habitats with a Surber net with a 1000 micron mesh net.

Laboratory methods

General procedures for processing invertebrate samples were similar to those recommended by the United States Geological Survey (Cuffney et al. 1993) and are described in greater detail and rationalized in Vinson and Hawkins (1996). Samples were sub-sampled if the sample appeared to contain more than 600 organisms. Sub-samples were obtained by pouring the sample into an appropriate diameter 500 micron sieve, floating this material by placing the sieve within an enamel pan partially filled with water and leveling the material within the sieve. The sieve was then removed from the water pan and the material within the sieve was divided into two equal parts. One half of the sieve was then randomly chosen to be processed and the other half set aside. The sieve was then placed back in the enamel pan and the material in the sieve again leveled and split in half. This process was repeated until approximately 600 organisms remained in one-half of the sieve. This material was placed into a Petri dish and all organisms were removed under a dissecting microscope at 10-30 power. Additional sub-samples were taken until at least 600 organisms were removed, All organisms within a sub-sample were removed, and separated into taxonomic Orders. When the sorting of the sub-samples was completed, the entire sample was spread throughout a large white enamel pan and searched for 10 minutes to remove any taxa that might not have been picked up during the initial sample sorting process. The objective of this "big/rare" search was to provide a more complete taxa list by finding rarer taxa that may have been excluded during the sub-sampling process. These rarer bugs were placed into a separate vial and the data entered separately from the bugs removed during the sub-sampling process. All the organisms removed during the sorting process were then identified using appropriate identification keys (see literature cited list for list of taxonomic resources used). Once the data had been entered into a computer and checked, the unsorted portion of the sample was discarded. The identified portion of the sample was placed in a 20 ml glass scintillation vial with polypropylene lids in 70% ethanol, given a catalog number, and retained. In this report, metrics were calculated using data from the sub-sampled and big/rare portions of the sample. Abundance data are presented as the estimated number of individuals per square meter for quantitative samples and the estimated number per sample for qualitative samples.

Table 2. Field comments and laboratory processing information.

Sample	Station	Sampling Date	Habitat Sampled	Sampling Method	Sampling Area Sqmts	% of sample processed	Number of individuals identified	Field Comments
141394	CRANDUP-01	09/16/2009	Multiple	Surber net	0.46	100	369	
141395	CRANDMD-02	09/16/2009	Multiple	Surber net	0.46	100	275	
141396	CRANDLWR-03	09/16/2009	Multiple	Surber net	0.46	100	274	

Data summarization

A number of metrics or ecological summaries can be calculated from an aquatic invertebrate sample. A summary and description of commonly used metrics is available in Barbour et al. (1999, http://www.epa.gov/owow/monitoring/rbp/index.html#Table%20of%20Contents) and Karr and Chu (1998). Both of these publications suggest use of the following metrics for assessing the health of aquatic invertebrate assemblages: Total taxa richness, EPT taxa richness, Ephemeroptera taxa richness, Plecoptera taxa richness, Trichoptera taxa richness, % EPT abundance, % Ephemeroptera abundance, % Chironomidae abundance, Intolerant taxa richness, % tolerant organisms, Hilsenhoff Biotic Index, % contribution of the dominant taxon, clinger taxa richness, % clinger abundance, % collector-filterer abundance, and the % scraper abundance. Assessments are best made by comparing samples to samples collected similarly at reference sites or from samples collected prior to impacts or management actions at a location. In this report, the following metrics were calculated for each sample.

Taxa richness - Richness is a component and estimate of community structure and stream health based on the number of distinct taxa. Taxa richness normally decreases with decreasing water quality. In some situations organic enrichment can cause an increase in the number of pollution tolerant taxa. Taxa richness was calculated for operational taxonomic units (OTUs) and the number of unique genera, and families. The values for operational taxonomic units may be overestimates of the true taxa richness at a site if individuals were the same taxon as those identified to lower taxonomic levels or they may be underestimates of the true taxa richness if multiple taxa were present within a larger taxonomic grouping but were not identified. All individuals within all samples were generally identified similarly, so that comparisons in operational taxonomic richness among samples within this dataset are appropriate, but comparisons to other data sets may not. Comparisons to other datasets should be made at the genera or family level.

Abundance - The abundance, density, or number of aquatic macroinvertebrates per unit area is an indicator of habitat availability and fish food abundance. Abundance may be reduced or increased depending on the type of impact or pollutant. Increased organic enrichment typically causes large increases in abundance of pollution tolerant taxa. High flows, increases in fine sediment, or the presence of toxic substances normally cause a decrease in invertebrate abundance. Invertebrate abundance is presented as the number of individuals per square meter for quantitative samples and the number of individuals collected in each sample for qualitative samples.

EPT - A summary of the taxonomic richness and abundance within the insect Orders Ephemeroptera, Plecoptera, and Trichoptera (EPT). These orders are commonly considered sensitive to pollution (Karr and Chu 1998).

Percent contribution of the dominant family or taxon - An assemblage largely dominated (>50%) by a single taxon or several taxa from the same family suggests environmental stress. Habitat conditions likely limit the number of taxa that can occur at the site.

Shannon diversity index - Ecological diversity is a measure of community structure defined by the relationship between the number of distinct taxa and their relative abundances. The Shannon diversity index was calculated for each sampling location for which there were a sufficient number of individuals and taxa collected to perform the calculations. The calculations were made following Ludwig and Reynolds (1988, equation 8.9, page 92).

Evenness - Evenness is a measure of the distribution of taxa within a community. The evenness index used in this report was calculated following Ludwig and Reynolds (1988, equation 8.15, page 94). Value ranges from 0-1 and approach zero as a single taxa becomes more dominant.

Clinger taxa - The number of clinger taxa have been found by Karr and Chu (1998) to respond negatively to human disturbance. Clinger taxa were determined using information in Merritt et al. (2008). These taxa typically cling to the tops of rocks and are thought to be reduced by sedimentation or abundant algal growths.

Long-live taxa - The number of long-lived taxa was calculated the number of taxa collected that typically have 2-3 year life cycles. Disturbances and water quality and habitat impairment typically reduces the number of long-lived taxa Karr and Chu (1998). Life-cycle length determinations were based on information in Merritt et al. (2008).

Biotic indices - Biotic indices use the indicator taxa concept. Taxa are assigned water quality tolerance values based on their tolerance to pollution. Scores are typically weighted by taxa relative abundance. In the United States the most commonly used biotic index is the Hilsenhoff Biotic Index (Hilsenhoff 1987, Hilsenhoff 1988). The USFS and BLM throughout the western United States have also frequently used the USFS Community Tolerance Quotient.

Hilsenhoff biotic index - The Hilsenhoff Biotic Index (HBI) summarizes the overall pollution tolerances of the taxa collected. This index has been used to detect nutrient enrichment, high sediment loads, low dissolved oxygen, and thermal impacts. It is best at detecting organic pollution. Families were assigned an index value from 0- taxa normally found only in high quality unpolluted water, to 10- taxa found only in severely polluted waters. Family level values were taken from Hilsenhoff (1987, 1988) and a family level HBI was calculated for each sampling location for which there were a sufficient number of individuals and taxa collected to perform the calculations. Sampling locations with HBI values of 0-2 are considered clean, 2-4 slightly enriched, 4-7 enriched, and 7-10 polluted. Rather than using mean HBI values for a sample, taxon HBI values can also be used to determine the number of pollution intolerant and tolerant taxa occurring at a site. In this report, taxa with HBI values ≤ 1 were considered intolerant clean water taxa and taxa with HBI values ≥ 9 were considered pollution tolerant taxa. The number of tolerant and intolerant taxa and the abundances of tolerant and intolerant taxa were calculated for each sampling location.

USFS community tolerant quotient - Taxa are assigned a tolerant quotient (TQ) from 2 - taxa found only in high quality unpolluted water, to 108 - taxa found in severely polluted waters. TQ values were developed by Winget and Mangum (1979). The dominance weighted community tolerance quotient (CTQd) was calculated. Values can vary from about 20 to 100, in general the lower the value the better the water quality.

Functional feeding group measures - A common classification scheme for aquatic macroinvertebrates is to categorize them by feeding acquisition mechanisms. Categories are based on food particle size and food location, e.g., suspended in the water column, deposited in sediments, leaf litter, or live prey. This classification system reflects the major source of the resource, either within the stream itself or from riparian or upland areas and the primary location, either erosional or depositional habitats. The number of taxa and individuals of the following feeding groups were calculated for each sampling location. Functional feeding group designations were from Merritt et al. (2008).

Shredders - Shredders use both living vascular hydrophytes and decomposing vascular plant tissue - coarse particulate organic matter. Shredders are sensitive to changes in riparian vegetation. Shredders can be good indicators of toxicants that adhere to organic matter.

Scrapers - Scrapers feed on periphyton - attached algae and associated material. Scraper populations increase with increasing abundance of diatoms and can decrease as filamentous algae, mosses, and vascular plants increase, often in response to increases in nitrogen and phosphorus. Scrapers decrease in relative abundance in response to sedimentation and higher levels of organic pollution or nutrient enrichment.

Collector-filterers - Collector-filterers feed on suspended fine particulate organic matter. Collector-filterers are sensitive to toxicants in the water column and to pollutants that adhere to organic matter.

Collector-gatherers - Collector-gatherers feed on deposited fine particulate organic matter. Collector-gatherers are sensitive to deposited toxicants.

Predators - Predators feed on living animal tissue. Predators typically make up about 25% of the assemblage in stream environments and 50% of the assemblage in still-water environments.

Unknown feeding group - This category includes taxa that are highly variable, parasites, and those that for which the primary feeding mode is currently unknown.

Results

Abundance data and taxa richness are reported as the estimated number of individuals per square meter for quantitative samples and the number per sample for qualitative samples. NC = Not calculated. * = unable to calculate. EPT = totals for the insect orders, Ephemeroptera, Plecoptera, Trichoptera. QL = qualitative sample.

Sample	Sampling date	Station	Total abundance	EPT abundance	Dominant family	% contribution dominant family
141394	09/16/2009	CRANDUP-01	794	217	Psychodidae	25.18
141395	09/16/2009	CRANDMD-02	592	133	Chironomidae	36.32
141396	09/16/2009	CRANDLWR-03	590	194	Baetidae	25.94
Mean			658.7	181.3		29.14

Diversity indices

Sample	Sampling Date	Station	Total taxa richness	Total genera richness	Total family richness	EPT taxa richness	Shannon diversity index	Evenness
141394	09/16/2009	CRANDUP-01	40	22	23	16	2.780	0.750
141395	09/16/2009	CRANDMD-02	32	20	20	11	2.540	0.730
141396	09/16/2009	CRANDLWR-03	28	12	17	10	2.500	0.750
Mean			33.3	18.0	20.0	12.3	2.610	0.750

Genera richness by major taxonomic group.

Sample	Sampling Date	Station	Coleoptera	Diptera	Ephemerotpera	Heteroptera	Megaloptera	Odonata	Plecoptera	Trichoptera	Annelida	Custacea	Mollusca
141394	09/16/2009	CRANDUP-01	1	18	5	0	0	0	6	5	1	0	1
141395	09/16/2009	CRANDMD-02	2	14	1	0	0	0	6	4	1	0	1
141396	09/16/2009	CRANDLWR-0	1	15	3	0	0	0	4	3	1	0	1
Mean			**1.3**	**15.7**	**3.0**	**0.0**	**0.0**	0.0	**5.3**	**4.0**	1.0	**0.0**	**1.0**

Total abundance by major taxonomic group.

Sample	Sampling Date	Station	Coleoptera	Diptera	Ephemerotpera	Heteroptera	Megaloptera	Odonata	Plecoptera	Trichoptera	Annelida	Custacea	Mollusca
141394	09/16/2009	CRANDUP-01	2	549	95	0	0	0	65	58	2	0	2
141395	09/16/2009	CRANDMD-02	13	297	41	0	0	0	58	34	6	0	116
141396	09/16/2009	CRANDLWR-0 3	9	329	155	0	0	0	32	6	22	0	37
Mean			8.0	391.7	97.0	0.0	0.0	0.0	51.7	32.7	10.0	0.0	51.7

Biotic Indices

Sample	Sampling date	Station	Hilsenhoff Biotic Index		USFS Community CTQd
			Index	Indication	
141394	09/16/2009	CRANDUP-01	5.28	Some organic pollution	71
141395	09/16/2009	CRANDMD-02	3.56	Possible slight organic pollution	78
141396	09/16/2009	CRANDLWR-03	3.82	Possible slight organic pollution	79
Mean			4.22		76.0

Taxa richness and relative abundance values with respect to tolerance or intolerance to pollution were based on the Hilsenhoff Biotic Index (HBI). Intolerant taxa have HBI score <= 1. Tolerant taxa have a HBI score >= 9. Data are presented as estimated count per square meter for quantitative samples and total number per sample for qualitative samples.

Sample	Sampling date	Station	Intolerant taxa Richness		Intolerant taxa Abundance		Tolerant Taxa Richness		Tolerant Taxa Abundance	
141394	09/16/2009	CRANDUP-01	11	(28)	136	(17)	1	(3)	200	(25)
141395	09/16/2009	CRANDMD-02	8	(25)	75	(13)	1	(3)	4	(1)
141396	09/16/2009	CRANDLWR-0	5	(18)	34	(6)	1	(4)	2	(0)
Mean			8.0	(23)	81.7	(12)	1.0	(3)	68.7	(9)

Functional feeding groups

Taxa richness by functional feeding group. The percent of the total is shown in parentheses.

Sample	Sampling date	Station	Shredders		Scrapers		Collector-filterers		Collector-gatherers		Predators		Unknown	
141394	09/16/2009	CRANDUP-01	7	(18)	1	(3)	5	(13)	11	(28)	14	(35)	1	(3)
141395	09/16/2009	CRANDMD-02	6	(19)	1	(3)	2	(6)	8	(25)	14	(44)	1	(3)
141396	09/16/2009	CRANDLWR-0	3	(11)	0	(0)	4	(14)	7	(25)	10	(36)	4	(14)
Mean			5.3	(16)	0.7	(2)	3.7	(11)	8.7	(26)	12.7	(38)	2.0	(7)

Invertebrate abundance by functional feed group. The percent of the total is shown in parentheses.

Sample	Sampling date	Station	Shredders		Scrapers		Collector-filterers		Collector-gatherers		Predators		Unknown	
141394	09/16/2009	CRANDUP-01	125	(16)	6	(1)	26	(3)	489	(62)	144	(18)	2	(0)
141395	09/16/2009	CRANDMD-02	32	(5)	2	(0)	131	(22)	276	(47)	140	(24)	11	(2)
141396	09/16/2009	CRANDLWR-0	19	(3)	0	(0)	62	(11)	385	(65)	108	(18)	15	(3)
Mean			58.7	(8)	2.7	(0)	73.0	(12)	383.3	(58)	130.7	(20)	9.3	(2)

The 10 metrics thought to be most responsive to human induced disturbance (Karr and Chu 1998).

Sample	Sampling Date	Station	Total taxa	Epheme-roptera taxa	Plecoptera taxa	Trichoptera taxa	Long-lived taxa	Intolerant taxa	Clinger taxa	% tolerant indi-viduals	% contribution dominant taxon	% predators
141394	09/16/2009	CRANDUP-01	40	2	3	4	2	11	9	25.18	25.18	18.13
141395	09/16/2009	CRANDMD-02	32	1	4	3	3	8	6	0.68	31.25	23.65
141396	09/16/2009	CRANDLWR-03	28	1	1	0	1	5	5	0.34	24.07	18.31
Mean			33.3	1.3	2.7	2.3	2.0	8.0	6.7	8.73	26.83	20.03

Taxonomic list and counts for 3 samples collected on September 16, 2009. Count is the total number of individuals identified and retained. Samples heading refers to the number of samples contain that taxon.

Order	Family	Subfamily/Genus/Species	Samples	Count
Phylum: Annelida				
Class: Clitellata	SubClass: Oligochaeta			
			3	14
Phylum: Arthropoda				
Class: Arachnida	SubClass: Acari			
Trombidiformes	Hydryphantidae	Protzia	1	1
Trombidiformes	Lebertiidae	Lebertia	2	13
Trombidiformes	Sperchonidae	Sperchon	2	7
Class: Insecta	SubClass: Pterygota			
Coleoptera	Dryopidae	Postelichus	1	1
Coleoptera	Elmidae	Narpus concolor	2	9
Coleoptera	Elmidae	Optioservus	1	1
Diptera			1	1
Diptera	Ceratopogonidae		1	1
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	3	16
Diptera	Chironomidae		3	19
Diptera	Chironomidae	Chironominae	2	14
Diptera	Chironomidae	Orthocladiinae	3	201
Diptera	Empididae		3	4
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	3	26
Diptera	Muscidae		3	9
Diptera	Psychodidae	Pericoma	3	96
Diptera	Simuliidae	Simuliinae Simuliini Simulium	2	17
Diptera	Simuliidae	Simuliinae Simuliini Simulium arcticum group	1	1
Diptera	Simuliidae	Simuliinae Simuliini Simulium tuberosum	1	2
Diptera	Stratiomyidae	Caloparyphus	1	2
Diptera	Stratiomyidae	Euparyphus	2	4
Diptera	Tabanidae		1	1
Diptera	Tipulidae		1	2
Diptera	Tipulidae	Dicranota	3	17
Diptera	Tipulidae	Hexatoma	2	7
Diptera	Tipulidae	Limoniinae Antocha monticola	2	42
Diptera	Tipulidae	Limoniinae Eriopterini Ormosia	1	17
Diptera	Tipulidae	Limoniinae Hexatomini Limnophila	1	11
Diptera	Tipulidae	Pedicia	1	1
Diptera	Tipulidae	Tipulinae Tipula	3	35
Ephemeroptera			1	1
Ephemeroptera	Baetidae		1	5
Ephemeroptera	Baetidae	Baetis	3	112
Ephemeroptera	Ephemerellidae		1	3
Ephemeroptera	Ephemerellidae	Drunella grandis	1	6
Ephemeroptera	Heptageniidae		1	3
Ephemeroptera	Leptophlebiidae		1	5
Plecoptera	Capniidae	Capniinae	3	5
Plecoptera	Chloroperlidae		1	1
Plecoptera	Nemouridae		1	6
Plecoptera	Nemouridae	Amphinemurinae Amphinemura	1	1

Plecoptera	Nemouridae	Zapada cinctipes	2	7
Plecoptera	Nemouridae	Zapada oregonensis group	2	18
Plecoptera	Perlodidae		3	22
Plecoptera	Perlodidae	Isoperlinae Isoperla	2	7
Plecoptera	Perlodidae	Megarcys signata	1	5
Trichoptera			1	1
Trichoptera	Brachycentridae		1	1
Trichoptera	Hydropsychidae		1	1
Trichoptera	Hydropsychidae	Arctopsychinae Parapsyche	2	8
Trichoptera	Limnephilidae		2	7
Trichoptera	Limnephilidae	Limnephilinae Limnephilini Hesperophylax	1	1
Trichoptera	Rhyacophilidae	Rhyacophila	2	7
Trichoptera	Rhyacophilidae	Rhyacophila vofixa group	2	20
Phylum: Mollusca				
Class: Bivalvia	SubClass: Heterodonta			
Veneroida	Pisidiidae	Pisidiinae Pisidium	3	72
Phylum: Nemata				
Class:	SubClass:			
			1	1

Total: OTU Taxa : **57** Genera : **33** Families : **28** Individuals : **918**

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Taxa Lists for Individual Samples

Taxonomic list and densities of aquatic invertebrates identified and retained from a sample collected September 16, 2009 at station CRANDUP-01, Crandall Creek, Upstream, Emery county, Utah. The sample was collected from multiple habitat using a surber net. The total area sampled was 0.465 square meters. The percentage of the sample that was identified and retained was 100% of the collected sample. A total of 369 individuals were removed, identified and retained. The sample identification number is 141394. OTU=operational taxonomic unit. Notes - identification to genus or species was not spported because: I - immature organisms, D- damaged organisms, M - poor slide mount, G - gender, U - indistint characters or distribution, R - retained in our reference collection.

Order	Family	Subfamily/Genus/Species	Life Stage	Density	Notes
Phylum: Annelida					
Class: Clitellata		SubClass: Oligochaeta			
			adult	2.15	
Phylum: Arthropoda					
Class: Arachnida		SubClass: Acari			
Trombidiformes	Lebertiidae	Lebertia	adult	10.76	
Trombidiformes	Sperchonidae	Sperchon	adult	8.61	
Class: Insecta		SubClass: Pterygota			
Coleoptera	Dryopidae	Postelichus	adult	2.15	
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	larvae	12.92	
Diptera	Chironomidae		pupae	19.37	
Diptera	Chironomidae	Chironominae	larvae	10.76	
Diptera	Chironomidae	Orthocladiinae	larvae	137.78	
Diptera	Empididae		pupae	2.15	
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	larvae	6.46	
Diptera	Muscidae		larvae	6.46	
Diptera	Psychodidae	Pericoma	larvae	200.21	
Diptera	Simuliidae	Simuliinae Simuliini Simulium	larvae	15.07	
Diptera	Simuliidae	Simuliinae Simuliini Simulium arcticum group	pupae	2.15	
Diptera	Simuliidae	Simuliinae Simuliini Simulium tuberosum group	pupae	4.31	
Diptera	Stratiomyidae	Euparyphus	larvae	4.31	
Diptera	Tipulidae	Dicranota	larvae	2.15	
Diptera	Tipulidae	Limoniinae Antocha monticola	larvae	2.15	
Diptera	Tipulidae	Limoniinae Eriopterini Ormosia	larvae	36.60	
Diptera	Tipulidae	Limoniinae Hexatomini Limnophila	larvae	23.68	
Diptera	Tipulidae	Pedicia	larvae	2.15	
Diptera	Tipulidae	Tipulinae Tipula	larvae	60.28	
Ephemeroptera	Baetidae	Baetis	larvae	58.12	
Ephemeroptera	Ephemerellidae		larvae	6.46	I
Ephemeroptera	Ephemerellidae	Drunella grandis	larvae	12.92	
Ephemeroptera	Heptageniidae		larvae	6.46	D
Ephemeroptera	Leptophlebiidae		larvae	10.76	D
Plecoptera	Capniidae	Capniinae	larvae	4.31	I
Plecoptera	Nemouridae		larvae	12.92	D
Plecoptera	Nemouridae	Zapada cinctipes	larvae	2.15	
Plecoptera	Nemouridae	Zapada oregonensis group	larvae	30.14	
Plecoptera	Perlodidae		larvae	4.31	D,I
Plecoptera	Perlodidae	Megarcys signata	larvae	10.76	
Trichoptera	Hydropsychidae	Arctopsychinae Parapsyche	larvae	2.15	
Trichoptera	Limnephilidae		pupae	6.46	
Trichoptera	Limnephilidae	Limnephilinae Limnephilini Hesperophylax	larvae	2.15	
Trichoptera	Rhyacophilidae	Rhyacophila	larvae	10.76	I
Trichoptera	Rhyacophilidae	Rhyacophila vofixa group	larvae	30.14	
Phylum: Mollusca					
Class: Bivalvia		SubClass: Heterodonta			

Veneroida	Pisidiidae	Pisidiinae Pisidium		adult	2.15
Phylum: Nemata					
Class:		SubClass:			
				adult	2.15

Total:	OTU Taxa : **40**	Genera : **26**	Families : **23**	794.36

Taxonomic list and densities of aquatic invertebrates identified and retained from a sample collected September 16, 2009 at station CRANDMD-02, Crandall Creek, Middle, Emery county, Utah. The sample was collected from multiple habitat using a surber net. The total area sampled was 0.465 square meters. The percentage of the sample that was identified and retained was 100% of the collected sample. A total of 275 individuals were removed, identified and retained. The sample identification number is 141395. OTU=operational taxonomic unit. Notes - identification to genus or species was not spported because: I - immature organisms, D- damaged organisms, M - poor slide mount, G - gender, U - indistint characters or distribution, R - retained in our reference collection.

Order	Family	Subfamily/Genus/Species	Life Stage	Density	Notes
Phylum: Annelida					
Class: Clitellata		SubClass: Oligochaeta			
			larvae	6.46	
Phylum: Arthropoda					
Class: Arachnida		SubClass: Acari			
Trombidiformes	Hydryphantidae	Protzia	adult	2.15	
Trombidiformes	Lebertiidae	Lebertia	adult	17.22	
Trombidiformes	Sperchonidae	Sperchon	adult	6.46	
Class: Insecta		SubClass: Pterygota			
Coleoptera	Elmidae	Narpus concolor	larvae	10.76	
Coleoptera	Elmidae	Optioservus	larvae	2.15	
Diptera	Ceratopogonidae		larvae	2.15	
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	larvae	19.37	
Diptera	Chironomidae		pupae	10.76	
Diptera	Chironomidae	Chironominae	larvae	19.37	
Diptera	Chironomidae	Orthocladiinae	larvae	185.14	
Diptera	Empididae		pupae	2.15	
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	larvae	21.53	
Diptera	Muscidae		larvae	10.76	
Diptera	Psychodidae	Pericoma	larvae	4.31	
Diptera	Stratiomyidae	Caloparyphus	larvae	4.31	
Diptera	Stratiomyidae	Euparyphus	larvae	4.31	
Diptera	Tipulidae	Dicranota	larvae	6.46	
Diptera	Tipulidae	Hexatoma	larvae	2.15	
Diptera	Tipulidae	Tipulinae Tipula	larvae	4.31	
Ephemeroptera	Baetidae	Baetis	larvae	40.90	
Plecoptera	Capniidae	Capniinae	larvae	2.15	I
Plecoptera	Nemouridae	Amphinemurinae Amphinemura	larvae	2.15	
Plecoptera	Nemouridae	Zapada cinctipes	larvae	12.92	
Plecoptera	Nemouridae	Zapada oregonensis group	larvae	8.61	
Plecoptera	Perlodidae		larvae	19.37	I
Plecoptera	Perlodidae	Isoperlinae Isoperla	larvae	12.92	
Trichoptera	Hydropsychidae	Arctopsychinae Parapsyche	larvae	15.07	
Trichoptera	Limnephilidae		larvae	2.15	I
Trichoptera	Rhyacophilidae	Rhyacophila	larvae	4.31	I
Trichoptera	Rhyacophilidae	Rhyacophila vofixa group	larvae	12.92	
Phylum: Mollusca					
Class: Bivalvia		SubClass: Heterodonta			
Veneroida	Pisidiidae	Pisidiinae Pisidium	adult	116.25	
Total: OTU Taxa : **32**		Genera : **22**	Families : **20**	592.00	

Taxonomic list and densities of aquatic invertebrates identified and retained from a sample collected September 16, 2009 at station CRANDLWR-03, Crandall Creek, Lower, Emery county, Utah. The sample was collected from multiple habitat using a surber net. The total area sampled was 0.465 square meters. The percentage of the sample that was identified and retained was 100% of the collected sample. A total of 274 individuals were removed, identified and retained. The sample identification number is 141396. OTU=operational taxonomic unit. Notes - identification to genus or species was not spported because: I - immature organisms, D- damaged organisms, M - poor slide mount, G - gender, U - indistint characters or distribution, R - retained in our reference collection.

Order	Family	Subfamily/Genus/Species	Life Stage	Density	Notes
Phylum: Annelida					
Class: Clitellata		SubClass: Oligochaeta			
			adult	21.53	approximate
Phylum: Arthropoda					
Class: Insecta		SubClass: Pterygota			
Coleoptera	Elmidae	Narpus concolor	larvae	8.61	
Diptera			larvae	2.15	I
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	larvae	2.15	
Diptera	Chironomidae		pupae	10.76	
Diptera	Chironomidae	Orthocladiinae	larvae	109.79	
Diptera	Empididae		larvae	2.15	I
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	larvae	27.99	
Diptera	Muscidae		larvae	2.15	
Diptera	Psychodidae	Pericoma	larvae	2.15	
Diptera	Simuliidae	Simuliinae Simuliini Simulium	pupae	10.76	
Diptera	Tabanidae		larvae	2.15	U
Diptera	Tipulidae		larvae	4.31	I,D
Diptera	Tipulidae	Dicranota	larvae	27.99	
Diptera	Tipulidae	Hexatoma	larvae	12.92	
Diptera	Tipulidae	Limoniinae Antocha monticola	larvae	88.26	
Diptera	Tipulidae	Tipulinae Tipula	larvae	10.76	
Ephemeroptera			adult	2.15	
Ephemeroptera	Baetidae		larvae	10.76	I,D
Ephemeroptera	Baetidae	Baetis	larvae	142.08	
Plecoptera	Capniidae	Capniinae	larvae	4.31	I
Plecoptera	Chloroperlidae		larvae	2.15	D
Plecoptera	Perlodidae		larvae	23.68	I
Plecoptera	Perlodidae	Isoperlinae Isoperla	larvae	2.15	
Trichoptera			pupae	2.15	D
Trichoptera	Brachycentridae		larvae	2.15	I
Trichoptera	Hydropsychidae		larvae	2.15	D
Phylum: Mollusca					
Class: Bivalvia		SubClass: Heterodonta			
Veneroida	Pisidiidae	Pisidiinae Pisidium	adult	36.60	

Total: OTU Taxa : 28 Genera : 12 Families : 17 589.85

APPENDIX 2
MACROINVERTEBRATE METRICS

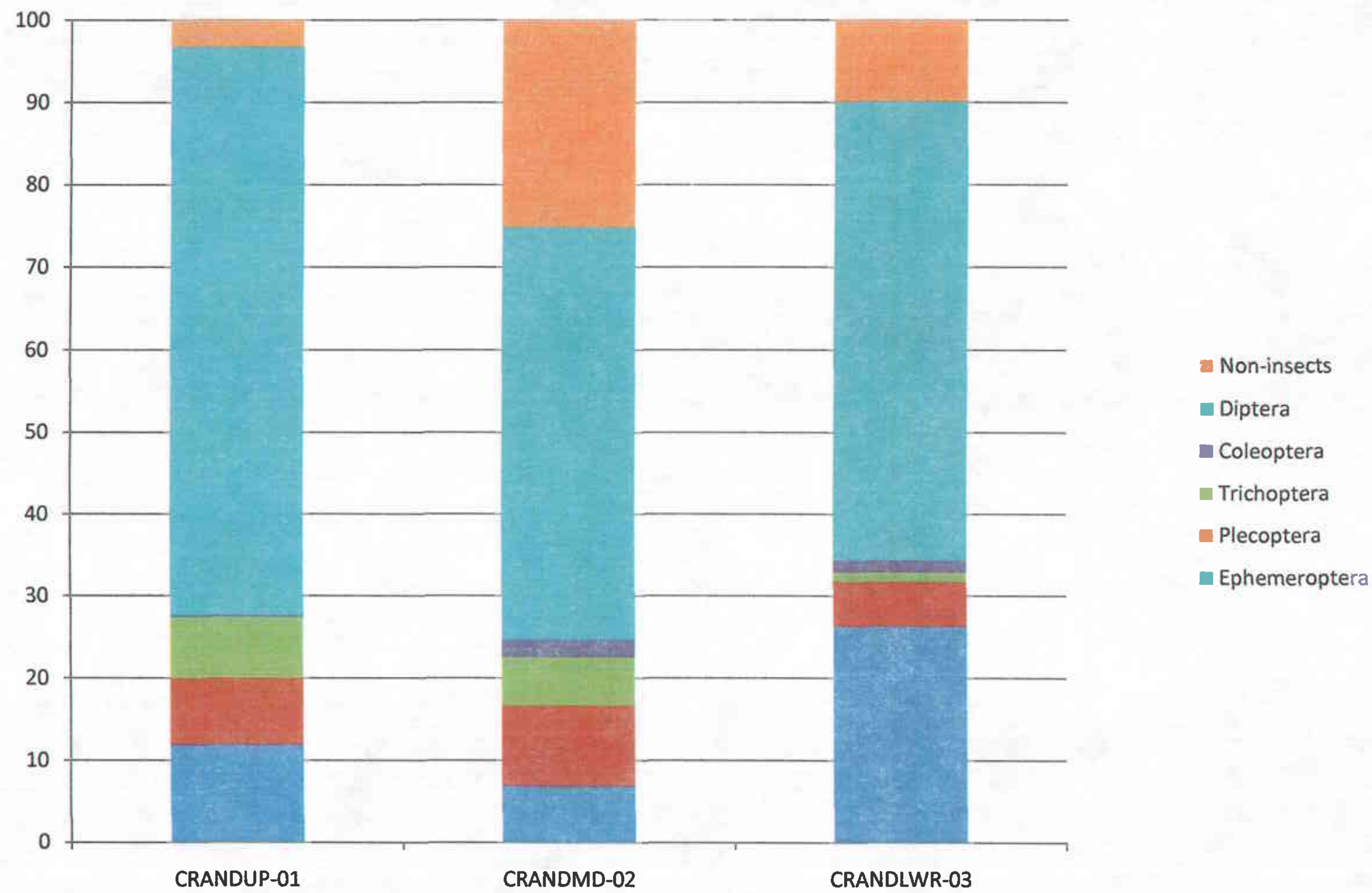
Notes:

1. Most metrics were calculated by the National Aquatic Monitoring Center's BugLab and included in their October 16, 2009 report on the September 16 Crandall Creek samples. Remaining metrics were calculated by JBR Environmental Consultants using data contained in the BugLab's report.

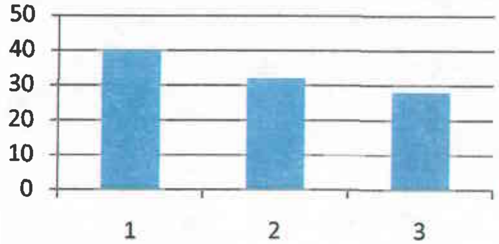
2. Samples designated on the graphs as 1, 2, and 3 represent sample sites CRANDUP-01, CRANDMD-02, and CRANDLWR-03, respectively.

3. Graphs shown with blue bars represent metrics for which a decrease would be expected to occur with a decline in stream health. Graphs shown with green bars represent metrics for which an increase would be expected to occur with a decline in stream health.

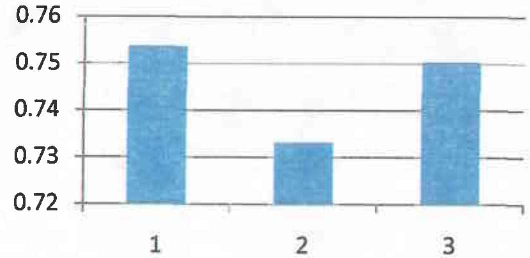
Percent Predominant Taxonomic Groups



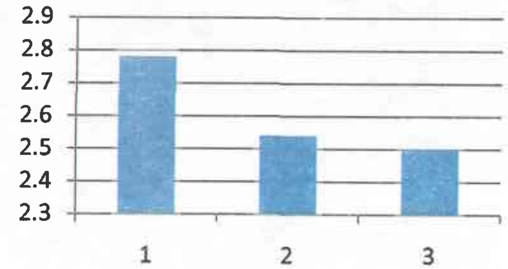
Richness



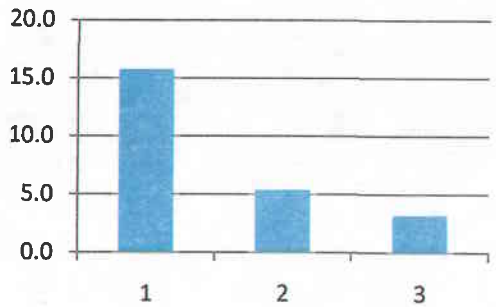
Evenness



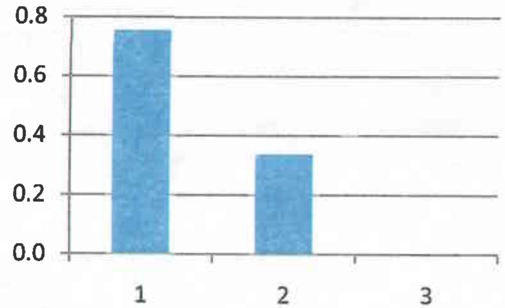
Shannon's Diversity



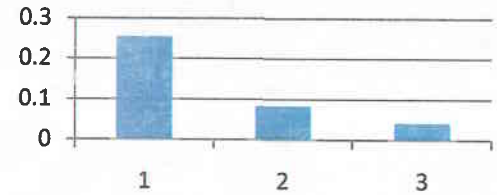
Percent Shredders



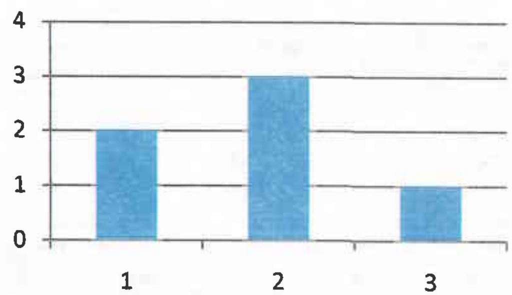
Percent Scrapers



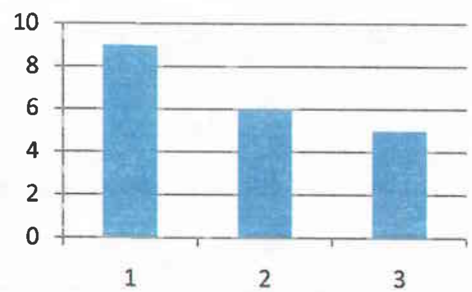
Specialist Feeders:Generalist Feeders



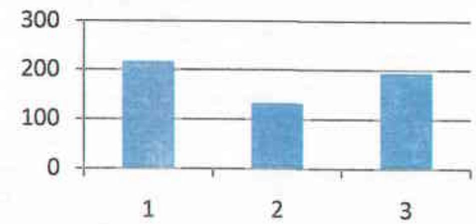
# of Long-lived Taxa



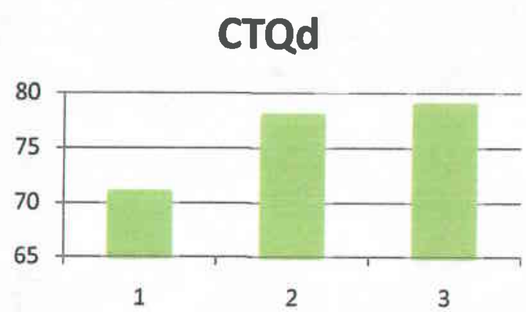
# of Clinger Taxa

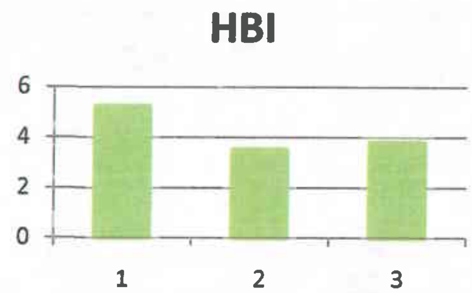


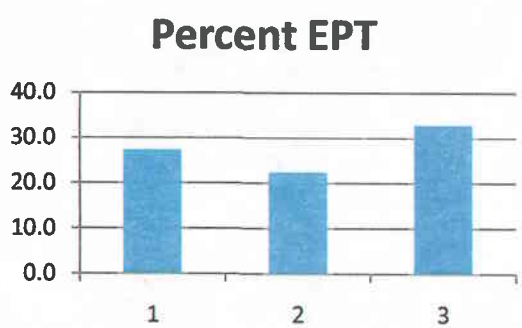
EPT Taxa Abundance

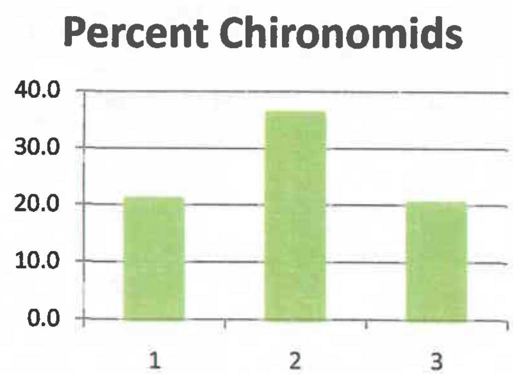


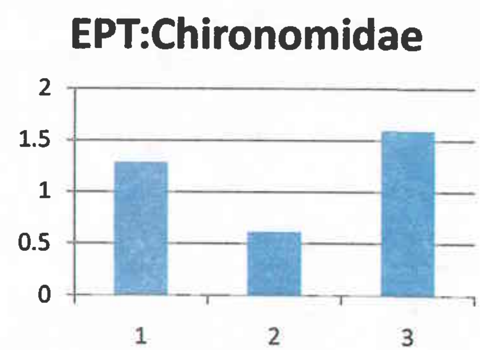
See notes on Page 1





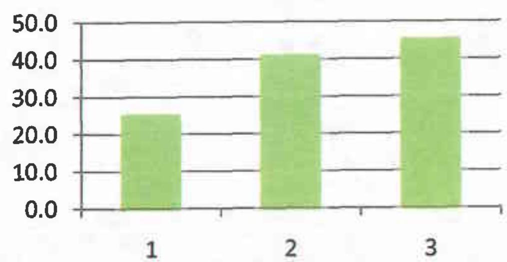




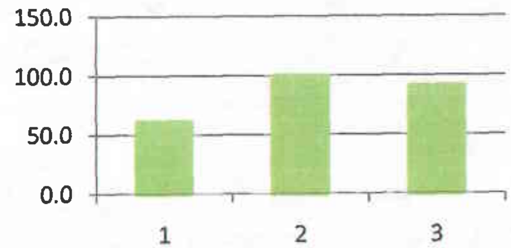


See notes on Page 1

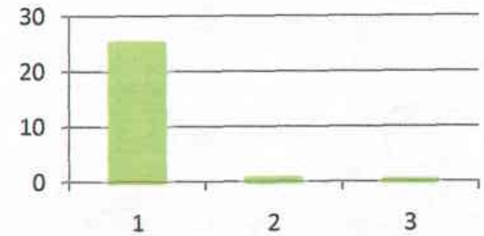
Percent Baetis, Hydropsychidae, & Orthocladiinae



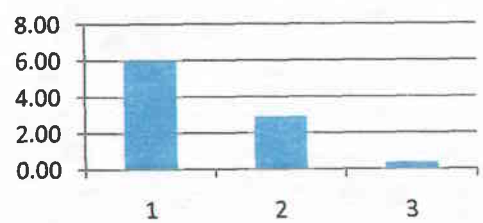
Baetis:All Ephemeroptera (Percent)



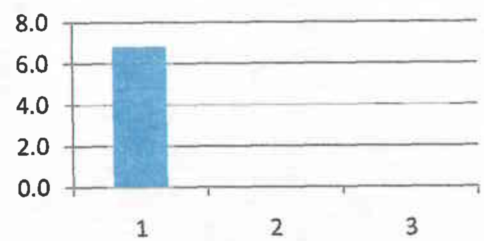
Percent Tolerant Organisms (HBI-based)



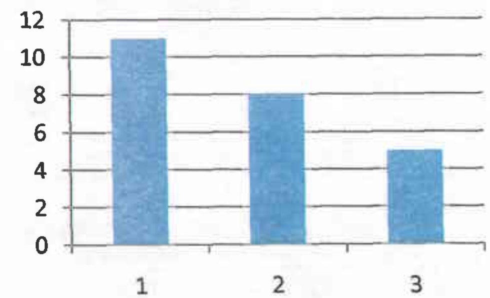
Percent Heptageniidae, Chloroperlidae, &⍰



Heptageniidae:All Ephemeroptera (Percent)

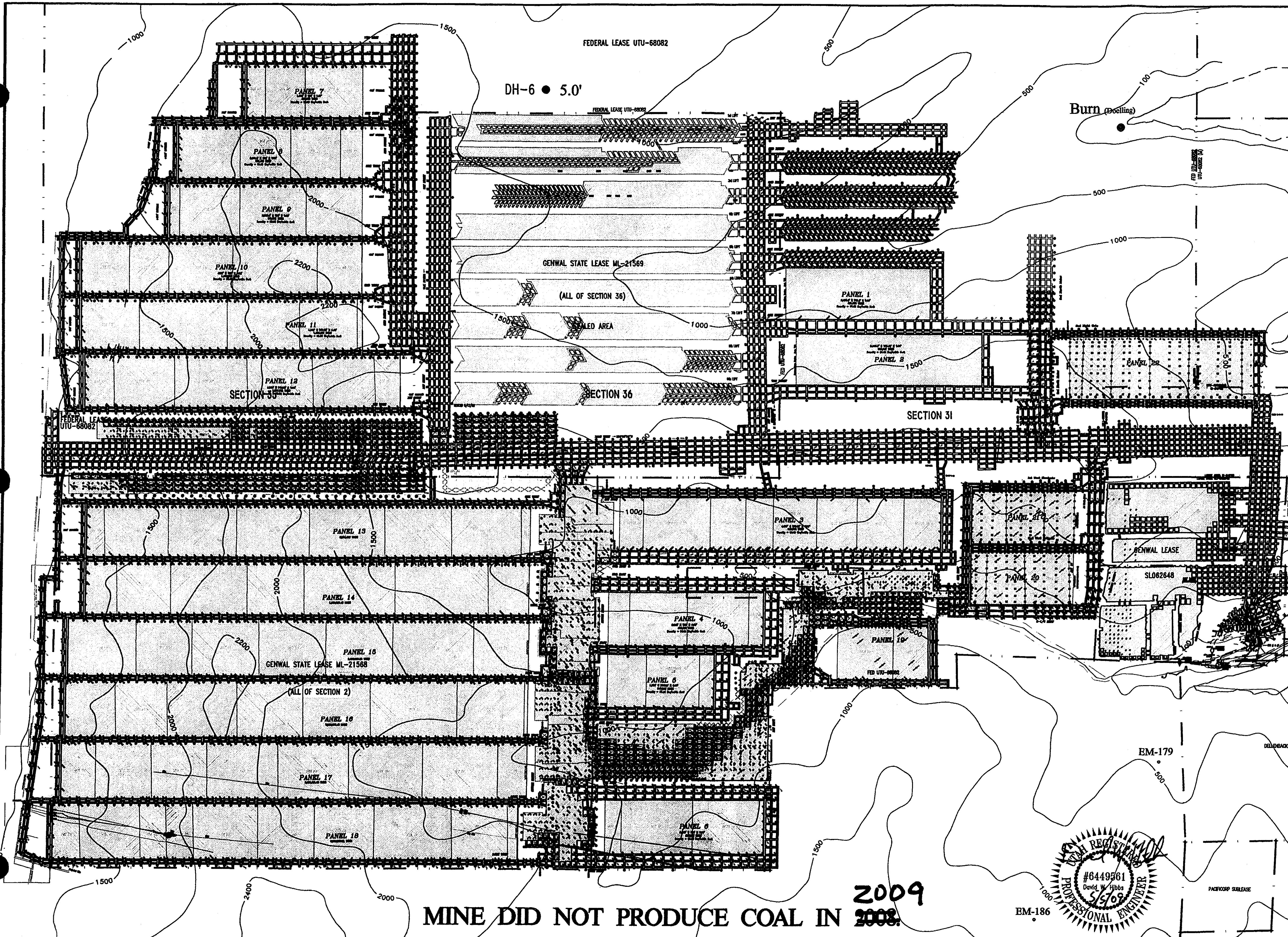


of Intolerant Taxa (HBI-based)



See notes on Page 1

MINE MAP



MINE DID NOT PRODUCE COAL IN ~~2008~~ 2009

Crandall Canyon Mines	
Crandall Canyon P.O. BOX 910 EAST CARBON, UTAH 84520	
MSHA ID #42-01715	
DRAWN BY PJ	SCALE 1" = 1250'
APPROVED BY DS	DATE 5 MAY 2009
SHEET	1 of 1